Ecological Soil Screening Levels for Copper

Interim Final

OSWER Directive 9285.7-68

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Issued July 2006
Revised February 2007

11-196779

This page intentionally left blank

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SUMMARY OF ECO-SSLs FOR COPPER 1

3.0 ECO-SSL FOR TERRESTRIAL PLANTS 4

4.0 ECO-SSL FOR SOIL INVERTEBRATES 4

5.0 ECO-SSL FOR AVIAN WILDLIFE 9
5.1 Avian TRV 9
5.2 Estimation of Dose and Calculation of the Eco-SSL 18

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE 18
6.1 Mammalian TRV 18
6.2 Estimation of Dose and Calculation of the Eco-SSL 24

7.0 REFERENCES 26
7.1 General Copper References 26
7.2 References for Plants and Soil Invertebrates 27
7.3 References Rejected for Use in Deriving Plant and Soil Invertebrate Eco-SSLs 29
7.4 References Used in Deriving Wildlife TRVs 56
7.5 References Rejected for Use in Derivation of Wildlife TRV 67

LIST OF TABLES

Table 2.1 Copper Eco-SSLs (mg/kg dry weight in soil) 3

Table 3.1 Plant Toxicity Data - Copper 5

Table 4.1 Invertebrate Toxicity Data - Copper 7

Table 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Copper 10

Table 5.2 Calculation of the Avian Eco-SSLs for Copper 18

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Copper 19

Table 6.2 Calculation of the Mammalian Eco-SSLs for Copper 24

LIST OF FIGURES

Figure 2.1 Typical Background Concentrations of Copper in U.S. Soils 2

Figure 5.1 Avian TRV Derivation for Copper 17

Figure 6.1 Mammalian TRV Derivation for Copper 25

LIST OF APPENDICES

Appendix 5-1 Avian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Copper

Appendix 6-1 Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Copper

1.0 INTRODUCTION

Ecological Soil Screening Levels (Eco-SSLs) are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Eco-SSLs are derived to be protective of the conservative end of the exposure and effects species distribution, and are intended to be applied at the screening stage of an ecological risk assessment. These screening levels should be used to identify the contaminants of potential concern (COPCs) that require further evaluation in the site-specific baseline ecological risk assessment that is completed according to specific guidance (U.S. EPA, 1997, 1998, and 1999). The Eco-SSLs are not designed to be used as cleanup levels and the United States (U.S.) Environmental Protection Agency (EPA) emphasizes that it would be inappropriate to adopt or modify the intended use of these Eco-SSLs as national cleanup standards.

The detailed procedures used to derive Eco-SSL values are described in separate documentation (U.S. EPA, 2003, 2005). The derivation procedures represent the collaborative effort of a multi-stakeholder group consisting of federal, state, consulting, industry, and academic participants led by what is now the U.S. EPA Office of Solid Waste and Emergency Response (OSWER).

This document provides the Eco-SSL values for copper and the documentation for their derivation. This document provides guidance and is designed to communicate national policy on identifying copper concentrations in soil that may present an unacceptable ecological risk to terrestrial receptors. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it does not impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances of the site. EPA may change this guidance in the future, as appropriate. EPA and state personnel may use and accept other technically sound approaches, either on their own initiative, or at the suggestion of potentially responsible parties, or other interested parties. Therefore, interested parties are free to raise questions and objections about the substance of this document and the appropriateness of the application of this document to a particular situation. EPA welcomes public comments on this document at any time and may consider such comments in future revisions of this document.

2.0 SUMMARY OF ECO-SSLs FOR COPPER

Copper is a naturally occurring element which can be found in all environmental media: air, soil, sediment, and water. In the metal state, copper is malleable, ductile, and a good conductor of heat and electricity (Alloway, 1990). Copper occurs in numerous minerals including cuprite, tenorite, malachite, azurite, and native copper (George, 1993). Copper forms sulphides, sulphates,

sulphosalts, carbonates and other compounds and occurs in reducing environments as the native metal. Copper ranks 26th, behind zinc in abundance in the lithosphere (Alloway, 1990).

The principal uses of copper are in the production of wire, and of its alloys, brass and bronze (Alloway, 1990). Copper compounds may also be released to the environment through their use in dyes, catalysts, feed additives, pesticides, pigments, iron and steel production, coal and oil combustion, copper sulfate production, municipal incineration, and mining activities (Alloway, 1990; U.S. EPA 1987). Copper may also be released from natural sources, such as volcanoes, windblown dusts, the weathering of soil, decaying vegetation, and forest fires (http://toxnet.nlm.nih.gov).

Background concentrations reported for many metals in U.S. soils are described in Attachment 1-4 of the Eco-SSL guidance (U.S. EPA, 2003). Typical background concentrations of copper in U.S. soils are plotted in Figure 2.1 for both eastern and western U.S. soils.

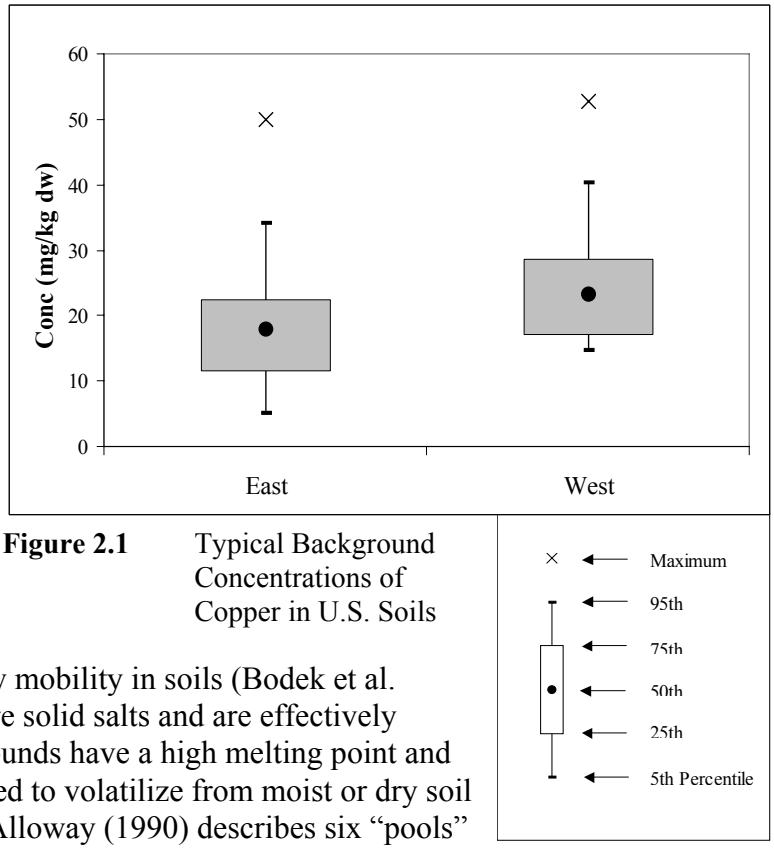


Figure 2.1 Typical Background Concentrations of Copper in U.S. Soils

In soils, copper may be present as soluble compounds including nitrates, sulfates, and chlorides, and insoluble compounds such as oxides, hydroxides, carbonates, and sulfides (Bodek et al. 1988; Budavari 1996). Soluble copper compounds strongly sorb to particles of organic matter, clay, soil, or sand, and demonstrate low mobility in soils (Bodek et al. 1988). Insoluble copper compounds are solid salts and are effectively immobile in soils. Most copper compounds have a high melting point and low vapor pressure, and are not expected to volatilize from moist or dry soil surfaces (Bodek et al. 1988; HSDB). Alloway (1990) describes six "pools" of copper in soils including soluble ions, inorganic and organic complexes in soil solution, exchangeable copper, stable organic complexes in humus, copper adsorbed by hydrous oxides of manganese, iron, and aluminum, copper adsorbed on the clay-humus colloidal complex and the crystal lattice-bound copper in soil minerals.

Copper is an essential element in both plants and animals. In animals, copper is essential for hemoglobin formation, carbohydrate metabolism, catecholamine biosynthesis, and cross-linking of collagen, elastin, and hair keratin (U.S. EPA 1987). Nutritional requirements of copper for common mammalian and avian test organisms are compiled in Attachment 4-3 of the Eco-SSL guidance (U.S. EPA, 2003, 2005). The primary route of exposure for animals to copper is through ingestion. Generally, the normal intake of copper by inhalation is a negligible fraction of the total (Friberg et al., 1986) and absorption through the skin is minimal (Venugopal and

Luckey, 1978). In animal tissues, copper exists as complexes with proteins, peptides, and amino acids in tissues such as the liver, brain, and kidney which retain more copper than do other soft tissues (Seiler et al., 1988). Muscle tissues contain about 35% of the total body copper. In tissues, copper cannot exist in the ionic form in appreciable amounts except in the acidic environment of the stomach (Seiler et al., 1988). Copper is excreted by the biliary system mainly through feces and bile, and to a smaller extent through urine and sweat (Venugopal and Luckey 1978). Absorption, distribution, metabolism, and utilization of copper can be affected by interaction with other metals such as iron, molybdenum, and zinc (U.S. EPA 1987; HSDB).

In plants, copper is especially important in oxidation, photosynthesis, and protein and carbohydrate metabolism. Also, copper concentrations may affect nitrogen fixation, valence changes, and cell wall metabolism (Kabata-Pendias and Pendias, 1992). Since copper is unlikely to be transported across leaf cuticles, the primary route of uptake by plants is through soil as opposed to atmospheric deposition (Hutchinson, 1979). Copper tends to affect various plant species differently, and low growing grasses tend to accumulate copper at higher levels than tree foliage (U.S. EPA, 1987). In plants, copper deficiency is demonstrated by wilting leaves, melanism, white twisted tips, and reduction in panicle formation (HSDB).

In mammals, the mechanism of copper toxicity is complex. Copper can increase cell permeability in erythrocytes leading to lysis and inhibition of intracellular enzymes. Thus, copper poisoning can lead to oxidative stress in erythrocytes and to accelerated loss of intracellular glutathione. In addition, copper ions can cause mitochondrial swelling and inhibit oxygen consumption, which leads to cell degeneration. In copper deficient animals, failure to form collagen in the walls of arterioles leads to subcutaneous bleeding and anemia. Other symptoms of acute copper toxicity in mammals include sporadic fever, tachycardia, hypotension, oliguria, uremia, coma, cardiovascular collapse, and death. Chronic copper poisoning in mammals may induce nausea, vomiting, epigastric pain, dizziness, jaundice, and general debility (Venugopal and Luckey, 1978).

The Eco-SSL values derived to date for copper are summarized in Table 2.1.

Table 2.1 Copper Eco-SSLs (mg/kg dry weight in soil)

Plants	Soil Invertebrates	Wildlife	
		Avian	Mammalian
70	80	28	49

Eco-SSL values were derived for all receptor groups. The Eco-SSL values for copper range from 28 mg/kg dry weight (dw) for avian wildlife to 80 mg/kg dw for soil invertebrates. With the exception of the avian value, these concentrations are higher than the 95th percentile of reported background soil concentrations of copper in eastern and western U.S. soils (Figure 2.1). The Eco-SSL for avian wildlife is equal to the median value for western U.S. soils and is higher than the median value for eastern U.S. soils.

3.0 ECO-SSL FOR TERRESTRIAL PLANTS

Of the papers identified from the literature search process, 479 papers were selected for acquisition for further review. Of those papers acquired, 49 met all 11 Study Acceptance Criteria (U.S. EPA, 2003; Attachment 3-1). Each of these papers were reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). Fifty-six study results received an Evaluation Score greater than ten (U.S. EPA, 2003; Attachment 3-1). These studies are listed in Table 3.1.

The studies in Table 3.1 are sorted by bioavailability score. There are 6 studies eligible for Eco-SSL derivation with a bioavailability score of two. These results are used to derive the plant Eco-SSL for copper (U.S. EPA, 2003; Attachment 3-2). The Eco-SSL is the geometric mean of the maximum acceptable toxicant concentration (MATC) and 10% effective concentration (EC_{10}) values for 4 species under different test conditions (pH and % organic matter (OM)) and is equal to 70 mg/kg dw.

4.0 ECO-SSL FOR SOIL INVERTEBRATES

Of the papers identified from the literature search process, 173 papers were selected for acquisition for further review. Of those papers acquired, 44 met all 11 Study Acceptance Criteria (U.S. EPA 2003; Attachment 3-1). Each of these papers were reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). Fifty-five studies received an Evaluation Score greater than ten. These studies are listed in Table 4.1. The studies in Table 4.1 are sorted by bioavailability score. There are ten studies eligible for Eco-SSL derivation with a bioavailability score of 2 that were used to derive the soil invertebrate Eco-SSL for copper (U.S. EPA, 2003; Attachment 3-2). The Eco-SSL is the geometric mean of the MATC and EC_{10} values for at least 6 test species under different test conditions (pH and OM%) and is equal to 80 mg/kg dw.

Table 3.1 Plant Toxicity Data - Copper

Reference	IP Number	Study ID	Test Organism		Soil pH	OM%	Bio-availability Score	ERE	Tox Parameter	Tox Value (Soil Conc at mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Kjaer and Elmegaard, 1996	4231	c	Black bindweed	*Polygonum convolvulus*	6.4	1.7	2	REP	MATC	251	14	Y	Y
Mozaffari et al, 1996	4176	b	Citrus cultivar	Cleopatra mandarin	6.0	0.98	2	GRO	MATC	141	13	Y	Y
Torres and De Varennes, 1998	13958	--	Perennial ryegrass	*Lolium perenne L.*	4.4 - 5.4	1.0	2	GRO	MATC	16	12	Y	Y
Gonzalez, 1991	4609	d	Alfalfa	*Medicago sativa*	6.3	1.3	2	GRO	EC_{10}	115	13	Y	Y
Gonzalez, 1991	4609	e	Alfalfa	*Medicago sativa*	5.5	2.8	2	GRO	EC_{10}	58	13	Y	Y
Gonzalez, 1991	4609	g	Alfalfa	*Medicago sativa*	5.4	1.1	2	GRO	EC_{10}	32	13	Y	Y
									Geometric Mean	70			
Data Not Used to Derive Plant Eco-SSL													
Rehab and Wallace, 1978	46710	--	Cotton	*Gossypium spp.*	6.6	2.4	1	GRO	MATC	141.4	14	Y	N
Chhibba et al, 1994	12325	a	Wheat	*Triticum aestivum*	7.8	0.2	1	GRO	MATC	28	13	Y	N
Gonzalez, 1991	4609	b	Alfalfa	*Medicago sativa*	7.8	1.8	1	GRO	EC_{10}	1253	12	Y	N
Gonzalez, 1991	4609	c	Alfalfa	*Medicago sativa*	7.5	1.1	1	GRO	EC_{10}	821	12	Y	N
Gonzalez, 1991	4609	f	Alfalfa	*Medicago sativa*	7.3	0.5	1	GRO	EC_{10}	41	12	Y	N
Aquaterra, 2000	22616	a	Alfalfa	*Medicago sativa*	7.8	2.9	0	GRO	EC_{20}	326.4	12	Y	N
Aquaterra, 2000	22616	b	Alfalfa	*Medicago sativa*	8.1	3.5	0	GRO	EC_{20}	674	12	Y	N
Aquaterra, 2000	22616	c	Barley	*Hordeum vulgare* var. Chapais	6.1	9.0	0	GRO	EC_{20}	143	12	Y	N
Aquaterra, 2000	22616	d	Barley	*Hordeum vulgare var. Chapais*	7.8	2.9	0	GRO	EC_{20}	0.74	12	Y	N
Aquaterra, 2000	22616	e	Barley	*Hordeum vulgare var. Chapais*	8.1	3.5	0	GRO	EC_{20}	234.8	12	Y	N
Aquaterra, 2000	22616	f	Carrot	*Daucus carota* var. Royal Chatenay	7.8	2.9	0	GRO	EC_{20}	659.0	12	Y	N
Aquaterra, 2000	22616	g	Corn	*Zea mays* var. Kandy Korn	7.8	2.9	0	GRO	EC_{20}	407.6	12	Y	N
Aquaterra, 2000	22616	h	Corn	*Zea mays* var. Kandy Korn	8.1	3.5	0	GRO	EC_{20}	776.2	12	Y	N
Aquaterra, 2000	22616	i	Cucumber	*Cucumis sativa* var. Marketer	7.8	2.9	0	GRO	EC_{20}	506.0	12	Y	N
Aquaterra, 2000	22616	j	Cucumber	*Cucumis sativa* var. Marketer	8.1	3.5	0	GRO	EC_{20}	804.9	12	Y	N
Aquaterra, 2000	22616	k	Grama grass	*Bouteloua graciiss*	7.8	2.9	0	GRO	EC_{20}	471.3	12	Y	N
Aquaterra, 2000	22616	l	Northern wheatgrass	*Agropyron dasystachyum*	6.1	9.0	0	GRO	EC_{20}	151.7	12	Y	N
Aquaterra, 2000	22616	m	Northern wheatgrass	*Agropyron dasystachyum*	7.8	2.9	0	GRO	EC_{20}	391.3	12	Y	N
Aquaterra, 2000	22616	n	Northern wheatgrass	*Agropyron dasystachyum*	8.1	3.5	0	GRO	EC_{20}	801.6	12	Y	N
Aquaterra, 2000	22616	o	Radish	*Raphanus sativus* var. Champion	7.8	2.9	0	GRO	EC_{20}	347.3	12	Y	N
Aquaterra, 2000	22616	p	Radish	*Raphanus sativus* var. Champion	8.1	3.5	0	GRO	EC_{20}	322.7	12	Y	N
Mitchell et al, 1988	15861	a	Common oat	*Avena sativa*	5.5	2.0	2	GRO	EC_{50}	535	14	N	N
Mitchell et al, 1988	15861	b	Cucumber	*Cucumis sativus*	5.5	2.0	2	GRO	EC_{50}	540	14	N	N
Mitchell et al, 1988	15861	c	Soybean	*Glycine max*	5.5	2.0	2	GRO	EC_{50}	550	14	N	N
Mitchell et al, 1988	15861	d	Heath-leaf banksia	*Banksia ericifolia*	5.5	2.0	2	GRO	EC_{50}	610	14	N	N
Mitchell et al, 1988	15861	e	She-oak	*Casuarina distyla Vent.*	5.5	2.0	2	GRO	EC_{50}	205	14	N	N
Mitchell et al, 1988	15861	f	Yellow bloodwood	*Eucalyptus eximia Shau.*	5.5	2.0	2	GRO	EC_{50}	560	14	N	N
Kjaer and Elmegaard, 1996	4231	a	Black bindweed	*Polygonum convolvulus*	6.4	1.7	2	GRO	EC_{50}	272	14	N	N
Kjaer and Elmegaard, 1996	4231	d	Black bindweed	*Polygonum convolvulus*	6.4	1.7	2	MOR	EC_{50}	219	14	N	N
Tikhomirav et al, 1988	4757	d	Common oat	*Avena sativa*	4.6	2.5	2	GRO	LOAEC	150	14	N	N

Table 3.1 Plant Toxicity Data - Copper

Reference	IP Number	Study ID	Test Organism		Soil pH	OM%	Bio-availability Score	ERE	Tox Parameter	Tox Value (Soil Conc at mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Mitchell et al, 1988	15861	g	Common oat	*Avena sativa*	5.5	2.0	2	GRO	LC_{50}	1765	13	N	N
Mitchell et al, 1988	15861	h	Cucumber	*Cucumis sativus*	5.5	2.0	2	GRO	LC_{50}	1725	13	N	N
Mitchell et al, 1988	15861	I	Soybean	*Glycine max*	5.5	2.0	2	GRO	LC_{50}	1140	13	N	N
Mitchell et al, 1988	15861	j	Heath-leaf banksia	*Banksia ericifolia*	5.5	2.0	2	GRO	LC_{50}	1520	13	N	N
Mitchell et al, 1988	15861	k	She-oak	*Casuarina distyla Vent.*	5.5	2.0	2	GRO	LC_{50}	580	13	N	N
Mitchell et al, 1988	15861	l	Yellow bloodwood	*Eucalyptus eximia Schau.*	5.5	2.0	2	GRO	LC_{50}	1845	13	N	N
Mozaffari et al, 1996	4176	a	Citrus cultivar	Cleopatra mandarin	5.0	0.98	2	GRO	NOAEC	200	13	N	N
Spencer, 1966	15004	--	citrus cultivar	Cleopatra mandarin	5.4	1.0	2	GRO	LOAEC	5	11	N	N
De Haan, 1985	5048	a	Common oat	*Avena sativa*	5.6	1.6	2	REP	MATC	283	11	N	N
Pedersen et al, 2000a	56463	a	Black bindweed	*Fallopia, convolvulus*	6.0-6.7	4.5	1	GRO	EC_{50}	284	16	N	N
Pedersen et al, 2000a	56463	b	Black bindweed	*Fallopia, convolvulus*	6.0-6.7	4.5	1	GRO	EC_{50}	258	16	N	N
Pedersen et al, 2000a	56463	c	Black bindweed	*Fallopia, convolvulus*	6.0-6.7	4.5	1	GRO	EC_{50}	259	16	N	N
Pedersen et al, 2000a	56463	d	Black bindweed	*Fallopia, convolvulus*	6.0-6.7	4.5	1	GRO	EC_{50}	329	16	N	N
Pedersen et al, 2000a	56463	e	Black bindweed	*Fallopia, convolvulus*	6.0-6.7	4.5	1	GRO	EC_{50}	260	16	N	N
Pedersen et al, 2000a	56463	f	Black bindweed	*Fallopia, convolvulus*	6.0-6.7	4.5	1	GRO	EC_{50}	291	16	N	N
Genovese, 1978	58147	a	Jack pine	*Pinus banksiana* Lamb.	0.04	7.7	1	GRO	NOAEC	400	11	N	N
Genovese, 1978	58147	b	Black spruce	*Pinus mariana* (Mill) B.S.P.	0.04	7.7	1	GRO	NOAEC	400	11	N	N
Tikhomirav et al, 1988	4757	c	Common oat	*Avena sativa*	5.9	2.9	1	GRO	LOAEC	400	13	N	N
Mozaffari et al, 1996	4176	c	Citrus cultivar	*Cleopatra mandarin*	7.0	0.98	1	GRO	LOAEC	200	12	N	N
Gonzalez, 1991	4609	a	Alfalfa	*Medicago sativa*	7.1	0.3	1	GRO	NOAEC	1600	12	N	N

EC_{10} = Effect concentration for 10% of test population
EC_{20} = Effect concentration for 10% of test population
EC_{50} = Effect concentration for 50% of test population
ERE = Ecologically relevant endpoint
GRO = Growth
LOAEC = Lowest observed adverse effect concentration
MATC = Maximum acceptable toxicant concentration. Geometric mean of NOAEC and LOAEC.
N = No
NOAEC = No observed adverse effect concentration
ns = Not specified
OM = Organic matter content
REP = Reproduction
Y = Yes
Bioavailability Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)
Total Evaluation Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)

Table 4.1 Invertebrate Toxicity Data - Copper

Reference	IP Number	Study ID	Test Organism		Soil pH	OM%	Bio-availability Score	ERE	Tox Parameter	Tox Value (Soil Conc at mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Scott-Fordsmand et al., 1997	2288	--	Springtail	*Folsomia fimetario*	5.5	4.0	2	REP	EC_{10}	38	16	Y	Y
Svendsen and Weeks, 1997a	11490	--	Earthworm	*Eisenia andrei*	5.6	<1.0	2	REP	MATC	133	15	Y	Y
Ma, 1984	11146	a	Earthworm	*Lumbricus rubellus*	4.8	5.7	2	REP	MATC	84	14	Y	Y
Korthals et al., 1996a	7848	a	Nematode	Not available	4.0	3.7	2	POP	MATC	116	14	Y	Y
Korthals et al., 1998	13828	--	Nematode	Not available	4.25	3.3	2	POP	MATC	141	13	Y	Y
Korthals et al., 1996b	4402	a	Nematode	Not available	4.1	3.2	2	REP	MATC	141	13	Y	Y
Svendsen and Weeks, 1997b	4449	--	Earthworm	*Lumbricus rubellus*	5.6	<1.0	2	GRO	MATC	188	13	Y	Y
Ma, 1988	7854	a	Earthworm	*Aporrectodea caliginosa*	5	5.0	2	REP	EC_{10}	27	13	Y	Y
Ma, 1988	7854	b	Earthworm	*Allolobophora chlorotica*	5	5.0	2	REP	EC_{10}	28	13	Y	Y
Ma, 1988	7854	c	Earthworm	*Lumbricus rubellus*	5	5.0	2	REP	EC_{10}	80	13	Y	Y
									Geometric Mean	80			
Data not Used to Derive Soil Invertebrate Eco-SSL													
Kula and Larink, 1997	11046	d	Earthworm	*Eisenia fetida*	5.8	4.0	1	REP	MATC	18	11	Y	N
Kula and Larink, 1997	11046	b	Earthworm	*Eisenia andrei*	5.8	4.0	1	REP	MATC	6	11	Y	N
Sandifer and Hopkin, 1996	4056	a	Springtail	*Folsomia candida*	5.8	10.0	1	REP	MATC	447	16	Y	N
Sandifer and Hopkin, 1996	4056	b	Springtail	*Folsomia candida*	5.1	10.0	1	REP	MATC	447	16	Y	N
Sandifer and Hopkin, 1996	4056	c	Springtail	*Folsomia candida*	4.5	10.0	1	REP	MATC	1732	16	Y	N
Bogomolov et al., 1996	4940	a	Earthworm	*A. tuberclata*	6.3	5.0	1	REP	MATC	141	16	Y	N
Bogomolov et al., 1996	4940	b	Nematode	Not available	6.3	5.0	1	POP	MATC	566	16	Y	N
Van Gestel et al., 1991	6826	b	Earthworm	*Eisenia andrei*	6.2	10.0	1	GRO	MATC	75	16	Y	N
Ma, 1984	11146	b	Earthworm	*Lumbricus rubellus*	7.1	5.7	1	REP	MATC	203	14	Y	N
Pedersen et al., 2000b	55995	a	Springtail	*Folsomia candida*	6.7	4.5	1	REP	EC_{10}	50	14	Y	N
Pedersen et al., 2000b	55995	b	Springtail	*F. fimetaria*	6.7	4.5	1	REP	EC_{10}	141	14	Y	N
Phillips et al., 1996	11508	a	Earthworm	*Eisenia fetida*	4.7	1.4	1	GRO	MATC	200	13	Y	N
Sandifer and Hopkin, 1997	758	--	Springtail	*Folsomia candida*	6.0	10.0	1	REP	MATC	447	13	Y	N
Kula and Larink, 1997	11046	a	Earthworm	*Eisenia fetida*	6.0	10.0	1	REP	MATC	18	11	Y	N
Van Gestel et al., 1989	4111	--	Earthworm	*Eisenia andrei*	6	10	1	REP	MATC	85	13	Y	N
Kula and Larink, 1997	11046	c	Earthworm	*Eisenia andrei*	6.0	10.0	1	REP	MATC	179	11	Y	N
Scott-Fordsman et al., 2000	22634	a	Springtail	*Folsomia fimetaria L.*	6.7-7.1	3.9-5.5	1	REP	MATC	500	15	Y	N
Aquaterra, 2000	22616	e	Springtail	*Onychiurus folsomi*	6.1	9.0	0	REP	EC_{20}	425	17	Y	N
Haque and Ebing, 1983	10944	--	Earthworm	*Lumbricus terrestris*	6.1	1.7	2	MOR	LC_{50}	98	13	N	N
Donkin and Dusenbery, 1993	7838	a	Nematode	*Caenorhabditis elegans*	5.2	1.7	2	MOR	LC_{50}	534	14	N	N
Donkin and Dusenbery, 1993	7838	b	Nematode	*Caenorhabditis elegans*	5.1	3.0	2	MOR	LC_{50}	413	13	N	N
Peredney and Williams, 2000b	56449	g	Nematode	*Caenorhabditis elegans*	4	1.14	2	MOR	LC_{50}	20	13	N	N
Peredney and Williams, 2000b	56449	h	Nematode	*Caenorhabditis elegans*	4	1.14	2	MOR	LC_{50}	25	13	N	N
Peredney and Williams, 2000b	56449	i	Nematode	*Caenorhabditis elegans*	4	4.2	2	MOR	LC_{50}	186	13	N	N
Peredney and Williams, 2000b	56449	j	Nematode	*Caenorhabditis elegans*	4	4.2	2	MOR	LC_{50}	252	13	N	N
Phillips et al., 1996	11508	b	Earthworm	*Eisenia fetida*	3.8	5.9	2	MOR	LOAEC	100	12	N	N
Korthals et al., 1996a	7848	b	Nematode	Not available	6.1	3.7	1	POP	NOAEC	168	13	N	N
Kammenga et al., 1996	5515	--	Nematode	*Plectus acuminatus*	5.5	10.0	1	REP	LOAEC	10	13	N	N
Posthuma et al., 1997	2380	a	Earthworm	*Enchytraeus crypticus*	5.5	10.0	1	REP	LC_{50}	477	16	N	N
Posthuma et al., 1997	2380	b	Earthworm	*Enchytraeus crypticus*	6.0	10.0	1	REP	LC_{50}	873	16	N	N
Spurgeon et al., 1994	4364	--	Earthworm	*Eisenia fetida*	6.3	10	1	REP	LC_{50}	53	15	N	N

Table 4.1 Invertebrate Toxicity Data - Copper

Reference	IP Number	Study ID	Test Organism		Soil pH	OM%	Bio-availability Score	ERE	Tox Parameter	Tox Value (Soil Conc at mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Spurgeon and Hopkin, 1995	6822	a	Earthworm	*Eisenia fetida*	6.1	10.0	1	REP	NOAEC	29	15	N	N
Donkin and Dusenbery, 1993	7838	c	Nematode	*Caenorhabditis elegans*	6.1	3.4	1	MOR	LC_{50}	1061	12	N	N
Donkin and Dusenbery, 1993	7838	d	Nematode	*Caenorhabditis elegans*	6.2	2.2	1	MOR	LC_{50}	629	12	N	N
Data not Used to Derive Soil Invertebrate Eco-SSL													
Neuhauser et al., 1986	17707	--	Earthworm	*Eisenia fetida*	6.0	10.0	1	MOR	LC_{50}	643	14	N	N
Peredney and Williams, 2000a	53082	--	Nematode	*Caenorhabditis elegans*	4	10	1	MOR	LC_{50}	1272	12	N	N
Peredney and Williams, 2000b	56449	k	Nematode	*Caenorhabditis elegans*	4	10	1	MOR	LC_{50}	431	12	N	N
Peredney and Williams, 2000b	56449	l	Nematode	*Caenorhabditis elegans*	4	10	1	MOR	LC_{50}	463	12	N	N
Neuhauser et al., 1985	6812	--	Earthworm	*Eisenia fetida*	6.0	10.0	1	MOR	LC_{50}	643	11	N	N
Aquaterra, 2000	22616	aa	Earthworm	*Eisenia fetida*	6.1	9.0	0	MOR	LC_{50}	632	15	N	N
Aquaterra, 2000	22616	ab	Earthworm	*Lumbricus terrestris*	6.1	9.0	0	MOR	LC_{50}	456	15	N	N
Aquaterra, 2000	22616	ca	Earthworm	*Eisenia fetida*	7.8	2.9	0	MOR	LC_{50}	721	14	N	N
Aquaterra, 2000	22616	cb	Earthworm	*Lumbricus terrestris*	7.8	2.9	0	MOR	LC_{50}	313	14	N	N
Aquaterra, 2000	22616	da	Earthworm	*Eisenia fetida*	8.1	3.5	0	MOR	LC_{50}	596	14	N	N
Aquaterra, 2000	22616	db	Earthworm	*Lumbricus terrestris*	8.1	3.5	0	MOR	LC_{50}	486	14	N	N
Data not Used to Derive Soil Invertebrate Eco-SSL													

EC_{10} = Effect concentration for 10% of test population
EC_{20} = Effect concentration for 50% of test population
ERE = Ecologically relevant endpoint
GRO = Growth
LC_{50} = Concentration lethal to 50% of test population
LOAEC = Lowest observed adverse effect concentration
MATC = Maximum acceptable toxicant concentration
MOR = Mortality
N = No
NOAEC = No observed adverse effect concentration
OM = Organic matter content
POP = Population
REP = Reproduction
Y = Yes
Bioavailability Score described in *Guidance for Developing Eco-SSLs* (U.S.EPA, 2003)
Total Evaluation Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)

5.0 ECO-SSL FOR AVIAN WILDLIFE

The derivation of the Eco-SSL for avian wildlife was completed as two parts. First, the toxicity reference value (TRV) was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species representing different trophic levels based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

5.1 Avian TRV

The literature search completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-1) identified 3,365 papers with possible toxicity data for either avian or mammalian species. Of these studies, 3,175 were rejected for use as described in Section 7.5. Of the remaining studies, 107 contained data for avian test species. These papers were reviewed and the data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are provided as Table 5.1. The complete results are included as Appendix 5-1.

Within the reviewed papers, there are 393 results for biochemical (BIO), behavior (BEH), physiology (PHY), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) effects that meet the Data Evaluation Score of >65 for use to derive the TRV (U.S. EPA, 2003; Attachment 4-4). These data are plotted in Figure 5.1 and correspond directly with the data presented in Table 5.1. The no-observed adverse effect level (NOAEL) results for growth and reproduction are used to calculate a geometric mean. This result is examined in relationship to the lowest bounded lowest-observed adverse effect level (LOAEL) for reproduction, growth, and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5).

A geometric mean of the NOAEL values for reproduction and growth was calculated at 18.5 mg copper/kg bw/day. This value, however, is higher than the lowest bounded LOAEL for reproduction, growth, or survival. Therefore, the TRV is equal to the highest bounded NOAEL lower than the lowest bounded LOAEL for reproduction, growth or survival and is equal to 4.05 mg copper/kg bw/day.

Table 5.1
Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 1 of 7

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
Biochemical (BIO)																		
1	Rangachar and Jayprakash, 1979	6530	Chicken (*Gallus domesticus*)	2	U	FD	105	d	10	w	JV	M	CHM	HMGL	BL	5.31		69
2	Chiou et al, 1999	2048	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	w	JV	NR	ENZ	CRKI	BL	5.32	13.3	77
3	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	DR	14	d	4	d	JV	NR	CHM	GLUC	BL	10.1		71
4	Pearce et al, 1983	2294	Chicken (*Gallus domesticus*)	4	U	FD	5	d	27	w	JV	F	CHM	LIPD	BL	12.3	24.7	75
5	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	224	d	17	w	SM	F	CHM	LIPD	LI	12.5	23.2	77
6	Pearce et al, 1983	2294	Chicken (*Gallus domesticus*)	5	U	FD	6	d	26	w	SM	F	CHM	LIPD	LI	13.9	27.8	76
7	Poupoulis and Jensen, 1976	36263	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	M	CHM	FFTA	LD	14.3	28.7	69
8	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	FD	10	d	5	d	JV	M	CHM	HMGL	BL	18.3		67
9	Stevenson and Jackson, 1980	2293	Chicken (*Gallus domesticus*)	4	U	FD	8	w	24	w	SM	F	CHM	LIPD	LI	22.6	45.2	76
10	Chiou et al, 1998	2049	Chicken (*Gallus domesticus*)	4	U	FD	1	w	38	w	SM	F	ENZ	LADH	SR	25.5	30.6	75
11	Chiou et al, 1997	2050	Chicken (*Gallus domesticus*)	5	M	FD	4	w	28	w	SM	F	ENZ	ASAT	SR	27.5	40.6	82
12	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	CHM	LIPD	LI	30.0	37.5	76
13	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	CHM	LIPD	LI	35.3	44.1	77
14	Ledoux et al, 1987	2194	Chicken (*Gallus domesticus*)	3	UX	FD	21	d	1	d	JV	F	ENZ	GOTR	SR	36.3		73
15	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	CHM	LIPD	LI	40.0	50.0	77
16	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	5	M	DR	14	d	4	d	JV	NR	CHM	URIC	BL	51.6	258	75
17	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	FD	35	d	3	d	JV	NR	CHM	HEMT	BL	75.5		69
18	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	4	M	FD	35	d	3	d	JV	NR	CHM	GLUC	SR	297		76
19	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	CHM	CHOL	BT		2.21	69
20	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	3	U	FD	42	d	1	d	JV	M	CHM	CHOL	BT		2.80	69
21	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	336	d	17	w	SM	F	CHM	LIPD	LI		5.11	71
22	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	3	U	FD	42	d	1	d	JV	M	CHM	CHOL	BT		5.57	69
23	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	4	U	FD	21	d	1	d	JV	M	CHM	CHOL	PL		5.83	69
24	Gill et al, 1995	2107	Chicken (*Gallus domesticus*)	4	U	FD	2	w	4	w	JV	M	ENZ	SGOT	SR		7.99	71
25	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	CHM	CHOL	BT		8.19	69
26	Skrivan et al, 2000	25969	Chicken (*Gallus domesticus*)	2	M	FD	38	d	1	d	JV	M	CHM	CHOL	AD		9.72	75
27	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	21	d	JV	M	CHM	CHOL	BT		11.5	69
28	Nam et al, 1984	2226	Chicken (*Gallus domesticus*)	3	U	FD	4	w	3	d	JV	NR	CHM	GBCM	NR		13.4	70
29	Poupoulis and Jensen 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	CHM	PHPH	GZ		14.3	69
30	Bakalli et al, 1995	3717	Chicken (*Gallus domesticus*)	2	U	FD	20	d	1	d	JV	M	CHM	CHOL	PL		17.8	69
31	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	ENZ	AATT	SR		23.9	76
32	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	ENZ	AATT	SR		30.4	76
33	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	ENZ	AATT	SR		35.2	76
34	Ekperigin and Vohra, 1981	2084	Chicken (*Gallus domesticus*)	3	U	FD	4	w	12	d	JV	NR	CHM	GLCN	LI		35.5	69
35	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	ENZ	GLPX	BL		201	69
Behavior (BEH)																		
36	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	NR	FDB	FCNS	WO	1.92		67
37	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	FDB	FCNS	WO	10.4	20.8	80
38	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	DR	14	d	4	d	JV	NR	FDB	WCON	WO	12.6		67
39	Chiou et al, 1999	2048	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	w	JV	NR	FDB	FCNS	WO	13.3	26.6	80
40	Jenkins et al, 1970	2162	Chicken (*Gallus domesticus*)	2	M	FD	6	w	1	d	JV	B	FDB	FCNS	WO	13.4		69
41	Harms and Buresh, 1986	2117	Chicken (*Gallus domesticus*)	3	U	FD	6	w	64	w	SM	F	FDB	FCNS	WO	13.9	19.5	72
42	Ledoux et al, 1989	5812	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	FDB	FCNS	WO	15.2	22.8	74
43	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	M	FDB	FCNS	WO	15.7	25.8	80
44	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	FDB	FCNS	WO	16.5	24.7	80
45	Pearce et al, 1983	2294	Chicken (*Gallus domesticus*)	5	U	FD	48	d	26	w	SM	F	FDB	FCNS	WO	16.6	33.1	79
46	Stevenson and Jackson, 1980	2292	Chicken (*Gallus domesticus*)	5	U	FD	6	d	24	w	SM	F	FDB	FCNS	WO	16.7	33.4	79
47	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	FDB	FCNS	WO	17.0	25.5	80
48	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	FDB	FCNS	WO	17.2	25.8	80
49	Jensen and Maurice, 1978	2165	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	FDB	FEFF	WO	17.8	35.5	79
50	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	FDB	FCNS	WO	17.9	26.9	80
51	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	FD	5	d	27	w	SM	F	FDB	FCNS	WO	18.0	28.0	76
52	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	FD	10	d	5	d	JV	M	FDB	WCON	WO	18.3		70
53	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	5	U	FD	14	d	8	d	JV	M	FDB	FCNS	WO	19.6	30.5	80
54	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	FDB	FCNS	WO	20.1	26.8	80
55	Pimentel et al, 1992	5617	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	B	FDB	FCNS	WO	20.9		66
56	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	M	FD	21	d	1	d	JV	B	FDB	FCNS	WO	21.9	34.0	85
57	Kassim and Suwanpradit, 1996	2172	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	FDB	FCNS	WO	22.7	34.1	79
58	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	224	d	17	w	SM	F	FDB	FCNS	WO	23.2	29.9	80
59	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	FDB	FCNS	WO	23.9		70
60	Ledoux et al, 1987	2194	Chicken (*Gallus domesticus*)	3	UX	FD	21	d	1	d	JV	F	FDB	FCNS	WO	25.7	51.5	84

Table 5.1
Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
61	Chiou et al, 1997	2050	Chicken (*Gallus domesticus*)	5	M	FD	4	w	28	w	SM	F	FDB	FCNS	WO	27.5	40.6	85
62	Jackson, 1977	2157	Chicken (*Gallus domesticus*)	6	U	FD	35	d	NR	NR	SM	F	FDB	FCNS	WO	29.1	47.5	80
63	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	M	FD	21	d	1	d	JV	B	FDB	FCNS	WO	29.5		79
64	Hill, 1990	5734	Chicken (*Gallus domesticus*)	4	U	FD	19	d	1	d	JV	F	FDB	FCNS	WO	30.4		72
65	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	FDB	FCNS	WO	30.4		70
66	Chiou et al, 1998	2049	Chicken (*Gallus domesticus*)	4	U	FD	4	w	38	w	SM	F	FDB	FCNS	WO	33.4	40.1	80
67	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	FDB	FCNS	WO	35.2		70
68	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	5	U	FD	14	d	8	d	JV	M	FDB	FCNS	WO	35.2	63.9	80
69	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	M	FDB	FCNS	WO	36.3		74
70	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	5	M	DR	14	d	4	d	JV	NR	FDB	WCON	WO	51.6	258	78
71	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)		U	GV	5	d	27	w	SM	F	FDB	FCNS	WO	65.4		68
72	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	FD	35	d	3	d	JV	NR	FDB	FCNS	WO	75.5		72
73	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	FD	35	d	3	d	JV	NR	FDB	FCNS	WO	143		67
74	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	4	M	FD	35	d	3	d	JV	NR	FDB	FCNS	WO	246		72
75	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	FDB	FCNS	WO		2.69	74
76	Gill et al, 1995	2107	Chicken (*Gallus domesticus*)	4	U	FD	4	w	4	w	JV	M	FDB	FCNS	WO		7.99	74
77	Griminger,1977	2112	Chicken (*Gallus domesticus*)	5	U	FD	2	w	7	mo	SM	F	FDB	FCNS	WO		22.4	73
78	Stevenson and Jackson, 1980	2293	Chicken (*Gallus domesticus*)	4	U	FD	8	w	24	w	SM	F	FDB	FCNS	WO		22.6	73
79	Yannakopoulos et al., 1990	2333	Japanese quail (*Coturnix japonica*)	4	U	FD	34	d	7	d	JV	B	FDB	FCNS	WO		27.5	74
80	Harms and Buresh, 1986	2118	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	FDB	FCNS	WO		30.8	74
81	Christmas and Harms, 1979	2052	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	FDB	FCNS	WO		31.4	74
82	Jensen and Maurice, 1978	2165	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	FDB	FEFF	WO		34.9	73
83	Jensen, 1975	1403	Chicken (*Gallus domesticus*)	2	U	FD	14	d	1	d	JV	M	FDB	FCNS	WO		92.9	74
Physiology (PHY)																		
84	Rangachar and Hegde, 1975	2259	Chicken (*Gallus domesticus*)	3	U	FD	120	d	1	d	JV	F	PHY	PROT	PL	3.93		72
85	Ankari et al, 1998	2006	Chicken (*Gallus domesticus*)	4	U	FD	84	d	25	w	SM	F	PHY	FDCV	WO	4.05	12.1	74
86	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	PHY	FDCV	WO	4.43		72
87	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	3	U	FD	42	d	1	d	JV	M	PHY	FDCV	WO	5.56		72
88	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	PHY	FDCV	WO	5.83	11.7	78
89	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	PHY	FDCV	WO	8.19		72
90	Skrivan et al, 2000	25969	Chicken (*Gallus domesticus*)	2	M	FD	39	d	1	d	JV	B	PHY	FDCV	WO	9.72		69
91	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	5	U	FD	35	d	1	d	JV	M	PHY	FDCV	WO	11.9		72
92	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	224	d	17	w	SM	F	PHY	FDCV	WO	12.5	23.2	80
93	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	PHY	FDCV	WO	14.3	28.7	78
94	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	PHY	FDCV	WO	16.5	24.7	80
95	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	PHY	FDCV	WO	17.0	25.5	80
96	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	PHY	FDCV	WO	17.2	25.8	80
97	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	PHY	FDCV	WO	17.9	26.9	80
98	Ward et al, 1995	6788	Turkey (*Meleagris gallopavo*)	2	M	FD	10	d	5	d	JV	M	PHY	FDCV	WO	18.3		70
99	Jensen and Maurice, 1979	2166	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	PHY	FDCV	WO	18.5	37.1	79
100	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	NR	PHY	FDCV	WO	21.3	42.7	79
101	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	2	U	FD	8	d	7	d	JV	NR	PHY	FDCV	WO	21.5		72
102	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	PHY	FDCV	WO	25.3	31.6	80
103	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	3	U	FD	8	d	8	d	JV	M	PHY	FDCV	WO	26.4	52.8	79
104	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	w	26	w	SM	F	PHY	FDCV	WO	27.2	36.2	80
105	Chiou et al, 1999	2048	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	w	JV	NR	PHY	FDCV	WO	28.4		74
106	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	PHY	FDCV	WO	28.7	57.4	78
107	Poupoulis and Jensen,1976	2250	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	PHY	FDCV	WO	28.7	57.4	78
108	Wang et al, 1987	2319	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	M	PHY	FDCV	WO	35.5		72
109	Wang et al, 1987	2319	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	PHY	FDCV	WO	35.5		72
110	Ledoux et al, 1987	2194	Chicken (*Gallus domesticus*)	3	UX	FD	21	d	1	d	JV	F	PHY	FDCV	WO	45.4		78
111	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	5	U	FD	14	d	8	d	JV	M	PHY	FDCV	WO	46.7	53.6	80
112	Yannakopoulos et al, 1990	2333	Japanese quail (*Coturnix japonica*)	4	U	FD	34	d	7	d	JV	B	PHY	FDCV	WO	82.0		74
113	Mehring and Brumbaugh, 1960	22	Chicken (*Gallus domesticus*)	5	M	FD	10	w	1	d	JV	B	PHY	FDCV	WO	84.3		69
114	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	PHY	FDCV	WO		2.69	74
115	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	PHY	FDCV	WO		2.70	72
116	Kashani et al, 1986	2171	Turkey (*Meleagris gallopavo*)	2	U	FD	8	w	1	d	JV	M	PHY	FDCV	WO		4.88	73
117	Pesti and Bakalli 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	PHY	FDCV	WO		5.43	72
118	Jensen and Maurice 1978	2164	Chicken (*Gallus domesticus*)	3	U	FD	3	w	1	d	JV	NR	PHY	GPHY	WO		9.43	67
119	Pesti and Bakalli 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	21	d	JV	M	PHY	FDCV	WO		11.5	72
120	Nam et al 1984	2226	Chicken (*Gallus domesticus*)	3	U	FD	4	w	3	d	JV	NR	PHY	FDCV	WO		13.4	73
121	Bakalli et al, 1995	3717	Chicken (*Gallus domesticus*)	2	U	FD	41	d	1	d	JV	M	PHY	FDCV	WO		14.3	72

Table 5.1
Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
122	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	PHY	IRRI	FE		16.6	67
123	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	PHY	GPHY	DT		18.2	73
124	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	PHY	GPHY	DT		18.3	73
125	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	PHY	GPHY	DT		18.4	73
126	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	PHY	GPHY	DT		18.6	73
127	Griminger, 1977	2112	Chicken (*Gallus domesticus*)	5	U	FD	2	w	7	mo	SM	F	PHY	IRRI	FE		22.4	73
128	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	3	U	FD	8	d	8	d	JV	M	PHY	FDCV	WO		26.4	73
129	Jensen and Maurice, 1979	2166	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	PHY	FDCV	WO		36.6	73
130	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	12	d	8	d	JV	NR	PHY	FDCV	WO		50.1	73
131	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	2	U	FD	8	d	8	d	JV	M	PHY	FDCV	WO		55.2	73
132	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	8	d	8	d	JV	NR	PHY	FDCV	WO		57.2	73
133	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	12	d	8	d	JV	NR	PHY	FDCV	WO		59.0	73
Pathology (PTH)																		
134	Guenthner et al, 1978	2114	Turkey (*Melagris gallopavo*)	2	U	FD	24	w	1	d	JV	M	HIS	GHIS	HE	2.97		73
135	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	M	ORW	SMIX	AT	3.61	7.21	80
136	Chiou et al, 1999	2048	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	w	JV	NR	HIS	GHIS	DT	5.73	14.3	80
137	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	NR	ORW	SMIX	LI	6.28		67
138	Jensen et al, 1991	2163	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	HIS	GLSN	MH	8.40	16.8	79
139	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ	12.3	24.7	78
140	Pearce et al, 1983	2294	Chicken (*Gallus domesticus*)	4	U	FD	5	d	27	w	JV	F	ORW	SMIX	LI	12.3	24.7	78
141	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ	14.3	28.7	78
142	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ	14.3	28.7	78
143	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ	14.3	28.7	78
144	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ	14.3	28.7	78
145	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ	14.3	28.7	78
146	Wideman et al, 1996	2325	Chicken (*Gallus domesticus*)	5	M	FD	2	w	1	d	JV	M	HIS	GHIS	PR	15.7	21.2	78
147	Pearce et al, 1983	2294	Chicken (*Gallus domesticus*)	5	U	FD	12	d	26	w	SM	F	ORW	SMIX	LI	15.8	31.6	79
148	Jensen and Maurice, 1978	2165	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	HIS	USTR	GZ	17.8	35.5	79
149	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	FD	5	d	27	w	SM	F	ORW	SMIX	LI	18.0	28.0	76
150	Wood and Worden, 1973	36216	Duck (*Anas platyrhynchos*)	2	U	FD	16	d	2	d	JV	B	ITX	GITX	WO	18.1		72
151	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	232	d	17	w	SM	F	ORW	ORWT	LI	23.2	29.9	80
152	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	ORW	ORWT	LI	23.7	29.7	80
153	Stevenson and Jackson 1980	2292	Chicken (*Gallus domesticus*)	5	U	FD	6	d	24	w	SM	F	ORW	SMIX	LI	27.2	54.4	79
154	Chiou et al 1997	2050	Chicken (*Gallus domesticus*)	5	M	FD	4	w	28	w	SM	F	HIS	GHIS	LI	27.9	35.3	85
155	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	GV	5	d	27	w	SM	F	ORW	SMIX	LI	34.0	65.4	79
156	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	ORW	SMIX	GZ	35.3	44.1	80
157	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	ORW	ORWT	GZ	40.0	50.0	80
158	Ledoux et al, 1987	2194	Chicken (*Gallus domesticus*)	3	UX	FD	21	d	1	d	JV	F	ORW	SMIX	LI	45.4		78
159	Jackson, 1977	2157	Chicken (*Gallus domesticus*)	6	U	FD	35	d	NR	NR	SM	F	ORW	ORWT	LI	49.9	54.8	80
160	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	5	M	DR	14	d	4	d	JV	NR	HIS	GLSN	WO	51.6	258	78
161	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	28	d	1	d	JV	M	HIS	NCRO	GZ	201		72
162	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	4	M	FD	35	d	3	d	JV	NR	HIS	GLSN	LI	297		70
163	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	6	U	OR	3	w	25	w	JV	M	PTH	ORWT	LI	637		66
164	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	M	ORW	SMIX	AT		1.02	74
165	Wood and Worden, 1973	36216	Chicken (*Gallus domesticus*)	2	U	FD	21	d	2	d	JV	B	ORW	ORWT	LI		3.55	72
166	King, 1975	2177	Duck (*Anas platyrhynchos*)	2	U	FD	56	d	8	d	JV	B	ORW	SMIX	IN		4.15	72
167	King, 1972	2178	Chicken (*Gallus domesticus*)	2	U	FD	9	w	1	d	JV	B	ORW	SMIX	IN		4.65	72
168	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	336	d	17	w	SM	F	ORW	ORWT	LI		5.11	74
169	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	ORW	SMIX	LI		7.87	67
170	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	ORW	ORWT	GZ		8.58	74
171	Wideman et al, 1996	2325	Chicken (*Gallus domesticus*)	4	U	FD	2	w	1	d	JV	M	HIS	GHIS	PR		13.3	72
172	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ		14.3	72
173	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ		14.3	72
174	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ		14.3	72
175	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ		14.3	72
176	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	HIS	GHIS	GZ		16.6	67
177	Latymer and Coates, 1981	2191	Chicken (*Gallus domesticus*)	2	U	FD	24	d	1	d	JV	B	ORW	ORWT	LI		21.3	73
178	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	NR	HIS	GHIS	GZ		21.3	73
179	Stevenson and Jackson, 1980	2293	Chicken (*Gallus domesticus*)	4	U	FD	8	w	24	w	SM	F	ORW	SMIX	LI		22.6	73
180	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	ORW	ORWT	KI		23.9	79
181	Smith, 1969	2284	Chicken (*Gallus domesticus*)	4	U	FD	25	d	1	d	JV	M	ORW	ORWT	LI		30.3	73
182	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	ORW	ORWT	KI		30.4	79

Table 5.1
Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
183	Christmas and Harms, 1979	2052	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	HIS	USTR	GZ		31.4	74
184	Jensen and Maurice, 1978	2165	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	ORW	SMIX	GZ		34.9	73
185	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	ORW	ORWT	KI		35.2	79
186	Jensen and Maurice, 1979	2166	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	ORW	SMIX	SP		36.6	73
187	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	HIS	NCRO	GZ		201	72
188	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	5	U	OR	3	w	25	w	JV	M	ORW	ORWT	LI		536	75
Reproduction (REP)																		
189	Ankari et al, 1998	2006	Chicken (*Gallus domesticus*)	4	U	FD	84	d	25	w	LB	F	REP	EGPN	WO	4.05	12.1	80
190	Harms and Buresh, 1986	2117	Chicken (*Gallus domesticus*)	3	U	FD	6	w	64	w	LB	F	REP	EGPN	WO	13.9	19.5	85
191	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	LB	F	EGG	EGWT	EG	15.6	23.3	86
192	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	GV	5	d	27	w	LB	F	REP	PROG	WO	16.7	34.0	89
193	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	LB	F	REP	EGPN	WO	17.0	25.5	86
194	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	FD	5	d	27	w	LB	F	REP	PROG	WO	18.0	28.0	86
195	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	LB	F	EGG	EGWT	EG	19.4	29.0	86
196	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	LB	F	REP	EGPN	WO	20.5	30.7	86
197	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	336	d	17	w	LB	F	REP	EGPN	WO	21.6		71
198	Griminger, 1977	2112	Chicken (*Gallus domesticus*)	5	U	FD	2	w	7	mo	LB	F	EGG	ESTH	EG	22.4	44.8	85
199	Pearce et al, 1983	2294	Chicken (*Gallus domesticus*)	5	U	FD	12	d	26	w	LB	F	REP	EGPN	WO	22.5	45.0	85
200	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	232	d	17	w	LB	F	REP	EGPN	WO	23.2	29.9	86
201	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	LB	F	REP	EGPN	WO	23.9		76
202	Stevenson and Jackson, 1980	2292	Chicken (*Gallus domesticus*)	5	U	FD	6	d	24	w	LB	F	REP	EGPN	WO	27.2	54.4	85
203	Chiou et al, 1997	2050	Chicken (*Gallus domesticus*)	5	M	FD	4	w	28	w	LB	F	REP	EGPN	WO	27.5	40.6	91
204	Jackson, 1977	2157	Chicken (*Gallus domesticus*)	6	U	FD	35	d	NR	NR	LB	F	REP	PROG	WO	29.1	47.5	86
205	Jackson and Stevenson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	LB	F	REP	EGPN	WO	30.4		76
206	Chiou et al, 1998	2049	Chicken (*Gallus domesticus*)	4	U	FD	4	w	38	w	LB	F	REP	EGPN	WO	33.4	40.1	86
207	Jackson and Stevenson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	LB	F	REP	EGPN	WO	35.2		76
208	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	LB	F	REP	ORWT	OV	40.0	50.0	86
209	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	LB	F	REP	EGPN	WO	43.3		71
210	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	6	U	OR	3	w	25	w	JV	M	REP	SPCV	TE	239	318	87
211	Kadirvel and Kothandaraman, 1978	11876	Chicken (*Gallus domesticus*)	2	U	FD	28	w	12	w	LB	F	EGG	EGWT	WO		19.7	80
212	Stevenson and Jackson, 1980	2293	Chicken (*Gallus domesticus*)	4	U	FD	8	w	24	w	LB	F	REP	EGPN	WO		22.6	79
213	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	5	U	OR	3	w	25	w	JV	M	REP	SPCV	TE		536	81
Growth (GRO)																		
214	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	M	GRO	BDWT	WO	1.92		78
215	Kashani et al, 1986	2171	Turkey (*Melagris gallopavo*)	4	U	FD	8	w	1	d	JV	M	GRO	BDWT	WO	2.34	4.68	83
216	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	2.70		76
217	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	2.75		76
218	Guenthner et al, 1978	2114	Turkey (*Melagris gallopavo*)	2	U	FD	24	w	1	d	JV	M	GRO	BDWT	WO	2.97		68
219	McGhee et al, 1965	14453	Chicken (*Gallus domesticus*)	5	U	FD	4	w	NR	NR	JV	NR	GRO	BDWT	WO	3.83	7.67	83
220	King, 1975	2177	Duck (*Anas platyrhynchos*)	2	U	FD	56	d	8	d	JV	B	GRO	BDWT	WO	4.15		76
221	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	4.43		76
222	King, 1972	2178	Chicken (*Gallus domesticus*)	2	U	FD	9	w	1	d	JV	B	GRO	BDWT	WO	4.65		67
223	Kayongo-Male and Palmer, 1998	5149	Turkey (*Melagris gallopavo*)	3	U	FD	4	w	NR	NR	JV	NR	GRO	BDWT	WO	4.75		68
224	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	5.43		76
225	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	3	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	5.56		76
226	Waibel et al, 1964	14405	Turkey (*Melagris gallopavo*)	3	U	FD	3	w	7	d	JV	NR	GRO	BDWT	WO	5.82	46.6	75
227	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	NR	GRO	BDWT	WO	6.28		78
228	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	NR	GRO	BDWT	WO	7.55		78
229	Hill, 1974	92	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	GRO	BDWT	WI	7.63		76
230	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	8.19		76
231	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	GRO	BDWT	WO	8.40		69
232	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	4	U	FD	7	d	6	d	JV	NR	GRO	BDWT	WO	8.59	42.9	80
233	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	3	U	FD	7	d	7	d	JV	NR	GRO	BDWT	WO	8.59	42.9	80
234	Gill et al, 1995	2107	Chicken (*Gallus domesticus*)	4	U	FD	3	w	4	w	JV	M	GRO	BDWT	WO	9.52	19.0	84
235	Skrivan et al, 2000	25969	Chicken (*Gallus domesticus*)	2	M	FD	38	d	1	d	JV	B	GRO	BDWT	WO	9.72		82
236	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	5	M	DR	14	d	4	d	JV	NR	GRO	BDWT	WO	10.2	51.6	82
237	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	3	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	11.1		76
238	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	21	d	JV	M	GRO	BDWT	WO	11.5		67
239	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	5	U	FD	35	d	1	d	JV	M	GRO	BDWT	WO	11.9		76
240	Nam et al, 1984	2226	Chicken (*Gallus domesticus*)	3	U	FD	4	w	3	d	JV	NR	GRO	BDWT	WO	12.2	24.3	83
241	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	DR	14	d	4	d	JV	NR	GRO	BDWT	WO	12.6		78
242	Chiou et al, 1999	2048	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	w	JV	NR	GRO	BDWT	WO	13.3	26.6	84

Table 5.1
Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
243	Jenkins et al, 1970	2162	Chicken (*Gallus domesticus*)	2	M	FD	6	w	1	d	JV	B	GRO	BDWT	WO	13.4		73
244	Marron et al, 2001	25968	Chicken (*Gallus domesticus*)	2	U	FD	21	d	7	d	JV	M	GRO	BDWT	WO	14.2		68
245	Hill, 1990	5734	Chicken (*Gallus domesticus*)	5	U	FD	19	d	1	d	JV	F	GRO	BDWT	WO	14.2		76
246	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
247	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
248	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
249	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
250	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
251	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3		67
252	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3		67
253	Bakalli et al, 1995	3717	Chicken (*Gallus domesticus*)	2	U	FD	41	d	1	d	JV	M	GRO	BDWT	WO	14.3		76
254	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	15.7	25.8	84
255	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	GRO	BDWT	WO	16.5	24.7	84
256	Stevenson and Jackson, 1980	2292	Chicken (*Gallus domesticus*)	5	U	FD	6	d	24	w	SM	F	GRO	BDWT	WO	16.7	33.4	83
257	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	GRO	BDWT	WO	17.2	25.8	84
258	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	17.5		76
259	Smith, 1969	2284	Chicken (*Gallus domesticus*)	4	U	FD	25	d	1	d	JV	M	GRO	BDWT	WO	17.8	31.1	83
260	Wang et al,1987	2319	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	17.8	35.5	82
261	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	FD	5	d	27	w	SM	F	GRO	BDWT	WO	18.0	28.0	80
262	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	18.2		68
263	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	FD	10	d	5	d	JV	M	GRO	BDWT	WO	18.3		74
264	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	18.3		68
265	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	18.4		68
266	Jensen and Maurice, 1978	2166	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	18.5	37.1	83
267	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	18.6		68
268	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	5	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	19.6	30.5	84
269	Kadirvel and Kothandaraman, 1978	11876	Chicken (*Gallus domesticus*)	2	U	FD	28	w	12	w	SM	F	GRO	BDWT	WO	19.7		69
270	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	GRO	BDWT	WO	20.5	30.7	84
271	Pimentel et al, 1992	5617	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	B	GRO	BDWT	WO	20.9		68
272	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	NR	GRO	BDWT	WO	21.3	42.7	83
273	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	5	U	FD	7	d	9	d	JV	NR	GRO	BDWT	WO	21.5	42.9	82
274	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	2	U	FD	8	d	9	d	JV	NR	GRO	BDWT	WO	21.5		76
275	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	336	d	17	w	SM	F	GRO	BDWT	WO	21.6		68
276	Wideman et al, 1996	2325	Chicken (*Gallus domesticus*)	5	M	FD	2	w	1	d	JV	M	GRO	BDWT	WO	21.7		76
277	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	M	FD	21	d	1	d	JV	B	GRO	BDWT	WO	21.9	34.0	89
278	Griminger, 1977	2112	Chicken (*Gallus domesticus*)	5	U	FD	2	w	7	mo	SM	F	GRO	BDWT	WO	22.4	44.8	83
279	Kassim and Suwanpradit, 1996	2172	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	22.7	34.1	83
280	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	GRO	BDWT	WO	23.0	30.7	84
281	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	232	d	17	w	SM	F	GRO	BDWT	WO	23.2	29.9	84
282	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	GRO	BDWT	WO	23.3	31.0	84
283	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	GRO	BDWT	WO	23.9		74
284	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	24.7		67
285	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	GRO	BDWT	WO	26.4	35.2	84
286	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	DR	10	d	5	d	JV	M	GRO	BDWT	WO	26.6		69
287	Ledoux et al, 1989	5812	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	26.9	40.4	78
288	Chiou et al, 1997	2050	Chicken (*Gallus domesticus*)	5	M	FD	28	d	28	w	SM	F	GRO	BDWT	WO	27.9	35.3	89
289	Hill, 1989	7091	Chicken (*Gallus domesticus*)	4	U	FD	19	d	NR	NR	JV	NR	GRO	BDWT	WO	28.4		70
290	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	28.7	57.4	82
291	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	28.7		67
292	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	M	FD	21	d	1	d	JV	B	GRO	BDWT	WO	29.5		83
293	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO	29.7	59.3	82
294	Hill, 1990	5734	Chicken (*Gallus domesticus*)	4	U	FD	19	d	1	d	JV	F	GRO	BDWT	WO	30.4		76
295	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	GRO	BDWT	WO	30.7		74
296	Mehring and Brumbaugh, 1960	22	Chicken (*Gallus domesticus*)	5	M	FD	10	w	1	d	JV	B	GRO	BDWT	WO	33.0	43.3	88
297	Jensen et al, 1991	2163	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	34.1		68
298	Harms and Buresh, 1986	2118	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO	34.6	51.9	84
299	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	5	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	35.2	63.9	83
300	Bafundo et al, 1984	2517	Chicken (*Gallus domesticus*)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	35.5		67
301	Hill, 1990	5734	Chicken (*Gallus domesticus*)	2	U	FD	19	d	1	d	JV	F	GRO	BDWT	WO	35.5		76
302	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	36.3		78
303	Jensen and Maurice, 1979	2166	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	36.6		77
304	Davis et al, 1996	1278	Chicken (*Gallus domesticus*)	2	U	FD	21	d	14	d	JV	M	GRO	BDWT	WO	37.1		69

Table 5.1
Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
305	Chiou et al, 1998	2049	Chicken (*Gallus domesticus*)	4	U	FD	4	w	38	w	SM	F	GRO	BDWT	WO	40.1		69
306	Southern and Baker, 1983	6368	Chicken (*Gallus domesticus*)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	41.0		68
307	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	GRO	BDWT	WO	43.3		69
308	Kassim and Suwanpradit, 1996	2172	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	w	JV	M	GRO	BDWT	WO	49.5	74.2	83
309	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	GRO	BDWT	WO	50.0		69
310	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO	50.1		76
311	Jackson, 1977	2157	Chicken (*Gallus domesticus*)	6	U	FD	35	d	1	yr	SM	F	GRO	BDWT	WO	50.9	55.9	84
312	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	4	M	FD	35	d	3	d	JV	NR	GRO	BDWT	WO	56.8	109	89
313	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	5	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO	60.0	120	82
314	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	GV	5	d	27	w	SM	F	GRO	BDWT	WO	65.4		68
315	Yannakopoulos et al., 1990	2333	Japanese quail (*Coturnix japonica*)	4	U	FD	34	d	7	d	JV	B	GRO	BDWT	WO	82.0		78
316	Leeson and Summers, 1982	2196	Chicken (*Gallus domesticus*)	4	U	FD	21	d	1	d	JV	M	GRO	BDWT	WO	103		68
317	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	FD	35	d	3	d	JV	NR	GRO	BDWT	WO	143		78
318	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	GRO	BDWT	WO		2.69	78
319	Kashani et al, 1986	2171	Turkey (*Melagris gallopavo*)	2	U	FD	8	w	1	d	JV	M	GRO	BDWT	WO		4.88	77
320	Harms and Eberst, 1974	9234	Turkey (*Melagris gallopavo*)	2	U	FD	3	w	1	d	JV	NR	GRO	GGRO	WO		10.3	77
321	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO		14.3	76
322	Jensen and Maurice, 1978	2165	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO		17.5	77
323	Latymer and Coates, 1981	2191	Chicken (*Gallus domesticus*)	2	U	FD	24	d	1	d	JV	B	GRO	BDWT	WO		21.3	77
324	Stevenson and Jackson, 1980	2293	Chicken (*Gallus domesticus*)	4	U	FD	8	w	24	w	SM	F	GRO	BDWT	WO		22.6	77
325	Ledoux et al, 1987	2194	Chicken (*Gallus domesticus*)	3	UX	FD	21	d	1	d	JV	F	GRO	BDWT	WO		22.7	82
326	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	3	U	FD	8	d	8	d	JV	M	GRO	BDWT	WO		26.4	77
327	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	3	U	FD	8	d	8	d	JV	M	GRO	BDWT	WO		26.4	77
328	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	5	w	1	d	JV	B	GRO	BDWT	WO		28.7	76
329	Christmas and Harms, 1979	2052	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO		31.4	78
330	Jensen and Maurice, 1978	2165	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO		34.9	77
331	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	GRO	BDWT	WO		35.2	83
332	Ekperigin and Vohra, 1981	2084	Chicken (*Gallus domesticus*)	3	U	FD	1	w	12	d	JV	B	GRO	BDWT	WO		35.5	76
333	Wang et al, 1987	2319	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO		35.5	76
334	Hill, 1974	92	Chicken (*Gallus domesticus*)	6	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO		42.9	76
335	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	12	d	8	d	JV	NR	GRO	BDWT	WO		50.1	77
336	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	2	U	FD	8	d	8	d	JV	M	GRO	BDWT	WO		55.2	77
337	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	8	d	8	d	JV	NR	GRO	BDWT	WO		57.2	77
338	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	12	d	8	d	JV	NR	GRO	BDWT	WO		59.0	77
339	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	4	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO		60.0	76
340	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	FD	35	d	3	d	JV	NR	GRO	BDWT	WO		75.5	83
341	Hill, 1979	1370	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO		85.9	76
342	Jensen, 1975	1403	Chicken (*Gallus domesticus*)	2	U	FD	14	d	1	d	JV	NR	GRO	BDWT	WO		92.9	78
343	Hill, 1980	395	Chicken (*Gallus domesticus*)	2	U	FD	1	w	1	d	JV	F	GRO	BDWT	WO		138	70
Survival (MOR)																		
344	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	2	w	NR	NR	JV	B	MOR	MORT	WO	2.75		70
345	Wood and Worden, 1973	36216	Chicken (*Gallus domesticus*)	2	U	FD	49	d	2	d	JV	B	MOR	MORT	WO	3.55		77
346	Wood and Worden, 1973	36216	Duck (*Anas platyrhynchos*)	2	U	FD	49	d	2	d	JV	B	MOR	MORT	WO	6.69		77
347	Hill, 1974	92	Chicken (*Gallus domesticus*)	2	U	FD	5	w	1	d	JV	B	MOR	MORT	WO	7.63		68
348	McGhee et al, 1965	14453	Chicken (*Gallus domesticus*)	5	U	FD	4	w	NR	NR	JV	NR	MOR	MORT	WO	8.14	16.3	84
349	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	MOR	MORT	WO	8.40		79
350	Skrivan et al, 2000	25969	Chicken (*Gallus domesticus*)	2	M	FD	38	d	1	d	JV	B	MOR	MORT	WO	9.72		74
351	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	11.7		68
352	Jenkins et al, 1970	2162	Chicken (*Gallus domesticus*)	2	M	FD	6	w	1	d	JV	B	MOR	MORT	WO	13.4		83
353	Marron et al, 2001	25968	Chicken (*Gallus domesticus*)	2	U	FD	21	d	7	d	JV	M	MOR	MORT	WO	14.2		78
354	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	14.3	28.7	83
355	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	14.3	28.7	83
356	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	14.3		77
357	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	14.3		77
358	Wood and Worden, 1973	36216	Duck (*Anas platyrhynchos*)	2	U	FD	16	d	2	d	JV	B	MOR	MORT	WO	18.1		77
359	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	FD	10	d	5	d	JV	M	MOR	MORT	WO	18.3		84
360	Ankari et al, 1998	2006	Chicken (*Gallus domesticus*)	4	U	FD	84	d	25	w	SM	F	MOR	MORT	WO	19.9		73
361	Latymer and Coates, 1981	2191	Chicken (*Gallus domesticus*)	2	U	FD	24	d	1	d	JV	B	MOR	MORT	WO	21.3		69
362	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	336	d	17	w	SM	F	MOR	MORT	WO	21.6		79
363	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	DR	10	d	5	d	JV	M	MOR	MORT	WO	26.6		79
364	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7	57.4	83
365	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7	57.4	83

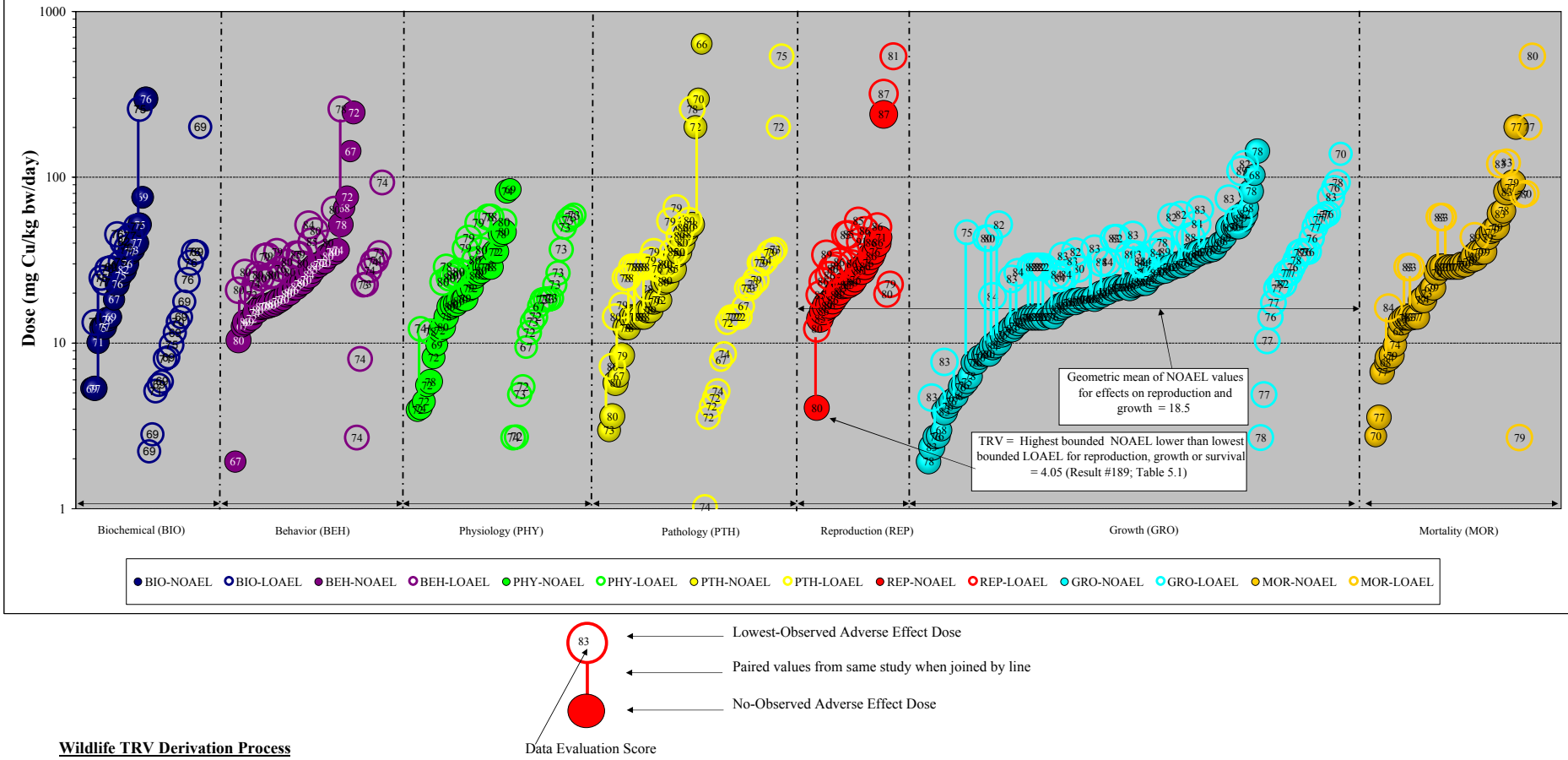
Table 5.1
Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
366	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	5	w	1	d	JV	M	MOR	MORT	WO	28.7		70
367	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7		77
368	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7		77
369	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7		77
370	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7		77
371	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	MOR	MORT	WO	29.7		79
372	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	MOR	MORT	WO	29.7		79
373	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	MOR	MORT	WO	30.8		70
374	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	MOR	MORT	WO	31.6		79
375	Mehring and Brumbaugh, 1960	22	Chicken (*Gallus domesticus*)	5	M	FD	10	w	1	d	JV	B	MOR	MORT	WO	33.0	43.3	89
376	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	MOR	MORT	WO	35.2		79
377	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	MOR	MORT	WO	35.4		79
378	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	232	d	17	w	SM	F	MOR	MORT	WO	35.5		79
379	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	MOR	MORT	WO	43.3		79
380	Waibel et al, 1964	14405	Turkey (*Melagris gallopavo*)	3	U	FD	3	w	7	d	JV	NR	MOR	SURV	WO	46.6		72
381	Christmas and Harms, 1979	2052	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	MOR	MORT	WO	48.3		79
382	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	MOR	MORT	WO	50.0		79
383	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	5	U	FD	21	d	NR	NR	JV	B	MOR	MORT	WO	60.0	120	83
384	Jackson, 1977	2157	Chicken (*Gallus domesticus*)	6	U	FD	35	d	NR	NR	SM	F	MOR	MORT	WO	62.7		78
385	Hill, 1974	92	Chicken (*Gallus domesticus*)	6	U	FD	5	w	1	d	JV	F	MOR	MORT	WO	81.6	122	83
386	Hill, 1979	1370	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	85.9		77
387	Jensen, 1975	1403	Chicken (*Gallus domesticus*)	2	U	FD	14	d	1	d	JV	NR	MOR	MORT	WO	92.9		79
388	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	MOR	MORT	WO	201		77
389	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	MOR	MORT	WO		2.69	79
390	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	DR	4	d	4	d	JV	NR	MOR	MORT	WO		78.5	77
391	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	6	U	OR	3	w	25	w	JV	M	MOR	MORT	WO		79.6	80
392	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	MOR	MORT	WO		201	77
393	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	5	U	OR	4	d	25	w	JV	M	MOR	MORT	WO		536	80

AATT = alanine aminotransferase; AD = adipose tissue; ASAT = aspartate aminotransferase; AT = alimentary tract; B = both; BDWT = body weight changes; BEH = behavior; BIO = biochemical; BL = blood; BT = breast; bw = body weight; CHM = chemical changes; CHOL = cholesterol; CRKI = creatine kinase; d = day; DR = drinking water; DT = digestive tract; EG = egg; EGG = egg; EGPN = eggs per nest; EGWT = egg weight; ENZ = enyzme level changes; ESTH = eggshell thickness; F = female; FCNS = food consumption; FD = food; FDB = feeding behavior; FDCV = food conversion efficiency; FE = feathers; FEFF = feeding efficiency; FFTA = free fatty acids; GCHM = general biochemical changes; GGRO = general growth; GHIS = general histology; GITX = general intoxication; GLCN = glycine; GLPX = glutathione peroxidase; GLSN = gross lesions; GLUC = glucose; GOTR = glutamic-oxaloacetic transaminase; GPHY = general pysiology changes; GRO = growth; GV = gavage; GZ = gizzard; HE = heart; HEMT = general hematology; HIS = histological changes; HMGL = hemoglobin; IN = intestinal tract; IRRI = skin irritation; ITX = intoxication; JV = juvenile; kg = kilograms; KI = kidney; LADH = lactate dehydrogenase; LB = egg-laying bird; LD = lipid; LI = liver; LIPD = lipid; LOAEL = lowest observed adverse effect level; mg = mil M = measured; MH = mouth; MOR = effects on mortality and survival; MORT = mortality; NCRO = necrosis; NOAEL = No Observed Advese Effect Level; NR = Not reported; OR = other oral; ORW = organ weight changes; ORWT = organ weight changes; OV = ovaries; PHPH = pH; PHY = physiology; PL = plasma; PR = proventriculus; PROG = progeny counts/numbers; PROT = prothrombin time; PTH = pathology; REP = reproduction; SGOT = serum glutamate oxalo aetate transaminase; SK = skin; SM = sexually mature; SMIX = weight relative to body weight; SP = spleen; SPCV = sperm cell viability; SR = serum; SURV = survival; TE = testes; U = unmeasured; URIC = uric acid; USTR = ultrastructural changes; UX = measured but values not reported; w = weeks; WCON = water consumption; WI = wings; WO = whole organism; yr = year.

*NOAEL and LOAEL values that are equal and from the same reference represent different experimental designs.
These are designated with different Phase numbers in Appendix 5.1.

Figure 5.1 Avian TRV Derivation for Copper



Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.

2) There are at least three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.

3) The geometric mean is equal to 18.5 mg copper/kg bw/d and is higher than the lowest bounded LOAEL for results within the reproduction, growth, and survival (MOR) effect groups.

3) The avian wildlife TRV for copper is equal to 4.05 mg copper/kg bw/day which is the highest NOAEL value lower than the lowest bound LOAEL value for effects on reproduction, growth or survival.

5.2 Estimation of Dose and Calculation of the Eco-SSL

Three separate Eco-SSL values were calculated for avian wildlife, one for each of three surrogate receptor species representing different trophic levels. The avian Eco-SSLs were calculated according to the Eco-SSL guidance (U.S. EPA, 2003) and are summarized in Table 5.2.

Table 5.2 Calculation of the Avian Eco-SSLs for Copper

Surrogate Receptor Group	TRV for Copper (mg dw/kg bw/d) [1]	Food Ingestion Rate (FIR)[2] (kg dw/kg bw/d)	Soil Ingestion as Proportion of Diet (P_s)[2]	Concentration of Copper in Biota Type (i)[2,3] (B_i) (mg/kg dw)	Eco-SSL (mg/kg dw)[4]
Avian herbivore (dove)	4.05	0.190	0.139	$\ln(B_i) = 0.394 * \ln(Soil_j) + 0.688$ where i = plants	76
Avian ground insectivore (woodcock)	4.05	0.214	0.164	$B_i = 0.515 * Soil_j$ where i = earthworms	28
Avian carnivore (hawk)	4.05	0.0353	0.057	$\ln(B_i) = 0.1444 * \ln(Soil_j) + 2.042$ where i = mammals	1600

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] HQ = [FIR * ($Soil_j$ * P_s + B_i)] / TRV solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE

The derivation of the Eco-SSL for mammalian wildlife was completed as two parts. First, the TRV was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate receptor species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

6.1 Mammalian TRV

The literature search was completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) and identified 3,365 papers with possible toxicity data for copper for either avian or mammalian species. Of these studies, 3,175 were rejected for use as described in Section 7.5. Of the remaining papers, 97 contained data for mammalian test species. These papers were reviewed and the data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are summarized in Table 6.1. The complete results are provided as Appendix 6-1.

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
Biochemical (BIO)																		
1	Cerklewski and Forbes, 1977	2625	Rat (*Rattus norvegicus*)	2	U	FD	1	w	NR	NR	JV	M	CHM	HMGL	UR	1.53		71
2	Uthus, 2001	36349	Rat (*Rattus norvegicus*)	2	U	FD	62	d	NR	NR	JV	M	CHM	HMGL	BL	2.07		70
3	Amer, et al, 1973	10086	Cattle (*Bos taurus*)	3	M	FD	4	w	3	d	JV	M	ENZ	GENZ	BL	2.71	5.09	80
4	Miranda et al, 1981	36240	Rat (*Rattus norvegicus*)	2	M	FD	5	w	NR	NR	JV	M	ENZ	ASAT	PL	3.60		74
5	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	13	w	6	w	JV	B	ENZ	AATT	BL	6.02	12.0	77
6	Irie, 1990	21243	Pig (*Sus scrofa*)	3	U	FD	8	w	4	mo	JV	NR	CHM	FFTA	WO	6.07		70
7	Thacker, 1991	2304	Pig (*Sus scrofa*)	2	U	FD	7	d	NR	NR	GE	F	CHM	PRTL	MK	6.51		70
8	Kline et al, 1971	20975	Pig (*Sus scrofa*)	4	M	FD	88	d	69	d	JV	NR	CHM	HMGL	BL	7.63		66
9	Kornegay et al, 1986	2182	Pig (*Sus scrofa*)	3	U	FD	25	d	NR	NR	JV	B	CHM	HMGL	BL	8.59	17.2	71
10	Brandt, 1983	2033	Mink (*Mustela vision*)	3	M	FD	4	mo	90	d	JV	M	CHM	HMGL	PL	10.2	19.6	81
11	Suttle and Mills, 1966	3757	Pig (*Sus scrofa*)	3	U	FD	34	d	NR	NR	JV	F	ENZ	ASAT	SR	11.9	20.3	77
12	Smith et al, 1975	3756	Horse - Shetland pony (*Equus caballus*)	4	M	FD	84	d	NR	NR	JV	NR	CHM	PCLV	BL	13.8		67
13	Moffitt and Murphy, 1973	12718	Rat (*Rattus norvegicus*)	4	U	DR	15	d	NR	NR	JV	B	ENZ	AHDX	LI	17.1	51.2	71
14	Bassuny, 1991	2020	Rabbit (*Oryctolagus cuniculus*)	5	U	FD	7	w	35	d	JV	M	CHM	PRTL	BL		0.758	71
15	Solaiman et al, 2001	36748	Goat (*Capra hircus*)	3	U	GV	9	w	7-8	mo	JV	F	ENZ	GGTR	PL		1.47	73
16	Kakela et al, 1999	36231	Mink (*Mustela vision*)	2	U	FD	28	d	6	mo	JV	F	CHM	VTMA	PL		4.01	70
17	Kakela and Hyvarinen, 1999	36248	Mink (*Mustela vision*)	2	U	FD	28	d	6	mo	JV	F	CHM	FFTA	LD		4.01	70
18	Adam et al, 1977	3752	Goat (*Capra hircus*)	4	U	GV	144	d	12	mo	AD	B	CHM	GLYC	LI		5.36	73
19	DeGoey et al, 1971	2064	Pig (*Sus scrofa*)	2	U	FD	98	d	NR	mo	JV	NR	CHM	HMGL	BL		7.46	71
20	Gipp et al, 1973	14396	Pig (*Sus scrofa*)	2	U	FD	12	w	NR	NR	JV	F	CHM	HMGL	BL		7.66	70
21	Myres and Bowland, 1973	12809	Pig (*Sus scrofa*)	2	U	FD	10	w	70	d	JV	B	CHM	FFTA	LD		7.84	71
22	Ritchie et al, 1963	14402	Pig (*Sus scrofa*)	2	U	FD	15	w	7	w	JV	NR	CHM	HMGL	WO		8.08	70
23	Onifade and Abu, 1998	2237	Rabbit (*Oryctolagus cuniculus*)	4	U	FD	70	d	7	w	JV	NR	CHM	TWBC	BL		9.47	70
24	Gipp et al, 1974	14397	Pig (*Sus scrofa*)	2	U	FD	35	d	3	w	JV	B	CHM	HMGL	BL		9.93	71
25	Radecki et al, 1992	2255	Pig (*Sus scrofa*)	2	U	FD	14	d	21	d	JV	B	ENZ	G6PD	GT		12.0	70
26	DeGoey et al, 1971	2064	Pig (*Sus scrofa*)	2	U	FD	23	d	NR	mo	JV	NR	CHM	HMGL	BL		15.5	70
27	Rana and Kumar, 1980	2256	Rat (*Rattus norvegicus*)	2	U	GV	20	d	90	d	JV	M	CHM	RBCE	BL		39.8	77
28	Kumar et al, 1987	2186	Rat (*Rattus norvegicus*)	2	U	GV	45	d	90	d	JV	M	CHM	PRTL	KI		39.8	77
29	Gautam et al, 2001	36346	Rat (*Rattus norvegicus*)	2	U	FD	2	w	NR	NR	JV	NR	CHM	CALC	LI		39.8	74
30	DeVries et al, 1986	10891	Rat (*Rattus norvegicus*)	2	U	DR	11	mo	3	w	JV	F	HRM	GHRM	BR		45.8	66
31	Aburto et al, 2001	25964	Rat (*Rattus norvegicus*)	2	U	FD	6	mo	10	w	JV	M	CHM	GCHM	LI		48.7	70
32	Pribyl et al, 1980	23825	Rat (*Rattus norvegicus*)	2	U	FD	4	d	NR	NR	JV	M	ENZ	GENZ	SR		63.5	70
33	Rana and Verma, 1997	36247	Rat (*Rattus norvegicus*)	2	U	FD	30	d	NR	NR	JV	M	CHM	GLTH	LI		75.0	79
34	Tatum et al, 2000	36389	Rat (*Rattus norvegicus*)	2	U	FD	6	w	NR	NR	JV	F	ENZ	GENZ	PL		75.7	70
35	Rana et al, 1985	13236	Rat (*Rattus norvegicus*)	2	U	GV	30	d	90	d	JV	M	CHM	GLYC	LI		100	77
36	Fuentealba et al, 2000	36364	Rat (*Rattus norvegicus*)	2	U	FD	12	w	21	d	JV	B	ENZ	AATT	LI		122	69
37	Fuentealba et al, 2000	36364	Rat (*Rattus norvegicus*)	2	U	FD	18	w	NR	NR	GE	F	ENZ	AATT	LI		132	69
38	Fuentealba et al, 1993	2097	Rat (*Rattus norvegicus*)	2	U	FD	1	w	NR	mo	JV	M	CHM	GBCM	LI		135	69
39	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	4	U	FD	92	d	6	w	JV	M	ENZ	AATT	BL		146	69
40	Haywood and Comerford, 1980	2123	Rat (*Rattus norvegicus*)	2	U	FD	1	w	NR	mo	JV	M	ENZ	AATT	BL		178	69
41	Zhang et al, 2000	36355	Rat (*Rattus norvegicus*)	2	U	GV	8	w	8	w	JV	B	ENZ	GENZ	SR		357	79
42	Pettersen, et al, 2002	36374	Mouse (*Mus musculus*)	3	U	FD	3	w	4	w	JV	B	CHM	NACO	HE		494	70
43	Gooneratne and Howell, 1980	36200	Sheep (*Ovis aries*)	2	U	DR	66	d	9-12	mo	JV	M	ENZ	GLPX	LI		1820	69
44	Sansinanea et al, 1996	36234	Sheep (*Ovis aries*)	2	U	OR	14	w	12	mo	JV	F	CHM	GLUC	SR		7140	77
Behavior (BEH)																		
45	Miranda et al, 1981	36240	Rat (*Rattus norvegicus*)	2	M	FD	5	w	NR	NR	JV	M	FDB	FCNS	WO	3.60		75
46	Anugwa et al, 1984	2010	Rabbit (*Oryctolagus cuniculus*)	3	M	FD	8	w	8	w	JV	B	FDB	FCNS	WO	3.64	6.67	85
47	Bassuny, 1991	2020	Rabbit (*Oryctolagus cuniculus*)	5	U	FD	7	w	35	d	JV	M	FDB	FCNS	WO	4.25		74
48	Ward, et al, 1991	1888	Pig (*Sus scrofa*)	2	M	FD	144	d	31	d	JV	B	FDB	FDNG	WO	4.37		70
49	Allcroft et al, 1961	14387	Pig (*Sus scrofa*)	4	M	FD	4	w	8-10	w	JV	B	FDB	FCNS	WO	5.60	9.34	84
50	Gershbein et alm 1983	136	Rat (*Rattus norvegicus*)	2	U	FD	80	d	44	d	JV	M	BEH	NMVM	WO	5.89		66
51	Thacker, 1991	2304	Pig (*Sus scrofa*)	2	U	FD	35	d	NR	NR	LC	F	FDB	FCNS	WO	6.69		74
52	Apgar et al, 1995	25922	Pig (*Sus scrofa*)	4	M	FD	5	w	31	d	JV	B	FDB	FCNS	WO	6.90		70
53	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	2	M	FD	28	d	29	d	JV	B	FDB	FCNS	WO	7.37		70
54	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	2	M	FD	28	d	29	d	JV	B	FDB	FCNS	WO	7.37		70
55	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	2	M	FD	28	d	30	d	JV	B	FDB	FCNS	WO	8.21		70
56	Allcroft et al, 1961	14387	Pig (*Sus scrofa*)	4	M	FD	19	w	8-10	w	JV	B	FDB	FCNS	WO	8.43		69
57	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	3	M	FD	28	d	29	d	JV	B	FDB	FCNS	WO	8.50		70
58	Cromwell et al 1989	2061	Pig (*Sus scrofa*)	5	U	FD	33	d	28	d	JV	B	FDB	FCNS	WO	8.67	13.0	80
59	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	4	M	FD	28	d	30	d	JV	B	FDB	FCNS	WO	8.68		70
60	Cromwell et al 1989	2061	Pig (*Sus scrofa*)	4	U	FD	28	d	28	d	JV	B	FDB	FCNS	WO	10.0	19.9	80

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
61	Edmonds and Baker, 1986	2075	Pig (*Sus scrofa*)	3	U	FD	28	d	4	w	JV	NR	FDB	FCNS	WO	10.3	26.9	80
62	Apgar and Kornegay, 1996	25928	Pig (*Sus scrofa*)	2	M	FD	14	d	NR	NR	JV	M	FDB	FCNS	WO	16.5		73
63	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	DR	15	d	6	w	JV	B	FDB	WCON	WO	17.2	51.7	75
64	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	FDB	FCNS	WO	27.7	45.7	85
65	Bush et al., 1995	2043	Mink (*Mustela vision*)	3	M	FD	132	d	10	w	JV	B	FDB	FCNS	WO	33.4		69
66	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	DR	15	d	6	w	JV	B	FDB	WCON	WO	33.8	101	75
67	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	13	w	6	w	JV	B	FDB	FCNS	WO	49.7	99.4	80
68	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	FDB	FCNS	WO	59.0		70
69	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	7	d	6	w	JV	B	FDB	FCNS	WO	179	359	80
70	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	5	U	DR	2	w	6	w	JV	M	FDB	WCON	WO	259	400	74
71	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	5	U	DR	2	w	6	w	JV	M	FDB	WCON	WO	589	1365	74
72	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	6	U	FD	15	d	6	w	JV	M	FDB	FCNS	WO	2050	3360	79
73	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	6	U	FD	15	d	6	w	JV	B	FDB	FCNS	WO	12500	18700	79
74	Ortolani et al, 2003	36759	Sheep (*Ovis aries*)	2	U	DR	14	d	6	mo	JV	M	FDB	FCNS	WO		3.00	72
75	Freundt and Ibrahim, 1990	2640	Rat (*Rattus norvegicus*)	2	U	DR	91	d	NR	NR	JV	F	FDB	WCON	WO		5.78	68
76	DeGoey et al, 1971	2064	Pig (*Sus scrofa*)	2	U	FD	98	d	NR	NR	JV	NR	FDB	FCNS	WO		7.46	74
77	Onifade and Abu, 1998	2237	Rabbit (*Oryctolagus cuniculus*)	4	U	FD	70	d	7	w	JV	NR	FDB	FCNS	WO		9.47	73
78	Boyden, 1938	14653	Rat (*Rattus norvegicus*)	5	U	FD	4	w	28	d	JV	B	FDB	FCNS	WO		23.5	73
79	Komulainen, 1983	12079	Rat (*Rattus norvegicus*)	4	U	DR	3	w	4	w	JV	M	FDB	WCON	WO		28.0	72
Physiology (PHY)																		
80	Bailey et al, 2001	25941	Cattle (*Bos taurus*)	3	M	FD	112	d	NR	NR	JV	NR	PHY	FDCV	WO	1.33		69
81	Arthur, 1965	2012	Guinea pig (*Cavia porcellus*)	3	U	FD	8	w	NR	NR	JV	B	PHY	GPHY	HA	1.48		73
82	Omole et al, 1976	43456	Pig (*Sus scrofa*)	3	U	FD	127	d	NR	NR	NR	B	PHY	FDCV	WO	2.77	4.43	76
83	Solaiman et al, 2001	36748	Goat (*Capra hircus*)	3	U	GV	9	w	7-8	mo	JV	F	PHY	FDCV	WO	3.14		69
84	Anugwa et al, 1984	2010	Rabbit (*Oryctolagus cuniculus*)	3	M	FD	8	w	8	w	JV	B	PHY	DIFD	WO	3.64	6.67	85
85	Ward et al, 1991	1888	Pig (*Sus scrofa*)	2	M	FD	144	d	31	d	JV	B	PHY	FDCV	WO	4.37		70
86	Apgar et al, 1995	25922	Pig (*Sus scrofa*)	4	M	FD	5	w	31	d	JV	B	PHY	FDCV	WO	6.90		70
87	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	2	M	FD	28	d	29	d	JV	B	PHY	FDCV	WO	7.37		70
88	Kline et al, 1971	20975	Pig (*Sus scrofa*)	4	M	FD	88	d	69	d	JV	NR	PHY	FDCV	WO	7.63		69
89	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	2	M	FD	28	d	30	d	JV	B	PHY	FDCV	WO	8.21		70
90	Braude and Ryder, 1973	2034	Pig (*Sus scrofa*)	4	M	FD	112	d	9	w	JV	NR	PHY	FDCV	WO	8.29		69
91	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	3	M	FD	28	d	29	d	JV	B	PHY	FDCV	WO	8.50		70
92	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	4	M	FD	28	d	30	d	JV	B	PHY	FDCV	WO	8.68		70
93	Cromwell et al, 1989	2061	Pig (*Sus scrofa*)	4	U	FD	28	d	28	d	JV	B	PHY	FDCV	WO	8.89	17.8	80
94	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	PHY	FDCV	WO	9.45	23.6	85
95	Edmonds and Baker, 1986	2075	Pig (*Sus scrofa*)	3	U	FD	28	d	4	w	JV	NR	PHY	FDCV	WO	10.3	26.9	80
96	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	PHY	FDCV	WO	33.6	59.0	85
97	Keen et al, 1982	11928	Rat (*Rattus norvegicus*)	4	U	FD	7	w	NR	NR	JV	F	PHY	GPHY	PL	189		66
98	Bassuny, 1991	2020	Rabbit (*Oryctolagus cuniculus*)	5	U	FD	7	w	35	d	JV	M	PHY	FDCV	WO		0.758	74
99	Cromwell et al, 1989	2061	Pig (*Sus scrofa*)	5	U	FD	33	d	28	d	JV	B	PHY	FDCV	WO		4.10	74
100	Cromwell et al, 1989	2061	Pig (*Sus scrofa*)	3	U	FD	28	d	28	d	JV	B	PHY	FDCV	WO		4.89	74
101	DeGoey et al, 1971	2064	Pig (*Sus scrofa*)	2	U	FD	23	d	NR	mo	JV	NR	PHY	IRRI	SK		15.5	73
102	Rana and Kumar, 1980	2256	Rat (*Rattus norvegicus*)	2	U	GV	20	d	90	d	JV	M	PHY	IRRI	FO		39.8	80
Pathology (PTH)																		
103	Uthus, 2001	36349	Rat (*Rattus norvegicus*)	2	U	FD	62	d	NR	NR	JV	M	ORW	ORWT	KI	2.07		73
104	Miranda et al, 1981	36240	Rat (*Rattus norvegicus*)	2	M	FD	5	w	NR	NR	JV	M	ORW	SMIX	LI	3.60		79
105	Humann-Ziehank et al, 2001	36762	Sheep (*Ovis aries*)	2	U	FD	84	d	1	yr	AD	M	ITX	GITX	WO	3.70		70
106	Ward et al, 1991	1888	Pig (*Sus scrofa*)	2	M	FD	144	d	31	d	JV	B	HIS	GHIS	GT	4.37		70
107	Adam et al, 1977	3752	Goat (*Capra hircus*)	4	U	GV	144	d	12	mo	AD	B	HIS	GHIS	LI	5.36	10.7	82
108	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	DR	15	d	6	w	JV	F	ORW	ORWT	TS	5.53	18.4	73
109	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	13	w	6	w	JV	F	HIS	GLSN	KI	6.01	12.0	80
110	Thacker, 1991	2304	Pig (*Sus scrofa*)	2	U	FD	7	d	NR	NR	GE	F	GRS	BDWT	WO	6.51		72
111	Anugwa et al, 1984	2010	Rabbit (*Oryctolagus cuniculus*)	3	M	FD	8	w	8	w	JV	B	ORW	SMIX	LI	6.67		70
112	Ritchie et al, 1963	14402	Pig (*Sus scrofa*)	2	U	FD	15	w	7	w	JV	NR	ORW	ORWT	LI	8.08		69
113	Onifade and Abu, 1998	2237	Rabbit (*Oryctolagus cuniculus*)	4	U	FD	70	d	7	w	JV	NR	ORW	SMIX	BR	9.47	18.9	79
114	Howell et al, 1991	36230	Sheep (*Ovis aries*)	2	U	GV	19	w	6-9	mo	JV	M	HIS	CTYP	LI	14.3		73
115	Prince et al, 1979	2253	Pig (*Sus scrofa*)	2	U	FD	63	d	53	d	JV	NR	ITX	GITX	WO	16.5		73
116	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	DR	15	d	6	w	JV	B	ITX	GITX	WO	17.2	51.6	75
117	Bush et al, 1995	2043	Mink (*Mustela vision*)	3	M	FD	132	d	10	w	JV	B	HIS	NCRO	LI	33.4		78
118	Kumar et al, 1987	2186	Rat (*Rattus norvegicus*)	2	U	GV	45	d	90	d	JV	M	ORW	ORWT	KI	39.8		76
119	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	15	d	6	w	JV	B	ORW	ORWT	LI	40.9	81.8	80
120	DeVries et al, 1986	10891	Rat (*Rattus norvegicus*)	2	U	DR	11	mo	3	w	JV	F	ORW	ORWT	LI	45.8		69

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
121	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	5	U	FD	92	d	6	w	JV	M	HIS	HYPL	SH	70.4	142	79
122	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	FD	13	w	6	w	JV	B	ORW	ORWT	LI	82.8	166	80
123	Keen et al, 1982	11928	Rat (*Rattus norvegicus*)	4	U	FD	7	w	NR	NR	JV	F	HIS	GHIS	MT	91.7	183	79
124	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	FD	15	d	6	w	JV	M	ORW	ORWT	LI	97.2	194	80
125	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	6	U	FD	15	d	6	w	JV	B	HIS	HYPL	SH	197	385	79
126	Dodds-Smith et al, 1992	2069	Common shrew (*Sorex araneus*)	2	U	FD	12	w	NR	NR	JV	B	ORW	ORWT	KI	251		69
127	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	5	U	DR	2	w	6	w	JV	B	ITX	GITX	WO	259	400	74
128	Haywood, 1985	2121	Rat (*Rattus norvegicus*)	5	U	FD	1	w	NR	NR	JV	M	HIS	NCRO	LI	274	365	73
129	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	5	U	DR	2	w	6	w	JV	B	ITX	GITX	WO	1430	3400	74
130	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	5	U	FD	92	d	6	w	JV	B	ITX	GITX	WO	48300		73
131	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	ORW	ORWT	DT		3.40	79
132	Howell et al, 1974	2148	Sheep (*Ovis aries*)	3	U	GV	37	w	6-12	mo	JV	B	HIS	GHIS	BR		5.09	80
133	Gopinath et al, 1974	36202	Sheep (*Ovis aries*)	2	U	DR	10	w	6	mo	JV	F	HIS	GHIS	KI		5.09	72
134	King, 1975	2179	Rabbit (*Oryctolagus cuniculus*)	2	U	FD	6	w	5	w	JV	B	ORW	SMIX	IN		5.43	72
135	Ishmael et al, 1971	2155	Sheep (*Ovis aries*)	2	U	OR	88	d	6	mo	JV	F	ORW	SMIX	LI		7.57	70
136	King, 1975	2179	Rabbit (*Oryctolagus cuniculus*)	2	U	FD	6	w	5	w	JV	B	ORW	SMIX	IN		10.9	72
137	Radecki et al, 1992	2255	Pig (*Sus scrofa*)	2	U	FD	14	d	21	d	JV	B	HIS	GHIS	GT		12.0	73
138	DeGoey et al, 1971	2064	Pig (*Sus scrofa*)	2	U	FD	23	d	NR	mo	JV	NR	HIS	NCRO	LI		15.5	73
139	Boyden, 1938	14653	Rat (*Rattus norvegicus*)	5	U	FD	4	w	28	d	JV	B	ORW	ORWT	SP		23.5	73
140	Rana and Kumar, 1980	2256	Rat (*Rattus norvegicus*)	2	U	GV	20	d	90	d	JV	M	HIS	NCRO	LI		39.8	80
141	Rana and Kumar, 1985	2257	Rat (*Rattus norvegicus*)	2	U	GV	20	d	90	d	AD	M	HIS	GHIS	LI		39.8	80
142	Aburto et al, 2001	25964	Rat (*Rattus norvegicus*)	2	U	FD	12	mo	10	w	JV	M	HIS	GHIS	LI		48.7	73
143	Chesta et al, 1989	2047	Guinea pig (*Cavia porcellus*)	2	U	DR	45	d	NR	NR	GE	F	HIS	GHIS	LI		73.7	67
144	Rana et al, 1985	13236	Rat (*Rattus norvegicus*)	2	U	GV	30	d	90	d	JV	M	ORW	SMIX	LI		100	80
145	Fuentealba et al, 2000	36364	Rat (*Rattus norvegicus*)	2	U	FD	12	w	21	d	JV	B	HIS	NCRO	LI		122	72
146	Fuentealba et al, 2000	36364	Rat (*Rattus norvegicus*)	2	U	FD	18	w	NR	NR	GE	F	HIS	NCRO	LI		132	72
147	Fuentealba et al, 1989	2095	Rat (*Rattus norvegicus*)	2	U	FD	4	w	6	w	JV	M	HIS	USTR	LI		135	66
148	Fuentealba et al, 1989	2096	Rat (*Rattus norvegicus*)	2	U	FD	16	w	NR	mo	JV	M	HIS	HYPL	BI		135	66
149	Fuentealba et al, 1993	2097	Rat (*Rattus norvegicus*)	2	U	FD	10	w	NR	mo	JV	M	HIS	HYPL	BI		135	72
150	Fuentealba et al, 1989	2098	Rat (*Rattus norvegicus*)	2	U	FD	3	w	6	w	JV	M	HIS	GHIS	KI		135	66
151	Fuentealba and Haywood, 1988	2094	Rat (*Rattus norvegicus*)	2	U	FD	1	w	6	w	JV	M	HIS	GHIS	LI		135	66
152	Haywood, 1980	2122	Rat (*Rattus norvegicus*)	2	U	FD	15	w	NR	mo	JV	M	HIS	HYPL	BI		157	72
153	Haywood et al, 1985	2125	Rat (*Rattus norvegicus*)	2	U	FD	5	w	NR	mo	AD	M	HIS	NCRO	KI		233	66
154	Haywood and Loughran, 1985	2124	Rat (*Rattus norvegicus*)	5	U	FD	6	w	NR	mo	JV	M	HIS	NCRO	LI		285	73
155	Gooneratne and Howell, 1980	36200	Sheep (*Ovis aries*)	2	U	DR	63	d	6-9	mo	JV	M	HIS	GHIS	MU		1817	72
	Reproduction (REP)																	
156	Aulerich et al, 1982	2013	Mink (*Mustela vision*)	5	U	FD	357	d	NR	mo	JV	F	REP	PROG	WO	3.40	6.79	85
157	Thacker, 1991	2304	Pig (*Sus scrofa*)	2	U	FD	7	d	NR	NR	GE	F	REP	PROG	WO	6.51		79
158	Webster, 1979	823	Mouse (*Mus musculus*)	4	U	FD	19	d	4	mo	GE	F	REP	PRWT	WO	50.7		79
159	Lecyk, 1980	2193	Mouse (*Mus musculus*)	7	U	FD	49	d	NR	NR	GE	B	REP	PROG	WO	90.9	136	84
160	Lecyk, 1980	2193	Mouse (*Mus musculus*)	7	U	FD	49	d	NR	NR	GE	B	REP	PROG	WO	90.9	136	84
161	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	13	w	6	w	JV	M	REP	SPCL	SM	107		80
162	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	4	U	FD	92	d	6	w	JV	M	REP	SPCL	SM	304		70
163	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	FD	13	w	6	w	JV	M	REP	SPCL	SM	358		76
164	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	4	U	FD	92	d	6	w	JV	M	REP	SPCL	SM	48300		70
165	Cromwell et al, 1993	2062	Pig (*Sus scrofa*)	2	U	FD	783	d	10	mo	GE	F	REP	RSUC	WO		5.51	80
166	Bataineh et al, 1998	1717	Rat (*Rattus norvegicus*)	2	U	DR	12	w	NR	NR	AD	M	REP	TEWT	TE		41.2	67
	Growth (GRO)																	
167	Engle and Spears, 2001	25940	Cattle (*Bos taurus*)	2	U	FD	239	d	NR	NR	JV	M	GRO	BDWT	WO	0.812		69
168	Engle et al, 2000	25935	Cattle (*Bos taurus*)	2	U	FD	154	d	NR	NR	JV	M	GRO	BDWT	WO	0.852		69
169	Bailey et al, 2001	25941	Cattle (*Bos taurus*)	3	M	FD	112	d	NR	NR	JV	NR	GRO	BDWT	WO	1.33		73
170	Arthur, 1965	2012	Guinea pig (*Cavia porcellus*)	3	U	FD	8	w	NR	NR	JV	B	GRO	BDWT	WO	1.48		70
171	Uthus, 2001	36349	Rat (*Rattus norvegicus*)	2	U	FD	62	d	NR	NR	JV	M	GRO	BDWT	WO	2.07		77
172	Miranda et al, 1981	36240	Rat (*Rattus norvegicus*)	2	M	FD	5	w	NR	NR	JV	M	GRO	BDWT	WO	3.60		81
173	Bassuny, 1991	2020	Rabbit (*Oryctolagus cuniculus*)	5	U	FD	7	w	35	d	JV	M	GRO	BDWT	WO	4.25		78
174	Ward et al, 1991	1888	Pig (*Sus scrofa*)	2	M	FD	144	d	31	d	JV	B	GRO	BDWT	WO	4.37		74
175	King, 1975	2179	Rabbit (*Oryctolagus cuniculus*)	2	U	FD	8	w	5	w	JV	B	GRO	BDWT	WO	5.43		76
176	Cromwell et al, 1993	2062	Pig (*Sus scrofa*)	2	U	FD	783	d	10.3	mo	GE	F	GRO	BDWT	WO	5.51		69
177	Allcroft et al, 1961	14387	Pig (*Sus scrofa*)	4	M	FD	4	w	8-10	w	JV	B	GRO	BDWT	WO	5.60	9.34	88
178	Gershbein et al, 1983	136	Rat (*Rattus norvegicus*)	2	U	FD	80	d	44	d	JV	M	GRO	BDWT	WO	5.89		68
179	Anugwa et al, 1984	2010	Rabbit (*Oryctolagus cuniculus*)	3	M	FD	8	w	8	w	JV	B	GRO	BDWT	WO	6.67		74
180	Apgar et al, 1995	25922	Pig (*Sus scrofa*)	4	M	FD	5	w	31	d	JV	B	GRO	BDWT	WO	6.90		74

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 4 of 5

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
181	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	4	U	FD	28	d	26-32	d	JV	B	GRO	BDWT	WO	7.19		69
182	Omole, 1977	12977	Rabbit (*Oryctolagus cuniculus*)	4	U	FD	8	w	6	w	JV	B	GRO	BDWT	WO	7.34		69
183	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	2	U	FD	28	d	26-32	d	JV	B	GRO	BDWT	WO	7.36		69
184	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	2	M	FD	28	d	29	d	JV	B	GRO	BDWT	WO	7.37		74
185	Kline et al, 1971	20975	Pig (*Sus scrofa*)	4	M	FD	88	d	69	d	JV	NR	GRO	BDWT	WO	7.63		73
186	Gipp et al, 1973	14396	Pig (*Sus scrofa*)	2	U	FD	12	w	NR	NR	JV	F	GRO	BDWT	WO	7.66		68
187	Cromwell et al, 1989	2061	Pig (*Sus scrofa*)	3	U	FD	28	d	28	d	JV	B	GRO	BDWT	WO	7.68		69
188	Luo and Dove, 1996	25929	Pig (*Sus scrofa*)	2	U	FD	15	d	26	d	JV	M	GRO	BDWT	WO	7.72		69
189	Myres and Bowland, 1973	12809	Pig (*Sus scrofa*)	2	U	FD	10	w	70	d	JV	B	GRO	BDWT	WO	7.84		69
190	Ritchie et al, 1963	14402	Pig (*Sus scrofa*)	2	U	FD	15	w	7	w	JV	NR	GRO	BDWT	WO	8.08		68
191	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	2	M	FD	28	d	30	d	JV	B	GRO	BDWT	WO	8.21		74
192	Braude and Ryder, 1973	2034	Pig (*Sus scrofa*)	4	M	FD	112	d	9	w	JV	NR	GRO	BDWT	WO	8.29		73
193	Allcroft et al, 1961	14387	Pig (*Sus scrofa*)	4	M	FD	19	w	8-10	w	JV	B	GRO	BDWT	WO	8.43		73
194	Prince et al 1979	2253	Pig (*Sus scrofa*)	2	U	FD	59	d	64	d	JV	NR	GRO	BDWT	WO	8.44		68
195	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	3	M	FD	28	d	29	d	JV	B	GRO	BDWT	WO	8.50		74
196	Cromwell et al, 1998	25930	Pig (*Sus scrofa*)	4	M	FD	28	d	30	d	JV	B	GRO	BDWT	WO	8.68		74
197	Cromwell et al 1989	2061	Pig (*Sus scrofa*)	3	U	FD	28	d	28	d	JV	B	GRO	BDWT	WO	9.60		69
198	Gipp et al, 1974	14397	Pig (*Sus scrofa*)	2	U	FD	35	d	3	w	JV	B	GRO	BDWT	WO	9.93		69
199	Brandt, 1983	2033	Mink (*Mustela vision*)	3	M	FD	4	mo	90	d	JV	M	GRO	BDWT	WO	10.2	19.6	88
200	Edmonds and Baker, 1986	2075	Pig (*Sus scrofa*)	3	U	FD	28	d	4	w	JV	NR	GRO	BDWT	WO	10.3	26.9	84
201	Radecki et al, 1992	2255	Pig (*Sus scrofa*)	2	U	FD	14	d	21	d	JV	B	GRO	BDWT	WO	12.0		68
202	Aulerich et al, 1982	2013	Mink (*Mustela vision*)	5	U	FD	20	w	NR	mo	JV	B	GRO	BDWT	WO	12.4		68
203	Felsman et al, 1973	3760	Cattle (*Bos taurus*)	4	U	FD	98	d	6	w	JV	M	GRO	BDWT	WO	12.7		68
204	Smith et al, 1975	3756	Horse - Shetland pony (*Equus caballus*)	4	M	FD	84	d	NR	NR	JV	NR	GRO	BDWT	WO	13.8		74
205	Suttle and Mills, 1966	3757	Pig (*Sus scrofa*)	3	U	FD	14	d	NR	NR	JV	F	GRO	BDWT	WO	16.2	27.6	84
206	Cromwell et al, 1989	2061	Pig (*Sus scrofa*)	5	U	FD	33	d	28	d	JV	B	GRO	BDWT	WO	16.4		69
207	Apgar and Kornegay, 1996	25928	Pig (*Sus scrofa*)	2	M	FD	14	d	NR	NR	JV	M	GRO	BDWT	WO	16.5		77
208	Cromwell et al, 1989	2061	Pig (*Sus scrofa*)	4	U	FD	28	d	28	d	JV	B	GRO	BDWT	WO	16.7		69
209	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	DR	15	d	6	w	JV	B	GRO	BDWT	WO	17.2	51.6	79
210	Lalich et al, 1965	2189	Rat (*Rattus norvegicus*)	2	U	FD	42	d	NR	NR	JV	M	GRO	BDWT	WO	17.5		68
211	Cromwell et al, 1989	2061	Pig (*Sus scrofa*)	4	U	FD	28	d	28	d	JV	B	GRO	BDWT	WO	17.8		69
212	Felsman et al, 1973	3760	Cattle (*Bos taurus*)	4	U	FD	98	d	6	w	JV	M	GRO	BDWT	WO	22.9		68
213	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	GRO	BDWT	WO	27.7	45.7	89
214	Onifade and Abu, 1998	2237	Rabbit (*Oryctolagus cuniculus*)	4	U	FD	70	d	7	w	JV	NR	GRO	BDWT	WO	28.4		77
215	Bush et al, 1995	2043	Mink (*Mustela vision*)	3	M	FD	132	d	10	w	JV	B	GRO	BDWT	WO	33.4		82
216	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	DR	8	d	6	w	JV	B	GRO	BDWT	WO	33.8	101	78
217	King, 1975	2179	Rabbit (*Oryctolagus cuniculus*)	2	U	FD	6	w	5	w	JV	B	GRO	BDWT	WO	37.1		67
218	White et al, 1985	2324	Rat (*Rattus norvegicus*)	2	U	FD	50	d	21	d	JV	M	GRO	BDWT	WO	43.1		68
219	DeVries et al, 1986	10891	Rat (*Rattus norvegicus*)	2	U	DR	11	mo	3	w	JV	F	GRO	BDWT	WO	45.8		73
220	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	13	w	6	w	JV	B	GRO	BDWT	WO	49.8	99.6	84
221	Komulainen, 1983	12079	Rat (*Rattus norvegicus*)	4	U	DR	1	w	4	w	JV	M	GRO	BDWT	WO	50.0	64.0	82
222	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	GRO	BDWT	WO	59.0		74
223	Myers et al, 1993	2225	Rat (*Rattus norvegicus*)	2	U	DR	6	w	NR	mo	JV	M	GRO	BDWT	WO	73.4		67
224	Tatum et al, 2000	36389	Rat (*Rattus norvegicus*)	2	U	FD	6	w	NR	NR	JV	F	GRO	BDWT	WO	75.7		68
225	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	15	d	6	w	JV	B	GRO	BDWT	WO	82.5	165	84
226	Keen et al, 1982	11928	Rat (*Rattus norvegicus*)	4	U	FD	7	w	NR	NR	JV	F	GRO	BDWT	WO	91.7	183	83
227	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	6	U	FD	92	d	6	w	JV	M	GRO	BDWT	WO	146	293	83
228	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	FD	13	w	6	w	JV	B	GRO	BDWT	WO	179	358	84
229	Dodds-Smith et al, 1992	440	Common shrew (*Sorex araneus*)	2	U	FD	12	w	NR	NR	JV	B	GRO	BDWT	WO	229		77
230	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	5	U	DR	2	w	6	w	JV	M	GRO	BDWT	WO	259	400	78
231	Pettersen et al, 2002	36374	Mouse (*Mus musculus*)	3	U	FD	3	w	4	w	JV	B	GRO	BDWT	WO	494	988	83
232	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	FD	15	d	6	w	JV	B	GRO	BDWT	WO	690		69
233	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	6	U	FD	15	d	6	w	JV	M	GRO	BDWT	WO	812	1740	83
234	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	5	U	DR	2	w	6	w	JV	M	GRO	BDWT	WO	1430	3400	78
235	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	6	U	FD	92	d	6	w	JV	M	GRO	BDWT	WO	2110	4670	83
236	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	6	U	FD	15	d	6	w	JV	F	GRO	BDWT	WO	19500	47500	83
237	Solaiman et al, 2001	36748	Goat (*Capra hircus*)	3	U	GV	9	w	7-8	mo	JV	F	GRO	BDWT	WO		1.47	80
238	Ortolani et al, 2003	36759	Sheep (*Ovis aries*)	2	U	DR	35	d	6	mo	JV	M	GRO	BDWT	WO		3.00	76
239	Freundt and Ibrahim, 1990	2640	Rat (*Rattus norvegicus*)	2	U	DR	91	d	NR	NR	JV	F	GRO	BDWT	WO		5.78	72
240	DeGoey et al, 1971	2064	Pig (*Sus scrofa*)	2	U	FD	98	d	NR	NR	JV	B	GRO	BDWT	WO		7.46	78
241	DeGoey et al, 1971	2064	Pig (*Sus scrofa*)	2	U	FD	23	d	NR	NR	JV	NR	MPH	MUSC	MU		15.5	77
242	Boyden, 1938	14653	Rat (*Rattus norvegicus*)	5	U	FD	4	w	28	d	JV	B	GRO	BDWT	WO		23.5	77

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose* (mg/kg bw/day)	LOAEL Dose* (mg/kg bw/day)	Total
243	Rana and Kumar, 1980	2256	Rat (*Rattus norvegicus*)	2	U	GV	20	d	90	d	JV	M	GRO	BDWT	WO		39.8	84
244	Kumar et al, 1987	2186	Rat (*Rattus norvegicus*)	2	U	GV	45	d	90	d	JV	M	GRO	BDWT	WO		39.8	84
245	Llewellyn et al, 1985	2203	Rat (*Rattus norvegicus*)	2	U	FD	21	w	NR	NR	JV	M	GRO	BDWT	WO		106	71
246	Fuentealba et al, 2000	36364	Rat (*Rattus norvegicus*)	2	U	FD	12	w	21	d	JV	B	GRO	BDWT	WO		122	76
247	Haywood, 1985	2121	Rat (*Rattus norvegicus*)	5	U	FD	15	w	NR	NR	JV	M	GRO	BDWT	WO		274	71
248	Haywood and Loughran, 1985	2124	Rat (*Rattus norvegicus*)	5	U	FD	6	w	NR	mo	JV	M	GRO	BDWT	WO		285	77
	Survival (MOR)																	
249	Bassuny, 1991	2020	Rabbit (*Oryctolagus cuniculus*)	5	U	FD	7	w	35	d	JV	M	MOR	MORT	WO	4.25		79
250	Cromwell et al, 1993	2062	Pig (*Sus scrofa*)	2	U	FD	783	d	10.3	mo	GE	F	MOR	MORT	WO	5.51		70
251	Allcroft et al, 1961	14387	Pig (*Sus scrofa*)	4	M	FD	4	w	8-10	w	JV	B	MOR	MORT	WO	5.60	9.34	89
252	Brandt, 1983	2033	Mink (*Mustela vision*)	3	M	FD	4	mo	90	d	JV	M	MOR	MORT	WO	10.2	19.6	89
253	Jenkins, 1989	48117	Cattle (*Bos taurus*)	5	U	FD	6	w	3	d	JV	M	MOR	MORT	WO	16.3	32.5	77
254	Boyden, 1938	14653	Rat (*Rattus norvegicus*)	5	U	FD	1	w	28	d	JV	B	MOR	MORT	WO	23.3	35.0	84
255	Edmonds and Baker, 1986	2075	Pig (*Sus scrofa*)	3	U	FD	28	d	4	w	JV	NR	MOR	MORT	WO	25.9		79
256	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	DR	15	d	6	w	JV	B	MOR	MORT	WO	33.3	111	78
257	Bush et al, 1995	2043	Mink (*Mustela vision*)	3	M	FD	132	d	10	w	JV	B	MOR	MORT	WO	33.4		83
258	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	DR	15	d	6	w	JV	F	MOR	MORT	WO	33.8	101	80
259	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	MOR	MORT	WO	45.5		75
260	Grobner et al, 1986	2113	Rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	d	28	d	JV	NR	MOR	MORT	WO	59.0		75
261	Keen et al, 1982	11928	Rat (*Rattus norvegicus*)	4	U	FD	7	w	NR	NR	JV	F	MOR	MORT	WO	91.7	183	84
262	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	13	w	6	w	JV	B	MOR	MORT	WO	107		79
263	Dodds-Smith et al, 1992	440	Common shrew (*Sorex araneus*)	2	U	FD	12	w	NR	NR	JV	B	MOR	MORT	WO	229		78
264	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	5	U	DR	2	w	6	w	JV	M	MOR	MORT	WO	259	400	79
265	Hebert, 1993	2126	Rat (*Rattus norvegicus*)	6	U	FD	15	d	6	w	JV	B	MOR	MORT	WO	307		79
266	Haywood, 1985	2121	Rat (*Rattus norvegicus*)	5	U	FD	2	w	NR	NR	JV	M	MOR	MORT	WO	457	548	78
267	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	FD	15	d	6	w	JV	B	MOR	MORT	WO	690		70
268	Hebert, 1993	2126	Mouse (*Mus musculus*)	6	U	FD	13	w	6	w	JV	B	MOR	MORT	WO	760		79
269	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	6	U	FD	92	d	6	w	JV	B	MOR	MORT	WO	798		78
270	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	5	U	DR	2	w	6	w	JV	B	MOR	MORT	WO	1430	3400	79
271	Hebert et al, 1993	2127	Rat (*Rattus norvegicus*)	6	U	FD	15	d	6	w	JV	M	MOR	MORT	WO	4160		78
272	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	6	U	FD	15	d	6	w	JV	B	MOR	MORT	WO	47500		78
273	Hebert et al, 1993	2127	Mouse (*Mus musculus*)	6	U	FD	92	d	6	w	JV	B	MOR	MORT	WO	48300		78
274	Gopinath et al, 1974	36202	Sheep (*Ovis aries*)	2	U	DR	10	w	6	mo	JV	F	MOR	MORT	WO		5.09	77
275	Ishmael et al, 1971	2155	Sheep (*Ovis aries*)	2	U	OR	31	d	6	mo	JV	F	MOR	MORT	WO		7.57	75
276	Ritchie et al, 1963	14402	Pig (*Sus scrofa*)	2	U	FD	15	w	7	w	JV	NR	MOR	MORT	WO		8.08	78
277	DeGoey et al, 1971	2064	Pig (*Sus scrofa*)	2	U	FD	23	d	NR	NR	JV	NR	MOR	MORT	WO		15.5	78
278	McNatt et al, 1971	2216	Rat (*Rattus norvegicus*)	2	U	DR	3	w	4-11	mo	JV	M	MOR	MORT	WO		114	68

AATT = alanine aminotransferase; AD = adult; AHDX = aniline hydroxylase; ASAT = aspartate aminotransferase; B = both; BDWT = body weight changes; BEH = behavior; Bl = bile; BIO = biochemical; BL = blood; BLPR = blood pressure; BR = brain; bw = body weight; CALC = calcium; CHM = chemical changes; CTYP = percent cell type; d = day; DIFD = digestibility of food; DR = Drinking water; DT - digestive tract; ENZ = enyzme level changes; F = female; FCNS = food consumption; FD = food; FDB = feeding behavior; FDCV = food conversion efficiency; FDNG = feeding behavior; FFTA = fatty acids, free; FO = foot; G6PD = glucose-6-phosphate dehydrogenase; GBCM = general biochemical changes; GE = gestation; GENZ = general enzyme changes; GGTR = (gamma) Y-glutamyltransferase; GHIS = general histology; GHRM = general hormone; GITX = general intoxication; GLPX = glutathione peroxidase; GLTH = glutathione; GLUC = glucose; GLYC = glycogen; GPHY = general pysiology changes; GRO = growth; GRS = gross body weight changes; GT = gastrointestinal tract; GV = gavage; HA = hair; HE = heart; HIS = histological changes; HMGL = hemoglobin; HRM = hormone changes; HYPL = hyperplasia; IN = intestinal tract; IRRI = skin irritation; ITX = intoxication; JV = juvenile; kg = kilograms; KI = kidney; LC = lactation; LD = lipid; LI = liver; LOAEL = lowest observed adverse effect level; mg = milligrams; mo = months; M = male; M = measured; MK = milk, lactating females; MOR = effects on mortality and survival; MORT = mortality; MPH = morphology; MT = multiple; MU = muscle; MUSC = muscle changes; NACO = sodium; NOAEL = No Observed Advese Effect Level; NCRO = necrosis; NR = Not reported; NMVM = number of movements; OR = other oral; ORW = organ weight changes; ORWT = organ weight changes; PCLV = packed cell volume; PHY = physiology; PL = plasma; PROG = progeny numbers/counts; PRTL = protein, total; PRWT = progeny weight; PTH = pathology; RBCE = red blood cell count; REP = reproduction; RSUC = sperm cell counts; SH = stomach; SK = skin; SM = sexually mature; SMIX = weight relative to body weight; SP = spleen; SPCL = sperm cell counts; SR = serum; SURV = survival; TE = testes; TEWT = testes weight; TS = thymus; TWBC = white blood cell count, total; U = unmeasured; UR = urine; USTR = ultrastructural changes; VTMA = vitamin A; w = weeks; WCON = water consumption; WO = whole organism; yr = year.

*NOAEL and LOAEL values that are equal and from the same reference represent different experimental designs.
These are designated with different Phase numbers in Appendix 6.1.

Within the reviewed papers there are 278 results for biochemical (BIO), behavior (BEH), physiology (PHY), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) endpoints with a total Data Evaluation Score >65 that were used to derive the TRV (U.S. EPA 2003; Attachment 4-4). These data are plotted in Figure 6.1 and correspond directly with the data presented in Table 6.1. The NOAEL results for growth and reproduction are used to calculate a geometric mean NOAEL. This geometric mean is examined in relationship to the lowest bounded LOAEL for reproduction, growth, and survival to derive the TRV according to the Eco-SSL guidance (U.S. EPA 2003; Attachment 4-5).

A geometric mean of the NOAEL values for reproduction and growth was calculated at 25 mg copper/kg bw/day. However, this value is higher than the lowest bounded LOAEL for reproduction, growth, or mortality results. Therefore, the TRV is equal to the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival, and is equal to 5.60 mg copper/kg bw/day.

6.2 Estimation of Dose and Calculation of the Eco-SSL

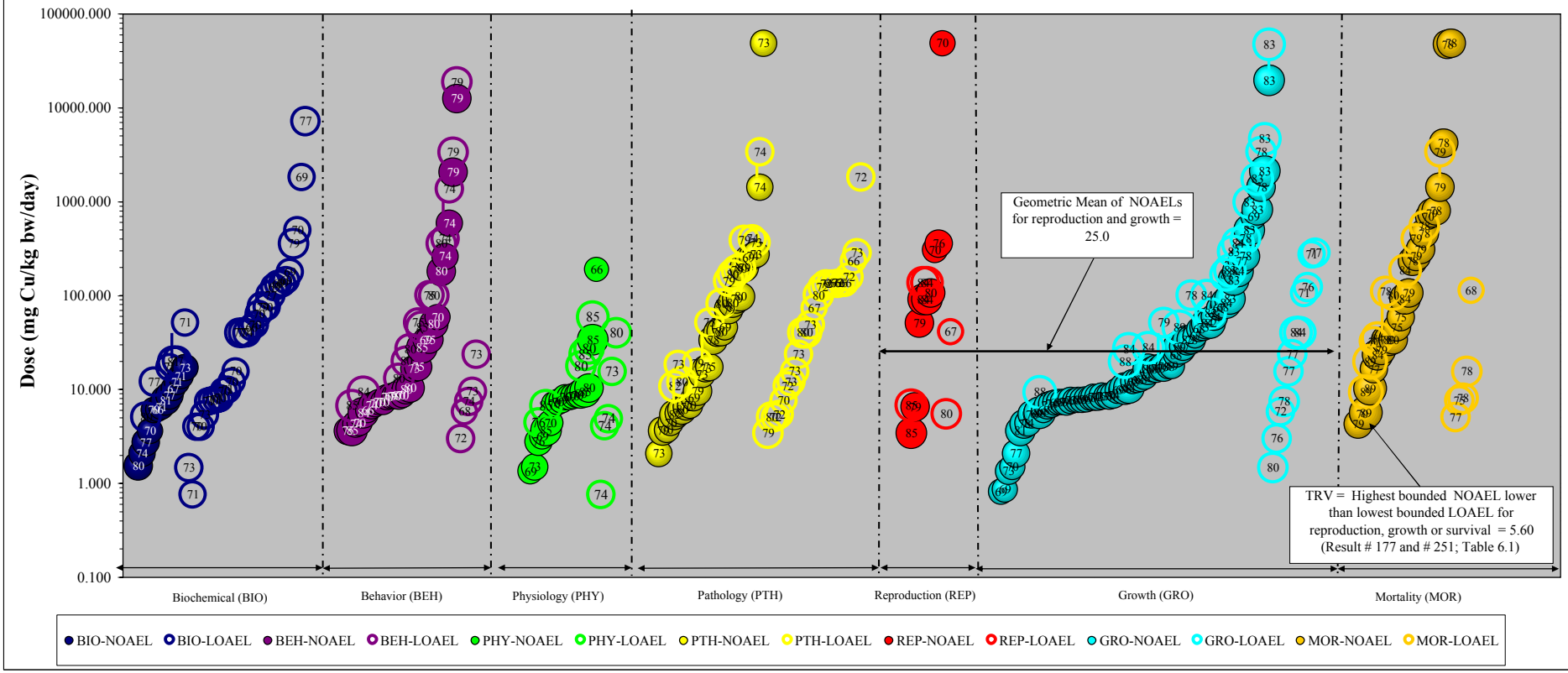
Three separate Eco-SSL values were calculated for mammalian wildlife, one for each of three surrogate receptor groups representing different trophic levels. The mammalian Eco-SSLs derived for copper were calculated according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5) and are summarized in Table 6.2.

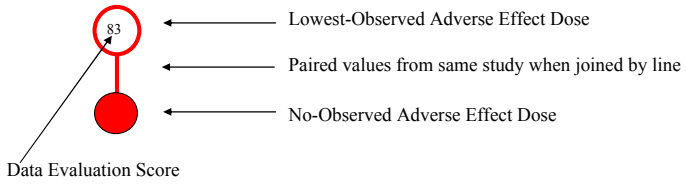
Table 6.2 Calculation of the Mammalian Eco-SSLs for Copper

Surrogate Receptor Group	TRV for Copper (mg dw/kg bw/d) [1]	Food Ingestion Rate (FIR)[2] (kg dw/kg bw/d)	Soil Ingestion as Proportion of Diet (P_s)[2]	Concentration of Copper in Biota Type (i)[2,3] (B_i) (mg/kg dw)	Eco-SSL (mg/kg dw)[4]
Mammalian herbivore (vole)	5.60	0.0875	0.032	$\ln(B_i) = 0.394 * \ln(Soil_j) + 0.688$ where i = plants	1100
Mammalian ground insectivore (shrew)	5.60	0.209	0.030	$B_i = 0.515 * Soil_j$ where i = earthworms	49
Mammalian carnivore (weasel)	5.60	0.130	0.043	$\ln(B_i) = 0.1444 * \ln(Soil_j) + 2.042$ where i = mammals	560

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] HQ = [FIR * ($Soil_j$ * P_s + B_i)] / TRV) solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).

Figure 6.1 Mammalian TRV Derivation for Copper





Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.

2) There are three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.

3) The geometric mean is equal to 25.0 mg copper/kg bw/d and is higher than the lowest bounded LOAEL for results within the reproduction, growth, and survival (MOR) effect groups.

4) The mammalian wildlife TRV for copper is equal to 5.60 mg copper/kg bw/day which is the highest NOAEL value lower than the lowest LOAEL value for reproduction and growth.

7.0 REFERENCES

7.1 General Copper References

Alloway, B.J. 1990. *Heavy Metals in Soils.* Blackie Academic & Professional, an imprint of Chapman & Hall, Wester Cleddens Road, Bishopbriggs, Glasgow, UK.

Bodek, I. et al. (eds.). 1988. *Environmental Inorganic Chemistry*. New York, NY: Pergamon Press.

Budavari, S. (ed). 1996. *The Merck Index*. 12th Edition. Whitehouse Station, New Jersey: Merck & Co., Inc. p. 444-449.

Clarke, M. L., Harvey, D. G., and Humphreys, D. J. 1981. *Veterinary Toxicology*. 2nd Edition. London: Bailliere Tindall, p. 46.

Friberg, L., Nordberg, G. F., Kessler, E., and Vouk, V. B. (eds.). 1986. *Handbook of the Toxicology of Metals*. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B. V.

George, D. B. 1993. *Kirk-Othmer Encyclopedia of Chemical Technologies*. 4th Edition. New York, NY: John Wiley & Sons.

Hutchinson, T. L. 1979. *Copper Environment*, p. 451-502, as cited in USEPA 1987; Health Issue Assessment: Copper p. 25. EPA/600/8-87/001.

Kabata-Pendias, A. and H. Pendias. 1992. *Trace Elements in Soils and Plants*, 2nd ed. CRC Press, Boca Raton. 365 p.

Seiler, H. G., Sigel, H. and Sigel, A. (eds.). 1988. *Handbook on the Toxicity of Inorganic Compounds*. New York, NY: Marcel Dekker, Inc. p. 268.

Venugopal, B. and Luckey, T. D. 1978. *Metal Toxicity in Mammals, 2*. New York: Plenum Press.

Hazardous Substances Database (HSBD). http://toxnet.nlm.nih.gov. National Library of Medicine.

United States Environmental Protection Agency (U.S. EPA). 2003. *Guidance for Developing Ecological Soil Screening Levels*. November. Office of Solid Waste and Emergency and Remedial Response. OSWER Directive 92857-55. Revised February 2005.

United States Environmental Protection Agency (U.S. EPA). 1999. *Ecological Risk Assessment and Risk Management Principles for Superfund Sites*. Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-28.P.

United States Environmental Protection Agency (U.S. EPA). 1998. *Guidelines for Ecological Risk Assessment*. Risk Assessment Forum. U.S. Environmental Protection Agency, Washington DC. EPA/630/R-95/002F. April. May 14, 1998 Federal Register 63(93): 26846-26924.

United States Environmental Protection Agency (U.S. EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. U.S. Environmental Protection Agency, Environmental Response Team (Edison, NJ). June 5, 1997.

United States Environmental Protection Agency (U.S. EPA). 1987. *Health Issues Assessment: Copper*. EPA/600/8-87/001.

7.2 References for Plants and Soil Invertebrates

Aquaterra Environmental and ESG International Inc. (Aquaterra). 2000. Assessment of the Biological Test Methods for Terrestrial Plants and Soil Invertebrates: Metals. Final Report, Prepared for the Method Development and Application Section, Environ. Technol.Centre, Environment Canada , 140 p.

Bogomolov, D. M., Chen, S. K., Parmelee, R. W., Subler, S., and Edwards, C. A. 1996. An ecosystem approach to soil toxicity testing: a study of copper contamination in laboratory soil microcosms. *Applied Soil Ecology : A Section Of Agriculture, Ecosystems & Environment*. 4[2]: 95-105.

Chhibba, I. M., Nayyar, V. K., and Takkar, P. N. 1994. Upper Critical Level of Copper in Wheat (Triticum aestivum) Raised on Typic Ustipsamment Soil. *Indian J. Agric. Sci.* 64[5]: 285-289.

De Haan, S. 1985. Acceptable Levels of Heavy Metals (Cd, Cr, Cu, Ni, Pb, Zn) in Soils. Hren (Gr), The Netherlands (Rapport 9-85) (Cited in Janus and Krajnc 1989)

Donkin, S. G. and Dusenbery, D. B. 1993. A Soil Toxicity Test Using the Nematode Caenorhabditis elegans and an Effective Methods of Recovery. *Arch. Environ. Contam. Toxicol.* 25[2]: 145-151.

Genovese, G. A. 1978. *Toxicity of Copper and Nickel to Some Coniferous Seedlings*. M.S.Thesis, University of Toronto, Ontario, Canada , 38 p.

Gonzalez, S. P. 1991. Upper Critical Level of Copper to Alfalfa in Ten Chilean Soils. *Water Air Soil Pollut.* 57/58: 201-208.

Haque, A. and Ebing, W. 1983. Toxicity Determination of Pesticides to Earthworms in the Soil Substrate. *J. Plant Dis. Prot.(Z. Pflanzenkr. Pflanzensch.)*. 90[4]: 395-408 (OECDG Data File).

Kammenga, J. E., Koert, P. H. G., Riksen, J. A. G., Korthals, G. W., and Bakker, J. 1996. A Toxicity Test in Artificial Soil Based on the Life-History Strategy of the Nematode *Plectus acuminatus*. *Environ. Toxicol. Chem.* 15[5]: 722-727.

Kjaer, C. and Elmegaard, N. 1996. Effects of Copper Sulfate on Black Bindweed (*Polygonum convolvulus L.)*. *Ecotoxicol. Environ. Saf.* 33[2]: 110-117.

Korthals, G. W., Popovici, I., Iliev, I., and Lexmond, T. M. 1998. Influence of Perennial Ryegrass on a Copper and Zinc Affected Terrestrial Nematode Community. *Appl. Soil Ecol.* 10[1-2], 73-85

Korthals, G. W., Alexiev, A. D., Lexmond, T. M., Kammenga, J. E., and Bongers, T. 1996a. Long-Term Effects of Copper and pH on the Nematode Community in an Agroecosystem. *Environ. Toxicol. Chem.* 15: 979-985.

Korthals, G. W., Ende, A. van de, Megen, H. van, Lexmond, T. M., Kammenga, J. E., and Bonger, T. 1996b. Short-Term Effects of Cadmium, Copper, Nickel and Zinc on Soil Nematodes from Different Feeding and Life-History Strategy Groups. Appl. Soil Ecol. 4[2]: 107-117.

Kula, H. and Larink, O. 1997. Development And Standardization Of Test Methods For The Prediction Of Sublethal Effects Of Chemicals On Earthworms. *Soil Biol Biochem* 29[3-4]: 635-639.

Ma, W. C. 1988. Toxicity of Copper to Lumbricide Earthworms in Sandy Agricultural Soils Amended with Cu-Enriched Organic Waste Materials. *Ecol. Bull.* 39: 53-56.

Ma, W. C. 1984. Sublethal Toxic Effects of Copper on Growth, Reproduction and Litter Breakdown Activity in the Earthworm *Lumbricus rubellus*, with Observations on the Influence of Temperature and Soil pH. *Environ. Pollut. Ser. A* 33: 207-219.

Mitchell, R. L., Burchett, M. D., Pulkownik, A., and Mccluskey, L. 1988. Effects of Environmentally Hazardous Chemicals on the Emergence and Early Growth of Selected Australian Plants. *Plant Soil*. 112[2]: 195-200.

Mozaffari, M. A. K. Alva and E. Q. Chen. 1996. Relation of Copper Extractable from Soil and pH to Copper Content and Growth of Two Citrus Rootstocks. *Soil Sci.* 161[11]: 786-792.

Neuhauser, E. F., Loehr, R. C., and Malecki, M. R. 1986. Contact and Artificial Soil Tests Using Earthworms to Evaluate the Impact of Wastes in Soil. In: J.K.Petros,Jr., W.J.Lacy, and R.A.Conway (Eds.), *Hazardous and Industiral Solid Waste Testing: 4th Symposium*, ASTM STP 886, Philadelphia, PA 886, 192-203

Neuhauser, E. F., Loehr, R. C., Milligan, D. L., and Malecki, M. R. 1985. Toxicity of Metals to the Earthworm Eisenia fetida. *Biol. Fertil. Soils*. 1[3]: 149-152.

Pedersen, M. B., Kjaer, C., and Elmegaard, N. 2000a. Toxicity and Bioaccumulation of Copper to Black Bindweed (*Fallopia convolvulus*) in Relation to Bioavailability and the Age of Soil Contamination. *Arch. Environ. Contam. Toxicol*. 39[4]: 431-439.

Pedersen, B. M., Van Gestel, C. A. M., and Elmegaard, N. 2000b. Effects of Copper on Reproduction of Two Collembolan Species Exposed Through Soil, Food, and Water. *Environ. Toxicol. Chem.* 19[10]: 2579-2588.

Peredney, C. L. and Williams, P. L. 2000a. Utility of Caenorhabditis elegans for Assessing Heavy Metal Contamination in Artificial Soil. *Arch. Environ. Contam. Toxicol*. 39[1]: 113-118.

Peredney, C. L. and Williams, P. L. 2000b. Comparison of the Toxicological Effects of Nitrate Versus Chloride Metallic Salts on Caenorhabditis elegans in Soil. In: F.T.Price, K.V.Brix, and N.K.Lane (Eds.), Recent Achievements in Environmental Fate and Transport, 9th Volume, ASTM STP 1381, West Conshohocken, PA , 256-268.

Phillips, Carlton T., Checkai, Ronald T., and Berg, Dorothy A. 1996. Standardized earthworm toxicity testing: comparison of artificial soil vs. natural soil using selected chemical pollutants on the earthworm *Eisenia foetida*. In: D.A.Berg (Eds.), ERDEC-SP-043, Proc.ERDEC Sci.Conf.Chem.Biol.Def.Res., Nov.14-17, 1995, Aberdeen Proving Ground, MD , 685-691

Posthuma, L., Baerselman, R., Van Veen, R. P. M., and Dirven-Van Breemen, E. M. 1997. Single and Joint Toxic Effects of Copper and Zinc on Reproduction of *Enchytraeus crypticus* in Relation to Sorption of Metals in Soils. *Ecotoxicol. Environ. Saf.* 38[2]: 108-121.

Rehab, F. I. and Wallace, A. 1978. Excess Trace Metal Effects on Cotton: 2. Copper, Zinc, Cobalt and Manganese in Yolo Loam Soil. *Commun. Soil Sci. Plant Anal*. 9[6]: 519-527.

Sandifer, R. D. and Hopkin, S. P. 1997. Effects of Temperature on the Relative Toxicities of Cd, Cu, Pb, and Zn to *Folsomia candida* (Collembola). *Ecotoxicol. Environ. Saf.* 37: 125-130.

Sandifer, R. D. and Hopkin, S. P. 1996. Effects Of Ph On The Toxicity Of Cadmium, Copper, Lead And Zinc To *Folsomia candida* Willem, 1902 (Collembola) In A Standard Laboratory Test System. *Chemosphere.* 33[12]: 2475-2486.

Scott-Fordsmand, J. J., Krogh, P. H., and Weeks, J. M. 2000. Responses of *Folsomia fimetaria* (Collembola: Isotomidae) to Copper Under Different Soil Copper Contamination Histories in Relation to Risk Assessment. *Environ.Toxicol.Chem*. 19[5]: 1297-1303.

Scott-Fordsmand, J. J., Krogh, P. H., and Weeks, J. M. 1997. Sublethal Toxicity of Copper to a Soil-Dwelling Springtail (*Folsomia fimetario*) (Collembola: Isotomidae). *Environ. Toxicol. Chem*. 16[2]: 2538-2542.

Spencer, W. F. 1966. Effect of Copper on Yield and Uptake of Phosphorus and Iron by Citrus Seedlings Grown at Various Phosphorus Levels. *Soil Sci.* 102: 296-299.

Spurgeon, D. J. and Hopkin, S. P. 1995. Extrapolation of the Laboratory-Based OECD Earthworm Toxicity Test to Metal Contaminated Field Sites. *Ecotoxicology.* 4[3]: 190-205.

Spurgeon, D. J., Hopkin, S. P., and Jones, D. T. 1994. Effects of Cadmium, Copper, Lead and Zinc on Growth, Reproduction and Survival of the Earthworm *Eisenia fetida* (Savigny): Assessing the Environmental Impact of Point-Source Metal Contamination in Terrestrial Ecosystems. *Environ. Pollut.* 84[2]: 123-130.

Svendsen, C. and Weeks, J. M. 1997a. Relevance and Applicability of a Simple Earthworm Biomarker of Copper Exposure I. Links to Ecological Effects in a Laboratory Study With *Eisenia andrei*. *Ecotoxicol. Environ. Saf.* 36[1]: 72-79.

Svendsen, C. and Weeks, J. M. 1997b. Relevance and Applicability of a Simple Earthworm Biomarker of Copper Exposure. II. Validation and Applicability Under Field Conditions in a Mesocosm Experiment with *Lumbricus rubellus*. *Ecotoxicol. Environ. Saf.* 36[1]: 80-88.

Tikhomirov, F. A. L. G. Magina and E. V. Kiseleva. 1988. Effect and Aftereffect on Plants of High Copper and Nickel Concentrations in Soil. *Moscow Univ. Soil Sci. Bull.* 43[1]: 24-27.

Torres, M. O. and De Varennes, A. 1998. Remediation of a Sandy Soil Artificially Contaminated with Copper Using a Polyacrylate Polymer. *Soil Use & Management.* 14[2]: 106-110.

Van Gestel, C. A. M., Dirven-Breemen, E. M., Sparenburg, P. M., and Baerselman, R. 1991. Influence of Cadmium, Copper and Pentachlorophenol on Growth and Sexual Development of *Eisenia andrei* (Oligochaeta, Annelida). *Biol. Fertil. Soils.* 12: 117-121.

Van Gestel, C. A. M., Van Dis, W. A., Van Breeman, E. M., and Sparenburg, P. M. 1989. Development of a Standardized Reproduction Toxicity Test with the Earthworm Species *Eisenia fetida* andrei Using Copper, Pentachlorophenol, and 2,4-Dichloroaniline. *Ecotoxicol. Environ. Saf.* 18[3]: 305-312 (OECDG Data File).

7.3 References Rejected for Use in Deriving Plant and Soil Invertebrate Eco-SSLs

These references were reviewed and rejected for use in derivation of the Eco-SSL. The definition of the codes describing the basis for rejection is provided at the end of the reference sections.

Media Abbas, M. A. - Effect of Copper and Iron on Their Uptake and on Chlorophyll Contents in Maize Seedlings. J.Environ.Sci.(Mansoura, Egypt) 6: 197-209 (1993)

Media Adalsteinsson, Sveinn. - Compensatory root growth in winter wheat: effects of copper exposure on root geometry and nutrient distribution. J.Plant Nutr. 17(9): 1501-1512 (1994)

OM Adams, T. M., McGrath, S. P., and Sanders, J. R. - The Effect of Soil pH on Solubilities and Uptake into Ryegrass of Zinc, Copper and Nickel Added to Soils in Sewage Sludges. In: T.D.Lekkas (Ed.), Heavy Metals in the Environment, Int.Conf., Volume 1, CEP Consultant Ltd., Edinburgh, UK : 484-486 (1985)

OM Agarwala, S. C., Bisht, S. S., and Sharma, C. P. - Relative Effectiveness of Certain Heavy Metals in Producing Toxicity and Symptoms of Iron Deficiency in Barley. Can.J.Bot. 55: 1299-1307 (1977)

Mix Alberici, T. M., Sopper, W. E., Storm, G. L., and Yahner, R. H. - Trace Metals in Soil Vegetation and Voles from Mine Land Treated with Sewage Sludge. J.Environ.Qual. 18: 115-120 (1989)

Media Allen, W. R. and Sheppard, P. M. - Copper Tolerance in Some Californian Populations of the Monkey Flower, Mimulus guttatus. Proc.R.Lond.Ser.B Biol.Sci. 177: 177-196 (1971)

OM Allison, R. V., Bryan, O. C., and Hunter, J. H. - The Stimulation of Plant Response on the Raw Peat Soils of the Florida Everglades Through the Use of Copper Sulphate and Other Chemicals. Fla.Univ.Agric.Exp.Stn.Bull.No.190 : 33-80 (1927)

No Control Alva, A. K. - Copper Contamination of Sandy Soils and Effects on Young Hamlin Orange Trees. Bull.Environ.Contam.Toxicol. 51(6): 857-864 (1993)

No Conc Alva, A. K., Graham, J. H., and Anderson, A. 1995. Soil pH and Copper Effects on Young 'Hamlin' Orange Trees. *Soil Sci. Soc .Am. J.* 59: 481-487.

Score Alva, A. K., Graham, J. H., and Tucker, D. P. H. 1993. Role of Calcium in Amelioration of Copper Phytotoxicity for Citrus. *Soil Sci.* 155[3]: 211-218.

Media Aoalsteinsson, Sveinn, Gussarsson, Monika, Asp, Hakan, and Jensen, Paul. - Monitoring copper-induced changes in fine root geometry of birch (Betula pendula) using nutrient film technique (NFT). Physiol.Plant. 99(3): 379-384 (1997)

Score Anderson, M. A., McKenna, J. R., Martens, D. C., Donohue, S. J., Kornegay, E. T., and Lindemann, M. D. 1991. Long-term effects of copper-rich swine manure application on continuous corn production. *Commun. Soil Sci. Plant Anal.* 22[9/10]: 993-1002.

Media Arduini, I., Godbold, D. L., and Onnis, A. - Influence of Copper on Root Growth and Morphology of Pinus pinea L. and Pinus pinaster Ait. Seedlings. Tree Physiol 15: 411-415 (1995)

Media Arnold, M. A., Lineberger, R. D., and Struve, D. K. - Copper Compounds Influence In Vitro Rooting of Birch Microcuttings. J.Am.Soc.Hortic.Sci. 119(1): 74-79 (1994)

OM Arnold, Michael A. and Struve, Daniel K. - Root distribution and mineral uptake of coarse-rooted trees grown in cupric hydroxide-treated containers. Hortscience 28(10): 988-992 (1993)

Media Arora, A. and Katewa, S. S. - Germination as a Screening Index of Heavy Metal Tolerance in Three Ethno Food Grasses. J.Environ.Biol. 20(1): 7-14 (1999)

Score Arsova, A. 1996. Effect of Soil Acidity Neutralization and Copper Toxicity on Maize Productivity, Copper Uptake and Biomass Cation Content. *Bulg .J. Plant Physiol.* 22[3/4]: 56-65.

OM Asensi, A., Bennett, F., Brooks, R., Robinson, B., and Stewart, R. - Copper Uptake Studies on Erica andevalensis, a Metal-Tolerant Plant from Southwestern Spain. Commun.Soil Sci.Plant Anal. 30(11/12): 1615-1624 (1999)

Media Ash, C. P. J. and Lee, D. J. - Lead, Cadmium, Copper and Iron in Earthworms from Road Sites. Environ.Pollut. 22(1): 59-67 (1980)

Media Babalakova, N. K., Traykova, D. A., and Matsumoto, H. - Reaction of H+-transporting activity and membrane potential formation by tonoplast ATPase proton pump of barley roots after uptake of Cu2+ and Ca2+. Dokl.Bulg.Akad.Nauk. 46(3): 117-120 (1993)

Media Babalakova, N. K., Kasai, M., and Matsumoto, H. - Effect of calcium on tonoplast H+-pyrophosphatase pump in barley roots during the uptake of copper ions. Dokl.Bulg.Akad.Nauk 46(3): 113-116 (1993)

Score Baijukya, F. P. and Semu, E. 1998. Effects of Kocide 101(R) on the Bean (*Phaseolus vulgaris*) l.

Rhizobium Symbiosis. *Acta Agric. Scand. Sect. B Soil Plant Sci.* 48[3]: 175-183.

Media Baker, A. J. M., Brooks, R. R., Pease, A. J., and Malaisse, F. - Studies on Copper and Cobalt Tolerance in Three Closely Related Taxa Within the Genus Silene L. (Caryophyllaceae) from Zaire. Plant Soil 73: 377-385 (1983)

Media Baker, D. E. - Copper: Soil, Water and Plant Relationships. Fed.Proc. 33(5): 1188-1193 (1974)

OM Baldwin, N. A. and Bennett, J. R. - Evaluation of Chemical Treatments for Inhibition of Earthworm Casting in Amenity Turf. Tests Agrochem Cultiv 0(11): 14-15 (1990)

FL Baluk, Antoni and Bukiewicz, Henryk. 1987. The action of increased copper content in soil on wicker willow rooting and growth. *Pr. Nauk. Inst. Ochr. Rosl.* 29[2]: 71-80.

OM Banu, F. and Y. D. Tiagi. - Physiological Studies Under Metal Stress Conditions 2. Effect of Zinc and Copper on Growth Performance of Lathyrus sativus. Indian Bot.Contactor 8(1): 1-7 (1991)

Score Barbosa Filho, M. P., Dynia, J. F., and Zimmermann, F. J. P. 1990. Response of upland rice to zinc and copper with a residual effect on corn. *Rev. Bras. Cienc. Solo*. 14[3]: 333-338.

No Dur Bardgett, R. D., Speir, T. W., Ross, D. J., Yeates, G. W., and Kettles, H. A. - Impact of Pasture Contamination by Copper, Chromium, and Arsenic Timber Preservative on Soil Microbial Properties and Nematodes. Biol.Fertil.Soils 18(1): 71-79 (1994)

Media Barker, W. G. - Toxicity Levels of Mercury, Lead, Copper and Zinc in Tissue Culture Systems of Cauliflower, Lettuce, Potato and Carrot. Can.J.Bot. 50: 973-976 (1972)

OM Barman, S. C. and Lal, M. M. - Accumulation of heavy metals (Zn, Cu, Cd and Pb) in soil and cultivated vegetables and weeds grown in industrially polluted fields. Journal Of Environmental Biology : 107-115 (1994)

OM Barnes, J. S. and Cox, F. R. - Effects of Copper Sources on Wheat and Soybeans Grown on Organic Soils. Agron.J. 65: 705-708 (1973)

No Dur Bartosova, M., Pavel, J., and Koch, M. - Relations between heavy metal levels in soil, detritophagous and phytophagous invertebrates. Toxicol.Environ.Chem. 52(1-4): 13-23 (1995)

Media A., Laborde, C., Montillet, J. L., Triantaphylides, C., and Chagvardieff, P. - Evaluation of Lipid Peroxidation as a Toxicity Bioassay for Plants Exposed to Copper. Environ.Pollut. 109(1): 131-135 (2000)

Mix Basta, N. T. and Sloan, J. J. - Bioavailability of heavy metals in strongly acidic soils treated with exceptional quality biosolids. J.Environ.Qual. 28(2): 633-638 (1999)

OM Batey, T., Berryman, C., and Line, C. - The Disposal of Copper-Enriched Pig-Manure Slurry on Grassland. J.Br.Grassld.Soc. 27: 139-143 (1972)

OM Bekker, A. W., Hue, N. V., Yapa, L. G. G., and Chase, R. G. - Peanut Growth as Affected by Liming, Ca-Mn Interactions and Cu Plus Zn Applications to Oxidic Samoan Soils. Plant Soil 164: 203-211 (1994)

OM Belanger, A., Levesque, M., and Mathur, S. P. - The Effect of Residual Copper Levels on the Nutrition and Yield of Oats Grown in Microplots on Three Organic Soils. Commun.Soil Sci.Plant Anal. 17(1): 85-96 (1986)

OM Bengtsson, G., Gunnarsson, T., and Rundgen, S. 1986. Effects of Metals Pollution on the Earthworm Dendrobaena rubida (Sav.) in Acidified Soils. *Water Air Soil Pollut*. 28: 361-383.

Media Effects of Iron Salts and Other Looseners on Fruit Abscission of Various Citrus Cultivars. J.Am.Soc.Hortic.Soc. 98(3): 265-269 (1973)

Media Bengtsson, G., Gunnarsson, T., and Rundgren, S. - Growth Changes Caused by Metal Uptake in a Population of Onychiurus armatus (Collembola) Feeding on Metal Polluted Fungi. Oikos 40: 216-225 (1983)

Media Bengtsson, G., Gunnarsson, T., and Rundgren, S. - Influence of Metals on Reproduction, Mortality and Population Growth in Onychiurus armatus (Collembola). J Appl Ecol 22: 967-978 (1985)

Media Berger, B. and Dallinger, R. - Accumulation of Cadmium and Copper by the Terrestrial Snail Arianta arbustorum L: Kinetics and Budgets. Oceanologia 79: 60-65 (1989)

Media Berry, W. L. - Dose-Reponse Curves for Lettuce Subjected to Acute Toxic Levels of Copper and Zinc. In: ERDA Symp.Ser.No.42, Biological Implications of Metals in the Environment, NTIS, Springfield, VA : 365-369

Media Berry, W. L. - Comparative Toxicity of VO3, CrO2-4, Ni2+, Cu2+, Zn2+, and Cd2+ to Lettuce Seedlings. In: D.C.Adriano and I.L.Brisbin,Jr.(Eds.), Environmental Cemistry and Cycling Processes, Proc.Symp.Held at Augusta, Georgia, April 18-May 1, 1976, Tech.Info.Center, U.S.Dep of Energy (U.S.NTIS CONF-760429) : 582-589 (1978)

ERE Beyer, W. N., Chaney, R. L., and Mulhern, B. M. - Heavy Metal Concentrations in Earthworms from Soil Amended with Sewage Sludge. J.Environ.Qual. 11(3): 381-385 (1982)

No Conc Bhuiya, M. R. H. and Cornfield, A. H. - Effects of Addition of 1000 ppm Cu, Ni, Pb and Zn on Carbon Dioxide Release During Incubation of Soil Alone and After Treatment with Straw. Environ.Pollut. 3: 173-177 (1972)

OM Bhuiya, M. R. H. and Cornfield, A. H. - Effect of Addition of Cu, Cr, Pb and Zn on Nitrogen Mineralisation and Nitrification During Incubation of Sandy Soils. Bangladesh J.Biol.Sci. 5(1): 18-20 (1976)

Score Biro, B., Koves-Pechy, K., Voros, I., and Kadar, I. 1998. Toxicity of Some Field Applied Heavy Metal Salts to the Rhizobial and Fungal Microsymbionts of Alfalfa and Red Clover. *Agrokem. Talajtan.* 47[1-4]: 265-276.

Media Blevins, R. L. and Massey, H. F. - Evaluation of Two Methods of Measuring Available Soil Copper and the Effects of Soil **pH** and Extractable Aluminum on Copper Uptake by Plants. Soil Sci.Soc.Am.Proc. 23: 296-298 (1959)

Mix Boisson, J., Ruttens, A., and Vangronsveld, J. - Evaluation of Hydroxyapatite as a Metal Immobilizing Soil Additive for the Re**Media**tion of Polluted Soils. Part I. Influence of Hydroxyapatite on Metal Exchangeability in Soil, Plant Growth and Plant Metal Accumulation. Environ.Pollut. 104(2): 225-233 (1999)

Score Bobrzecka, D. and Krauze, A. 1989. Copper Fertilization in Crop Rotation. Part I. Effect of Copper on Yield and Copper Content in Crops. *Acta Acad. Agric. Tech. Olstenensis Agric.* 48[365]: 117-125.

No Conc Boon, Gerben T., Bouwman, Lucas A., Bloem, Jaap, and Roemkens, Paul F. A. M. 1998. Effects of a copper-tolerant grass (*Agrostis capillaris*) on the ecosystem of a copper-contaminated arable

soil. *Environ. Toxicol. Chem*. 17: 1964-1971.

OM Borkert, C. M. and Cox, F. R. - Effects of Acidity at High Soil Zinc, Copper and Manganese on Peanut, Rice and Soybean. Commun.Soil Sci.Plant Anal. 30(9/10): 1371-1384 (1999)

Media Bowen, J. E. - Manganese-Silicon Interaction and Its Effect on Growth of Sudan Grass. Plant Soil 37: 577-588 (1972)

Media Brams, E. A. and Fiskell, J. G. A. - Copper Accumulatino in Citrus Roots and Desorption with Acid. Soil Sci.Soc.Am.Proc. 35: 772-775 (1971)

Media Brenchley, W. E. - The Influence of Copper Sulphate and Manganese Sulphate upon the Growth of Barley. Ann.Bot.(Lond.) 24: 571-583 (1910)

Media Brenchley, W. E. - Comparative Effects of Cobalt, Nickel and Copper on Plant Growth. Ann.Appl.Biol. 25(4): 671-694 (1938)

No Conc Brennan, R. F. 1991. Effect of Copper Application on Take-All Severity and Grain Yield of Wheat in Field Experiments near Esperance, Western Australia. *Aust. J. Exp. Agric.* 31: 255-258.

Media Brown, B. E. - Uptake of Copper and Lead by a Metal Tolerant Isopod Asellus meridianus Rac. Freshw.Biol. 7(3): 235-244 (1977)

OM Brown, J. C., Holmes, R. S., Shapiro, R. E., and Specht, A. W. - Effects of Phosphorus and Copper Salts on Iron Chlorosis of Rice in Flooded and Nonflooded Soil and the Associated Enzymatic Activity. Soil Sci. 79: 363-372 (1955)

ERE Brown, J. C. and Jones, W. E. - Heavy-Metal Toxicity in Plants: 1. A Crisis in Embryo. Commun.Soil Sci.Plant Anal. 6: 421-438 (1975)

No Tox Brun, L. A., Maillet, J., Hinsinger, P., and Pepin, M. 2001. Evaluation of Copper Availability to Plants in Copper-Contaminated Vineyard Soils. *Environ. Pollut.* 111[2]: 293-302.

Media Brunner, I. and Frey, B. - Detection and Localization of Aluminum and Heavy Metals in Ectomycorrhizal Norway Spruce Seedlings. Environ.Pollut. 108(2): 121-128 (2000)

OM Caro, J. H. and Taylor, A. W. - Pathways of Loss of Dieldrin from Soils Under Field Conditions. J.Agric.Food Chem. 19(2): 379-384 (1971)

ERE Cataldo, D. A. and Wildung, R. E. - Soil and Plant Factors Influencing the Accumulation of Heavy Metals by Plants. Environ.Health Perspect. 27: 149-159 (1978)

Media Cedeno-Maldonade, A. J., Swader, J. A., and Heath, R. L. - The Cupric Ion as an Inhibitor of Photosynthetic Electron Transport in Isolated Chloroplasts. Plant Physiol. 50: 698-701 (1972)

FL Celardin, F. and Landry, J. C. - Bioindicators of pollution earthworms and heavy metals in soil. Arch.Sci.(Geneva) 41(2): 225-228 (1988)

Media Chaney, R. L. - Effect of Nickel on Iron Metabolism by Soybean. Diss.Abstr.Int. 31: 1692-1693 (1970)

OM Chaney, R. L., White, M. C., and Simon, P. W. - Plant Uptake of Heavy Metals from Sewage Sludge Applied to Land. In: Proc.2nd Natl.Conf.Munic.Sludge Manage., Information Transfer, Rockville, MD : 169-178 (1975)

Media Chaney, W. R. and Strickland, R. C. - Relative toxicity of heavy metals to red pine pinus-resinosa pollen germination and germ tube elongation. J.Environ.Qual. 13(3): 391-394 (1984)

OM Chatterjee, J. and Chatterjee, C. - Phytotoxicity of Cobalt, Chromium and Copper in Cauliflower. Environ.Pollut. 109(1): 69-74 (2000)

OM Chaudri, A. M., McGrath, S. P., and Giller, K. E. - Survival of the Indigenous Population of Rhizobium leguminosarum Biovar trifolii in Soil Spiked with Cd, Zn, Cu and Ni Salts. Soil Biol.Biochem. 24(7): 625-632 (1992)

Media Cheng-nong, Y., Yi, L., Tian-zhi, W., Zhi-qun, T., Song-sheng, Q., and Ping, S. - Thermochemical Studies of the Toxic Actions of Heavy Metal Ions on Rhizopus nigricans. Chemosphere 38(4): 891-898 (1999)

Media Cheung, Y. H., Wong, M. H., and Tam, N. F. Y. - Root and Shoot Elongation as an Assessment of Heavy Metal Toxicity and `Zn Equivalent Value' of Edible Crops. Hydrobiologia 188/189: 377-383 (1989)

Media Chiu, C. Y. and Chou, C. H. - The distribution and influence of heavy metals in mangrove forests of the tamshui estuary in taiwan. Soil Sci Plant Nutr 37(4): 659-669 (1991)

ERE Chlopecka, A. - Forms of Trace Metals from Inorganic Sources in Soils and Amounts Found in Spring Barley. Water Air Soil Pollut. 69(1-2): 127-134 (1993)

ERE Chlopecka, Anna. - Copper and lead species in soil and their uptake by plants when applied as carbonates. Dev.Plant Soil Sci. 71: 459-468 (1997)

Media Chongpraditnun, Praphasri, Mori, Satoshi, and Chino, Mitsuo. - Excess copper induces a cytosolic copper-zinc superoxide dismutase in soybean root. Plant Cell Physiol. 33(3): 239-244 (1992)

OM Chowdhury, A. K. and Mitra, P. - Resistance Induced by Non-Conventional Compounds in Selected Crop Plants Against Their Fungal Pathogens. Environ.Ecol. 17(3): 640-642 (1999)

ERE Christie, P. and Beattie, J. A. M. - Grassland Soil Microbial Biomass and Accumulation of Potentially Toxic Metals from Long-term Slurry Application. J.Appl.Ecol. 26(2): 597-612 (1989)

Media Clark, R. B., Pier, P. A., Knudsen, D., and Maranville, J. W. - Effect of Trace Element Deficiencies and Excesses on Mineral Nutrients in Sorghum. J.Plant Nutr. 3(1-4): 357-374 (1981)

OM Clements, H. F. - Soil Toxicities as Causes of Sugarcane Leaf Freckle, Macadamia Leaf Chlorosis (Keaau) and Maui Sugarcane Growth Failure. Hawaii Agric Exp Stn Tech Bull 88: 52 (1974)

Mix Cook, C. M., Sgardelis, S. P., Pantis, J. D., and Lanaras, T. - Concentrations of Pb, Zn, and Cu in Taraxacum spp. in Relation to Urban Pollution. Bull.Environ.Contam.Toxicol. 53(2): 204-210 (1994)

PH Cook, C. M., Vardaka, E., and Lanaras, T. - Concentrations of Cu, growth, and chlorophyll content of field-cultivated wheat growing in naturally enriched Cu soil. Bull.Environ.Contam.Toxicol. 58(2): 248-253 (1997)

Media Crawford, L. A., Hodkinson, I. D., and Lepp, N. W. - The Effects of Feeding by the Black Bean Aphid Aphis fabae Scop. (Homoptera: Aphididae) on Copper and Cadmium Accumulation in Broad Bean (Vicia faba L.). Environ.Geochem.Health 12: 245-251 (1990)

Media Cresswell, G. C., Nair, N. G., and Evans, J. C. - Effect of Boron and Copper Contaminants in

Poultry Manure on the Growth of the Common Mushroom, Agaricus bisporus. Aust.J.Exp.Agric. 30(5): 707-712 (1990)

Mix Cunningham, J. D., Keeney, D. R., and Ryan, J. A. - Phytotoxicity and Uptake of Metals Added to Soils as Inorganic Salts or in Sewage Sludge. J.Environ.Qual. 4(4): 460-462 (1975)

Mix Cunningham, J. D., Ryan, J. A., and Keeney, D. R. - Phytotoxicity in and Metal Uptake from Soil Treated with Metal-Amended Sewage Sludge. J.Environ.Qual. 4(4): 455-459 (1975)

OM Czuba, M. and Hutchinson, T. C. - Copper and Lead Levels in Crops and Soils of the Holland Marsh Area-Ontario. J.Environ.Qual. 9(4): 566-575 (1980)

Score De Iorio, A. F., Rendina, A., Barros, M. J., Bargiela, M., Garcia, A., and Iriarte, A. 1998. Copper and Molybdenum Interaction in Elytrigia elongata Growing on a Halomorphic Soil. *J. Plant Nutr.* 21[5]: 937-947.

Score De Varennes, A., Torres, M. O., Coutinho, J. F., Rocha, M. M. G. S., and Neto, M. M. P. M. 1996. Effects of Heavy Metals on the Growth and Mineral Composition of a Nickel Hyperaccumulator. *J. Plant Nutr.* 19[5]: 669-676.

Media Dallinger, R. and Wieser, W. - The Flow of Copper Through a Terrestiral Food Chain. I. Copper and Nutrition in Isopods. Oecologia 30: 253-264 (1977)

Media Dallinger, R. and Wieser, W. - Patterns of Accumulation, Distribution and Liberation of Zn, Cu, Cd and Pb in Different Organs of the Land Snail Helix pomatia, L. Comp.Biochem.Physiol. 79C: 117-124 (1984)

Media Daniels, R. R., Struckmeyer, B. E., and Peterson, L. A. - Copper Toxicity in Phaseolus vulgaris L. as Influenced by Iron Nutrition. I. An Anatomical Study. J.Am.Soc.Hortic.Sci. 97: 249-254 (1972)

Media Daniels, R. R. and Struckmeyer, B. E. - Copper Toxicity in {haseolus vulgaris L. as Influenced by Iron Nutrition. III. Partial Alleviation by Sucinnic Acid 2,2-Dimethyl Hydrazide. J.Am.Soc.Hortic.Sci. 98: 449-452 (1973)

Media Daniels, R. R., Struckmeyer, B. E., and Peterson, L. A. - Copper Toxicity in Phaseolus vulgaris L. as Influenced by Iron Nutrition. II. Elemental and Electron Microprobe Analysis. J.Am.Soc.Hortic.Sci. 98: 31-34 (1973)

Mix Davies, B. E. and Roberts, L. J. - Heavy Metals in Soils and Radish in a Mineralised Limestone Area of Wales, Great Britain. Sci.Total Environ. 4: 249-261 (1975)

OM, **pH** Davis, R. D. and Beckett, P. H. T. - Upper Critical Levels of Toxic Elements in Plants. II. Critical Levels of Copper in Young Barley, Wheat, Rape, Lettuce and Ryegrass and of Nickel and Zinc in Young Barley and Ryegrass. New Phytol. 80(1): 23-32 (1978)

OM, **pH** Davis, R. D. and Carlton-Smith, C. H. - An Investigation into the Phytotoxicity of Zinc, Copper and Nickel Using Sewage Sludge of Controlled Metal Content. Environ.Pollut.Ser.B 8(3): 163-185 (1984)

OM De Abreu, C. A., Van Raij, B., De Abreu, M. F., Dos Santos, W. R., and De Andrade, J. C. - Efficiency of Multinutrient Extractants for the Determination of Available Copper in Soils. Commun.Soil Sci.Plant Anal. 27(3/4): 763-771 (1996)

Media DeKock, P. C. - Heavy Metal Toxicity and Iron Chlorosis. Ann.Bot. 20(77): 133-141 (1956)

OM Dell, B. - Copper Nutrition of Eucalyptus maculata Hook. Seedlings: Requirements for Growth, Distribution of Copper and the Diagnosis of Copper Deficiency. Plant Soil 167: 181-187 (1994)

FL DeMaeseneer, J. - Nematicidal Action of Copper Sulphate (Nematicide Werking van Kopersulfaat). Med.Rijksfac.Landbouwsch.Gent. 32: 559-564 (GER) (1967)

OM, **pH** Denneman, C. A. J. and Van Straalen, N. M. - The Toxicity of Lead and Copper in Reproduction Tests Using the Oribatid Mite Platynothrus peltifer. Pedobiologia 35: 305-311 (1991)

Media Dennis, J. L., Mutwakil, M. H. A. Z., Lowe, K. C., and De Pomerai, D. I. - Effects of Metal Ions in Combination with a Non-Ionic Surfactant on Stress Responses in a Transgenic Nematode. Aquat.Toxicol. 40(1): 37-50 (1997)

No Conc Dias, R. M. S., Soveral-Dias, J. C., Costa, A. S. V., Fragoso, M. A. C., and Van, Beusichem M. L. - The effect of liming and organic manuring on the reduction of copper toxicity in an acid soil of granitic origin of dao wine region, portugal. <Book> developments in plant and soil sciences; optimization of plant nutrition. Dev.Plant Soil Sci. 509-516 (1993)

Rev Diaz-Lopez, G. and Mancha, R. - Usefulness of Testing with Eisenia fetida for the Evaluation of Agrochemicals in Soils. In: M.H.Donker, H.Eijsackers, and F.Heimbach (Eds.), Ecotoxicology of Soil Organisms, Chapter 17, Lewis Publ., Boca Raton, FL : 251-256 (1994)

Media Dokiya, Y., Owa, N., and Mitsui, S. - Comparative Physiological Study of Iron, Manganese and Copper Absorption by Plants. Soil Sci.Plant Nutr. 14(5): 169-174 (1968)

Rev Donkin, Steven G. - Graphical determination of metal bioavailability to soil invertebrates utilizing the Langmuir sorption model. ASTM Spec.Tech.Publ., VSTP 1317, Environmental Toxicology and Risk Assessment: Modeling and Risk Assessment 6: 28-43 (1997)

OM Dorn, C. R., Pierce, J. O., Chase, G. R., and Phillips, P. E. - Environmental Contamination by Lead, Cadmium, Zinc, and Copper in a New Lead-Producing Area. Environ.Res. 9: 159-172 (1975)

FL Dorn, J. and Metz, R. - Effects of Organic Pollutants (PAH; PCB) and Heavy Metals in Sewage Fields on Biomass Production and Heavy Metal Transfer of Rye (Wirkung von Organischen Schadstoffen (PAK; PCB) und Schwermetallen in Rieselfeldboden auf Biomasseertrag und Schwermetalltransfer bei Roggen (Secale cereale)). Z.Pflanzenernahr.Bodenkd. 159(1): 87-91 (1996)

No Conc Dorn, J., Koch, C., Metz, R., and Wilke, B. M. - Effect of 2,2',5,5'-Tetrachlorobiphenyl, Benzo-a-Pyren, Cadmium and Copper in an Original Sewage Field Soil and Uptake of These Substances by Rye (Wirkung von 2,2',5,5' Tetrachlorbiphenyl, Benzo-a-pyren, Cadmium und Kupfer in Einem Rieselfeldboden und Aufnahme Dieser Stoffe Durch Roggen (Secale cereale)). Z.Pflanzenernahr.Bodenkd. 160(2): 217-222 (1997)

OM, **pH** Doroshenko, T. N. and Biryukov, S. A. - Peculiarities of Stock Scion Activity of Apple Tree at Increased Content of Copper in Soil: Physiological Aspects. Acta Horticult. 448: 31-36 (1997)

Mix Dowdy, R. H. and Ham, G. E. - Soybean Growth and Elemental Content as Influenced by Soil Amendments of Sewage Sludge and Heavy Metals: Seedling Studies. Agron.J. 69: 300-303 (1977)

Media Downes, Geoffrey M. and Turvey, Nigel D. - The effect of nitrogen and copper on characteristics of wood tissue in Pinus radiata. Can.J.For.Res. 20(9): 1369-1377 (1990)

OM Dueck, T. A. - Effects of Sulphur Dioxide, Zinc, Copper on Life History Characteristics of Silene cucubalus. In: T.A.Dueck, Impact of Heavy Metals and Air Pollutants on Plants, Acadmisch

Proefschrift, Free University Press, Amsterdam : 133-149 (1986)

Media Ebbs, S. D. and Kochian, L. V. - Toxicity of Zinc and Copper to Brassica Species: Implications for Phytore**Media**tion. J.Environ.Qual. 26(3): 776-781 (1997)

Score Edwards, C. A. 1983. Development of a Standardized Laboratory Method for Assessing the Toxicity of Chemical Substances to Earthworms. EUR 8714 EN, Comm.Eur.Communities , 141p.

Score Edwards, C. A. and Bater, J. E. 1992. The Use of Earthworms in Environmental Management. *Soil Biol. Biochem.* 24[12]: 1683-1689.

OM,**pH** Eleftheriou, E. P. and Karataglis, S. - Ultrastructural and Morphological Characteristics of Cultivated Wheat Growing on Copper-polluted Fields. Bot.Acta 102(2): 134-140 (1989)

OM,**pH** Engler, R. M. and Patrick, W. H. - Stability of Sulfides of Manganese, Iron, Zinc, Copper, and Mercury in Flooded and Non-flooded Soil. Soil Sci 119: 217-221 (1975)

Media Fargasova, A. - Root Growth Inhibition, Photosynthetic Pigments Production, and Metal Accumulation in Sinapis alba as the Parameters for Trace Metals Effect Determination. Bull.Environ.Contam.Toxicol. 61(6): 762-769 (1988)

No Conc Farkas, S., Hornung, E., and Fischer, E. 1996. Toxicity of Copper to *Porcellio scaber* Latr. (Isopoda) Under Different Nutritional Status. *Bull. Environ. Contam. Toxicol.* 57[4]: 582-588.

Mix Ferrari, B., Radetski, C. M., Veber, A. M., and Ferard, J. F. - Ecotoxicological Assessment of Solid Wastes: A Combined Liquid- and Solid-Phase Testing Approach Using a Battery of Bioassays and Biomarkers. Environ.Toxicol.Chem. 18(6): 1195-1202 (1999)

No Dur Filser, J., Fromm, H., Nagel, R. F., and Winter, K. - Effects of Previous Intensive Agricultural Management on Micoorganisms and the Biodiversity of Soil Fauna. Plant Soil 170: 123-129 (1995)

No Conc Filser, J. and Hoelscher, G. - Experimental Studies on the Reactions of Collembola to Copper Contamination. Pedobiologia 41(1-3): 173-178 (1997)

No Conc Filser, J., Wittmann, R., and Lang, A. - Response Types in Collembola Towards Copper in the Microenvironment. Environ.Pollut. 107(1): 71-78 (2000)

OM, **pH** Fischer, Erno and Molnar, Laszlo. - Growth and Reproduction of *Eisenia fetida* (Oligochaeta, Lumbricidae) in Semi-natural Soil Containing Various Metal Chlorides. Soil Biol.Biochem. 29(3/4): 667-670 (1997)

OM, **pH** Fiskell, J. G. A. and Leonard, C. D. - Soil and Root Copper. Evaluation of Copper Fertilization by Analysis of Soil and Citrus Roots. J.Agric.Food Chem. 15: 350-353 (1967)

Score Fodor, L. 1998. Effect of Heavy Metals on Wheat and Maize Crop on Brown Forest Soil. *Agrokem. Talajtan* 47[1-4]: 197-206.

Media Forge, T. A., Berrow, M. L., Darbyshire, J. F., and Warren, A. - Protozoan Bioassays of Soil Amended with Sewage Sludge and Heavy Metals, Using the Common Soil Ciliate Colpoda steinii. Biol.Fertil.Soils 16: 282-286 (1993)

OM Freeman, M. N., Peredney, C. L., and Williams, P. L. 1999. A Soil Bioassay Using the Nematode Caenorhabditis elegans. In: D.S.Henshel, M.C.Black, and M.C.Harrass (Eds.), Standardization of Biomarkers for Endocrine Disruption and Environmental Assessment, 8th Volume, ASTM STP 1364, West Conshohocken, PA , 305-318.

Media Fujita, M. and Kawanishi, T. - Purification and Characterization of Cd-Binding Complex from the Root Tissue of Water Hyacinth Cultivated in a Cd+2-Containing Medium. Pant Cell Physiol. 27(7): 1317-1325 (1986)

Media Gadgil, R. L. - Tolerance of Heavy Metals and the Reclamation of Industrial Waste. J Appl Ecol 6: 247-259 (1969)

OM, **pH** Gal, J. Y. and Bouche, M. B. - Correlation of Lethal Concentrations of Heavy Metals with Tissue Levels of Earthworms. University of France, Montpellier, France (NTIS#ADA199269) : 34 (1988)

Media Garten, C. T. J. - Multispecies Methods of Testing for Toxicity: Use of the Rhizobium-Legume Symbiosis in Nitrogen Fixation and Correlations Between Responses by Algae and Terrestrial Plants. In: W.Wang, J.W.Gorsuch, and W.R.Lower (Eds.), Plants for Toxicity Assessment, ASTM STP 1091, Philadelphia, PA : 69-84 (1990)

OM, **pH** Gartside, D. W. and McNeilly, T. - The Potential for Evaluation of Heavy Metal Tolerance in Plants. II. Copper Tolerance in Normal Populations of Different Plant Species. Heredity 32(3): 335-348 (1974)

Media Geiger, G., Federer, P., and Sticher, H. - Reclamation of heavy metal-contaminated soils: field studies and germination experiments. J.Environ.Qual. 22(1): 201-207 (1993)

OM, **pH** Georgiev, G., Atanasov, B., Kalmuckov, K., and Alexandrova, E. - Effect of Cu Concentrations on Nitrogen Fixation and Cu Accumulation in Black Locust Plant (Robinia pseudoacacia L.) and its Symbiotic Rhizobium sp. Dokl.Bulg.Akad.Nauk 50(3): 67-70 (1997)

OM Gibb, J. O. T., Svendsen, C., Weeks, J. M., and Nicholson, J. K. - 1H NMR Spectroscopic Investigations of Tissue Metabolite Biomarker Response to Cu(II) Exposure in Terrestrial Invertebrates: Identification of Free Histidine as a Novel Biomarker of Exposure to Copper in Earthworms. Biomarkers 2(5): 295-302 (1997)

OM Gimenez, S. M. N., Chaves, J. C. D., Pavan, M. A., and Cruces, I. I. - Copper Toxicity in Coffee Seedlings. Rev.Bras.Cienc.Solo 16(3): 361-366 (1992)

No Species Gimeno-Garcia, E., Andreu, V., and Boluda, R. - Distribution of heavy metals in rice farming soils. Arch.Environ.Contam.Toxicol. 29(2): 476-483 (1995)

Media Gorsuch, J. W., Kringle, R. O., and Robillard, K. A. - Chemical Effects on the Germination and Early Growth of Terrestrial Plants. In: W.Wang, J.W.Gorsuch., and W.R.Lower (Eds.), Plants for Toxicity Assessment, ASTM STP 1091, Philadelphia, PA : 49-58 (1990)

Media Goven, A. J., Chen, S. C., Fitzpatrick, L. C., and Venables, B. J. - Lysozyme Activity in Earthworm (Lumbricus terrestris) Coelomic Fluid and Coelomocytes: Enzyme Assayf for Immunotoxicity of Xenobiotics. Environ.Toxicol.Chem. 13(4): 607-613 (1994)

Mix Gray, N. F. - Ecology of Nematophagous Fungi: Effect of the Soil Nutrients Nitrogen, Phosphorus, and Potassium and Seven Major Metals on Distribution. Plant Soil 108(2): 286-290 (1988)

Media Gregory, R. P. G. and Bradshaw, A. D. - Heavy Metal Tolerance in Populations of Agrostis tenuis Sibth. and Other Grasses. New Phytol. 64: 131-143 (1965)

Media Gregory, T. J. and Foy, C. D. - The Role of Chelation in Metal Tolerance and Toxicity; Differential Uptake and Toxicity of Ionic and Chelated Copper in Triticum aestivum L. In: T.D.Lekkas (Ed.), Heavy Metal Environ.5th Int.Conf., Volume 2, CEP Consultant Ltd., Edinburgh, UK : 147-149 (1985)

OM Gunnarsson, T. and Rundgren, S. 1986. Nematode Infestation and Hatching Failure of Lumbricid Cocoons in Acidified and Metal Polluted Soils. *Pedobiologia.* 29[3]: 165-173.

Media Gussarsson, M., Adalsteinsson, S., Jensen, P., and Asp, H. - Cadmium and copper interactions on the accumulation and distribution of cd and cu in birch (betula pendula roth) seedlings. Plant Soil 171(1): 185-187 (1995)

Media Gussarsson, Monika and Jensen, Paul. - Effects of copper and cadmium on uptake and leakage of potassium in birch (betula pendula) roots. Tree Physiology 11(3): 305-313 (1992)

ERE Gworek, B. - The Effect of Zeolites on Copper Uptake by Plants Growing in Contaminated Soils. J.Inclusion Phenom.Mol.Recognit.Chem. 15(1): 1-7 (1993)

Media Halsall, D. M. - Effects of Certain Cations on the Formation and Infectivity of Phytophthora Zoospores. 2. Effects of Copper, Boron, Cobalt, Manganese, Molybdenum and Zinc Ions. Can.J.Microbiol. 23(8): 1002-1010 (1977)

OM Harmer, P. M. - Studies on the Effect of Copper Sulfate Applied to Organic Soil on the Yield and Quality of Several Crops. Soil Sci.Soc.Am.Proc. 10: 284-294 (1945)

ERE Harreus, D., Kohler, H. R., and Weeks, J. M. - Combined Non-invasive Cell Isolation and Neutral-Red Retention Assay for Measuring the Effects of Copper on the Lumbricid Aporrectodea rosea (Savigny). Bull.Environ.Contam.Toxicol. 59(1): 44-49 (1997)

Media: Hartenstein, R., Neuhauser, E. F., and Collier, J. - Accumulation of Heavy Metals in the Earthworm, Eisenia foetida. J.Environ.Qual. 9(1): 23-26 (1980)

No Conc Hartenstein, R., Neuhauser, E. F., and Narahara, A. 1981. Effects of Heavy Metal and Other Elemental Additives to Activated Sludge on Growth of *Eisenia foetida*. *J. Environ. Qual.* 10[3]: 372-376.

Media Heale, E. L. and Ormrod, D. P. - Effects of Nickel and Copper on Acer rubrum, Cornus stolonifera, Lonicera tatarica, and Pinus resinosa. Can.J.Bot. 60: 2674-2681 (1982)

Score Heimbach, F. 1985. Comparison of Laboratory Methods, Using *Eisenia foetida* and *Lumbricus terrestris*, for the Assessment of the Hazard of Chemicals to Earthworms. *J. Plant Dis. Prot.* 92[2]: 186-193 (OECDG Data File).

No Data Heimbach, F. 1984. Correlations Between Three Methods for Determining the Toxicity of Chemicals to Earthworms. *Pestic. Sci.* 15: 605-611 (OECDG Data File).

No Dur Herawati, N., Rivai, I. F., Koyama, H., Suzuki, S., and Lee, Y. - Copper in rice and in soils according to soil type in Japan, Indonesia, and China: a baseline study. Bull.Environ.Contam.Toxicol. 60(2): 266-272 (1998)

Media Herstein, U. and Jager, H. J. - Tolerances of Different Populations of Three Grass Species to Cadmium and Other Metals. Environ.Exp.Bot. 26(4): 309-319 (1986)

OM Hill, J., Robson, A. D., and Loneragan, J. F. - The Effect of Copper Supply on the Senescence and the Retranslocation of Nutrients of the Oldest Leaf of Wheat. Ann.Bot. 44: 279-287 (1979)

Rev Hill, R. - Copper Toxicity. I. Br.Vet.J. 133(3): 219-225 (1977)

Media Hogan, G. F., Courtin, G. M., and Ravser, W. E. - Copper Tolerance in Clones of Agrostis gigantae from a Mine Waste Site. Can J Bot 55: 1043-1050 (1977)

No Conc Holmstrup, M. - Drought Tolerance In Folsomia candida Willem (Collembola) After Exposure To Sublethal Concentrations Of Three-Soil Polluting Chemicals. Pedobiologia 41(4): 361-368 (1997)

Media Hopkin, S. P. and Hames, C. A. C. - Zinc, among a 'cocktail' of metal pollutants, is responsible for the absence of the terrestrial isopod Porcellio scaber from the vicinity of a primary smelting works. Ecotoxicology 3(1): 68-78 (1994)

ERE Howard, K., Colquhoun, I. J., and Hardy, G. - The Potential of Copper Sulphate to Control Phytophthora cinnamomi During Bauxite Mining in Western Australia. Aust.Plant Pathol. 27(1): 51-58 (1998)

Media Hsu, Fu Hsing and Lin, H. S Ed. - Studies on seed germination of miscanthus species. <Book> taichung district agricultural improvement station special publication; crop genetics, breeding, physiology and cultivation. Taichung District Agricultural Improvement Station Special Publication : 205-217 (1993)

No Control Huber, M. C., Winter, R. E. K., and Bolla, R. I. - Effect of Copper Sulfate and Lead Acetate on Infection of Pines with Bursaphelenchus-xylophilus. J.Nematol. 21(1): 1-9 (1989)

OM, **pH** Hylander, L. - Changes in Plant Nutrient Content of Barley as a Result of Lime, Phosphorus, Manganese, Copper and Zinc Supplies on Three Swedish Mineral Soils in a Pot Experiment. Swed.J.Agric.Res. 25(3): 93-107 (1995)

Mix Ibekwe, A. M., Angle, J. S., Chaney, R. L., and Van, Berkum P. - Enumeration and N-2 fixation potential of rhizobium Leguminosarum biovar trifolii grown in soil with varying pH values and heavy metal concentrations. Agric.Ecosyst.Environ. 61: 103-111 (1997)

Media Imai, I. and Siegel, S. M. - A Specific Response to Toxic Cadmium Levels in Red Kidney Bean Embryos. Physiol.Plant. 29: 118-120 (1973)

OM Jackson, B. P., Miller, W. P., Schumann, A. W., and Sumner, M. E. - Trace Element Solubility from Land Application of Fly Ash/Organic Waste Mixs. J.Environ.Qual. 28(2): 639-647 (1999)

OM, **pH** Jackson, D. R., Selvidge, W. J., and Ausmus, B. S. - Behavior of Heavy Metals in Forest Microcosms: II. Effects on Nutrient Cycling Processes. Water Air Soil Pollut. 10: 13-18 (1978)

Score Jaggy, A. and Streit, B. 1982. Toxic Effects of Soluble Copper on *Octolasium cyaneum* Sav. (Lumbricidae). *Rev Suisse De Zool*. 89[4]: 881-889.

OM Jaros-Su, J., Groden, E., and Zhang, J. X. - Effects of Selected Fungicides and the Timing of Fungicide Application on Beauveria bassiana-Induced Mortality of the Colorado Potato Beetle (Coleoptera: Chrysomelidae). Biol.Control 15(3): 259-269 (1999)

OM, **pH** Jarvis, S. C. and Whitehead, D. C. - The Absorption, Distribution and Concentration of Copper in White Clover Grown on a Range of Soils. Plant Soil 75: 427-434 (1983)

Score Jarvis, S. C. 1978. Copper Uptake and Accumulation by Perennial Ryegrass Grown in Soil and Solution Culture. *J. Sci. Food Agric.* 29[1]: 12-18.

OM Javadi, M., Beuerlein, J. E., and Arscott, T. G. - Effects of Phosphorus and Copper on Factors Influencing Nutrient Uptake, Photosynthesis and Grain Yield of Wheat. Ohio J.Sci. 91(5): 191-194 (1991)

Score Javadi, M. 1988. *Plastocyanin Evaluation in Wheat (T. aestivum L.) as Affected by Rates of Phosphate and Copper.* Ph.D Thesis, Ohio State University , 47p.

Media Jaworska, M., Gorczyca, A., Sepiol, J., and Tomasik, P. - Effect of Metal Ions on the Entomopathogenic Nematode Heterorhabditis bacteriophora Poinar (Nematode: Heterohabditidae) Under Laboratory Conditions. Water Air Soil Pollut. 93: 157-166 (1997)

Media Jiang, W., Liu, D., and Li, H. - Effects of Cu2+ on Root Growth, Cell Division, and Nucleolus of Helianthus annuus L. Sci.Total Environ. 256: 59-65 (2000)

OM Jones, M. D., Browning, M. H. R., and Hutchinson, T. C. - The Influence of Mycorrhizal Associations on Paper Birch and Jack Pine Seedlings When Exposed to Elevated Copper, Nickel or Aluminum. Water Air Soil Pollut. 31(3-4): 441-448 (1986)

Score Kadar, I. and Morvai, B. 1998. Effect of Micropollutants on Soil and Crop on Calcareous Sandy Soil. *Agrokem. Talajtan*. 47[1-4]: 207-214.

OM Kalyanaraman, S. B. and Sivagurunathan, P. - Effect of Cadmium, Copper and Zinc on the Growth of Blackgram. J.Plant Nutr. 16(10): 2029-2042 (1993)

ERE Kanabo, I. A. K. and Gilkes, R. J. - Low-Contaminant Jarosite Waste as a Fertilizer Amendment. J.Environ.Qual. 21(4): 679-684 (1992)

OM Karamanos, R. E., Fradette, J. G., and Gerwing, P. D. - Evaluation of Copper and Manganese Nutrition of Spring Wheat Grown on Organic Soils. Can.J.Soil Sci. 65: 133-148 (1985)

OM, Karamanos, R. E., Hodge, N., and Stewart, J. W. B. - The Effect of Sulfur on Manganese and Copper Nutrition of Canola. Can.J.Soil Sci. 69(1): 119-125 (1989)

No Conc Karlen, D. L. and Hunt, P. G. 1985. Copper, Nitrogen, and Rhizobium japonicum Relationships in Determinate Soybean. *J. Plant Nutr*. 8[5]: 395-404.

Media Ke, Hueli Yang David, Anderson, Wendy L., Moncrief, Robyn M., Rayson, Gary D., and Jackson, Paul J. - Luminescence studies of metal ion-binding sites on Datura inoxia biomaterial. Environ.Sci.Technol. 28(4): 586-591 (1994)

Media Keltjens, W. G. and Van Beusichem, M. L. - Phytochelatins as Biomarkers for Heavy Metal Toxicity in Maize: Single Metal Effects of Copper and Cadmium. J.Plant Nutr. 21(4): 635-648 (1998)

Media Keltjens, W. G. and Van Beusichem, M. L. - Phytochelatins as biomarkers for heavy metal stress in maize (Zea mays L) and wheat (Triticum aestivum L): Combined effects of copper and cadmium. Plant Soil 203(1): 119-126 (1998)

OM Khalil, M. A., Abdel-Lateif, H. M., Bayoumi, B. M., and Straalen, N. M. - Analysis of Separate and Combined Effects of Heavy Metals on the Growth of Aporrectodea caliginosa (oligochaeta;annelida) using the Toxic Unit Approach. Applied Soil Ecology : A Section Of Agriculture, Ecosystems & Environment. 4(3): 213-219 (1996)

Media Khan, D. H. and Frankland, B. - Cellulolytic Activity and Root Biomass Production in Some Metal-Contaminated Soils. Environ.Pollut.Ser.A Ecol.Biol. 33: 63-74 (1984)

Rev Kiss, T. and Osipenko, O. - Metal Ion-Induced Permeability Changes in Cell Membranes: A Minireview. Cellular and Molecular Neurobiology 14(6): 781-789 (1994)

No Data Kjaer, C., Pedersen, M. B., and Elmegaard, N. 1998. Effects of Soil Copper on Black Bindweed (*Fallopia convolvulus*) in the Laboratory and in the Field. Arch. Environ. Contam. Toxicol. 35[1]: 14-19.

OM Kloke, A. and Egels, W. - Effect of Excess Fertilization with Boron, Cobalt, Copper Manganese, and Zinc on the Content of These Elements in Soil and Plants. Dokl.Zarub.Uchastnikov-Mezhdunar.Kongr.Miner.Udobr., 8th 2(4/5): 115-121 (1976)

Media Kong, F. X. - Influence of Copper, Manganese and pH on the Growth and Several Enzyme Activities in Mycorrhizal Fungus Amanita muscaria. Chemosphere 30(1): 199-207 (1995)

OM Kozdroj, J. and Piotrowska-Seget, Z. - Indigenous Microflora and Bean Responses to Introduction of Genetically Modified Pseudomonas fluorescencens Strains into Soil Contaminated with Copper. J.Environ.Sci.Health.Part A 30(10): 2133-2158 (1995)

No Conc Kramarz, P. and Laskowski, R. 1999. Toxicity and Possible Food-Chain Effects of Copper, Dimethoate and a Detergent (LAS) on a Centipede (*Lithobius mutabilis*) and its Prey (Musca domestica). *Appl. Soil Ecol.* 13: 177-185.

OM Krebs, R., Gupta, S. K., Furrer, G., and Schulin, R. - Solubility and Plant Uptake of Metals with and without Liming of Sludge-amended Soils. J.Environ.Qual. 27(1): 18-23 (1998)

Media Kruckeberg, A. L. and Wu, L. - Copper tolerance and copper accumulation of herbaceous plants colonizing inactive California copper mines. Ecotoxicol.Environ.Saf. 23(3): 307-319 (1992)

OM, **pH** Kubota, J., Lemon, E. R., and Allaway, W. H. - The Effect of Soil Moisture upon the Uptake of Molybdenum, Copper and Cobalt by Alsike Clover. Soil Sci.Soc.Am.Proc. 27: 679-683 (1963)

FL Kuduk, Czeslaw. 1988. Copper effect on the initial growth of wheat and on biological properties of cohesive soil. *Rocz. Glebozn.* 39[1]: 63-70.

OM, **pH** Kula, C. - A Prolonged Laboratory Test on Sublethal Effect of Pesticides on Eisenia fetida. In: M.H.Donker, H.Eijsackers, and F.Heimbach (Eds.), Ecotoxicology of Soil Organisms, Chapter 17, Lewis Publ., Boca Raton, FL : 257-262 (1994)

Nutrient Kumar, Vinod, Yadav, D. V., and Yadav, D. S. 1990. Effects of nitrogen sources and copper levels on yield, nitrogen and copper contents of wheat (*Triticum aestivum* L.). *Plant Soil.* 126[1]: 79-83.

OM, **pH** Lambert, D. H. - Response of Sweetgum to Mycorrhizae, Phosphorus, Copper, Zinc, and Sewage Sludge. Can.J.For.Res. 12: 1024-1027 (1982)

Media Lane, I. and Puckett, K. J. - Responses of the Phosphatase Activity of the Lichen Cladina rangiferina to Various Environmental Factors Including Metals. Can.J.Bot. 57: 1534-1540 (1979)

No Species Laskowski, R. and Hopkin, S. P. - Accumulation of Zn, Cu, Pb, and Cd in the Garden Snail (Helix aspersa): Implications for Predators. Environ.Pollut. 91(3): 289-297 (1996)

FL Lee, F. Y. and Liao, C. R. - Reclamation Methods for Copper-Contaminated Soils. II. Effect of Soil Conditioners. J.Environ.Prot.Saf.Rep.China 15(1): 75-83 (1992)

ERE Leendertse, Peter C., Scholten, Martin C. T., and Van, Der Wal Jan Tjalling. - Fate and effects of nutrients and heavy metals in experimental salt marsh ecosystems. Environ.Pollut. 94(1): 19-29 (1996)

Media Lepp, N. W. and Dickinson, N. M. - Effect of Copper on Germination of Coffea Pollen: Possible Induction of Copper Tolerance. In: 2nd Intl.Conf on Environ.Contam.in Amsterdam, Sept.1986, CEP Consultants Ltd., Edinburgh, Great Britian : 33-35 (1986)

Media Lepp, Nicholas W., Hartley, Jeanette, Toti, Mihai, and Dickinson, Nicholas M. - Patterns of soil copper contamination and temporal changes in vegetation in the vicinity of a copper rod rolling factory. Environ.Pollut. 95(3): 363-369 (1997)

Mix Lexmond, T. M. - The Effect of Soil pH on Copper Toxicity of Forage Maize Grown Under Field Conditions. Neth.J.Agric.Sci. 28: 164-184 (1980)

No Conc Liang, J., Stewart, J. W. B., and Karamanos, R. E. - Distribution and plant availability of soil copper fractions in saskatchewan. Can J Soil Sci 71(1): 89-100 (1991)

Media Lidon, F. C. and Henrique., F. S. - Effects of Copper Toxicity on Growth and the Uptake and Translocation of Metals in Rice Plants. J.Plant Nutr. 16(8): 1449-1464 (1993)

Media Lidon, F. C. and Henriques, F. S. - Copper **Media**ted Inhibition on Protein Synthesis in Rice Shoots. J.Plant Nutr. 16(9): 1619-1630 (1993)

Media Lidon, Fernando C. and Henriques, Fernando S. - Effects of copper on the ascorbate, diamine and o-diphenol oxidases activities of rice leaves. Phyton 52(2): 97-104 (1991)

Media Lidon, Fernando C. and Henriques, Fernando S. - Effects of increasing concentrations of copper on metal uptake kinetics and biomass yields. Soil Sci. 154(1): 44-49 (1992)

Media Lidon, Fernando Cebola, Barreiro, Maria da Graca, and Henriques, Fernando Santos. - Interactions between biomass production and ethylene biosynthesis in copper-treated rice. J.Plant Nutr. 18(6): 1301-1314 (1995)

Media Liu, D., Jiang, W., Lu, C., Zhao, F., Hao, Y., and Guo, L. - Effects of Copper Sulfate on the Nucleolus of Allium cepa Root Tip Cells. Hereditas 120: 87-90 (1994)

Media Lolkema, P. C. and Vooijs, R. - Copper Tolerance in Silence cucubalus; Subcellular Distribution of Copper and Its Effects on Chloroplasts and Plastocyanin Synthesis. Planta 167: 30-36 (1986)

Media Lu, W. P. and Kirkham, M. B. - Genotypic tolerance to metals as indicated by ethylene production. International Conference on Metals in Soils, Waters, Plants and Animals, Orlando, Florida, Usa, April 30-May 3, 1990.Water Air Soil Pollut.57-58 (0).1991.605-616

.

Media Lui, Donghua, Jiang, Wusheng, Wang, Wei, and Zhai, Lin. - Evaluation of metal ion toxicity on root tip cells by the allium test. Israel Journal of Plant Sciences 43: 125-133 (1995)

No Control Luwe, Michael W. F., Nilsson, L. O., Huttl, R. F., and Johansson, U. T Eds. - Distribution of nutrients and phytotoxic metal ions in the soil and in two forest floor plant species of a beech (fagus sylvatica l.) Stand. <Book> developments in plant and soil sciences; nutrient uptake and cycling in forest ecosystems. Dev.Plant Soil Sci. 168-169: 195-202 (1995)

Score Ma, W. C. 1982. The Influence of Soil Properties and Worm-Related Factors on the Concentrations of Heavy Metals in Earthworms. *Pedobiologia.* 24: 109-119.

Score MacLean, A. J. and Dekker, A. J. 1978. Availability of Zinc, Copper and Nickel to Plants Grown in Sewage-Treated Soils. *Can J Soil Sci.* 58: 381-389.

Media Madan, V. K., Yadav, J. P. S., Taneja, A. D., and Kudesia, V. P. - Fungicidal and nematicidal activity of pyrimidyl and thiazolyl substituted thioureas and their complexes of some bivalent metal. Crop Res. 4(1): 141-145 (1991)

OM, **pH** Mahatanya, E. T. - The Effect of Phosphorus and Copper on the Bean Plant (*Phaseolus vulgaris*

L.). Mysore J.Agric.Sci. 10(2): 214-225 (1976)

OM, **pH** Malecki, M. R., Neuhauser, E. F., and Lehr, R. C. - The Effect Of Metals On The Growth And Reproduction Of Eisenia Foetida (Oligochaeta, Lumbricidae). Pedobiologia 24(3): 129-137 (1982)

OM, **pH** Manninen, A. M., Laatikainen, T., and Holopainen, T. - Condition of Scots pine fine roots and mycorrhiza after fungicide application and low-level ozone exposure in a 2-year field experiment. Trees-Structure & Function 12(6): 347-355 (1998)

Media Marigomez, J. A., Angulo, E., and Moya, J. - Copper Treatment of the Digestive Gland of the Slug Arion ater L. 2. Morphometrics and Histropathology. Bull.Environ.Contam.Toxicol. 36: 608-615 (1986)

Media Marigomez, J. A., Angulo, E., and Moya, J. - Copper Treatment of the Digestive Gland of the Slug (Arion ater L. 1. Bioassay Conduction and Histochemical Analysis. Bull.Environ.Contam.Toxicol. 36: 600-607 (1986)

No Dur Marino, F., Ligero, A., and Diaz Cosin, D. J. - Heavy Metals in Several Earthworm Species Living in Serpentine Soils. Nova-Acta-Cient.-Compostel.-(Biol.) 5: 245-250 (1994)

No Dur Marino, F., Ligero, A., and Diaz, C. - Heavy Metals in Earthworms and Soils Around to a Thermic Power Station at as Pontes (La Coruna, NW Spain). Boletin De La Real Sociedad Espanola De Historia Natural Seccion Biologica 92(1-4): 65-73 (1996)

No Control Marinussen, M. P. J. C., Van der Zee, S. E. A. T., and De Haan, F. A. M. - Cu Accumulation in the Earthworm Dendrobaena veneta in a Heavy Metal (Cu, Pb, Zn) Contaminated Site Compared to Cu Accumulation in Laboratory Experiments. Environ.Pollut. 96(2): 227-233 (1997)

No Control Marinussen, M. P. J. C., Van der Zee, S. E. A. T. M., and De Haan, F. A. M. - Effect of Cd or Pb Addition to Cu-Contaminated Soil on Tissue Cu Accumulation in the Earthworm, Dendrobaena veneta. Ecotoxicol.Environ.Saf. 38(3): 309-315 (1997)

OM Marinussen, M. P. J. C., Van der Zee, S. E. A. T., and De Haan, F. A. M. - Cu Accumulation in Lumbricus Rubellus Under Laboratory Conditions Compared with Accumulation Under Field Conditions. Ecotoxicol.Environ.Saf. 36(1): 17-26 (1997)

ERE Marinussen, M. P. J. C. and Van der Zee, S. E. A. T. M. - Cu Accumulation by Lumbricus rubellus as Affected by Total Amount of Cu in Soil, Soil Moisture and Soil Heterogeneity. Soil Biol.Biochem. 29(3/4): 641-647 (1997)

No Control Marr, K., Fyles, H., and Hendershot, W. - Trace Metals in Montreal Urban Soils and the Leaves of Taraxacum officinale. Can.J.Soil Sci. 79(2): 385-387 (1999)

Media Martensson, A. - Assessing Anthropogenic Impact on Nitrogen Fixing Legumes. In: J.P.E.Anderson, et al.(Eds.), Proc.of the Int.Symp.on Environmental Aspects of Pesticide Microbiology, Aug.17-21, 1992, Sigtuna, Sweden : 121-126 (1992)

OM, **pH** Martin, N. A. - Toxicity of Pesticides to Allolobophora caliginosa (Oligochaeta: Lumbricidae). N.Z.J.Agric.Res. 29(4): 699-706 (1986)

OM, **pH** Masarovicova, E. and Holubova, M. - Effect of Copper on Growth and Chlorophyll Content of some Herbs. Rostl.Vyroba 44(6): 261-265 (1998)

OM Mathur, S. P., Belanger, A., Sanderson, R. B., Valk, M., and Knibbe, E. N. - The Influence of Variations in Soil Copper on the Yield and Nutrition of Spinach Grown in Microplots on Two

Organic Soils. Commun.Soil Sci.Plant Anal. 15(6): 695-706 (1984)

OM Mathur, S. P. and Belanger, A. - The Influence of Variation in Soil Copper on the Yield and Nutrition of Carrots Grown in Microplots on Two Organic Soils. Commun.Soil Sci.Plant Anal. 18(6): 615-624 (1987)

OM, **pH** Mathys, W. - Enzymes of Heavy-Metal-Resistant and Non-Resistant Populations of Silene cucubalus and Their Interaction with some Heavy Metals In Vitro and In Vivo. Physiol.Plant 33: 161-165 (1975)

OM Maxchmeyer, J. R. and Quinn, J. A. - Copper Tolerance in New Jersey Populations of Agrostis stolonifera and Paronychia fastigiata. Bull Torrey Bot Club 103(6): 244-251 (1976)

OM, **ERE** McAndrew, D. W., Loewen-Rudgers, L. A., and Racz, G. J. - A Growth Chamber Study of Copper Nutrition of Cereal and Oilseed Crops in Organic Soil. Can.J.Plant Sci. 64: 505-510 (1984)

OM, **pH** McFarland, M. L., Ueckert, D. N., Hons, F. M., and Hartmann, S. - Selective-Placement Burial of Drilling Fluids: II. Effects on Buffalograss and Fourwing Saltbush. J.Environ.Qual. 21(1): 140-144 (1992)

Media Medici, J. C. and Taylor, M. W. - Interrelationships Among Copper, Zinc and Cadmium in the Diet of the Confused Flour Beetle. J.Nutr. 93: 307-309 (1967)

No Control Merry, R. H., Tiller, K. G., and Alston, A. M. - The Effects of Contamination of Soil with Copper, Lead and Arsenic on the Growth and Composition of Plants. I. Effects of Season, Genotype, Soil Temperature and Fertilizers. Plant Soil 91: 115-128 (1986)

No Conc Metz, R., Dorn, J., and Wilke, B. W. - Combined Effects of Organic and Mineral Pollutants to Soil-Plant Transfer on Artificially Enriched Original Sewage Field Soil in Pots (Das Zusammenwirken von Organischen und Mineralischen Schadstoffen beim Boden-Pflanze-Transfer auf Einem Aufdotierten Rieselfeldboden im Gafab). Verh.Ges.Oekol.(Proc.Soc.Ecol.) 28: 465-470 (1998)

OM, **pH** Mikula, W. and Indeka, L. - Heavy metals in allotment gardens close to an oil refinery in plock. Water Air Soil Pollut. 96(1/4): 61-71 (1997)

Media Mikunthan, G. - Effect of some fungicides on Metarrhizium sp. Sorok: An entomopathogen on insect pests of rice and pulses. International Rice Research Notes : 24-25 (1995)

No Conc Miles, L. J. and Parker, G. R. - Heavy Metal Interaction for Andropogon scoparius and Rudbeckia hirta Grown on Soil from Urban and Rural Sites with Heavy Metals Additions. J.Environ.Qual. 8(4): 443-449 (1979)

Media Millikan, C. R. - Effects of Flax of a Toxic Concentration of Boron, Iron, Molybenum, Aluminum, Copper, Zinc, Cobalt, or Nickel in the Nutrient Solution. R Soc Victoria Proc 61: 25-42 (1949)

Mix Miner, G. S., Gutierrez, R., and King, L. D. - Soil factors affecting plant concentrations of cadmium, copper, and zinc on sludge-amended soils. J.Environ.Qual. 26(4): 989-994 (1997)

No Control Minnich, M. M., McBride, M. B., and Chaney, R. L. - Copper Activity in Soil Solution: II. Relation to Copper Accumulation in Young Snapbeans. J.Soil Sci.Soc.Am. 51: 573-578 (1987)

OM Mishra, M., Widianarko, B., Vink, K., and Van Straalen, N. M. - Growth Performance of Soybean on Soils Treated with Metal Based Fungicides. Environ.Toxicol.South East Asia : 167-174 (1994)

FL Misra, S. G. and Misra, Uma Shanker. - Effect of adding soluble form of heavy metals on the numbers of earthworms at different depths. Vijnana Parishad Anusandhan Patrika 39(2): 79-83 (1996)

Mix Mitchell, G. A., Bingham, F. T., and Page, A. L. - Yield and Metal Composition of Lettuce and Wheat Grown on Soils Amended with Sewage Sludge Enriched with Cadmium, Copper, Nickel and Zinc. J.Environ.Qual. 7(2): 165-171 (1978)

Effl Mitchell, G. A., Jr. 1977. Relative Phytotoxicity, Uptake and Interactive Effects of Cd, Cu, Ni and Zn to Plants Grown on Soils Amended with Metal-Enriched Sewage Sludge. PhD Thesis.Univ.of Calif.Riverside, CA 38[4]: 95.

Media Mocquot, B., J.Vangronsveld, H., Clijsters, H., and Mench, M. - Copper Toxicity in Young Maize (Zea mays L.) Plants: Effects on Growth, Mineral and Chlorophyll Content and Enzyme Activities. Plant Soil 182: 287-300 (1996)

OM, **pH** Morrison, R. S., Brooks, R. R., Reeves, R. D., and Malaisse, F. - Copper and Cobalt Uptake by Metallophytes from Zaire. Plant Soil 53: 535-539 (1979)

Media Moser, H. and Wieser, W. - Copper and Nutrition in Helix pomatia (L.). Oecologia (Berl) 42: 241-251 (1979)

OM Moustakas, M., G.Ouzounidou, L.Symeonidis, and S.Karataglis. - Field Study of the Effects of Excess Copper on Wheat Photosynthesis and Productivity. Soil Sci.Plant Nutr.(Tokyo) 43(3): 531-539 (1997)

Media Mukherji, S. and Das Gupta, B. - Characterization of Copper Toxicity in Lettuce Seedlings. Physiol Plant 27: 126-129 (1972)

Media Nagoor, S. and Vyas, A. V. - Physiological and Biochemical Responses of Cereal Seedlings to Graded Levels of Heavy Metals. III-Effects of Copper on Protein Metabolism in Wheat Seedlings. J.Environ.Biol. 20(2): 125-129 (1999)

Mix Narwal, R. P. and Singh, B. R. - Effect or organic materials on partitioning, extractability and plant uptake of metals in an alum shale soil. Water Air Soil Pollut. 103(1/4): 405-421 (1998)

OM, **pH** Nelson, L. G., Berger, K. C., and Andries, H. J. - Copper Requirements and Deficiency Symptoms of a Number of Field and Vegetable Crops. Soil Sci.Soc.Am.Proc. 20: 69-72 (1956)

Media Neuhauser, E. F., Malecki, M. R., and Loehr, R. C. - Methods Using Earthworms for the Evalution of Potentially toxic Materials in Siols. In: R.A.Conway and W.P.Gulledge (Eds.), Hazardous and Industrial Solid Waste Testing, Volume 2, ASTM STP 805, Philadelphia, PA : 313-320 (1983)

OM, **pH** Neuhauser, E. F., Malecki, M. R., and Loehr, R. C. - Growth and Reproduction of the Earthworm Eisenia fetida After Exposure to Sublethal Concentrations of Metals. Pedobiologia 27: 89-97 (1984)

Score Nicholas, D. J. D. 1950. Some Effects of Metals in Excess on Crop Plants Grown in Soil Culture. I. Effects of Copper, Zinc, Lead, Cobalt, Nickel and Manganese on Tomato Grown in an Acid *Soil. Bristol Agric. Hortic. Res. Stn. Annu. Rep*. 1950 , 96-108

Media Nieboer, E., Puckett, K. J., Richardson, D. H. S., Tomassini, F. D., and Grace, B. - Ecological and Physiochemical Aspects of the Accumulation of Heavy Metals and Sulphur in Lichens. In: Intl.Conf.on Heavy Metals in the Environment, Symp.Proc., Institute for Environmental Studies, Univ.of Toronto, Ontario, Canada 2(1): 331-351 (1975)

OM, **pH** Nieminen, T. M. - The Effect of Soil Copper and Nickel on Survival and Growth of Scots Pine Saplings. Chemosphere 36(4/5): 745-750 (1998)

Media Nusetti, O., Parego, E., Esclapes, M. M., Rodriguez-Grau, J., and Marcano, L. - Acute-Sublethal Copper Effects on Phagocytosis and Lysozyme Activity in the Earthworm Amynthas hawayanus. Bull.Environ.Contam.Toxicol. 63(3): 350-356 (1999)

pH Nyarai-Horvath, F., Szalai, T., Kadar, I., and Csatho, P. - Germination characteristics of pea seeds originating from a field trial treated with different levels of harmful elements. Acta Agron.Hung. 452(147-154) (1997)

OM, **pH** Nylund, R. E. - The Response of Onions to Soil and Foliar Applications of Manganese and to Soil Applications of Other Trace Elements. Proc.Am.Soc.Hortic.Sci. 60: 283-285 (1952)

Media Okamoto, K., Suzuki, M., Fukanim, M., Toda, S., and Fuwa, K. - Heavy Metal Tolerance of Penicillium Ochro-Chloron II. Uptake of Heavy Metals by Copper Tolerant Fungus Penicillium Ochro-Chloron. Agric.Biol.Chem. 41: 17-22 (1977)

OM, **pH** Olechowicz, E. and Mochnacka-Lawacz, H. - Chemical Composition Of Invertebrates Related To Taxonomic Position Trophic Conditions And Environmental Impact. Ekol.Pol. 33(1): 123-142 (1986)

OM, **pH** Omar, S., Husni, M. H. A., Anuar, A. R., and Rozilan, M. A. - Copper and Lime Interaction on the Growth of Corn on Tropical Peat. Pertanika 14(1): 31-35 (1991)

Media Osawa, Takaya and Tazuke, Akio. - The Effect of Form of Nitrogen Supplied and pH Level of the Nutrient Solution on Copper Toxicities in Vegetable Crops. Engei Gakkai Zasshi 59(3): 519-525 (1990)

No Species Oshima, N. and Dickens, L. E. - Effects of Copper Sprays on Secondary Spread of Common Bacterial Blight of Beans. Plant Dis Rep 55(7): 609-610 (1971)

Media Ouzounidou, G., Symeonidis, L., Babalonas, D., and Karataglis, S. - Comparative Responses of a Copper-Tolerant and a Copper-Sensitive Population of Minuartia hirsuta to Copper Toxicity. J.Plant Physiol. 144(1): 109-115 (1994)

Media Ouzounidou, G. - Effect of copper on germination and seedling growth of Minuartia, Silene, Alyssum and Thlaspi. Biol.Plant. 37(3): 411-416 (1995)

OM Paoletti, M. G., Sommaggio, D., Petruzzelli, G., Pezzarossa, B., and Barbafieri, M. - Soil Invertebrates As Monitoring Tools For Agricultural Sustainability. Polskie Pismo Entomologiczne 64(1-4): 113-122 (1995)

Media Parker, D. R., Pedler, J. F., Thomason, D. N., and Li, H. - Alleviation of Copper Rhizotoxicity by Calcium and Magnesium at Defined Free Metal-Ion Activities. Soil Sci.Soc.Am.J. 62(4): 965-972 (1998)

pH Parmelee, R. W., Wentsel, R. S., Phillips, C. T., Simini, M., and Checkai, R. T. - Soil Microcosm for Testing the Effects of Chemical Pollutants on Soil Fauna Communities and Trophic Structure. Environ.Toxicol.Chem. 12(8): 1477-1486 (1993)

pH Parmelee, R. W., Phillips, C. T., Checkai, R. T., and Bohlen, P. J. - Determining the Effects of Pollutants on Soil Faunal Communities and Trophic Structure Using a Refined Microcosm System. Environ.Toxicol.Chem. 16(6): 1212-1217 (1997)

Media Parry, K. E. and Wood, R. K. S. - The Adaptation of Fungi to Fungicides: Adaptation to Copper and Mercury Salts. Ann.Appl.Biol. 46(3): 446-456 (1958)

Media Patel, P. M., Wallace, A., and Mueller, R. T. - Some Effects of Copper, Cobalt, Cadmium, Zinc, Nickel and Chromium on Growth and Mineral Element Concentration in Chrysanthemum. J.Am.Soc.Hortic.Sci. 101(5): 553-556 (1976)

OM Patterson, W. A. III and Olson, J. J. - Effects of Heavy Metals on Radicle Growth of Selected Woody Species Germinated on Filter Paper, Mineral and Organic Soil Substrates. Can.J.For.Res. 13: 233-238 (1983)

ERE Payne, G. G., Martens, D. C., Winarko, C., and Perera, N. F. - Form and Availability of Copper and Zinc Following Long-Term Copper Sulfate and Zinc Sulfate Applications. J.Environ.Qual. 17(4): 707-711 (1988)

No Conc. Payne, G. G., Martens, D. C., Kornegay, E. T., and Lindemann, M. D. 1988. Availability and Form of Copper in Three Soils Following Eight Annual Applications of Copper-Enriched Swine Manure. *J. Environ. Qual.* 17[4]: 740-746.\

ERE Peles, J. D., Brewer, S. R., and Barrett, G. W. - Metal uptake by agricultural plant species grown in sludge-amended soil following ecosystem restoration practices. Bull.Environ.Contam.Toxicol. 57(6): 917-923 (1996)

ERE Piha, M. I., Vallack, H. W., Reeler, B. M., and Michael, N. - A Low Input Approach to Vegetation Establishment on Mine and Coal Ash Wastes in Semi-Arid Regions. I. Tin Mine Tailings in Zimbabwe. J.Appl.Ecol. 372-381 (1995)

OM, **pH** Pitcher, R. S. and McNamara, D. G. - The Toxicity of Low Concentrations of Silver and Cupric Ions to the Three Species of Plant-Parasitic Nematodes. Nematologica 18: 385-390 (1972)

No Control Pizl, V. and Sterzynska, M. - The Influence of Urbanization on the Earthworm Infection by Monocystid Gregarines. Fragm Faun (Warsaw) 35(9-14): 203-212 (1991)

OM Polson, D. E. and Adams, M. W. - Differential Reponse of Navy Beans (Phaseolus vulgaris L.) to Zinc. I. Differential Growth and Elemental Composition at Excessive Zn Levels. Agron.J. 62: 557-560 (1970)

Media Popham, J. D. and Webster, J. M. - Comparative toxicity of heavy metals with special reference to cadmium on caenorhabditis-elegans. Proc Int Colloq Invertebr Pathol : 372-373 (1976)

No Species Pouyat, Richard V., Mcdonnell, Mark J., and Pickett, S. T. A. - Soil characteristics of oak stands along an urban-rural land-use gradient. J.Environ.Qual. 24(3): 516-526 (1995)

ERE Premi, P. R. and Cornfield, A. H. - Effects of Addition of Copper, Manganese, Zinc and Chromium Compounds on Ammonification and Nitrification During Incubation of Soil. Plant Soil 31(2): 345-352 (1969)

Media Puckett, K. J., Nieboer, E., Gorzynski, M. J., and Richardson, D. H. S. - The Uptake of Metal Ions by Lichens: A Modified Ion-Exchange Process. New Phytol. 72: 329-342 (1973)

Media Puckett, K. J. - The Effect of Heavy Metals on Some Aspects of Lichen Physiology. Can J Bot 54: 2695-2703 (1976)

Media Ranta, H., Neuvonen, S., Kaariainen, S., and Vesanto, S. - Copper and Nickel Pollution: Frequency of Endophytic Fungi in Scots Pine Shoots and Endophyte Growth In Vitro. Can.J.Bot. 72(1): 93-99

(1994)

No Control Reboredo, F., Ferreira, F., Ferreira, A., Simoes, M. C., Astruc, M., and Lester, John Norman. - Accumulation of Copper and Lead by Halimione portulacoides (L) Aellen: A Seasonal Study. Heavy Met.Hydrol.Cycle : 173-180 (1988)

Score Reboredo, F. 1994. Interaction Between Copper and Zinc and Their Uptake by *Halimione portulacoides* (L.) Aellen. *Bull. Environ. Contam. Toxicol*. 52[4: 598-605.

OM, **pH** Reddy, D. S., Reddy, G., and Polasa, H. - Biotoxic Effects of Copper on Ureide Metabolism of Pigeon Pea. Bull.Environ.Contam.Toxicol. 54(6): 884-891 (1995)

Media Reddy, D. V., Raghava, and Apparao, A. - Adaptation of Sclerotium rolfsii to Copper Compounds. Indian Phytopathol. 17: 35-41 (1964)

Media Reddy, T. and Vaidyanath, K. - Mutagenic Potentiating and Antimutagenic Activity of Certain Metallic Ions in the Rice Genetic System. Curr Sci 47(14): 513-515 (1978)

Score Reed, S. T., Allen, M. G., Martens, D. C., and McKenna, J. R. 1993. Copper fractions extracted by mehlich-3 from soils amended with either copper sulfate or copper rich pig manure. *Commun. Soil Sci. Plant Anal.* 24[9/10]: 827-839.

Media Reilly, C., Rowell, J., and Stone, J. - The Accumulation and Binding of Copper in Leaf Tissue of Becium homblei (De Wild.) Duvign. & Plancke. New Phytol. 69(4): 993-997 (1970)

Media Reinecke, A. J. and Reinecke, S. A. - The Influence of Heavy Metals on the Growth and Reproduction of the Compost Worm Eisenia fetida (Oligochaeta). Pedobiologia 40(5): 439-448 (1996)

Media Reinecke, A. J., Reinecke, S. A., and Lambrechts, H. - Uptake and Toxicity of Copper and Zinc for the African Earthworm, Eudrilus eugeniae (Oligochaeta). Biol.Fertil.Soils 24(1): 27-31 (1997)

No Stats Reitz, H. J. and Shimp, N. F. 1953. Copper Oxide as a Soil Amendment for Citrus. *Proc. Fla. State Hortic. Soc.* 66: 37-42.

OM, **pH** Renan, L. - Effect of Long-Term Applications of Copper on Soil and Grape Copper (*Vitis vinifera*). Can.J.Soil Sci. 74(3): 345-347 (1994)

OM Reuther, W. and Smith, P. F. - Toxic Effect of Copper on Growth of Citrus Seedlings and Its Possible Relation to Acid-Soil Chlorosis in Florida Citrus Groves. Citrus Mag. 14(11): 25-27 (1952)

Score Reuther, W., Smith, P. F., and Scudder, G. K., Jr. 1953. Relation of pH and Soil Type to Toxicity of Copper to Citrus Seedlings. *Proc. Fl. State Hortic. Soc.* 66: 73-80.

ERE Rhoads, F. M., Olson, S. M., and Manning, A. - Copper toxicity in tomato plants. J.Environ.Qual. 18(2): 195-197 (1989)

Mix Rida, A. and Bouche, M. B. - Heavy Metal Linkages With Mineral, Organic And Living Soil Compartments. Soil Biol Biochem 29(3-4): 649-655 (1997)

OM, **pH** Roberts, B. L. and Dorough, H. W. - Relative Toxicities of Chemicals to the Earthworm *Eisenia foetida*. Environ.Toxicol.Chem. 3(1): 67-78 (1984)

Media Robinson, N. J. and Thurman, D. A. - Copper-Binding Protein in Mimulus guttatus. In: T.D.Lekkas (Ed.), Heavy Metal Environ.5th Int.Conf., Volume 2, CEP Consultant Ltd., Edinburgh, UK : 47-50 (1985)

OM Roth, J. A., Wallihan, E. F., and Sharpless, R. G. - Uptake by Oats and Soybeans of Copper and Nickel Added to a Peat Soil. Soil Sci. 112(5): 338-342 (1971)

No Conc Sahu, M. P., Sharma, D. D., and Jain, G. L. - Phosphorus-copper Interactions in the Incidence of Chlorosis in Garden Peas (Pisum sativum L.) on Calcareous Soil. Plant Soil 108(2): 291-293 (1988)

OM Salgare, S. A. and Asthana, S. - Copper an Environmental Pollutant. Environ.Ser.,Environ.Pollut.Health Hazards 3: 101-119 (1990)

OM Salim, R., Sayrafi, S. A., Sayrafi, O., and Isa, M. - Growth, Metal Uptake and Uptake Distribution of Spinach and Parsley Plants Irrigated with Copper Solutions. Journal of Environmental Science and Health Part A Environmental Science and Engineering & Toxic and Hazardous Substance Control 30: 2057-2069 (1995)

Mix Sanglimsuwan, Sarunya, Yoshida, Naoto, Morinaga, Tsutomu, and Murooka, Yoshikatsu. - Resistance to and uptake of heavy metals in mushrooms. Journal of Fermentation and Bioengineering 75(2): 112-114 (1993)

Media Sarada, R. L. and Polasa, H. - Effect of Manganese, Copper and Cobalt on the In Vitro Growth of R. leguminosarum-2001 and on the Symbiotic Nitrogen Fixation in Lentil Plants. Indian J.Agric.Res. 26(4): 187-194 (1992)

pH Saur, E. - Interactive Effects of P-Cu Fertilizers on Growth and Mineral Nutrition of Maritime Pine. New For. 7(2): 93-105 (1993)

No Control Sauve, S., Cook, N., Hendershot, W. H., and McBride, M. B. - Linking Plant Tissue Concentrations and Soil Copper Pools in Urban Contaminated Soils. Environ.Pollut. 94(2): 153-157 (1996)

pH Sawan, Z. M., Gregg, B. R., and Yousef, S. E. - Effect of Phosphorus, Chelated Zinc and Calcium on Cotton Seed Yield, Viability and Seedling Vigour. Seed Sci.Technol. 27(1): 329-337 (1999)

Score Sawan, Z. M., Mahmoud, M. H., and Gregg, B. R. 1993. Effect of Foliar Application of Chelated Copper and Manganese on Yield Components and Fiber Properties of Egyptian Cotton (*Gossypium barbadense*). *J. Agric. Sci.* 121[1]: 199-204.

Mix Schafer, J., Hannker, D., Eckhardt, J. D., and Stuben, D. - Uptake of Traffic-Related Heavy Metals and Platinum Group Elements (PGE) by Plants. Sci.Total Environ. 215(1/2): 59-67 (1998)

Media Schiller, W. - Studies on the Resistance to Copper of Two Ecotypes of Silene cucubalus Wif. Flora 163: 327-341 (1974)

No Dur Schuhmacher, M., Domingo, J. L., Llobet, J. M., and Corbella, J. - Cadmium, chromium, copper, and zinc in rice and rice field soil from southern Catalonia, Spain. Bull.Environ.Contam.Toxicol. 53(1): 54-60 (1994)

Media Schultz, C. L. and Hutchinson, T. C. - Copper Tolerance in the Grass Deschampsia cespitosa: Metallothionein Involved? In: T.D.Lekkas (Ed.), Heavy Metal Environ.5th Int.Conf., Volume 2, CEP Consultant Ltd., Edinburgh, UK : 51-54 (1985)

Media Sharma, S. S., Schat, H., Vooijs, R., and Van Heerwaarden, L. M. - Combination Toxicology of Copper, Zinc, and Cadmium in Binary Mixs: Concentration-Dependent Antagonistic, Nonadditive, and Synergistic Effects on Root Growth in Silene vulgaris. Environ.Toxicol.Chem. 18(2): 348-355 (1999)

Media Shaw, J. - Genetic Variation for Tolerance to Copper and Zinc Within and Among Populations of the Moss, Funaria hygrometrica Hedw. New Phytol. 109: 211-222 (1988)

Media Shen, Zhenguo, Zhang, Fenqin, and Zhang, Fusuo. - Toxicity of copper and zinc in seedlings of mung bean and inducing accumulation of polyamine. J.Plant Nutr. 21(6): 1153-1162 (1998)

Media Shirazi, M. A., Robideaux, M. L., Kapustka, L. A., Wagner, J. J., and Reporter, M. C. - Cell Growth in Plant Cultures: An Interpretation of the Influences of Initial Weight in Cadmium and Copper Toxicity Tests. Arch.Environ.Contam.Toxicol. 27(3): 331-337 (1994)

In Vit Siegel, S. M. - The Cytotoxic Response of Nicotiana Protoplast to Metal Ions: A Survey of the Chemical Elements. Water Air Soil Pollut. 8(1-4): 293-304 (1977)

Media Singh, R. P., Bharti, N., and Kumar, G. - Differential Toxicity of Heavy Metals to Growth and Nitrate Reductase Activity of Sesamum indicum Seedlings. Phytochemistry 35(5): 1153-1156 (1994)

Score Singh, B. P., Das, M., Prasad, R. N., and Ram, M. 1992. Characteristics of Fe-Toxic Soils and Affected Plants and Their Correction in Acid Haplaquents of Meghalaya. *Int. Rice Res. News* l. 17[2]: 18-19.

OM, **pH** Sjogren, M. - From Heavy Metals Affect Soil Fauna To Choosing Variables And Organisms For A Test System. Anderson, J.P.E., et al.(Eds.), Proc.Int.Symp.on Environmental Aspects of Pesticide Microbiology, Aug.17-21, 1992, Sigtuna, Sweden, Dep.of Microbiol., Swedish Univ.of Agric.Sci. 242-247 (1992)

Mix Sjogren, M., Augustsson, A., and Rundgren, S. - Dispersal And Fragmentation Of The Enchytraeid Cognettia Sphagnetorum In Metal Polluted Soil. Pedobiologia 39(3): 207-218 (1995)

Media Skilling, D. D. and Nicholls, T. H. - Brown Spot Needle Disease--Biology and Control in Scotch Pine Plantations. U.S.Dep.Agric., Forest Serv., Resear.Pap.FSRP-NC-109, North Central Forest Experiment Station, St.Paul, MN : 19 p. (1974)

Media Slade, S. J. - The Effect of Silver and Other Metal Ions on the In Vivo Growth of Root-Rotting Phytophthora and Other Fungal Species. Ann.Appl.Biol. 122(2): 233-251 (1993)

No Species Smith, C. J., Hopmans, P., and Cook, F. J. - Accumulation of Cr, Pb, Cu, Ni, Zn and Cd in soil following irrigation with treated urban effluent in Australia. Environ.Pollut. 94(3): 317-323 (1996)

Media Smith, P. F. and Specht, A. W. - Mineral Composition of Valencia Orange Seedlings Grown in Solution with Varying Amounts of Copper, Zinc, Manganese, and Iron. Proc.Fla.State Hortic.Soc. 66: 85-89 (1953)

Media Smith, P. F. and Specht, A. W. - Heavy Metal Nutrition and Iron Chlorosis of Citrus Seedlings. Plant Physiol. 28: 371-382 (1953)

OM Smith, P. F. - Effects of High Levels of Copper, Zinc and Manganese on Tree Growth and Fruiting of Valencia Orange in Sand Culture. Proc.Am.Soc.Hortic.Sci. 67: 202-209 (1956)

OM Smith, R. E. and Thomas, H. E. - Copper Sulphate as a Remedy for Exanthema in Prunes, Apples,

Pears and Olives. Phytopathology 18: 449-454 (1928)

Media Sowell, W. F., Rouse, R. D., and Wear, J. I. - Copper Toxicity of the Cotton Plant in Solution cultures. Agron.J. 49: 206-207 (1957)

OM Srivastava, A. K. and Gupta, M. L. - Interaction Effect of Copper and Phosphorus on the Availability of Phosphorus Under Rice Cultivation. Orissa J.Agric.Res. 4(3/4): 211-213 (1991)

Media Starkey, R. L. and Waksman, S. A. - Fungi Tolerant to Extreme Acidity and High Concentrations of Copper Sulfate. J.Bacteriol. 45: 509-519 (1943)

ERE Streit, B. - Effects of High Copper Concentrations on Soil Invertebrates (Earthworms and Oribated Mites): Experimental Results and a Model. Oecologia (Berlin) 64(3): 381-388 (1984)

Score Streit, B. and Jaggy, A. 1983. Effect of Soil Type on Copper Toxicity and Copper Uptake in *Octolasium cyaneum* (Lumbricidae). In: P.Lebrun, et al.(Eds.), *Trends in Soil Biology*, Ottignies-Louvain-la-Neuve , 569-575

Media Struckmeyer, B. E., Peterson, L. A., and Tai, F. H. M. - Effects of Copper on the Composition and Anatomy of Tobacco. Agron.J. 61: 932-936 (1969)

ERE Svendsen, C. and Weeks, J. M. - A Simple Low-Cost Field Mesocosm For Ecotoxicological Studies On Earthworms. Comp.Biochem.Physiol. 117C(1): 31-40 (1997)

OM, **pH** Szakal, P. and Schmidt, R. - Copper Fertilization of Wheat with Copper Complex and Changes in Flour Quality. Mengen- Spurenelem., Arbeitstag., 17th 17: 53-62 (1997)

Media Tadano, T., Pantanahiran, W., and Nilnond, C. - Inhibitory effect of canal water drained from a tropical deep peat soil on the elongation of rice roots. Soil Sci Plant Nutr 38(1): 149-157 (1992)

Media Taylor, G. J. and Foy, C. D. - Differential Uptake and Toxicity of Ionic and Chelated Copper in Triticum aestivum. Can.J.Bot. 63: 1271-1275 (1985)

Soil Thind, T. S. and Jhooty, J. S. - Use of Malathion and Stickers for Increasing the Efficacy of Fungicides for Controlling Purple Blotch of Onion. Indian J.Agric.Sci. 54(4): 299-302 (1984)

Media Thornton, B. and Macklon, A. E. S. - Copper uptake by ryegrass seedlings; contribution of cell wall adsorption. J.Exp.Bot. 40(219): 1105-1111 (1989)

Mix Tolle, D. A., Arthur, M. F., Chesson, J., and Van Voris, P. - Comparison of Pots Versus Microcosms for Predicting Agroecosystem Effects due to Waste Amendment. Environ.Toxicol.Chem. 4(4): 501-509 (1985)

Media Tso, T. C., Sorokin, T. P., and Engelhaupt, M. E. - Effects of Some Rare Elements on Nicotine Content of the Tobacco Plant. Plant Physiol. 51: 805-806 (1973)

FL Tu, C. and Qing, C. - Effect of Copper Adsorption Characteristics on Copper Toxicological Threshold of the Vegetables in Purple Soil. Huanjing Kexue 11(1): 31-35 (1990)

FL Tu, C. - Ecological and Environmental Effects of Copper in Different Soils. Zhongguo Huanjing Kexue 13(5): 361-366 (1993)

Media Turner, A. P., Dickinson, N. M., and Lepp, N. W. - Indices of metal tolerance in trees. International Conference on Metals in Soils, Waters, Plants and Animals, Orlando, Florida, Usa, April 30-May 3, 1990.Water Air Soil Pollut.57-58 (0).1991.617-626.

Media Turner, R. G. and Marshall, C. - The Accumulation of 65Zn by Root Homogenates of Zinc-Tolerant and Non-Tolerant Clones of Agrostis tenuis Sibth. New Phytol. 70: 539-545 (1971)

OM Udaiyan, K., Greep, S., Muthukumar, T., and Chitra, A. - Effect of Fumigation and Pesticide Drenches on VAM Status and Growth in Cereals. J.Environ.Biol. 20(2): 167-175 (1999)

Media Utriainen, M. A., Karenlampi, L. V., Karenlampi, S. O., and Schat, H. - Differential Tolerance to Copper and Zinc of Micropropagated Birches Tested in Hydroponics. New Phytol. 137: 543-549 (1997)

Mix Valdares, J. M. A. S., Gal, M., Mingelgrin, U., and Page, A. L. - Some Heavy Metals in Soils Treated with Sewage Sludge, Their Effects on Yield, and Their Uptake by Plants. J.Environ.Qual. 12(1): 49-57 (1983)

Score Van Gestel, C. A. M., Van Hezkezen, J., Bot, J., and Doornekamp, A. 1995. Development of a Standardized Soil Ecotoxicity Test with *Platynothrus peltifer* (Acari: Orobatida), Using Copper as a Reference Chemical. In: W.J.Van den Brink, R.Bosman, and F.Arendt (Eds.), Contaminated Soil '95 , 611-612

OM, **pH** Van Rhee, J. A. - Copper Contamination Effects on Earthworms by Disposal of Pig Waste in Pastures. Prog Soil Zool 1975: 451-457 (1975)

Score Van Rhee, J. A. 1969. Effects of Biocides on and Their Residues in Earthworms. *Meded. Rijksfac. Landouwwet*. Gent. 34: 682-689.

OM, **pH** Van Tichelen, K. K., Vanstraelen, T., and Colpaert, J. V. - Nutrient Uptake by Intact Mycorrhizal Pinus sylvestris Seedlings: a Diagnostic Tool to Detect Copper Toxicity. Tree Physiology 19(3): 189-196 (1999)

FL Vasconcelos, H. L., Luchese, E. B., and Lenzi, E. - A Study of Copper Phytodisponibility in Some Soils of Parana State, Brazil (Estudo da Fitodisponibilidade do Cobre em Alguns solos do Estado do Parana). Arq.Biol.Tecnol. 40(3): 580-585 (POR) (1997)

OM, **pH** Control,Conc Veavington, F. - Heavy Metal Contamination of Vegetables and Soil in Domestic Gardens Around a Smelting Complex. Environ.Pollut. 9(3): 211-217 (1975)

OM, **pH** Veijalainen, H. - The Applicability of Peat and Needle Analysis in Heavy Metal Deposition Surveys. Water Air Soil Pollut. 107(1-4): 367-391 (1998)

Media Veltrup, W. - Characteristics of Zinc Uptake by Barley Roots. Physiol.Plant. 42: 190-194 (1978)

Media Venkateswerlu, G. and Sastry, K. S. - Interrelationships in Trace-Element Metabolism in Metal Toxicities in a Cobalt-Resistant Strain of Neurospora crassa. Biochem.J. 132(4): 673-680 (1973)

OM, **pH** Verma, R. K. and Shekhawat, G. S. - Effect of Crop Rotation and Chemical Soil Treatment on Bacterial Wilt of Potato. Indian Phytopathol. 44(1): 5-8 (1991)

OM, **pH** Vesper, S. J. and Weidensaul, T. C. - Effects of Cadmium, Nickel, Copper and Zinc on Nitrogen Fixation by Soybeans. Water Air Soil Pollut. 9: 413-422 (1978)

Media Von Rosen, G. - Mutations Induced by the Action of Metal Ions in Pisum. II. Further Investigations on the Mutagenic Action of Metal Ions and Comparison with the Activity of Ionizing Radiation. Hereditas 51: 89-134 (1964)

Media Wainwright, S. J. and Woolhouse, H. W. - Some Physiological Aspects of Copper and Zinc Tolerance in Agrostis tenuis Sibth: Cell Elongation and Membrane Damage. J.Exp.Bot. 28(105): 1029-1036 (1977)

OM Wallace, A. and Mueller, R. T. - Effects of Chelated and Nonchelated Cobalt and Copper on Yields and Microelement Composition of Bush Beans Grown on Calcareous Soil in a Glasshouse. Soil Sci.Soc.Am.Proc. 37: 907-908 (1973)

No Conc Wallace, A., Mueller, R. T., and Alexander, C. V. - High Levels of Four Heavy Metals on the Iron Status of Plants. Comm.Soil Sci.Plant Anal. 7(1): 43-46 (1976)

OM Wallace, A., Alexander, G. V., and Chaudgry, F. M. - Phytotoxicity and Some Interactions of the Essential Trace Metals Iron, Manganese, Molybdenum, Zinc, Copper, and Boron. Commun.Soil Sci.Plant Anal. 8(9): 741-750 (1977)

Media Wallace, A., Romney, E. M., Mueller, R. T., and Lunt, O. R. - Influence of Environmental Stresses on Response of Bush Bean Plants to Excess Copper. J.Plant Nutr. 2(1/2): 39-49 (1980)

Media Wallace, A. - Additive, Protective and Synergistic Effects of Plants with Excess Trace Elements. Soil Sci. 133(5): 319-323 (1982)

Media Wallace, Arthur and Cha, Jong Whan. - Interactions involving copper toxicity and phosphorus deficiency in bush bean plants grown in solutions of low and high pH. Soil Sci. 147(6): 430-431 (1989)

OM, **pH** Walley, K. A., Khan, M. S. I., and Bradshaw, A. D. - The Potential for Evolution of Heavy Metal Tolerance in Plants. I. Copper and Zinc Tolerance in Agrostis tenuis. Heredity 32(3): 309-319 (1974)

No Conc Walsh, L. M., Erhardt, W. H., and Seibel, H. D. 1972. Copper Toxicity in Snapbeans (*Phaseolus vulgaris* L.). *J. Environ. Biol.* 1: 197-203.

Media Wan, M. T., Rahe, J. E., and Watts, R. G. - A New Technique for Determining the Sublethal Toxicity of Pesticides to the Vesicular-Arbuscular Mycorrhizal Fungus Glomus intraradices. Environ.Toxicol.Chem. 17(7): 1421-1428 (1998)

Media Wang, W. - Root Elongation Method for Toxicity Testing of Organic and Inorganic Pollutants. Environ.Toxicol.Chem. 6(5): 409-414 (1987)

Aquatic Wang, W. - Rice Seed Toxicity Tests for Organic and Inorganic Substances. Environ.Monit.Assess. 29: 101-107 (1994)

FL Wang, Y. P. and Chao, C. C. - Effects of Vesicular-Arbuscular Mycorrhizae and Heavy Metals on the Growth of Soybean and Phosphate and Heavy Metal Uptake by Soybean in Major Soil Groups of Taiwan. J AGRIC ASSOC CHINA NEW SER (157): 6-20 (CHI) (ENG ABS) (1992)

OM Wang, Z. and Chen, Y. - Alleviation of Copper Toxicity to Maize by Phosphorus Fertilizer in Purple Soil. Pedosphere 7(3): 281-288 (1997)

Mix Wang, Zhenzhong, Zhang, Youmei, Hu, Juelian, Zheng, Yunyou, Hu, Zhaoyang, Guo, Yongcan, Lai, Qing, Yan, Hengmei, and Deng, Jifu. - Effect of heavy metals in soil on earthworms (Opisthopora). Huanjing Kexue Xuebao 14(2): 236-243 (1994)

No Dur Watmough, S. A. and Dickinson, N. M. - Dispersal and mobility of heavy metals in relation to tree survival in an aerially contaminated woodland soil. Environ.Pollut. 90(2): 135-142 (1995)

pH Webber, J. - Effects of Toxic Metals in Sewage on Crops. Water Pollut Control 71: 404-413 (1972)

ERE Weeks, J. M. and Svendsen, C. - Neutral Red Retention By Lysosomes From Earthworm (Lumbricus rubellus) Coelomocytes: A Simple Biomarker Of Exposure To Soil Copper. Environ.Toxicol.Chem. 15(10): 1801-1805 (1996)

Mix Weltje, L. - Mixture Toxicity and Tissue Interactions of Cd, Cu, Pb and Zn in Earthworms (Oligochaeta) in Laboratory and Field Soils: A Critical Evaluation of Data. Chemosphere 36(12): 2643-2660 (1998)

OM Westgate, P. J. - Preliminary Report on Copper Toxicity and Iron Chlorosis in Old Vegetable Fields. Proc.Fla.State Hortic.Sci. 65: 143-146 (1952)

Media Wettlaufer, S. H., Osmeloski, J., and Weinstein, L. H. - Response of polyamines to heavy metal stress in oat seedlings. Environ.Toxicol.Chem. 10(8): 1083-1088 (1991)

Media Wheeler, D. M., Power, I. L., and Edmeades, D. C. - Effect of Various Metal Ions on Growth of Two Wheat Lines Known to Differ in Aluminum Tolerance. Plant Soil 155/156: 489-492 (1993)

Media Wheeler, D. M., Power, I. L., and Edmeades, D. C. - Effect of Various Metal Ions on Growth of Two Wheat Lines Known to Differ in Aluminium Tolerance. In: Barrow,N.J.(Ed.), Developments in Plant and Soil Sciences, Plant Nutrition from Genetic Engineering to Field Practice : 723-726 (1993)

Media Wong, M. H. and Bradshaw, A. D. - A Comparison of the Toxicity of Heavy Metals, Using Root Elongation of Rye Grass, Lolium perenne. New Phytol. 91: 255-261 (1982)

Media Wong, Y. S., Lam, E. K. H., and Tam, N. F. Y. - Physiological effects of copper treatment and its uptake pattern in festuca rubra cv. Merlin. Resources Conservation and Recycling 11(1-4): 311-319 (1994)

Media Wu, L. and Bradshaw, A. D. - Aerial Polluation and the Rapid Evolution of Copper Tolerance. Nature 238: 167-169 (1972)

Media Wu, L., Thurman, D. A., and Bradshaw, A. D. - The Uptake of Copper and Its Effects upon Respiratory Processes of Roots of Copper-Tolerant and Non-Tolerant Clones of Agrostis stolonifera. New Phytol. 75: 225-229 (1975)

Media Wu, Zhenqiu and Wu, Yuexuan. - Effects of Copper and Zinc on Growth and Superoxide Dismutase Activity of Rice Seedlings. Zhiwu Shengli Xuebao 16(2): 139-146 (1990)

Media Xu, Z., Bowers, N., and Pratt, J. R. - Variation in Morphology, Ecology, and Toxicological Responses of Colpoda inflata (Strokes) Collected from Five Biogeographic Realms. Euro J Protist 33: 136-144 (1997)

Mix Yeates, G. W., Orchard, V. A., and Speir, T. W. - Reduction In Faunal Populations And Decomposition Following Pasture Contamination By A Cu-Cr-As Based Timber Preservative. Acta Zool.Fenn. (196): 297-300 (1995)

No Conc Younts, S. E. 1964. Response of Wheat to Rates, Dates of Application, and Sources of Copper and to Other Micronutrients. *Agron. J.* 56: 266-269.

ERE Zhu, B. and Alva, A. K. - Comparison of Single and Sequential Soil Extractions for Predicting Copper Phytotoxicity. Commun.Soil Sci.Plant Anal. 24(5-6): 475-486 (1993)

Score Zhu, Y. M., Berry, D. F., and Martens, D. C. 1991. Copper Availability in Two Soils Amended with Eleven Annual Applications of Copper-Enriched Hog Manure. *Commun. Soil Sci. Plant Anal.* 22[7/8]: 769-783.

7.4 References Used in Deriving Wildlife TRVs

Aburto, E. M. A. E. Cribb and C. Fuentealba. 2001. effect of chronic exposure to excess dietary copper and dietary selenium supplementation on liver specimens from rats. *American Journal of Veterinary Medicine.* 62(9): 1423-1427. Ref ID: 25964

Adam, S. E., Wasfi, I. A., and Magzoub, M. 1977. chronic copper toxicity in nubian goats. *J. Comp. Pathol.* 87(4): 623-627. Ref ID: 3752

al Ankari, A., Najib, H., and al Hozab, A. 1998. yolk and serum cholesterol and production traits, as affected by incorporating a supraoptimal amount of copper in the diet of the leghorn hen. *Br. Poult. Sci.* 39(3): 393-397. Ref ID: 2006

Allcroft, R, Burns, KN, and Lewis, G. 1961. the effects of high levels of copper in rations for pigs. *Vet. Rec.* 73: 714. Ref ID: 14387

Amer, M. A., St-Laurent, G. J., and Brisson, G. J. 1973. supplemental copper and selenium for calves effects upon ceruloplasmin activity and liver copper Concentration. *Can J Physiol Pharmacol.* 51(9): 649-653. Ref ID: 10086

Anugwa, F. O. I., Okorie, A. U., and Enunwaonye, C. A. 1984. effect of varying copper and protein levels on the performance tissue copper and zinc concentrations of growing rabbits in the tropics. *Trop. Vet.* 2(2): 103-112. Ref ID: 2010

Apgar, G. A. and E. T. Kornegay. 1996. mineral balance of finishing pigs fed copper ssulfate or a copper-lysine complex at growth-stimulating levels. *Journal of Animal Science.* 74: 1594-1600. Ref ID: 25928

Apgar, G. A. E. T. Kornegay M. D. Lindemann and D. R. Notter. 1995. evaluation of copper sulfate and a copper lysine complex as growth promoters for weanling swine. *Journal of Animal Science.* 73: 2640-2646. Ref ID: 25922

Arthur, D. 1965. interrelationships of molybdenum and copper in the diet of the guinea pig. *J. Nutr.* 87(1): 69-76. Ref ID: 2012

Aulerich, R. J., Ringer, R. K., Bleavins, M. R., and Napolitano, A. 1982. effects of supplemental dietary copper on growth, reproductive performance and kit survival of standard dark mink and the acute toxicity of copper to mink. *J. Anim. Sci.* 55(2): 337-343. Ref ID: 2013

Bafundo, K. W., Baker, D. H., and Fitzgerald, P. R. 1984. lead toxicity in the chick as affected by excess copper and zinc and by eimeria acervulina infection. *Poult. Sci.* 63(8): 1594-1603. Ref ID: 2517

Bailey, J. D. R. P. Ansotegui J. A. Paterson C. K. Swenson and A. B. Johnson. 2001. effects of supplementing combinations of inorganic and complexed copper on performance and liver mineral status of beef heifers consuming antagonists. *Journal of Animal Science.* 79: 2926-2934. Ref ID: 25941

Bakalli, R. I., Pesti, G. M., Ragland, W. L., and Konjufca, V. 1995. dietary copper in excess of nutritional requirement reduces plasma and breast muscle cholesterol of chickens. *Poult. Sci.* 74(2): 360-365. Ref ID: 3717

Bassuny, S. M. 1991. the effect of copper sulfate supplement on rabbit performance under egyptian conditions. *Journal of Applied Rabbit Research.* 14(2): 93-97. Ref ID: 2020

Bataineh, H., Al-Hamood, M. H., and Elbetieha, A. M. 1998. assessment of aggression, sexual behavior and fertility in adult male rat following long-term ingestion of four industrial metals salts. *Hum Exp Toxicol.* 17(10): 570-6. Ref ID: 1717

Boyden, R., Potter, V. R., and Elvehjem, C. A. 1938. effect of feeding high levels of copper to albino rats. *The Journal of Nutrition.* 15(4) Ref ID: 14653

Brandt, A. 1983. effect of dietary copper and zinc on the haemotology of male pastel mink kits: a pilot investigation [iron, fe, blood plasma analysis, 300 ppm copper per kg wet feed highly toxic to mink]. *Scientifur.* 7(2): 61-65. Ref ID: 2033

Braude, R. and Ryder, K. 1973. copper levels in diets for growing pigs. *Journal of Agricultural Science, UK.* 80(3): 489-493. Ref ID: 2034

Bush, C. R., Restum, J. C., Bursian, S. J., and Aulerich, R. J. 1995. responses of growing mink to supplemental dietary copper and biotin. *Scientifur.* 19(2): 141-147. Ref ID: 2043

Cerklewski, F. L. and Forbes, R. M. 1977. influence of dietary copper on lead toxicity in the young male rat. *J. Nutr.* 107(1): 143. Ref ID: 2625

Chesta, J., Srai, S. K., Burroughs, A. K., Scheuer, P. J., and Epstein, O. 1989. copper overload in the developing guinea pig liver: a histological, histochemical and biochemical study. *Liver.* 9(4): 198-204. Ref ID: 2047

Chiou Wen-Shyg, P., Chen, C. L., Chen, K. L., and Wu, C. P. 1999. effect of high dietary copper on the morphology of gastro-intestinal tract in broiler chickens. *Asian-Australas. J. Anim. Sci.* 12(4): 548-553. Ref ID: 2048

Chiou WenShyg, P., Chen, K. L., and Yu, B. 1998. effect of dietary organic arsenicals and cupric sulfate on copper toxicity, liver accumulation and residue in eggs and excreta of laying hens. *Animal Feed Science and Technology.* 73(1-2) Ref ID: 2049

Chiou, WenShyg P., Chen, K. L., and Yu, B. 1997. toxicity, tissue accumulation and residue in egg and excreta of copperin laying hens. *Animal Feed Science and Technology.* 67(1): 49-60. Ref ID: 2050

Christmas, R. B. and Harms, R. H. 1979. the effect of supplemental copper and methionine on the performance of turkey poults. *Poult Sci.* 58(2): 382-384. Ref ID: 2052

Cromwell, G. L., Stahly, T. S., and Monegue, H. J. 1989. effects of source and level of copper on performance and liver copper stores in weanling Pigs. *J Anim Sci.* 67(11): 2996-3002. Ref ID: 2061

Cromwell, G. L. a, Monegue, H. J., and Stahly, T. S. 1993. long-term effects of feeding a high copper diet to sows during gestation and lactation. *Journal of Animal Science.* 71(11): 2996-3002. Ref ID: 2062

Cromwell, G. L. M. D. Lindemann H. J. Monegue D. D. Hall and D. E. Orr Jr. 1998. tribasic copper chloried and copper sulfate as copper sources for weanling pigs. *Journal of Animal Science.* 76: 118-123. Ref ID: 25930

Davis, R. H., Fear, J., and Winton, A. C. 1996. interactions between dietary selenium, copper and sodium nitroprusside, a source of cyanide in growing chicks and laying hens. *Br Poult Sci.* 37(1): 87-94. Ref ID: 1278

De Goey, L. W., Wahlstrom, R. C., and Emerick, R. J. 1971. studies of high level copper supplementation to rations for growing swine. *Journal of Animal Science.* 33(No.1): 52-57. Ref ID: 2064

De Vries, D. J., Sewell, R. B., and Beart, P. M. 1986. effects of copper on dopaminergic function in the rat corpus striatum. *Exp Neurol.* 91(3): 546-58. Ref ID: 10891

Dodds-Smith, M. E., Johnson, M. S., and Thompson, D. J. 1992. trace metal accumulation by the shrew sorex araneus. i. total body burden, growth, and mortality. *Ecotoxicol Environ Saf.* 24(1): 102-17. Ref ID: 440

Dodds-Smith, M. E., Johnson, M. S., and Thompson, D. J. 1992. trace metal accumulation by the shrew sorex araneus. ii. tissue distribution in kidney and liver. *Ecotoxicol Environ Saf.* 24(1): 118-30. Ref ID: 2069

Edmonds, M. S. and Baker, D. H. 1986. toxic effects of supplemental copper and roxarsone when fed alone or in combination to young pigs. *Journal of Animal Science.* 63(2): 533-537. Ref ID: 2075

Ekperigin, H. E. and Vohra, P. 1981. influence of copper supplementation on the relationship between dietary methionine and free plasma methionine. *J Nutr.* 111(9): 1621-9. Ref ID: 2084

Ekperigin, H. E. and P. Vohra. 1981. influence of dietary excess methionine on the relationship between dietary copper and the concentration of copper and iron in organs of broiler chicks. *J. Nutr. (1981)* 111(9): 1630-40 . Ref ID: 6474

Elliot, J. I. and Bowland, J. P. 1972. response of rats of diets containing 250 ppm supplemental copper. growth, food conversion, liver copper accumulation, and fat composition. *Can. J. Anim. Sci.* 52(1): 97-101. Ref ID: 2085

Engle, T. E. and J. W. Spears. 2001. performance, carcass characteristics and lipid metabolism in growing and finishing simmental steers fed varying concentrations of copper. *Journal of Animal Science.* 79: 2920-2925. Ref ID: 25940

Engle, T. E. J. W. Spears L. Xi and F. W. Edens. 2000. dietary copper effects on lipid metabolism and circulating catecholamine concentrations in finishing steers. *Journal of Animal Science.* 78: 2737-2744. Ref ID: 25935

Felsman, R. J., Wise, M. B., Harvey, R. W., and Barrick, E. R. 1973. effect of added dietary levels of copper sulfate and an antibiotic on performance and certain blood constituents of calves. *J. Anim. Sci.* 36: 157-160. Ref ID: 3760

Foster, SD. 1999. The biological and physiological effects of excess copper in juvenile mallards (Anas platyrhynchos): An investigation of the toxicity of acid mine drainage in waterfowl. Master Thesis. Colorado State University. Fort Collins, CO. 131pg. Ref ID: 18769

Freundt, K. J. and Ibrahim, H. A. 1990. growth of rats during a subchronic intake of the heavy metals pb, cd, zn, mn, cu, hg, and be. *Pol. J. Occup. Med.* 3(2): 227-232. Ref ID: 2640

Fuentealba, I. and Haywood, S. 1988. cellular mechanisms of toxicity and tolerance in the copper-loaded rat. i. ultrastructural changes in the liver. *Liver.* 8(6): 372-80. Ref ID: 2094

Fuentealba, I., Haywood, S., and Foster, J. 1989. cellular mechanisms of toxicity and tolerance in the copper-loaded rat. ii. pathogenesis of copper toxicity in the liver. *Exp Mol Pathol.* 50(1): 26-37. Ref ID: 2095

Fuentealba, I., Haywood, S., and Trafford, J. 1989. variations in the intralobular distribution of copper in the livers of copper-loaded rats in relation to the pathogenesis of copper storage diseases. *J Comp Pathol.* 100(1): 1-11. Ref ID: 2096

Fuentealba, I. C., Davis, R. W., Elmes, M. E., Jasani, B., and Haywood, S. 1993. mechanisms of tolerance in the copper-loaded rat liver. *Exp Mol Pathol.* 59(1): 71-84. Ref ID: 2097

Fuentealba, I. C., Haywood, S., and Foster, J. 1989. cellular mechanisms of toxicity and tolerance in the copper-loaded rat. iii. ultrastructural changes and copper localization in the kidney. *Br J Exp Pathol.* 70(5): 543-56. Ref ID: 2098

Fuentealba, I. C., Mullins, J. E., Aburto, E. M., Lau, J. C., and Cherian, G. M. 2000. effect of age and sex on liver

damage due to excess dietary copper in fischer 344 rats. *Journal of Toxicology: Clinical Toxicology [j. Toxicol.: Clin. Toxicol.]. Vol. 38, No. 7, Pp. 709-717. 2000.* Ref ID: 36364

Funk, M. A. and Baker, D. H. 1991. toxicity and tissue accumulation of copper in chicks fed casein and soy-based diets. *J Anim Sci.* 69(11): 4505-11. Ref ID: 2099

Gautam, R. K., Khan, R., and Tejeshwarilal. 2001. effect of the heavy metals on calcium and the activity of iron in the albino rats. *Journal of Ecotoxicology & Environmental Monitoring [j. Ecotoxicol. Environ. Monitoring]. Vol. 11, No. 3-4, Pp. 177-180. Jul-Oct 2001.* Ref ID: 36346

Gershbein, L. L., Gershbein, J. D., and French, R. 1983. behavior of male rats fed low levels of metallic salts. *Res Commun Chem Pathol Pharmacol.* 39(3): 507-510. Ref ID: 136

Gill, B. S., Pawar, H. S., and Singh, R. 1995. studies on different dietary copper levels in male white leghorn chicks. *International Journal of Animal Sciences.* 10(2): 325-329. Ref ID: 2107

Gipp, WF, Pond, WG, Kallfelz, FA, Tasker, JB, VanCampen, GR, Krook, L, and Visek, WJ. 1974. effect of dietary copper, iron and ascorbic acid levels on hematology, blood and tissue coper, iron and zinc concentrations and 64cu and 59fe metabolism in young pigs. *J. Nutr.* 104: 532. Ref ID: 14397

Gipp, WF, Pond, WG, and Walker, EF. 1973. influence of diet, composition and mode of copper administration on the response of growing-finishing swine to supplemental copper. *J. Anim. Sci.* 36: 91. Ref ID: 14396

Goldberg, A, Williams, CB, Jones, RS, Yanagita, M, Cartwright, GE, and Wintrobe, MM. 1956. studies on copper metabolism. xxii. hemolytic anemia in chickens induced by the administration of copper. *J. Lab. Clin. Med.* 48: 442. Ref ID: 14398

Gooneratne, S. R. and J. McC Howell. 1980. creatine kinase release and muscle changes in chronic copperpoisoning in sheep . *Res.Vet.Sci.* 28: 351-361. Ref ID: 36200

Gopinath, C. and J. McC Howell. 1975. experimental chronic copper toxicity in sheep. changes that follow the cessation of dosing at the onset of haemolysis. *Res.Vet.Sci.*(19): 35-43. Ref ID: 36201

Gopinath, C. Hall G. A. and Howell M. C. C. 1974. the effect of chronic copper poisoning on the kidneys of sheep. *Res.Vet.Sci.* 16: 57-69. Ref ID: 36202

Griminger, P. 1977. effect of copper sulfate on egg production and shell thickness. *POULT SCI.* 56(1): 359-361. Ref ID: 2112

Grobner, M. A., Cheeke, P. R., and Patton, N. M. 1986. effect of dietary copper and oxytetracycline on growth and mortality of weanling rabbits. *Journal of Applied Rabbit Research.* 9(2): 46-53. Ref ID: 2113

Guenthner, E., Carlson, C. W., and Emerick, R. J. 1978. copper salts for growth stimulation and alleviation of aortic rupture losses in turkeys. *Poult Sci.* 57(5): 1313-1324. Ref ID: 2114.

Harms, R. H. and Buresh, R. E. 1986. influence of nutrient density and copper levels of diets upon performance of laying Hens. *Nutr Rep Int.* 33(2): 261-268. Ref ID: 2117

Harms, R. H. and Buresh, R. E. 1987. influence of three levels of copper on the performance of turkey poults with diets containing two sources of Methionine. *Poult Sci.* 66(4): 721-724. Ref ID: 2118

Harms, R. H. and Eberst, D. P. 1974. influence of dietary cupric sulfate on the response of young turkeys tosodium sulfate. *Poultry Science* 53(4): 1629-1631 . Ref ID: 9234

Haywood, S. 1985. copper toxicosis and tolerance in the rat. i. changes in copper content of the liver and kidney. *J Pathol.* 145(2): 149-158. Ref ID: 2121

Haywood, S. 1980. the effect of excess dietary copper on the liver and kidney of the male rat. *J Comp Pathol.* 90(2): 217-32. Ref ID: 2122

Haywood, S. and Comerford, B. 1980. the effect of excess dietary copper on plasma enzyme activity and on the copper content of the blood of the male rat. *J COMP PATHOL.* 90(2): 233-238. Ref ID: 2123

Haywood, S. and Loughran, M. 1985. copper toxicosis and tolerance in the rat. ii. tolerance--a liver protective adaptation. *Liver.* 5(5): 267-75. Ref ID: 2124

Haywood, S., Trafford, J., and Loughran, M. 1985. copper toxicosis and tolerance in the rat: iv. renal tubular excretion of copper. *Br J Exp Pathol.* 66(6): 699-707. Ref ID: 2125

Hebert, C. D. 1993. *NTP Technical Report on Toxicity Studies of Cupric Sulfate (Cas No. 7758-99-8) Administered in Drinking Water and Feed to F344/n Rats and B6C3F1 Mice.* Ref ID: 2126

Hebert, C. D., Elwell, M. R., Travlos, G. S., Fitz, C. J., and Bucher, J. R. 1993. subchronic toxicity of cupric sulfate administered in drinking water and feed to rats and mice. *Fundam Appl Toxicol.* 21(4): 461-75. Ref ID: 2127

Hill, C. H. 1990. effect of ***dietary*** copper on vanadate toxicity in chicks. *Biol. Trace Elem. Res. (1990)* : Volume Date 1989, 23, 17-23. Ref ID: 5734

Hill, C. H. 1974. influence of high levels of minerals on the susceptibility of chicks to salmonella gallinarum. *J Nutr.* 104(10): 1221-1226. Ref ID: 92

Hill, C. H. 1980. influence of time of exposure to high levels of minerals on the susceptibility of chicks to *salmonella gallinarum.* *J Nutr.* 110(3): 433-6. Ref ID: 395

Hill, C. H. 1989. interaction of vanadium with other dietary constituents. 6th International Trace Element Symposium. Vol 1: 37-43. Ref ID: 7091

Hill, C. H. 1974. reversal of selenium toxicity in chicks by mercury copper and Cadmium. *J Nutr.* 104(5): 593-598. Ref ID: 1369

Hill, C. H. 1979. studies on the ameliorating effect of ascorbic acid on mineral toxicities in the chick. *J Nutr.* 109(1): 84-90. Ref ID: 1370

Hoda, Ali H. A. and Hady, M. M. 1995. potency of copper as a growth promoter in broiler chickens. *Veterinary Medical Journal, Cairo Univ. Veterinary Medical Journal, Cairo Univ.* 43(1): 77-85. Ref ID: 2007

Howell, J. M. Deol H. S. Dorling P. R. and Thomas J. B. 1991. experimental copper and heliotrope intoxication in sheep: morphological changes. *J. Comp. Pathol.* 105: 49-74. Ref ID: 36230

Howell, J. McC., Blakemore, W. F., Gopinath, C., Hall, G. A., and Parker, J. H. 1974. chronic copper poisoning and changes in the central nervous system of sheep. *Acta Neuropathologica.* 29(Fasc. 1): 9-24. Ref ID: 2148

Humann-Ziehank, E., Coenen, M., Ganter, M., and Bickhardt, K. 2001. long-term observation of subclinical chronic copper poisoning in two sheep breeds. *Journal of Veterinary Medicine. A, Physiology, Pathology, Clinical Medicine, 2001 Sep, 48(7):429-39.* Ref ID: 36762

Irie, M. 1990. effect of dietary supplementation of copper and kapok meal on fat characteristics of pigs. *Asian-Australasian Journal of Animal Sciences. 3 (1). 1990. 33-38.* Ref ID: 21243

Ishmael, J., Gopinath, C., and Howell, J. M. 1971. experimental chronic copper toxicity in sheep histological and histochemical changes during the development of the lesions in the liver. *RES VET SCI.* 12(4): 358-366. Ref ID: 2155

Jackson, N. 1977. the effect of dietary copper sulphate on laying performance, nutrient intake and tissue copper and iron levels of the mature, laying, domestic fowl. *Br J Nutr.* 38(1): 93-100. Ref ID: 2157

Jackson, N. and Stevenson, M. H. 1981. identification of the component responsible for the effects of added dietary copper sulphate in the female domestic fowl. *J Sci Food Agric.* 32(11): 1047-56. Ref ID: 2158

Jackson, N. and Stevenson, M. H. 1981. a study of the effects of dietary added cupric oxide on the laying, domestic fowl and a comparison with the effects of hydrated copper sulphate. *Br J Nutr.* 45(1): 99-110. Ref ID: 2159

Jackson, N., Stevenson, M. H., and Kirkpatrick, G. M. 1979. effects of the protracted feeding of copper sulphate-supplemented diets to laying, domestic fowl on egg production and on specific tissues, with special reference to mineral content. *Br J Nutr.* 42(2): 253-66. Ref ID: 2160

Jenkins, K. J. 1989. effect of copper loading of preruminant calves on intracellular distribution of hepatic copper, zinc, iron, and molybdenum. *Journal of Dairy Science* 72(9): 2346-2350. Ref ID: 48117

Jenkins, N. K., Morris, T. R., and Valamotis, D. 1970. the effect of diet and copper supplementation on chick growth. *Br Poult Sci.* 11(2): 241-8. Ref ID: 2162

Jensen, L. S. 1975. modification of a selenium toxicity in chicks by dietary silver and copper. *J NUTR.* 105(6): 769-775. Ref ID: 1403

Jensen, L. S., Dunn, P. A., and Dobson, K. N. 1991. induction of oral lesions in broiler chicks by supplementing the diet with copper. *Avian Dis.* 35(4): 969-73. Ref ID: 2163

Jensen, L. S. and Maurice, D. V. 1978. effect of high dietary copper on the ceca of chicks. *Poult Sci.* 57(1): 166-70. Ref ID: 2164

Jensen, L. S. and Maurice, D. V. 1978. effect of methionine on copper induced growth depression and gizzard erosion. *POULT SCI.* 57(6): 1530-1532. Ref ID: 2165

Jensen, L. S. and Maurice, D. V. 1979. influence of sulfur amino-acids on copper toxicity in chicks. *J NUTR.* 109(1): 91-97. Ref ID: 2166

Kadirvel, R. and Kothandaraman, P. 1978. the need for inorganic sulphate in grower and layer mashes of white leghorn birds. *Cheiron.* 7(1/2): 34-39. Ref ID: 11876

Kakela, R. and Hyvarinen H. 1999. fatty acid alterations caused by pcbs (aroclor 1242) and copper in adipose tissue around lymph nodes of mink. *Comp. Biochem. Physiol. C* . 122: 45-53. Ref ID: 36248

Kakela, R. Kakela A. Hyvarinen H. Asikainen J. and Dahl S. K. 1999. vitamins a1, a2, and e in minks exposed to polychlorinated biphenyls (aroclor 1242) and copper, via diet based on freshwater or marine fish. *Environ. Toxicol. Chem.* 18(11): 2595-2599. Ref ID: 36231

Kashani, A. B., Samie, H., Emerick, R. J., and Carlson, C. W. 1986. effect of copper with three levels of sulfur containing amino acids in diets for turkeys. *Poult Sci.* 65(9): 1754-9. Ref ID: 2171

Kassim, H. a and Suwanpradit, S. 1996. the influence of copper on the total sulphur amino acids requirement of broilers during two growing periods. *Asian-Australasian Journal of Animal Sciences.* 9(4): 359-362. Ref ID: 2172

Kayongo-Male, H. and Palmer, I. S. 1998. copper-silicon interaction studies in young, rapidly growing turkeys fed semipurified starter diets. *Biol. Trace Elem. Res.* 63(3): 195-204. Ref ID: 5149

Keen, C. L., Feldman, B. F., Knight, J., O'Neill, S., Ferrell, F., and Hurley, L. S. 1982. the influence of high concentrations of dietary copper on vitamin k-dependent coagulation factors. *Proc Soc Exp Biol Med.* 170(4): 471-5. Ref ID: 11928

King, J. O. 1975. the feeding of copper sulphate to ducklings. *Br Poult Sci.* 16(4): 409-11. Ref ID: 2177

King, J. O. 1972. the feeding of copper sulphate to growing fowls. *Br Poult Sci.* 13(1): 61-5. Ref ID: 2178

King, J. O. 1975. the feeding of copper sulphate to growing rabbits. *Br Vet J.* 131(1): 70-5. Ref ID: 2179

Ko, Y. G., Han, I. K., Ha, J. K., and Kim, S. K. 1985. effects of copper and sulfur sources on the performance of broiler chicks. *KOREAN J ANIM SCI.* 27(10): 651-654. Ref ID: 2181

Komulainen, H. 1983. monoamine uptake in brain synaptosomes after administration of copper to rats. *Acta Pharmacol Toxicol* . 53(1): 33-8. Ref ID: 12079

Kornegay, E. T., Blodgett, D. J., Schurig, G. G., and Lindemann, M. D. 1986. interactive effects for supplemental biotin and copper for weanling pigs. *Animal Science Research Report, Virginia Agricultural Experiment Station.*(5): 5-9. Ref ID: 2182

Kumar, Ajay, Rana, S. V. S., Sharma, C. B., and Gabuchyan, V. V. 1987. influence of dietary methionine on copper toxicity in rats: impairment mechanism of the reproductive function in copper chloride-exposed white male rats. *Adv. Biosci. (Muzaffarnagar, India).* 6(1): 1-8. Ref ID: 2186

Lalich, J. J., Groupner, K., and Jolin, J. 1965. the influence of copper and molybdate salts on the production of bony deformities in rats. *Lab Invest.* 14(8): 1482-93. Ref ID: 2189

Latymer, E. A. and Coates, M. E. 1981. the effects of high dietary supplements of copper sulphate on pantothenic acid metabolism in the chick. *Br J Nutr.* 45(2): 431-9. Ref ID: 2191

Lecyk, M. 1980. toxicity of cuso4 in mice embryonic Development. *Zool Pol* . 28: 101-105. Ref ID: 2193

Ledoux, D. R., Henry, P. R., Ammerman, C. B., and Miles, R. D. 1989. effect of ***dietary*** copper and age on tissue mineral composition of broiler-type chicks as a bioassay of inorganic copper sources. *Nutr. Rep. Int. (1989)* 40(1): 53-66 . Ref ID: 5812

Ledoux, D. R., Henry, P. R., Ammerman, C. B., and Miles, R. D. 1989. effect of ***dietary*** copper on tissue mineral composition as an estimate of copper bioavailability in broiler chicks. *Nutr. Rep. Int. (1989)* 39(6): 1117-26. Ref ID: 5824

Ledoux, D. R., Miles, R. D., Ammerman, C. B., and Harms, R. H. 1987. interaction of dietary nutrient concentration and supplemental copper on chick performance and tissue copper concentrations. *Poult Sci.* 66(8): 1379-84. Ref ID: 2194

Leeson, S. and Summers, J. D. 1982. effect of high dietary levels of supplemental zinc manganese copper or iron on broiler performance to 3 weeks of age and accumulation of these minerals in tissue and excreta. *NUTR REP INT.* 25(3): 591-599. Ref ID: 2196

Llewellyn, G. C., Floyd, E. A., Hoke, G. D., Weekley, L. B., and Kimbrough, T. D. 1985. influence of dietary aflatoxin, zinc, and copper on bone size, organ weight, and body weight in hamsters and rats. *Bull Environ Contam Toxicol.* 35(2): 149-56. Ref ID: 2203

Luo, X. G. and C. R. Dove. 1996. effect of dietary copper and fat on nutrient utilization, digestive enzyme activities and tissue mineral levels in weanling pigs. *Journal of Animal Science.* 74: 1888-1896. Ref ID: 25929

Marron, L. M. R. Bedford and K. J. McCracken. 2001. the effects of adding xylanase, vitamin c, and copper sulphate to wheat-based diets on broiler performance. *British Poultry Science.* 42: 493-500 . Ref ID: 25968

McGhee, F, Greger, CR, and Couch, JR. 1965. copper and iron toxicity. *Poult. Sci.* 44: 310. Ref ID: 14453

McNatt, E. N., Campbell, W. G. Jr, and Callahan, B. C. 1971. effects of dietary copper loading on livers of rats. i. changes in subcellular acid phosphatases and detection of an additional acid p-nitrophenylphosphatase in the cellular supernatant during copper loading. *Am J Pathol.* 64(1): 123-44. Ref ID: 2216

Mehring, A. L., Brumbaugh, J. H., Sutherland, A. J., and Titus, H. W. 1960. tolerance of growing chickens for dietary copper. *Poultry Sci* . 39: 713-719. Ref ID: 22

Mercado, R. C. and Bibby, B. G. 1973. trace element effects on enamel pigmentation incisor growth and molar morphology in rats. *ARCH ORAL BIOL.* 18(5): 629-635 . Ref ID: 757

Miles, R. D., O'Keefe, S. F., Henry, P. R., Ammerman, C. B., and Luo, X. G. 1998. the effect of dietary supplementation with copper sulfate or tribasic copper chloride on broiler performance, relative copper bioavailability, and dietary prooxidant activity. *Poult Sci.* 77(3): 416-25. Ref ID: 2221

Miranda, C. L. Henderson M. C. and Buhler D. R. 1981. dietary copper enhances the hepatotoxicity of senecio jacobaea in rats. *Toxicol. Appl. Pharmacol.* 60(3): 418-423. Ref ID: 36240

Moffitt, A. E. Jr. and Murphy, S. D. 1973. effect of excess and deficient copper intake on rat liver microsomal enzyme activity. *Biochem Pharmacol.* 22(12): 1463-76. Ref ID: 12718

Myers, B. M., Predergast, F. G., Holman, R., Kuntz, S. M., and Larusso, N. F. 1993. alterations in hepatocyte lysosomes in experimental hepatic copper overload in rats. *GASTROENTEROLOGY.* 105(6): 1814-1823. Ref ID: 2225

Myres, A. W. and Bowland, J. P. 1973. effects of environmental temperature and dietary copper on growth and lipid metabolism in pigs. i. growth, carcass quality, and tissue copper levels. ii. fatty acid composition of adipose tissue lipids. iii.concentration and composition of plasma free fatty acids. *Canadian Journal of Animal Science.* 53(No.1): 115-120, 121-126, 127-132. Ref ID: 12809

Nam, D. S., Han, I. K., and Kim, J. D. 1984. effects of supplemental copper and excess dietary methionine on the growing performance of broiler chicks. *KOREAN J ANIM SCI.* 26(7): 621-630. Ref ID: 2226

Olson, K. J., Fontenot, J. P., and Failla, M. L. 1984. influence of molybdenum and sulfate supplementation and withdrawal of diets containing high copper broiler litter on tissue copper levels in ewes. *J. Anim. Sci.* 59(1): 210-216. Ref ID: 3755

Omole, T. A. 1977. influence of levels of dietary protein and supplementary copper on the performance of growing rabbits. *Br Vet J.* 133(6): 593-9. Ref ID: 12977

Omole, T. A. and Bowland, J. P. 1974. copper and zinc supplementation of pig diets containing soybean meal or rapeseed meal (brassica campestris cv. span). *Canadian Journal of Animal Science* 54(3): 363-372. Ref ID: 41706

Omole, T. A., Ilori, J. O., and Leigh, A. O. 1976. effects of dietary copper and zinc on performance carcass characteristics and tissue copper stores of market pigs. *Malaysian Agricultural Research* 5(1): 67-73. Ref ID: 43456

Onifade, A. A. a and Abu, O. A. 1998. productive response of rabbits to supplemental copper in a diet based on tropical feedstuffs. *Journal of Applied Animal Research.* 13(1-2): 129-135. Ref ID: 2237

Ortolani, E. L., Machado, C. H., and Sucupira, M. C. A. 2003. assessment of some clinical and laboratory variables for early diagnosis of cumulative copper poisoning in sheep. *Veterinary and Human Toxicology [Vet. Hum. Toxicol.]. Vol. 45, No. 6, P. 289. Dec 2003.* Ref ID: 36759

Ozcelik, D., Ozaras, R., Gurel, Z., Uzun, H., and Aydin, S. 2003. copper-**Media**ted oxidative stress in rat liver. *Biological Trace Element Research [Biol. Trace Elem. Res.]. Vol. 96, No. 1-3, Pp. 209-215. 2003.* Ref ID: 36321

Pearce, J., Jackson, N., and Stevenson, M. H. 1983. the effects of dietary intake and of dietary concentration of copper sulphate on the laying domestic fowl: effects on some aspects of lipid, carbohydrate and amino acid metabolism. *Br Poult Sci.* 24(3): 337-348. Ref ID: 2294

Pesti, G. M. and Bakalli, R. I. 1996. studies on the feeding of cupric sulfate pentahydrate and cupric citrate to broiler chickens1. *Poult. Sci.* 75(9): 1086-1091. Ref ID: 2244

Pettersen, A. J., Andersen, R. A., and Zachariassen, K. E. 2002. effects of dietary intake of trace metals on tissue contents of sodium and calcium in mice (*mus musculus*). *Comparative Biochemistry and Physiology. Toxicology & Pharmacology : Cbp, 2002 May, 132(1):53-60.* Ref ID: 36374

Pimentel, Julio L., Cook, Mark E., and Greger, J. L. 1992. anemia induced by ingestion of excess zinc in chicks: importance of red blood cell turnover. *Journal of Nutritional Biochemistry (1992)* 3(3): 146-50 . Ref ID: 5617

Pimentel, Julio L., Greger, J. L., Cook, Mark E., and Stahl, James L. iron metabolism in chicks fed various levels of zinc and copper. *J. Nutr. Biochem. (1992)* 3(3): 140-5. Ref ID: 5619

Poupoulis, C. and Jensen, L. S. 1976. effect of high dietary copper on gizzard integrity of the chick. *Poult Sci.* 55(1): 113-21. Ref ID: 2250

Poupoulis, C. and Jensen L. S. 1976. effect of high dietary copper on fatty acid composition of the chick. *Poult. Sci.* 55: 122-129. Ref ID: 36263

Pribyl, T., Schreiber, V., and Jahodova, J. 1980. inhibition of rat serum polyphenoloxidase activity by silver ions abolished by administration of copper ions. *Folia Biologica* 26(1): 47-52. Ref ID: 23825

Prince, T. J., Hays, V. W., and Cromwell, G. L. 1979. effects of copper sulfate and iron ii sulfide on performance and liver copper ion stores of pigs. *J ANIM SCI.* 49(2): 507-513. Ref ID: 2253

Radecki, S. V., Ku, P. K., Bennink, M. R., Yokoyama, M. T., and Miller, E. R. 1992. effect of dietary copper on intestinal mucosa enzyme activity morphology and turnover rates in weanling Pigs. *J Anim Sci.* 70(5): 1424-1431. Ref ID: 2255

Rana, S. V. and Kumar, A. 1980. biological haematological and histological observations in copper poisoned rats. *Ind Health.* 18(1): 9-17. Ref ID: 2256

Rana, S. V. S. and Kumar, A. 1985. effect of molybdenum and copper on the nucleus of rat kidney. *Mikroskopie.* 42(3-4): 102-7. Ref ID: 2257

Rana, S. V. S. and Kumar, A. 1979. enzyme modification in rat kidney after individual and combined treatments with molybdenum and Copper. *Ind Health.* 17(1): 11-20. Ref ID: 13235

Rana, S. V. S., Prakash, R., Kumar, A., and Sharma, C. B. 1985. a study of glycogen in the liver of metal-fed rats. *Toxicol Lett* . 29(1): 1-4. Ref ID: 13236

Rana, S. V. S. and Verma S. 1977. protective effects of gsh, alpha-tocopherol, and selenium on lipid-peroxidation in liver and kidney of copper fed rats. *Bull. Environ. Contam. Toxicol.* 59(1): 152-158. Ref ID: 36247

Rangachar, T. R. S. and Hegde, V. R. 1975. effect of copper sulfate feeding on prothrombin time in chicks. *Mysore J. Agric. Sci.* 9(1): 129-32. Ref ID: 2259

Rangachar, T. R. S. and Jayaprakash. 1979. effect of copper and zinc supplementation on the hemogram of poultry. *Indian J. Poult. Sci. (1979)* 14(4): 189-93. Ref ID: 6530

Ritchie, HD, Luecke, RW, Baltzer, BV, Miller, ER, Ullrey, DE, and Hoefer, JA. 1963. copper and zinc interrelationships in the pig. *J. Nutr.* 79: 117. Ref ID: 14402

Robbins, K. R. and Baker, D. H. 1980. effect of high-level copper feeding on the sulfur amino acid need of chicks fed corn-soybean meal and purified crystalline amino acid diets. *Poult Sci.* 59(5): 1099-108. Ref ID: 2266

Robbins, K. R. and Baker, D. H. 1980. effect of sulfur amino-acid level and source on the performance of chicks fed high levels of copper. *POULT SCI* . 59(6): 1246-1253. Ref ID: 2267

Sansinanea, A. S. Cerone S. I. Elperding A. and Auza N. 1996. glucose-6-phophate dehydrogenase activity in erythrocytes from chronically copper-poisoned sheep. *Comp. Biochem. Physiol. C* . 114(3): 197-200. Ref ID: 36234

Shajahan, G. M. and Coligado, E. C. 1982. the effect of zinc bacitracin, copper and quindoxin on the small intestine of broilers. *Bangladesh Veterinary Journal.* 16(1/4): 71-77. Ref ID: 2282

Shivanandappa, T., Krishnakumari, M. K., and Majumder, S. K. 1983. testicular atrophy in gallus domesticus fed acute doses of copper fungicides. *Poult. Sci.* 62(2): 405-408. Ref ID: 3727

Skrivan, M. V. Skrivanova M. Marounek E. Tumova and J. Wolf. 2000. influence of dietary fat source and copper supplementation on broiler performance, fatty acid profile of mead and depot fat, and on cholesterol content of meat. *British Poultry Science.* 41: 608-614. Ref ID: 25969

Smith, J. D., Jordan, R. M., and Nelson, M. L. 1975. tolerance of ponies to high levels of dietary copper. *J. Anim. Sci.* 41(6): 1645-1649. Ref ID: 3756

Smith, M. S. 1969. responses of chicks to dietary supplements of copper sulfate. *Brit. Poult. Sci.* 10(2): 97-108. Ref ID: 2284

Solaiman, S. G., Maloney, M. A., Qureshi, M. A., Davis, G., and D'Andrea, G. 2001. effects of high copper supplements on performance, health, plasma copper and enzymes in goats. *Small Ruminant Research.* 41(2): 127-139. Ref ID: 36748

Southern, L. Lee and Baker, David H. 1983. zinc toxicity, zinc deficiency and zinc-copper interrelationship in eimeria acervulina-infected chicks. *J. Nutr.* 113(3): 688-96 . Ref ID: 6368

Stevenson, M. H. and Jackson, N. 1981. an attempt to distinguish between the direct and indirect effects, in the laying domestic fowl, of added dietary copper sulphate. *Br J Nutr.* 46(1): 71-6. Ref ID: 2291

Stevenson, M. H. and Jackson, N. 1980. effects of level of dietary copper sulphate and period of feeding on the laying, domestic fowl, with special reference to tissue mineral content. *Br J Nutr.* 43(1): 205-15. Ref ID: 2292

Stevenson, M. H. and Jackson, N. 1980. effects of withdrawal of copper sulphate from the diet of the mature domestic fowl with special reference to production and tissue mineral content. *Br J Nutr.* 43(3): 551-9. Ref ID: 2293

Stevenson, Mary H., Pearce, J., and Jackson, N. 1983. the effects of ***dietary*** intake and of ***dietary*** concentration of copper sulfate on the laying domestic fowl: effects on laying performance and tissue mineral contents. *Br. Poult. Sci. (1983)* 24(3): 327-35. Ref ID: 6170

Suttle, N. F. and Mills, C. F. 1966. studies of the toxicity of copper to pigs. 2. effect of protein source and other dietary components on the response to high and moderate intakes of copper. *Br. J. Nutr.* 20(2): 149-161. Ref ID: 3757

Tatum, L., Shankar, P., Boylan, L. M., and Spallholz, J. E. 2000. effect of dietary copper on selenium toxicity in fischer 344 rats. *Biological Trace Element Research, 2000 Dec, 77(3):241-9.* Ref ID: 36389

Thacker, P. A. 1991. effect of high levels of copper or dichlorvos during late gestation and lactation on sow productivity. *CAN J ANIM SCI.* 17(1): 227-232. Ref ID: 2304

Thompson, R. H. and Todd, J. R. 1976. role of pentose-phosphate pathway in haemolytic crisis of chronic copper toxicity of sheep. *Research in Veterinary Science.* 20(3): 257-260. Ref ID: 2307

Uthus, E. O. 2001. high dietary arsenic exacerbates copper deprivation in rats. *Journal of Trace Elements in Experimental Medicine [j. Trace Elem. Exp. Med.]. Vol. 14, No. 1, Pp. 43-55. 2001.* Ref ID: 36349

Van Vleet, J. F., Boon, G. D., and Ferrans, V. J. 1981. induction of lesions of selenium-vitamin e deficiency in ducklings fed silver, copper, cobalt, tellurium, cadmium, or zinc: protection by selenium or vitamin e supplements. *Am J Vet Res.* 42(7): 1206-1217. Ref ID: 80

Vohra, P and Kratzer, FH. 1968. zinc, copper and manganese toxicities in turkey poults and their alleviation by edta. *Poult. Sci.* 47: 699. Ref ID: 14404

Waibel, PE, Snetsinger, DC, Ball, RA, and Sautter, JH. 1964. variaiton in tolerance of turkeys to dietary copper. *Poult. Sci.* 43: 504. Ref ID: 14405

Wang, J. S., Rogers, S. R., and Pesti, G. M. 1987. influence of choline and sulfate on copper and toxicity and substitution of and antagonism between methionine and copper supplements to chick diets. *Poult Sci.* 66(9): 1500-7. Ref ID: 2319

Ward, T. L., Watkins, K. L., and Southern, L. L. 1995. interactive effects of dietary copper, water copper, and eimeria spp.infection on growth, water intake, and plasma and liver copperconcentrations of poults. *Poultry Science* 74(3): 502-509. Ref ID: 6788

Ward, T. L., Watkins, K. L., Southern, L. L., Hoyt, P. G., and French, D. D. 1991. interactive effects of sodium zeolite a and copper in growing swine growth and bone and tissue mineral concentrations. *J ANIM SCI.* 69(2): 726-733. Ref ID: 1888

Webster, W. S. 1979. cadmium-induced fetal growth retardation in mice and the effects of dietary supplements of zinc, copper, iron and selenium. *J.Nutr.* 109(9): 1646-1651. Ref ID: 823

White, C. L., Chandler, B. S., and Musk, J. 1985. copper deficiency and excess in rats: interactions with selenium and iron. *Nutrition Research.* 1985(suppl. 1): 531-534. Ref ID: 2324

Wideman, R. F. Jr., Kirby, Y. K., Barton, T. L., Clark, D., Bayyari, G. R., Huff, W. E., Moore, P. A. Jr., and Dunn, P. A. 1996. excess dietary copper triggers enlargement of the proventriculus in broilers. *J. Appl. Poult. Res.* 5(3): 219-230. Ref ID: 2325

Wilson, J. L., Tugwell, R. L., and Wilson, C. C. 1975. the effects of karmex and copper sulfate on chicks. *Tennessee Farm and Home Science.*(July/September): 3. Ref ID: 2329

Wood, E. C. and Worden A. N. 1973. the influence of dietary copper concentration on hepatic copper in the ducking and the chick. *J. Sci. Food Agric.* 24: 167-174. Ref ID: 36216

Yannakopoulos, A. L., Tserveni-Gousi, A. S., and Zervas, G. 1990. effect of dietary copper sulfate on the performance of growing japanese Quail. *J Agric Sci.* 115(2): 291-293. Ref ID: 2333

Zacharias, B., Ott, Helga, and Drochner, W. 2003. the influence of dietary microbial phytase and copper on copper status in growing pigs. *Animal Feed Science and Technology.* 106(1-4): 139-148. Ref ID: 36756

Zhang, S. S. Z., Noordin, M. M. *., Rahman S-OA, and Haron, M. J. 2000. effects of copper overload on hepatic lipid peroxidation and antioxidant defense in rats. *Veterinary and Human Toxicology [Vet. Hum. Toxicol.]. Vol. 42, No. 5, Pp. 261-264. Oct 2000.* Ref ID: 36355

7.5 References Rejected for Use in Derivation of Wildlife TRV

These references were reviewed and rejected for use in derivation of the Eco-SSL. The definition of the codes describing the basis for rejection is provided at the end of the reference sections.

Unrel addition of calcium ions for enhancing the safety of metal-ligand chelates as magnetic resonance imaging agents and x-ray contrast agents. *PCT Int. Appl.* 10 pp.

Diss adriamycin cardiotoxicity and essential trace metal homeostasis in the in vivo rat heart (doxorubicin, cardiomyopathy, manganese, iron). *901491 ORDER NO: AAD85-26534*

Not Avail amino acid metal complexes using hydrolyzed protein as the amino acid source and methods re same. *U.S.* 11 pp.

Unrel animal care system and litter with reduced malodor. *PCT Int. Appl.* 76 pp.

Unrel 1976. annual report of studies in animal nutrition and allied sciences.volume 32. *Rowett Research Institute* : 125pp.

Abstract 1973. annual report of the secretary for agricultural technical services forthe period 1 july 1971 to 30 june 1972. *Department of Agricultural Technical Services, South Africa* : 270pp.

Nut def 1985.*Annual Report of the West of Scotland Agricultural College* : 92-95.

Drug antioxidative biophylactic agents for radiation damage protection and therapy. *PCT Int. Appl.* 40 pp.

Unrel antiviral, antibacterial, antifungal agents containing polysaccharide antimicrobial metal salts and their compositions. *Jpn. Kokai Tokkyo Koho* : 7 pp.

Mix aqueous feed additive comprising lactic acid, organic acid and chelated trace elements. *PCT Int. Appl.* 15 pp.

Diss arsenic: an analytical procedure to determine its total content in biological samples and signs of its deprivation in rats and chicks. *788794 ORDER NO: AAD82-20750*

Diss the biochemistry of transition metals: copper, vanadium, and iron. *738101 ORDER NO: AAD81-03507*

FL birds and fowls fodder additive prescription and its prepn. *Faming Zhuanli Shenqing Gongkai Shuomingshu* : 10 pp.

FL 1985. a case of copper poisoning in calves. *TIJDSCHR DIERGENEESKD.* 10(10): 405-406.

Diss characterization, fate and environmental risk assessment of microbial, elemental and toxic components of fractionated broiler litter during storage and reutilization. *01295605 ORDER NO: AAD93-16361*

Not Avail 1969.*Contemporary Agriculture, Volume 16, Number 4, 1968. SFCSI-AGR(TT-68-50058/4)*

Diss content and evolution of cadmium, cobalt, chromium, copper, nickel, lead, and zinc in soils of l'horta and ribera baixa regions (valencia) (spain) original title: contenido y evolucion de cadmio, cobalto, cromo, cobre, niquel, plomo, cinc en suelos de las comarcas de l'horta y la baixa (valencia). *01269400 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss copper absorption from the small intestine of the chicken (gallus domesticus) (metallothionein, estrogen). *845064 ORDER NO: AAD84-12711*

Nut def 1983. copper deficiency and developmental emphysema. *Nutrition Reviews* 41(10): 318-20.

Diss crystallographic studies of transport proteins and ligands (thiobacillus ferrooxidans, didelphins virginiana, multiplewavelength anomalous dispersion). *01695894 ORDER NO: AAD99-23629*

Diss development of a cloning system for gene expression in pasteurella multocida|. *01295811 ORDER NO: AAD93-16820*

Diss diabetes teratogenicity: role of altered mineral metabolism. *1070710 ORDER NO: AAD89-10542*

Diss ecology and toxicology of arsenic in contaminated grassland. *0996661 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss ecophysiology of the common cockle (cerastoderma edule l.) in southampton water, with particular reference to pollution (england). *1092481 ORDER NO: AADDX-87466*

Diss the effect of chromium depletion and streptozotocin-induced diabetes in pregnancy. *01593456 ORDER NO: AAD97-30469*

Diss the effect of zinc deficiency on immune function. *01173644 ORDER NO: AAD91-18419*

Diss effects of cellulase from trichoderma viride on wheat bran utilization and the minerals influenced by cell wall components in broiler diets|. *858634 ORDER NO: AAD84-21622*

Diss effects of dietary fatty acids, polyunsaturated/saturated ratios, and fat levels on growth and mineral deposition in young male rats (fatty acids). *01156306 ORDER NO: AAD91-05922*

Diss effects of dietary glycine and copper on metabolic symptoms induced by a methionine toxicity in the chick. *774569 ORDER NO: AAD82-07283*

Diss the effects of dietary sodium zeolite a on growth and mineral utilization of chickens. *01295923 ORDER NO: AAD93-17007*

Diss elastin metabolism in avian lung and aorta: effects of selected nutritional factors. *771828 ORDER*

NO: AAD82-05013

Mix electrolyte feed supplement for poultry hatchlings. *U.S.S.R. From: Izobreteniya 1992* (7): 14.

Diss etiology and physiology of chemical-induced tibial dyschondroplasia in broiler chickens|. *01124219 ORDER NO: AAD90-27533*

Diss etude de l'evolution des systemes antioxydants au cours du developpement de l'insuffisance cardiaque experimentale chez le rat original title: study of antioxidant systems during the development of experimental cardiac failure in rat (mrna, ischemia, superoxide dismutase, manganese, copper-zinc). *01476944 ORDER NO: AADAA-IC484409*

Diss an examination of the development and maintenance of the deafferented olfactory cortex. *1053096 ORDER NO: AAD82-12323*

Diss experimental copper deficiency in the golden hamster and in healthy adult men. *800202 ORDER NO: AAD83-01960*

Diss expression of antioxidant enzymes in copper deficient rat brain, heart, and liver. *01452581 ORDER NO: AADAA-I9543281*

Diss factors affecting copper utilization (bioavailability). *01409018 ORDER NO: AADAA-I9512287*

Diss factors affecting the toxicity and metabolism of organic arsenicals (roxarsone, copper, cysteine). *1003496 ORDER NO: AAD85-02122*

Diss functional assessment of manganese status (superoxide dismutase, biliary excretion). *01447018 ORDER NO: AADAA-I9527297*

Meth glucaric acid-containing formula and method for the prevention and treatment of hypercholesterolemia and cellular hyperproliferative disorders. *PCT Int. Appl.* 45 pp.

Nut def 1978. grasslands and animal health. nutritional disorders in cattle andsheep. *Annotated Bibliography, Commonwealth Bureau of Animal Health* (No.V22)

Diss heavy metal toxicity and nutrient depletion in upper bear creek reservoir. *01229302 ORDER NO: AAD13-46169*

Diss hepatic effects of combined heavy metal administration in the pekin duck (anas platyrynchos) (methylmercury, lead, cadmium)|. *01347768 ORDER NO: AADNN-65241*

Diss the influence of environmental, nutritional, and management factors on feathering and incidence of dermatitis of broiler chickens. *699794 ORDER NO: AAD80-26067*

Unrel 1983. [information from the soviet toxicology center]. *Gig Tr Prof Zabol.*(2): 52-3.

Diss interactions among zinc, copper, iron, manganese, and ascorbic acid in the japanese quail (dietary supplements, toxicity, perosis, trace elements, anemia). *887582 ORDER NO: AAD85-14498*

Diss investigation of dietary zinc and linoleic acid interactions in the sprague-dawley rat (rat). *1076906 ORDER NO: AAD89-21281*

FL 1968.*Journal for Scientific Agricultural Research, Volume 21, Number 73, 1968. SFCSI-AGR(TT-68-50057/2)*

Diss	1972.*Journal for Scientific Agricultural Research. Volume 24, Number 88, 1971*
Diss	metabolism of zinc, iron, copper and manganese of men and rats as affected by dietary protein, calcium and phosphorus. *799169 ORDER NO: AAD82-24068*
Nut def	metal propionates for use as animal feed supplements. *U.S.* 6 pp. Cont.-in-part of U.S. Ser. No. 315,557, abandoned..
Unrel	metal salt-containing developing system and a method of using the developing system for detection of carboxylic acids, especially free fatty acids indicative of helminth infestation. *PCT Int. Appl.* 50 pp.
Nutr	metallic complexes of streptogramin-b, their preparation and their use in animal food. *Eur. Pat. Appl.* 12 pp.
Nutr	method of increasing amino acids content in grains of cereals and legumes by treatment with ammonia or urea. *Czech.* 5 pp.
Meth	method to accelerate the color forming reaction between an enzyme and an indolyl derivative by adding a free radical and/or chelate to the reaction medium and its application for immunoassays and immunochromatography. *Ger. Offen.* 16 pp.
Gene	methods for generating doubled haploid plants from microspores. *PCT Int. Appl.* 43 pp.
Rev	1968. more clues in the cadmium and zinc puzzle. *Food Cosmet. Toxicol.* 6(4): 523-527.
Diss	nutrient availability of wheat feed screenings in broiler diet (chicken). *808758 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*
Diss	the occurrence and toxicology of heavy metals in chesapeake bay waterfowl (duck, clangula, melanitta, hyemalis, deglandi, anas, platyrhynchos, rubripes, strepera, maryland, virginia) . *856378 ORDER NO: AAD83-12307*
Unrel	preparation of a fruit nutrient "zengguosu" which can increase fruit production. *Faming Zhuanli Shenqing Gongkai Shuomingshu* : 4 pp.
No Org	preparation of biologic inorganic composite feed additive for animals and fowls. *Faming Zhuanli Shenqing Gongkai Shuomingshu* : 48 pp.
Diss	role of copper in the phenotypic expression of scoliosis. *849880 ORDER NO: AAD84-16905*
Diss	skeletal development and performance of broilers. *1080439 ORDER NO: AAD89-24144*
Method	somatotropin-transition metal complexes as animal growth stimulants and a method for their preparation. *Eur. Pat. Appl.* 10 pp. C.
Nutr	therapeutic diet for dogs with lymphoma. *PCT Int. Appl.* 25 pp.
Diss	therapeutic management of avian lead intoxication (columba livia). *01400165 ORDER NO: AAD95-05799*
Unrel	1987. toxicology and biochemistry of acaricides. <document title>report 1984-86, division of tropical animal sciences,csiro. 25-31.

Nutr trace element deficiencies and fertility in ruminants: a review.| au-. 62(8): 1195-1206.

Nutr trace element supplement for chicks. *U.S.S.R. From: Otkrytiya* Izobret. 1987, (39): 13.

Fungus tracking-resistant electrically insulating polymer compositions for outdoors with good resistance to moss and fungi and high-voltage outdoor electric machineries therefrom. *Jpn. Kokai Tokkyo Koho* : 6 pp..

Drug treatment of septic shock with transition metal complexes. *PCT Int. Appl.* 13 pp.

Unrel use of hyaluronic acid derivatives in the preparation of biomaterials with a physical hemostatic and plugging activity and a preventive activity in the formation of adhesions following anastomosis. *PCT Int. Appl.* 60 pp.

Diss zinc and calcium effects on nickel dermatitis in the guinea pig. *0961875 ORDER NO: AAD87-17748*

Rev Aaseth, J. and Norseth, T. 1986. copper.

Gene Abad, F. X., Pinto, R. M., Diez, J. M., and Bosch A(A). 1994. disinfection of human enteric viruses in water by copper and silver in combination with low levels of chlorine. *Applied and Environmental Microbiology* 60(7): 2377-2383.

FL Abd El-Fadil Ibrahim Hassan, H. 1988.*Influence of the Heavy Metals Lead, Cadmium, Zinc, Manganese, Copper, Mercury and Beryllium on the Glutathione S-Transferases in the Rat Liver. <Original> Einfluss Der Schwermetalle Pb, Cd, Zn, Mn, Cu, Hg Und Be Blei, Cadmium, Zink, Mangan, Kupfer, Quecksilber Und Beryllium Auf Die Glutathion-S-Transferasen Der Rattenleber*

Diss Abd-El-Moula, E. A. 1994.*Effect of Different Copper Sulfate Supplementation on Some Physiological Traits of Rabbits*

No Oral Abd-El-Samee, A. M. and El-Masry, K. A. 1997. effect of varying copper levels or selenium with vitamin e supplementation on growth and reproductive performances of new zealand white rabbits under subtropical conditions. *Egyptian Poultry Science Journal.* 17(1): 133-149.

Nut def Abdallah, Abdou G., Harms, R. H., Wilson, H. R., and El-Husseiny, O. effect of removing trace minerals from the diet of hens laying eggs with heavy or light shell weight. *Poult. Sci. (1994)* 73(2): 295-301

Surv Abdel-Ghaffar, A. E., Abou-Salem, M. E., and Ashoub, M. M. 1994. relationship between environmental pollution and incidence of repeat breeder in buffalo cows. *Annals of Agricultural Science, Moshtohor.* 32(3): 1715-1726.

Unrel Abdel-Mageed, A. B. and Oehme, F. W. 1990. a review of the biochemical roles toxicity and interactions of zinc copper and iron iii. iron. *Vet Hum Toxicol.* 32(4): 324-328.

Phys Abdel-Rahim, A. G. 1980. dietary factors affecting selenium utilization by animals. 169pp.

Surv Abdel Rahim, A. G., Arthur, J. R., and Mills, C. F. 1986. effects of dietary copper, cadmium, iron, molybdenum and manganese on selenium utilization by the rat. *J Nutr.* 116(3): 403-11.

No COC Abdelrahim, A. I. Wensign T. and Schotman A. J. H. 1986. distribution of iron and copper in the liver and spleen of veal calves in relation to the concentration of iron in the diet. *Res. Vet. Sci.* 40: 109.

CP Abdelrahman, M. M. and Kincaid, R. L. 1993. deposition of copper, manganese, zinc and selenium in bovine fetal tissue. *FASEB Journal* 7(3-4): A306.

Bio Acc Abdelrahman, M. M. and Kincaid, R. L. 1993. deposition of copper, manganese, zinc, and selenium in bovine fetaltissue at different stages of gestation. *Journal of Dairy Science* 76(11): 3588-3598.

FL Abe, H., Urakabe, S., Sugita, M., Shichiri, M., and Suematsu, T. 1973. environmental pollution and health problems: pathophysiology: interpretation of physical disorders induced by heavy metals. *Jap. J. Clin. Med.* 31(6): 2017-2026.

No Oral Abe Reishi, Shimosegawa Tooru(A), Moriizumi Shigeki, Kikuchi Yoshifumi, Kimura Kenji, Satoh Akihiko, Koizumi Masaru, and Toyota Takayoshi. 1995. lipopolysaccharide induces manganese superoxide dismutase in the rat pancreas: its role in caerulein pancreatitis. *Biochemical and Biophysical Research Communications* 217(3): 1216-1222.

Not Avail Abo-El-Ezz, Z. R., Salem, M. H., Hassan, G. A., El-Komy, A., and Abd-El-Moula, E. 1996. effect of different levels of copper sulfate supplementation on some physical traits of rabbits. *Egyptian Poultry Science Journal.* 16(1): 11-29.

Aquatic Achard, M., Baudrimont, M., Boudou, A., and Bourdineaud, J. P. *. 2004. induction of a multixenobiotic resistance protein (mxr) in the asiatic clam corbicula fluminea after heavy metals exposure. *Aquatic Toxicology [Aquat. Toxicol.]. Vol. 67, No. 4, Pp. 347-357. 12 May 2004.*

Surv Ackerman, D. J., Reinecke, A. J., Els, H. J., Grobler, D. G., and Reinecke, S. A. 1999. sperm abnormalities associated with high copper levels in impala (aepyceros melampus) in the kruger national park, south africa. *Ecotoxicology and Environmental Safety*. 43(3): 261-266.

No Oral Acuna-Castillo Claudio, Morales Bernardo, and Huidobro-Toro, J. Pablo(A). 2000. zinc and copper modulate differentially the p2x4 receptor. *Journal of Neurochemistry.* 74(4): 1529-1537.

No Oral Adachi, Shuichi, Takemoto, Kazuo, Hirouse, Toshiko, and Hosogai, Yuutaro. spontaneous and 2-nitropropane induced levels of 8-hydroxy-2'- deoxyguanosine in liver dna of rats fed iron-deficient or manganese- and copper-deficient diets. *Carcinogenesis (London) (1993)* 14(2): 265-8

Bio Acc Adam, J. and Pinta, M. 1982. comparative pathology studied by atomic absorption spectrophotometry.ii. tibial dyschondroplasia. *Bulletin De L'Academie Veterinaire De France* 55(1): 67-70.

Bio Acc Adam, J. and Pinta, M. 1986. tibial dyschondroplasia of broilers. syndrome of s-shaped tibias. *Bulletin Mensuel De La Societe Veterinaire Pratique De France* 70(7): 425-428.

No Dose Adam, J., Pinta, M., and Viel, M. 1981. hyaena disease in cattle and nickel deficiency. *Bulletin De L'Academie Veterinaire De France* 54(3): 329-335.

No Oral Adamis, Z., Tatrai, E., Honma, K., Karpati, J., and Ungvary, G. 1997. a study on lung toxicity of respirable hard metal dusts in rats. *Ann. Occup. Hyg. (1997)* 41(5): 515-526 .

Abstract Adamson, A. H., Valks, D. A., Appleton, M. A., and Shaw, W. B. 1969. copper toxicity in housed lambs. *Vet. Rec.* 85(13): 368-369.

Abstract <Additional> Abplanalp, H., Lowry, D., Ali, N. M., Krueger, W. F., Fanguy, R. C., Bradley, J. W., Andrews, L. D., Morrow, D., Becker, W. A., Spencer, J. V., Verstrate, J. A., Mirosh, L. W., Bernier, P. E., Arscott, G. H., Dorminey, R. W., Alaiya, Y. A., Fatokun, G. O., Parker, J. E., Birrenkott, G. P., McGibbon, W. H., Burke, W. H., Wentworth, B. C., Briggs, D. M., Williams, C. M., Briles, W.

E., Schelling, E. P., Brown, K. I., Bacon, W. L., Nestor, K. E., Musser, M. A., Long, D. W., Buss, E. G., Carson, J. R., Berry, J., Adams, R. L., Choudhury, H., Srivastava, L., Murthy, L., Petering, H., Christensen, V. L., Johnston, N. P., Classen, H. L., Smyth, J. R. Jr. , Coleman, M. A., McDaniel, G. R., Neely, W. C., Ivey, W. D., Coleman, T. H., Ringer, R. K., Chang, T. S., Dodson, D. L., Crawford, R. D., Doerr, D. C., Law, G. R. J., Quarles, C. L., Edens, F. W., Benton, E., Morgan, G. W. , Bursian, S. J., Thaxton, P., Enos, H. L., Monsi, A., Moreng, R. E., Garwood, V. A., Lowe, P. C., Gavora, J. S., Gleaves, E. Q., Mather, F. B., Ahmad, M. M., Goldrosen, A., Buckland, R. B., Gyles, N. R., Test, P., and Patterson, L. T. 1975. abstracts of papers presented at the 64th annual meeting of the poultryscience association, inc. *Poultry Science* 54(5): 1724-1831.

CP <Additional> Foley, P., Linkswiler, H., Kim, Y, Wolinsky, I., Guggenheim, K., Simkin, A., Brown, E. D., Howard, M. P., Smith, J. C. Jr., Rayton, J. K., Harris, E. D., O'Neal, R. M., Abrahams, O. G., Paulsen, D. S., Lorah, E. J., Eklund, D. L., Dowdy, R. P., Anderson, R. A., Brantner, J. H., Polansky, M. M., Anderson, R. A., Liu, V. J. K. , Nordstrom, J., Kohrs, M. B., Lorah, E., Dowdy, R., Nielsen, F. H., Uthus, E. O., Coupain, J. G., Beecher, G. R., Robbins, B., Carlisle, E. M., Tripp, M. J., Black, R. S., Christman, D., Whanger, P. D., Porta, E. A., Ching, B. K. F., Joun, N. S., Freeland, J. H., Ebangit, M. L., Bodzy, P. W., Vaughan, L. A., Weber, C. W., Kemberling, S. R., Miller, J., O'Hanlon, P., Eklund, D., Johnson, P. E., Evans, G. W., Martin, P. G., Kuemmerle, N. B., King, J. F., Chen, N., Johnson, R. J., Dyer, I. A., Nichols, B. L., Soriano, H. A., Kimzey, S., Mizrahi, L., Hazlewood, C. F., Schwartz, R., Spencer, H., Wentworth, R. A., Greger, J. L., Bennett, O. A., Abernathy, R. P., Kramer, L., Lesniak, M., Osis, D., Norris, C., Johnson, H. L., Consolazio, C. F., Schnakenberg, D. D., Ghumman, M., Schwenneker, B. W., Buck, D. R., Mahoney, A. W., Hendricks, D. G., Johnson, R. M., Chang, Y. O., Pan, M. J. F., Varnell, T. R., Sifri, M., Kratzer, F. H., Norris, L. C., Garlich, J. D., Edens, F. W., Parkhurst, C. R., Garg, R. C., Powanda, M. C., Powers, J. D., and Powers, T. E. 1977. federation of american societies for experimental biology; 61st annualmeeting, chicago, illinois april 1 - 8, 1977. minerals. *Federation Proceedings* 36(3): 1122-1125, 1130-1131.

Plant <Additional> Tiller, K., Chamel, A., Gambonnet, B., Garcia, G., L'Annunziata, M. F., Ortega, M. L., Alvarado, R., D'Souza, T. J., Mistry, K. B., and Gissel-Nielsen, G. 1979. micronutrients. <document title>international atomic energy agency: isotopes andradiation in research on soil-plant relationships. *International Atomic Energy Agency* : 359-434.

Mineral Adeola, O. 1995. digestive utilization of minerals by weanling pigs fed copper- andphytase-supplemented diets. *Canadian Journal of Animal Science* 75(4): 603-610.

FL Admina, L. 1983. trace element requirements of young pigs. *Svinovodstvo.*(4): 28-29.

Rev Agarwal, K. Sharma A. and Talukder G. 1989. effects of copper on mammalian cell components. *Chem.- Biol. Interact.* 69(1): 1-16.

Unrel Agarwala, O. N., Mehra, U. R., and Pachauri, V. C. 1985. plasma cholesterol and yellowing of wool in chokla sheep. *Indian Vet J.* 62(2): 182-183.

Not Avail Agunbiade, J. A. and Babatunde, G. M. 1995. copper and iron supplementation in the tropical environment - effects on haematological measurements, organ weights, tissue copper and iron levels in layers. *Nigerian Journal of Animal Production.* 22(1/2): 49-55.

FL Agunbiade, S. O. and Longe, O. G. african yam bean hull chemical composition and its effects on rat 's mineral retention, serum biochemical components and enzymic activities. *Nahrung (1998)* 42(2): 89-93.

Unrel Ahmad, S., Duval, D. L., Weinhold, L. C., and Pardini, R. S. cabbage looper antioxidant enzymes tissue specificity.. *Insect Biochemistry. 21 (5). 1991. 563-572.*

FL Al-Awadi, F. M., Khan, I., Dashti, H. M., and Srikumar, T. S. colitis-induced changes in the level of trace elements in rat colon and other tissues. *Ann. Nutr. Metab. (1998)* 42(5): 304-310

Unrel Al-Bader, A. A., Mathew, T. C., Abul, H., Al-Mosawi, M., Dashti, H. M., Kumar, D., and Singal, P. K. thioacetamide-induced changes in trace elements and kidney damage. *J. Trace Elem. Exp. Med. (1999)* 12(1): 1-14.

No COC Al-Bader A(A), Mathew, T. C., Khoursheed, M., Asfar, S., Al-Sayer, H., and Dashti, H. M. 2000. thioacetamide toxicity and the spleen: histological and biochemical analysis. *Anatomia Histologia Embryologia* 29(1): 3-8.

Abstract Al-Zubaidy, S. S. and Sullivan, T. W. antibiotics probiotics and high level copper in turkey diets. *Poultry Science. 56 (5). 1977 1692-1693*

Species Albers, P. H. and Camardese, M. B. effects of acidification on metal accumulation by aquatic plants and invertebrates: 1. constructed wetlands. *ENVIRON TOXICOL CHEM; 12 (6). 1993. 959-967.*

Aquatic Albers, Peter H. and Camardese, Michael B. effects of acidification on metal accumulation by aquatic plants and invertebrates. 2. wetlands, ponds, and small lakes. *Environ. Toxicol. Chem. (1993)* 12(6): 969-76 .

In Vit Alcain, F. J., Low, H., and Crane, F. L. iron at the cell surface controls both dna synthesis and plasma membrane redox system. *Protoplasma (1995)* 184(1-4): 233-7.

FL Alekseev, V. I. 1982. trace elements in blood of sheep fed differently. <document title>voprosy geografii i okhrany prirody severnogokazakhstana. 113-116.

FL Aleksiev, A. D., Kr"steva, E., and Aleksieva-Drbokhlavova, D. 1986. study on the interaction of vitamin a and cobalt in feeding broilerchickens. *Zhivotnov"Dni Nauki* 23(6): 84-89.

FL Aleksiev, A. D., Kr"Steva, E., and Aleksieva-Drboklavova, D. a study on interaction of vitamin a with cobalt on feeding broiler chickens. *Zhivotnov'Dni Nauki. 23 (6). 1986. 84-89.*

Nutr Aletor, V. A. and Egberongbe, O. 1992. feeding different processed soya bean. 2. an assessment ofhaematological responses in the chicken. *Nahrung* 36(4): 364-369.

FL Alimbekov, S. S. 1984. utilization of dietary protein by sheep. *Zhivotnovodstvo* (12): 38-39.

Alt Allain, P., Krari, N., Chaleil, D., Balanant, Y., Bled, F., and Girault, M. the distribution of elements in the tissues of watanabe heritable hyperlipidemic rabbits. *Biol. Trace Elem. Res. (1989)* 19(3): 153-60 .

Nut def Allen, C. B. 1996. effects of dietary copper deficiency on relative food intake and growth efficiency in rats. *Physiol Behav.* 59(2): 247-53.

CP Allen, W. M. 1984 . use and misuse of minerals and trace elements in cattle diets. *British Cattle Veterinary Association Proceedings for 1983-1984.* 47-52.

Mix Allen, W. M. and Sansom, B. F. 1989. accidental contamination of the public water supply at lowermoor,camelford: an assessment of the possible veterinary consequences. *Veterinary Record.* 124(18): 479-482.

Rev Alt, E. R., Sternlieb, I., and Goldfischer, S. 1990. the cytopathology of metal overload. *Int. Rev. Exp. Pathol.* 31: 165-188.

Unrel Alva, A. K. 1994. possible utilization of flue-gas desulfurization gypsum and fly ash for citrus production: evaluation of crop growth response. *Waste Manage. (N. Y.)* 14(7): 621-7.

FL Amboulou, D. and Lamand, M. 1977. variations in the digestibility of trace elements (cu, zn and mn)during the first cycle of cocksfoot growth. *Annales De Recherches Veterinaires* 8(3): 241-249.

Nut def Amemiya Tsugio(A). 1999. the eye and nutrition. *Nippon Ganka Gakkai Zasshi* 103(12): 829-850.

Surv Amiard-Triquet, C., Pain, D., and Delves, H. T. exposure to trace elements of flamingos living in a biosphere reserve, the camargue (france). *Environ. Pollut. (1991)* 69(2-3): 193-201 .

Unrel Ammerman, C. B. 1970. recent developments in cobalt and copper in ruminant nutrition a review. *J Dairy Sci.* 53(8): 1097-1107.

Rev Ammerman, C. B. and Miller, S. M. 1972. biological availability of minor mineral ions: a review. *J. Anim. Sci.* 35(3): 681-694.

CP Ammerman, Clarence B., Henry, Pamela R., and Miles, Richard D. 1997. bioavailability of supplemental sources of manganese and copper for chicks and lambs estimated from high dietary additions. *Trace Elem. Man Anim.--9 Proc. Int. Symp., 9th* : Meeting Date 1996, 308-309. Editor(s): Fischer, Peter W. F. Publisher: National Research Council of Canada, Ottawa, Ont.

Mix Amrith Kumar, M. N., Bhaskar, B. V., Nagarcenkar, R., and Sampath, S. R. 1973. study on the effect of supplementation of copper, cobalt and liv-52 in the ration of heifers. *Indian Journal of Nutrition and Dietetics*. 10(3): 139-147.

No Effect Anandan, S. a, Dey, A., and Deb, S. M. 1998. effect of zinc and copper supplementation on wool production in german angora rabbits. *Indian Journal of Animal Nutrition.* 15(3): 216-217.

Org met Anderson, R. A. N. A. Bryden C. M. Evock-Clover and N. C. Steele. 1997. beneficial effects of chromium on glucose and lipid variables in control and somatotropin-treated pigs are associated iwht increased tissue chromium and latered tissue copper, iron and zinc. *Journal of Animal Science.* 75: 657-661.

CP Andon, M., Luhrsen, K., Kanerva, R., and Chatzidakis, C. 1992. effects of dietary copper and manganese restriction on serum mineral concentrations and femoral shaft bone density in rats. *Journal of the American College of Nutrition* 11(5): 600.

Nut def Andres, J. M., Hurd, R. W., Van Rinsvelt, H. A., Small, P. A., Maenhaut, W., and Vandenhaute, J. 1987. pixe analysis of trace metals in selenium and copper deficient mice exposed to influenza virus and salicylate. *Nucl. Instrum. Methods Phys. Res. Sect. B* B22(1-3): 217-22

Surv Andreu Perez, Vicente. 1991. content and evolution of cadmium, cobalt, chromium, copper, nickel, lead, and zinc in soils of l'horta and ribera baixa regions (valencia) (spain): <original> contenido y evolucion de cadmio, cobalto, cromo, cobre, niquel, plomo, cinc en suelos de las comarcas de l'horta y la ribera baixa (valencia).

Gene ANDREWS, G. K. environmental toxicology using transgenic mouse models. *Crisp Data Base National Institutes Of Health*

Gene Andrews, G. K., Fernando, L. P., Moore, K. L., Dalton, T. P., and Sobieski, R. J. 1996. avian metallothioneins: structure, regulation and evolution. *The Journal Of Nutrition.* 126(4S): 1317S-

1323S.

FL Angelico, R., Manganaro, M., Maggiore, L. M., and Quintiliani, M. 1965. [influence of the inorganic components of the diet on sensitivity to ionizing radiations and radiomimetic compounds]. <original> influenza dei costituenti inorganici della dieta sulla sensibilita alle radiazioni ionizzanti e alle sostanze radiomimetiche. *Annali Dell'Istituto Superiore Di Sanita* 1(11): 689-97.

FL Angelow, L. Institut fuer Tierzucht Kostinbrod Bulgaria, Petrova, I., Yanchev, I., Anke, M., Groppel, B., Guertler, H., Gruen, M., Lombeck, I., and Schneider, H. J. 1992. the influence of a copper, zinc, arsenic, molybdenum and sulphur supply on the flora and fauna, 1: the influence on the trace element content of the flora. <original> die wirkung einer kupfer-, zink-, arsen-, molybdaen- und schwefelbelastung auf die flora und fauna, 1: der einfluss auf den spurenelementgehalt der flora. macro and trace elements. <original> mengen- und spurenelemente. *P. 395-402*

Mix Angerhofer, R. A. and Metker, L. W. preliminary assessment of the relative toxicity of copper naphthenate, (mooney chemicals), acute studies. phase 3. may 1984 - october 1987. *Govt-Reports-Announcements-&-Index-(GRA&I),-Issue-08,-1989.*

Mix Angerhofer, R. A. and Taylor, L. M. preliminary assessment of the relative toxicity of copper naphthenate acute studies. phase 2. may 1984 - june 1986. *Govt-Reports-Announcements-&-Index-(GRA&I),-Issue-15,-1988.*

Not Avail Anjum, A. D., Anjum, M. S., Rizvi, F., Raza, T., and Arbi, G. S. 1992. pathological features of induced copper sulphate poisoning in broiler chicks. *Pakistan Veterinary Journal.* 12(1): 21-24.

Rev Anke, M., Dorn, W., Gunstheimer, G., Arnhold, W., Glei, M., Anke, S., and Losch, E. 1998. effect of trace and ultratrace elements on the reproduction performanceof ruminants. *Veterinarni Medicina.* 43(9): 272-282.

Nut def Anke, M., Groppel, B., and Grun, M. 1973. manganese deficiency in ruminants. 5. effect of manganese deficiency onmajor and trace element contents of adult male and female goats. *Archiv Fur Tierernahrung* 23(6): 483-500.

QAc Anke, M., Groppel, B., Krauter, U., and Muller, M. 1991. effect of sulphur, cadmium and molybdenum pollution in ruminants and in man. (33): 421-426.

Surv Anke, M., Groppel, B., Prien, S., Briedermann, L., and Mehlitz, S. 1980. the supply of major and trace elements for wild ruminants. 4th communication. the copper content of winter grazing and the copperstatus of red, fallow and roe deer and mouflon. *Archiv Fur Tierernahrung.* 30(9): 707-721.

Nut def Anke, M., Gruen, M., Groppel, B., Luedke, H., and Partschefeld, M. the use of mineral mixtures specific to the locality for ruminants in the manganese zinc and copper deficiency areas of east germany. *HENNIG, A. AND J. KIELANOWSKI (ED.). TIERERNAEHRUNG UND FUETTERUNG. ERFAHRUNGEN, ERGEBNISSE, ENTWICKLUNGEN, (9). (ANIMAL NUTRITION AND FEEDING. EXPERIMENTS, RESULTS, DEVELOPMENTS, (9).). (IN GER. WITH ENGL. SUMM.). 404P. ILLUS. VEB DEUTSCHER LANDWIRTSCHAFTSVERLAG: BERLIN, EAST GERMANY. 1975 (Recd 1977) 18-27*

FL Anke, M., Hennig, A., Groppel, B., and Ludke, H. 1971. [effect of cadmium on growth, reproductive function and the metabolism of iron, zinc and copper]: <original> der einfluss des kadmiums auf das wachstum, die fortpflanzungsleistung und den eisen-, zink- und kupferstoffwechsel. *Arch Exp Veterinarmed.* 25(5): 799-803.

FL Anke, M., Hennig, A., Groppel, B., and Luedke, H. effect of cadmium on growth, reproductive function, and the metabolism of iron, zinc, and copper. *Arch. Exp. Veterinaermed. (1971)* 25(5):

799-803 .

Rev Anke, M, Hennig, A, Schneider, HJ, Ludke, H, von Gargen, W, and Schlegel, H. 1970. the interrelations between cadmium, zinc, copper and iron in metabolism of hens, ruminants and man. *In C.F. Mills, Ed. Trace Element Metabolism in Animals.*: p.317.

No COC Anke, M., Richter, G., and Leiterer, M. 1997. study of microbial phytase use with different phosphorus supply in fattening broilers. part 3: the influence of different phytase amounts in the feed on the iron, zinc and copper content in the tibia of chickens. *Mengen- Spurenelem. Arbeitstag., 17th* : 810-820. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

CP Anke, M., Salchert, E., <Editors> Anke, M., Groppel, B., Gurtler, H., Grun, M., Lombeck, I., and Schneider, H. J. 1991. influence of trace elements on growth and reproduction of mink. *Mengen- Und Spurenelmente. 11. Arbeitstagung, Leipzig, 12/13 Dezember 1991* : 196-203.

Nutr Anke, M., Salchert, E., <Editors> Anke, M., Groppel, B., Gurtler, H., Grun, M., Lombeck, I., and Schneider, H. J. 1991. influence of trace elements on growth and reproduction of mink. <document title>mengen- und spurenelemente. 11. arbeitstagung,leipzig, 12./13. dezember 1991. 196-203.

FL Anke, M., Schaeller, G., Arnhold, W., Knorre, D. von, Mueller, M., Glei, M. and others. 1992. effects of emissions in the middle valley of the saale on the composition of flora and fauna, 5: trace element content (zinc, lithium, copper manganese, cadmium) of several species of mice and shrewmice: <original> die auswirkungen der emissionen eines phosphatwerkes im mittleren saaletal auf die zusammensetzung der flora und fauna, 5: der spurenelementgehalt (mangan, zink, kupfer, lithium, kadmium) verschiedener maus- und spitzmausarten. *Macro and Trace Elements: <Original> Mengen- Und Spurenelemente* : 483-491.

CP Anke, M. a, Salchert, E., Anke, M., Groppel, B., Guertler, H., Gruen, M., Lombeck, I., and Schneider, H. J. 1991. effect of trace elements on growth and reproduction in minks . *Macro and Trace Elements* : 196-203.

CP Anke, M. a, Schaeller, G., Arnhold, W., Knorre, D. von, Mueller, M., Glei, M., Kraemer, K., Anke, M., Groppel, B., Guertler, H., Gruen, M., Lombeck, I., and Schneider, H. J. 1992. effects of emissions in the middle valley of the saale on the composition of flora and fauna, 5: trace element content (zinc, lithium, copper manganese, cadmium) of several species of mice and shrew mice . *Macro and Trace Elements* : 483-491.

FL Anke, M. Jena Univ. Germany Biologisch-Pharmazeutische Fakultaet. Inst. fuer Ernaehrung und Umwelt, Groppel, B., and Glei, M. 1994. the influence of cutting time on macro and trace element contents of forage. <original> der einfluss des nutzungszeitpunktes auf den mengen- und spurenelementgehalt des gruenfutters. *Wirtschaftseigene Futter. V. 40(2-3) P. 304-319*

FL Anke, M. Jena Univ. Germany Biologische Fakultaet, Salchert, E., Anke, M., Groppel, B., Guertler, H., Gruen, M., Lombeck, I., and Schneider, H. J. 1991. effect of trace elements on growth and reproduction in minks. <original> der einfluss von spurenelementen auf wachstum und fortpflanzung beim nerz. [macro and trace elements]. <original> mengen- und spurenelemente. *P. 196-203*

FL Anke, M. Jena Univ. Germany Biologische Fakultaet. Inst. fuer Ernaehrung und Umwelt, Schaeller, G., Arnhold, W., Knorre, D. von, Mueller, M., Glei, M., Kraemer, K., Anke, M., Groppel, B., Guertler, H., Gruen, M., Lombeck, I., and Schneider, H. J. 1992. effects of emissions in the middle valley of the saale on the composition of flora and fauna, 5: trace element content (zinc, lithium, copper manganese, cadmium) of several species of mice and shrewmice. <original> die auswirkungen der emissionen eines phosphatwerkes im mittleren saaletal auf die zusammensetzung der flora und fauna, 5: der spurenelementgehalt (mangan, zink, kupfer, lithium, kadmium)

verschiedener maus- und spitzmausarten. macro and trace elements. <original> mengen- und spurenelemente. *P. 483-491*

FL Anokhin, B. M., Murzagulov, K. K., and Kondrat'ev, Yu. N. 1984. prevention of nutritional anaemia in lambs. *Veterinariya, Moscow, USSR* (12): 51-53.

FL Anshan, S. et al. 1992. effects of fiber treated with different methods on utilizations ofdietary nutrients in chicks. *Acta Veterinaria Et Zootechnica Sinica* 23(4): 324-329.

Bio Acc Anthony, Robert G., Miles, A. Keith, Estes, James A., and Isaacs, Frank B. 1999. productivity, diets, and environmental contaminants in nesting bald eagles from the aleutian archipelago. *Environ. Toxicol. Chem.* 18(9): 2054-2062 .

FL Antipova, N. I. 1973. biosynthesis of riboflavin in pigs and the value of supplements ofsynthetic riboflavin. <. *Document Title>Vitaminnoe Pitanie Sel'Skokhozyaistvennykh Zhivotnykh.* 162-173.

Nut def Aoyagi, S. and Baker, D. H. 1993. nutritional evaluation of copper-lysine and zinc-lysine complexes for chicks. *Poultry Science* 72(1): 165-71.

Bio Acc Aoyagi, S. K. Hiney and D. H. Baker. 1995. estimates of zinc and iron bioavailability in pork liver and the effect of sex of pig on the bioavailability of copper in pork liver fed to male and female chicks. *Journal of Animal Science.* 73: 793-798.

Nutr Aoyagi, Seiji, Hiney, Kristina M., and Baker, David H. copper bioavailability in pork liver and in various animal byproducts as determined by chick bioassay. *J. Anim. Sci. (1995)* 73(3): 799-804

Nut def Aoyagi Seiji, Hiney Kristina M, and Baker David H. 1994. effects of iron status on copper bioavailability in chicks fed copper-deficient diets. *Poultry Science* 73(SUPPL. 1): 114.

Nut def Apgar, Jean. comparison of the effect of copper, manganese, and zinc deficiencies on parturition in the rat. *Amer. J. Physiol. (1968)* 215(6): 1478-81 .

No Oral Appel, N. M., Rapoport, S. I., and O'Callaghan, J. P. 1997. sequelae of parenteral domoic acid administration in rats: comparison of effects on different anatomical markers in brain. *Vol. 25, No. 4, Pp. 350-358* Synapse

CP Apsite, M. changes in the morphological composition of blood and in the levels of some trace elements in blood and bone marrow of chicks given large doses of barium, copper, and cobalt. *(1968) Mikroelem. Organizme Ryb Ptits* . 99-124. Editor: 99-124. Editor(s): Bermane, S.. Publisher: Izd. "Zinatne", Riga, USSR.

FL Apsite, M. 1968. effect of the trace elements cobalt, copper, zinc, and manganese on the blood of chicks. *Mikroelem. Organizme Ryb Ptits* 63-83. Editor: 63-83. Editor(s): Bermane, S.. Publisher: Izd. "Zinatne", Riga, USSR.

In Vit Apsite, M. 1969. effect of the trace elements manganese, cobalt, and copper on the luminescence of chick leukocytes. *Vop. Biol. Mater. Konf.* Meeting Date 1968, 165-71. Editor(s): Maurina, H. Publisher: Izd. "Zinatne", Riga, USSR.

Mix Apsite, M. effect of trace nutrients and amino acid mixture on the blood system of chicks. *Regul. Rosta Metab. Zhivotn. (1971)* 169-79. Editor: 169-79. Editor(s): Valdmanis, A. Publisher: "Zinatne", Riga, Latv. SSR. .

CP Apsite, M., Atlavins, A., and Svilane, A. assimilation of trace elements by liver and changes in

blood composition depending on the content of molybdenum and copper salts in the ration during growth. *Vsasyvanie Obmen Pitatel'Nykh Veshchestv Org. Zhivotn. (1975)* : 124-36. Editor(s): Shmit, A. A. Publisher: "Zinatne", Riga, USSR.

Bio Acc Apsite, M., Atlavins, A., and Svilane, A. molybdenum and copper in subcellular fractions of chicken liver. *Vsasyvanie Obmen Pitatel'Nykh Veshchestv Org. Zhivotn. (1975)* : 137-43. Editor(s): Shmit, A. A. Publisher: "Zinatne", Riga, USSR.

FL Apsite, M. R., Atlavin, A. B., and Svilane, A. B. 1982. functional relation between cadmium and selenium in chickens. *<Document Title>Biokhimiya Vsasyvaniya Pitatel'Nykh Veshchestv Uzhivotnykh.* 116-123.

FL Apsite, M. R., Atlavin, A. B., and Svilane, A. B. 1982.*Functional Relation Between Cadmium and Selenium in Chickens.: <Document Title>Biokhimiya Vsasyvaniya Pitatel'Nykh Veshchestv Uzhivotnykh.* 116-123.

FL Ar'kov, A. 1991. don limestones. *Ptitsevodstvo* (10): 16-17.

No Dose Ardiningsasi Sri Murni, Maeda Yoshizane(A), Kawabe Kotaro, Okamoto Shin, and Hashiguchi Tsutomu. 1993. comparative studies of calcium atpase activity in epiphysis of tibia tarsus of quail lines selected for body weight. *Comparative Biochemistry and Physiology A Comparative Physiology* 105(2): 219-222.

CP Arkhipova, O. G., Demokidova, N. K., Medved, T. Ya., and Rudomino, M. V. 1972. biological action of organophosphorus complexons. *Khim. Primen. Fosfororg. Soedin. Tr. Vses. Konf., 3rd* : Meeting Date 1965, 497-502. Editor(s): Kabachnik, M. I. Publisher: "Nauka", Moscow, USSR.

Nut def Arnhold, W., Anke, M., Krauter, U., <Editors> Anke, M., Groppel, B., Gurtler, H., Grun, M., Lombeck, I., and Schneider, H. J. 1991. influence of lithium deficiency on trace element status of animals. <document title>mengen- und spurenelemente. 11. arbeitstagung,leipzig, 12.13. dezember 1991. 627-634.

Dead Arora, R. G., Andersson, L., Bucht, R. S., Frank, A., and Kronevi, T. 1977. chronic copper toxicosis in sheep. *Nordisk Veterinaermedicin.* 29(4/5): 181-187.

FL Arrieta, A. J. M. and Rosiles, M. R. 1997. liver concentrations of selenium, copper, iron and zinc in broilerswith and without ascites. *Veterinaria Mexico* 28(4): 313-316.

Mix Arrieta, A. J. M. a and Rosiles, M. R. 1998. selenium, copper, iron and zinc liver concentrations in healthy and ascitic broilers. *Veterinaria - Mexico.* 28(4): 313-316.

No Dose Arrieta Acevedo, Jose Mauro and Rosiles Martinez, Rene. hepatic concentration of selenium, copper, iron, and zinc in healthy and ascitic broilers. *Vet. Mex. (1997)* 28(4): 313-316

FL Arrieta Acevedo, Jose Mauro and Rosiles Martinez, Rene. 1997. [selenium, copper, iron and zinc liver concentrations in healthy and ascitic broilers]. <original> concentraciones hepaticas de selenio, cobre, hierro y zinc en pollos de engorda con y sin sindrome ascitico. *Veterinaria Mexico. v 28(4) P. 313-316*

Unrel Asayama, K., Dobashi, K., Hayashibe, H., and Kato, K. effects of beta-adrenergic blockers with different ancillary properties of lipid peroxidation in hyperthyroid rat cardiac muscle. *Endocrinologia Japonica. 36 (5). 1989. 687-694.*

No COC Asayama, K., Dobashi, K., Hayashibe, H., and Kato, K. 1989. effects of beta-adrenergic blockers

with different ancillary properties on lipid peroxidation in hyperthyroid rat cardiac muscle. *Endocrinologia Japonica* 36(5): 687-94.

Alt Asayama, K., Hayashibe, H., Dobashi, K., and Kato, K. differential development of antioxidant enzymes in liver of female and castrated and non-castrated male rats. *Journal of Clinical Biochemistry and Nutrition. 9 (2). 1990. 87-92.*

Alt Asayama, K., Hayashibe, H., Dobashi, K., Niitsu, T., Miyao, A., and Kato, K. 1989. antioxidant enzyme status and lipid peroxidation in various tissues of diabetic and starved rats. *Diabetes Research* 12(2): 85-91.

Unrel Asayama, K., Hayashibe, H., Dobashi, K., Uchida, N., and Kato, K. 1992. effect of dexamethasone on antioxidant enzymes in fetal rat lungs and kidneys. *Biology of the Neonate* 62(2-3): 136-44.

Phys Asayama, K., Hayashibe, H., Dobashi, K., Uchida, N., Kobayashi, M., Kawaoi, A., and Kato, K. 1991. immunohistochemical study on perinatal development of rat superoxide dismutases in lungs and kidneys. *Pediatric Research* 29(5): 487-91.

In Vit Ashizawa, Koji, Ozawa, Yoko, and Okauchi, Keizo. changes of elemental concentrations around and on the surface of fowl sperm membrane during maturation in the male reproductive tract and after in vitro storage. *Gamete Res. (1988)* 21(1): 23-8

Nut def Ashraf, M. and Zafar, Z. U. pattern of accumulation of some major and trace elements in salt-tolerant and salt-sensitive lines of lentil under nitrogen deficiency. *J. Plant Nutr. (1998)* 21(6): 1067-1081

FL Aslanyan, M. M. and Dariush, N. S. 1972. stimulation of reproduction in rams by trace elements. *Ovtsevodstvo.*(9): 38-39.

No Oral Asmatullah, S. N. Q. and Shakoori, A. R. 1998. embryotoxic and teratogenic effects of hexavalent chromium in developing chicks of gallus domesticus. *Bulletin of Environmental Contamination and Toxicology.* 61(3): 281-288.

In Vit Aspberg, A. and Tottmar, O. 1992. development of antioxidant enzymes in rat brain and in reaggregation culture of fetal brain cells. *Brain Research. Developmental Brain Research* 66(1): 55-8.

Food Astawan, Made, Wahyuni, Mita, Yamada, Kazuhiro, Tadokoro, Tadahiro, and Maekawa, Akio. effect of high salt content of indonesian dried-salted fish on rats. *J. Agric. Food Chem. (1994)* 42(10): 2265-9

Fate Atkinson, S. A., Shah, J. K., Webber, C. E., Gibson, I. L., and Gibson, R. S. 1993. a multi-element isotopic tracer assessment of true fractionalabsorption of minerals from formula with additives of calcium,phosphorus, zinc, copper and iron in young piglets. *Journal of Nutrition* 123(9): 1586-1593.

Rev ATSDR. 1990.

Nutr Attia, F. M., Alsobayel, A. A., Kriadees, M. S., Al-Saiady, M. Y., and Bayoumi, M. S. nutrient composition and feeding value of salicornia bigelovii torr meal in broiler diets . *Anim. Feed Sci. Technol. (1997)* 65(1-4): 257-263

Mix Atuahene, C. C., Donkoh, A., and Asante, F. value of sheanut cake as a dietary ingredient for broiler chickens. *Anim. Feed Sci. Technol. (1998)* 72(1-2): 133-142

Bio Acc Augier, H., Bayle, P., Gulbasdian, S., and Ramonda, G. 19970000. study on metallic content of the yellow-legged gull larus cachinnans michahellis and its eggs collected on the coastline of the bouches-du-rhone (france). *Toxicological and Environmental Chemistry* VOL. 63, NO. 1-4: pp. 83-96.

No Effect Aulerich, R. J. and Ringer, R. K. 1977. can copper sulphate in mink feed give advantages? *Vara Palsdjur.* 48(3): 103-105.

Nut def Aupperle, H., Schoon, H. A., and Frank, A. 2001. experimental copper deficiency, chromium deficiency and additional molybdenum supplementation in goats--pathological findings. *Acta Veterinaria Scandinavica, 2001, 42(3):311-21.*

In Vit Avakyan, A. Kh. effect of camposan on the content of cytochrome p-450 and manganese in rat liver microsomes and lipid per oxidation. *Biologicheskii Zhurnal Armenii. 33 (11). 1980 (Recd. 1981). 1234-1236.*

Unrel Avery, M. L. and Decker, D. G. 1991. repellency of fungicidal rice seed treatments to red-winged blackbirds. *J. Wildl. Manage.* 55(2): 327-334.

Surv Avram, N., Medrea, N., Serdaru, M., and Tanasescu, V. 1996. industrial pollution with heavy metals and animal health. *Revista Romana De Medicina Veterinara.* 6(4): 489-495.

Food Awad, Els. T., Ibrahim, Janett M., and Ahmed, R. M. the effect of modulation of prolactin secretion in hens on cholesterol, phospholipids and mineral elements of egg yolk. *Bull. Natl. Res. Cent. (Egypt) (1994)* 19(3): 165-76.

No COC Awad, Els. T., Ibrahim, Janette M., and Ahmed, R. M. spectroscopic study and the effect of modulation of prolactin on cholesterol, phospholipids and certain mineral elements in hen's egg yolk. *Pak. J. Biochem. Mol. Biol. (1996)* 29(1-2): 6-13 .

Alt Aykac, G., Ozdemirler, G., and Uysal, M. 1989. lipid peroxidation in erythrocytes of rats fed a high copper diet. *J. Clin. Biochem. Nutr.* 6: 35-38.

Not Avail Ayyat, M. S. 1994. effect of different levels of dietary protein and copper on growth performance in rabbits. *Egyptian Journal of Rabbit Science.* 4(1): 83-92.

CP Ayyat, M. S., Gabr, H. A., Marai, I. F. M., and Abdel-Monem, U. M. 1997. alleviation of heat-stressed growing rabbits by using some chemicalgrowth enhancers, under subtropical egyptian conditions. *International Conference on Animal, Poultry & Rabbitproduction and Health, Egyptian International Centre for Agriculture,Dokki, Cairo, Egypt 2-4 September, 1997.* 637-651.

No Control Ayyat, M. S, Marai, I. F. M., and Alazab, A. M. 1995. copper-protein nutrition of new zealand white rabbits under egyptian conditions. *World Rabbit Science.* 3(3): 113-118.

CP Baars, A. J., Van Beek, H., De Graaf, G. J., Spierenburg, T. J., Beeftink, W. G., and Nieuwenhuize, J. 1986. metal pollution in a salt marsh and its effect on sheep. *Archives of Toxicology, Suppl. 9. Toxic Interfaces of Neurones, Smoke and Genes; European Society of Toxicology Meeting, Kuopio, Finland, June 16-19, 1985. Illus. Paper. Isbn 0-387-16589-4; Isbn 3-540-16589-4. Chambers, P. L., J. Tuomisto and C. M. Chambers (ED.).*: 410-413.

Surv Baars, A. J., Van Beek H, Spierenburg, T. J., Beeftink, W. G., Nieuwenhuize, J. , Pekelder, J. J., and Boom, J. 1988. environmental contamination by heavy metals and fluoride in the saeftinge salt marsh the netherlands and its effect on sheep. *VET Q.* 10(2): 90-98.

Alt Babedzhanov, S. N. balance of iron, vanadium, manganese, nickel and copper in experimental cholesterol atherosclerosis. *Med. Zh. Uzb. (1973)* (10): 18-21

CP Babin, Ya. A. 1976. coupling and uncoupling of oxidative phosphorylation in chicks during ontogenesis and during fattening with trace element salts. *Aktual. Vopr. Obmena Veshchestv, Mater. Konf. Vopr. Fiziol. Obmena Veshchestv Org. Chel. Zhivotn.* 20-3 .

FL Babin, Ya. A., Latyshev, V. I., and Vasyunin, V. V. 1982. paired combinations of trace element salts in diets for chickens. *Khimiya v Sel'Skom Khozyaistve* (2): 44-47.

Mix Babish, J. G., Stoewsand, G. S., Furr, A. K., Parkinson, T. F., Bache, C. A., Gutenmann, W. H., Wszolek, P. C., and Lisk, D. J. 1979. elemental and polychlorinated biphenyl content of tissues andintestinal aryl hydrocarbon hydroxylase activity of guinea pigs fedcabbage grown on municipal sewage sludge. *Journal of Agricultural and Food Chemistry* 27(2): 399-402.

Unrel Babu, T. H. 1988. effectiveness of certain chemicals and fungicides on the feeding behavior of house sparrows. *PAVO.* 26(1-2): 17-24.

Surv Badawy, E. M., Edrise, B. M., and Al-Wakeel, A. M. 1987. the relationship between quality, egg constituents and hatchability of the eggs of hubbard broiler breeders. a field study. *Veterinary Medical Journal, Egypt.* 35(1): 105-115.

Mix Bag, Shomesubra, Vora, Tasnim, Ghatak, Runa, Nilufer, Irani, D'Mello, Denness, Pereira, Leon, Pereira, James, Cutinho, Christine, and Rao, Vaman. a study of toxic effects of heavy metal contaminants from sludge-supplemented diets on male wistar rats. *Ecotoxicol. Environ. Saf. (1999)* 42(2): 163-170 .

No COC Bai, Yisheng and Hunt, Curtiss D. dietary boron enhances efficacy of cholecalciferol in broiler chicks. *J. Trace Elem. Exp. Med. (1996)* 9(3): 117-132.

FL Baiturin, M. A. and Tanatarov, A. B. 1972. determination of optimum doses of a combination of trace elements for ducklings. *Tr. Alma-At. Zoovet. Inst.* 24: 135-8.

Abstract Bakalli, R. I. and Pesti, G. M. 1997. influence of high dietary supplementation of cu, fe, zn, ni, mn and mg on delta-aminolevulinic acid dehydratase activity in domestic chickens. *FASEB Journal* 11(3): A588.

Nutr Bakanov, V. N., Ovsishcher, B. R., Lepeshkin, V. V., and Alimzhanov, B. O. effect of trace elements copper zinc cobalt manganese on the efficiency of grass protein utilization by dairy cows on cultivated irrigated pastures. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii. (2). 1976 161-167.*

Rev Baker, D. H. and Czarnecki-Maulden, G. L. 1987. pharmacologic role of cysteine in ameliorating or exacerbating mineraltoxicities. *Journal of Nutrition* 117(6): 1003-1010.

Drug Baker, D. H., Robbins, K. R., and Willis, G. M. 1982. amino acid utilization as influenced by antibacterial and anticoccidial drugs. *Federation Proceedings* 41(11): 2824-7.

Unrel Bakhiet, A. O. and Adam, S. E. 1995. an estimation of citrullus colocynthis toxicity for chicks. *Veterinary and Human Toxicology* 37(4): 356-8.

Unrel Balaban, C. D. 1985. central neurotoxic effects of intraperitoneally administered 3-acetylpyridine, harmaline and niacinamide in sprague-dawley and long-evans rats: a critical review of central 3-acetylpyridine neurotoxicity. *Brain Research* 356(1): 21-42.

Unrel Balaban, C. D. 1988. distribution of inferior olivary projections to the vestibular nuclei of albino rabbits. *Neuroscience* 24(1): 119-34.

Unrel Balaban, C. D., O'Callaghan, J. P., and Billingsley, M. L. 1988. trimethyltin-induced neuronal damage in the rat brain: comparative studies using silver degeneration stains, immunocytochemistry and immunoassay for neuronotypic and gliotypic proteins. *Neuroscience* 26(1): 337-61.

BioX Balaban, C. D. and Severs, W. B. toxic effects of somatostatin in the cerebellum and vestibular nuclei multiple sites of action. *Neuroscience Research. 12 (1). 1991. 140-150.*

FL Balabanova, E. L. and Kurlyandskii, B. A. the dependence of inhibition of isolated liver mitochondria respiration on copper and vanadium phthalocyanines structure. *Gig. Sanit. (1990)* (7): 64-5

Nutr Balakhontseva, V., Dubinskaya, A., and Rozhkova, M. 1986. products of microbiological synthesis - paprin. *Mukomol'No-Elevatornaya i Kombikormovaya Promyshlennost'* (10): 41-42.

CP Balatincz, J., Ajtony, Z., and Tamasy, V. 1997. prenatal protein-energy malnutrition: its effects on mineral concentrations in rats ' brain. *Mengen- Spurenelem. Arbeitstag., 17th* : 525-535. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

FL Balayan, D. E. 1982. the effect of helminthiases on the amounts of trace elements (copper,molybdenum, manganese, iron) in the tissues and organs of sheep. *Zoologicheskii Sbornik, Akademiya Nauk Armyanskoi SSR, Institut Zoologii (Fauna Parazitov Zhivotnykh i Vyzyvaemye Imi Zabolevaniya)* (No.18): 46-56.

Nut def Balevska, P. S., Russanov, E. M., and Kassabova, T. A. 1981. studies on lipid peroxidation in rat liver by copper deficiency. *International Journal of Biochemistry* 13(4): 489-93.

Plant Baligar, V. C., Wright, R. J., Fageria, N. K., and Foy, C. D. differential responses of forage legumes to aluminum. *J. Plant Nutr. (1988)* 11(5): 549-61 **No Dose** Ballarini, G. and Maletto, S. 1983. hyena disease and mineral deficiencies in cattle. *Bulletin D'Academie Veterinaire De France* 56(2): 227-234.

No Dose Balnave, D. and Scott, T. 1986. the influence of minerals in drinking water on egg shell quality. *Nutr. Rep. Int.* 34(1): 29-34.

Unrel Banton, M. I., Nicholson, S. S., Jowett, P. L. H., Brantley, M. B., and Boudreaux, C. L. 1987. copper toxicosis in cattle fed chicken Litter. *J Am Vet Med Assoc.* 191(7): 827-828.

Surv Bao, S. F., Stangl, G. I., and Kirchgessner, M. a. 1995. comparison of the efficiency of chinese herbs, copper-gluconate and copper-sulfate on copper status in copper-deficient rats. *Trace Elements and Electrolytes.* 12(3): 141-147.

Unrel Baozhen, Wang. 1987. the development of ecological wastewater treatment and utilization systems (ewtus) in china. *Water Sci. Technol. (1987)* 19(1-2, Water Pollut. Res. Control, Rio de Janeiro, 1986, Pt. 1): 51-63 .

No Org Bara, J. J., Szubinska, S. M., and Misiak, L. 1989. mossbauer and esr study of iron in livex--a product of blood. *Journal of Biochemical and Biophysical Methods* 19(2-3): 241-8.

FL Baranski, Boguslaw. 1986. disturbances in the sexual cycle, fertility, prenatal and postnatal development of progeny and distribution of cadmium, copper, and zinc of rat females exposed to cadmium . *Med. Pr.* 37(2): 120-125.

FL Baranski, Boguslaw. 1987. disturbances of the ovarian cycle and fertility, and the prenatal and postnatal offspring development and the cadmium, copper, and zinc distribution under the effect of female rats exposure to cadmium. *Stud. Mater. Monogr. - Inst. Med. Pr.* 27: 134.

CP Barataud, C. and Truchet, M. 1990. diversity and limits of cellular responses against experimental metal exposure. *Thirtieth Annual Colloquium of the Societe Francaise De Microscopie Electronique (French Society of Electron Microscopy) Biol Cell.* 69(2): 27A.

Rev Barbeau, A. and Donaldson, J. 1974. zinc, taurine, and epilepsy. *Archives of Neurology* 30(1): 52-8.

Nut def Barhoum, S. 1989. influence of a moderate phosphorus deficiency on the ash content andmineral status of different parts of the body of goats. 595-602.

Gene Barkats, M., Nakao, N., Grasbon-Frodl, E. M., Bilang-Bleuel, A., Revah, F., Mallet, J., and Brundin, P. 1997. intrastriatal grafts of embryonic mesencephalic rat neurons genetically modified using an adenovirus encoding human cu/zn superoxide dismutase. *Neuroscience* 78(3): 703-13.

Nutr Barker, Dayna, Fitzpatrick, Marianne P., and Dierenfeld, Ellen S. nutrient composition of selected whole invertebrates. *Zoo Biol. (1998)* 17(2): 123-134

Unrel Barker, J. C. and Zublena, J. P. livestock manure nutrient assessment in north carolina. *Int. Symp. Agric. Food Process. Wastes* Proc., 7th (1995): 98-106. Editor(s): Ross, Charles C. Publisher: American Society of Agricultural Engineers, St. Joseph, Mich..

FL Barkhatov, N. A. 1978. the effect of trace elements on metabolism and reproductive function. *Veterinariya, Moscow, USSR* (1): 76-79.

Nut def Barnouin, J., Quechon, M., Petit, B., Nicolas, J. A., and Brochart, M. 1985. continuous eco-pathological survey. 5. the main diseases and healthmanagement of sheep flocks under semi-confinement conditions. *Bulletin Technique Centre De Recherches Zootechniques Et Veterinaires De Theix.*(No.61): 11-19.

Nut def Barrow, L., Ashmore, S. P., Patel, H. R., and Tanner, M. S. 1989. vitamin e deficiency and copper hepatotoxicity. *Journal of Pediatric Gastroenterology and Nutrition.* 9(2): 264.

HHE Barrows, K. and Snook, J. T. 1987. effect of a high-protein, very-low-calorie diet on body composition and anthropometric parameters of obese middle-aged women. *American Journal of Clinical Nutrition.* 45(2): 381-390.

Nutr Barry, T. N., Reid, T. C., Millar, K. R., and Sadler, W. A. 1981. Nutral evaluation of kale brassica-oleracea diets 2. copper deficiency thyroid function and selenium status in young cattle and sheep fed kale for prolonged periods. *J AGRIC SCI.* 96(2): 269-282.

Unrel Bartov, I. 1983. effects of propionic-acid and of copper sulfate on the nutritional value of diets containing moldy corn for broiler Chicks. *Poult Sci.* 62(11): 2195-2200.

Bio Acc Baruah Anubha(A), Baruah, R. N., Baruah, K. K., Goswami, J. N., Baruah, K. K(A), Baishya, N., and Goswami, R. N. 1999. effect of seasons and locations on serum microminerals in prepuberal jersey heifers. *Indian Journal of Animal Sciences* 69(1): 59-60.

FL Basile, G. and Lucisano, A. 1982. distribution of cadmium, zinc and copper in tissues of chickens givencadmium. *Acta Medica Veterinaria.* 28(1/2): 93-100.

Meth Basketter, D. A., Lea, L. J., Cooper, K., Stocks, J., Dickens, A., Pate, I., Dearman, R. J., and Kimber, I. 2000. threshold for classification as a skin sensitizer in the local lymph node assay: a statistical evaluation. *Food Chem. Toxicol.* Volume Date 1999, 37(12): 1167-1174 .

FL Basso, L. R. and Vieites, C. M. 1983. supplying enriched water to piglets from the first day of life. *Revista De La Facultad De Agronomia, Universidad De Buenos Aires.* 4(2): 105-108.

Mix Bastien, R. W., Bradley, J. W., Pennington, B. L., and Ferguson, T. M. 1979. effect of dietary mineral supplements on radius breaking strength andegg characteristics of caged layers. *Poultry Science* 58(1): 90-92.

FL Bataeva, A. P. and Plekhanov, L. A. 1977. activity of magnesium-dependent atpase in some hen organs and tissues under the effect of trace element additives. *Byull. Vses. Nauchno-Issled. Inst. Fiziol., Biokhim. Pitan. S-Kh. Zhivotn.* 11(1): 34-6.

Rev Bath, G. F. 1979. enzootic icterus a form of chronic copper poisoning. *J S AFR VET ASSOC.* 50(1): 3-14.

No Org Batinic-Haberle, I., Liochev, S. I., Spasojevic, I., and Fridovich, I. 1997. a potent superoxide dismutase mimic: manganese beta-octabromo-meso-tetrakis-(n-methylpyridinium-4-yl) porphyrin. *Archives of Biochemistry and Biophysics* 343(2): 225-33.

Surv Batty, J., Leavitt, R. A., Biondo, N., and Polin, D. 1990. an ecotoxicological study of a population of the white footed mouse (peromyscus leucopus) inhabiting a polychlorinated biphenyls-contaminated area. *Arch Environ Contam Toxicol.* 19(2): 283-90.

Herp Baudo, Renato. 1976. heavy metals concentrations (chromium, copper, manganese, and lead) in tadpoles and adults of rana esculenta l. *Mem. Ist. Ital. Idrobiol. Dott. Marco De Marchi.* 33: 325-44.

FL Bauer, M. 1975. copper sulfate poisoning in horses. *Vet. Arch.* 45: 257.

Mix Bayyari, G. R., Huff, W. E., Beasley, J. N., Balog, J. M., and Rath, N. C. 1995. the effect of dietary copper sulfate on infectious proventriculitis. *Poult Sci.* 74(12): 1961-9.

Mix Beames, R. M. 1969. trials on the response of early-weaned pigs and rats to diets supplemented with tylosin and high levels of copper. *J. Anim. Sci.* 29(4): 573-7.

Bio Acc Beardsley, A., Vagg, M. J., Beckett, P. HT, and Sansom, B. F. 1978. use of the field vole (m. agrestis) for monitoring potentially harmful elements in the environment. *Environ Pollut.* 16(1): 65-72.

Rev Beattie, John H. and Bremner, Ian. 1998. roles of metallothionein in cellular metabolism. *Met. Ions Biol. Med. Proc. Int. Symp., 5th* : 117-127. Editor(s): Collery, Phillipe. Publisher: Libbey Eurotext, Montrouge, Fr..

Mix Beaudouin, J., Shirley, R. L., and Hammell, D. L. 1980. effect of sewage sludge diets fed (to) swine on nutrient digestibility,reproduction, growth and minerals in tissues. *Journal of Animal Science* 50(4): 572-580.

Fate Bebe, F. N. and Panemangalore, M. 1996. modulation of tissue trace metal concentrations in weanling rats fed different levels of zinc and exposed to oral lead and cadmium. *Nutrition Research.* 16(8): 1369-1380.

Unrel Beck, M. M., Kuenzel, W. J., and Switzer, R. C. 1983. auditory and vestibular pathology of seizure-prone chicks. *Brain Research* 260(1): 11-20.

Species Bedwal, R. S. and Bahuguna, A. 1994. zinc, copper and selenium in reproduction. *Experientia.* 50(7): 626-40.

No COC Beguin, D. P. and Kincaid, R. L. 1984. 3-hydroxy-3-methyl-glutaryl coenzyme a reductase activity in chicks fed coumestrol, a phytoestrogen. *Poultry Science* 63(4): 686-90.

No COC Behari, Jai Raj, Mengel, K., and Friedberg, K. D. zinc, copper and manganese in the organs of rats after sublethal cyanide intoxication. *Arch. Toxicol. (1981)* 48(1): 41-50 .

Nutr Beker, V. F., Urtane, M. S., Vasil'eva, S. V., Krauze, R. Yu., Apsite, M. R., and Kalntsiema, V. Kh. 1984. composition and biological value of biomass from mycelium of the funguspolyporus squamosus a-42. <. *Document Title>Transportnye i Obmennye Protsessy v Kishechnikezhivotnykh.* 183-194.

FL Bel'kov, G. I., Chernikov, V. A., and Zhukov, N. S. 1983. increasing the nutritive value of diets during fattening of cattle. *Zhivotnovodstvo* (9): 51-52.

Chem Meth Belew, M., Yip, T. T., Andersson, L., and Ehrnstrom, R. 1987. high-performance analytical applications of immobilized metal ion affinity chromatography. *Analytical Biochemistry* 164(2): 457-65.

HHE Belford, C. J., Raven, C. R., and Black, H. 1989. chronic copper poisoning in angora kids. *New Zealand Veterinary Journal.* 37(4): 152-154.

Unrel Bell, B. D. 1996. blackbird (turdus merula) predation on the endemic copper skink (cyclodina aenea). *Notornis.* 43(4): 213-217.

Bio Acc Belokobyl'skii, A. I., Ginturi, E. N., Shoniya, N. I., Rcheulishvili, A. N., and Mosulishvili, L. M. 1990. trace elements in chromatin in embryo- and postembryogenesis. *Soobshch. Akad. Nauk Gruz. SSR (1990)* 137(1): 157-60 .

Fate Belokobyl'skii, A. I., Ginturi, E. N., Shoniya, N. I., Rcheulishvili, A. N., and Mosulishvili, L. M. 1990. trace elements in chromatin in embryogenesis and postembryogenesis. *SOOBSHCH AKAD NAUK GRUZ SSR.* 137(1): 157-160.

Nutr Ben-Ghedalia, D., Hasdai, A., and Josef, E. availability of macro elements and micro elements from edible domestic waste fed to sheep. *Journal of Dairy Science. 66 (6). 1983. 1298-1302.*

Mineral Ben-Ghedalia, D., Miron, J., and Yosef, E. 1996. apparent digestibility of minerals by lactating cows from a total mixedration supplemented with poultry litter. *Journal of Dairy Science* 79(3): 454-458.

Bio Acc Bendell-Young, L. I(a) and Bendell, J. F. 1999. grit ingestion as a source of metal exposure in the spruce grouse, dendragapus canadensis. *Environmental Pollution.* 106(3): 405-412.

Mix Bengoumi, M., Essamadi, A. K., Tressol, J. C., Chacornac, J. P., and Faye, B. a. 1998. comparative effects of selenium supplementation on the plasma selenium concentration and erythrocyte glutathione peroxidase activity in cattle and camels. *Animal Science* . 67(3): 461-466.

Mix Bengoumi, M., Essamadi, A. K., Tressol, J. C., and Faye, B. a. 1998. comparative study of copper and zinc metabolism in cattle and camel. *Biological Trace Element Research.* 63(2): 81-94.

No Dose Berry, J. P., Zhang, L., and Galle, P. 1995. interaction of selenium with copper, silver, and gold salts. electron microprobe study. *Journal of Submicroscopic Cytology and Pathology* 27(1): 21-8.

Unrel Bertone, A. L., Van Soest P J, and Stashak, T. S. digestion fecal and blood variables associated with extensive large colon resection in the horse. *AM J VET RES. American Journal of Veterinary Research. 50 (2). 1989. 253-258.*

Nutr Bertoni, G. and Marzoli, A. L. 1975. trace elements and relative deficiencies. *Rivista Di Zootecnia e Veterinaria* (1): 61-78.

CP Bertrand, J. E., Lutrick, M. C., Edds, G. T., and West, R. L. 1981. animal performance, carcass quality, and tissue residues with beefsteers fed forage sorghum silages grown on soil treated with liquiddigested sludge. *Soil and Crop Science Society of Florida Proceedings* 40: 111-114.

FL Beseda, I., Rippel, A., Kovac, J., and Monisova, M. 1977. [microelements in the liver and kidney of laying hens kept on large-capacity poultry farms under normal and increased supply to the organism]. <original> mikroelementy v peceni a oblicke nosnic v sucasnych podmienkach velkochovov pri ich normalnom, ako aj zvysenom privode do organizmu. *Veterinarni Medicina* 22(10): 613-20.

FL Beseda, I., Rippel, A., Kovac, J., and Monisova, M. trace elements in the liver and kidneys of laying hens on large modern poultry farms with normal and increased supply of the trace elements to the organism. *Vet. Med. (Prague) (1977)* 22(10): 613-20

Bio Acc Besschetnov, I. I. and Chorayan, O. G. dynamics of informational characteristics of the chemical content of developing chicken embryo organs. *Arkh. Anat.* Gistol. Embriol. (1981): 81(11), 89-92 .

Diss Besschetnov, I. I. and Chorayan, O. G.*Informational Characteristics of the Chemical Composition of Chick Embryos in the Increased Mortality Periods. Deposited Doc. (1982)*

FL Besschetnov, I. I. and Chorayan, O. G. 1982.*Informational Characteristics of the Chemical Composition of Chick Embryos in the Increased Mortality Periods*

Diss Besschetnov, I. I. and Zhulidov, A. V.*Level of Some Trace Elements in the Constituents of an Egg and in the Body of Chick Embryos in the Increased Mortality Periods. Deposited Doc. (1983)*

FL Besschetnov, I. I. and Zhulidov, A. V. 1983.*Level of Some Trace Elements in the Constituents of an Egg and in the Body of Chick Embryos in the Increased Mortality Periods*

Nut def Bettger, William J., Savage, James E. , and O'Dell, Boyd L. effects of dietary copper and zinc on erythrocyte superoxide dismutase activity in the chick. *Nutr. Rep. Int. (1979)* 19(6): 893-900 .

Surv Beyer, W. N., Day, D., Morton, A., and Pachepsky, Y. 1998. relation of lead exposure to sediment ingestion in mute swans on the chesapeake bay, usa. *Environmental Toxicology and Chemistry.* 17(11): 2298-2301.

FL Bezel', V. S. and Bel'skii, E. A. 1994. the reproductive parameters of the hole-nesting birds by industrial contamination of the Environment. *Doklady Akademii Nauk.* 338(4)

FL Bezel', V. S. and Mukhacheva, S. V. 1995. character of reproductive losses in bank vole populations under the conditions of toxic environmental pollution. *Doklady Akademii Nauk .* 345(1): 135-137.

Nutr Bhattacharya, M., Dey, S. C., Mukit, A., and Sapcota, D. 1993. effect of feed additives on the microelements of poultry liver. *Indian Journal of Poultry Science* 28(2): 141-143.

Bio Acc Bhatti Mohammad S. 1995. protein, energy and mineral analyses of pigeon's milk. *Poultry Science* 74(SUPPL. 1): 33.

Unrel Bhavsar, B. K., Vadodaria, V. P., Dhami, A. J., and Kodagali, S. B. 1989 . seminal trace elements with reference to freezability and fertility of mehsana buffalo bulls. *INDIAN J ANIM SCI.* 59(5): 566-569.

Herp Bhosale, S. M., Patil, S., and Kanase, A. 1994. ovarian acid phosphatases from rana cyanophlyctis (schn.). *Uttar Pradesh Journal of Zoology.* 14(1): 37-41.

Acute Bhunya, S. P. and Jena G. B. 1996. 1966. clastogenic effects of copper sulphate in chick in vivo test system. *Mutat. Res.* 367(2): 57-63.

Nutr Bialkowski, Z. the influence of micro climate the mineral elements copper manganese and zinc and vitamins a plus d-3 added on selected blood indices and effects of piglet rearing. *Polskie Archiwum Weterynaryjne. 23 (4). 1983. 23-36.*

FL Bialkowski, Z. 1983. the influence of microclimate, supplements of copper, manganese andzinc and vitamin a + cholecalciferol on some blood values and resultsof rearing piglets. *Polskie Archiwum Weterynaryjne* 23(4): 23-35.

Unrel Bicanin, M. 1975. contribution to the knowledge of quality of grassland herbage on thewestern sides of mount sara with special reference to essential traceelements in the diet of sheep. *Veterinaria, Yugoslavia.* 24(2): 199-207.

FL Bicanin, M. 1979. effect of different altitudes and nutrition on haematological valuesthe offspring of merinized sarplanina ewes. *Veterinaria, Yugoslavia* 28(1): 27-38.

Rev Bidewell, C. A., David, G. P., and Livesey, C. T. 2000. copper toxicity in cattle.

FL Bineev, R. G., Dunyavin, A. V., Kazakov, Kh. Sh., Grigor'yan, B. R., and Loginov, V. V. 1983. effect of copper sulphate and copper methioninate on the distributionof metals and amino acids in fractionated rumen contents. <document title>vosproizvodstvo i bolezni molodnyaka krupnogo rogatogoskota. 99-105.

CP Binnerts, W. T., D. Giesecke, G. Dirksen editor, and M. Stangassinger (editor). 1981. intensification and trace element intake of dairy cows. *Metabolic Disorders in Farm Animals. Proceedings of the IVth International Conference on Production Disease in Farm Animals.*: 263-266.

Chem Meth Binnerts, W. T. and Wassenaar, J. E. assay of somatomedin c in bovine plasma. *Tijdschrift Voor Diergeneeskunde*|

FL Bires, J. 1989. interactions between copper, iron, zinc, arsenic, cadmium, and lead in the liver of sheep after experimental poisoning with copper oxide. *Veterinarni Medicina.* 34(11): 665-674.

Mix Bires, J., Dianovsky, J., and Bartko, P. 1993. changes in selected biochemical indicators and in the genetic apparatus of sheep in the course of application of copper from industrial pollution. *Ekologia.* 12(2): 153-162.

Mix Bires, J., Kovac, G., and Vrzgula, L. 1991. interactions between copper and selenium in sheep in

the course of experimentally-produced copper intoxication. *Veterinary and Human Toxicology.* 33(5): 489-491.

No Oral Bires, J., Maracek, I., Bartko, P., Biresova, M., and Weissova, T. 1995. accumulation of trace elements in sheep and the effects upon qualitative and quantitative ovarian changes. *Veterinary and Human Toxicology.* 37(4): 349-356.

Bio Acc Bires, J. and Vrzgula, L. 1990. wool as an indicator of sheep exposure to copper iron zinc molybdenum arsenic lead cadmium and selenium from the industrial emission source. *Ekologia-CSSR.* 9(4): 419-428.

FL Bires, J., Vrzgula, L., and Mudron, P. 1990. the influence of experimental and spontaneous copper intoxication on the contents of copper, iron, zinc, cadmium, arsenic and lead in the liver and kidneys of ewes and their foetuses. *Zivocisna Vyroba - UVTIZ.* 35(2): 159-168.

FL Bires, J. a, Kovac, G., and Vrzgula, L. 1991. the effect of selenium on haematological profile and selected parameters of blood serum in sheep during experimental intoxication by copper. *Zivocisna Vyroba - UVTIZ.* 36(6): 507-516.

FL Bires, J. Ustav Experimentalnej Veterinarnej Mediciny Kosice Czechoslovakia, Vrzgula, L., and Mudron, P. 1990. the influence of experimental and spontaneous copper intoxication on the contents of copper, iron, zinc, cadmium, arsenic and lead in the liver and kidneys of ewes and their foetuses. <original> vplyv experimentalnej a spontannej intoxikacie medou na obsah medi, zeleza, zinku, kadmia, arzenu a olova v peceni a oblickach bahnic a ich plodov. *Zivocisna Vyroba - UVTIZ. V. 35(2) P. 159-168*

FL Bires, J. Vysoka Skola Veterinarska Kosice CSFR, Vrzgula, L., and Juhasova, Z. 1991. distribution of harmful metals in ewes after experimental industrial contaminant intake. <original> distribucia rizikovych kovov v organizme oviec po prijme priemyselnej emisie v experimente. *Veterinarni Medicina - UVTIZ. V. 36(6) P. 361-371*

Herp Birge, W. J., Black, J. A., and Westerman, A. G. 1985. short-term fish and amphibian embryo-larval tests for determining the effects of toxicant stress on early life stages and Estimating Chronic Values for Single Compounds and Complex Effluents. *Environ Toxicol Chem.* 4: 807-821.

Herp Birge, W. J., Hoyt, R. D., Black, J. A., Kercher, M. D., and Robinson W. A. 1993. effects of chemical stresses on behavior of larval and juvenile fishes and amphibians. *American Fisheries Society Symposium, 14. Water Quality and the Early Life Stages of Fishes* : p55-65.

Aquatic Bishop, C. A., Struger, J., Shirose, L. J., Dunn, L., and Campbell, G. D. 2000. contamination and wildlife communities in stormwater detention ponds in guelph and the greater toronto area, ontario, 1997, and 1998. part 2. contamination and biological effects of contamination. *Water Quality Research Journal of Canada [Water Qual. Res. J. Can.]. Vol. 35, No. 3, Pp. 437-434. 2000.*

No Org Bishop Philip Keith(A), Lerner David Nicholas, Jakobsen Rasmus, Gosk Edmund, Burston Mark William, and Chen Tong. 1993. investigation of a solvent polluted industrial site on a deep sandstone-mudstone sequence in the uk: part 2. contaminant sources, distributions, transport and retardation. *Journal of Hydrology (Amsterdam)* 149(1-4): 231-256.

Alt Bjoerklund, Haakan, Lind, Birger, Piscator, Magnus, Hoffer, Barry, and Olson, Lars. 1981. lead, zinc, and copper levels in intraocular brain tissue grafts, brain, and blood of lead-exposed rats. *Toxicol. Appl. Pharmacol.* 60(3): 424-30 .

Unrel Blaauwgeers, H. G., Vianney de Jong, J. M., Verspaget, H. W., van den Berg, F. M., and Troost, D. 1996. enhanced superoxide dismutase-2 immunoreactivity of astrocytes and occasional neurons in

amyotrophic lateral sclerosis. *Journal of the Neurological Sciences* 140(1-2): 21-9.

Aquatic Blanck, Hans. 2002. a critical review of procedures and approaches used for assessing pollution-induced community tolerance (pict) in biotic communities. *Human and Ecological Risk Assessment.* 8(5): 1003-1034.

CP Blanusa, M., Bremner, I., Schonwald, N., Piasek, M., Kosicek, M., Kostial, K., <Editors> Anke, M., Meissner, D., and Mills, C. F. 1993. influence of maternal iron deficiency and cadmium exposure on traceelement status of suckling rats.. *Trace Elements in Man and Animals - TEMA 8: Proceedings of the Eighth International Symposium on Trace Elements in Man and Animals.* 955-958.

Bio Acc Blomqvist, Sven, Frank, Adrian, and Petersson, Lars R. metals in liver and kidney tissues of autumn-migrating dunlin calidris alpina and curlew sandpiper calidris ferruginea staging at the baltic sea. *Mar. Ecol.: Prog. Ser. (1987)* 35(1-2): 1-13 .

Surv Blus, L. J., Henny, C. J., Anderson, A., and Fitzner, R. E. 1985. reproduction mortality and heavy metal concentrations in great blue herons ardea-herodias from three colonies in washington and idaho usa. *Colon Waterbirds.* 8(2): p110-116.

Surv Blus, L. J., Henny, C. J., Hoffman, D. J., and Grove, R. A. 1993. accumulation and effects of lead and cadmium on wood ducks near a mining and smelting complex in idaho. *Ecotoxicology.* 2(2): 139-154.

Bio Acc Blus, L. J., Henny, C. J., and Mulhern, B. M. 1987. concentrations of metals in mink and other mammals from washington and idaho. *Environ Pollut.* 44(4): 307-318.

Dead Blus, L. J., Stroud, R. K., Reiswig, B., and Mceneaney, T. 1989. lead poisoning and other mortality factors in trumpeter swans. *Environ Toxicol Chem.* 8(3): p263-271.

FL Boccignone, M., Damasio, L., and Sarra, C. high content of some metals in the diet and fatty acid composition of different tissues of growing chicks. *Riv. Zootec. Vet. (1982)* 10(3): 164-70

Nut def Bodai, J. 1976. the effect of phosphorus and trace element deficiency on reproductionand newborn calves. *Magyar Allatorvosok Lapja* 31(9): 589-593.

Chem Meth Boerma, D. O., Smit, E. P., and Roosnek, N. 1989. pixe trace-element determination and its accuracy in the analysis of bile. *Nucl. Instrum. Methods Phys. Res. Sect. B* B36(1): 60-73.

Phys Bofill, Roger, Palacios, Oscar, Capdevila, Merce, Cols, Neus, Gonzalez-Duarte, Roser, Atrian, Silvia, and Gonzalez-Duarte, Pilar. a new insight into the ag+ and cu+ binding sites in the metallothionein .beta. domain. *J. Inorg. Biochem. (1999)* 73(1,2): 57-64 .

No COC Bogden, J. D., Al-Rabiai, S., and Gilani, S. H. 1984. effect of chronic ethanol ingestion on the metabolism of copper, iron, manganese, selenium, and zinc in an animal model of alcoholic cardiomyopathy. *Journal of Toxicology and Environmental Health* 14(2-3): 407-17.

Alt Bogden, John D., Al-Rabiai, Suad, and Gilani, Shamshad H. effects of chronic ethanol ingestion on the metabolism of copper, iron, manganese, selenium, and zinc in an animal model of alcoholic cardiomyopathy. *J. Toxicol. Environ. Health (1984)* 14(2-3): 407-17 .

FL Boiadzhieva, A., Iotov, M., and Dilov, P. 1975. [experimental study of a combination preparation of a ferrodextran complex, gamma-globulin, trace elements and vitamins]. <original> eksperimentalno prouchvane v'rkhu poluchavane na kombiniran preparat ot zheliazo-dekstranov

kompleks, gamma-globulin, mikroelementi i vitamini. *Veterinarno-Meditsinski Nauki* 12(8): 45-51.

Bio Acc Boila, R. J. 1987. cupric oxide needles for grazing cattle - growth and metabolic interrelationships. *Canadian Journal of Animal Science* 67(2): 577-581.

Nutr Boila, R. J. 1987. supplementary trace minerals for the feedlot finishing of beef steers. *CAN J ANIM SCI.* 67(3): 765-774.

Mineral Boila, R. J., Kennedy, A. D., and Belluk, B. M. 1990. effects of exogenous somatotropin on the concentration of minerals inthe tissues of growing ram lambs. *Journal of Animal Science* 68(1): 206-213.

No COC Boila, R. J., Mcbride, B. W., Early, R. J., and Ball, R. O. effects of somatotropin on the concentration of minerals in the heart liver kidneys and carcass of steers. *Canadian Journal of Animal Science. 71 (2). 1991. 593-598.*

Unrel Boila, R. J. and Wittenberg, K. M. 1990. carryover effects of supplemental copper, molybdenum and sulfur ingrowing cattle. *Canadian Journal of Animal Science* 70(2): 735-738.

Mix Boitor, I., Muntean, M., Groza, I., Moise, D., Musca, M., Kadar, L., and Ghitulescu, C. 1988. investigations on the stimulating effect of minerals in heifers with acquired utero-ovarian hypoplasia: <original> cercetari privind efectul stimulativ al unui complex mineral asupra unui lot de tineret bovin cu hipoplazie utero-ovariana dobindita. *Buletinul Institutului Agronomic Cluj-Napoca: Seria Zootehnie Si Medicina Veterinara* 42: 91-94.

Alt Boitor, I., Muntean, M., Groza, I., Moise, D., Musca, M., Kadar, L., and Ghitulescu, C. investigations on the stimulating effect of minerals on young female cattle with acquired utero-ovarian hypoplasia. *Buletinul Institutului Agronomic Cluj-Napoca Seria Zootehnie Si Medicina Veterinara. 42 (0). 1988. 91-94.*

Nutr Boitor, I., Munteanu, M., Groza, I., Moise, D., Musca, M., Kadar, L., and Ghitulescu, C. 1988. the stimulating effect of a mineral complex on young cattle withacquired utero-ovarian hypoplasia. *Buletinul Institutului Agronomic Cluj-Napoca. Seria Zootehnica Si Medicina Veterinara* 42: 91-94.

FL Bokori, Jozsef and Tolgyesi, Gyorgy. correlations between the metabolism of sulfur and certain trace elements in broilers. *Magy. Allatorv. Lapja (1983)* 38(11): 659-64

Mineral Bond, P. L., Meinecke, C. F., and Stephenson, E. L. 1987. identity of nutrients responsible for the growth increase obtained by feeding condensed fish solubles to chicks. *NUTR REP INT.* 35(4): 863-870.

Diss Bond, P. L., Sullivan, T. W., Douglas, J. H., Robeson, L. G., and Baier, J. G. effects of trace mineral supplementation and bird density on growth and bone strength of turkeys. *78th Annual Meeting of the Poultry Science Association, Inc. Poult Sci. 68 (Suppl. 1). 1989. 16.*

Bio Acc Bonner, Frank W., King, Laurence J., and Parke, Dennis V. 1980. the effect of dietary cadmium on zinc, copper and iron levels in the bone of rats. *Toxicol. Lett. (1980)* 5(2): 105-8 .

Unrel Bonner, James C., Rice, Annette B., Lindroos, Pamela M., O'Brien, Patricia O., Dreher, Kevin L., Rosas, Irma, Alfaro-Moreno, Ernesto, and Osornio-Vargas, Alvaro R. induction of the lung myofibroblast pdgf receptor system by urban ambient particles from mexico city. *Am. J. Respir. Cell Mol. Biol. (1998)* 19(4): 672-680

FL Bonomi, A., Bosticco, A., Quarantelli, A., Sabbioni, A., and Superchi, P. 1988 . relationships between the copper content of feed and the appearance of the effects of zinc deficiency in dairy cows. *RIV SOC ITAL SCI ALIMENT.* 17(4): 273-286.

FL Bonomi, A., Quarantelli, A., Sabbioni, A., Superchi, P., and Lucchelli, L. 1985. chelated trace element complexes in the feeding of ducks. (experimentalcontribution). *Annali Della Facolta Di Medicina Veterinaria, Universita Di Parma* 5: 153-166.

FL Bonomi, A., Quarantelli, A., Superchi, P., Sabbioni, A., and Bolsi, D. 1982. chelated trace element complexes in the feeding of meat turkeys. *Annali Della Facolta Di Medicina Veterinaria Di Parma* 2: 103-125.

Mix Bonomi, A., Quarantelli, A., Superchi, P., Sabbiono, A., Lucchelli, L., and Ashmead, H. D. 1993.*The Dynamics of Feeding Amino Acid Chelates to Broilers.: The Roles of Amino Acid Chelates in Animal Nutrition* : 302-317.

Nutr Bonomi, Alberto, Quarantelli, Afro, Superchi, Paola, Sabbiono, Alberto , and Lucchelli, Luigina. the dynamics of feeding amino acid chelates to broilers. *Roles Amino Acid Chelates Anim. Nutr. (1993)* 302-17. Editor: 302-17. Editor(s): Ashmead, H. DeWayne. Publisher: Noyes, Park Ridge, N. J.

No Dose Borch-Iohnsen, Berit a, Nilssen, Kjell J, and Norheim, Gunnar. 1996. influence of season and diet on liver and kidney content of essential elements and heavy metals in svalbard reindeer. *Biological Trace Element Research.* 51(3): 235-247.

FL Bordas, E. and Bretter, E. 1972. proliferations of the mucosa of the kidney pelvis in rats after administration of mineral residue of the drinking water from a focus of endemic nephropathy. *Arch Roum Pathol Exp Microbiol.* 31(2): 305-313.

Mix Bordas, E., Bretter, E., Ghelberg, N. W., and Costin, I. 1980. experimental studies on the toxic effects of a complex of heavy metals including cadmium, lead, zinc, copper and iron from a Surface Water Source. *Rev IG BACTERIOL VIRUSOL PARAZITOL EPIDEMIOL PNEUMOFTIZIOL SER IG.* 29(1): 17-22.

Surv Bordas, E., Gabor, S., and Nagy, S. 1980. cadmium and copper in organs and blood in experimental cadmiumpoisoning. *Igiena.* 29(4): 331-336.

Surv Bordas, E., Gabor, S., and Nagy, S. 1979. in vivo interactions of copper and cadmium. *Revue Roumaine De Biochimie.* 16(1): 3-6.

FL Bordas, E. and Papilian, V. V. 1983. myocardial changes induced by nickel and by nickel in association with cadmium. *Rev. Ig. Bacteriol., Virusol., Parazitol., Epidemiol., Pneumoftiziol., Ig.* 32(1): 51-6

No COC Borodaikevich, D. T. dynamics of copper and manganese levels in mice subjected to pulsed magnetic fields. *Mikroelem. Med. (1972)* : No. 3, 113-16 .

FL Bosi, P., Tedeschi, M., Casini, L., and Macchioni, P. 1985. digestibility in vivo of grape skin residues from oenocyaninextraction. *Atti Della Societa Italiana Delle Scienze Veterinarie* 39(2): 459-462.

No Oral Botha, C. J., Shakespeare, A. S., Gehring, R., and van der Merwe, D. 2001. evaluation of a commercially available molybdate formulation and zinc oxide boluses in preventing hepatic copper accumulation and thus enzootic icterus in sheep. *Journal of the South African Veterinary*

Association, 2001 Dec, 72(4):183-8.

FL Bouquegneau, J. M., Debacker, V., Antoine, N. Liege Univ. Belgium Inst. de Chimie. Lab. d'Oceanologie, Coignoul, F., Holsbeek, L., Jauniaux, T., Tapia, G., and Joiris, C. 1994. causes of mortality and heavy metals content of guillemots uria aalge stranded along the belgian coast. <original> causes de mortalite et teneur en metaux lourds de guillemots de troil uria aalge echoues le long du littoral belge. *Bulletin De La Societe Royale Des Sciences De Liege. V. 63(1-2) P. 211-217*

Fate Bourcier, D. R., Sharma, R. P., and Brinkerhoff, C. R. 1981. cadmium-copper interaction: tissue accumulation and subcellular distribution of cadmium in mice after simultaneous administration of cadmium and copper. *Trace Subst. Environ. Health* : 15, 190-7 .

Mix Bourcier, Denis R., Sharma, Raghubir P., Bracken, William M., and Taylor, Michael J. 1982. cadmium-copper interaction: effect of copper pretreatment and cadmium-copper chronic exposure on the distribution and accumulation of cadmium, copper, zinc and iron in mice. *Trace Subst. Environ. Health* : 16, 273-9 .

Surv Bourne, W. R. P. the mass mortality of common murres in the irish sea in 1969. *J. Wildl. Manage. 40(4): 789-792 1976 (35 References)*

Phys Bourre, J. M. 1991. protection against peroxidation by free radicals in capillaries andmicrovessels during aging of the brain. *Comptes Rendus Des Seances De La Societe De Biologie Et De Ses Filiales* 185(1-2): 5-13.

FL Bouska, J., Kukla, J. Stanice Veterinarni Pece Hustopece Czechoslovakia, and Lazar, V. 1988. dynamics of changes in selected biochemical parameters of the blood plasma of geese depending on their age, sex and egg laying. <original> dynamika zmen vybranych biochemickych ukazatelu krevni plasmy hus v zavislosti na veku, pohlavi a snasce. *Biologizace a Chemizace Zivocisne Vyroby - Veterinaria. V. 24(6) P. 517-528*

Ecol Bowell, R. J(A) and Ansah, R. K. 1993. trace element budget in an african savannah ecosystem. *Biogeochemistry (Dordrecht)* 20(2): 103-126.

Rev Bowland, J. P. 1990. copper as a performance promoter for pigs. *Pig News and Information.* 11(2): 163-167.

No COC Boyne, R. and Arthur J. R. 1986. 1986. effects of molybdenum or iron induced copper deficiency on the viability and function of neutrophils from cattle. ***Res. Vet. Sci.*** *V41, 417-419.* 41: 417-419.

FL Bozhkov, A. I., Dlubovskaya, V. L., Linnik, M. A., Shabani, M., and Belus, A. M. 1998. age peculiarities of the adaptation of animals to copper sulfate. *Dopovidi Natsional'noyi Akademiyi Nauk Ukrayiny.*(5): 153-157.

FL Bradley, C. H. 1993. copper poisoning in a dairy herd fed a mineral supplement. *Canadian Veterinary Journal.* 34(5): 287-292.

FL Brainer, M. M. de A. 1998.*Effects of Cupric Citrate on Different Phases As Growth Promotant of Broilers*

CP Brar, Balbir S. and Evans, J. L. 1967. morphological changes in the spleen and other body organs of growing rats as affected by different dietary levels of copper, iron, and pantothenic acid. *Proc. Int. Congr. Nutr., 7th* 5: 683-7.

Unrel Braude, R. and Hosking, Z. D. 1982. copper in diets for growing pigs. *J AGRIC SCI.* 99(2): 365-372.

Mineral Braude, R., Mitchell, K. G., and Pittman, R. J. 1973. a note on cuprous chloride as a feed additive for growing pigs. *Animal Production.* 17(3): 321-323.

Alt Braun, K. 1985.*Blood Picture and Iron and Copper Concentrations in Serum of Swine Undergoing Copper Sulphate Medication During Eperythrozoonosis and After Iron Dextran Administration.*

Phys Brautigam, R. T., Porter, R. S., Frasch, F., and Kutalek, S. P. 1991. chronic stability of bipolar epicardial plunge electrodes in dogs. *Journal of Investigative Surgery* 4(2): 153-9.

FL Bravo Ojeda, M. A. 1995.*Influence of Cooper and Zinc in Diets for Growing Goat*

Rev Bremner, I. 1979. copper toxicity studies using domestic and laboratory animals. *In: Copper in the Environment. Part II: Health Effects. Nriagu, J. O. : CH10.* 286-306 .

Rev Bremner, I. 1998. manifestations of copper excess. *American Journal of Clinical Nutrition.* 67(5 SUPPL.): 1069S-1073S.

Mix Bremner, I. and Campbell, J. K. 1978. effect of copper and zinc status on susceptibility to cadmium intoxication. *Environ Health Perspect.* 25: 125-128.

CP Bremner, I. and Campbell, J. K. 1980. influence of dietary copper intake on the toxicity of cadmium. 319-332.

Mix Bremner, I., Young, B. W., and Mills, C. F. 1976. protective effect of zinc supplementation against copper toxicosis in sheep. *BR J NUTR.* 36(3): 551-561.

An Prod Brenes, A., Diez, M. V., Yuste, P., and Rubio, L. A. effect of sodium chloride and sodium bicarbonate on abdominal fat and bone mineral contents in chicks. *Arch. Zootec. (1988)* 37(138): 105-13

Plant Brennan, R. F. and Bolland, M. D. A. 2003. comparing copper requirements of faba bean, chickpea, and lentil with spring wheat. *Journal of Plant Nutrition, 26 (4) Pp. 883-899, 2003.*

Surv Brochart, M. 1975. deficiency and excess of copper in the feed of rats: effects in plasma,liver, bone and hair. *Annales De Recherches Veterinaires.* 6(2): 231-235.

Plant Browaldh Mikael. 1992. influence of organic and inorganic fertilizers on common bean (phaseolus vulgaris l.) grown in a phosphorus-fixing mollic andosol. *Biological Agriculture & Horticulture* 9(1): 87-104.

No COC Brown, John C. W. and Strain, John J. effect of dietary homocysteine on copper status in rats. *J. Nutr. (1990)* 120(9): 1068-74 .

Plant Bruce, R. C. a review of the trace element nutrition of tropical pasture legumes in northern australia. *TROP GRASSL. Tropical Grasslands. 12 (3). 1978 (Recd. 1979). 170-183.*

Diss Bruckner, C. 1988. the influence of various feed additives on cadmium retention in the kidney of chickens. 113 pp.

In Vit Bruemmer, J. E(A), Rueda, B. R., Hawkins, D. E(A), Ross, T. T(A), Hallford, D. M. A, Botros, I. W., Renner, R. A(A), and Hoyer, P. B. 1996. steady state levels of mrna encoding manganese

superoxide dismutase (mnsod), copper/zinc superoxide dismutase (cu/znsod), catalase (cat) and glutathione peroxidase (gshpx) in the bovine corpus luteum (bcl) throughout the estrous cycle. *Journal of Animal Science* 74(SUPPL. 1): 304.

Bio Acc Brueske, C. C. and Barrett, G. W. 1991. dietary heavy metal uptake by the least shrew cryptotis-parva. *Bull Environ Contam Toxicol.* 47(6): 845-849.

In Vit Bruinink, A., Faller, P., Sidler, C., Bogumil, R., and VASAK, M. growth inhibitory factor and zinc affect neural cell cultures in a tissue specific manner. *Chemico-biological Interactions; 115 (3). 1998. 167-174.*

Surv BRUM, P. A RD, SOUSA, J. D., COMASTRI FILHO JA, and ALMEIDA, I. LD. mineral deficiencies of cattle in paiaguas region in pantanal mato-grossense brazil ii. copper zinc manganese and iron. *PESQUI AGROPECU BRAS; 22 (9-10). 1987. 1049-1060.*

Nutr Brzozowska, A., Sicinska, A., Witkowska, J., and Roszkowski, W. effect of protein quality and dietary levels of iron zinc and copper on apparent absorption and tissue trace elements concentration in the rats. *Southgate, D. A. T., I. T. Johnson and G. R. Fenwick (Ed.). Royal Society of Chemistry and Special Publications, No. 72. Nutrient Availability: Chemical and Biological Aspects; Conference, Norwich, England, Uk, August 21-24, 1988. Xix+404p. Royal Society of Chemistry: Cambridge, England, UK. ILLUS. ISBN 0-85186-856-8. 0 (0). 1989. 206-208.*

Rev Buck, W. B. 1978. chapter 22: copper/molybdenum toxicity in animals. 491-515.

Mix Buckley, W. T., Huckin, S. N., Fisher, L. J., and Eigendorf, G. K. 1986. effect of selenium supplementation on copper metabolism in dairy cows. *CAN J ANIM SCI.* 66(4): 1009-1018.

Nutr Buckley, W. T. and Tait, R. M. 1981. chronic copper toxicity in lambs a survey of blood constituent responses. *CAN J ANIM SCI.* 61(3): 613-624.

No Oral Budai, P., Fejes, S., Varnagy, L., Somlyay, I. M., and Takacs, I. 2001. teratogenicity test of dimethoate containing insecticide formulation and heavy elements (cu, cd) in chicken embryos after administration as single compounds or in combination. *Meded Rijksuniv Gent Fak Landbouwkd Toegep Biol Wet, 2001, 66(2b):885-9.*

No Oral Budai, P., Fejes, S., Varnagy, L., Szabo, R., and Keseru, M. 2002. embryonic toxicity of a dimethoate containing insecticide formulation and cu-sulphate in chicken after individual or combined administration. *Meded Rijksuniv Gent Fak Landbouwkd Toegep Biol Wet, 2002, 67(2):99-103.*

No Oral Budai, P. Fejes S. Varnagy L. Somlyay I. M. and Takacs I. 2001. teratogenicity test of dimethoate containing insecticide formulation and heavy elements (cu, cd) in chicken embryos after administration as single compounds or in combination. *Meded. Fac. Landbouwwet. Univ. Gent* . 66(2b): 885-889.

No Oral Budai, P. Fejes S. Varnagy L. Szabo R. and Keseru M. 2002. 2002. embryonic toxicity of a dimethoate containing insecticide formulation and cu-sulphate in chicken after individual or combined administration. *Meded. Fac.Landbouwwet. Univ. Gent* . 67(2): 99-103.

No COC Bui, L. M., Keen, C. L., and Dubick, M. A. 1994. influence of 12-week nicotine treatment and dietary copper on blood pressure and indices of the antioxidant system in male spontaneous hypertensive rats. *Biological Trace Element Research.* 46(1/2): 67-78 .

No COC Bui, Linh M. University of California Davis, Keen, Carl L., and Dubick, Michael A. comparative

effects of 6-week nicotine treatment on blood pressure and. *Toxicol. V98, N1-3, P57(9)*

FL Bukovjan, K., Hallmannova, A., Karpenko, A., and Sebesta, J. 1993. a study of heavy metals in placentae, foetuses and organs of european hare females. *BIOPHARM (JILOVE).* 3(3-4): 111-116.

Surv Bukovjan, K., Wittlingerova, Z., and Cerna, E. 1997. chemical elements in tissues and histological changes in tissues ofhares (l. europaeus pall.). *Scientia Agriculturae Bohemica.* 28(3): 215-226.

Nutr Bularga, I. A. and Vranchan, V. G. 1982. effect of the energy content of diet on metabolism and productivity ofpigs in relation to trace element availability. <document title>puty, povysheniya effektivnosti kormleniyasel'skokhozyaistvennykh zhivotnykh. 8-12.

No Dose Bundza, A., Sugden, E. A., Nielsen, K., and Hartin, K. E. 1982. copper toxicosis in lambs fed milk replacer. *Canadian Veterinary Journal.* 23(3): 102-105.

Fate Bunn, Clara R. and Matrone, Gennard. 1966. in vivo interactions of cadmium, copper, zinc, and iron in the mouse and rat. *J. Nutr.* 90(4): 395-399.

Nut def Burch, R. E., Williams, R. V., Hahn, H. K. J., Jetton, M. M., and Sullivan, J. F. 1975. serum and tissue enzyme activity and trace-element content in responseto zinc deficiency in the pig. *Clinical Chemistry* 21(4): 568-577.

Fate Burch, R. E., Williams, R. V., Hahn, H. K. J., Jetton, M. M., and Sullivan, J. F. 1975. tissue trace element and enzyme content in pigs fed a low manganese diet part 1 a relationship between manganese and selenium. *J LAB CLIN MED* . 86(1): 132-139.

Alt Burch, Robert E. and Hahn, Henry K. J. 1982. the effect of aging on rat tissue content of moisture, protein, zinc, copper, and manganese with partial food deprivation: ii. middle stages of aging. *Age (Omaha Nebr.)* 5(3): 80-6 .

No COC Burchard, J. F(A), Nguyen, D. H., and Block E(A). 1999. macro- and trace element concentrations in blood plasma and cerebrospinal fluid of dairy cows exposed to electric and magnetic fields. *Bioelectromagnetics* 20(6): 358-364.

Nutr Burdelev, T. E., Kokorina, E. K., and Ivanova, L. Ya. the growth and development of calves in addition of vitamins and poly salt trace elements to the feed. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii. 0 (5). 1979. 137-144.*

CP Burton, J. H. 1992. how green is copper? 147-154.

Surv Butler, D. L., Krueger, R. P., Osmundson, B. C., and Thompson, A. J. 1993.*Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated With Irrigation Drainage in the Pine River Project Area, Southern Ute Indian Reservation, Southwestern Colorado and Northwestern New Mexico, 1988-89* : 105 pp.

No Oral Butt, E. M., Pearson, H. E., and Simonsen, D. G. 1952. production of meningoceles and cranioschisis in chick embryos with lead nitrate. *PROC SOC EXP BIOL MED.* 79: 247-249.

In Vit Byczkowski, J. Z. and Gessner, T. effects of inhibition of nadph: cytochrome p-450 reductase on benzo(a)pyrene metabolism in mouse liver microsomes. *Int-J-Biochem; VOL 21, ISS 5, 1989, P525-9.*

Species Caballero-Cordoba, Glenys M., Pacheco, Maria Teresa B., and Sgarbieri, Valdemiro C. 1997 . chemical composition of yeast biomass (saccharomyces sp.) and protein nutritive value of integral or

mechanically ruptured cells. *Cienc. Tecnol. Aliment.* 17(2): 102-106 .

FL Cachoni, C. C., Bertechini, A. G. a, and Hossain, S. M. 1995. bioavailability of commercial copper sources for broiler in the initial phase. *Ciencia e Pratica.* 19(1): 92-100 .

Mix Calvert, C. C. and Wheeler, W. E. 1979. limestone or dried poultry excreta (dpe) in corn silage as calciumsources for lactating cows. i. feed and milk composition. *Journal of Animal Science* 49(Suppl. 1): 360.

Unrel Calvet, H., Friot, D., and Chambon, J. 1972. effect of mineral supplements on growth and on some biochemicalindicators of mineral metabolism in tropical cattle. *Revue D'Elevage Et De Medecine Veterinaire Des Pays Tropicaux* . 25(3): 397-408.

Phys Calvin, H. I., Yu, C. C., and Bedford, J. M. 1973. effects of epididymal maturation, zinc (ii) and copper (ii) on the reactive sulfhydryl content of structural elements in rat spermatozoa. *Exp Cell Res.* 81(2): 333-41.

FL Camanes, J., Viloria, A. J., and Gracia, J. 1987. [ovulation induction in the female rabbit with chorionic gonadotropin and copper gluconate]. *Noticias Neosan.*(224): 141-143.

Acu Cameron, H. J., Boila, R. J., McNichol, L. W., and Stanger, N. E. 1989. cupric oxide needles for grazing cattle consuming low-copper,high-molybdenum forage and high-sulfate water. *Journal of Animal Science* 67(1): 252-261.

No Oral Camner, P., Casarett-Bruce, M., Curstedt, T., Jarstrand, C., Wiernik, A., Johansson, A., Lundborg, M., and Robertson, B. 1984. toxicology of nickel. *IARC Scientific Publications* (53): 267-76.

Diss Campbell, J. K. 1978.*Growth, Reproduction and Copper Metabolism in Animals Exposed to Elevated Dietary Levels of Cadmium and Zinc.* 199 pp.

CP Campbell, J. K., Davies, N. T., Mills, C. F., and <EDITOR> Kirchgessner, M Ed. 1978. interactions of cadmium, copper and zinc in animals chronically exposed to low levels of dietary cadmium. *Trace Elem. Metab. Man Anim., Proc. Int. Symp., 3rd* : 553-556.

No Efct Campbell, J. K. and Mills, C. F. 1979. the toxicity of zinc to pregnant sheep. *ENVIRON RES.* 20(1): 1-13.

Abstract Campbell, M. H. and Miller, J. K. 1997. effect of additional zinc, copper, manganese, and cobalt on reproduction and milk production of lactating dairy cows receiving bovine somatotropin. *Journal of Animal Science* 75(SUPPL. 1): 250.

Mix Campbell, M. H., Miller, J. K., and Schrick, F. N. 1999. effect of additional cobalt, copper, manganese, and zinc on reproduction and milk yield of lactating dairy cows receiving bovinesomatotropin. *Journal of Dairy Science* 82(5): 1019-1025.

Mix Camps, D. M. and Collia, L. 1997. diets for commercial layers, without and with fish meal and dl-methionine, supplemented with copper sulfate. *Revista Cubana De Ciencia Avicola.* 21(1): 1-5.

FL Canton Castillo, J. G., Moguel Ordonez, Y., Rojas Rodriguez, O., Sauri Duch, E., Miranda Soberanis, J., and Castellanos Ruelas, A. F. 1994. estimation of damage induced by copper in poultry litter used in feeding sheep. *Tecnica Pecuaria En Mexico.* 32(2): 82-89.

In Vit Cantoni, Orazio, Hussain, Saber, Guidarelli, Andrea, and Cattabeni, Flaminio. 1994. cross-resistance to heavy metals in hydrogen peroxide-resistant cho cell variants. *Mutat. Res.* 324(1-2):

1-6 .

Nut def Cao, J. and Chavez, E. R. 1995. the effects of low dietary copper intake during pregnancy onphysiological fluids and reproductive performance of first-littergilts. *Journal of Trace Elements in Medicine and Biology* 9(1): 18-27.

Herp Carattino, Marcelo D., Peralta, Susana, Perez-Coll, Cristina, Naab, Fabian, Burlon, Alejandro, Kreiner, Andres J., Preller, Ana F, and Fonovich de Schroeder, Teresa M. 2004. effects of long-term exposure to cu2+ and cd2+ on the pentose phosphate pathway dehydrogenase activities in the ovary of adult bufo arenarum: possible role as biomarker for cu2+ toxicity. *Ecotoxicology and Environmental Safety.* 57(3): 311-318.

Unrel Carlsen, J. and De Olmos, J. S. 1981. a modified cupric-silver technique for the impregnation of degenerating neurons and their processes. *Brain Research* 208(2): 426-31.

QAc Carlton, W. W. and Kelly, W. A. 1968. reproductive response of female rats receiving a multipesticide mixture and diets containing deficient, marginal or excess amounts of copper. *IMS Ind Med Surg.* 37(7): 547.

Nut def Carlton, W. W. and Henderson W. 1963. 1963. cardiovascular lesions in experimental copper deficiency in chickens. *J. Nutr.* 81: 200-208.

Nut def Carlton, W. W. and Henderson W. 1964. 1964. studies on the copper requirement of growing chickens. *Avian Dis.* 8: 227-234.

No Oral Carmignani, M., Finelli, V. N., and Boscolo, P. mechanisms in cardiovascular regulation following chronic exposure of male rats to inorganic mercury. *Toxicol. Appl. Pharmacol. (1983)* 69(3): 442-50 .

Bio Acc Carpene, E., Fedrizzi, G., Cortesi, P., and Cattani, O. 1990. heavy metals (zn, cu, cd) in fish and aquatic birds. *ITAL. J. BIOCHEM* VOL. 39, NO. 2: pp. 133A-134A.

Bio Acc CARPENE, E., SERRA, R., and ISANI, G. heavy metals in some species of waterfowl of northern italy. *Journal of Wildlife Diseases; 31 (1). 1995. 49-56.*

Surv Carpene, E., Serra, R., Isani, G., Nygard, T., Jordhoy, P., and Skare, J. U. 1995. heavy metals in some species of waterfowl of northern italy.: environmental pollutants in merlin in norway. *JOURNAL OF WILDLIFE DISEASES.* 31(1): 49-56.

Alt Carpenter, T. O., Pendrak, M. L., and Anast, C. S. 1988. metabolism of 25-hydroxyvitamin d in copper-laden rat: a model of wilson's disease. *Am J Physiol.* 254(2 Pt 1): 150-4.

CP CARSON, T. L. 1988. copper poisoning and other toxicology problems in sheep. *125TH ANNUAL AMERICAN VETERINARY MEDICAL ASSOCIATION MEETING JULY 17-26, 1988. J AM VET MED ASSOC.* 192(12): 1764.

No Oral Cartana, J. Romeu A. and Arola L. 1992. 1992. effects of copper, cadmium and nickel on liver and kidney glutathione redox cycle of rats (rattus sp.). *Comp. Biochem. Physiol. C* . 101(2): 209-213.

Mix Casati, Rodoleo Mario, Vazhapilly, Paul, Cappa, Vittorio, and Tonna, Mauro. effects of heavy metal-supplemented diets on the mineral contents in rabbits. *Ann. Fac. Agrar. (Univ. Cattol. Sacro Cuore) (1988)* 28(2): 241-69.

Mix Cavalchini, L., Pignatelli, P., and Baroli, D. 1997. effects of chelated trace-elements with amino acids on egg shell quality in commercial laying hens. *Atti Della Associazione Scientifica Di Produzione Animale* (12): 361-362.

FL Cavalchini, L., Pignatelli, P., Baroli, D. Milan Univ. Italy Istituto di Zootecnica, and Lancioni, F. SIMIR Srl S. Mauro Pascoli Forli' Italy. 1997. effects of chelated trace-elements with aminoacids on egg shell quality in commercial laying hens. <original> effetto degli oligoelementi chelati con aminoacidi sulla qualita' del guscio nella gallina ovaiola. *Atti Della Associazione Scientifica Di Produzione Animale. (No.12) P. 361-362*

CP Cavalheiro, A. C. L., Trindade, D. S., Rodrigues, C. O., Costanzi, A. R., and Castagna, M. the mineral supplementation effects for growth of grazing lambs. *Combined Meeting of the American Dairy Science Association and the American Society of Animal Science, Lexington, Kentucky, Usa, July 31-august 4, 1989. J Dairy Sci. 72 (Suppl. 1). 1989. 481-482.*

Surv Cerklewski, F. L. 1979. determination of a copper requirement to support gestation and lactation for the female albino rat. *J Nutr.* 109(9): 1529-33.

Unrel Cerovsky, J. 1981. the effect of addition of some chlorides on survival rate of boarspermatozoa in glucose solution. *Vedecke Prace Vyzkumneho Ustavu Pro Chov Prasat v Kostelci Nad Orlici* 5: 76-87.

FL Chabanet, D. 1986.*Ovine Toxicology: Epidemiological Study From the Data of the National Veterinary Antipoison Center and the Toxicology Laboratory in France, 1980-1983. Clinical Observations and Assays*

FL Chaika, P. A. 1968. [effect of cobalt and copper salts on the toxic action of lead on the animal organism]: <original> o vliianii solei kobal'ta i medi pri toksicheskom vozdeistvii svintsa na organizm zhivotnykh. *Vopr Pitan.* 27(6): 29-33.

Nutr Chairatanayuth, P. inclusion of amaranth crop residues in diet for cattle. *Food Reviews International. 8 (1). 1992. 159-164.*

Nutr Chairatanayuth, P. and <Editors> Dixon, R. M. 1986. inclusion of amaranth crop residue in diets for cattle. 131-135.

FL Chairerk Suwannarat, Amnat Suwanarit, and Chamchan Vijarnsorn (Kasetsart Univ., Bangkok Thailand Faculty of Agriculture. Dept. of Soil Science. 1984. studies on soils and fertilizers for peanut production. <original> ngan wichai din lae pui phua kan phalit thualisong. research reports 1984. <original> raingan khonkhwa wichai prachampi 2527. *P. 37-39*

In Vit Chan W-S, Marshall, J. F., Svensen, R., Phillips, D., and Hart, I. R. photosensitizing activity of phthalocyanine dyes screened against tissue culture cells. *PHOTOCHEM PHOTOBIOL. Photochemistry and Photobiology. 45 (6). 1987. 757-762.*

Unrel Chandolia, R. K. and Verma, S. K. 1987. blood plasma trace elements in anoestrous buffalo heifers. *Indian Journal of Animal Sciences.* 57(3): 201-203.

Mix Chaney, R. L., Stoewsand, G. S., Furr, A. K., Bache, C. A., and Lisk, D. 1978. elemental content of tissues of guinea pigs fed swiss chard grown onmunicipal sewage sludge-amended soil. *Journal of Agricultural and Food Chemistry* 26(4): 994-997.

No Oral CHANG, C. C., TATUM, H. J., and KINCL, F. A. effect of intrauterine copper and other metals on implantation in rats and hamsters. *Fertil Steril 21:274-278,1970*

FL Chang Cuiqing, Su Yin, Wang Zhongbo, Lu Xuesong, and Zhang Jing. 1993. an experimental study of the pathogenic effects of multielement contents and its patterns in feeds from keshan disease area in rats. *Acta Nutrimenta Sinica* 15(3): 245-255.

In Vit Chang Ling-Yi(A), Kang Bor-Hwang, Slot Jan W, Vincent Renaud, and Crapo James D. 1995. immunocytochemical localization of the sites of superoxide dismutase induction by hyperoxia in rat lungs. *Laboratory Investigation* 73(1): 29-39.

FL Chang, W. F., Wu, F. M., Shyu, J. J., Lin, J. H., Tsay, C. E., and Lin, H. K. 1992. clinical and pathological studies of swine copper intoxication. *J CHIN SOC VET SCI.* 18(2): 97-108.

FL Chang, W. K., Lee, J. H., and Cheong, S. K. 1988. the effect of substituting copper sulfate for antibiotics on the performance of finishing pigs. *RES REP RURAL DEV ADM (SUWEON).* 30(3 Livest.): 25-30.

Surv Chapin, Robert E., Harris, Martha W., Allen, Janet D., Haskins, Eric A., Ward, Sandra M., Wilson, Ralph E., Davis, Barbara J., Collins, Bradley J., and Lockhart, Ann C. 1994. the systemic and reproductive toxicities of copper indium diselenide, copper gallium diselenide, and cadmium telluride in rats. *Brookhaven Natl. Lab., (Rep.) BNL, NBNL 61480, Understanding and Managing Health and Environmental Risks of CIS, CGS, and CdTe Photovoltaic Module Production and Use* : 5-22.

Nutr Charmley, L. L. and Ivan, M. 1989. the relative accumulation of copper in the liver and kidneys of sheep fed corn silage supplemented with copper chloride copper acetate or copper sulfate. *CAN J ANIM SCI.* 69(1): 205-214.

Unrel Chashchukhin, V. A. 1992. the content of traced elements in the liver and kidneys of muskrats from different habitats. *Byulleten' Moskovskogo Obshchestva Ispytatelei Prirody Otdel Biologicheskii* 97(2): 36-38.

CP Chatterjee, I. B(A). 1998. vitamin c: biosynthesis, evolutionary significance and biological function. *Proceedings of the Indian National Science Academy Part B Biological Sciences* 64(3-4): 213-233.

No Oral Chattopadhyay, A., Sarkar, M., and Biswas, N. M. *. 2002. effect of copper chloride on adrenocortical activities in adult and immature male rats. *Environmental Toxicology and Pharmacology [Environ. Toxicol. Pharmacol.]. Vol. 11, No. 2, Pp. 79-84. Mar 2002.*

Surv Chauhan, F. S(A) and Nderingo, N. E. 1997. seasonal variations in mineral elements of soil pasture and blood serum in different phases of normal reproduction in dairy cattle. *Indian Veterinary Journal* 74(1): 32-34.

Not Avail Chavez, E. R. 1987. nutritional and reproductive response of first-litter gilts fed apractical diet without trace mineral supplementation during gestationand lactation. <document title>research report, department of animal science. mcgilluniversity. 67-72.

Mineral Chavez, E. R., Gallo, G. F., Algire, J. E., Downey, B. R., <Editors> Anke, M., Meissner, D., and Mills, C. F. 1993. variation in trace mineral content of semen collected from young dairybulls on a progeny-testing program. 445-448.

Bio Acc Cheek, Donald B., Powell, Geraldine K., Reba, Richard C., and Feldman, Milton H. manganese, copper, and zinc in rat muscle and liver cells and in thyroid and pituitary insufficiency. *Bull. Johns Hopkins Hosp. (1966)* 118(4): 338-48 .

FL Chen, K. L., Chen, C. L., Lien, T. F., and Horng, Y. M. 1997. effects of dietary levels of copper on tissues residues and the blood chemistry of chicks. *Taiwan Journal of Veterinary Medicine and Animal Husbandry.* 67(1): 39-44.

Drug CHEN, L. H., XI, S., and COHEN, D. A. liver antioxidant defenses in mice fed ethanol and the ain-76a diet. *ALCOHOL; 12 (5). 1995. 453-457.*

No Org Chen, M, Ma, LQ, and Harris, WG. 1999. baseline concentrations of 15 trace elements in florida surface soils. *J. Environ. Quality.* 28: 1173-1181.

Nutr Chen, M. C., Lee, C. F., Lee, S. J., Chen, C. P., Shiao, T. F., Shiao, T. W., Yang, S. P., and Liang, Y. 1991. the effect of high dietary copper, manganese or zinc supplementation ontheir contents in milk. *Journal of Chinese Society of Animal Science* 20(2): 135-144.

No Oral Chen, M. T., Yiin, S. J., Sheu, J. Y., and Huang, Y. L. 2002. brain lipid peroxidation and changes of trace metals in rats following chronic manganese chloride exposure. *Journal of Toxicology and Environmental Health. Part a, 2002 Feb, 65(3-4):305-16.*

Abstract CHEN, N., CHEN, N., JOHNSON, R. J., and DYER, I. A. effects of ethanol and diet on trace element levels in rat tissues. *FED PROC; 36 (3). 1977 1125*

Abstract Chen, R. W., Whanger, P. D., and Weswig, P. H. rat liver metallo thionein relationship to metal metabolism. *Federation Proceedings. 34 (3). 1975 927*

CP Chen, S. Y., Collipp, P. J., and Hsu, J. M. 1984. the effect of selenium toxicity on tissue distribution of zinc, iron, and copper in rats. *Selenium in Biology and Medicine : Proceedings of the Third International Symposium on Selenium in Biology and Medicine, Held May 27-June 1, 1984, Xiangshan (Fragrance Hills) Hotel Beijing, People's Republic of China.* 367-376.

Dup Chen, S. Y., Collipp, P. J., Hsu, J. M., Watanabe, T., Takayama, K., Horie, S, Babicky, A., Rychter, Z., Kopoldova, J., and Ostadalova, I. 1985. the effect of sodium selenite toxicity on tissue distribution of zinc, iron, and copper in rats: studies on the effect of sulfite, and the related compounds on the function of mitochondria. (ii). decrease in the growth rate and hepatic mitochondrial respiratory control rate on feeding selenite to mice: age dependence of selenite uptake in rat eye lenses. *Biol. Trace Elem. Res.* 7(3): 169-79 .

Unrel Cheng, B. T. sawdust as a greenhouse growing medium. *J. Plant Nutr. (1987)* 10(9-16): 1437-46

Nutr Chernikov, M. P., Nikolaevskaya, V. R., Tsupak, L. E., Aleshko-Ozhevskii, Yu. P., Makhova, N. N., and Shevyakova, L. V. nutritional value of modified casein. *Vopr. Pitan. (1991)* (3): 27-9

Aquatic Cherry, D. S., Van Hassel, J. H., Farris, J. L., Soucek, D. J., and Neves, R. J. 2002. site-specific derivation of the acute copper criteria for the clinch river, virginia. *Human and Ecological Risk Assessment [Hum. Ecol. Risk Assess.]. Vol. 8, No. 3, Pp. 591-601. Apr 2002.*

Acu Chertok, R. J, Kullgren, B., and Burbank, D. 1984. the effects of cdcl sub 2 on the maternal-to-fetal clearance of sup 6 sup 7 cu and placental blood flow. *Proceedings of the Society for Experimental Biology and Medicine* 176(2): 138-142.

In Vit Cheton, P. L-B and Archibald, F. S. manganese complexes and the generation and scavenging of hydroxyl free radicals. *Free Radical Biology & Medicine. 5 (5-6). 1988. 325-334.*

Phys Chi, Pei-Yuan. a study of the effects of environmental temperatures on dietary iron and copper utilization in animals [chickens]. *Chung-Hua Nung Hsueh Hui Pao (1975)* : 90, 82-6.

Fate Chmielnicka, Jadwiga, Komsta-Szumska, Elzbieta, and Zareba, Grazyna. 1988. effects of interaction between zinc-65, cadmium, and copper in rats. *Biol. Trace Elem. Res.* 17: 285-92.

No Oral Cho, Y. H. and Lim, S. K. 1986. protective effect of several metals against cadmium injury to mouse testicle. *J Cathol Med Coll.* 39(4): 1391-1403.

Lead Shot Choi, J. S., Jung, W. H., Youn, K. S., and Lee, D. P. 1994. heavy metal concentrations of some game species captured in kyeongsangnam-do, korea. *Journal of Korean Forestry Society.* 83(1): 6-11.

Phys Choi Jin-Ho(A), Kim Dae-Ik(A), Park Soo-Hyun(A), Kim Dong-Woo(A), and Koo Jae-Geun. 1999. effects of sea tangle (laminaria japonica) and fucoidan components on the attack of oxygen radicals in kidney. *Journal of the Korean Fisheries Society.* 32(6): 758-763.

FL Choi, Mi-Kyeong and Jun, Ye-Sook. effect of copper supplementation on mineral utilizations in rats. *Han'Guk Sikp'Um Yongyang Kwahak Hoechi (1999)* 28(5): 1124-1130 .

FL Choi, Y. J. and Paik, I. K. 1989. the effect of supplementing copper sulfate on the performance of broiler chicken. *Korean J Anim Nutr Feedst.* 13(4): 193-200.

No Dur Chooi, K. F., Hutagalung, R. I., and Mohamed, W. E. W. 1988 . copper toxicity in sheep fed oil palm by-products. *Aust Vet J.* 65(5): 156-157.

Unrel Chowdhury, N. and Rajvir Singh (Punjab Agricultural University, Department of Veterinary Parasitology and Physiology College of Veterinary Science Ludhiana 141 004 Punjab India. 1993. distribution of some elements in hydatid cysts of echinococcus granulosus from buffalo (bubalus bubalis). *Journal of Helminthology. V. 67(2) P. 112-114*

Org Met Chowdhury, S. D., Paik, I. K., Namkung, H., and Lim, H. S. 2004. responses of broiler chickens to organic copper fed in the form of copper-methionine chelate. *Animal Feed Science and Technology.* 115(3-4): 281-293.

No Dose Christmas, R. B. and Harms, R. H. 1983. the performance of laying hens as affected by copper sulfate and methionine level. *Poult Sci.* 62(2): 389-91.

Drug Christmas, R. B. and Harms, R. H. 1984. the value of protein methionine or other nutrients for the alleviation of copper toxicity in the broiler chick diet. *NUTR REP INT.* 29(5): 1217-1222.

HHE Chugh, K. S., Singhal, P. C., Sharma, B. K., Mahakur, A. C., Pal, Y., Datta, B. N., and Das, K. C. acute renal failure due to intravascular hemolysis in the north indian patients. *Am-J-Med-Sci; VOL 274, ISS 2, 1977, P139-46.*

In Vit Chukhlovin, A. B., Tokalov, S. V., Yagunov, A. S., and Zharskaya, V. D. acute effects of copper, chromium, and manganese upon immature blood cells and macrophages. *Trace Elem. Electrolytes (1996)* 13(1): 37-41

Soil Chukhlovin, A. B., Yagunov, A. S., Tokalov, S. V., Reshchikov, A. M., and Zharskaya, V. D. 1996. acute effects of metal-enriched soil samples upon immature blood cells and macrophages. *Trace Elem. Electrolytes (1996)* 13(3): 151-154 .

Mix Chumachenka, U. Ya. and Zharkina, T. A. 1983. changes in the activity of transaminases in the liver of pigs givendiets with different vitamin and mineral mixtures. *Vestsi Akademii Nauk BSSR, Sel'Skagaspadarchykh Navuk.*(1): 108-111, 127.

Fate Chun, Ki-Jung and Kim, Bong-Hee. 1996. changes of heavy metal concentration in rat 's tissues and urine after cd-administration. *Yakhak Hoechi* 40(5): 501-506.

FL Chung, K. H., Kang, M. H., and Han, I. K. 1984. the toxicity of chromium and its interaction with silver, copper and zinc in chicks. *Korean Journal of Animal Sciences.* 26(2): 172-176.

FL Chung, K. H. Samyuk Junior Agricultural Coll. Seoul Korea R., Kang, M. H. KOrea Univ. Seoul Korea R. Coll. of Agriculture, and Han, I. K. Seoul National Univ. Suweon Korea R. Coll of Agriculture. 1983. the toxicity of hexavalent chromium and its interaction with copper and zinc in chicks. *Korean Journal of Animal Sciences. V. 25(6) P. 692-696*

FL Chung, Keun H., Kang, Myun H., Han, In K., and Kim, Chun S. 1984. the effect of copper and zinc on chromium toxicity in chicks. *Hanguk Ch'Uksan Hakhoe Chi* 26(2): 177-80.

FL Chung, Keun H., Kang, Myun H., Han, In K., and Kim, Chun S. 1984. the toxicity of chromium and its interaction with silver, copper and zinc in the chicks. *Hanguk Ch'Uksan Hakhoe Chi* 26(2): 172-6 .

FL Cibulka, J., Sova, Z., Muzikar, V., Bernatzik, K., Sevcikova, I., and Nemec, Z. 1981. influence of addition of dried activated mud from town waste waterpurification station on copper, chromium, iron, zinc and manganesecontents in liver, kidneys and muscles of broilers. *Sbornik Vysoke Skoly Zemedelske v Praze, Fakulta Agronomicka, B* (35): 127-140.

FL Cid, Jose Antonio, Petenatti, Elisa, Arellano, Mirta, Muzaber, Jorge, and de Mucciarelli, Sara L. protein biological value from atriplex suberecta leaves. *Arch. Latinoam. Nutr. (1991)* 41(3): 421-7

Fate Ciravolo, T. G., Martens, D. C., Hallock, D. L., Collins, E. R. Jr, Kornegay, E. T., and Thomas, H. R. pollutant movement to shallow ground water tables from anaerobic swine waste lagoons . *Journal of Environmental Quality. 8 (1). 1979. 126-130.*

Plant Clancy, K. M., Chen, Z., and Kolb, T. E. 2004. foliar nutrients and induced susceptibility: genetic mechanisms of douglas-fir resistance to western spruce budworm defoliation. *Canadian Journal of Forest Research, 34 (4) Pp. 939-949, 2004.*

Mineral Clark, C. K., Ansotegui, R. P., and Paterson, J. A. 1995. the relationship between mineral nutrition of the beef cow andreproductive performance. *Bovine Practitioner* (29): 38-42.

Surv Clark, D. R. Jr. 1992. organochlorines and heavy metals in 17-year cicadas pose no apparent dietary threat to birds. *ENVIRON MONIT ASSESS.* 20(1): 47-54.

CP Clark, R. G. 1982 . trace element analysis in the diagnosis of poor growth in sheep; withspecial reference to cobalt and selenium. *Proceedings of the 12th Seminar of the Sheep and Beef Cattle Society of the New Zealand Veterinary Association, 8th-12th November 1982.* 150-163.

FL Clausing, P. 1978 . shell thinning in avian eggs as influenced by pesticides. *Biol. Rundsch.* 16(1): 28-37.

CP Clawson, A. J., Southern, L. L., and Armstrong, W. D. effect of excessive dietary minerals on performance of weanling and growing finishing pigs. *MEETING OF THE AMERICAN SOCIETY OF ANIMAL SCIENCE, SOUTHERN SECTION, HOT SPRINGS, ARKANSAS, USA, FEB. 3-6, 1980. J ANIM SCI. 51 (Suppl. 1). 1980 (Recd. 1981). 48.*

Rev Clegg, J. A. 1994. male reproductive toxicity testing. *Adverse Drug Reactions and Toxicological*

Reviews. 13(4): 235-247.

Bio Acc Clegg, M. S., Casey, S. M., and Keen, C. L. 1986. waterborne copper toxicity in sheep. *Agri-Practice.* 7(1): 19-22.

Drug Clerch, L. B., Neithardt, G., Spencer, U., Melendez, J. A., Massaro, G. D., and Massaro, D. pertussis toxin treatment alters manganese superoxide dismutase activity in lung: evidence for lung oxygen toxicity in air-breathing Rats. *Journal of Clinical Investigation; 93 (6). 1994. 2482-2489.*

Nut def Cloete, S. W. P a, Van, Niekerk F E, Kritzinger, N. M., Van, Der Merwe G D, Heine, E. W. P., and Scholtz, Anna J a. 1994. production responses of sheep supplemented with copper, cobalt and selenium on kikuyu ryegrass pastures. *Journal of the South African Veterinary Association.* 65(2): 52-58.

Alt Cloez, Isabelle and Bourre, Jean Marie. copper, manganese and zinc in the developing brain of control and quaking mice. *Neurosci. Lett. (1987)* 83(1-2): 118-22.

Surv Cloutier, N. R., Clulow, F. V., Lim, T. P., and Dave, N. K. 1985. metal copper nickel iron cobalt zinc lead and radium-226 levels in meadow voles microtus-pennsylvanicus living on nickel and uranium mine tailings in ontario canada environmental and tissue levels. *Environ Pollut Ser B Chem Phys.* 10(1): 19-46.

Surv Cloutier, N. R., Clulow, F. V., Lim, T. P., and Dave, N. K. 1986. metal copper nickel iron cobalt zinc lead and radium-226 levels in tissues of meadow voles microtus-pennsylvanicus living on nickel and uranium mine tailings in ontario canada site sex age and season effects with calculation of average skeletal radiation dose. *Environ Pollut Ser A Ecol Biol.* 41(4): 295-314.

Bio Acc Clum Nancy J(A), Fitzpatrick Marianne P, and Dierenfeld Ellen S. 1996. effects of diet on nutritional content of whole vertebrate prey. *Zoo Biology* 15(5): 525-537.

Anat Cockell, Kevin A., Fischer, Peter W. F., and Belonje, Bartholomeus. elemental composition of anatomically distinct regions of rat liver. *Biol. Trace Elem. Res. (1999)* 70(3): 251-263 .

BioX Codina, J. C., Perez-Garcia, A., Romero, P., and De Vicente A. 1993. a comparison of microbial bioassays for the detection of metal toxicity. *Archives of Environmental Contamination and Toxicology* 25(2): 250-254.

Unrel Collins Michael A(A), Corso Thomas D, and Neafsey Edward J. 1996 . neuronal degeneration in rat cerebrocortical and olfactory regions during subchronic "binge" intoxication with ethanol: possible explanation for olfactory deficits in alcoholics. *Alcoholism Clinical and Experimental Research* 20(2): 284-292.

In Vit Collinson, Simon R. and Fenton, David E. metal complexes of bibracchial schiff base macrocycles. *Coord. Chem. Rev. (1996)* : 148, 19-40.

Nut def Combs, G. F. Jr., Su, Q., Liu, C. H., and Combs, S. B. effects of dietary selenite, copper, and zinc on tissue trace mineral levels in chicks. *Biol. Trace Elem. Res. (1986)* : 11, 51-64 .

No Dose Combs, GE, Ammerman, CB, Shirley, RL, and Wallace, HD. 1966. effects of source and level of dietary prtein on pigs fed high-copper rations. *J. Anim. Sci.* 25: 618.

Nut def Conde-Martel, A., Gonzalez-Reimers, E., Santolaria-Fernandez, F., Castro-Aleman, V., Galindo-Martin, L., Rodriguez-Moreno, F., and Martinez-Riera, A. combined effects of ethanol and protein deficiency on hepatic iron, zinc, manganese, and copper contents. *Alcohol (N. Y.) (1992)* 9(5):

341-8

FL Conde Martel, A., Gonzalez Reimers, E., Santolaria Fernandez, F., Castro Aleman V, Marchena Gomez, J., and Martinez Riera, A. 1993. [liver changes in protein malnutrition. an experimental study in rats]. <original> cambios hepaticos en la malnutricion proteica. estudio experimental en ratas. *Nutricion Hospitalaria* 8(6): 358-63 .

FL Contrea, A., Milos, M., Halmagean, P., Tuluca, E., Alda, M., Ratiu, G., and Schmidt, S. 1979. effect of trace minerals chelated with polyphosphate on biochemicalindices in pigs. *Lucrari Stiintifice, Institutul Agronomic Timisoara, Zootehnie* 16: 105-109 .

Unrel Cooke, J. A. and Fontenot, J. P. 1990. utilization of phosphorus and certain other minerals from swine waste and broiler litter. *Journal of Animal Science* 68(9): 2852-63.

CP Cooper, G. P., Choudhury, H., Hastings, L., and Petering, H. G. 1978. prenatal cadmium exposure effects on essential trace metals and behavior in rats. *DOE (US Department of Energy) Symposium Series, Vol. 47. Developmental Toxicology of Energy-related Pollutants; Proceedings of the 17th Annual Hanford Biology Symposium, Richland, WASH., USA, OCT. 17-19, 1977.* . 47: 627-638.

In Vit Copin, J. C(A), Ledig, M., and Tholey, G. 1994. alteration of astrocyte metabolism during the ischemic stress. *Circulation Et Metabolisme Du Cerveau* 11(2): 161-169.

Nutr Corah, L. Kansas State Univ. Manhattan KS USA. 1996. trace mineral requirements of grazing cattle. *Animal Feed Science Technology. V. 59(1-3) P. 61-70*

Rev Corah, L. R. and Ives, S. 1991. the effects of essential trace minerals on reproduction in beef cattle. *Veterinary Clinics of North America, Food Animal Practice.* 7(1): 41-57.

Surv Corbett, W. S., Saylor, W. W., Long, T. A., and Leach, R. M. Jr. 1978. intracellular distribution of hepatic copper in normal and copper-loaded sheep. *J ANIM SCI.* 47(5): 1174-1179.

FL Cornelio, F., Frattola, L., and Pellegrini, G. 1970. (chronic copper intoxication in the rat: biochemical and histochemical alterations in the brain and Liver.). *Acta Neurol* . 25(5): 594-604.

Surv Cory-Slechta, D. A. 1990. alterations in tissue pb distribution and hematopoietic indices during advanced age. *Arch Toxicol.* 64(1): 31-7.

Species Cottenie, A. 1972. effect of soil enrichment with mineral elements and fertilizers onsurface water and plants. *Qualitas Plantarum Et Materiae Vegetabiles* 22(1): 37-53.

Herp Cotter, M. A., Policz, D. L., Poech, G., and Dawson, D. A. 2000. analysis of the combined osteolathyritic effects of beta -aminopropionitrile and diethyldithiocarbamate on xenopus development. *Toxicological Sciences [Toxicol. Sci.]. Vol. 58, No. 1, Pp. 144-152. Nov 2000.*

Fate Cousins, R. J. 1985. absorption, transport, and hepatic-metabolism of copper and zinc - special reference to metallothionein and ceruloplasmin. *Physiological Reviews* 65(2): 238-309.

Unrel COX, S. W. and ELEY, B. M. microscopy and x-ray microanalysis of subcutaneously implanted conventional and high-copper dental amalgam powders in the guinea-pig. *Arch Oral Biol; 32 (4). 1987. 265-272.*

Unrel Crapo, J. D., Barry, B. E., Foscue, H. A., and Shelburne, J. 1980. structural and biochemical changes in rat lungs occurring during exposures to lethal and adaptive doses of oxygen. *American Review of Respiratory Disease* 122(1): 123-43.

Nutr Creech, B. L(A), Spears, J. W(A), Flowers, W. L(A), and Hill, G. M. 1998. effects of dietary level and source of zinc and copper on performance and metal excretion in swine. *Journal of Dairy Science* 81(SUPPL. 1): 172.

Unrel Creffield, J. W. and Tam Mun Kwong. 1979. laboratory assessments of the efficacy of cca and pcp-treated dyeracostulata (jelutong) against two species of australian termites. *Malaysian Forester.* 42(3): 230-239.

FL Creteanu, Emilia, Creteanu, H., Ionut, Carmen, and Vlad, Mariana. 1997. calcium, magnesium, copper and zinc modifications in rats exposed to lead with supplemental dietary fiber intake. *Clujul Med.* 70(3): 425-430 .

Mineral Criste, R. D., Burlacu, G., Taranu, I., and Tibara, D. 1993. research on the optimum amount of minerals given to pigs. 1. absorptionand metabolism of calcium, phosphorus, iron, copper and manganese inyoung pigs (10 to 30 kg). *Analele Institutului De Biologie Si Nutritie Animala Balotesti* 16: 141-156.

Nutr Criste, R. D., Taranu, I., Burlacu, G., Borcea, F., and Fodorean, M. 1995. the effect of feeding phosphatic glass to broiler chicks under various feeding conditions. *Analele Institutului De Biologie Si Nutritie Animala Balotesti* 17: 115-122.

Bio Acc Cristofori, P., Terron, A., Marella, M., Moretti, U., Pasqualicchio, M., Velo, G. P., and Milanino, R. 1992. copper supplementation in the rat: preliminary observations on the clinical, hematological and histopathological profile. *Agents Actions.* Spec No: C118-20.

Nut def Critchfield, James W., Carl, Frank G. , and Keen, Carl L. 1993. anticonvulsant-induced changes in tissue manganese, zinc, copper, and iron concentrations in wistar rats. *Metab. Clin. Exp.* 42(7): 907-10 .

No COC Crosby, T. F., Quinn, P. J., Callan, J. J., and O'Hara, M. 2004. effect of floor type and dietary molybdenum content on the liver copper concentration at slaughter and performance of intensively finished lambs. *Livestock Production Science.* 90(2-3): 181-190.

Surv Crowe, A. and Morgan, E. H. 1996. iron and copper interact during their uptake and deposition in the brain and other organs of developing rats exposed to dietary excess of the two metals. *J Nutr.* 126(1): 183-94.

Bio Acc Csapo, J., Horn, A., Csapo, J., Sugar, L., Nagy, I., and Nagyne Gal E. milk composition of the red deer roe deer and fallow deer ii. macroelement and microelement fat fatty acid and vitamin content. *Allattenyesztes Es Takarmanyozas. 35 (6). 1986 (Recd. 1987). 559-564.*

Nutr Csapo J(A), Martin, T. G., Csapo-Kiss, Z. S(A), and Hazas Z(A). 1996. protein, fats, vitamin and mineral concentrations in porcine colostrum and milk from parturition to 60 days. *International Dairy Journal* 6(8-9): 881-902.

Bio Acc Cuesta, P. A(A), Mcdowell, L. R., Kunkle, W. E., Bullock, F., Drew, A., Wilkinson, N. S, and Martin, F. G. 1993. seasonal variation of soil and forage mineral concentrations in north florida. *Communications in Soil Science and Plant Analysis* 24(3-4): 335-347.

CP Cui, C. T., Heine, E., Stites, T., Keen, C., Mitchell, A. E., and Rucker, R. B. 1999. influence of dietary vanadium on copper accumulation and lysyl oxidase activity in rat tendon. *FASEB Journal* 13(4 PART 1): A577.

CP Cui C-T(A), Chung, K. H., Mitchell, A., Keen, C. L., Uriu-Hare, J. Y., and Rucker, R. B. 1998.

dietary vanadium and its influence on copper accumulation in skin and liver. *FASEB Journal* 12(4): A220.

FL Cui, X. 1991. [the effect of cu, zn, mn, on selenium content in the liver, brain, blood and kidney of mice]. *Chung Hua Yu Fang I Hsueh Tsa Chih.* 25(6): 345-6.

Nutr Cunha, T. J. 1981. bone development in horses: vitamins and minerals. *Feedstuffs, USA* 53(33): 27-29.

Bio Acc Cunningham, IJ. 1946. the toxicity of copper to bovines. *N.Z. J. Sci. Technol.* 27 A: 372.

n=1 Cupps, PT and Howell, CE. 1949. the effects of feeding supplemental copper to growing foals. *J. Anim. Sci.* 8: 286.

Unrel Curca, D. 1991. metabolic profile of intensively reared pigs. ii. blood electrolytevalues in clinically healthy pigs, as related to age, and in unthriftypigs. *Lucrari Stiintifice, Institutul Agronomic 'Nicolae Balcescu', Bucuresti, Seria C, Medicina Veterinara* 34(1): 29-46.

No Dose Currie, D. and Valkama, J. 1998. limited effects of heavy metal pollution on foraging and breeding success in the curlew (numenius arquata). *Environmental Pollution.* 101(2): 253-261.

Surv Custer, Thomas W. and Hohman, William L. trace elements in canvasbacks (aythya valisineria) wintering in louisiana, usa, 1987-1988. *Environ. Pollut. (1994)* 84(3): 253-9 .

Bio Acc Cymbaluk, N. F. and Christensen, D. A. 1986. copper, zinc and manganese concentrations in equine liver, kidney and plasma. *Canadian Veterinary Journal* 27(5): 206-210.

Species Cyriac, P. J., Antony, A., and Nambisan, P. N. K. 1989. hemoglobin and hematocrit values in the fish oreochromis-mossambicus peters after short term exposure to copper and mercury. *Bull Environ Contam Toxicol.* 43(2): 315-320.

No Oral Czako Laszlo(A), Takacs Tamas, Varga Ilona S, Tiszlavicz Laszlo, Hai Do= Quy, Hegyi Peter, Matkovics Bela, and Lonovics Janos. 1998. involvement of oxygen-derived free radicals in l-arginine-induced acute pancreatitis. *Digestive Diseases and Sciences* 43(8): 1770-1777.

Org met Czarnecki, G. L. and Baker, D. H. 1985. reduction of liver copper concentration by the organic arsenical, 3-nitro-4-hydroxyphenylarsonic acid. *Journal of Animal Science* 60(2): 440-50.

No COC Dalton, T., Pazdernik, T. L., Wagner, J., Samson, F., and Andrews, G. K. 1995. temporalspatial patterns of expression of metallothionein-i and -iii and other stress related genes in rat brain after kainic acid-induced seizures. *Vol. 27, No. 1, Pp. 59-71* Neurochem. Int.

Nut def Dameron, C. T. and Harris, E. D. 1987. regulation of aortic cuzn-superoxide dismutase with copper. effects in vivo. *Biochemical Journal* 248(3): 663-8.

CP Damerson, C. T. and Harris, E. D. copper-zinc superoxide dismutase in the developing chick aorta a critical role of copper. *69th Annual Meeting of the Federation of American Societies for Experimental Biology, Anaheim, Calif., USA, APR. 21-26, 1985. FED PROC. 44 (4). 1985. 995.*

Mix Damron, B. L., Wilson, H. R., Hall, M. F., Johnson, W. L., Osuna, O., Suber, R. L., and Edds, G. T. effects of feeding dried municipal sludge to broiler-type chicks and laying hens. *Poult. Sci. (1982)* 61(6): 1073-81 .

Rev Daniels, A. L. and Everson, G. J. relation of manganese to congenital debility. *J NUTR 9:191-*

203,1935

Nut def Dankowski, A. and Janicki, B. 1991. preliminary observations on mineral and vitamin feeding of merino ewesduring breeding season. *Akademia Techniczno-Rolnicza w Bydgoszczy, Zeszyty Naukowe, Zootechnika.* 21(176): 33-41.

Unrel Danks, D. M. 1985. inborn errors of trace element metabolism. *Clinics in Endocrinology and Metabolism* 14(3): 591-615.

Plant Darmody, Robert G., Green, William P., and Dreher, Gary B. 1998. coal slurry solids/coal fluidized bed combustion byproduct mixtures as plant growth media. *Int. J. Surf. Min.* (Reclam. Environ.): 12(3), 111-115 .

In Vit DARR, D. J., YANNI, S., and PINNELL, S. R. protection of chinese hamster ovary cells from paraquat-mMediated cytotoxicity by a low molecular weight mimic of superoxide dismutase df-mn. *FREE RADICAL BIOL MED; 4 (6). 1988. 357-364.*

Surv Das, S. S., Sarker, S., Basak, D. N., and Bhowmik, M. K. 1990. micromineral status of soil and plants of grazing fields in hooghlydistrict of west bengal. *Journal of Veterinary and Animal Sciences* 21(2): 19-23 .

Bio Acc Das Virgens N C and Ferreira Neto J M. the level of copper iron manganese and zinc in the blood serum of semi confined and confined goats. *Arquivos Da Escola De Veterinaria Universidade Federal De Minas Gerais. 33 (2). 1981 (Recd. 1982). 235-246.*

Bio Acc Das Virgens N C, Machado, M. A., Ferreira Neto J M, and Marques Junior A D. the level of copper iron manganese and zinc in the liver and pancreas of confined and semi confined goats. *Arquivos Da Escola De Veterinaria Universidade Federal De Minas Gerais. 33 (2). 1981 (Recd. 1982). 229-234.*

Alt Dashti, H., Behbehani, A., Abul, H., Hussain, T., and Madda, P. 1995. alterations of trace elements in kidney, spleen and lungs in treated and untreated experimental liver cirrhosis. *Journal of the Royal College of Surgeons of Edinburgh* 40(3): 173-9.

Bio Acc DAUWE, T., BERVOETS, L., BLUST, R., PINXTEN, R., and EENS, M. are eggshells and egg contents of great and blue tits suitable as indicators of heavy metal pollution? *BELGIAN JOURNAL OF ZOOLOGY; 129 (2). 1999. 439-447.*

Surv Davies, G. R. and Crawshaw, R. 1978. a field study of the soil and herbage relationships for the trace elements copper, molybdenum and cobalt. *Experimental Husbandry.*(No.34): 53-60.

No COC Davies, N. T. and Nightingale, R. effects of phytate on intestinal absorption and secretion of zinc, and whole-body retention of zinc, copper, iron, and manganese in rats. *Br. J. Nutr. (1975)* 34(2): 243-58 .

No COC Davies, N. T. and Nightingale, R. 1975. the effects of phytate on intestinal absorption and secretion of zinc, and whole-body retention of zn, copper, iron and manganese in rats. *British Journal of Nutrition* 34(2): 243-58.

Nutr Davies, N. T. and Reid, H. 1979. an evaluation of the phytate, zinc, copper, iron and manganeseof, and zn availability from, soya-based textured-vegetable-proteinmeat-substitutes or meat-extenders. *British Journal of Nutr* 41(3): 579-589.

Nutr Davies, N. T. and Reid, Hilary. an evaluation of the phytate, zinc, copper, iron and manganese

contents of, and zinc availability from, soya-based textured-vegetable-protein meat-substitutes or meat-extenders. *Br. J. Nutr. (1979)* 41(3): 579-89 .

Nut def Davis, C. D. and Johnson, W. T. 2002. dietary copper affects azoxymethane-induced intestinal tumor formation and protein kinase c isozyme protein and mrna expression in colon of rats. *The Journal of Nutrition, 2002 May, 132(5):1018-25.*

Nut def Davis, C. D. and Johnson, W. T. 2001. dietary copper and dimethylhydrazine affect protein kinase c isozyme protein and mrna expression and the formation of aberrant crypts in colon of rats. *Biofactors (Oxford, England), 2001, 15(1):11-26.*

Phys Davis, Cindy D. and Feng, Yi. dietary copper, manganese and iron affect the formation of aberrant crypts in colon of rats administered 3,2'-dimethyl-4-aminobiphenyl. *J. Nutr. (1999)* 129(5): 1060-1067.

Herp Dawson, D. A., Cotter, M. A., Policz, D. L., Stoffer, D. A., Nichols, J. P., and Poech, G. 2000. comparative evaluation of the combined osteolathyritic effects of two nitrile combinations on xenopus embryos. *Toxicology [Toxicology]. Vol. 147, No. 3, Pp. 193-207. 5 Jul 2000.*

Minseral Day, M. J., Pearson, G. R., Lucke, V. M., Lane, S. J., and Sparks, R. S. 1996. lesions associated with mineral deposition in the lymph node and lung of the dog. *Veterinary Pathology* 33(1): 29-42.

Ecol Day, R. H., Wolfe, D. H., Colbert, K. V., and Sherrod, S. K. 1993. population census and productivity of nesting golden eagles, prairie falcons, copper's hawks, swainson's hawks, and ferruginous hawks in cimarron county, oklahoma. *Journal of Raptor Research* 27(1): 87.

Nutr De Arellano, Mirta L., Fernandez, Silvia, Luco, Juan, De Sanchez, Nora E., Petenatti, Elisa, and De Mucciarelli, Sara I. L. composition and biological evaluation of amaranthus standleyanus l. seed flour. *Sci. Aliments (1996)* 16(3): 289-296.

Mix De Boer G, Buchanan-Smith, J. G., Macleod, G. K., and Walton, J. S. responses of dairy cows fed alfalfa silage supplemented with phosphorus copper zinc and manganese. *Journal of Dairy Science. 64 (12). 1981 (Recd. 1982). 2370-2377.*

Aquatic De Haas, E. M., Paumen, M. L., Koelmans, A. A., and Kraak, M. H. S. 2004. combined effects of copper and food on the midge chironomus riparius in whole-sediment bioassays. *Environmental Pollution [Environ. Pollut.]. Vol. 127, No. 1, Pp. 99-107. Jan 2004.*

Meth De Olmos, Jose S., Beltramino, Carlos A., and De Olmos De Lorenzo, Soledad. use of an amino-cupric-silver technique for the detection of early and semiacute neuronal degeneration caused by neurotoxicants, hypoxia, and physical trauma. *Neurotoxicol. Teratol. (1994)* 16(6): 545-61 .

CP Deahl, S. T., Oberley, L. W., Oberley, T. D., and Elwell, J. H. antioxidant enzymes in rat bone. *69th General Session of the International Association for Dental Research, 20th Annual Session of the American Association for Dental Research, and the 12th Annual Session of the Mexican Division of the Iadr (International Association for Dental Research), Acapulco, Mexico, April 17-21, 1991. J DENT RES. 70 (Spec. Issue April). 1991. 340.*

Nut def Deas, D. W., Melrose, D. R., Reed, H. C. B., Vandeplassche, M., and Pidduck, H. 1979. other non-infectious abnormalities. *Fertility and Infertility in Domestic Animals, 3rd Edition* : 137-159.

Rev Deas, D. W., Melrose, D. R., Reed, H. C. B., Vandeplassche, M., Pidduck, H., and <Editors> J.A. Laing. 1979. chapter 7: other non-infectious abnormalities. *Fertility and Infertility in Domestic*

Animals : 137-159.

Alt Debacker, V., Rutten, A., Jauniaux, T., Daemers, C., and Bouquegneau, J. M. 2001. combined effects of experimental heavy-metal contamination (cu, zn, and ch3hg) and starvation on quail's body condition: parallelism with a wild common guillemot (uria aalge) population found stranded at the belgian coast. *Biological Trace Element Research, 2001 Summer, 82(1-3):87-107.*

Bio Acc Decker, W. J. Goldsmith W. A. Mills R. C. and Banez R. J. 1972. systemic absorption of copper after oral administration of radioactive copper sulfate emetic in rats. *Toxicol.Appl.Pharmacol.* 21: 331-334.

Chem Meth Decocklereverend, B., Perly, B., and Sarkar, B. 1987. isolation and two-dimensional h-1-nmr of peptide [1-24] of dog serum-albumin and studies of its complexation with copper and nickel by nmr and cd spectroscopy. *Biochimica Et Biophysica Acta* 912(1): 16-27.

No Tox Del Maestro, R. and McDonald, W. 1987. distribution of superoxide dismutase, glutathione peroxidase and catalase in developing rat brain. *Mechanisms of Ageing and Development* 41(1-2): 29-38.

No Tox Del Maestro, R. and McDonald, W. 1989. subcellular localization of superoxide dismutases, glutathione peroxidase and catalase in developing rat cerebral cortex. *Mechanisms of Ageing and Development* 48(1): 15-31.

FL Delgado Gonzalez, R A., Fortoul van der Goes, T. I., and Rosiles Martinez, R. 1994. lead, chromium and cadmium concentrations and their relationship to tissue morphological alterations in pigeons (columba livia) from the valley of mexico city and ixtlahuaca in the state of mexico. *Veterinaria-Mexico.* 25(2): 109-115.

FL Demenko, V. I(A), Kkorzinnikov Yu S, Petrova, E. L., and Konon, S. A. 1992. regulation of the fall of ripe sea buckthorn and dog rose fruits. *Agrokhimiya* 0(8): 99-104.

Herp Demichelis, S. O., de la Torre, F. R., Ferrari, L., Garcia, M. E., and Salibian, A. 2001. tadpoles assay: its application to a water toxicity assessment of a polluted urban river. *Environmental Monitoring and Assessment [Environ. Monit. Assess.]. Vol. 68, No. 1, Pp. 63-73. Apr 2001.*

FL Demko, E. B. 1967. [the effect of copper on the condition of the thyroid in albino rats against the background of a predominantly carbohydrate diet and iodine deficiency]: <original> vliianie medi na sostoianie shchitovidnoi ahelezy belykh krys na fone preimushchestvenno uglevodistogo pitaniia pri iodnoi nedostatochnosti. *Vopr Pitan.* 26(2): 42-7.

Mix Demko, E. B. 1970. [an increase in the role of iodine in combination with other trace elements in pathologic conditions of the thyroid gland]: <original> o povyshenii roli ioda v sochetanii s drugimi mikroelementami pri ptologicheskikh sostoianiiakh shchitovidnoi zhelezy. *Probl Endokrinol (Mosk).* 16(5): 102-6.

FL Demko, E. B. and Ugnenko, V. K. 1974. role of some trace elements in copper and manganese metabolism and in thyroid gland malfunction and its normalization in experimental animals. *Tezisy Dokl. - Konf. Beloruss. Biokhim. O-Va. 2nd* : 64-6. Editor(s): Vecher, A. S. Publisher: "Nauka i Tekhnika", Minsk, USSR.

In Vit Denizeau, F. and Marion, M. 1989. genotoxic effects of heavy metals in rat hepatocytes. *Cell Biology and Toxicology* 5(1): 15-25.

FL Denneman, W. D. 1990. insectivore food chains as biological monitors in polluted ecosystems.

LUTRA. 33(1): 80-82.

Bio Acc Denneman, W. D. and Douben, P. E. T. 1993. trace metals in primary feathers of the barn owl (tyto alba guttatus) in the netherlands. *Environ. Pollut.* 82(3): 301-10 .

Bio Acc Deol, H. S., Howell, J. M., and Dorling, P. R. 1994. effect of the ingestion of heliotrope and copper on the concentration of zinc, selenium and molybdenum in the liver of sheep. *Journal of Comparative Pathology.* 110(3): 303-307.

Unrel DeOlmos, J. S. and Ingram, W. R. 1971. an improved cupric-silver method for impregnation of axonal and terminal degeneration. *Brain Research* 33(2): 523-9.

Unrel Dergacheva, T. S. 1981. [establishment of the maximum permissible concentration of a copper-diammonium complex of hydroxyethylidene diphosphonic acid in the water of reservoirs]. *Gig Sanit.*(3): 72.

Unrel Derr, Robert F., Draves, K., and Rao, G. Ananda. liquid alcohol diets which provide recommended quantities of nutrients for lactation of the rat. *Nutr. Rep. Int. (1988)* 38(2): 361-7.

Unrel Derr, Robert F., Draves, Kay, and Rao, G. Ananda. inadequate intake by female rats during gestation and lactation of essential nutrients from liquid diets used for alcohol studies: implication for the fetal alcohol syndrome. *Biochem. Arch. (1987)* 3(1): 137-45.

Surv Desai, M. C., Thakkar, T. P., Darshana, R. A., and Janakiraman, J. 1978. a note on serum copper levels in relation to reproductive performance in surti Buffaloes. *Indian J Anim Sci.* 48(7): 534-536.

Dead DeSloovere, J., Debackere, M., and Hoorens, J. poisoning of domestic animals. *Vlaams Diergeneesk. Tijdschr. 40(1): 8-29; 1971(REF:18)*

Unrel Desnuelle, P. 1973. some properties of selectively hydrogenated soya oil. *Annales De La Nutrition Et De L'Alimentation* 27(4): 225-232.

In Vit Devi, B. G., Schenker, S., Mazloum, B., and Henderson I(A). 1996. ethanol-induced oxidative stress and enzymatic defenses in cultured fetal rat hepatocytes. *Alcohol* 13(4): 327-332.

CP Deyhim, F. and Teeter, R. G. the effects of dietary zinc methionine manganese methionine and copper lysine on broiler performance and some body parameters during thermoneutral and ambient temperature distress. *Thirteenth Annual Meeting of the Southern Poultry Science Society, Atlanta, Georgia, USA, JANUARY 20-21, 1992. Poult Sci. 71 (Suppl. 1). 1992. 147.*

No Tox Deyhim, Farzad, Stoecker, Barbara S., Adeleye, Bernece G., and Teeter, Robert G. 1995. the effects of heat distress environment, vitamin, and trace mineral supplementation on performance, blood constituents, and tissue mineral concentrations in broiler chickens. *Nutr. Res. (N. Y.)* 15(4): 521-6 .

No Dose Dhami, A. J., Mohan Greesh, and Sahni, K. L. 1994. relationships of seminal attributes and enzymatic profiles with biochemical and mineral constituents of seminal plasma in friesian and murrah buffalo bulls. *Indian Veterinary Medical Journal* 18(3): 155-161.

Diss Di Giulio, R. T. 1982.*The Occurrence and Toxicology of Heavy Metals in Chesapeake Bay Waterfowl (Duck, Clangula Hyemalis, Melanitta Deglandi, Anas-Platyrhynchos, Rubripes, Strepera, Maryland, Virginia)*

Bio Acc Di, Giulio R T and Scanlon, P. F. 1984. effects of cadmium and lead ingestion on tissue concentrations of cadmium lead copper and zinc in mallard ducks anas-platyrhynchos. *Sci Total Environ.* 39(1-2): p103-110.

No Oral Dicarlo, F. J. Jr. 1979. copper-induced heart malformations in hamsters. *Experientia.* 35: 827-828.

No Oral Dicarlo Jr., F. J. 1980. syndromes of cardiovascular malformations induced by copper citrate in hamsters. *Teratology.* 21: 89-101.

In Vit Dicesare, J. L. and Dain, J. A. 1971. the enzymic synthesis of ganglioside. iv. udp-n-acetylgalactosamine: (n-acetylneuraminyl)-galactosylglucosyl ceramide n-acetylgalactosaminyltransferase in rat brain. *Biochimica Et Biophysica Acta* 231(2): 385-93.

CP Dick, A. T. 1956.: 445-473.

Surv Dickinson, N. M., Watmough, S. A., and Turner, A. P. 1996. ecological impact of 100 years of metal processing at prescot, northwest england. *Environmental Reviews.* 4(1): 8-24.

Bio Acc Dierenfeld Ellen S(A), Fitzpatrick Marianne P, Douglas Tara C, and Dennison Stacey A. 1996. mineral concentrations in whole mice and rats used as food. *Zoo Biology* 15(1): 83-88.

In Vit Diez-Fernandez Carmen, Sanz Nuria, Wolf Armin, and Cascales Maria. 1998. effect of phorbol ester (pma) on antioxidant enzyme expression in tgf-beta1-induced apoptosis in primary cultures of hepatocytes. *Biofactors* 8(1-2): 65-71.

Plant Dillon, C. R., Maurice, D. V., and Jones, J. E. 1988. composition of egeria densa. *J. Aquat. Plant Manage.* 26, 44-5 .

FL Dinu, I., Boghianu, L., Botescu, E., and Sporn, A. 1972. effect of some metals on carbohydrate metabolism. *Igiena.* 21(8): 469-476.

Rev Dirksen, G. and Hofmann, W. 1974. actual health problems in the rearing and fattening of calves: a review. *Veterinary Medical Review.*(No.1): 3-21.

No Oral DiSilvestro, R. A. 1989. effects of inflammation on copper antioxidant enzyme levels. *Advances in Experimental Medicine and Biology* 258: 253-8.

Nutr Divanov, B. 1980. the effect of supplementary feeding with trace elements on the course of theileriasis in cattle. *Sbornik Nauchnykh Rabot, Leningradskii Veterinarnyi Institut (Infektsionnye i Parazitarnye Bolezni Sel'Skokhozyaistvennykh Zhivotnykh)* (No.63): 41-44.

CP Djujic, Ivana, Jozanov-Stankov, Olga, Demajo, M., and Mandic, M. 1995. effects of ionizing radiation and selenium on microelement concentration. *Naucni Skupovi - Srp. Akad. Nauka Umet. Od. Prir.-Mat. Nauka* 6: (Conference on Selenium, 1993), 139-148.

CP Djujic, Ivana, Mandic, M., Jozanov-Stankov, Olga, Demajo, M., and Vrvic, M. M. 1995. effects of selenium-enriched yeast on microelement content in rat tissues. *Naucni Skupovi - Srp. Akad. Nauka Umet.Od. Prir.-Mat. Nauka* 6: (Conference on Selenium, 1993), 105-113.

No Oral Do Thanh, X., Djebbar-Sid, S., Duchene, S., Benali-Baitich, O., Bouet, G., and Khan, M. A. 2001. chronotoxicity of a copper (ii) complex with a linear tetradentate ligand in mice. *Biological Rhythm Research [Biol. Rhythm Res.]. Vol. 32, No. 4, Pp. 423-429. Oct 2001.*

Phys Dobashi, K. lipid peroxide in plasma and tissues and antioxidant enzyme status in streptozotocin-induced diabetic rats. *Journal of the Japan Diabetes Society. 33 (1). 1990. 13-18.*

Bio Acc Dobos, Robert Z., Painter, D. Scott, and Mudroch, Alena. 1991. contaminants in wildlife utilizing confined disposal facilities. *Int. J. Environ. Pollut. (1991)* 1(1-2): 73-86 .

CP Doerr, J. A., Nicholson, J. L., and Johnson, E. 1980. influence of dietary copper on litter quality and broiler performance. *Proceedings of the Maryland Nutrition Conference for Feed Manufacturers.* 61-65.

Dead Doherty, PC, Barlow, RM, and Angus, KW. 1969. spongy changes in the brains of sheep poisoned by excess dietary copper. *Res. Vet. Sci.* 10: 303.

Unrel Doll, K., Erer, H., Hanichen, T., Bauer, J., and Gunzler, D. 1989. liver cirrhosis in newborn calves. *Tierarztliche Praxis.* 17(2): 149-156.

CP Domanska, K., Grosicki, A., and Kowalski, B. 1998. effects of mercury, copper, manganese, zinc, and cobalt on tissue glutathione in rats. *Mengen- Spurenelem. Arbeitstag., 18th* : 354-360. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

Bio Acc Donaldson, J., Cloutier, T., Minnich, J. L., and Barbeau, A. 1974. trace metals and biogenic amines in rat brain. *Advances in Neurology* 5: 245-52.

Food Donangelo, C. M., Trugo, L. C., Trugo, N. M. F., and Eggum, B. O. effect of germination of legume seeds on chemical composition and on protein and energy utilization in rats. *Food Chem. (1995)* 53(1): 23-7.

FL Donchev, S. and Ivanov, B. 1978. recherche sur l'influence de la pollution industrielle des oiseau dans la region de l'usine de cuive "georges damianov", pres de pirdop. *Ekologija* 4: 12-18.

No Oral Donovan, B. T. and Gledhill, B. 1981. changes in fsh (follicle-stimulating hormone) and lh (luteinizing hormone) secretion in the ferret associated with the induction of ovulation by copper acetate. *Biology of Reproduction.* 25 (1): 72-76.

Nutr Doong, G., Keen, C. L., Rogers, Q., Morris, J., and Rucker, R. B. selected features of copper metabolism in the cat. *Journal of Nutrition. 113 (10). 1983. 1963-1971.*

Unrel Donovan, W. P. and Appledorf, H. 1973. protein, fat and mineral analyses of franchise chicken dinners. *Journal of Food Science* 38(1): 79-80.

Nutr Dorton, K. L., Engle, T. E., Hamar, D. W., Siciliano, P. D., and Yemm, R. S. 2003. effects of copper source and concentration on copper status and immune function in growing and finishing steers. *Animal Feed Science and Technology.* 110(1-4): 31-44.

FL dos Santos, B. M. 1987.*Morphological, Morphometrical and Functional Aspects of Parathyroid Glands in Broilers Submitted to Diets With Different Copper and Vitamin D3 Levels*

Unrel Dostal, J. and Mueller, W. an archean oceanic felsic dike swarm in a nascent arc: the hunter mine group, abitibi greenstone belt, canada. *J. Volcanol. Geotherm. Res. (1996)* 72(1-2): 37-57 .

No Control Dove, C. R. 1995. the effect of copper level on nutrient utilization of weanling pigs. *Journal of Animal Science.* 73: 166-171.

CP Dove, C. R. 1990. factors affecting the efficacy of growth promoting levels of coppersulfate in

swine diets. 63-72.

Unrel Dove, C. R. and Ewan, R. C. 1990. effect of excess dietary copper iron or zinc on the tocopherol and selenium status of growing pigs. *J Anim Sci.* 68(8): 2407-2413.

Minseral Dove, C. R. and Ewan, R. C. 1991. effect of trace minerals on the stability of vitamin e in swine growerdiets. *Journal of Animal Science* 69(5): 1994-2000.

Mix Dove, C. R. and Ewan, R. C. 1991. effect of vitamin e and copper on the vitamin e status and performance of growing pigs. *J Anim Sci.* 69(6): 2516-2523.

In Vit Dowdy, R. P. and Matrone, G. 1968. copper-molybdenum interaction in sheep and chicks. *J Nutr.* 95(2): 191-6.

Nutr Doyle, J. C., Huston, J. E., and Thompson, P. V. 1990. influence of mineral supplementation on bovine serum, liver andendometrium at day 1 and day 12 of the estrous cycle. *Theriogenology* 34(1): 21-31.

Rev Doyle, J. J. 1977. effects of low levels of dietary cadmium in animals: a review. *J Environ Qual.* 6(2): p111-116.

Rev Doyle, J. J. 1979. toxic and essential elements in bone. a review. *J. Anim. Sci.* 49(2): 482-497 .

Rev Doyle, J. J. and Spaulding, J. E. 1978. toxic and essential trace elements in meat - a review. *Journal of Animal Science.* 47(2): 398-419.

Mix Draganov, I. F., Vrakin, V. F., and Volkonskii, V. A. 1991. effect of trace element concentration in the diet on metabolism in young bulls fattened using malt residues. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii.* 0(3): 133-144.

Diss Draper, Alison J. and Hammock, Bruce D. 1999. inhibition of soluble and microsomal epoxide hydrolase by zinc and other metals. *(1999) Toxicol. Sci.* 52(1): 26-32.

No Oral Dreifuss, J. J. Kelly J. S. and Krenjevic K. 1969. 1969. effects of copper on cortical neurones. *Brain Res 13, 607-611.* 13: 607-611.

Surv Dressler, R. L., Strom, G. L., Tzilkowski, W. M., and Sopper, W. E. 1986. heavy metals in cottontail rabbits sylvilagus-floridanus on mined lands treated with sewage sludge. *J Environ Qual.* 15(3): 278-281.

No Dose Droual, R., Meteyer, C. U., and Galey, F. D. 1991. zinc toxicosis due to ingestion of a penny in a gray-headed chachalaca ortalis-cinereiceps. *Avian Dis; 35 (4). 1991. 1007-1011.* 35(4): 1007-1011.

No Dose Drozd, U. V., Bondarenko, S. V., Yasnetsov, V. V., Batrakov, S. G., Sakandelidze, O. G., and Shashkov, V. S. composition from laminaria saccharina increases the survival time of mice at low temperatures. *Byull. Eksp. Biol. Med. (1991)* (4): 383-4.

No Control Du, Z., Hemken, R. W., Jackson, J. A., and Trammell, D. S. utilization of copper in copper proteinate, copper lysine, and cupric sulfate using the rat as an experimental model. *J. Anim. Sci. (1996)* 74(7): 1657-1663 .

Unrel Dube, Benoit, Dunning, Greg, and Lauziere, Kathleen. geology of the hope brook mine, newfoundland, canada: a preserved late proterozoic high-sulfidation epithermal gold deposit and its

implications for exploration. *Econ. Geol. (1998)* 93(4): 405-436 .

No COC Dubick, M. A. and Keen, C. L. 1985. alterations in tissue trace element and ascorbic acid metabolism in phenytoin-fed rats and mice. *Journal of Nutrition* 115(11): 1481-7.

No Oral Dubick, Michael A., Zidenberg-Cherr, Sheri, Rucker, Robert B., and Keen, Carl L. superoxide dismutase activity in lung from copper- and manganese-deficient mice exposed to ozone. *Toxicol. Lett. (1988)* 42(2): 149-57.

FL Dubreuil, P. and Sauvageau, R. 1993. chronic intoxication of lambs with copper in drinking water. *Canadian Veterinary Journal.* 34(7): 428-430.

Unrel Dubrovol'skii, V. V. biogeochemistry of atolls. *Tr. Biogeokhim. Lab.* Akad. Nauk SSSR (1990): 21, 5-34 .

FL Dudka, J., Szczepaniak, S., and Tomaszewska, B. 1995. [evaluation of the combined effect of cupric chloride and sodium nitrite on selected biochemical parameters in rat plasma (subchronic exposure)]. *Rocz Panstw Zakl Hig.* 46(4): 383-7.

No COC Dumitru, C. 1987. efficacy of microsol in treatment of underdevelopment and anaemia inweaned piglets under intensive husbandry conditions. 56-67.

Surv Dunbar, M. R. a, Velarde, R., Gregg, M. A., and Bray, M. 1999. health evaluation of a pronghorn antelope population in oregon. *Journal of Wildlife Diseases.* 35(3): 496-510.

Species Dusenbery, D. B. 1989. screening test for neurotoxins using caenorhabditis elegans. *Report (1987) Order No. PB89-130025, Avail.: NTIS From: Gov. Rep. Announce. Index U. S.) 1989,. 89(6. Abstr. No. 914,213.* 6 pp.

Species Dusenbery, D. B. 1987.*Screening Test for Neurotoxins Using 'Caenorhabditis Elegans'. <NOTE> Final Rept. <CAS REG. NO.> 7440-50-8; 7440-41-7; 7439-97-6; 7439-92-1; 121-75-5; 7646-85-7; 62-73-7; 7487-94-7; 13510-49-1; 13473-90-0; 7447-39-4; 10099-74-8; 10108-64-2; 10043-76-9*

Nutr Dyachenko, L. S. and Syvyk, T. L. 1998. non-traditional feed supplement for pigs. *Kormoproizvodstvo* (8): 30-32.

FL Dyatlov, M. K. 1972. dynamics of copper, cobalt, and zinc in the colostrum and milk of cows when these elements are present in the ration in different amounts (dynamika medzyi, kobal'tu yi tsynku yi malodzyive yi malatseh karow pry roznym uzrowni gehtykh elementaw u ratsyene). *Vestn. Akad. Nauk Belorus.* 2: 90-92.

FL Dzanagov, Kh. B. 1966. effect of trace element additives in chick rations on their growth. *Uch. Zap., Kabardino-Balkar. Gos. Univ.* 28: 297-303.

FL Dzhurov, A. 1979. patho morphology of the chronic copper intoxication of sheep. *Obshcha Sravn Patol.* 7: 110-120.

Surv E. C. and Worden, A. N. 1973. the influence of dietary copper concentration on hepatic copper in the duckling and the chick. *J Sci Food Agric.* 24(2): 167-74.

BioAcc Eckert, G. E. L. W. Greene G. E. Carstens and W. S. Ramsey. 1999. copper status of ewes fed increasing amounts of copper from copper sulfate or copper proteinate. *Journal of Animal Science.* 77: 244-249.

Unrel Economides, S. 1986. comparative studies of sheep and goats milk yield and composition and growth rate of lambs and Kids. *J Agric Sci.* 106(3): 477-484.

Surv Edelsten, R. M. 1980. chronic copper poisoning of sheep in nigeria. *Trop Anim Health Prod.* 12(2): 69-76.

Nut def Eder, K., Kirchgessner, M., and Kralik, A. the effect of trace element deficiency (iron, copper, zinc, manganese, and selenium) on hepatic fatty acid composition in the rat. *Trace Elem. Electrolytes (1996)* 13(1): 1-6.

Mix Edwards, H. M. 1987. effects of thiuram disulfiram and a trace element mixture on the incidence of tibial dyschondroplasia in chickens. *Journal of Nutrition.* 117(5): 964-969.

Bio Acc Eens, Marcel, Pinxten, Rianne, Verheyen, Rudolf F., Blust, Ronny, and Bervoets, Lieven. great and blue tits as indicators of heavy metal contamination in terrestrial ecosystems. *Ecotoxicol. Environ. Saf. (1999)* 44(1): 81-85.

Bio Acc Eeva, T., Laurinolli, M., and Bendell-Young, L. I. 1996. direct and indirect effects of air pollution on two hole-nesting bird species: copper, zinc, and cadmium concentrations in peromyscus maniculatus sampled near an abandoned copper mine. *Arch Environ Contam Toxicol.* 30(4): 481-486.

Surv Eeva, T. and Lehikoinen, E. 1995. egg shell quality, clutch size and hatching success of the great tit (parus major) and the pied flycatcher (ficedula hypoleuca) in an air pollution gradient. *Oecologia* . 102(3): 312-23.

Surv Eeva, T. and Lehikoinen, E. 1996. growth and mortality of nestling great tits (parus major) and pied flycatchers (ficedula hypoleuca) in a heavy metal pollution Gradient. *Oecologia (Berlin).* 108(4): 631-639.

Air P Eeva, T. and Lehikoinen, E. 1998. local survival rates of the pied flycatchers (fijcedula hypoleuca) and the great tits (parus major) in an air pollution gradient. *Ecoscience.* 5(1): 46-50.

Surv Eeva, T., Lehikoinen, E., and Pohjalainen, T. 1997. pollution-related variation in food supply and breeding success in two hole-nesting passerines. *Ecology* . 78(4): 1120-1131.

Surv Eeva, T., Lehikoinen, E., and Ronka, M. 1998. air pollution fades the plumage of the great tit. *Functional Ecology.* 12(4): 607-612.

Surv Eeva, T., Lehikoinen, E., and Sunell, C. 1997. the quality of pied flycatcher (ficedula hypoleuca) and great tit (parus major) females in an air pollution gradient. *Annales Zoologici Fennici.* 34(1): 61-71.

FL Efthymiou, M. L., Cristofini, P., Pierron, E., and Djezzar, S. 1995. diagnosis of toxic or drug induced pancreatitis. *Therapie (Paris).* 50(5): 467-468.

FL Egorov, I., Kupina, L., Dolbeneva, E., Santsevich, B., Shutova, M., and Koltykov, N. 1985. an effective feed for birds. *Ptitsevodstvo* (8): 33-35.

FL Egorov, I., Pan'kov, P., Makarov, N., and Zharkova, G. 1995. a biopreparation - rial. *Ptitsevodstvo* (5): 18-19.

FL Egorov, I. A. and Kureneva, V. P. finely divided metal powders - sources of trace elements for chickens. *Sb. Nauch. Tr. VNII Fiziol.* Biokhimii i Pitaniya S.-kh. Zhivotnykh (1985): (31), 80-8

From: Ref. Zh., Zhivotnovod. 1986, Abstr. No. 1058667.

FL Egorov, I. A. and Kureneva, V. P. 1985. highly dispersive metallic powders as sources of trace elements indiets for poultry. *Sbornik Nauchnykh Trudov Vsesoyuznogo Nauchno-Issledovatel'Skogo Instituta Fiziologii, Biokhimii i Pitaniya Sel'Skokhozyaistvennykh Zhivotnykh* 31: 80-88.

FL Egorov, I. A., Kureneva, V. P., Glushchenko, N. N., Fatkullina, L. D., and Fedorov, Yu. I. high-dispersion metal powders as sources of trace elements for poultry. *Nauchn. Tr. - Vses. Nauchno-Issled. Inst. Fiziol.* Biokhim. Pitan. S-kh. Zhivotn. (1985): 31, 80-8.

Rev Eisler, R. 1997.*Copper Hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review.*

Unrel El-Azab, A. M. M. A. 1995.*Some Nutritional Studies on Farm Animals [Rabbits]*

Bio Acc El-Azab, M. A., Badr, A., Shawki, G., and El-Meged, S. S. A. 1993. some microelements profile in cyclic non-breeding cow syndrome (repeatbreeder). *Assiut Veterinary Medical Journal* 29(58): 245-253.

Bio Acc El-Deek, A. A. and El-Sokkary, I. 1984. effect of feeding different animal proteins on the trace-element composition of broiler droppings. *Indian Journal of Animal Sciences* 54(8): 806-809.

Not Avail El-Deek, A. A., Safaa H., Asar, M. A., El-Ansary, E., and Shebl, M. K. 1988. interaction effects of supplementing plant protein diets with methionine, choline and copper sulphate on live performance. *Assiut Journal of Agricultural Sciences.* 19(4): 375-387.

CP EL-DEMERDASHE, S., DAHDOH, M. SA, EL-SHERIF, S. M., and KANDIL, S. A. 1910. soil factors controlling trace metals in forage plants grown in calcareous soil. *International Symposium on Soil Testing and Plant Analysis: Quality of Soil and Plant Analysis in View of Sustainable Agriculture and the Environment*

Nut def El Hendy, H. A., Yousef, M. I., and El-Naga, N. I. A. 2001. effect of dietary zinc deficiency on hematological and biochemical parameters and concentrations of zinc, copper, and iron in growing rats. *Toxicology [Toxicology]. Vol. 167, No. 2, Pp. 163-170. 15 Oct 2001.*

FL El-Katcha, M. I., Sharaf, M. M., Mandour, M. A., and Abd-El-Hamid, H. S. Alexandria Univ. Egypt Faculty of Veterinary Medicine. 1991. influences of breed and dietary suplementation of methionine, copper and zinc on broiler performance. *Benha Veterinary Medical Journal. V. 2(2) P. 7-20*

Mineral El-Leboudy, A. and Taha, N. evaluation of some nutritionally essential mineral contents in camel buffalo and human Milks. *J Med Res Inst. 12 (3). 1991. 217-229.*

Nutr El-Rahim, M. I. A., El-Gaafary, M. N., Tawfeek, M. I., El-Kelawy, H. M., and Rawia, S. A. 1995. effect of dietary supplementation with different levels of zinc ongrowth performance, nutrient digestibility, mineral metabolism, bloodconstituents, organ histopathology and reproductive efficiency in nzwrabbits. *Egyptian Journal of Rabbit Science* 5(1): 11-31.

CP Eldeeb, M. A., Soares, J. H. Jr, and Johnson, E. skeletal development and performance of broilers fed various levels of copper and Zinc. *75th Annual Meeting of the Poultry Science Association, Inc. Poult Sci. 65 (Suppl. 1). 1986. 38.*

HHE Elgasim, E. A. and Alkanhal, M. A. proximate composition, amino acids and inorganic mineral content of arabian camel meat: comparative study. *Food Chem. (1992)* 45(1): 1-4.

Mix Elgerwi, A., Pistl, J., Bires, J., and Klikova, K. 1999. the influence of industrial intoxication with copper on selected parameters of cellular immunity in sheep. *Veterinarni Medicina.* 44(6): 171-176.

Mix Elgerwi, A. Al-Fateh Univ. Tripoli Libya Faculty of Veterinary Medicine and Bires, J. 1999. distribution of minerals in organs of sheep after intoxication with copper from industrial emissions. *Czech Journal of Animal Science. V. 44(11) P. 487-495*

Mix Elgerwi, A. J. Bires M. Levrut. 1999. industrial copper intoxication in sheep: clinical and pathological findings. *Acta. Vet BrNO.* 68: 197-202.

Surv Elinder, C. Nordberg M. Palm B. and Piscator M. 1981. cadmium, zinc, and copper in horse liver and in horse liver metallothionein: comparisons with kidney cortex. *Environmental Research.* 26(22-52)

FL Ellen, G., Loon, J. W. van, and Tolsma, K. 1989. copper, chromium, manganese, nickel and zinc in kidneys of cattle, pigsand sheep and in chicken livers in the netherlands. *Zeitschrift Fur Lebensmittel-Untersuchung Und -Forschung* 189(6): 534-537.

Rev Ellison, R. S. 1992. a review of copper and selenium reference ranges in cattle and sheep. *Publication - Veterinary Continuing Education, Massey University.*(145): 3-27.

Unrel Ellison, R. S. 1991. the role of laboratory tests for detecting bone disease and vitamin and mineral nutrition in the horse. *Publication - Veterinary Continuing Education, Massey University.*(135): 57-72.

Drug Elsasser, T. H. potential interactions of ionophore drugs with divalent cations and their function in the animal body. *J. Anim. Sci. (1984)* 59(3): 845-53.

CP Elsenhans, B., Ademuyiwa, O., Schmolke, G., Schaper, J., and Hunder, G. 1993. arsenic-copper interactions in the kidneys of laboratory animals. *Met.-Met. Interact. [Symp.]* : 110-28. Editor(s): Elsenhans, Bernd; Forth, Wolfgang; Schuemann, Klaus. Publisher: Bertelsmann Found. Publ., Guetersloh, Germany.

CP Elsenhans, B., Beck, R., Strugala, G., Forth, W., <Editors> Anke, M., Meissner, D., and Mills, C. F. 1993. oral doses of bismuth, dietary zinc supply and trace-metal levels inthe rat. <document title>trace elements in man and animals - tema 8:proceedings of the eighth international symposium on trace elements inman and animals. 928-932.

CP Elsenhans, B., Schuemann, K., Schaefer, S., and Forth, W. interactions among cadmium arsenic lead nickel and essential trace elements in rat tissue after dietary exposure. *Second Joint Meeting of the Nederlandse Vereniging Voor Toxicologie (Toxicological Society of the Netherlands) and the British Toxicology Society, Leyden, Netherlands, May 17-19, 1987. Hum Toxicol. 7 (1). 1988. 78.*

FL Eltohamy, Magda Mohammed, Takahara, Hitoshi, and Okamoto, Masao. effects of dietary zinc levels on zinc, iron and copper content in tissues of the white leghorn cockerels. *J. Fac. Agric.* Kyushu Univ. (1979): 24(2-3), 65-74 .

Nutr Engle, T. E. and J. W. Spears. 2000. effects of dietary copper concentrations and source on performance and copper status of growing and finishing steers. *Journal of Animal Science.* 78: 2446-2451.

Nutr Engle, T. E. and J. W. Spears. 2000. dietary copper efects on lipid metabolism, performance and ruminal fermentation in finishing steers. *Journal of Animal Science.* 78: 2462-2458.

Nutr Engle, T. E. J. W. Spears T. A. Amstrong C. L. Wright and J. Odle. 2000. effects of dietary copper source and concentration on carcass characteristics and lipid and cholesterol metabolism in growing and finishing steers. *Journal of Animal Science.* 78: 1053-1059.

Nutr Engle, T. E. J. W. Spears V. Fellner and J. Odle. 2000. effects of soybean oil and dietary copper on ruminal and tissue lipid metabolism in finishing steers. *Journal of Animal Science.* 78: 2713-2721.

FL Epifanov, G., Zakachurin, A., Kalinin, V., and Kirilov, M. 1984. vitamin-mineral supplements during finishing of cattle on distillers'grains. *Molochnoe i Myasnoe Skotovodstvo* (11): 22-23.

FL Epifanov, G. V., Zakachurin, A. F., Kalinin, V. V., and Puchnin, A. M. 1985. increasing the biological completeness of diets during the fattening ofyoung bulls. *Khimiya v Sel'Skom Khozyaistve* 23(8): 45-47.

Nutr Eppard, P. J., Bauman, D. E., Bitman, J., Wood, D. L., Akers, R. M., and House, W. A. effect of dose of bovine growth hormone on milk composition alpha lactalbumin fatty-acids and mineral elements. *Journal of Dairy Science. 68 (11). 1985. 3047-3054.*

Food Eppendorfer, W. H. and Eggum, B. O. 1996. fertilizer effects on yield, mineral and amino acid composition, dietary fiber content and nutritive value of leeks. *Plant Foods Hum. Nutr. (Dordrecht Neth.)* 49(2): 163-174.

Mineral Eppendorfer, Wilfried Hermann and Eggum, Bjoern Ottar. 1995. effects of nitrogen, phosphorus, sulfur, potassium, calcium and water stress on yield, mineral and amino acid composition, dietary fiber and nutritive value of carrots. *Acta Agric. Scand. Sect. B* 45(2): 124-31.

CP Eriksson, O., Frank, A., Nordkvist, M., and Petersson, L. R. 1990. heavy metals in reindeer and their forage plants. *Proceedings of the Fifth International Reindeer/Caribou Sumposium, Arvidsjaur, Sweden, August 18-22, 1988. Rangifer.*(Special Issue No. 3): 315-331.

Abstract Eriksson, U. J., Dahlstrom, E., and Styrud, J. congenital malformations and trace metal metabolism in the offspring of diabetic rats. *19th Annual Meeting of the Scandinavian Society for the Study of Diabetes, Trondheim, Norway, June 14-16, 1984. Acta Endocrinol Suppl. 106 (263). 1984. No Pagination.*

Abstract Eriksson, U. J., Dahlstrom, E., and Styrud, J. metabolism and transport of nutrients in the growth-retarded and malformed offspring of diabetic Rats. *20th Annual Meeting of the European Association for the Study of Diabetes, London, England, Sept. 12-15, 1984. Diabetologia. 27 (2). 1984. 272a.*

Alt Eriksson, Ulf J. diabetes in pregnancy: retarded fetal growth , congenital malformations and fetomaternal concentrations of zinc, copper and manganese in the rat. *J. Nutr. (1984)* 114(3): 477-84 .

FL Ermenkov, K. 1986. role of cholecalciferol and vitamin b-12 in mineral metabolism ingrowing chickens. *Zhivotnov"Dni Nauki* 23(4): 57-65.

FL Ermolaev, G. F., Kolomiichuk, T. V., Litvyak, V. S., and Nikolaenko, G. V. 1984 . effect of trace elements, ferroglyukin, isoleucine and cystine on aminoacid content of blood in young pigs. *Veterinarnaya Nauka - Proizvodstvu, Mezhvedomstvennyi Tematicheskii Sbornik* (21): 139-144.

FL Erokhin, A. S. and Kuvshinov, V. L. 1981. stimulation of ovulation in animals using a copper complexonate. *Dokl. Vses. Akad. S-Kh. Nauk Im. V. I. Lenina* . 12: 40-1.

Plant Esechie, Humphrey A. distribution of chemical constituents in the plant parts of six tropical-origin forage grasses at early anthesis. *J. Sci. Food Agric. (1992)* 58(3): 435-8.

Mix Eskin, G. 1984. trace elements in the diet for fattening pigs. *Svinovodstvo, Moscow.* (7): 35-36.

Drug Esparza, J. L., Gomez, M., Domingo, J. L(A), and Corbella, J. 2000. effects of age and chelation therapy on tissue concentrations of essential elements in aluminum-loaded rats. *Trace Elements and Electrolytes* 17(2): 102-108.

FL Espinosa, M., Velasco, M. E., Sanz, M., and Camps, M. 1991. inclusion of copper sulphate (cuso4/5h2o) in diets for white leghorn laying hens. *Revista Cubana De Ciencia Avicola.* 18(1): 54-61.

FL Estrada Ruiz J L, Rosiles Martinez R, and Rivero Medina V. mean concentration of macrominerals and microminerals essential in commercial food for dogs. *Veterinaria (Mexico City). 19 (4). 1988. 329-334.*

Gene Evans, C. D., LaDow, K., Schumann, B. L., Savage, R. E. Jr, Caruso, J., Vonderheide, A., Succop, P., and Talaska, G. 2004. effect of arsenic on benzo[a]pyrene dna adduct levels in mouse skin and lung. *Carcinogenesis, 2004 Apr, 25(4):493-7.*

CP Evans, Joe L. and Davis, George K. 1976. copper-sulfur-molybdenum interrelationship(s) in the growing rat evaluated via the factorial arrangement of diet treatments. *Molybdenum Environ., Proc. Int. Symp.* 1: 149-61.

No Dose Evans, N. A. effect of copper and zinc upon the survival and infectivity of echinoparyphium-recurvatum cercariae. *Parasitology. 85 (2). 1982. 295-304.*

Meth Evering, W. E., Haywood, S., Elmes, M. E., Jasani, B., and Trafford, J. 1990. histochemical and immunocytochemical evaluation of copper and metallothionein in the liver and kidney of copper-loaded rats. *Journal of Pathology* 160(4): 305-12.

Unrel Ewer, T. K. animal husbandry. *Grunsell, C.s.g. (Ed.). the Veterinary Annual, Issue 11. Xvi+361p. Illus. John Wright & Sons, Ltd.: Bristol, England; (Dist. In U.s.a. by Williams & Wilkins Co.: Baltimore, Md.). 1971 310-335.*

Nutr Failla, Mark L. and Seidel, Karen E. total body content of copper and other essential metals in rats fed fructose or starch. *Nutr. Res. (N. Y.) (1988)* 8(12): 1379-89 .

No Oral Falandysz, J. 1986. metals and organochlorines in adult and immature males of white-tailed eagle Haliaeetus-albicilla. *Environ Conserv.* 13(1): p69-70.

HHE FALANDYSZ, J., CENTKOWSKA, D., FALANDYSZ, J., and LORENC-BIALA, H. 1986. trace metals and organochlorine pesticides content in duck goose and rabbit tissues. *BROMATOL CHEM TOKSYKOL.* 19(3): 151-155.

Bio Acc Falandysz, J., Jakuczun, B., and Mizera, T. 1988. metals and organochlorines in four female white-tailed eagles. *MAR POLLUT BULL.* 19(10): 521-526.

Surv Falkenberg, H. a, Micklich, D., Matthes, H. D., and Moehring, H. 1996. concentration of blood traits at different breeds of pigs in dependence of keeping indoor or outdoor. *Archiv Fuer Tierzucht.* 39(2): 153-168.

Surv Fan, P. 1988. adverse effects of environmental contamination with molybdenum andcadmium on

cattle, swine and ducks. *Chinese Journal of Veterinary Science and Technology.*(2): 20-22.

Surv Fang, S., Huang, M., Feng, W., Liu, S., Zhang, A., Yu, J., He, G., Li, S., Li, G., Huang, X., and Liu, C. 1994. study on the eds of male reproductive organs of the giant pandas. *Sichuan Daxue Xuebao.* 31(2): 269-274.

No Control Farmer, P. E. Adams T. E. and Humphries W. R. 1982. 1982. copper supplementation of drinking water for cattle grazing molybdenum-rich pastures. *Vet. Rec* .: 193-195.

Nut def Fascetti, A. J., Morris, J. G., and Rogers, Q. R. 1998. dietary copper influences reproductive efficiency of queens. *The Journal of Nutr.* 128(12S): 2590S-2592S.

Mix Faye, B., Bengoumi, M., and Tressol, J. C. 1999. comparative trace-element excretion in the camel and cow. *Journal of Camel Practice and Research* 6(1): 19-25.

Fate Fehrs, M. S., Miller, W. J., Gentry, R. P., Neathery, M. W., Blackmon, D. M., and Heinmiller, S. R. 1981. effect of high but nontoxic dietary intake of copper and selenium on metabolism in calves . *J DAIRY SCI.* 64(8): 1700-1706.

No Oral Fejes, S., Budai, P., Varnagy, L., Molnar, T., Szabo, R., and Fancsi, T. 2002. toxicity of a mancozeb containing fungicide formulation and cu-sulphate to chicken embryos after administration as single compounds or in combination. *Meded Rijksuniv Gent Fak Landbouwkd Toegep Biol Wet, 2002, 67(2):105-9.*

Bio Acc Fendick, E. A., Stevens, G. L., Brown, R. J., and Jordan, W. P. 1989. element content in tissues of four rodent species sampled in the geysers geothermal steamfield california usa. *Environ Pollut.* 58(2-3): 155-178.

Mix Fendick, E. A., Stevens, G. L., Brown, R. J., and Jordan, W. P. 1989. element content in tissues of four rodent species sampled in the geysers geothermal steamfield. *Environ. Pollut. (1989)* 58(2-3): 155-78 .

HHE Ferguson, E. L., Gibson, R. S., Weaver, S. D., Heywood, P., Heywood, A., and Yaman, C. the mineral content of commonly consumed malawian and papua new guinean foods. *Journal of Food Composition and Analysis. 2 (3). 1989. 260-272.*

No Control Ferguson, WS. 1943. the teart pastures of somerset. iv. the effect of continuous administration of copper sulfate to dairy cows. *J. Agric. Sci.* 33: 116.

No Oral Ferm, V. H. and Hanlon, D. P. 1974. toxicity of copper salts in hamster embryonic development. *Biol Reprod.* 11(1): 97-101.

Rev Ferm, V. H., Hanlon, D. P., Clarkson, T. W., Nordberg, G. F., and Sager, P. R. eds. 1983. metal-induced congenital malformations. *Reproductive and Developmental Toxicity of Metals.* 383-398.

Rev Ferm, V. H., Hanlon, D. P., Clarkson, T. W., Nordberg, G. F., and Sager, P. R. eds. 1983. metal-induced congenital malformations. reproductive and developmental toxicity of metals. *Pp. 383-398*

Alt Fernandez-Lopez, Jose-Antonio, Esteve, Montserrat, Rafecas, Immaculada, Remesar, Xavier, and Alemany, Maria. management of dietary essential metals (iron, copper, zinc, chromium and manganese) by wistar and zucker obese rats fed a self-selected high-energy diet. *BioMetals (1994)* 7(2): 117-29 .

No Oral Ferrell, J. B., Fleisher, L. N., Smith, M. G., and Mcgahan, M. C. 1992. effects of copper loading and depletion on rabbit superoxide dismutase Activity. *Trace Elem Med.* 9(2): 55-58.

FL Filgueiras, E. P. a, Hossain, S. M., Bertechnini, A. G., and Oliveira, A. I. Gomes De. 1997. bioavailability of copper sulfate and oxide for piglets form 10 to 25 kg. *Ciencia e Agrotecnologia.* 21(1): 96-102.

Surv Finelli, V. N. 1977. lead, zinc, and d-aminolevulinate dehydratase. *Biochemical Effects of Environmental Pollutants, Edited by S. D. Lee and B. Peirano* : 351-363.

Unrel Fini, C., Palmerini, C. A., Damiani, P., Stochaj, U., Mannherz, H. G., and Floridi, A. 1990. 5'-nucleotidase from bull seminal plasma, chicken gizzard and snake venom is a zinc metalloprotein. *Biochim Biophys Acta; 1038 (1). 18-22.*

Rev Fishbein, L. 1987. trace and ultra trace-elements in nutrition - an overview .1. zinc, copper, chromium, vanadium and nickel. *Toxicological And Environmental Chemistry.* 14(1-2): 73-99.

No Control Fisher, C., Laursen-Jones, A. P., Hill, K. J., and Hardy, W. S. 1973. the effect of copper sulphate on performance and the structure of the gizzard in broilers. *Br Poult Sci.* 14(1): 55-68.

Rev Fisher, C., Stilinovic, Z., Pajalic, J., Beric, Z., and Braun, B. 1973. use of copper sulfate as a growth-promoter for broilers: effect of various amounts of dietary copper and manganese on the activity of alkaline phosphatase in the blood plasma of chickens. *Feedstuffs.* 45(29): 24-5.

Reg Fitzgerald, D. J. 1995. copper guideline values for drinking water reviews in need of review? *Regulatory Toxicology and Pharmacology.* 21(1): 177-179.

Nutr FLachowsky, G., Kronemann, H., and Grun, M. 1994. influence of type of diet and incubation time on in sacco release ofcu, fe, mn and zn from italian ryegrass, untreated and ammonia treatedwheat straw. *Archives of Animal Nutrition* 46(3): 295-304.

Nutr FLachowsky, G., Polzin, S., Kronemann, H., Grun, M., <Editors> Anke, M., Meissner, D., and Mills, C. F. 1993. ruminal trace elements release from ryegrass, alfalfa and wheat strawin sheep and goats. 374-377.

Gene FLanagan, P. R., Haist, J., Mackenzie, I., and Valberg, L. S. 1984. intestinal absorption on zinc: competitive interactions with iron, cobalt, and copper in mice with sex-linked anemia (sla). *Canadian Journal of Physiology and Pharmacology* 62(9): 1124-1128.

CP FLeet, James C. and McCormick, Charles C. the ontogeny and induction by zinc of hepatic chick embryo metallothionein. *Proc. Soc. Exp. Biol. Med. (1988)* 188(1): 52-60.

FL FLemming, J. S., Flemming, R., Bona, A., Brandalize, V. H., Roling, R., Bordignon, A., da Silva, A. V. F., Almeida, R., and Azevedo, L. F. 1988. performance of broilers fed high levels of copper. *Revista Do Setor De Ciencias Agrarias.* 10(1/2): 163-166.

Unrel FLood, D. G., Reaume, A. G., Gruner, J. A., Hoffman, E. K., Hirsch, J. D., Lin, Y. G., Dorfman, K. S., and Scott, R. W. 1999. hindlimb motor neurons require cu/zn superoxide dismutase for maintenance of neuromuscular junctions. *American Journal of Pathology.* 155(2): 663-72.

Mix FLora, S. J., Coulombe, R. A. Jr, Sharma, R. P., and Tandon, S. K. 1989. influence of dietary protein deficiency on lead-copper interaction in rats. *Ecotoxicol Environ Saf.* 18(1): 75-82.

No Dose FLoris, B., Bini, P. P., and Nuvole, P. 1988. postprandial changes of some parameters in the rumen

of cattle. *Clinica Veterinaria* 111(4): 193-202.

No COC FLoyd, C. R., Purvis, H. T. II, Lusby, K. S., and Wettemann, R. P. 1995. effect of monensin and 4-plex on growth and puberty of beef heifers. *Animal Science Research Report - Agricultural Experiment Station, Oklahoma State University* (P-943): 75-80.

No Oral FLynn, A. and Franzmann, A. W. 1974. seasonal variations in hair mineral levels of the alaskan moose. 444-447.

CP FLynn, A., Franzmann, A. W., and Oldemeyer, J. L. 1979. seasonal variations in plant animal mineral element relationships. *13th Annual Conference, Columbia, Mo., Usa, June 4-7, 1979. Proc Univ Mo Annu Conf Trace Subst Environ Health: .*: 79-83.

Nutr Fomichev, A. A. and Khochenkov, A. A. 1994. a finely pelleted premix for pigs. *Zootekhniya* 33(3): 19-20.

Herp Fort, D. J., Stover, E. L., Rogers, R. L., Copley, H. F., Morgan, L. A., and Foster, E. R. 2000. chronic boron or copper deficiency induces limb teratogenesis in xenopus. *Biological Trace Element Research, 2000 Nov, 77(2):173-87.*

No Dose Fox, J. G., Zeman, D. H., and Mortimer, J. D. 1994. copper toxicosis in sibling ferrets. *Journal of the American Veterinary Medical Association.* 205(8): 1154-6.

Rev FOX, M. effect of essential minerals on cadmium toxicity: a Review. *J Food Sci; 39 (2). 1974 321-324.*

Alt Fox, M. C., Brown, D. R., and Southern, L. L. 1987. effect of dietary buffer additions on gain efficiency duodenal ph and copper concentration in liver of eimeria-acervulina infected chicks. *Poult Sci.* 66(3): 500-504.

Diss Fox, M. R. S., Hamilton, R. D. P., Fry, B. E. Jr, Tao S-H, and Stone, C. L. copper and manganese interactions with varying dietary zinc. *72nd Annual Meeting of the Federation of American Societies for Experimental Biology, Las Vegas, Nevada, Usa, May 1-5, 1988. Faseb (Fed Am Soc Exp Biol) J. 2 (4). 1988. Abstract 3326.*

Diss Fox, M. R. S., Tao S-H, Fry, B. E. Jr, Hamilton, R. D., Johnson, M. L., and Stone, C. L. effects of soy products on zinc manganese copper and magnesium utilization. *66th Annual Meeting of the Federation of American Societies for Experimental Biology, New Orleans, La., Usa, April 15-23, 1982. Fed Proc. 41 (3). 1982. Abstract 1119.*

Mix Fox, M. R. Spivey, Tao, Shyy Hwa, Stone, Charles L., and Fry, Bert E. Jr. 1984. effects of zinc, iron and copper deficiencies on cadmium in tissues of japanese quail. *Environ. Health Perspect.* 54: 57-65.

CP FOX, M. RS, TAO, S. H., FRY, B. E JR, and HAMILTON, R. P. 1980. interactions among zinc iron manganese copper and Magnesium. *64th Annual Meeting of the Fed. Am. Soc. Exp. Biol.*

Rev Franchini, A. and Bertuzzi, S. 1991. micronutrients and immune functions. 63-80.

Nut def Frank, Adrian, Anke, Manfred, and Danielsson, Rolf. 2000. experimental copper and chromium deficiency and additional molybdenum supplementation in goats i. feed consumption and weight development. *The Science of The Total Environment.* 249(1-3): 133-142.

Nut def Frank, Adrian, Danielsson, Rolf, and Jones, Bernt. 2000. experimental copper and chromium

deficiency and additional molybdenum supplementation in goats. ii. concentrations of trace and minor elements in liver, kidneys and ribs: haematology and clinical chemistry. *The Science of The Total Environment.* 249(1-3): 143-170.

Bio Acc Franson, J. Christian, Koehl, Philip S., Derksen, Dirk V., Rothe, Thomas C., Bunck, Christine M., and Moore, John F. 1995. heavy metals in seaducks and mussels from misty fjords national monument in southeast alaska. *Environ. Monit. Assess.* 36(2): 149-67 .

Nut def Fraser, D. 1987. mineral-deficient diets and the pig's attraction to blood: implicationsfor tail-biting. *Canadian Journal of Animal Science* 67(4): 909-918.

Herp Freda, Joseph Miami Univ Oxford O. H. 1991. the effects of aluminum and other metals on amphibians. *Environ Pollut.* 71(2-4): 305-329.

FL Fregoni, M. and Scienza, A. 1978. role of trace elements in regulating vegetative growth and fruiting(yield and quality) in vines. problems of diagnosis. *Vignevini* 5(8): 7-18.

FL Freitas, E. A. G. de, Cordeiro, J. L. F., and Torres, C. L. A. 1995. importance of minerals for the reproductive performance of beef cattle. *Agropecuaria Catarinense.* 8(2): 47-50.

Unrel Friedman, B. and Price, J. L. 1986. age-dependent cell death in the olfactory cortex: lack of transneuronal degeneration in neonates. *Journal of Comparative Neurology* 246(1): 20-31.

Plant Friedman, Mendel and Atsmon, Dan. comparison of grain composition and nutritional quality in wild barley (hordeum spontaneum) and in a standard cultivar. *J. Agric. Food Chem. (1988)* 36(6): 1167-72.

Nut def Friend, B. A., Williams, R. V., Mehlman, M. A., and Tobin, R. B. 1973. effect of thiamin deficiency on liver and kidney metal ionconcentrations in rats. *Nutrition Reports International* 8(1): 33-38.

Mix Frimpong, N. A. and Magee, A. C. 1989. effects of dietary copper and zinc on growth and trace mineral status of young male rats.*Nutr REP INT.* 40(4): 695-706.

Surv Fuentealba, I. C. and Bratton, G. R. 1994. the role of the liver, kidney and duodenum in tolerance in the copper-loaded rat. *Anal Cell Pathol.* 6(4): 345-58.

Diss Fuentealba, I. D. C. 1988.*Cellular Mechanisms of Toxicity and Tolerance in the Copper-Loaded Rat*

Alt Fuentes, H. V. O. 1987. the administration of electrolyte solutions to the dehydrated newborn baby chick. *VETERINARIA* . 18(2): 125-132.

FL Fugli, K., Regiusne, M. A., Gundel, J., and Rozsa, L. Allattenyesztesi es Takarmanyozasi Kutatointezet Herceghalom Hungary. 1996. data to copper, zinc and manganese supply of horses (1st paper). <original> adatok a lovak rez-, cink- es mangan-ellatottsagahoz 1. kozlemeny. *Allattenyesztes Es Takarmanyozas. V. 45(2-3) P. 255-260*

Unrel Fujihara, T., Hosoda, C., and Matsui, T. 1995. mineral status of grazing sheep in the dry area of midland china. *Asian-Australasian Journal of Animal Sciences.* 8(2): 179-186.

Unrel Fujihara, T., Matsui, T., Hayashi, S., Robles, A. Y., Serra, A. B., Cruz, L. C., and Shimizu, H. 1992. mineral status of grazing philippine goats ii. the nutrition of selenium copper and zinc of goats in luzon island. *Asian-Australas J Anim Sci.* 5(2): 389-395.

An Prod Fujimura, Shinobu, Koga, Hidenori, Takeda, Hiromi, Tone, Naoko, Kadowaki, Motoni, and Ishibashi, Teru. chemical compositions of pectoral meat of japanese native chicken , hinai-jidori, the broiler of the same and marketing age. *Anim. Sci. Technol. (1996)* 67(6): 541-548.

An Prod Fujimura, Shinobu, Muramoto, Takayuki, Doura, Isamu, Koga, Hidenori, Itou, Hiromi, Tone, Naoko, Kadowaki, Motoni, and Ishibashi, Teru. effect of feeding area and feed intake on meat compositions and taste-related components of broiler chickens. *Nippon Kakin Gakkaishi (1997)* 34(6): 373-381.

FL Fujishima, T., Miyamoto, H., Okada, T., and Furuta, K. 1990. effect of formaldehyde liberation from formalin mixed with a tablet of bleaching powder on disinfection of chicken houses and hatching Eggs. *Jpn Poult Sci; 27 (4). 1990. 329-333.* 27(4): 329-333.

FL Fujita, M. and Nakazawa, H. 1985. the influence of chronic exposure to basic cupric carbonate on levels of copper iron and zinc in tissues of rats studies on the toxicity of green patina basic cupric carbonate ii. *J Food Hyg Soc Jpn.* 26(6): 617-623.

In Vit Fujiwara Yasuyuki and Kaji Toshiyuki(A). 1997. zinc potentiates the stimulation by basic and acidic fibroblast growth factors on the proliferation of cultured vascular smooth muscle cells. *Research Communications in Molecular Pathology and Pharmacology* 97(1): 95-106.

In Vit Fujiwara Yasuyuki, Kaji Toshiyuki(A), Yamamoto Chika, Sakamoto Michiko, and Kozuka Hiroshi. 1995. stimulatory effect of lead on the proliferation of cultured vascular smooth-muscle cells. *Toxicology* 98(1-3): 105-110.

No Tox Furmaga, S. and Gundlach, J. L. 1978. the behaviour of certain mineral elements in the sera of calves in the course of the experimental invasion due to fasciola hepatica. 21.

In Vit Furuno, Koji, Suetsugu, Tatsuya, and Sugihara, Narumi. 1996. effects of metal ions on lipid peroxidation in cultured rat hepatocytes loaded with .alpha.-linolenic acid. *J. Toxicol. Environ. Health (1996)* 48(2): 121-129 .

No Dose Gabraschanski, P., Karagosoff, P., Djakoff, L., Simeonoff, S., Nedkova, L., and Daskolova, A. 1973. relations between selenium and copper in spontaneous deficiency and selenium poisoning of lambs. *Deutsche Tierarztliche Wochenschrift.* 80(8): 184-187.

Acute Gabrashanska, M., Galvez Morros, M. M., Garcia Martinez, O., <Editors> Anke, M., and Meissner, D. 1994. application of mixed basic salts of copper and zinc to ascaridiagalli-infected chicks. *<Document Title>Megen- Und Spurenelemente. 14. Arbeitstagung, Jena25./26. November 1994.* 513-517.

Alt Gabrashanska, M., Teodorova, S., Galvez-Morros, M., and Martinez, O. Garcia. 1999. a kinetic model for ascaridia galli populations in chickens treated with mixed salts of copper and zinc. *J. Helminthol.* 73(1): 45-50 .

BioX Gabrashanska, M., Tsocheva-Gaitandjieva, N., Tepavitcharova, S., and Balarew, C. 1997. trace element content in rat spleen under experimental fascioliasis and zn-cu treatment. *Mengen-Spurenelem. Arbeitstag., 17th* : 306-310. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

FL Gabrashanskii, P., Koichev, K. B., and Troev, T. some diseases in fallow deer in northeast bulgaria and their prevention. *Veterinarno Meditsinski Nauki. 23 (10). 1986 (Recd. 1987). 83-88.*

Surv Gabryszuk, M. 1994. the effect of selected minerals and vitamin e on the reproduction of the polish

merino sheep. i. content of macro- and microelements in blood plasma, feeds and drinking water. *Animal Science Papers and Reports.* 12(1): 39-46.

FL Gabuchian, V. V. 1987. [mechanism of disorders of reproductive function of male albino rats exposed to copper chloride]. *Gig Tr Prof Zabol.*(9): 28-31.

FL Gaeta, G. B., Adinolfi, L., and Utili, R. 1980. [chronic copper toxicity of the liver in rat: preliminary observations]. *Boll Soc Ital Biol Sper.* 56(16): 1626-8.

FL Gaffarov, A. K. and Kamalov, A. 1974. effect of copper manganese and cobalt salts on growth development and change of the thyroid of gissar ram lambs. *Izvestiya Akademii Nauk Tadzhikskoi Ssr Otdelenie Biologicheskikh Nauk.* 3: 85-88.

FL Gaffarov, A. K., Muruvatov, D. M., and Olimov, O. S. 1985. effect of various doses of copper sulfate on calf growth and development. *Izv Akad Nauk Tadzh Ssr Otd Biol Nauk.*(3): 70-73.

FL Gaffarov, A. K., Muruvatov, D. M., and Olimov, O. S. 1990. effectiveness of using various doses of copper sulfate when breeding young bulls. *Izv Akad Nauk Tadzh Ssr Otd Biol Nauk.*(3): 48-52.

FL Gagern, W. von and Gumz, W. 1974. effect of endogenous factors on ash, calcium, magnesium, potassium,sodium, phosphorus, zinc, iron, copper and manganese contents of pigbristles. 2. effect of age of the animal on the mineral composition ofpig bristles. *Archiv Fur Tierernahrung* 24(9/10): 671-679.

Phys Gainer, J. H. activation of the rauscher leukemia virus by metals. *J. Nat. Cancer Inst. (1973)* 51(2): 609-13.

Acute Gaines, T. B. 1969. acute toxicity of pesticides. *Toxicol.Appl.Pharmacol.* 14: 515-574.

FL Gakhniyan, R., Nakov, S., Dimitrov, D., Stancheva, T., and Vasilev, K. tranquilizing activity of 1-phenyl-2,3-dimethyl-4- naphthalenemorpholinomethylpyrazolin-5-one and biochemical changes in broiler chickens. *Zhivotnovud. Nauki (1986)* 23(7): 67-73 .

Surv Gale, Nord L., Wixson, Bobby G., Hardie, Michael G., and Jennett, J. Charles. 1973. aquatic organisms and heavy metals in missouri's new lead belt. *Water Resour. Bull.* 9(4): 673-88.

No Oral Gamcik, P., Bires, J., Vrzgula, L., and Mesaros, P. 1990. effect of experimental intoxication with copper from industrial emission on reproductive ability in Rams. *Reprod Domest Anim.* 25(5): 235-241.

Phys Gangadharan, B., Rajan, A., Valsala, K. V., and Mariamma, K. I. 1990. chemically induced copper depletion in ducks as a model for transdifferentiation study-preliminary observations. *J Vet Anim Sci.* 21(1): 137-138 .

An Prod Ganpule, S. P. and Swamy, M. C. M. 1999. broiler breeder field trial on bio-evaluation of dietary methomin - afeed grade mha fortified with chelated trace minerals. *Indian Journal of Poultry Science* 34(1): 46-49.

Aquatic Garnacho, E., Tyler, P. A. *., and Peck, L. S. 2001. reproduction, seasonality and copper toxicity in the coastal mysid praunus flexuosus. *Journal of the Marine Biological Association of the United Kingdom [j. Mar. Biol. Assoc. U.k.]. Vol. 81, No. 3, Pp. 433-440. 2001.*

No Org Garratt, R. C., Evans, R. W., Hasnain, S. S., Lindley, P. F., and Sarra, R. 1991. x.a.f.s. studies of chicken dicupric ovotransferrin. *Biochemical Journal* 280(Pt 1): 151-5.

Nut def Gay, C. C., Gallina, A. M., Breeze, R. G., and White, R. L. 1983. ill-thrift in lambs. *Veterinary Medicine & Small Animal Clinician.* 78(3): 420-422.

Unrel Gayet, Jean Charles, Haouz, Ahmed, Geloso-Meyer, Annette, and Burstein, Claude. 1993. detection of heavy metal salts with biosensors built with an oxygen electrode coupled to various immobilized oxidases and dehydrogenases. *Biosens. Bioelectron.* 8(3-4): 177-83 .

Bio Acc Gebauer Martin B and Weseloh, D. Vaughn(A). 1993. accumulation of organic contaminants in sentinel mallards utilizing confined disposal facilities at hamilton harbour, lake ontario, canada. *Archives of Environmental Contamination and Toxicology* 25(2): 234-243.

FL Geisel, O., Betzl, E., Dahme, E., Schmahl, W., and Hermanns, W. 1997. enzootic spinal ataxia among farmed fallow deer and red deer in upperbavaria, germany. *Tierarztliche Praxis. Ausgabe G, Grosstiere/Nutztiere* 25(6): 598-604.

CP Geissinger, H. D., Yamashiro, S., Ackerley, C. A., and Rhodes, P. A. 1985. copper-induced skeletal myopathy in rabbits ultrastructural observations. *Meeting of the American Association of Veterinary Anatomists, Baton Rouge, LA., USA, JULY, 1984. Anat Histol Embryol.* 14(1): 84-85.

No Dose Genge, Brian R., Wu, Licia N. Y., and Wuthier, Roy E. identification of phospholipid-dependent calcium-binding proteins as constituents of matrix vesicles. *J. Biol. Chem. (1989)* 264(18): 10917-21.

Imm Gengelbach, G. P. and Spears, J. W. a. 1998. effects of dietary copper and molybdenum on copper status, cytokine production, and humoral immune response of calves. *Journal of Dairy Science.* 81(12): 3286-3292.

Surv Genlin, W., Yuanxin, W., Quanhai, Y., and Maochang, H. Nanjing Agricultural Univ. China. 1996. concentrations of protein, glucose, fructose and ions in the flushings of the oviducts and uteri of erhualian and meishan sows. *Reproduction in Domestic Animals. V. 31(4-5) P. 623-627*

FL Gennaro-Soffietti, M., Guarda, F., Nachtmann, N., Vigliani, E., and Perottino, R. 1978. copper poisoning in cattle: relationships between chemical, histopathological and histochemical findings in the liver. *Annali Della Focolta Di Medicina Veterinaria Di Torino.* 25: 252-264.

Surv George, Joy and Nair, K. Prabhakaran . 1995. phosphorus and trace element status of anoestrous and repeat breeder cross bred cows. *Journal of Veterinary and Animal Sciences.* 26(2): 91-94.

HHE George, R. J. and Parker, C. W. 1990. preliminary characterization of phosphotyrosine phosphatase activities in human peripheral blood lymphocytes: identification of cd45 as a phosphotyrosine phosphatase. *Journal of Cellular Biochemistry* 42(2): 71-81.

Unrel Georges, A. a and Rose, M. 1993. conservation biology of the pig-nosed turtle, carettochelys insculpta. *Chelonian Conservation and Biology.* 1(1): 3-12.

FL Georgievskii, V. and Khazin, D. 1982. standards for trace elements in diets for broilers. *Ptitsevodstvo* (5): 33-34.

FL Georgievskii, V. I., Khazin, D. A., and Polyakova, E. P. accretion of major and trace elements in broilers in relation to the trace element content of the diet. *S-Kh. Biol. (1981)* 16(3): 446-9.

FL Georgievskii, V. I., Khazin, D. A., and Polyakova, E. P. accumulation of macro elements and micro elements in broilers depending on their content in rations. *Sel'Skokhozyaistvennaya Biologiya. 16 (3). 1981. 446-449.*

FL Georgievskii, V. I., Khazin, D. A., and Polyakova, E. P. 1981. retention of major- and trace elements in broilers in relation to thetrace element content of the diet. *Sel'Skokhozyaistvennaya Biologiya* 16(3): 446-449.

FL Georgievskii, V. I. and Kozina, A. S. age related dynamics of the concentration of trace elements in calf organs and tissues. *Dokl Vses (Ordena Lenina) Akad S-kh Nauk Im V I Lenina. (6). 1973 32-34.*

FL Georgievskii, V. I. and Poliakova, E. P. 1983. content of microelements in the egg and their utilization by chicks during the process of embryoval development depending on the level of copper in the diets of chickens. *Izvestiia - Timiriazevskoi Sel'Skokhoziaistvennoi Akademiia.*(3): 155-163.

Nutr Georgievskii, V. I. and Polyakova, E. P. 1983. concentration of trace elements in the egg and their utilization by the embryo during development in relation to the level of copper in thediet of the hens. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii.*(3): 155-163.

FL Georgievskii, V. I. and Polyakova, E. P. 1980. effect of different doses of copper in diets on retention of traceelements in the liver and muscle of laying hens. *Doklady Moskovskoi Sel'Skokhozyaistvennoi Akademii Imeni K. A. Timiryazeva* (260): 90-95.

FL Georgievskii, V. I. and Polyakova, E. P. trace element content in eggs and their use by chicks in the embryonal development process as related to the copper level in chicken rations. *Izv. Timiryazevsk. S-Kh. Akad. (1983)* (3): 155-63.

FL Georgievskii, V. I., Polyakova, E. P., Khazin, D. A., and Smirnova, L. D. 1993. distribution of trace elements in tissues of broiler chickens on a dietcontaining different levels of magnesium. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii* (No.1): 123-131.

FL Georgijevsky V. I., Polyakova, E. P., Khazin, D. A., and Smirnova, L. D. redistribution of microelements in tissues of chicken -broilers with different level of magnesium in the ration. *Izv. Timiryazevsk. S-Kh. Akad. (1993)* (1): 123-31.

Aquatic Geracitano, Laura, Monserrat, Jose M. , and Bianchini, Adalto. 2002. physiological and antioxidant enzyme responses to acute and chronic exposure of laeonereis acuta (polychaeta, nereididae) to copper. *Journal of Experimental Marine Biology and Ecology.* 277(2): 145-156.

No Dose Gerega, K., Kozlowski, H., Masiukiewicz, E., Pettit, L. D., Pyburn, S., and Rzeszotarska, B. metal complexes of luteinizing hormone-releasing hormone lhrh potentiometric and spectroscopic studies. *Journal of Inorganic Biochemistry. 33 (1). 1988. 11-18.*

Plant Gervais, Paul. influence of growth stage on yield, chemical composition and nutrient reserves of birdsfoot trefoil. *Can. J. Plant Sci. (1988)* 68(3): 755-62.

Surv Ghosh, A., Sarkar, S., Pramanik, A. K., Chowdhury, S. P., and Ghosh, S. 1993. selenium toxicosis in grazing buffaloes and its relationship with soil and plant of west bengal. *Indian J. Anim. Sci.* 63(5): 557-560.

Bio Acc Ghosh, J. K., Ghosh, R. K., Chowdhury, M. N., and Bhattacharyya, B. 1996. micronutrient status in the blood of prehatched developing white leghorn chick embryo. *Environment and Ecology* 14(3): 543-545.

FL Giannakopoulos, A. L. and Tserbene-Gouse, A. S. 1987. the effect of copper sulfate on the performance of japanese quails. *Epitheorese Zootehnikes Epistemes.*(5): 79-91.

No Oral Giavini, E., Prati, M., and Vismara, C. 1980. effects of cadmium,lead and copper on rat preimplantation embryos. *Bull Environ Contam Toxicol* . 25: 702-705.

Unrel Gibbons, C. C., Singleton, N., and Nyenhuis, J. effects of exercise on alcohol-fed rats. *BIOCHEM ARCH. Biochemical Archives. 3 (1). 1987. 23-30.*

CP Gibbs, P. J. 1992-31820. heavy metal and organochlorine concentrations in tissues of the little penguin eudyptula minor. *DANN*

No Org Gidas, M.-B., Garnier, O., and Gidas, N. K. performance of chitosan as a primary coagulant for the wastewater treatment. *Prog. Water Resour. (1999)* 1(Water Pollution V): 47-56.

CP GILANI, S. H. and ALIBAI, Y. 1985. the effects of heavy metals on the chick embryo Development. *American Association of Anatomists 98th Annual Meeting and the Association Canadienne Des Anatomistes (Canadian Association of Anatomists) 29th Annual Meeting*

Acu Gilani, Shamshad H. New Jersey Medical School Newark and Alibhai, Yasmin New Jersey Inst of Technology Newark. teratogenicity of metals to chick embryos. *J Toxicol Environ Health. V30, N1, P23(9)*

Nutr Gilardi, James D., Duffey, Sean S., Munn, Charles A., and Tell, Lisa A. biochemical functions of geophagy in parrots: detoxification of dietary toxins and cytoprotective effects. *J. Chem. Ecol. (1999)* 25(4): 897-922 .

No Control Gilbert, R. W., Sander, J. E., and Brown, T. P. 1996. copper sulfate toxicosis in commercial laying hens. *Avian Diseases.* 40(1): 236-239.

No COC Gilka, J., Jelinek, P., Jankova, B., Knesel, P., Krejci, P., Masek, J., and Docekalova, H. 1989. amino acid composition of meat, fatty acid composition of fat andcontent of some chemical elements in the tissues of male lambs fedmonensin or lasalocid. *Meat Science* 25(4): 273-280.

Surv Gill, J. M. and Darby, J. T. 1993. deaths in yellow-eyed penguins (megadyptes antipodes) on the otagopeninsula during the summer of 1990. *New Zealand Veterinary Journal.* 41(1): 39-42.

Carc Gilman, J. P. W. 1962. 1962. metal carcinogenesis. ii. a study on the carcinogenic activity of cobalt, copper, iron, and nickel compounds. *Cancer Res.* 22: 158-162.

Nut def Gipp, WF, Pond, WG, Tasker, J, VanCampen, D, Krook, L, and Visik, WJ. 1973. influence of level of dietary copper on weight gain, hematology and liver copper and iron storage in young pigs. *J. Nutr.* 103: 713.

Aquatic Girling, A. E., Pascoe, D. *., Janssen, C. R., Peither, A., Wenzel, A., Schaefer, H., Neumeier, B., Mitchell, G. C., Taylor, E. J., Maund, S. J., Lay, J. P., Juettner, I., Crossland, N. O., Stephenson, R. R., and Persoone, G. 2000. development of methods for evaluating toxicity to freshwater ecosystems. *Ecotoxicology and Environmental Safety [Ecotoxicol. Environ. Saf.]. Vol. 45, No. 2, Pp. 148-176. Feb 2000.*

No Oral Gleed, P. T., Allen, W. M., Mallinson, C. B., Rowlands, G. J., Sansom, B. F., Vagg, M. J., and Caswell, R. D. 1983. effects of selenium and copper supplementation on the growth of beef steers. *Veterinary Record.* 113(17): 388-392.

CP Glore, S. R. and Stoecker, B. J. mineral status during protein-energy malnutrition. *Meeting of the Federation of American Societies for Experimental Biology (Faseb), Part 1, Anaheim, California, Usa, April 5-9, 1992. Faseb (Fed Am Soc Exp Biol) J. 6 (4). 1992. A1378.*

CP Glover, R. 1998. deer herd reproductive performance: a commercial farmer's view. *Proceedings of a Deer Course for Veterinarians.*(15): 43-47.

No Oral Glushchenko, N. N., Ol'khovskaia, I. P., Pletneva, T. V., Fatkullina, L. D., and Ershov, I. U A. 1989. [the biological action of highly dispersed metal powders]. *Izv Akad Nauk SSSR [Biol].*(3): 415-21.

Diss Goetz, G. 1985.*Animal Experiments in Order to Determine the Effects of Cd on Parameters of the Reticuloendothelial and Hematopoietic System and on the Distribution of Essential Metals in Different Organs. <NOTE> Diss. (Dr.Rer.Nat. NP-8770267*

FL Gokel, E. M., Kirchgessner, M., and Roth, H. P. alimentary-induced chromium deficiency in growing rats. *J. Anim. Physiol. Anim. Nutr. (1986)* 56(5): 251-7.

Nut def Gokel, E. M., Kirchgessner, M., and Roth, H. P. 1986. diet-induced chromium deficiency in growing rats. *Journal of Animal Physiology and Animal Nutrition* 56(5): 251-257.

Aquatic Goldberg, E. D. 1972.*Baseline Studies of Pollutants in the Marine Environment and Research Recommendations. NSF/IDOE-74-26*

CP Golfman, L. S. and Boila, R. J. influence of supplemental molybdenum and sulfur upon the flow and solubility of copper zinc manganese and iron along the digestive tract of steers. *Symposium on Energy Usage in Livestock Production Systems Held at the Canadian Society of Animal Science Annual Meeting, Calgary, Alberta, Canada, August 24, 1988. Can J Anim Sci. 69 (1). 1989. 296-297.*

CP Golub, M. S., Keen, C. L., and Gershwin, M. E. 1991. neurobehavioral effects of subchronic dietary aluminum in mice . *21ST Annual Meeting of the Society for Neuroscience*

FL Golushko, V. M., Borisenko, E. N., Goryachev, I. I., Demidovich, B. K., Lebedkova, V. A., Kozlova, S. L., and Ivanov, D. P. finely granulated calcium carbonate feed additive containing trace elements. *Khim. Sel'Sk. Khoz. (1989)* (2): 69-71 .

Alt Gong Xin, Shang Fu, Obin Martin, Palmer Helen, Scrofano Mona M, Jahngen-Hodge Jessica, Smith Donald E, and Taylor Allen(A). 1997. antioxidant enzyme activities in lens, liver and kidney of calorie restricted emory mice. *Mechanisms of Ageing and Development* 99(3): 181-192.

No Oral Gonskii, Ya. I. copper and manganese levels in organs and tissues of guinea pigs during experimental tuberculosis. *Mikroelem. Med. (1968)* : No. 1, 107-11.

Surv Gonzalez, J., Hernandez, L. M., Rico, C., and Baluja, G. 1984. residues of organochlorine pesticides, polychlorinated biphenyls and heavy metals in the eggs of predatory birds from donana national park (spain), 1980-1983. *J Environ Sci Health Part B Pestic Food Contam Agric Wastes.* 19(8-9): 759-772.

BioAcc Gonzalez, L. M. and Hiraldo, F. 1988. organochlorine and heavy metal contamination in the eggs of the spanish imperial eagle aquila-adalberti and accompanying changes in eggshell morphology and chemistry. *Environ Pollut.* 51(4): 241-258.

No Dose Gonzalez, M. M., Madrid, R., and Arahuetes, R. M(A). 1995 . physiological changes in antioxidant defences in fetal and neonatal rat liver. *Reproduction Fertility and Development* 7(5): 1375-1380.

Minseral Gonzalez, N. J., Sullivan, T. W., Douglas, J. H., and Beck, M. M. 1993. effect of inorganic sulfate and sulfur amino acids on bone mineralization in broilers. *Poultry Science.* 72(10): 1935-1943.

Nut def Gonzalez-Reimers, E., Martinez-Riera, A., Santolaria-Fernandez, F., Mas-Pascual, A., Rodriguez-Moreno, F., Galindo-Martin, L., Molina-Perez, M., and Barros-Lopez, N. relative and combined effects of ethanol and protein deficiency on zinc, iron, copper, and manganese contents in different organs and urinary and fecal excretion. *Alcohol (N. Y.) (1998)* 16(1): 7-12.

Nut def Gonzalez-Reimers, E., Santolaria-Fernandez, F., Perez-Labajos, J., Rodriguez-Moreno, F., Martinez-Riera, A., Hernandez-Torres, O., Valladares-Parrilla, F., and Molina-Perez, M. relative and combined effects of propylthiouracil, ethanol and protein deficiency on liver histology and hepatic iron, zinc, manganese and copper contents. *Alcohol Alcohol. (1996)* 31(6): 535-545.

Prim Goodis, H. E. and Rosenberg, R. J. 1991. histologic evaluation of the pulpal response to temperature probe placement in the macaca fascicularis monkey. *Oral Surgery, Oral Medicine, and Oral Pathology* 72(1): 105-7.

Rev Gooneratne, S. R., Buckley, W. T., and Christensen, D. A. 1989. review of copper deficiency and metabolism in ruminants . *Can.J.Anim.Sci.* 69: 819-845.

No Dose Gooneratne, S. R. and Christensen, D. A. 1989. a survey of maternal copper status and fetal tissue copper concentrations in saskatchewan bovine. *Can. J. Anim. Sci.* 69: 141-150.

No Oral Gooneratne, S. R., Christensen, D. A., and Wenger, B. S. effects of thiomolybdates in chick embryos. *Nutr. Rep. Int. (1989)* 40(1): 85-92.

Fate Gooneratne, S. R., Gawthorne, J. M., and Howell, J. M. distribution of copper zinc and iron in the soluble fraction of the kidney in normal copper-poisoned and thiomolybdate-treated sheep. *Journal of Inorganic Biochemistry. 35 (1). 1989. 37-54.*

Alt Gooneratne, S. R., Symonds, H. W., Bailey, J. V., and Christensen, D. A. 1994. effects of dietary copper, molybdenum and sulfur on biliary copper and zinc excretion in simmental and angus cattle. *Canadian Journal of Animal Science. V. 74(2) P. 315-325*

No COC Gooneratne, S. R. Howell J. M. and Gawthorne J. M. 1985. 1985. distribution of copper in the kidney of sheep after thiomolybdate administration. *Nutr. Res.* Suppl.I, 546-554.

No Oral Goresky, C. A. Holmes T. H. and Sass-Korstak A. 1968. 1968. the initial uptake of copper by the liver in the dog. *Can J Physiol Pharmacol* . 46: 771-784.

FL Gorobets, A. I. accumulation of fat-soluble vitamins by broilers and their productivity in response to feeding of chelated trace elements. *S-Kh. Biol. (1991)* (6): 82-4.

FL Gorobets, A. I. efficiency of application of chelate complexes of trace elements with amino acids of blue-green algae hydrolyzate in rations of broilers. *S-Kh. Biol. (1986)* (8): 26-9.

FL Grabovenskii, I. I. and Kalachnyuk, G. I. 1984. use of natural clinoptilolite for rearing of young bulls. *Zhivotnovodstvo* (2): 55-56.

Bio Acc Grace, N. D. amounts and distribution of mineral elements associated with fleece free empty body weight gains in the grazing sheep. *New Zealand Journal of Agricultural Research. 26 (1). 1983. 59-70.*

CP Grace, N. D. 1986. an estimation of the dietary allowances of copper zinc iron manganese and selenium for single and twin-bearing ewes. *46th Annual Conference of the New Zealand Society of Animal Production, Dunedin, New Zealand, February 11-14, 1986. PROC N Z SOC ANIM PROD* 46: 37-40.

Mix Grace, N. D. and Lee, J. 1989. the effect of increasing copper intake on the bone mineral content ofthe growing lamb. <document title>trace elements in new zealand: environmental, humanand animal. 201-205.

Mix Grace, N. D., Maunsell, L. A., and Scott, D. 1974. growth responses of ewe hoggets supplemented with selenium copper cobalt and iodine in the lake ohau Area. *N Z J Exp Agric.* 2(2): 99-102.

Nutr Grace, N. D. and Scott, D. 1974. diet and mineral nutrition of sheep on undeveloped and developedtussock grassland. 1. the macro- and micro-element composition of bloodplasma and herbage. *New Zealand Journal of Agricultural Research* 17(2): 165-175.

Nutr Grace, N. D(A), Pearce, S. G., Firth, E. C., and Fennessy, P. F. 1999. content and distribution of macro- and micro-elements in the body of pasture-fed young horses. *Australian Veterinary Journal* 77(3): 172-176.

An Prod Graf, Ernst and Panter, S. Scott. inhibition of warmed-over flavor development by polyvalent cations. *J. Food Sci. (1991)* 56(4): 1055-8, 1067.

Nut def Graham, T. W. 1991. trace element deficiencies in cattle. *Veterinary Clinics of North America, Food Animal Practice.* 7(1): 153-215.

Bio Acc Graham, T. W., Thurmond, M. C., Mohr, F. C., Holmberg, C. A., Anderson, M. L., and Keen, C. L. 1994. relationships between maternal and fetal liver copper, iron, manganese,and zinc concentrations and fetal development in california holsteindairy cows. *Journal of Veterinary Diagnostic Investigation* 6(1): 77-87.

Unrel Graham, T. W. a, Giri, S. N., Daels, P. F., Cullor, J. S., Keen, C. L., Thurmond, M. C., Dellinger, J. D., Stabenfeldt, G. H., and Osburn, B. I. 1995. associations among prostaglandin f2alpha, plasma zinc, copper and iron concentrations and fetal loss in cows and mares. *Theriogenology.* 44(3): 379-390.

Unrel Gralak, M. A., Leontowicz, H., Leontowicz, M., Bogucka-Sciezynska, A., and Kulasek, G. W. 1998. effect of pea lectins or type of diet on bioavailability of mineral elements from rat diets. *Mengen- Spurenelem. Arbeitstag., 18th* : 591-596. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

Nutr Gralak, M. A., Leontowicz, M., Morawiec, M., Bartnikowska, E., and Kulasek, G. W. comparison of the influence of dietary fiber sources with different proportions of soluble and insoluble fiber on ca, mg, fe, zn, mn, and cu apparent absorption in rats. *Arch. Anim. Nutr. (1996)* 49(4): 293-299 .

No COC Grandhi, R. R. and Ibrahim, E. A. changes in apparent absorption and retention of nutrients during gestation in gilts fed two dietary calcium and phosphorus levels. *Canadian Journal of Animal Science. 70 (3). 1990. 927-936.*

Unrel Grant, G. and Ygge, J. somatotopic organization of the thoracic spinal nerve in the dorsal horn demonstrated with trans ganglionic degeneration. *Journal of Comparative Neurology. 202 (3). 1981. 357-364.*

Nutr Grau, C. R., Roudybush, T. E., Vohra, P., Kratzer, F. H., Yang, M., and Nearenberg, D. 1989. obscure relations of feather melanization and avian nutrition. *World's Poultry Science Journal* 45(3): 241-246.

Alt Gray, L. F. and Daniel, L. J. 1973. effect of copper status on the urinary excretion of tryptophan metabolites and amino acids by the rat. *J Nutr.* 103(12): 1764-71.

Drug Graziano, J. H., Cuccia, D., and Friedheim, E. 1978. the pharmacology of 2,3-dimercaptosuccinic acid and its potential use in arsenic poisoning. *Journal of Pharmacology and Experimental Therapeutics* 207(3): 1051-5.

Unrel Greene, L. W. and Chirase, N. K. 1998. influence of stocker program mineral nutrition on feedlot performance. *Compendium on Continuing Education for the Practicing Veterinarian.* 20(12): 1372-1379.

Nutr Greer, E. B. and Lewis, C. E. mineral and vitamin supplementation of diets for growing pigs part 3 salt calcium and phosphorus and trace mineral supplements in a wheat soybean meal diet. *Australian Journal of Experimental Agriculture and Animal Husbandry. 18 (95). 1978 (Recd. 1979). 781-787.*

Rev Greger, J. L. 1987. food, supplements, and fortified foods: scientific evaluations in regard to toxicology and nutrient bioavailability. *Journal of the American Dietetic Association.* 87 (10): 1369-1373.

No COC Greger, Janet L. and Emery, Susan M. mineral metabolism and bone strength of rats fed coffee and decaffeinated coffee. *J. Agric. Food Chem. (1987)* 35(4): 551-6.

Unrel Gregoire, Michel, Lorand, Jean Pierre, Cottin, Jean Yves, Giret, Andre, Mattielli, Nadine, and Weis, Dominique. 1997. xenoliths evidence for a refractory oceanic mantle percolated by basaltic melts beneath the kerguelen archipelago. *Eur. J. Mineral. (1997)* 9(5): 1085-1100 .

Rev Gregory, D. A(A), Johnson, D. L., and Thompson, B. H. 1993. the impact of bran baits treated with the insecticides carbaryl, chlorpyrifos and dimethoate on the survivorship and reproductive success of non-target mouse populations. *Agriculture Ecosystems & Environment* 45(1-2): 95-103 .

Unrel Greve, C., Trachtenberg, E., Opsahl, W., Abbott, U., and Rucker, R. 1987. diet as an external factor in the expression of scoliosis in a line of susceptible chickens. *The Journal Of Nutrition.* 117(1): 189-193 .

FL Gribovskii, G. P. content of carotenoids in the liver of hens fed cobalt, manganese, and copper salts. *Profil. Zaraznykh Nezaraznykh Zabol. Zhivotn. Sib.* Mater. Nauch. Konf., Posvyashch. 50-letiyu Sib. NIVI (Nauch.-Issled. Vet. Inst.) (1973): Meeting Date 1971, 340-1. Editor(s): Kopyrin, A. V. Publisher: Sib. Nauch.-Issled. Vet. Inst., Omsk, USSR.

FL Grigor'eva, T. E. and Ivanov, G. I. 1996. prophylaxis of alimentary infertility in cows. <original> profilaktika alimentarnogo besplodiya korov. *Veterinariya. (No.3) P. 41-45*

Unrel Grimson, R. E., Riemer, G. E., Stilborn, R. P., Volek, R. J., and GUMMESON, P. K. agronomic and chemical characteristics of kochia-scoparia l. schrad. and its value as a silage crop for growing beef cattle. *Can J Anim Sci; 69 (2). 1989. 383-392.*

FL Grin', N. V. and Govorunova, N. N. 1986. studying the embryotoxic effect of copper chloride in an Experiment. *Gig Sanit.* (8): 38-39.

Nutr Grings, E. E., Staigmiller, R. B., Short, R. E., Bellows, R. A., and MacNeil, M. D. 1999. effects of stair-step nutrition and trace mineral supplementation onattainment of puberty in beef heifers of three sire breeds. *Journal of Animal Science* 77(4): 810-815.

Bio Acc Groce, A. W., Taylor, C. E., Pettry, D. E., and Kerr, L. A. 1995. levels of selenium and other essential minerals in forages, bovine blood and serum relative to soil type. *Veterinary Clinical Nutrition.* 2(4): 146-152.

Unrel Groot Bruinderink Geert W T A(A), Lammertsma Dennis R(A), and Hazebroek Ed= (A). 2000. effects of cessation of supplemental feeding on mineral status of red deer cervus elaphus and wild boar sus scrofa in the netherlands. *Acta Theriologica* 45(1): 71-85.

FL Groppel, B. and Anke, M. 1991.*The Effects of a Sulphur, Cadmium and Molybdenum Contamination in Swine: <Original> Die Auswirkungen Einer Schwefel-, Cadmium- Und Molybdaenbelastung Beim Schwein: Environmental Aspects of Animal Production: <Original> Umweltaspekte Der Tierproduktion* (33): 463-468.

Unrel Groppel, B. and Anke, M. 1991. effects of sulphur, cadmium and molybdenum loading in pigs. (33): 463-468.

Aquatic Grosell, M., McDonald, M. D., Walsh, P. J., and Wood, C. M. 2004. effects of prolonged copper exposure in the marine gulf toadfish (opsanus beta) ii: copper accumulation, drinking rate and na+/k+-atpase activity in osmoregulatory tissues.*Aquatic Toxicology.* 68(3): 263-275.

Aquatic Grosell, M., McDonald, M. D., Wood, C. M., and Walsh, P. J. 2004. effects of prolonged copper exposure in the marine gulf toadfish (opsanus beta): i. hydromineral balance and plasma nitrogenous waste products. *Aquatic Toxicology.* 68(3): 249-262.

Mix Grosicki, A., Kowalski, B., and Domanska, K. 1998. distribution of subtoxic doses of mercury in rats fed a diet enriched with cobalt, manganese, zinc and copper. *Mengen- Spurenelem. Arbeitstag., 18th* : 366-369. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

Food Groten, J. P., Sinkeldam, E. J., Muys, T., Luten, J. B., and Van Bladeren, P. J. interaction of dietary calcium, phosphorus, magnesium, manganese, copper, iron, zinc, and selenium with the accumulation and oral toxicity of cadmium in rats. *Food Chem. Toxicol. (1991)* 29(4): 249-58.

Mix Grozhevskaya, S. B., Terekhina, A. N., and Terekhin, V. S. 1974. effect of copper sulphate on reproduction in cattle and, in combinationwith cobalt chloride, on some biological processes in heifers. *Trudy Permskogo Sel'Skokhozyaistvennogo Instituta.* 103: 63-69.

FL Gruber, L. Bundesanstalt fuer alpenlaendische Landwirtschaft Gumpenstein Irdning Austria, Steinwender, R., Haeusler, J., and Krautzer, B. 1992. production and utilization of mixed fodder beet silages in alpine regions, 2: utilization of mixed fodder beet silages in the feeding of dairy cows. <original> erzeugung und verwertung von ruebenmischsilagen im alpenraum, 2: verwertung von ruebenmischsilagen in der milchviehfuetterung. *Wirtschaftseigene Futter. V. 38(3) P. 155-178*

Mix Gry, J., Bille, N., Kristiansen, E., Madsen, C., Meyer, O., Olsen, P., Roswall, K., Thorup, I., and Wurtzen, G. thermally oxidized soya bean oil interacted with mono- and diglycerides of food fatty acids (esters of glycerol and thermally oxidized soybean fatty acids): a long-term study in rats. *Publ. - Levnedsmiddelstyr. (Den.) (1988)* : 172, 154 pp.

Bio Acc Guimaraes, Jorge Almeida, Garcia, Eloide Souza, and Ubatuba, Fernando Braga. analysis of biological materials by atomic absorption spectrophotometry. i. determination of total copper, iron, and zinc in chicken livers. *Pesqui. Agropecuar. Brasil.* Ser. Vet. (1971): 6, 45-5..

No Dose Gunshin, H., Imamura, T., Kato, N., Todoriki, H., Akamatsu, T., Noguchi, T. , and Naito, H. effect of dietary calcium level on tissue levels of trace elements chromium, cobalt, nickel, molybdenum, manganese, copper, zinc and iron. *Biomed. Res. Trace Elem. (1990)* 1(2): 113-14.

No Org Gunshin, Hiromi, Mackenzie, Bryan, Berger, Urs V., Gunshin, Yoshimi, Romero, Michael F., Boron, Walter F., Nussberger, Stephan, Gollan, John L., and Hediger, Matthias A. cloning and characterization of a mammalian proton-coupled metal-ion transporter. *Nature (London) (1997)*

388(6641): 482-488.

No Control Guo, R. P. R. Henry H. A. Holwerda J. Cao R. C. Littell R. D. Miles and C. B. Ammerman. 2001. chemical characteristics and relative bioavailability of supplemental organic copper sources for poultry. *Journal of Animal Science.* 79: 1132-1141.

No Dose Gupta, Alka and Shukla, Girja S. 1996. ontogenic profile of brain lipids following perinatal exposure to cadmium. *J. Appl. Toxicol.* 16(3): 227-233 .

Nut def Gupta, R. P., Verma, P. C., Sadana, J. R., and Gupta, V. K. 1989. effect of experimental zinc deficiency and repletion on sodium, potassium, copper and iron concentrations in guinea pigs. *Br. J. Nutr.* 62(2): 407-14 .

Mix Gusakov, K. and Sinkovets, A. 1998. mineral additives. *Ptitsevodstvo.*(6): 27-28.

Surv Guthova, Z. 1993. reproduction disorders in black-headed gull (larus ridibundus) from a suburban colony near ceske budejovice, southern bohemia. *Folia Zoologica.* 42(4): 95-302.

Phys Gwathmey, J. K. and Davidoff, A. J. 1994. pathophysiology of cardiomyopathies part ii. drug-induced and other interventions. *Current Opinion in Cardiology.* 9(3): 369-378.

Surv Gydesen, H. Rasmussen L. Pilegaard K. Andersen A. and Hovmand. 1981. differences in the regional deposition of cadminum, copper, lead and zinc in denmark as reflected in bulk precipitation,epiphytic cryptogams and animal kidneys. *Ambio.* 10(5): 229-230.

Nutr Hacklander, R., Enbergs, H., Niess, E., and Ahlswede, L. 1996. analysis of the feeding of warm blooded foals during the 2nd halfyear. *Pferdeheilkunde* 12(3): 307-311.

No Dose Haddad, D. S., al-Alousi, L. A., and Kantarjian, A. H. 1991. the effect of copper loading on pregnant rats and their offspring. *Funct Dev Morphol.* 1(3): 17-22.

Nut def Hahn, C. J. and Evans, G. W. 1975. absorption of trace metals in the zinc-deficient rat. *American Journal of Physiology* 228(4): 1020-1023.

CP Hahn, E., Ostapczuk, P., Ellenberg, H., and Stoeppler, M. 1985. environmental monitoring of heavy metals with birds as pollution integrating biomonitors. ii. cadmium, lead and copper in magpie (pica pica) feathers from a heavily polluted and a control area. *Heavy Met. Environ. Int. Conf., 5th* . 1: p721-3.

Bio Acc Hahn, Edmund, Hahn, Karin, and Ellenberg, Hermann. heavy metal load in the feathers of magpies. *Verh. - Ges. Oekol. (1989)* : Volume Date 1988, 18, 317-24 .

Abstract Hahn, K. J. and Burch, R. E. aging rat tissue content of moisture protein zinc copper and manganese with partial food deprivation. *64th Annual Meeting of the Fed. Am. Soc. Exp. Biol., Anaheim, Calif., USA, APR. 13-18, 1980. FED PROC. 39 (3). 1980. Abstract 2744.*

Surv Hair Bin Bejo, M. 1990.*Gastrointestinal Response to Copper Excess: Studies on Copper (and Zinc) Loaded Rats (Metallothionein)*

Nut def Halevy, O. and Sklan, D. 1986. effect of copper and zinc depletion on vitamin a and triglyceridemetabolism in chick liver. *Nutrition Reports International* 33(5): 723-727.

Mix Hall, A. T., Taylor, D. H., and Woods, P. E. 1987. effects of municipal sludge on locomotor activity and exploratory behavior of meadow voles Microtus-pennsylvanicus. *Environ Toxicol*

Chem. 9(1): 31-36.

Aquatic Hall, M. J. and Brown, M. T. 2002. copper and manganese influence the uptake of cadmium in marine macroalgae. *Bulletin of Environmental Contamination and Toxicology [Bull. Environ. Contam. Toxicol.]. Vol. 68, No. 1, Pp. 49-55. Jan 2002.*

Nutr Halpin, Kevin M. and Baker, David H. mechanism of the tissue manganese-lowering effect of corn, soybean meal, fish meal, wheat bran, and rice bran. *Poult. Sci. (1987)* 66(2): 332-40.

Plant Halvorson, A. D. and White, L. M. seasonal zinc copper manganese and iron levels of western wheat grass agropyron-smithii and green needle grass stipa-viridula as affected by nitrogen fertilization. *Agronomy Journal. 75 (2). 1983. 225-229.*

Not Avail Hamam, Abdel-Mohsen M., El-Tohamy, Magda M., and Ali, Gamal A. effect of nickel administration on some biochemical parameters and ovarian hormones in female rabbits. *Zagazig J. Pharm. Sci. (1996)* 5(2): 13-20 .

No Dose Hamar, D. W., Bedwell, C. L., Johnson, J. L., Schultheisis, P. C., Raisbeck, M., Grotelueschen, D. M., Williams, E. S., O'Toole, D., Paumer, R. J., Vickers, M. G., and Graham, T. J. 1997. iatrogenic copper toxicosis induced by administering copper oxide boluses to neonatal calves. *Journal of Veterinary Diagnostic Investigation.* 9(4): 441-443 .

Nutr Hambidge, K. M. 1985. trace minerals and fetal development. *Current Concepts in Nutrition* 14: 73-82.

Mix Han, Bin, Qi, Zhouyue, Hou, Jiangwen, Zhao, Famiao, Zhou, Yumei, and Xue, Dengmin. utilization of trace elements in fly ash by chicken. *Zhongguo Xumu Zazhi (1986)* (3): 25-7.

FL Han, I. K., Lee, C. H. Seoul National University Suwon Korea Republic College of Agriculture and Life Sciences, and Shin, I. S. American Soybean Association Seoul Korea Republic. 1995. supplementation of copper, zinc and iron to broiler diet with different levels of methionine. *Korean Journal of Animal Nutrition and Feedstuffs. V. 19(6) P. 458-467*

No Dose Han, Shenggao, Li, Wenjie, Jamil, Uzma, Dargan, Kyle, Orefice, Michelle, Kemp, Francis W., and Bogden, John D. 1999. effects of weight loss and exercise on the distribution of lead and essential trace elements in rats with prior lead exposure. *Environ. Health Perspect.* 107(8): 657-662 .

CP Han, Shenggao, Qiao, Xianwen, Kemp, Francis W., and Bogden, John D. 1996. age at lead exposure influences lead retention in bone. *Ther. Uses Trace Elem. [Proc. Int. Congr. Trace Elem. Med. Biol.], 5th* : 303-307. Editor(s): Neve, Jean; Chappuis, Philippe; Lamand, Michel. Publisher: Plenum, New York, N. Y.

Bio Acc Hanif, M., Ali, C. S., Samad, H. A., and Hanjra, S. H. 1984. influence of pregnancy stress on blood mineral profile in the buffalo. *Pakistan Veterinary Journal* 4(3): 165-168.

Abstract Hanna, L., Peters, J. M., Wiley, L. M., Clegg, M. S., and Keen, C. L. 1996. comparative effects of essential and nonessential metals on preimplantation mouse embryo development. *EXPERIMENTAL BIOLOGY 96*

Rev Hansard, S. L. 1983. microminerals for ruminant animals. *Nutrition Abstracts and Reviews, B.* 53(1): 1-24.

FL Hao, Z. L., Wu, Y. X., Zhang, C. Z., Huang, Q. G., Zhang, Z. G., Gyo, Y. S., and Quo, T. Y. 1993. analysis on trace elements in blood, hair, milk and semen from cows andstud bulls of austria line,

simmental. *Acta Veterinaria Et Zootechnica Sinica* 24(1): 36-40.

FL Hapke, H. J. (general toxicological viewpoints in the use of pesticides, particularly weedkillers.). *Tieraerztl. Umschau; 26(4): 149-52 1971*

Surv Harlow, H. E. and Hodson, P. V. chemical contamination of hamilton harbour canada a review. *Canadian Technical Report of Fisheries and Aquatic Sciences. 0 (1603). 1988. I-Ix, 1-91.*

Unrel Harris, Christine E., Simonne, Eric H., and Eakes, D. Joseph. effect of nitrogen form ratio on pansy growth and nutrition and the palatability to white-tailed deer. *J. Plant Nutr. (1999)* 22(12): 1807-1814.

No Effect Harris, D. J., Cheeke, P. R., and Patton, N. M. 1984. effect of supplemental copper on postweaning performance of rabbits. *Journal of Applied Rabbit Research.* 7(1): 10-12.

Abstract Harris, E. D. and Rayton, J. K. regulation of lysyl oxidase activity in-vitro with copper. *FED PROC. Federation Proceedings. 37 (6). 1978 1425*

Abstract Harris, R. A., Bhargava, H. N., Loh, H. H., and Way, E. L. alteration of narcotic effects by calcium and other ions. *FED PROC. Federation Proceedings. 33 (3 Part 1). 1974 515*

No Oral Harrison, T. J., Sykes, A. R., and Familton, A. S. 1989. efficacy of coprin in deer and sheep: an evaluation and comparative study. *Proceedings of the New Zealand Society of Animal Production 1989.* 49: 11-14.

No Oral Hart, B. A., Voss, G. W., Shatos, M. A., and Doherty, J. cross-tolerance to hyperoxia following cadmium aerosol pretreatment. *Toxicol. Appl. Pharmacol. (1990)* 103(2): 255-70 .

In Vit Hartman, W. J. and Kalnitsky, G. 1952.*Competitive Effects of Metallic Ions on Citrate Oxidation. 2 Archives of Biochemistry and Biophysics, V37 N1 P72-82, May 52.*: 12p.

FL Hartmans, J. 1975. 1975. the incidence of copper poisoning in sheep and the role of concentrates as a causative factor. report of an injury (de frequentie van het optreden van koperver-giftiging bij schapen en de rol van het schapen-krachtvoer daarbij. verslag van een enquete). *Tijdschr. Diergeneeskd.* 100

CP Hartner, L., Hueber, N., and Schreiber, H. 1992. suitability of bird feathers as bioindicators. *(Hohenheim Environmental Meeting, 24. Bioindicators for Environmental Pollution: New Aspects and Developments); Meeting, Hohenheim, Germany, January 31, 1992. ISBN 3-8236-1213-1.* 75-91.

Wqual Hartung, R. 1973. biological effects of heavy metal pollutants in water. *Adv Exp Med Biol.* 40: 161-72.

HHE Harvey, I. R. 1994. halogen-assisted metal migration: an infant mortality mechanism for adjacent-finger shorting in an hpppga package. *ISTFA '94 Proc. Int. Symp. Test. Failure Anal., 20th* : 245-54 Publisher: ASM, Materials Park, Ohio.

CP Harvey M(A), Zhang, X., Arcellana-Panlilio M(A), Schultz, G. A(A), and Watson, A. J. 1994. expression of antioxidant mrnas during murine and bovine preimplantation development. *Molecular Biology of the Cell* 5(SUPPL.): 351A.

Mix Haschek, W. M., Furr, A. K., Parkinson, T. F., Heffron, C. L., Reid, T., Bache, C. A., Wszolek, P. C., Gutenmann, W. H., and Lisk, D. J. 1979. element and polychlorinated biphenyl deposition and

effects in sheepfed cabbage grown on municipal sewage sludge. *Cornell Veterinarian* 69(3): 302-314.

In Vit Hasegawa, T., Hagiwara, Y., Saito, K., and Ozawa, E. 1982. effect of transferrin on chick cell growth in-vitro and transferrin receptor. *15th Annual Meeting of the Japanese Society of Developmental Biologists, Tokyo, May 27-29, 1982. Dev Growth Differ.* 29(4): 388.

CP Hashani, A. and Carlson, C. W. effect of zinc bacitracin and copper sulfate on growing turkeys. *69th Annual Meeting of the Poultry Science Association, Inc. Poult Sci. 59 (7). 1980. 1626.*

Surv Hashmi, N. S., Kachru, D. N., Khandelwal, S., and Tandon, S. K. 1989. interrelationship between iron deficiency and lead intoxication (part 2). *Biol Trace Elem Res.* 22(3): 299-307.

CP Hatayde, M. R., Pinheiro, L. E. L., and Franceschini, P. H. 1994. clinical and reproduction evaluation of normal and subfertilepitangueiras breed heifers. <document title>proceedings, 18th world buiatrics congress: 26thcongress of the italian association of buiatrics, bologna, italy,august 29-september 2, 1994. volume 2. 1005-1008.

Dead Hatch, R. C., Blue, J. L., Mahaffey, E. A., Jain, A. V., and Smalley, R. E. 1979. chronic copper toxicosis in growing swine. *Journal of the American Veterinary Medical Association.* 174(6): 616-619.

Nutr Hatzipanagiotou, A., Liamadis, D., and Hatzikas, A. 1993 . effect of different copper levels on the lactate dehydrogenase isoenzymes in the blood of pregnant young ewes. *Animal Science Review* (18): 89-102.

Nut def Hawk, S. N., Lanoue, L., Keen, C. L., Kwik-Uribe, C. L., Rucker, R. B., and Uriu-Adams, J. Y. 2003. copper-deficient rat embryos are characterized by low superoxide dismutase activity and elevated superoxide anions. *Biology of Reproduction, 2003 Mar, 68(3):896-903.*

Nut def Hayashi, Emiko, Suzuki, Kazutomo, Arakawa, Yasuyuki, and Takeuchi, Shigeo. kinetics of trace metals and their pathophysiological significance in liver regeneration in spontaneous ascorbic acid-deficient rats (ods rats). *Biomed. Res. Trace Elem. (1997)* 8(1): 19-28.

FL Hayashi, M., Ogura, Y., Murata, H., Saeki, T., Shoya, S., Nakamura, K., Ide, Y., and Obara, Y. 1987. experimental studies on toxic activities of copper in calves. *Bull Natl Inst Anim Health.*(91): 25-32.

Unrel Hayashibe, H., Asayama, K., Dobashi, K., and Kato, K. 1990. prenatal development of antioxidant enzymes in rat lung, kidney, and heart: marked increase in immunoreactive superoxide dismutases, glutathione peroxidase, and catalase in the kidney. *Pediatric Research* 27(5): 472-5.

Surv Haywood, S. 1979. the effect of the sex of weaned rats on the accumulation of dietary copper in their livers. *J Comp Pathol.* 89(4): 481-7.

Surv Haywood, S., Loughran, M., and Batt, R. M. 1985. changes in intracellular copper in liver and kidney of rat during the development of copper tolerance. *Nutrition Research.* .(suppl. 1): 678-682.

Fate Haywood, S., Loughran, M., and Batt, R. M. 1985. copper toxicosis and tolerance in the rat. iii. intracellular localization of copper in the liver and kidney. *Exp Mol Pathol.* 43(2): 209-19.

FL He TianPei and Zhou YuPing. 1998. effect of taurine on mineral element concentration in the liver ofbroilers. *Chinese Journal of Veterinary Science* 18(1): 24-26.

Nut Heath, J. S. and Donaldson, W. E. 1984. dietary manipulation of membrane fatty-acid content and erythrocyte fragility in chicks. *NUTR REP INT.* 29(5): 1061-1070.

Soil Invert Heikens, A., Peijnenburg WJGM, and Hendriks, A. J. 2001. bioaccumulation of heavy metals in terrestrial invertebrates. *Environmental Pollution [Environ. Pollut.]. Vol. 113, No. 3, Pp. 385-393. 2001.*

Org met Helling, B., Reinecke, S. A., and Reinecke, A. J. 2000. effects of the fungicide copper oxychloride on the growth and reproduction of eisenia fetida (oligochaeta). *Ecotoxicology and Environmental Safety [Ecotoxicol. Environ. Saf.]. Vol. 46, No. 1, Pp. 108-116. May 2000.*

No Oral Helman, R. G., Adams, L. G., Pierce, K. R., Bridges, C. H., and Bailey, E. M. 1985. the role of lysosomes in the pathogenesis of copper-inducedhepatotoxicity: morphological studies. *Journal of Comparative Pathology.* 95(1): 25-35.

Nut def Helwig, L. R. Jr., Mulnix, E. J., and Regenstein, J. M. effects of varied zinc/copper ratios on egg and plasma cholesterol level in white leghorn hens. *J. Food Sci. (1978)* 43(3): 666-9 .

Surv Henderson, B. M. and Winterfield, R. W. 1975. acute copper toxicosis in the canada goose. *Avian Diseases.* 19(2): 385-387.

Aquatic Hendriks A.J. modelling equilibrium concentrations of microcontaminants in organisms of the rhine delta: can average field residues in the aquatic foodchain be predicted from laboratory accumulation? *Aquat.-toxicol. 1995 Vol. 31, No. 1, Pp. 1-25.*

Bio Acc Hendriks, A. J., Ma, W. C., Brouns, J. J., de Ruiter-Dijkman, E. M., and Gast, R. 1995. modelling and monitoring organochlorine and heavy metal accumulation in soils, earthworms, and shrews in rhine-delta floodplains. *Arch Environ Contam Toxicol.* 29(1): 115-27.

Effl Hendrosoekarjo, S. and Pearce, G. R. 1978. utilization by sheep of dried pig feces containing a high concentration of copper. *Anim Feed Sci Technol.* 3(1): 31-40.

Rev Henkens, C. H. and Koopman, J. J. 1973.*Tracing and Treating Mineral Disorders in Dairy Cattle.* 61pp.

Nutr Hennig, A., Richter, G., Grun, M., and Zander, R. 1990. the influence of a very high straw supply as fibre source on themineral status of the broiler hen. *Nahrung* 34(2): 189-193.

CP Hennig, V. 1992. element analysis on feathers of raven corvus-corax and peregrine falcon falco-peregrinus-peregrinus possibilities and trends in biomonitoring. *(Hohenheim Environmental Meeting, 24. Bioindicators for Environmental Pollution: New Aspects and Developments); Meeting, Hohenheim, Germany, January 31, 1992. ISBN 3-8236-1213-1.* 93-110.

Surv Henny, C. J., Blus, L. J., and Grove, R. A. western grebe, aechmophorus occidentalis, wintering biology and contaminant accumulation in commencement bay, puget sound, washington (usa). *Can Field-nat; 104 (3). 1990. 460-472.*

Drug Henry, P. R., Ammerman, C. B., Campbell, D. R., and Miles, R. D. 1987. effect of antibiotics on tissue trace mineral concentration and intestinal tract weight of broiler chicks. *Poult. Sci.* 66(6): 1014-18 .

Herp Herkovits, J., Corro, L., Perez-Coll, C., and Domingue, O. 2002. fluid motion effect on metal toxicity in bufo arenarum embryos. *Bulletin of Environmental Contamination and Toxicology, 2002 Apr, 68(4):549-54.*

FL Herlin, A. H. and Andersson, I. 1996.*Soil Ingestion in Farm Animals. A Review.*

Not Avail Herlin, A. H. and Andersson, I. 1996. soil ingestion in farm animals. a review. <document title>report - department of agricultural biosystems andtechnology, swedish university of agricultural sciences. (105): 35 pp.

Mix Hermann, J. C. Goad A. Arquitt B. Stoecker R. Porter and P. L. Claypool. effects of dietary chromium, copper and zinc on plasma lipid concentrations in male japanese quail. *Nutr. Res. (N. Y.) (1998)* 18(6): 1017-1027 .

Mix Hermann, Janice, Goad, Carla, Stoecker, Barbara, Arquitt, Andrea, Porter, Rebecca, Adeleye, Bernice, Claypool, P. L., and Brusewitz, Gerald. effects of dietary chromium, copper and zinc on femur fracture force and femur calcium concentration in male japanese quail. *Nutr. Res. (N. Y.) (1997)* 17(10): 1529-1540 .

Surv Hernandez, L. M., Gonzalez, M. J., and Fernandez, M. A. 1988. organochlorines and metals in spanish imperial eagle eggs 1986-87. *Environ Conserv.* 15(4): 363-364.

Bio Acc Hernandez, L. M., Gonzalez, M. J., Rico, M. C., Fernandez, M. A., and Aranda, A. 1988. organochlorine and heavy metal residues in falconiform and ciconiform eggs Spain. *Bull Environ Contam Toxicol.* 40(1): p86-93.

Bio Acc Hernandez, L. M., Rico, M. C., Gonzalez, M. J., Hernan, M. A., and Fernandez, M. A. 1986. presence and time trends of organochlorine pollutants and heavy metals in eggs of predatory birds of spain. *J Field Ornithol.* 57(4): 270-282.

Surv Hernandez, L. M., Rico, M. C., Gonzalez, M. J., Montero, M. C., and Fernandez, M. A. 1987. residues of organochlorine chemicals and concentrations of heavy metals in ciconiiform eggs in relation to diet and habitat. *J Environ Sci Health Part B Pestic Food Contam Agric Wastes.* 22(2): 245-258.

Sludge Hernandez, T., Moreno, J. I., and Costa, F. influence of sewage sludge application on crop yields and heavy metal availability. *Soil Sci Plant Nutr; 37 (2). 1991. 201-210.*

FL Herrawie, M. El. 1976. toxicity of copper oxychloride for hens. *Zeszyty Naukowe Akademii Rolniczej We Wroclawiu, Weterynaria.* 34(116): 125-145.

Aquatic Hickey, C. W. and Golding, L. A. 2002. response of macroinvertebrates to copper and zinc in a stream mesocosm. *Environmental Toxicology and Chemistry [Environ. Toxicol. Chem.]. Vol. 21, No. 9, Pp. 1854-1863. Sep 2002.*

Nut def Hidiroglou, M. zinc copper and manganese deficiencies and the ruminant skeleton a review. *Canadian Journal of Animal Science. 60 (3). 1980. 579-590.*

No COC Hidiroglou, M., Ho, S. K., Williams, C. J., and Ivan, M. effects of level of dietary sulfur on the growth performance and blood mineral profile of sheep fed urea supplemented corn silage. *International Journal for Vitamin and Nutrition Research. 47 (3). 1977 284-291.*

QAC Hidiroglou, M. and Spurr, D. T. 1975. influence of cold exposure and diet change on the trace element composition of hair from shorthorn cattle. *Canadian Journal of Animal Science: 55 (1).* 55(1): 31-38.

Nut def Hidiroglou, M. and Williams, C. J. 1982. trace elements status of fetuses from ewes fed a copper-deficientration. *American Journal of Veterinary Research* 43(2): 310-313.

Surv Higgins, R. J. 1981. chronic copper poisoning in growing pigs. *Veterinary Record.* 109(7): 134-135.

Rev Hill, C. H. 1979. dietary influences on resistance to salmonella infection in chicks. *Federation Proceedings* 38(7): 2129-33.

CP Hill, C. H. 1981. the effect of iron and zinc on metal toxicities in the chick. *65th Annual Meeting of the Federation of American Societies for Experimental Biology, Atlanta, GA., USA, APRIL 12-17, 1981. FED PROC. 40 (3 Part 1) 715.*

HHE Hill, C. H. interactions among trace elements. *Prasad, A. S. (Ed.). Current Topics in Nutrition and Disease, Vol. 18. Essential and Toxic Trace Elements in Human Health and Disease; First International Meeting of the International Society for Trace Element Research in Humans, Palm Springs, California, Usa, December 8-12, 1986. Xxiii+679p. Alan R. Liss, Inc.: New York, New York, Usa. Illus. ISBN 0-8451-1617-7. 0 (0). 1988. 491-500.*

CP HILL, C. H. 1985. interactions of copper and mercury with vanadate in the chick. *69th Annual Meeting of the Federation of American Societies for Experimental Biology*

Rev Hill, C. H. 1980. interactions of vitamin c with lead and mercury. *Annals of the New York Academy of Sciences* 355: 262-6.

Rev Hill, C. H. 1975. interrelationships of selenium with other trace elements. *Fed. Proc.* 34(11): 2096-2100.

Abstract Hill, C. H. 1975. the reduction of metal toxicities by ascorbic-acid in the chick. *FED PROC. Federation Proceedings. 34 (3). 926*

CP Hill, C. H., Gonzalez, L. M., Hiraldo, F., Lee, D. P., Honda, K., and Tatsukawa, R. 1988. interactions among trace elements: organochlorine and heavy metal contamination in the eggs of the spanish imperial eagle aquila-adalberti and accompanying changes in eggshell morphology and chemistry: comparison of tissue distributions of heavy metals in birds in japan and korea. *Current Topics in Nutrition and Disease, Vol. 18. Essential and Toxic Trace Elements in Human Health and Disease; First International Meeting of the International Society for Trace Element Research in Humans, Palm Springs, California, Usa, December 8-12, 1986. ILLUS. ISBN 0-8451-1617-7.* 491-500 .

Rev Hill, C. H. and Matrone, G. 1970. chemical parameters in the study of in vivo and in vitro interactions of transition elements. *Federation Proceedings.* 29(4): 1474-81.

Mix Hill, Ch, Starcher, B, and Matrone, G. 1964. mercury and silver interrelationships with copper. *J. Nutr.* 83: 107.

CP Hill, R. changes in circulating copper, manganese, and zinc with the onset of lay in the pullet. *Trace Elem. Metab. Anim.* Proc. Int. Symp., 2nd (1974): Meeting Date 1973, 632-4. Editor(s): Hoekstra, W. G. Publisher: Univ. Park Press , Baltimore, Md.

Rev Hill, R. 1977. copper toxicity ii. *Br Vet J.* 133(4): 365-73.

Rev Hill, R. 1977. copper toxicity part 1. *Br. Vet. J.* 133(3): 219-224.

BioAcc Hill R, Leighton M, Heys V, and Jones D M. the accumulation of copper, zinc, manganese and iron in the foetus of deer. *Trace Elements in Man and Animals* 6 1988. 128: 617-618, illustr.

Mix Hill, R. and Smith, I. M. 1974. the effects of trace elements and ethylenediaminetetraacetic acid on the survival of chicks inoculated with salmonella gallinarum. *Proc Nutr Soc.* 33(3): 89A-90A.

Nutr Hill, R and Williams, HL. 1965. the effects on intensively reared lambs of diets containing excess copper. *Vet.Rec.* 77: 1043.

Nutr Hill, R. R. Jr. and Guss, S. B. 1976. genetic variability for mineral concentration in plants related tomineral requirements of cattle. *Crop Science* 16(5): 680-685.

Mix Hill, R. Royal Vet. Coll. London Univ. Boltons Park Potters Bar Herts UK, Smith, I. M., and Leech, F. B. 1977. the effect of dietary supplements of copper, zinc and iron sulphates alone or with a chelator on survival in experimental fowl typhoid in the chick. *Avian Pathology. V. 6(4) P. 425-434*

Mineral Hill, W. J., Secrist, D. S., Owens, F. N., Strasia, C. A., Gill, D. R., Basalan, M., and Johnson, A. B. 1996. effects of trace mineral supplements on performance of feedlot steers. *Animal Science Research Report - Agricultural Experiment Station, Oklahoma State University* (P-951): 153-163.

Mix Hilliard, E. P. and Pearce, G. R. limitations of guidelines governing rates of application of pig manure to land. *Agriculture and Environment. 4 (1). 1978 65-76.*

No Dose Hilliard, E. P. and Pearce, G. R. 1936. variability in the composition of commercial pig diets with particularreference to minerals. *Australian Journal of Experimental Agriculture and Animal Husbandry*

Dead Hillis, T. L. and Parker, G. H. 1993. age and proximity to local ore-smelters as determinants of tissue metal levels in beaver (castor canadensis) of the sudbury (ontario) area. *Environ Pollut.* 80(1): 67-72.

Surv Hilmy, A. M., El-Domiaty, N. A., Daabees, A. Y., and Abou-Taleb, E. M. 1986. studies of zinc magnesium copper calcium and iron in cadmium poisoned toads bufo-regularis before and after treatment with edta. *Comp Biochem Physiol C Comp Pharmacol Toxicol.* 85(1): 167-170.

Acu Hilmy, A. M., El-Domiaty, N. A., Kamal, M. A., Mohamed, M. A., and Abou Samra, W. E. 1991. effect of some arsenic antagonists on the toxicity, distribution and excretion of arsenite and arsenate in rats. *Comp. Biochem. Physiol. C: Comp. Pharmacol. Toxicol.* 99C(3): 357-62.

Unrel Hintz, H. F. 1969. effect of coprophagy on digestion and mineral excretion in the guinea pig. *Journal of Nutrition* 99(3): 375-8.

Nut def Hintz, H. F. and Schryver, H. F. 1987. nutrition and bone development in dogs. *Companion Anim Pract.* 1(1): 44-47.

Surv Hintz, H. F. and Schryver, H. F. 1976. nutrition and bone development in horses. *Journal of the American Veterinary Medical Association.* 168(1): 39-44.

Unrel Hirasawa Fujiko(A), Sato Mitsuru, and Takizawa Yukio. 1994. organ distribution of silver and the effect of silver on copper status in rats. *Toxicology Letters (Amsterdam)* 70(2): 193-201.

FL Hlasny, J. Vyzkumny Ustav pro Chov Skotu Rapotin Czech Republic. 1998. [rational use of mineral-vitamin premixes in cattle, especially in dairy cows]. <original> racionalni vyuziti mineralne-vitaminovych smesi u skotu, zejmena u dojnic. *Vyzkum v Chovu Skotu. V. 142(2) P. 26-32*

FL Hlynczak, A. J., Greinert, H., Kawczynska, M., Stelmaszyk, Z. J., and Wozniak, Z. 1975. studies on congenital abnormalities in cattle in pomerania. xxii. use of mineral fertilizers in relation to the occurrence of developmental defects in cattle in szezecin province. *Zeszyty Naukowe Akademia Rolnicza w Szczecinie, Zootechnika.*(52): 85-91.

FL Hodate, K., Hamada, T., and Maeda, S. 1994. the role of excessive amounts of dietary copper and vitamin e in lipid peroxidation in tissues of the pig. *Animal Science and Technology.* 65(9): 856-861.

FL Hoehler, D. 1992. [investigations on the effect of a corn-soybean diet supplemented with citric and fumaric acid on the utilization of zinc as well as of other minerals in the piglet]. <original> untersuchungen zum einfluss einer zulage an citronen- und fumarsaeure zu einer mais-soja-diaet auf die verwertung von zink sowie weiterer mineralstoffe beim ferkel . *183 P.*

FL Hoehler, D. Giessen Univ. Germany Inst. fuer Tierernaehrung and Pallauf, J. 1993. effect of citric acid added to a maize-soya-diet with or without zn-supplementation on the availability of minerals. <original> untersuchungen zum einfluss von citronensaeure auf die mineralstoffverwertung beim ferkel anhand einer mais-soja-diaet mit und ohne zn-ergaenzung . *Journal of Animal Physiology and Animal Nutrition. V. 69(2-3) P. 133-142*

FL Hoehler, D. Kiel Univ. Germany Inst. fuer Tierernaehrung und Stoffwechselphysiologie and Pallauf, J. 1994. effects of zn-supply and addition of citric acid to a maize-soya-diet on the nutritional efficiency and adsorption of minerals in piglets. <original> effekt einer abgestuften zn-zufuhr und zulagen von citronensaeure zu einer mais-soja-diaet auf leistungsparameter und mineralstoffverwertung beim ferkel. *Journal of Animal Physiology and Animal Nutrition. V. 71(4-5) P. 189-199*

No Oral Hoey, M. J. 1966. the effects of metallic salts on the histology and functioning of the rat testis. *J Reprod Fertil.* 12(3): 461-472.

In Vit Hojima, Y., Behta, B., Romanic, A. M., and Prockop, D. J. a. 1994. cadmium ions inhibit procollagen c-proteinase and cupric ions inhibit procollagen n-proteinase. *Matrix Biology.* 14(2): 113-120.

HHE Holbrook, J. T., Smith, J. C., and Reiser, S. 1989. dietary fructose or starch - effects on copper, zinc, iron, manganese, calcium, and magnesium balances in humans. *American Journal Of Clinical Nutrition* 49(6): 1290-1294.

Abstract Holden, L. A., Muller, L. D., Moore, D. A., and Hammerschmidt, K. J. 1996. evaluation of chelated cu, mn, and zn for lactating dairy cows. *Journal of Dairy Science* 79(SUPPL. 1): 198.

No Dose Holgren, GGS, Meyer, MW, Chaney, RL, and Daniels, RB. 1993. cadmium, lead, zinc, copper, nickel in agricultural soils of the united states of america. *J. Environ. Qual.* 22: 335-348.

Nut def Holmes, J. H. G. 1992. trace element deficiency in sheep in east gippsland, victoria. *Australian Veterinary Journal.* 69(11): 292-293.

Nut def Holmes, J. H. G., Edye, L. A., Potter, J., and Walton, E. 1986. mineral status of beef cattle in papua new-guinea . *Trop Anim Health Prod.* 18(1): 31-39.

Surv Holsbeek Ludo^Joiris Claude R_(A)^Debacker Virginie^Ali Ishaque B^Roose= Patrick^Nellissen Jean-Pierre^Gobert Sylvie^Bouquegneau= Jean-Marie^Bossicart Michele. 1999. heavy metals, organochlorines and polycyclic aromatic hydrocarbons in sperm whales stranded in the southern north sea during the 1994/1995 winter. *Marine Pollution Bulletin.* 38(4): 304-313.

Bio Acc Honda, K., Ichihashi, H., and Tatsukawa, R. 1987. tissue distribution of heavy metals and their variations with age sex and habitat in japanese serows capricornis-crispus. *Arch Environ Contam Toxicol.* 16(5): 551-562.

Bio Acc Honda, K., Min, B. Y., and Tatsukawa, R. 1986. distribution of heavy metals and their age-related changes in the eastern great white egret, egretta alba modesta, in korea. *Arch Environ Contam Toxicol.* 15(2): p185-198.

Bio Acc Honda, K., Min, B. Y., and Tatsukawa, R. 1985. heavy metal distribution in organs and tissues of the eastern great white egret egretta-alba-modesta. *Bull Environ Contam Toxicol.* 35(6): 781-789.

Bio Acc Honda, Katsuhisa, Marcovecchio, Jorge Eduardo, Kan, Shinya, Tatsukawa, Ryo, and Ogi, Haruo. metal concentrations in pelagic seabirds from the north pacific ocean. *Arch. Environ. Contam. Toxicol. (1990)* 19(5): 704-11.

Bio Acc Honda, Katsuhisa Ehime Univ Japan, Min, Byung Yoon, and Tatsukawa, Ryo. heavy metal distribution in organs and tissues of the eastern great. *Bull Environ Contam Toxicol. V35, N6, P781(9)*

Abstract Hood, R. D., Baxley, M. N., and Harrison, W. P. evaluation of chromated copper arsenate(cca)for teratogenicity. *Teratology 19:31A,1979*

Abstract Hood, R. D., Baxley, M. N., and Harrison, W. P. evaluation of chromated copper arsenate for teratogenicity. *Teratology. 19 (2). 1979 31a*

Herp Hopkins, W. A., Mendonca, M. T., and Congdon, J. D. 1997. increased circulating levels of testosterone and corticosterone in southern toads, bufo terrestris, exposed to coal combustion waste. *General and Comparative Endocrinology.* 108(2): 237-246.

Mix Horky, D., Illek, J., and Pechova, A. 2002. histochemical and ultrahistochemical localization of heavy metals in calf organs. *Microscopy Research and Technique [Microsc. Res. Tech.]. Vol. 56, No. 6, Pp. 435-450. 15 Mar 2002.*

Surv Hornfeldt, B. and Nyholm, N. EI. 1996. breeding performance of tengmalm's owl in a heavy metal pollution gradient. *Journal of Applied Ecology.* 33(2): 377-386.

Bio Acc Hornshaw, T. G., Aulerich, R. J., Ringer, R. K., and Martin, M. B. 1985. mineral concentrations in the hair of natural dark and pastel mink(mustela vison). *Scientifur* 9(3): 216-219.

No Org Horstmann, Uwe E. and Haelbich, Ingo W. chemical composition of banded iron-formations of the griqualand west sequence, northern cape province, south africa, in comparison with other precambrian iron formations . *Precambrian Res. (1995)* 72(1-2): 109-45 .

No Oral Hoshishima, K. 1983. 'play' behavior and trace dose of metal(s) in mice. *Dev. Toxicol. Environ. Sci.* 11: 525-528.

No Oral Hoshishima, K. and Shimai, S. 1985. trace amounts of metal(s) prenatally administered and the circadian drinking rhythm in mice. *Trace Elem. Man Anim. -- TEMA 5, Proc. Int. Symp., 5th,* 292-4.

CP Hoshishima, K., Tujii, H., and Kano, K. 1978. effects of the administration of trace amounts of metals to pregnant mice upon the behavior and learning of their offspring. *Proc Int Congr Toxicol 1st 1977* .: 569-570.

Bio Acc Hothem, Roger L., Roster, Douglas L., King, Kirke A., Keldsen, Timothy J., Marois, Katherine C., and Wainwright, Susan E. 1995. spatial and temporal trends of contaminants in eggs of wading birds from san francisco bay, california. *Environ. Toxicol. Chem.* 14(8): 1319-31 .

Unrel Houpt, K., Zgoda, J. C., and Stahlbaum, C. C. 1984. use of taste repellants and emetics to prevent accidental poisoning of dogs. *Am J Vet Res.* 45(8): 1501-3.

Minseral House, W. A. and Bell, A. W. 1993. mineral accretion in the fetus and adnexa during late gestation inholstein cows. *Journal of Dairy Science* 76(10): 2999-3010.

Minseral House, William A., Apgar, Jean, and Smith, J. Cecil. the gerbil: a model for studying the metabolism of beta-carotene and minerals. *Nutr. Res. (N. Y.) (1997)* 17(8): 1293-1302.

Rev Howell, J. M., <Editors> Masters, D. G., and White, C. L. 1996. toxicities and excessive intakes of minerals. <book>detection and treatment of mineral nutrition problems in grazingsheep. 95-117.

CP Howell, J. M. and Kumaratilake, J. 1985. observation on the morphological distribution of copper loaded and necrotic hepatic parenchymal cells during the development of chronic copper poisoning in sheep. *Trace Elements in Man and Animals-TEMA 5. Proceedings of the Fifth International Symposium* : 184-186.

Rev Howell, J. M., Masters, D. G., and White, C. L. 1996. toxicities and excessive intakes of minerals. *Detection and Treatment of Mineral Nutrition Problems in Grazing Sheep.* 95-117.

No Oral Howell, J. M. and Gopinath C. 1977. copper toxicity in sheep: the effects of repeated intravenous injections of copper sulphate. *Res. Vet. Sci.* 22: 86-94.

Unrel Howick, C. D. and Creffield, J. W. 1975. the development of a standard laboratory bio-assay technique with mastotermes darwiniensis froggatt (isoptera: mastotermitidae). *Zeitschrift Fur Angewandte Entomologie.* 78(2): 126-138.

FL Hristic, V. 1994. effect of prolonged dietary intake of cadmium on the concentrations ofsome major and trace elements in broiler chickens. *Veterinarski Glasnik* 48(11/12): 1025-1028.

FL Hristic, V. and Knezevic, J. 1980. effect of cadmium on trace element status of chickens. *Veterinaria, Yugoslavia.* 29(1/2): 166-170.

FL Hristic, V. and Knezevic, Jovanka. effect of cadmium on the trace element status in chicks. *Veterinaria (Sarajevo) (1980)* 29(1-2): 166-70.

FL Hristic, V. and Krsmanovic, Jovanka. influence of dietary cadmium on the absorption of radioactive iron-59, in vitro, and possible protective role of zinc and copper. *Veterinaria (Sarajevo) (1984)* 33(4): 503-8.

Plant Hsieh, C. F. and Hsu, K. N. an experiment of the organic farming of sweet corn and vegetable soybean. *Bulletin of Taichung District Agricultural Improvement Station; 0 (39). 1993. 29-39.*

Nutr Huan, Jianya, Cheeke, Peter R., Lowry, Robert R., Nakaue, Harry S., Snyder, Stanley P., and Whanger, Philip D. dietary pyrrolizidine (senecio) alkaloids and tissue distribution of copper and vitamin a in broiler chickens. *Toxicol. Lett. (1992)* 62(2-3): 139-53.

Nutr Huang MeiHua. 1994. verification and research on the effects of fermented loess feed onpigs. *Journal of Hunan Agricultural College* 20(1): 74-81.

Minseral Huang Siqi. 1993. evaluation of biological utilization of minerals and trace elements from foods of infant formulas. *Hunan Yike Daxue Xuebao* 18(4): 403-406.

Surv Hudec, K., Kredl, F., Pellantova, J., Svobodnik, J., and Svobodova, R. 1988. residues of chlorinated pesticides pcb and heavy metals in the eggs of water birds in southern moravia czechoslovakia. *Folia Zool.* 37(2): p157-166.

Mix Hudgens, R. E. and Hallford, D. M. 1984. feedlot performance, carcass characteristics, serum constituents andtissue minerals in lambs produced by ewes fed sewage solids through twolambing seasons. *Nutrition Reports International* 29(1): 11-21.

Unrel Huff, W. E., Malone, G. W., and Chaloupka, G. W. 1984. effect of litter treatment on broiler performance and certain litter quality parameters. *Poultry Science* 63(11): 2167-71.

Minseral Hufstedler, G. D. and Greene, L. W. 1995. mineral and nitrogen balance in lambs implanted with zeranol. *Journal of Animal Science* 73(12): 3785-3788.

Bio Acc Hui, A., Takekawa, J. Y., Baranyuk, V. V., and Litvin, K. V. 1998. trace element concentrations in two subpopulations of lesser snow geese from wrangel island, russia. *Arch Environ Contamin Toxicol* . 34(2): 197-203.

Surv Hui, Clifford A. metal and trace element burdens in two shorebird species at two sympatric wintering sites in southern california. *Environ. Monit. Assess. (1998)* 50(3): 233-247.

No Dose Hui, Clifford A. University of California Davis and Beyer, W. Nelson USGS Laurel MD. sediment ingestion of two sympatric shorebird species. *Sci Total Environ. V224, N1-3, P227(7)*

Surv Hui-Min, J., Guo'an, H., Xi, C., and Hongjun, Z. 1997. effect of selenium on the change in cadmium-induced distribution of trace elements in pregnant rats. *Trace Elements and Electrolytes.* 14(1): 9-12.

FL Hulliger, L., Pohler, O., and Straumann, F. 1967. [influence of some pure metals and alloys on the growth of rabbit fibrocytes in tissue culture]. <original> einfluss einiger reiner metalle und legierungen auf das wachstum von kaninchenfibrocyten in gewebekulturen. *Zeitschrift Fur Die Gesamte Experimentelle Medizin Einschliesslich*

Mix Hullinger, G., Sangster, L., Colvin, B., and Frazier, K. 1998. bovine arsenic toxicosis from ingestion of ashed copper-chrome-arsenatetreated timber. *Veterinary and Human Toxicology* 40(3): 147-148.

Unrel Hultman, P., Lindh, U., and Horsted-Bindslev, P. activation of the immune system and systemic immune-complex deposits in brown norway rats with dental amalgam restorations. *J. Dent. Res. (1998)* 77(6): 1415-1425.

Unrel Humbert Willy(A) and Pevet Paul . 1996. electron probe x-ray microanalysis of the elemental composition of the pineal gland of young adults and aged rats. *Journal of Pineal Research* 20(1): 39-44.

Nut def Humphries, W. R., MacPherson A., and Farmer, P. E. 1983. drinking water as a carrier of trace elements for cattle. *Trace Elements in Animal Production and Veterinary Practice* : 143-144.

Nut def Hunt, Charles E., Landesman, Joanne, and Newberne, Paul M. copper deficiency in chicks: effects of ascorbic acid on iron, copper, cytochrome oxidase activity, and aortic mucopolysaccharides. *Brit. J. Nutr. (1970)* 24(3): 607-14..

No COC Hunt, Curtiss D. dietary boron modified the effects of magnesium and molybdenum on mineral metabolism in the cholecalciferol-deficient chick. *Biol. Trace Elem. Res. (1989)* 22(2): 201-20.

Nutr Hunt, Curtiss D., Halas, Edward S., and Eberhardt, Marilou J. long-term effects of lactational zinc deficiency on bone mineral composition in rats fed a commercially modified luecke diet. *Biol. Trace Elem. Res. (1988)* 16(2): 97-113 .

Nut def Hunt, D. M. and Port, A. E. trace element binding in the copper deficient mottled mutants in the mouse. *Life Sciences. 24 (16). 1979. 1453-1466.*

Unrel Hunt, Janet R, Gallagher, Sandra K, Johnson, LuAnn K, and Lykken, Glenn I. high- versus low-meat diets: effects on zinc absorption, iron status, and calcium, copper, iron, magnesium, manganese, nitrogen, phosphorus, and zinc balance in postmenopausal women. *Am. J. Clin. Nutr. (1995)* 62(3): 621-32.

Surv Hunter, B. A., Johnson, M. S., and Thompson, D. J. 1987. ecotoxicology of copper and cadmium in a contaminated grassland ecosystem iii. small Mammals. *J Appl Ecol.* 24(2): 601-614.

Surv Hunter, B. A., Johnson, M. S., and Thompson, D. J. 1989. ecotoxicology of copper and cadmium in a contaminated grassland ecosystem. iv. tissue distribution and age accumulation in small mammals. *J. Appl. Ecol.*. 26(1): 89-90.

Gene Hurley, L. S. 1976. interaction of genes and metals in development. *Federation Proceedings* 35(11): 2271-5.

Rev Hurley, L. S. 1981. teratogenic aspects of manganese, zinc, and copper nutrition. *Physiological Reviews.* 61(2): 249-295.

Nutr Hurley, L. S. 1981. trace metals in mammalian development. *Johns Hopkins Medical Journal* 148(1): 1-10.

Bio Acc Hurley, L. S. Reinstein N. Lonnerdal B. and Keen C. L. 1985. 1985. interaction between dietary zinc and copper during pregnancy in the rat. *Nutr. Res.* Suppl I: 543-545.

Mix Hurley, Lucille S., Keen, Carl L., and Loennerdal, Bo. 1983. aspects of trace element interactions during development. *Fed. Proc. Fed. Am. Soc. Exp. Biol.* 42(6): 1735-9 .

No COC Husain, K. and Somani, S. M(A). 1998. interaction of exercise training and chronic ethanol ingestion on testicular antioxidant system in rat. *Journal of Applied Toxicology* 18(6): 421-429.

Diss Hussain, R. 1991.*Pathological Aspects of Immunosuppression Induced by Dietary Excess of Sodium Chloride and Copper Sulphate in Broiler Chickens*

Fate Hussein, K. S. M., Jones B-E, V., and Frank, A. 1985. selenium copper interaction in goats. *Zentralbl Veterinaermed Reihe A.* 32(5): 321-330.

FL Hussein, S. A., Azab, M. E(A), and Abdel-Maksoud, H. 1999. metabolic changes concerning the effect of castration on some blood constituents in male rabbits. *DTW (Deutsche Tieraerztliche Wochenschrift)* 106(3): 113-118.

Unrel Hylland, K a, Haux, C., Hogsrand, C., Sletten, K., and Andersen, R. A. 1994. properties of cold metallothionein, its presence in different tissues and effects of cd and zn treatment. *Fish Physiology and Biochemistry.* 13(1): 81-91.

Nutr Ibnouf, F. O. and El-Zubeir, E. A. 1992. the effect of dietary tannins on incidence of leg

abnormalities in chicks fed different calcium:phosphorus ratios. *Sudan Journal of Animal Production* 5: 71-79.

Nut def Ibragimov, Kh. Z., Norbaev, K. N., and Bakirov, B. B. 1984. prevention of protein and mineral disorders during fattening of sheep. *Ovtsevodstvo.*(9): 37.

Soil Invert Idinger, J. 2002. laboratory studies to detect effects of selected plant protection products on folsomia candida (collembola: isotomidae). *Zeitschrift Fur Pflanzenkrankheiten Und Pflanzenschutz, 109 (5) Pp. 512-529, 2002.*

Aquatic Ifon, E. T. and Umoh, I. B. biochemical and nutritional evaluation of egreria radiata (clam), a delicacy of some riverine peasant populations in nigeria. *Food Chem. (1987)* 24(1): 21-7.

Bio Acc Igawa, Takahiko. determination of mineral contents in chicken liver. *Kachiku Hoken Eisei Gijutsu Kenkyukai Kaiho (1977)* : 25, 97-9.

Acu Ignesti, G., Perretti, M., and Buffoni, F. 1986. diamine oxidase activity in japanese quail liver induced with aroclor 1254. *Agents Actions.* 18(1-2): 41-3.

Alt Iguchi, H., Kasai, R., Okumura, H., Yamamuro, T., and Kagan, H. M. 1990. effect of dietary cadmium and/or copper ont the bone lysyl oxidase in copper-deficient rats relative to the metabolism of copper in the bone. *Bone and Mineral* 10(1): 51-59.

Bio Acc Ikebe, Katsuhiko, Nishimune, Takahiro, and Sueki, Kenji. 1994. behavior of several elements in foods. vii. contents of 17 metal elements in food determined by inductively coupled plasma atomic emission spectrometry. meat and meat products. *Shokuhin Eiseigaku Zasshi* 35(3): 323-7.

No Oral Il'ina, N. I. effect of cobalt, copper, zinc, and manganese on the development of the resistance of [shigella] sonnei dystentery bacteria to streptomycin. *Mikroelem. Med. (1971)* : No. 2, 31-3 .

Nutr Imik, H., Gucus, A. I., and Cetinkaya, N. 1998. effects of supplementation of angora goat diet with minerals andvitamins on live weight gain, mohair produce, quality, and mineralcontent, and blood mineral concentration. *Veteriner Fakultesi Dergisi, Ankara Universitesi* 45(1): 83-95.

FL Inoue, T. and Maitani, T. 1985. effect of copper on rats. (ii). effect of peroral administration. *Kyoto-Fu Eisei Kogai Kenkyusho Nenpo.* 30: 53-9.

Unrel Iqbal, M. Z. and Rahmati, K. 1992. tolerance of albizia lebbek to copper and iron application. *Ekologia* . 11(4): 427-430.

FL Isaeva, T. 1974. effect of trace element salts on growth and development of young mink. *Krolikovodstvo i Zverovodstvo.*(1): 19.

FL Isar, M., Isar, O., Poleacu, I., Bellea, S., Groza, I., Nemteanu, S., Popescu, V., Raducanescu, H., Popii, V. B., Togoe, I., Borhan, G., Popescu, I., Bosinceanu, M., Iacoban, N., and Boier, L. 1983. effect of biological sludge given to piglets and fattening pigs. *Lucrarile Stiintifice Ale Institutului De Biologie Si Nutritie Animala* 12: 59-72.

No Oral Isar, O., Raileanu, M., Radu, C., Epuran, E., and Boianu, D. metabolic disorders in poultry with locomotory affections. *Lucrarile Institutului De Cercetari Veterinare Si Biopreparate Pasteur. 19 (0). 1991. 91-98.*

Bio Acc Ishizawa, Masaichi, Okada, Kyoko, and Yoshida, Nobuo. iron, copper, zinc, and manganese contents in rat tissues. *Igaku To Seibutsugaku (1968)* 77(5): 187-9 .

n=1 Ishmael, J., Gopinath, C., and Howell, J. M. 1972. experimental chronic copper toxicity in sheep biochemical and hematological studies during the development of lesions in the Liver. *Res Vet Sci.* 13(1): 22-29.

FL Istomina, N. A. 1980. effect of copper compounds on the growth of calves and assimilation of dietary Nutrients. *Sov Agric Sci* .(2): 66-69.

Nutr Itakura, C., Kazama, T., and Goto, M. 1982. comparative pathology of gizzard lesions in broiler chicks fed fish meal histamine and copper. *Avian Pathol.* 11(3): 487-502.

Phys Iturri Sergio and Nunez Marco Tulio(A). 1998. effect of copper, cadmium, mercury, manganese and lead on fe2+ and fe3+ absorption in perfused mouse intestine. *Digestion* 59(6): 671-675.

No Oral Ivakhnenko, A. N. effect of atp on the degree of atrophy and metabolism of trace nutrients in muscles of immobilized extremities of pubescent and senile rabbits. *Mikroelem. Med. (1971)* : No. 2, 71-3.

Nutr Ivan, M. and Grieve, C. M. 1975. effects of zinc, copper, and manganese supplementation ofhigh-concentrate ration on digestibility, growth, and tissue content ofholstein calves. *Journal of Dairy Science* 58(3): 410-415.

Bio Acc Ivan, M and Grieve, CM. 1976. effects of zinc, copper, and manganese supplementation of high-concentrate ration on gastrintestinal absorption of copper and manganese in holstein calves. *J. Dairy Sci.* 59: 1764.

No COC Ivan, M., Ihnat, M., and Hidiroglou, M. 1979. effects of nitrilotriacetic acid on apparent absorption and duodenalflow of manganese, iron, zinc and copper in sheep. *Canadian Journal of Animal Science* 59(2): 273-281.

No COC Ivan, M., Jui, P., and Hidiroglou, M. 1979. the effects of nitrilotriacetic acid on solubilities of zinc, copper,manganese, and iron in the stomach of sheep. *Canadian Journal of Physiology and Pharmacology* 57(4): 369-374.

Nutr Ivan, M. and Veira, D. M. 1981. effect of dietary protein on the solubilities of manganese, copper,zinc and iron in the rumen and abomasum of sheep. *Canadian Journal of Animal Science* 61(4): 955-959.

FL Ivanov, A. T. and Petrova, V. S. 1987. sapropel in the diets for young pigs as a factor increasing bonestrength. *Veterinarnaya Nauka - Proizvodstvu* (25): 170-175.

FL Ivanov, D. P., Bogush, A. A., Seregin, V. V., Filiptsov, G. T., Sheshko, P. M., and Kutuzov, L. S. 1984. trace element salts in the diets for pigs. *Veterinarnaya Nauka - Proizvodstvu, Minsk, Belorussian SSR* (22): 151-154.

FL Ivanov, D. P., Lipnitskii, S. S., Litvyak, V. S., and Bril', E. E. 1983. effect of trace element supplements and mikroanemin (a dextrinpreparation of iron, copper and cobalt) on blood morphology and aminoacid and folic acid concentrations in young pigs. *Veterinarnaya Nauka -- Proizvodstvu* (20): 119-123.

FL Ivanov, D. P., Seregin, V. V., Filiptsov, G. T., Morozov, M. N., and Kutuzov, L. S. 1984. increased amounts of trace elements in diets for sows kept in largeindustrial complexes. *Veterinarnaya Nauka - Proizvodstvu, Minsk, Belorussian SSR* (22): 147-151.

No Oral Izumi, Kanji, Donaldson, John, and Barbeau, Andre. yawning and stretching in rats induced by intraventricularly administered zinc. *Life Sci. (1973)* 12(5)(Pt. 1): 203-10 .

Dup Jackson, N. the effect of dietary copper sulfate on laying performance, nutrient intake and tissue copper and iron levels of the mature, laying, domestic fowl. *Br. J. Nutr. (1977)* 38(1): 93-100.

CP Jackson, S. G. 1996. feeding and nutrition of the performance horse. *Equine Neurology and Nutrition. Proceedings of Eighteenth Bain-Fallon Memorial Lectures, Stamford Grand Hotel, 22nd-26th July 1996.* 151-161.

CP Jackson, S. G. and <Editors> Dyke, T. M. 1996. feeding and nutrition of the performance horse. <document title>equine neurology and nutrition. proceedings ofeighteenth bain-fallon memorial lectures, stamford grand hotel,glenelg, south australia, australia 22nd-26th july 1996. 151-161.

CP Jackson, S. G., Pagan, J. D., and <Editors> Dyke, T. M. 1996. nutrition of the broodmare: maximizing longevity and reproductiveperformance. <document title>equine neurology and nutrition. proceedings ofeighteenth bain-fallon memorial lectures, stamford grand hotel,glenelg, south australia, australia 22nd-26th july 1996. 177-186.

Abstract Jacobs, R. M., Fox, M. R. S., and Fry, B. E. Jr. temporal changes in quail tissue mineral element concentrations on exposure to dietary cadmium and effects of cadmium on retention of mineral elements. *Federation Proceedings. 31 (2). 1972 699*

CP Jacobs, Richard M., Jones, A. O. Lee, Fox, M. R. Spivey, and Lener, Jaroslav. effects of dietary zinc, manganese, and copper on tissue accumulation of cadmium by japanese quail. *Proc. Soc. Exp. Biol. Med. (1983)* 172(1): 34-8 .

Mix Jacobs, Richard M., Jones, Ann O. Lee, Fry, Bert E. Jr., and Fox, M. R. Spivey. 1978. decreased long-term retention of cadmium-115m in japanese quail produced by a combined supplement of zinc, copper, and manganese. *J. Nutr.* 108(6): 901-10 .

CP Jacobson, K. B., Turner, J. E., Christie, N. T., and Owenby, R. K. 1981.*Toxic and Biochemical Effects of Divalent Metal Ions in Drosophila: Correlation to Effects in Mice and to Chemical Softness Parameters. CONF-811035-3*

FL Jaczewski, S., Dynarowicz, I., and Monkiewicz, J. 1977. the effect of long-term administration of copper and lead-containingsubstances to rabbits on semen characters. *Medycyna Weterynaryjna.* 33(7): 410-412.

CP Jaczewski, S. and Monkiewicz, J. 1983. effect of heavy metals on the health and reproduction of rabbits. *Bioindyk. Skazen Przem. Roln., Mater. Pokonf.* 421-7.

FL Jaczewski, S., Monkiewicz, J., and Pawlina, E. 1991. deposition of some heavy metals in tissues of purebred and crossbred cattle raised within the reach of copper metallurgic works. *Roczniki Nauk Rolniczych Seria B Zootechniczna.* 107(4): 179-185.

FL Jaczewski, S., Monkiewicz, J., and Pawlina, E. 1991. effect of contaminated environment on the growth rate of different genotype heifers. *Roczniki Nauk Rolniczych. Seria B - Zootechniczna.* 107(3): 75-82.

FL Jaczewski, S., Monkiewicz, J., and Pawlina, E. 1989. fertility of the cows maintained in the copper mill polluted areas. *Zeszyty Naukowe Akademii Rolniczej We Wroclawiu. Zootechnika.*(179): 29-35.

Unrel Jager, H. H. 1976. trace elements, their significance and determination. *Deutsche Molkerei-Zeitung.* 97(8): 193-195.

Mix Jakab, L., Rafai, P., Papp, Z., Brydl, E. a, Beres, J., and Kelemen, A. 1996. the effect of galli-

stibol(r) on egg production, reproduction parameters and metabolism of poultry parent stocks and on the production of their progeny. *Allattenyesztes Es Takarmanyozas* 45(1)

In Vit Jakobson, A. M. and Hahnenberger, R. antiangiogenic effect of heparin and other sulfated glycosaminoglycans in the chick embryo chorioallantoic membrane. *Pharmacology & Toxicology. 69 (2). 1991. 122-126.*

Model Jamall, I. S. 1988. modulation of peroxidative injury by dietary trace elements cadmium cardiotoxicity as a model. *Current Topics in Nutrition and Disease, Vol. 18. Essential and Toxic Trace Elements in Human Health and Disease; First International Meeting of the International Society for Trace Element Research in Humans Decemeber8-12, 1986.* 415-430.

Mix Jamall, I. S., Naik, M., Sprowls, J. J., and Trombetta, L. D. 1989. a comparison of the effects of dietary cadmium on heart and kidney antioxidant enzymes: evidence for the greater vulnerability of the heart to cadmium toxicity. *J Appl Toxicol.* 9(5): 339-45 .

CP Jamall, I. S. and Roque, H. 1989. cadmium-induced alterations in ocular trace elements. influence of dietary selenium and copper. *Biol Trace Elem Res.* 23: 55-63.

No Control James, L. F., Lazar, V. A., and Binns, W. 1966. effects of sublethal doses of certain minerals on pregnant ewes and fetal development. *Am J Vet Res.* 27(116): 132-135.

FL Jamroz, D., Pres, J., Mazurkiewicz, M., and Kroliczek, A. 1971. (some nutritional and physiological values in broilers given copper andzinc by various methods). *Medycyna Weterynaryjna* 27(No.8): 497-500.

FL Jancic, S., Crnojevic, Z., Pesut, M., Crnojevic, T., and Pozezanac, T. 1973. effect of the source of large doses of copper in the diet onconcentrations of copper, iron, manganese and vitamin a in some tissuesof fattening pigs. *Poljoprivredna Znanstvena Smotra* 40: 353-362.

Unrel Jandal, J. M. 1995. some factors affecting lipase activity in goat milk. *Small Ruminant Research* 16(1): 87-91.

HHE Janghorbani, M. and Young, V. R. 1982. advances in the use of stable isotopes of minerals in human studies. *Federation Proceedings* 41(10): 2702-8.

Nut def Jankowski, Margaret A., Uriu-hare, Janet Y., Rucker, Robert B., and Keen, Carl L. effect of maternal diabetes and dietary copper on fetal development in rats. *Reprod. Toxicol. (1993)* 7(6): 589-98 .

Unrel Japenga, J., Zschuppe, K. H., De Groot, A J., and Salomons, W. 1990. heavy metals and organic micropollutants in floodplains of the river waal (netherlands) a distributary of the river rhine, (netherlands), 1958-1981. *Neth J Agric Sci.* 38(3A): 381-397.

FL Jarosz, S. and Barabasz, B. 1983. effect of industrial environment on reproductive performance in mink. *Zeszyty Problemowe Postepow Nauk Rolniczych.*(302): 53-61.

Nut def Jarvinen, R. and Ahlstrom, A. effect of the dietary manganese level on tissue manganese, iron, copper, and zinc concentrations in female rats and their fetuses. *Med. Biol. (1975)* 53(2): 93-9 .

No COC JASIM, S. H. chelate-induced changes in metal disposition in pregnant and non-pregnant mice studies on diethyldithiocarbamate thiuram sulfides ethylxanthate and pyridinethiones. *Acta Pharm Suec; 23 (3). 1986. 191-192.*

Bio Acc Jeannin, B. trace elements and herbage production. *C R ACAD AGRIC FR. Comptes Rendus De*

L'Academie D'Agriculture De France. 77 (8). 1991. 103-110.

Dead Jefferies, D. J. 1991. some observations on scottish wildcats felis-silvestris based on the results of autopsies. *Glasg Nat.* 22(1): 11-20.

Mix Jelic, T., Velickovic, G., Stankovic, G., and Nikolic, N. 1972. effect of small amounts of trace elements on growth and fattening ofpigs. *Krmiva* 14(5): 97-100.

No Control Jenkins, K. J. and Hidiroglou, M. 1989. tolerance of the calf for excess copper in milk replacer. *J Dairy Sci.* 72(1): 150-156 .

Nut def Jenkinson, S. G., Lawrence, R. A., Burk, R. F., and Williams, D. M. 1982. effects of copper deficiency on the activity of the selenoenzyme glutathione peroxidase and on excretion and tissue retention of 75seo3(2-). *J Nutr.* 112(1): 197-204.

Abstract Jensen, L. S. interactions of silver and copper with selenium in chicks. *Federation Proceedings. 33 (3 Part 1). 1974 694*

CP Jensen, L. S. 1975. precipitation of a selenium deficiency by high dietary levels of copper and zinc. *Proc Soc Exp Biol Med.* 149(1): 113-116.

Nutr Jensen, L. S., Casey, J. M., Savage, S. I., and Britton, W. M. an association of hardness of water with incidence of fatty liver syndrome in laying hens. *Poult. Sci. (1976)* 55(2): 719-24.

Abstract Jensen, L. S. and Maurice, D. V. 1977. effect of dietary copper on cecal contents of broilers. *Poultry Science* 56(5): 1726.

Abstract Jensen, L. S., Werho, D. B., and Leyden, D. E. hepatic selenium content of chicks fed toxic levels of selenium as affected by copper silver and linseed meal. *Federation Proceedings. 35 (3). 1976 577*

CP Jensen, Leo S. precipiation of a selenium deficiency by high dietary levels of copper and zinc. *Proc. Soc. Exp. Biol. Med. (1975)* 149(1): 113-16.

No COC Jia, Xiujuan, Emerick, Royce J., and Kayongo-Male, Henry. 1997. the ph dependence of silicon-iron interaction in rats. *Biol. Trace Elem. Res. (1998)* 59(1-3): 113-122 .

In Vit Jiang, Huimin, Han, Guoan, Cui, Xi, Liu, Ping, Wang, Shue, and Sun, Shuai. the effect of selenium, zinc, copper, and manganese on the content of gsh in mouse liver. *Shandong Yike Daxue Xuebao (1993)* 31(1): 37-9 .

HHE Jiang, W., Graham, B., Spiccia, L., and Hearn, M. T. 1998. protein selectivity with immobilized metal ion-tacn sorbents: chromatographic studies with human serum proteins and several other globular proteins. *Analytical Biochemistry* 255(1): 47-58.

In Vit Jimenez Del Rio, Marlene, Pinxteren, Jef, De Potter, Werner, Ebinger, Guy, and Vauquelin, Georges. serotonin binding proteins in bovine retina: binding of serotonin and catecholamines. *Neurochem. Int. (1993)* 22(2): 111-19 .

In Vit Jimenez del Rio, Marlene, Pinxteren, Jef, De Potter, Werner, Ebinger, Guy, and Vauquelin, Georges. serotonin-binding proteins in the bovine cerebral cortex: interaction with serotonin and catecholamines. *Eur. J. Pharmacol.* Mol. Pharmacol. Sect. (1992): 225(3), 225-34 .

Mix Jirgena, A. and Leja, D. 1966. effect of vanadium, cobalt, manganese, and copper on lipid metabolism indexes in serum and liver of experimental animals. *Biokhim. Fiziol. Morfol. Obosnovaniya Diagn. Ter.* 449-54.

FL Jirgena, A. and Leja, D. effect of vanadium, cobalt, manganese, and copper on lipid metabolism of hamsters under normal conditions and durng alimentary hypercholesteremia. *Latv. PSR Zinat. Akad. Vestis (1967)* (6): 88-93.

Bio Acc Joblin, K. N. and Keogh, R. G. the element composition of herbage at urine patch sites in a rye grass pasture. *Journal of Agricultural Science. 92 (3). 1979. 571-574.*

No Oral Johansson, A. and Camner, P. 1986. adverse effects of metals on the alveolar part of the lung. *Scanning Electron Microsc.* 1986(2): 631-638.

CP Johnson, A. B. and Fakler, T. M. Zinpro Corporation Minnesota USA. 1998. trace minerals in swine and poultry nutrition. recent developments in animal feeds and feeding. proceedings of a congress of the animal feed manufacturers association. may 6-8 1998, sun city (south africa). *P. 12.1-12.25*

FL Johnson, Hope and Johnson, Janice Marie. environmental policies in developing countries: algeria (republic). *Beitrage Zur Umweltgestaltung Report a 27. P801550(9)*

No Oral Johnson, Phyllis E. and Korynta, Eugene D. effects of copper, iron, and ascorbic acid on managanese availability to rats. *Proc. Soc. Exp. Biol. Med. (1992)* 199(4): 470-80 .

No Oral Johnson, R. W., Curtis, S. E., Dantzer, R., Bahr, J. M., and Kelley, K. W. sickness behavior in birds caused by peripheral or central injection of endotoxin. *Physiol. Behav. (1993)* 53(2): 343-8

Nut def Jones, D. G. 1984. effects of dietary copper depletion on acute and delayed inflammatory responses in mice. *Research in Veterinary Science* 37(2): 205-10.

CP Jones, D. G., Suttle, N. F., Jones, G. E., Woolliams, J. A., Woolliams, C., and Wiener, G. 1985. associations between copper (cu) and selenium (se) status, mortality and infection in young lambs. *Trace Elements in Man and Animals-TEMA 5. Proceedings of the Fifth International Symposium.*: 46-48.

Acu Jones, K. H. Sanderson D. M. and Noakes D. N. 1968. 1968. acute toxicity data for pesticides (1968). *World Rev. Pest Control* . 7(3): 135-143.

CP Jongbloed, A. W. and Lenis, N. P. 1969-1993. excretion of nitrogen and some minerals by livestock. *VERSTEGEN*

Species Jordan, F. T. W. and Nassar, T. J. 1971. the influence of copper on the survival of infectious bronchitisvaccine virus in water. *Veterinary Record* 89(No.23): 609-610.

Surv Jovic, S. 1991. blood biochemistry of fallow deer cervus-dama l. 1958 from brioni islands yugoslavia and its influence on the growth of antlers. *Vet Glas* . 45(2): 125-132.

No Oral Judson, G. J., Brown, T. H., Kempe, B. R., and Turnbull, R. K. 1988. trace element and vitamin b-12 status of sheep given an oral dose of one two or four soluble glass pellets containing copper selenium and cobalt. *Aust J Exp Agric.* 28(3): 299-306.

Unrel Juntti-Berggren, L., Lindh, U., Berggren P-O, and Frankel, B. J. elemental composition in the pancreatic b cell is normal in the prediabetic chinese hamster. *Pancreas. 7 (1). 1992. 11-14.*

Mix Jurczuk, M., Brzoska, M. M., Moniuszko-Jakoniuk, J., Galazyn-Sidorczuk, M., and Kulikowska-Karpinska, E. 2004. antioxidant enzymes activity and lipid peroxidation in liver and kidney of rats exposed to cadmium and ethanol. *Food and Chemical Toxicology [Food Chem. Toxicol.]. Vol. 42, No. 2, Pp. 429-438. Feb 2004.*

Mix Kaalaas, John Atle, Ringsby, Thor Harald, and Lierhagen, Syverin. metals and selenium in wild animals from norwegian areas close to russian nickel smelters. *Environ. Monit. Assess. (1995)* Volume Date 1995, 36(3): 251-70.

Nutr Kaantee, E. and Kurkela, P. 1980. the effects of trace element supplements on blood levels of horses. *Journal of the Scientific Agricultural Society of Finland* 52(5): 468-475.

FL Kabaija, E. and Smith, O. B. 1988. trace element kinetics in the digestive tract of sheep fed diets withgraded levels of dietary fibre. *Journal of Animal Physiology and Animal Nutrition* 59(4): 218-224.

No Oral Kabata, H., Kimura, M., Yokoi, K., Matsuda, A., and Itokawa, Y. change of magnesium concentration in rats administered trace elements (iron, zinc, copper, manganese, and iodine) intravenously. the effect of manganese concentration. *Maguneshumu (Kyoto) (1988)* 7(2): 111-16.

FL Kabulbekov, A. A., Dzhumadillaev, D. N., and Demina, T. V. macro- and trace elements in conditions of cariogenic nutrition and physical exercise. *Stomatologiya (Moscow) (1988)* 67(4): 10-12.

FL Kabulbekov, A. A., Dzhumadillaev, D. N., Musabekov, S. M., Buitov, B. K., Adibaev, B. M. , Egorova, Z. D., and Orlova, G. V. 1984. effect of nutrition on major and trace element content of teeth and jawbones. *Izvestiya Akademii Nauk Kazakhskoi SSR, Biologicheskaya* (2): 57-59.

FL Kachalova, E. Ya. dynamics of trace element content in the blood of lactating pregnant cows fed premixes. *Doklady Vsesoyuznoi Ordena Lenina i Ordena Trudovogo Krasnogo Znameni Akademii Sel'Skokhozyaistvennykh Nauk Imeni V I Lenina. 0 (11). 1989. 22-24.*

FL Kaemmerer, K., Fink-Gremmels, J., and Kietzmann, M. 1984. [trials with organic and inorganic copper compounds. 2. effects on liver protein synthesis and growth in rats]. *Zentralbl Veterinarmed [A]*. 31(9): 660-70.

FL Kaemmerer, K., Kietzmann, M., and Fink-Gremmels, J. 1984. studies with organic and inorganic copper compounds 2. effects on liver protein synthesis and growth in rats. *Zentralbl Veterinaermed Reihe A*. 31(9): 660-670.

Surv Kaemmerer, K., Kietzmann, M., and Fink-Gremmels, J. 1984. [trials with organic and inorganic copper compounds. 1. oral substitution of a copper deficiency state in rats and swine]. *Zentralbl Veterinarmed [A]*. 31(9): 645-59.

Unrel Kageyama, N., Kusuzaki, K., Yamashita, F., Hirasawa, Y., and Ashihara, T. 1991. [staining of bone canaliculi using decalcified bone tissues]. *Nippon Seikeigeka Gakkai Zasshi* 65(9): 757-61.

In Vit Kaji, T., Kawatani, R., Takata, M., Hoshino, T., Miyahara, T., Kozuka, H., and Koizumi, f. the effects of cadmium copper or zinc on formation of embryonic chick bone in tissue culture. *Toxicology; 50 (3). 1988. 303-316.*

In Vit Kaji, T., Miyahara, T., Kawatani, R., Hoshino, T., Kozuka, H., and Koizumi, F. biochemical and histological study of the effects of cadmium copper or zinc on bone formation of embryonic chick bone in tissue culture . *Joint Japan-usa Congress of Pharmaceutical Sciences, Honolulu, Hawaii, USA, December 2-7, 1987. J Pharm Sci. 76 (11). 1987. S134.*

In Vit Kaji Toshiyuki(A), Fujiwara Yasuyuki(A), Sakurai Shigeru(A), Yamamoto Chika(A), Kozuka Hiroshi, and Koizumi Fumitomo. 1995. zinc promotes the repair of wounded monolayers of cultured vascular endothelial cells. *Research Communications in Molecular Pathology and*

Pharmacology 89(2): 189-198.

In Vit Kaji, Toshiyuki Toyama Medical & Phamaceutical Univ Japan, Takata, Masakazu, Miyahara, Tatsuro, Kozuka, Hiroshi, and Koizumi, Fumitomo. interaction of zinc with cadmium and copper on ossification of. *Arch Environ Contam Toxicol. V19, N5, P653(4)*

Minseral Kakuta, I. and Nishimura, Y. effects of dietary chitosan on mineral metabolism in rat. *Biomed. Res. Trace Elem. (1993)* 4(2): 203-4.

Nutr Kal'nitskii, B. 1987. mineral nutrition of heifers. *Molochnoe i Myasnoe Skotovodstvo* (2): 42-43.

FL Kal'nitskii, B. 1983. mineral nutrition of young male cattle. *Molochnoe i Myasnoe Skotovodstvo.*(9): 34-36.

Unrel Kal'nitskii, B. D. 1984. biological availability of manganese, iron and zinc from various compounds in young pigs. *Khimiya v Sel'Skom Khozyaistve.* 22(8): 45-48.

Nut def Kal'nitskii, B. D. 1986. mineral nutrition of cattle. *Zhivotnovodstvo.*(7): 33-36.

FL Kal'nitskii, B. D., Bataeva, A. P., and Kuznetsov, S. G. 1986. comparative effectiveness in utilization of trace elements in diets forpiglets. *Byulleten' Vsesoyuznogo Nauchno-Issledovatel'Skogo Instituta Fiziologii, Biokhimii i Pitaniya Sel'Skokhozyaistvennykh Zhivotnykh* (5 (84)): 33-36.

FL Kal'nitskii, B. D. and Kuznetsov, S. G. 1987. glucosaminoglucans in young pigs given varying amounts of traceelements. *Vestnik Sel'Skokhozyaistvennoi Nauki Kazakhstana* (7): 105-110.

Nutr Kal'nitskii, B. D., Kuznetsov, S. G., and Kharitonova, O. V. 1991. recommendations on the mineral nutrition of female calves, heifers andcows. *Zootekhniya* (9): 29-33.

Bact Kalachnyuk, H. I(A), Marounek, M., Kalachnyuk, L. H., and Savka, O. H. 1994. rumen bacterial metabolism as affected by extracellular redox potential. *Ukrainskii Biokhimicheskii Zhurnal* 66(1): 30-40.

FL Kalas, J. A. and Myklebust, I. 1994. monitoring terrestrial ecosystems: accumulation of metals in cervids. *Nina Utredning.* 58: 1-45.

Nutr Kalashnikov, A. P. and Vishnayakov, M. I. 1996. a premix for breeding bulls. *Zootekhniya* (9): 7-9.

Nutr Kalchreuter, S. 1994. starch feeds are not always favourable. *Tierzuchter* 46(8): 33-35.

No COC Kalimullin, Yu. N. 1985. metabolism of copper and iodine in sows during feeding with syntheticchelated compounds. <document title>fiziologiya i patologiya obmena veshchestv uproduktivnykh zhivotnykh. 3-5.

Mix Kalinin, V. V., Epifanov, G. V., Zakachurin, A. F., Naumenko, P. A., and Ryzhkov, V. A. 1986. fattening young cattle on distiller's grains. *Zhivotnovodstvo.*(2): 38-39.

Nut def Kalinowski, J. and Chavez, E. R. 1986. low dietary zinc intake during pregnancy and lactation of gilts. 1.effects on the dam. *Canadian Journal of Animal Science* 66(1): 201-216.

Minseral Kalinowski, J. and Chavez, E. R. 1990. nitrogen and trace mineral balance of pregnant gilts under low dietaryzinc intake. *Journal of Trace Elements and Electrolytes in Health and Disease* 4(2): 115-125.

Minseral Kalinowski, J. and Chavez, E. R. 1991. tissue composition and trace mineral content of the dam and litterunder low dietary zinc intake during gestation and lactation offirst-litter gilts. *Journal of Trace Elements and Electrolytes in Health and Disease* 5(1): 35-46.

Bio Acc Kalisinska, E. and Szuberla, U. heavy metals in the brain of long-tailed duck (clangula hyemalis) wintering in the pomeranian bay, poland. *Biological Trace Element Research; 55 (1-2). 1996. 191-197.*

Minseral Kalita, D. J., Sarmah, B. C., and Bhattacharyya, B. N. 1999. mineral profile and fertility of cows. *Indian Veterinary Journal* 76(11): 971-972.

FL Kalous, J., Stradal, M., Jedlicka, Z., and Volaufova, E. 1981. effect of a supplement of trace elements (co, cu, mn and zn) in feedsfor fattening cattle on performance, and retention of trace elements insome tissues and organs. *Sbornik Vysoke Skoly Zemedelske v Praze, Fakulta Agronomicka, B* (35): 261-273.

No Oral Kamel, S. H. Khater A. R. and Farid A. F. 1971. pathological changes in experimental copper poisoning in chickens. *Zbl.Vet.Med.A V18, 465-474.* 18: 465-474.

Surv Kaminski, P. 1998. the impact of ca and heavy metals upon the nest development of sparrows. *Polish J Environ Stud.* 7(2): 53-65.

Rev Kaminski, P. 1998. the impact of ca and heavy metals upon the nest development of sparrows (passer spp.) and other synanthropic birds . *Polish J Environ Stud.* 7(2): 53-65.

Surv Kaminski, P., Choinski, A., and Wolosiuk, B. 1993. dynamics of the content of selected elements in the nestling development of the house martin delichon urbica in a rural landscape. *Acta Ornithologica (Warsaw).* 28(1): 23-37.

Bio Acc Kaminski, P. and Matus, A. 1998. the impact of urban environments on the growth and histopathological. *Polish J Environ Stud.* 7(3): 131-151.

Surv Kaminski, P. and Matus, A. 1998. the impact of urban environments on the growth and histopathological changes of tree sparrow (passer montanus) nestlings. *Polish J Environ Stud.* 7(3): 131-151.

Unrel Kamo, S. L., Wasteneys, H., Gower, C. F., and Krogh, T. E. u-pb geochronology of labradorian and later events in the grenville province, eastern labrador. *Precambrian Res. (1996)* 80(3-4): 239-260.

FL Kamphues, J. 1991. nutrition-related health problems in livestock. *Uebersichten Zur Tierernaehrung* 19(3): 247-272.

FL Kamphues, J., Matschullat, G., and Mueller, E. 1991. copper intoxication in sheep due to ad libitum feeding of a mineral supplement. *DTW (Dtsch Tieraerztl Wochenschr).* 98(3): 109-111.

In Vit Kanematsu, Nobutake, Hachinohe, Masaki, Naito, Koichi, Oogane, Kiyoshi, Kawahara, Haruyuki, and Kuroda, Yukiaki. effect of metal ions on tissue culture cells. iii. effect of metal ions on aggregation of embryonic quail liver cells in rotation culture. *Shika Kiso Igakkai Zasshi (1979)* 21(3): 498-510.

FL Kang, M. H., Chung, K. H., Choi, W. J., and Kim, C. S. 1980. toxicity of chromium and its interaction with copper and silver in chicks. *Korean Journal of Animal Sciences. 22 (4). 1980 (Recd. 1981). 314-322.* 22(4): 314-322.

Alt Kanno, S., Aoki, Y., Suzuki, J. S., Takeichi, N., Misawa, S., and Suzuki, K. T. 1994. enhanced synthesis of metallothionein as a possible cause of abnormal copper accumulation in lec rats. *Journal Of Inorganic Biochemistry.* 56(2): 117-125.

FL Kanwar, K. C. and Singh, M. zinc, copper and manganese levels in various tissues following fluoride administration. *Experientia (1981)* 37(12): 1328-9.

Nutr Karring, M., Pohjanvirta, R., Rahko, T., and Korpela, H. 1981. the influence of dietary molybdenum and copper supplementation on thecontents of serum uric acid and some trace elements in cocks. *Acta Veterinaria Scandinavica* 22(3/4): 289-295. Ref ID: 9018

Nutr Karabanov, A. M. 1990. biological effectiveness of sapropel. *Zootekhniya* (9): 38-40.

FL Karunskii, A. I. 1987. dry gluten in diets for piglets. *Zhivotnovodstvo* (7): 43-45.

In Vitro Kasabova, T., Balevska, P., and Rusanov, E. 1976. oxidative phosphorylation in rat liver mitochondria upon alimentary copper deficiency and copper loading. *Dokl. Bolg. Akad. Nauk.* 29(1): 117-19.

No Dose Kasahara, T., Iwasaki, K., and Sato, M. 1987. ingestive responses to some heavy metal salts in mice and inhibition oftaste nerve responses by metals. *Chemical Senses* 12(2): 295-305.

Diss Kasahara, T., Iwasaki, K., and Sato, M. 1984-1985. preference-aversion for heavy metals in mice. *18th Japanese Symposium on Taste and Smell*

No Dose Kasahara, Tetsuzo, Iwasaki, Kazuo, and Sato, Masayasu. 1987. ingestive responses to some heavy metal salts in mice and inhibition of taste nerve responses by metals. *Chem. Senses.* 12(2): 295-305.

Alt Kasama, T. and Tanaka, H. 1989. effects of oral copper administration to pregnant heterozygous brindled mice on fetal viability and copper levels. *J Nutr Sci Vitaminol* . 35(6): 627-38.

HHE Kashem, A., Endoh, M., Yamauchi, F., Yano, N., Nomoto, Y., Sakai, H., Pronai, L., Tanaka, M., and Nakazawa, H. 1996. superoxide dismutase activity in human glomerulonephritis. *American Journal of Kidney Diseases* 28(1): 14-22.

Minseral Kashimura, Jun, Kimura, Mieko, Kondo, Hisao, Yokoi, Katsuhiko, Nakajima, Yoshikazu, Nishio, Koji, and Itokawa, Yoshinori. effects of palatinose and its condensates on contents of various minerals in rat tissues. *Nippon Eiyo* Shokuryo Gakkaishi (1992): 45(1), 49-54.

In Vit Kassabova, T. and Russanov, E. 1977. effect of chronic copper loading on the functions of rat liver mitochondria. *Acta Physiol Pharmacol Bulg.* 3(3): 42-8.

Alt Kato, J., Kohgo, Y., Sugawara, N., Katsuki, S., Shintani, N., Fujikawa, K., Miyazaki, E., Kobune, M., Takeichi, N., and Niitsu, Y. 1993. abnormal hepatic iron accumulation in lec rats. *Japanese Journal of Cancer Research* 84(3): 219-222.

FL Kato, T. the protection mechanism of pretreatment with low doses of manganese against the acute toxicity of manganese in rats. *Acta Scholae Medicinalis Universitatis in Gifu. 37 (1). 1989. 78-93.*

No Oral Kato, Takayasu, Sone, Iseki, Hattori, Akio, and Yoshikawa, Hiroshi. protective effect of iron against acute metal toxicity in mice. *Igaku to Seibutsugaku (1989)* 118(2): 89-91.

Unrel Kawada Yasusuke, Asayama Kohtaro(A), Dobashi Kazushige, Nakane Takaya, Hayashibe Hidemasa, Kawaoi Akira, and Nakazawa Shinpei. 1996. immunohistochemical localization and

quantitative analysis of superoxide dismutases in fetal and neonatal rat tissues: fluorescence microscopy image analysis. *Acta Histochemica Et Cytochemica* 29(4): 289-297.

Alt Kawaguchi, Hideaki, Iizuka, Kenji, Takahashi, Hajime, and Yasuda, Hisakazu. inositol trisphosphate kinase activity in hypertrophied rat heart. *Biochem. Med. Metab. Biol. (1990)* 44(1): 42-50 .

In Vit Kawaguchi, Hideaki and Kitabatake, Akira. phosphatidylinositol and inositolphosphatide metabolism in hypertrophied rat heart. *Prog. Hypertens. (1995)* 3(New Advances in SHR Research: Pathophysiology & Pharmacology): 139-157.

Method Kawamura, M., Washizu, T., Ishida, T., and Motoyoshi, S. electron-microscopic observations on the distribution of copper in biopsied liver of toxic milk mice. *Bulletin of the Nippon Veterinary and Animal Science University; 0 (44). 1995. 34-40.*

FL Kawamura, Y. and Hamada, T. 1985. effects of excessive, normal, and subnormal dietary copper levels with or without vitamin e supplementation on growth and tissue copper storage of rats. *Bulletin of National Institute of Animal Industry.*(43)

FL Kawamura, Yojiro, Yamamoto, Takashi, and Takano, Noboru. 1974. gustatory nerve discharge and preference behavior during copper intoxication in the rat. *Osaka Daigaku Shigaku Zasshi.* 19(1): 47-50.

Unrel Kawasaki, H., Yamano, T., Iwane, S., and Shimada, M. 1988. golgi study on macular mutant mouse after copper therapy. *Acta Neuropathologica* 76(6): 606-12.

In Vit Kayanoki Yoshiro, Fujii Junichi, Suzuki Keiichiro, Kawata Sumio, Matsuzawa Yuji, and Taniguchi Naoyuki(A). 1994. suppression of antioxidative enzyme expression by transforming growth factor-beta-1 in rat hepatocytes. *Journal of Biological Chemistry* 269(22): 15488-15492.

Nut def Kazakov, A. M. 1970. [effect of trace element (cu, mo, mn) deficiency in the diet on the state of the water-electrolyte balance]. <original> vliianie defitsita mikroelementov (cu, mo, mn) v ratsione na sostoianie vodno-solevogo obmena. *Gigiena i Sanitariia* 35(12): 19-22.

FL Kazakova, M. V. and Volkova, O. I. 1977. effect of copper on development of internal organs in chickens. *Sbornik Nauchnykh Trudov Moskovskoi Veterinarnoi Akademii.* 90: 105-108.

CP Keefer, Robert F., Singh, Rabindar N., Bennett, Orus L., and Horvath, Donald J. 1983. chemical composition of plants and soils from revegetated mine soils. *Univ. Ky. Off. Eng. Serv., [Bull.] UKY BU 133, Symp. Surf. Min. Hydrol. Sedimentol. Reclam.,* 155-61 .

CP Keen, C. L., Cohen, N. L., Lonnerdal, B., and Hurley, L. S. 1983. teratogenesis and low copper status resulting from triethylenetetramine in rats. *Proceedings of the Society for Experimental Biology and Medicine; 173*

Prim Keen, C. L., Golub, M. S., Gershwin, M. E., Lonnerdal, B., and Hurley, L. S. 1988. studies of marginal zinc deprivation in rhesus monkeys. iii. use of liver biopsy in the assessment of zinc status. *American Journal of Clinical Nutrition* 47(6): 1041-5 .

CP Keen, C. L., Loennerdal, B., and Hurley, L. S. 1982. teratogenic effects of copper deficiency and excess. *Inflammatory Dis Copper (Proc Symp)1981.*: 109-121.

Bio Acc Keen, C. L., Lonnerdal, B., Clegg, M., and Hurley, L. S. 1981. development changes in composition of rat milk: trace elements,minerals, protein, carbohydrate and fat. *Journal of Nutrition* 111(2): 226-236.

Abstract Keen, C. L., Lonnerdal, B., Clegg, M., and Hurley, L. S. developmental changes in nutrient composition of rat milk. *64th Annual Meeting of the Fed. Am. Soc. Exp. Biol., Anaheim, Calif., USA, APR. 13-18, 1980. FED PROC. 39 (3). 1980. Abstract 3347.*

No COC Keen, Carl L., Fransson, Gun Britt, and Loennerdal, Bo. supplementation of milk with iron bound to lactoferrin using weanling mice . ii: effects on tissue manganese, zinc, and copper. *J. Pediatr. Gastroenterol. Nutr. (1984)* 3(2): 256-61 .

Nut def Keen, Carl L., Lonnerdal, Bo, Golub, Mari S., Uriu-Hare, Janet Y., Olin, Katherine L., Hendrickx, Andrew G., and Gershwin, M. Eric. influence of marginal maternal zinc deficiency on pregnancy outcome and infant zinc status in rhesus monkeys. *Pediatr. Res. (1989)* 26(5): 470-7.

Mix Kehe, X., Tingxian, X., Jiangwi, Z., and Shilin, D. effects of rare earth nitrate on internal organs and mineral elements in the serum of broiler chickens. *Asian-australas J Anim Sci; 5 (1). 1992. 63-67.*

Nutr Keith, M. O. and Bell, J. M. 1987. effects of canola meal on absorption and tissue levels of traceminerals in rats. *Canadian Journal of Animal Science* 67(1): 141-149.

Unrel Kelley, Timothy R., Pancorbo, Oscar C., Merka, William C., Thompson, Sidney A., Cabrera, Miguel L., and Barnhart, Harold M. 1998. accumulation of elements in fractionated broiler litter during re-utilization. *J. Appl. Poult. Res.* 7(1): 27-34 .

Phys Kelly, F. J., Rickett, G. M., Hunt, A. N., Town, G. I., Holgate, S. T., and Postle, T. D. 1991. biochemical maturation of the guinea pig lung and survival following premature delivery. *International Journal of Biochemistry* 23(4): 467-71.

Unrel Kelly, F. J., Rickett, G. W., and Phillips, G. J. 1992. magnitude of hyperoxic stress and degree of lung maturity determine the nature of pulmonary antioxidant response in the guinea pig. *Free Radical Research Communications* 17(5): 335-47.

Diss Kelly, W. A. investigations of the responses of rats to diets containing multipesticide components when copper and manganese were fed at deficient, marginal and excess concentrations. *Diss. Abstr. Int.; 32(2): 1045B-1046B; 1971*

Mix Kelly, William Alva. 1971.*Responses of Rats to Diets Containing Multipesticide Components When Copper and Manganese Were Fed at Deficient, Marginal, and Excess Concentrations*

No Oral Kendall, N. R., Mackenzie, A. M., and Telfer, S. B. 2001. effect of a copper, cobalt and selenium soluble glass bolus given to grazing sheep. *Livestock Production Science.* 68(1): 31-39.

Unrel Kennedy, B. W. and Beal, T. S. 1991. minerals leached into drinking water from rubber stoppers. *Lab Anim Sci.* 41(3): 233-6.

Alt Kennedy, M. L., Failla, M. L., and Smith, J. C. Jr. 1986. influence of genetic obesity on tissue concentrations of zinc, copper, manganese and iron in mice. *The Journal Of Nutrition.* 116(8): 1432-1441.

FL Kenzhegalieva, M. A. and Baiturin, M. A. effect of the level of a complex of trace elements (copper, manganese, cobalt, zinc, and iodine) on the growth and development of chicks in the semipalatinsk region. *Tr. Alma-At. Zoovet. Inst. (1974)* : 30, 34-7 .

Fate Kern, S. R., Smith, H. A., Fontaine, D., and Bryan, S. E. 1981. partitioning of zinc and copper in fetal liver subfractions: appearance of metallothionein-like proteins during development. *Toxicology and Applied Pharmacology* 59(2): 346-54.

Rev Kerr, L. A. 1990. incidence and management of poisonings in livestock. *Vet Hum Toxicol.* 32(5): 475-476.

Surv Kerr, L. A. and McGavin, H. D. 1991. chronic copper poisoning in sheep grazing pastures fertilized with swine manure. *J Am Vet Med Assoc.* 198(1): 99-101.

FL Kessler, J. 1993. heavy metals in animal production. *Landwirtschaft Schweiz.* 6(5): 273-277.

FL Kessler, J. 1983. sewage sludge and trace element metabolism in ruminants and swine. *Schweizer Archiv Fur Tierheilkunde* 125(10): 673-683.

Nutr Kessler, J. and Faria, A. de. 1998. the effect of an organic trace element supplement on metabolicparameters, milk yield and milk composition of dairy cows. *Revue Suisse D'Agriculture* 30(4): 147-150.

Mix Kessler, J. and Faria, A. de. 1998. organic trace element supplement in the nutrition of dairy cows. *Agrarforschung.* 5(6): 273-276.

FL Khadanovich, I. V., Rakhimov, I. Kh., and Vtorykh, E. A. 1984. mixed feeds and premixes for lactating cows. *Zhivotnovodstvo* (10): 51-52 .

Mineral Khalili, M., Lindgren, E., and Varvikko, T. 1993. a survey of mineral status of soil, feeds and cattle in the selaleethiopian highlands. ii. trace elements. *Tropical Animal Health and Production* 25(4): 193-201.

Mineral Khalili, M., Lindgren, E. Swedish Univ. of Agricultural Sciences Kungsangen Research Station Uppsala Sweden, Varvikko, T. ILCA Addis Ababa Ethiopia, and Varvikko, T. comp. 1991. a survey of mineral status of soil, feeds and cattle in the selale ethiopian highlands: ii. trace elements. development of appropriate feeding systems for dairy cattle in the ethiopian highlands. research and development project in collaboration between international centre for africa (ilca) and ministry of agriculture, ethiopia. funded by the finnish international development agency - finnida. final report. *14 P.*

Nutr Khan, Aqueel, Vohra, P. N., and Kratzer, F. H. the effect of protein level and dietary guar gum and pectin on copper and zinc utilization in chicks. *Nutr. Rep. Int. (1987)* 36(1): 193-200.

Herp Khangarot, B. S. and Ray, P. K. 1987. sensitivity of toad tadpoles, bufo melanostictus (schneider), to heavy metals. *BULL. ENVIRON. CONTAM. TOXICOL.* 38(3): 523-527.

Aquatic Khangarot, B. S., Ray, P. K., and Chandra, H. daphnia magna as a model to assess heavy metal toxicity: comparative assessment with mouse system. *Acta Hydrochim. Hydrobiol. (1987)* 15(4): 427-32.

FL Kharitonova, O. V., Kal'nitskii, B. D., and Vinokurov, V. N. 1988. utilization of mineral substances from diets containing varying levelsof grain concentrates and grass pellets in dairy cattle during rearingperiod. *Sbornik Nauchnykh Trudov Vsesoyuznogo Nauchno-Issledovatel'Skogo Instituta Fiziologii, Biokhimii i Pitaniya Sel'Skokhozyaistvennykh Zhivotnykh* 35: 25-34, 134.

FL Kharitonova, O. V. and Vinokurova, V. T. 1989. deposition and assimilation of main mineral elements in first-calvingheifers fed on diets containing lucerne pellets. *Byulleten' Vsesoyuznogo Nauchno-Issledovatel'Skogo Instituta Fiziologii, Biokhimii i Pitaniya Sel'Skokhozyaistvennykh Zhivotnykh* (2/94): 15-19.

Mix Khodyrev, A. A. and Volkonskii, V. A. 1986. carbohydrate metabolism in young cattle on a diet containing varying amounts of iodine, cobalt and copper.: povyshenie effektivnosti zhivotnovodstva

kalininskoioblasti. 50-54.

FL Khokhlov, A. and Kislyi, A. 1997. let us control the mineral nutrition of laying hens. *Ptitsevodstvo* (2): 20-21.

FL Khristov, L., Stoyanov, D. P., and Kostova, V. Ts. 1985. mammals insectivora lagomorpha rodentia in the vicinity of l. i. brezhnev metallurgical plant bulgaria and the effect of pollution on them. *Ekologiya.*(15): 20-27.

Abstract Kidder, RW. 1949. symtoms of induced copper toxicity in a steer. *J. Anim. Sci.* 8: 623.

CP Kienholz, E. W., Chappell, W. R., Meglen, R. R., and Rudolph, H. 1974. effects of dietary supplements of copper sulfate and molybdate upon liver and kidney concentrations of 10 minerals in young chickens. *Proc Univ Mo Annu Conf Trace Subst Environ Health.* 8: 373-378.

Mix Kienholz, E. W., Ward, G. M., Johnson, D. E., Baxter, J., Braude, G., and Stern, G. 1979. metropolitan denver colorado usa sewage sludge fed to feedlot steers. *Journal of Animal Science. 48 (4): 735-741.*

Mix Kienholz, Eldon W., Chappell, W. R., Meglen, R. R., and Rudolph, H. effects of dietary supplements of copper, sulfate and molybdate upon liver and kidney concentrations of ten minerals in young chickens. *Trace Subst. Environ. Health (1974)* : 8, 373-8..

FL Kienzle, E. Tieraerztliche Hochschule Hannover Germany F. R. Inst. fuer Tierernaehrung. 1988. [the trace element requirements of the dog]. <original> spurenelementbedarf des hundes. *Uebersichten Zur Tierernaehrung. V. 16(2) P. 153-212*

FL Kim, C. S. and Kang, Y. S. nutritional studies on the interrelation of copper with zinc. *Han'Guk Ch'Uksan Hakhoe Chi (1971)* 13(1): 68-71.

FL Kim, J. J., Grassmann, E., and Kirchgessner, M. 1981. [body mass development and hematological values of growing rats given varying amounts of fe and cu]. *Zentralbl Veterinarmed [A]*. 28(7): 516-25.

FL Kim, J. W., Kim, C. S. a, Kim, S. H., and Park, K. S. b. 1993 . the effect of copper, selenium and vitamin e on the igg level and growth rate of broiler chicks. *Korean Journal of Poultry Science* 20(2): 55-64.

FL Kim, M. K. and Seo, M. S. a. 1996. effect of dietary protein level and source on cadmium intoxicification in rats. *The Korean Journal of Nutrition* 29(6): 579-589.

Alt Kim Sae Chul(A), Kim In Kyu, Seo Kyung Keun, Baek Kwang Jin, and Lee Moo= Yeol. 1997. involvement of superoxide radical in the impaired endothelium-dependent relation of cavernous smooth muscle in hypercholesterolemic rabbits. *Urological Research* 25(5): 341-346.

FL Kim, Y. K., Choi, K. H., and Paik, I. K. 1993. effects of interaction of copper sulfates and dietary fat on the performance of broiler chickens. *Korean Journal of Animal Nutrition & Feedstuffs.* 17(1): 7-14.

FL Kim, Y. K., Paik, I. K., Gangadharan, B., Rajan, A., Valsala, K. V., Mariamma, K. I., Miller, E. R., Lei, X., and Ullrey, D. E. 1993. the effects of sources and levels of supplementary copper on the performance of broiler chicken.: chemically induced copper depletion in ducks as a model for transdifferentiation study-preliminary observations: trace elements in animal nutrition. *Korean J Anim Sci.* 35(1): 52-59.

CP Kimbrough, T. D., Weekley, L. B., Lawson, C. J., O'rear, C. E., and Llewellyn, G. C. 1981. myco toxin and copper induced gastro intestinal disturbances in male holtzman rats. *Society for Industrial Microbiology. Developments in Industrial Microbiology . 22. Proceedings of the 37th General Meeting, Flagstaff, Ariz., Usa, Aug. 9-15, 1980. . Society for Industrial Microbiology: Arlington, VA., USA.* 771-780.

Nutr Kimmel, C. A., Butcher, R. E., and Schumacher, H. J. salicylates and nutrition:pre- and postnatal effects. *Anat Rec 172:345,1972*

No Oral Kimmel, C. A., Butcher, R. E., Vorhees, C. V., and Schumacher, H. J. 1974. metal-salt potentiation of salicylate-induced teratogenesis and behavioral changes in rats. *Teratology* 10(3): 293-300.

Drug Kimoto, I., Mano, M., Tomioka, E., Uenokawa, K., Ogawa, A., Shimada, Y., Ogiwara, S., Suzuki, Y., Mouri, M., and et al. relationship between diabetes mellitus pathogenesis and trace metal changes in rats administered stz (streptozotocin). *Biomed. Res. Trace Elem. (1991)* 2(2): 207-8.

Unrel Kimoto-Kinoshita Saori, Nishida Shozo(A), and Tomura Takanori T. 1999. age-related change of antioxidant capacities in the cerebral cortex and hippocampus of stroke-prone spontaneously hypertensive rats. *Neuroscience Letters* 273(1): 41-44.

No COC Kimura, M., Matumura, K., Hatsuda, N., Takeda, T., Noumi, S., and Yokoyama, Y. growth check and magnesium imbalance on young rats by over intakes of calcium . *Magnesium: Curr. Status New Dev.* [Int. Symp. Magnesium], 8th (1997): 151-168. Editor(s): Theophanides, Theophile; Anastassopoulou, Jane. Publisher: Kluwer, Dordrecht, Neth.

Mix Kincaid, R. L., Blauwiekel, R. M., and Cronrath, J. D. 1986. supplementation of copper as copper sulfate or copper proteinate for growing calves fed forages containing molybdenum. *Journal of Dairy Science* 69(1): 160-163.

No COC King, B. D., Lassiter, J. W., Neathery, M. W., Miller, W. J., and Gentry, R. P. effect of lactose, copper and iron on manganese retention and tissue distribution in rats fed dextrose-casein diets. *J. Anim. Sci. (1980)* 50(3): 452-8 .

CP King, D. W. 1977. effect of heavy metals on chick embryonic development - copper sulfate. *Proc. Natl. Sci. Counc. Part 2.* 10: 89-102 .

Mix King, L. D. effect of swine manure lagoon sludge and municipal sewage sludge on growth nitrogen recovery and heavy metal content of fescue grass festuca-arundinacea. *J ENVIRON QUAL. Journal of Environmental Quality. 10 (4). 1981. 465-472.*

No Oral King, Laura Marie. 1998.*Alteration in Cadmium Transport As a Mechanism of Resistance to Reproductive Toxicity in Murine Strain a/j (Zinc, Testicular Toxicity)* : PAGE 4770.

FL Kirchgessner, M., Heindl, U., and Schwarz, F. J. 1994. content and deposition of trace elements in various tissues and in theempty body of growing german simmental bulls. *Journal of Animal Physiology and Animal Nutrition* 72(4/5): 260-271.

FL Kirchgessner, M., Kim, J. J., and Grassmann, E. 1983. [cu and fe content and ceruloplasmin and catalase activities in the blood of growing rats receiving different amounts of fe and cu]. *Zentralbl Veterinarmed [A].* 30(1): 15-25.

FL Kirchgessner, M., Maier, R., and Reichlmayr-Lais, A. M. 1984. concentrations of iron, copper, zinc, manganese, cobalt and magnesiumin different organs and tissues after different supplies of nickel. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 52(4/5): 217-227.

FL Kirchgessner, M., Maier, R., and Reichlmayr-Lais, A. M. iron copper zinc manganese cobalt and magnesium content in tissues resulting from different nickel supplies. *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 52 (4-5). 1984 (Recd. 1985). 217-227.*

FL Kirchgessner, M., Maier, R., and Reichlmayr-Lais, A. M. 1984. <translated> fe, cu, zn, mn, co, and mg content in tissues resulting from different ni supply. konzentrationen von fe, cu, zn, mn, co und mg in verschiedenen organen und geweben nach unterschiedlicher ni-versorgung . *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde = Journal Of Animal Physiology And Animal Nutrition.* 52(4/5): 217-227.

FL Kirchgessner, M., Maier, R., and Reichlmayr-Lais, Anna M. 1984. concentration of iron, copper, zinc, manganese, cobalt and magnesium in various organs and tissues resulting from different nickel supply. *Z. Tierphysiol. Tierernaehr. Futtermittelkd.* 52(4-5): 217-27.

FL Kirchgessner, M. and Mueller, H. L. the effect of varying the protein diet on the trace elements content of early weaned piglets. *Landwirtschaftliche Forschung. 27 (3-4). 1974 (Recd 1975) 358-364.*

FL Kirchgessner, M. and Pallauf, J. 1973. effect of iron, cobalt, or nickel supplements on zinc deficiency. *Z. Tierphysiol. Tierernaehr. Futtermittelk.* 31(5): 268-74.

FL Kirchgessner, M., Reichlmayr-Lais, A. M., and Mathur, A. K. 1985. concentration of iron, copper and manganese in selected organs andtissues of rats given different amounts of zn and ni. 3. interactionsbetween nickel and zinc. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 53(3-4): 214-222.

FL Kirchgessner, M., Reichlmayr-Lais, Anna M., and Mathur, A. K. 1985. iron, copper and manganese concentrations in selected organs and tissues after different zinc and nickel supply in rats . 3. interactions between zinc and nickel. *Z. Tierphysiol. Tierernaehr. Futtermittelkd.* 53(3-4): 214-22.

FL Kirchgessner, M., Reithmayer, F., Kosters, W. W., and Roth-Maier, D. A. 1985. excretion and retention of trace elements by early weaned piglets witha deficient supply of vitamin b-6. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 54(4): 184-189.

FL Kirchgessner, M., Roth-Maier, D. A., and Spoerl, R. copper zinc nickel and manganese contents of sow milk during lactation with different dietary supplies of trace elements. *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 44 (4-5). 1980. 233-238.*

FL Kirchgessner, M., Roth-Maier, D. A., and Spoerl, R. pregnancy anabolism of copper zinc nickel and manganese of sows. *Archiv Fuer Tierernaehrung. 31 (1). 1981. 21-34.*

FL Kirchgessner, M., Roth-Maier, D. A., and Sporel, R. trace element balances copper zinc nickel and manganese of lactating sows. *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 50 (4-5). 1983 (Recd. 1985). 230-239.*

FL Kirchgessner, M., Roth-Maier, D. A., and Sporl, R. 1980. the effect of different dietary supply of trace elements on the cu, zn,ni and mn content of sows' milk during lactation. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 44(4/5): 233-238.

FL Kirchgessner, M., Roth-Maier, D. A., and Sporl, R. 1981. studies on pregnancy anabolism of copper, zinc, nickel and manganese inbreeding sows. *Archiv Fur Tierernahrung* 31(1): 21-34.

Bio Acc Kirchgessner, M., Roth-Maier, Dora A., and Schnegg, A. contents and distribution of iron, copper, zinc, nickel, and manganese in fetuses, amniotic fluid, placenta, and uterus of rats. *Res. Exp. Med.*

(1982) 180(3): 247-54.

Nut def Kirchgessner, M. and Schnegg, A. 1976. malate dehydrogenase and glucose-6-phosphate dehydrogenase activity in livers of ni-deficient rats. *Bioinorganic Chemistry* 6(2): 155-61.

Mix Kirchgessner, M., Schwarz, F. J., and Stangl, G. I. 1998. growth performance of beef cattle fed corn silage-based rations without cu, zn, mn, co and se supplementation. *Journal of Animal Physiology and Animal Nutrition.* 78(3): 141-153.

FL Kirchgessner, M., Schwarz, F. J., and Stangl, G. I. 1997. growth performance of beef cattle fed corn silage-based rations without cu, zn, mn, co and se supplementation. <original> mast- und schlachtleistung von rindern bei einsatz maissilage-reicher rationen mit fehlender cu-, zn-, mn-, co- und se-supplementierung. *Journal of Animal Physiology and Animal Nutrition. V. 78(3) P. 141-153*

Surv Kirchgessner, M. and Spoerl, R. 1975. [anabolism of copper in pregnancy in relation to cu supply]: <original> zum trachtigkeitsanabolismus an kupfer in abhangigkeit von der cu-versorgung. *Z Tierphysiol Tierernahr Futtermittelkd.* 36(2): 75-86.

Surv Kirchgessner, M. and Spoerl, R. 1976. [cu concentration in the milk of rats receiving diets with varying cu content]: <original> zur cu-konzentration von rattenmilch bei unterschiedlichen cu-gehalten der diaten. *Arch Tierernahr.* 25(7): 505-12.

FL Kirchgessner, M., Spoerl, R., and Roth-Maier, D. A. fecal excretion and apparent absorption of copper zinc nickel and manganese of nongravid and gravid sows with different dietary supply of trace elements. *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 44 (2). 1980. 98-111.*

CP Kirchgessner, M., Spoerl, R., and Schneider, Ursula A. 1978. studies on the superretention of trace elements (copper, zinc, manganese, nickel, iron) during gravidity. *Trace Elem. Metab. Man Anim. Proc. Int. Symp., 3rd* : Meeting Date 1977, 440-3. Editor(s): Kirchgessner, M. Publisher: Arbeitskreis Tierernaehrungsforschung Weihenstephan Inst. Ernaehrungsphysiol., Freising-Weihenstephan, Ger.

FL Kirchgessner, M., Sporl, R., and Roth-Maier, D. A. 1980. excretion in faeces and apparent absorption of copper, zinc, nickel andmanganese in nonpregnant and pregnant sows with different supplies oftrace elements. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 44(2): 98-111.

FL Kirchgessner, M., Weser, U., and Muller, H. L. 1967. [copper absorption with dietary administration of gluconic, citric, salicylic and oxalic acids. 7. dynamics of copper absorption]: <original> cu-absorption bei zulage von glucon-, cionen-, salicyl- und oxalsaure. 7. zur dynamik der kupferabsorption. *Z Tierphysiol Tierernahr Futtermittelkd.* 23(1): 28-30.

No COC Kirchgessner, M., Windisch, W., and Roth, F. X. 1994. effect of avilamycin and tylosin on apparent digestibility of iron,zinc, copper, manganese and selenium in growing and finishing pigs. *Archives of Animal Nutrition* 46(4): 321-325.

FL Kirchgessner, M. Technische Univ. Muenchen Freising Germany Inst. fuer Ernaehrungsphysiologie, Windisch, W., and Roth, F. X. 1994. effect of phytase supplementation on apparent digestibility of fe, cu, zn and mn at varying dietary p levels in piglets. <original> zum effekt mikrobieller phytase auf die scheinbare verdaulichkeit von eisen, kupfer, zink und mangan bei abgestufter p-versorgung von ferkeln. *Agribiological Research. V. 47(2) P. 156-159*

FL Kirchgessner, Manfred and Mueller, H. L. trace element contents in fattening chicks. *Arch.*

Tierernaehr. (1968) 18(6-7): 527-32.

Rev Kirkwood, R. N. and Thacker, P. A. 1988. nutritional factors affecting embryo survival in pigs (results and speculations). *Pig News and Information.* 9(1): 15-21.

FL Kirpichev, M. P. 1970. [effect of trace elements (iron, copper, nickel, zinc) on the pantothenic acid requirements of animals]. <original> vliianie mikroelementov (zheleza, medi, nikelia, tsinka) na obespechennost' zhivotnogo organizma pantotenovoi kislotoi. *Voprosy Pitaniia* 29(4): 15-7.

Surv Kishida, Y. Okayama Univ. Japan Faculty of Agriculture, Okabe, T., and Inoue, R. 1991. mineral concentration in water on the livestock farm on hilly land [in japan]. *Scientific Reports of the Faculty of Agriculture - Okayama University. (No.78) P. 35-39*

CP Kitagawa, Y. and Wada, O. 1990. [pharmacokinetics of trace elements by noncompartmental analysis in rats (part 1): significance of the pharmacokinetic parameters]. *Nippon Eiseigaku Zasshi* 44(6): 1097-106.

CP Kitagawa, Yasuhisa and Wada, Osamu. noncompartmental analysis of trace-element pharmacokinetics in rats . i. significance of the pharmacokinetic parameters. *Nippon Eiseigaku Zasshi (1990)* 44(6): 1097-106.

Drug Kitani Kenichi(A), Kanai Setsuko, Ivy Gwen O, and Carrillo Maria Cristina. 1999. pharmacological modifications of endogenous antioxidant enzymes with special reference to the effects of deprenyl: a possible antioxidant strategy. *Mechanisms of Ageing and Development* 111(2-3): 211-221.

No Oral Kiyozumi, Morio, Honda, Toshiya, Hiroto, Kiyonobu, Kitajima, Kaori, Ohnishi, Mizuo, and Kojima, Shoji. effect of essential metals on small intestinal absorption of l-histidine and l-leucine in rats. *Eisei Kagaku (1988)* 34(6): 531-5.

No Oral Kiyozumi, Morio, Nouchi, Toshinobu, Honda, Toshiya, Kojima, Shoji, and Tsuruoka, Michio. comparison of effectiveness of 3 dithiocarbamates on excretion and distribution of cadmium in rats and mice. *Toxicology (1990)* 60(3): 275-85.

Drug Klakow F-J, Mueller, M., and Jonas, K. use of magnesium chloride brine in drinking water for prophylaxis against grass tetany of cattle. *Monatshefte Fuer Veterinaermedizin. 41 (15). 1986. 505-509.*

Unrel Klasing, K. C. and Johnstone, B. J. 1991. monokines in growth and development. *Poultry Science.* 70(8): 1781-1789.

IMM Klasing, K. C., Laurin, D. E., Peng, R. K. , and Fry, D. M. 1987 . immunologically Mediated growth depression in chicks: influence of feed intake, corticosterone and interleukin-1. *Journal of Nutrition* 117(9): 1629-37.

CP Klasing, K. C., Richards, M. P., and Darcey, S. E. 1964. influence of endotoxin on trace mineral metabolism of embryonic turkeys cultured ex Ovo. *74th Annual Meeting of the Poultry Science Association*

CP KLASING, K. C., RICHARDS, M. P., DARCEY, S. E., and LAURIN, D. E. presence of acute phase changes in zinc iron and copper metabolism in turkey embryos. *Proc Soc Exp Biol Med; 184 (1). 1987. 7-13.*

IMM Klasing, Kirk C. and Barnes, David M. decreased amino acid requirements of growing chicks due to immunologic stress. *J. Nutr. (1988)* 118(9): 1158-64.

Rev Klauder, D. S. and Petering, H. G. 1977. anemia of lead intoxication: a role for copper. *J Nutr.* 107(10): 1779-85.

Drug Klauder, D. S. and Petering, H. G. 1975. protective value of dietary copper and iron against some toxic effects of lead in rats. *Environ Health Perspect.* 12: 77-80.

Diss Klauder, D. S. IV. 1975.*The Effects of Dietary Copper, Iron, and Zinc on the Toxicity of Lead in Male Rats* : 251.

Abstract Klevay, L. M., Evans, G. W., and Sandstead, H. H. zinc copper hyper cholesterolemia the effect of sodium phytate. *American Journal of Clinical Nutrition. 28 (4). 1975 426*

Surv Klimowicz Zbigniew, Melke Jerzy, and Uziak Stanislaw. 1997. peat soils in the bellsund region, spitsbergen. *Polish Polar Research* 18(1): 25-39.

Nut def Kline, E. A., Kostelic, G. C., Ashton, G. C., Homeyer, P. G., Quinn, L., and Catron, D. V. 1954. the effect of the growth performance of young pigs of adding cobalt, vitamin b12 and antibiotics to semipurified rations. *J Nutr.* 53: 543.

Nutr Kline, R. D. V. W. Hays and G. L. Cromwell. 1971. effects of copper, molybdenum and sulfate on performance, hematology and copper stores of pigs and lambs. *J. Anim. Sci.* 33(4): 771-779.

Chem Meth Klingenberg, Andreas and Seubert, Andreas. comparison of silica-based and polymer-based cation exchangers for the ion chromatographic separation of transition metals. *J. Chromatogr. (1993)* 640(1-2): 167-78.

Unrel Klocking, R. 1980. [intoxication and detoxication of heavy metals by humic acids]. <original> giftung und entgiftung von schwermetallen durch huminsauren. *Archiv Fur Experimentelle Veterinarmedizin* 34(3): 389-93.

Drug Klosowski, B. 1971. the effect of gonadotropic hormones (pms) on gonadal function in rams subjected to deficiencies of copper and cobalt in the diet. *Zeszyty Problemowe Postepow Nauk Rolniczych.*(124): 187-191.

Phys Klucinski, Wlodzimierz, Borzemska, Wanda, Janowski, Tomasz, and Gozlinski, Henryk. effect of microclimate on biochemical changes in serums of chicks and their mothers. *Med. Weter. (1980)* 36(5): 288-91.

Unrel Knapp, F. F., Ambrose, A. P., Callahan, A. P., Allred, J. F., and Blystone, S. L. 1989.*Nuclear Medicine Program: Progress Report for Quarter Ending June 30, 1988. ORNL/TM-11014*

Nutr Knudsen, K. E. Bach, Steenfeldt, Sanna, Borsting, C. F., and Eggum, B. O. the nutritive value of decorticated mill fractions of wheat. 1. chemical composition of raw and enzyme treated fractions and balance experiments with rats. *Anim. Feed Sci. Technol. (1995)* 52(3,4): 205-25 .

No COC Kobayashi, T., Shiki, Y., Meyrick, B., Burr, I. M., and Newman, J. H. simultaneous exposure of sheep to endotoxin and 100 percent oxygen . *American Review of Respiratory Disease. 144 (3 Part 1). 1991. 600-605.*

Dead Kobayashi, Y., Shimada, A., Umemura, T., and Nagai, T. an outbreak of copper poisoning in mute swans (cygnus olor). *J Vet Med Sci; 54 (2). 1992. 229-233.*

Meth Kobayashi, Yoshinori. development of an x-ray fluorescence element mapping spectrometer and its application to biological samples. *Kagaku Gijutsu Kenkyusho Hokoku (1989)* 84(12): 643-54.

Drug Koch, Heinrich P., Hofeneder, Maria, and Bohne, Bernd. the yeast test: an alternative method for the testing of acute toxicity of drug substances and environmental chemicals. *Methods Find. Exp. Clin. Pharmacol. (1993)* 15(3): 141-52.

Nut def Koh, T. S., Peng, R. K., and Klasing, K. C. 1996. dietary copper level affects copper metabolism during lipopolysaccharide-induced immunological stress in chicks. *Poultry Science* 75(7): 867-872.

FL Kohiyama, Masatake, Chimi, Kenji, Maruyama, Takenori, Sudo, Motoo, Fujita, Tadao, Kamei, Masaharu, Niiya, Isao, and Sugano, Michihiro. time course study of accumulation and excretion of dietary nickel and copper in rats. *Nihon Yukagakkaishi (1996)* 45(3): 251-7.

Surv Kohiyama Masatake, Kanematsu Hiromu, and Niiya Isao. 1992. studies on the behavior of trace components in oils and fats during processing for edible use: iv. decrease of trace metals in oils and fats during deacidifying, bleaching and deodorizing. *Journal of the Japan Oil Chemists' Society* 41(12): 1180-1184.

Chem Meth Koizumi, N., Hatayama, F., Akabori, F., and Masaoka, T. 1981. gel filtration pattern of cadmium zinc and copper in liver and renal cortex supernatants of cadmium treated monkeys macaca-mulatta. *Kobe Journal of Medical Sciences.* 27(6): 239-250.

FL Kolb, E., Engmann, S., Klemm, R., and Nestler, K. 1995. content of trace elements and minerals (na, k, ca, mg, inorganic-p) andfe, cu and zn in ten different tissues of geese. *Tierarztliche Umschau* 50(1): 52-54, 57-60.

Surv Kolczak, T. 1988. the content of heavy metals in the bone decoction of hens from a polluted district. *Med Weter* 44(5): 303-304 .

FL Koleva, M., Boyadzhiev, P., and Kuneva, T. effect of enriched food ration on concentrations of cadmium, iron, manganese, zinc and copper in the organism of experimental animals during cadmium intoxication. *Khig. Zdraveopaz. (1988)* 31(3): 32-7.

FL Koloiitseva, M. G., Voznesenskaya, F. M., Isaeva, E. A., and Generalov, A. A. 1972. role of ultraviolet irradiation in increasing the natural resistance of animals in relation to various levels of copper and manganese in their rations. *Zh. Gig. Epidemiol., Mikrobiol. Immunol* 16(2): 223-9.

FL Kolomiitseva, M. G. and Salii, N. S. stimulating effect of copper and manganese on the vitamin a and c requirements and on the activity of some enzymes. *Tr. Leningrad. Pediat. Med. Inst. (1968)* : 43, 182-9.

FL Kolomiitseva, M. G. and Voznesenskaya, F. M. effect of dietary copper and manganese on immunobiological activity. *Gig. Sanit. (1968)* 33(11): 31-4.

FL Kolomiitseva, M. G. and Voznesenskaya, F. M. importance of different proportions of copper and manganese in the diet for the defensive responses of the body rat leukocyte blood. *Vop Pitan. 27 (6). 77-78. 1968.*

FL Kolomiitseva, M. G. and Voznesenskaya, F. M. significance of copper and manganese ratios in the food ration for protective reactions of the organism. *Vop. Pitan. (1968)* 27(6): 77-8.

No COC Kolomiytseva, M. G., Voznesenskaya, F. M., Isayeva, E. A., and Generalov, A. A. 1972. role of ultraviolet radiation in increasing natural resistance of the animal organism when associated with different amounts of copper and manganese in the daily ration. *Journal of Hygiene, Epidemiology, Microbiology, and Immunology* 16(2)

CP Kondo, H., Kimura, M., and Itokawa, Y. 1991. manganese, copper, zinc, and iron concentrations and subcellular distribution in two types of skeletal muscle. *Proceedings Of The Society For Experimental Biology And Medicine.* 196(1): 83-88.

FL Kondratyuk, V. A. hygienic significance of trace elements in partially demineralized drinking water. *Gig. Sanit. (1989)* (2): 81-2.

FL Kondratyuk, V. A. hygienic significance of trace elements in slightly mineralized drinking water. *GIG SANIT. Gigiena i Sanitariya. 0 (2). 1989. 81-82.*

Surv Kondratyuk, V. A. 1989. public health significance of trace elements in drinking water low inminerals. *Gigiena i Sanitariya.*(2): 81-82.

Nut def Konishi, Y., Saito, N., and Kinebuchi, H. 1992. effect of calcium deficiency on changes of various trace elements in serum and tibia in the rats treated with long term aluminum administration. *Biomed. Res. Trace Elem* 3(2): 251-2 .

Nut def Konstantinova, S. G. and Russanov, E. M. 1994. liver superoxide dismutases after copper deficiency and/or indomethacin treatment of rats. *Comp. Biochem. Physiol. C: Pharmacol., Toxicol. Endocrinol.* 107C(3): 423-8.

No Tox Konstantinova, S. G. and Russanov, E. M. Institute Physiol. Acadamy of Sciences 1113 Sofia Bulgaria. 1988. effect of pregnancy and fetal development on sheep liver superoxide dismutase activity. *Research in Veterinary Science. V. 45(3) P. 287-290*

FL Kooiker, G. recommendations for analytical methods of heavy metals in bird eggs and feathers with atomic-absorption Spectrophotometry. *J Ornithol; 127 (1). 1986. 9-24.*

FL Kopbosynov, B. 1976. prophylaxis of anoplocephalata infections in sheep. *Veterinariya, Moscow* (6): 60-61.

Unrel Kopp, S. J., Perry, H. M. Jr, Perry, E. F., and Erlanger, M. 1983. cardiac physiologic and tissue metabolic changes following chronic low-level cadmium and cadmium plus lead ingestion in the rat. *Toxicol Appl Pharmacol.* 69(1): 149-60.

FL Koreleski, J. 1971. effect of dietary copper and its antagonistic trace elements content on protein utilization in rats. *Acta Agrar Silvestria Ser Zootech.* 11(1): 17-46.

No Oral Korhonen, A., Hemminki, K., and Vainio, H. embryo toxicity of industrial chemicals on the chicken embryo di thio carbamates. *Teratogenesis Carcinogenesis and Mutagenesis. 3 (2). 1983. 163-176.*

No COC Korhonen, A., Hemminki, K., and Vainio, H. toxicity of rubber chemicals towards three-day chicken embryos. *Scand J Work Environ Health 9:115-119,1983*

Unrel Korkhov, V. V., Boikova, V. V., and Lesik, E. A. 1995. effect of talicoside on experimental reproductivity. *Eksperimental'Naya i Klinicheskaya Farmakologiya.* 58(1): 43-44.

No COC Kornegay, E. T., Thomas, H. R., and Bartlett, H. S. 1981. phosphorus in swine. 3. influence of dietary calcium and phosphoruslevels and growth rate on mineral content of hair from gilts andbarrows or boars. *Journal of Animal Science* 52(5): 1060-1069.

Imm Kornegay, E. T., Van Heugten, P. H. G., Lindemann, M. D., and Blodgett, D. J. 1989. effects of biotin and high copper levels on performance and immune response of weanling pigs. *J Anim Sci.* 67(6): 1471-1477.

Mix Kornegay, E. T a, Zhou, W., and Risley, J. W. G. M. Swinkels and C R. 1995. characterization of cobalt-copper antagonism in the study of copper-stimulated growth in weanling pigs. *Journal of Animal and Feed Sciences.* 4(1): 21-33.

FL Korolev, A. 1987. a feed additive (for chickens). *Ptitsevodstvo* (9): 30-31.

Unrel Korte, J. J. and Prohaska, J. R. 1987. dietary copper deficiency alters protein and lipid composition of murine lymphocyte plasma membranes. *Journal of Nutrition* 117(6): 1076-84.

FL Kosaka, Michio. 1983. effects of lead, other metals and diphenylthiocarbazone on conditioned avoidance behavior in rats. *Nichidai Igaku Zasshi.* 42(5): 537-546.

FL Kosheleva, G. N. 1982. effective use of chelated compounds of trace elements (cu, zn and mn)in premixes for growing, fattening pigs. *Byulleten' Nauchnykh Rabot, Vsesoyuznyi Nauchno-Issledovatel'Skii Institut Zhivotnovodstva* (68): 58-61.

FL Kosheleva, G. N. 1981. efficiency of utilization of trace elements from mineral and chelatedcompounds by pigs. *Khimiya v Sel'Skom Khozyaistve* (8): 52-55.

FL Koshkina, N. G., Logachev, E. D., and Tishchenko, L. G. 1978. fine morphology of the genital organs of moniezia when normal andaction of some anthelmintics. *Trudy Kazakhskogo Nauchno-Issledovatel'Skogo Veterinarnogo Instituta (Voprosy Veterinarnoi Parazitologii v Kazakhstane)* 17: 100-102.

No Dose Koski, Kristine G., Anderson, Susan, and Boulay, Marjolaine. level of fructose and glucose during pregnancy alter maternal and fetal trace element status in rats at term. *Nutr. Res. (N. Y.) (1997)* 17(10): 1503-1515.

Bio Acc Kossila, V. and Huida, L. 1980. of the bone mineral contents of young dairy beef cattle. *Annales Agriculturae Fenniae* 19(2): 180-185.

Nutr Kossila, V. and Ljung, G. value of whole oat plant pellets in horse feeding. *Annales Agriculturae Fenniae. 15 (4). 1976 (Recd 1978) 316-321.*

Drug Kossor, D. C., Han Shenggao, Kemp, F. W., Slauter, R. W., Serota, D., Rajaskarian, D., Milner, N., Davidovich, A., and Bogden, J. D. 2001. administration of the oral antibiotic frenolicin-b selectively alters copper nutriture in male rats. *Journal of Nutrition [j. Nutr.]. Vol. 131, No. 12, Pp. 3247-3250. Dec 2001.*

Unrel Kothari, H. V. and Kritchevsky, D. aortic cholesterol esterase ec-3.1.1.13 effect of cations. *Artery. 4 (1). 1978 61-66.*

FL Kotowski, K. 1990. the efficacy of wisol-t in pig production. *Medycyna Weterynaryjna* 46(10): 401-402.

No Dose Kowalczyk, D. F., Gunson, D. E., Shoop, C. R., and Ramberg, C. F JR. 1986. the effects of natural exposure to high levels of zinc and cadmium in the immature pony as a function of age. *Environ Res.* 40(2): 285-300.

FL Kozikov, E. V. 1984. growth and development of black pied heifers to 6 months old when fedon diets enriched with mineral supplements and vitamins a and d. *Byulleten' Vsesoyuznogo Nauchno-Issledovatel'Skogo Instituta Razvedeniya i Genetiki Sel'Skokhozyaistvennykh Zhivotnykh* (75): 25-28.

In Vit Kozuka, H. interactive exhibition of heavy metal toxicity in bone metabolism. from the viewpoint of deductive toxicology. *Yakugaku Zasshi; 115 (3). 1995. 157-169.*

Nut def Kralik, A., Eder, K., and Kirchgessner, M. 1995. effect of deficient iron, copper, zinc and manganese supply on thyroid hormone metabolism. *Mengen- Spurenelem. Arbeitstag., 15th* : 443-450. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany..

CP Kralik, A. Technische Univ. Muenchen Freising Germany Inst. fuer Ernaehrungsphysiologie, Eder, K., Kirchgessner, M., and Giesecke, D. 1995. proceedings of the society of nutrition physiology. <original> berichte der gesellschaft fuer ernaehrungsphysiologie. *P. 84. V. 4*

Plant Kranabetter, J. M. and Trowbridge, R. 1998. soil nitrogen and lodgepole pine seedling responses to five years of legume cover. *The Forestry Chronicle.* 74(4): 578-582.

Bio Acc Krantz, W. C., Mulhern, B. M., Bagley, G. E., Sprunt, A., Ligas, F. J., and Robertson, W. B. Jr. 1970. organochlorine and heavy metal residues in bald eagle eggs. *Pestic Monit J.* 4(3): 136-40.

No COC Krasowska, Alicja and Wlostowski, Tadeusz. 1992. the effect of high fluoride intake on tissue trace elements and histology of testicular tubules in the rat. *Comp. Biochem. Physiol. C: Comp. Pharmacol. Toxicol.* 103C(1): 31-4 .

FL Kravtsiv, R. I. 1989. physiological basis for optimal level of trace elements in diets foryoung fattening bulls. *Vestnik Sel'Skokhozyaistvennoi Nauki* (3): 64-68.

Unrel Kreuzer, M. Technische Univ. Muenchen-Weihenstephan Freising Germany F. R. Inst. fuer Ernaehrungsphysiologie and Kirchgessner, M. 1990. faecal and urinary excretion of iron, copper, zinc and manganese in faunated and defaunated wethers fed semi-purified diets of different carbohydrate composition. *Animal Feed Science and Technology. V. 28(1) P. 135-143*

Mix Kroc, M. and Vymola, J. 1990. effect of vitamins and microelements in the high producing dairy cows feed rations. *Biol Chem Zivocisne Vyroby - Vet.* 26(4-5): 341-351.

FL Krol, M. Yu. effect of intoxication with mercury on redistribution of copper, zinc and iron in animal organisms. *Veterinariya (Moscow) (1998)* (1): 51-55 .

FL Krol, M. Yu. 1988. poisoning of sheep with copper sulfate. *Veterinariya, Moscow.*(8): 52-54.

CP Kronfeld, D. S., Cooper, W. L., Crandell, K. M., Gay, L. A., Hoffman, R. M., Holland, J. L., Wilson, J. A., Sklan, D., and Harris, P. A. 1996. supplementation of pasture for growth. *Nutrition and Nutritional Related Disorders in the Foal. Proceedings of the 2nd European Conference on Horse Nutrition. 16-17 May 1996 Pferdeheilkunde.* 12(3): 317-319.

Rev Kronfeld, D. S., Meacham, T. N., and Donoghue, S. 1990. dietary aspects of developmental orthopedic disease in young horses. *Veterinary Clinics of North America, Equine Practice.* 6(2): 451-465.

Mineral Kropp, J. R. 1990. reproductive performance of first calf heifers supplemented with aminoacid chelate minerals. *Animal Science Research Report, Agricultural Experiment Station, Oklahoma State University* (MP-129): 35-43.

Nutr Krusic, L., Schramel, P., Dermlj, M., Usaj, A., Stibilj, V., Pagan, J. D., <Editors> Anke, M., Meissner, D., and Mills, C. F. 1993. influence of high carbohydrate and high fibre diet on mineralmetabolism in horses. 310-313.

No Dose Krusic, L. I., Haready, M. S., Schramel, P., and Dolinar, J. urine and hair analysis as potential indicators of some macroelements and microelements in performing horses. *Acta Veterinaria (Belgrade). 40 (2-3). 1990. 65-76.*

FL Kubantsev, B. S. and Rybakova, T. I. 1975. content of trace elements in the body of the vole (microtus arvalis). *Zh. Obshch. Biol.* 36(1): 142-5.

Nut def Kubena, L. F., May, J. D., Deaton, J. W., Reece, F. N., and Lott, B. D. 1972. effect of dietary iron and copper on mortality of chicks at two temperatures. *Poultry Science* 51(4): 1470-2.

Fate Kubow, S., Bray, T. M., and Bettger, W. J. 1986. effects of dietary zinc and copper on free radical production in rat lung and liver. *Can J Physiol Pharmacol.* 64(10): 1281-5.

FL Kucherova, F. N. and Chorayan, O. G. 1983. comparative informational characteristics of the microbiogenetic composition of reproductive cells in various animals. *Izv. Sev.-Kavk. Nauchn. Tsentra Vyssh. Shk. Estestv. Nauki* (4): 79-80 .

FL Kudlac, E. and Simonik, I. 1990. toxic elements in cow genital organs and their relation to fertility. *DTW (Dtsch Tieraerztl Wochenschr).* 97(10): 396-398.

Nutr Kudryavtseva, S. V. 1983. efficiency of adding trace element salts to pig diets containing feedyeasts. *Khimiya v Sel'Skom Khozyaistve* 21(2): 35-37.

Mix Kuhlman, G. and Rompala, R. E. 1998. the influence of dietary sources of zinc, copper and manganese on canine reproductive performance and hair mineral content. *J Nutr.* 128(12 Suppl): 2603S-2605S.

CP Kuhlman G(A) and Rompala, R. E. 1995. the influence of dietary sources of zinc, copper and manganese on canine reproductive performance. *Journal of Animal Science* 73(SUPPL. 1): 186.

Surv Kujawa, K. 1994. the white stork ciconia ciconia in the legnica-glogow copper industry district (sw poland) - population density and breeding results. *Acta Ornithologica.* 29(1): 49-57.

CP Kujawa, M., Macholz, R., Lewerenz, H. J., and Schnaak, W. 1988. on the toxicity of a cu++-treated rapeseed meal. *7th International Rapeseed Congress / Convened Under the Patronage of Stanislaw Zieba ; by the Plant Breeding and Acclimatization Institute Under the Auspices of the Group Consultatif International De Recherche Sur Le Colza.* 1742-1744.

Surv Kulikov, N. E. and Morozova, K. N. 1981. effect of iron and copper additives in the diet on their levels in the rabbit . *Nauch. Tr. NII Pushn. Zverovod. i Krolikovod.* 25: 101-5.

FL Kulikov, N. E., Morozova, K. N., and Aleksandrova, V. S. 1985. requirement of young (rabbits) for minerals. *Krolikovodstvo i Zverovodstvo* (1): 14-15.

Mineral Kulinskii, V. I., Sonich, M. G., and Polikarpov, R. V. 1993. effect of minerals on survival and changes in body weight and weight oforgans in starved rats. *Voprosy Pitaniya* (5): 58-59.

In Vit Kulkarni-Narla, A., Getchell, T. V., and Getchell, M. L. 1997. differential expression of manganese and copper-zinc superoxide dismutases in the olfactory and vomeronasal receptor neurons of rats during ontogeny. *Journal of Comparative Neurology* 381(1): 31-40.

Mineral Kumadani, S., Kataoka, M., Sumadani, S., Hayashi, T., Sato, M., Kimura, M., and Itokawa, Y. effects of an essential trace element preparation for parenteral use on mineral nutrition in rats fed an essential trace element-deficient diet. *Biomed. Res. Trace Elem. (1990)* 1(2): 119-20.

No COC Kumagai, Hajime, Kawashima, Ryoji, and Yano, Hideo. effects of excessive amounts of dietary iron on pregnant rats : iron, copper, zinc, manganese and selenium statuses in mothers and fetuses. *Anim. Sci. Technol. (1993)* 64(8): 780-9 .

Mix Kumamoto, T., Matsuda, A., Kataoka, M., Sato, M., Kimura, M., and Itokawa, Y. influence of zn, cu, mn-mixture solution on metallothionein concentration and sod activity of organ in rats fed zn, cu, mn-deficient diet. *Biomed. Res. Trace Elem. (1993)* 4(2): 63-4.

Phys Kumar, Manish. 1996. effects of dietary magnesium on copper and manganese status and activity of selected antioxidant enzymes in adult male rats (free radicals). *Avail.: Univ. Microfilms Int. Order No. DA9711754 From: Diss. Abstr. Int., B 1997, 57.* 107 pp.

Bio Acc Kumar, R. and Rattan, P. J. S. distribution of trace elements in whole blood plasma and erythrocytes of buffalo-heifers. *Journal of Research Punjab Agricultural University. 28 (2). 1991 (1992). 253-256.*

No Control Kumaratilake, J. S. and Howell, J. M. 1989. lysosomes in the pathogenesis of liver injury in chronic copper poisoned sheep an ultrastructural and morphometric study. *J. Comp. Pathol.* 100(4): 381-390.

Bio Acc Kume, S., Kurihara, M., Takahashi, S., Shibata, M., and Aii, T. effects of hot environmental temperatures on trace element balance in lactating cows. *Japanese Journal of Zootechnical Science. 58 (7). 1987. 604-610.*

Nutr Kume Shin-Ichi and Tanabe Shinobu. 1993. effect of parity on colostral mineral concentrations of holstein cows and value of colostrum as a mineral source for newborn calves. *Journal of Dairy Science* 76(6): 1654-1660.

Bio Acc Kummer, H., Polheim, P. von, and Scholl, W. 1973. mineral contents (major and trace elements) in meadow hay. first-cut innorth and south baden. *Landwirtschaftliche Forschung* (Sonderheft 28/2): 215-227.

Unrel Kurlyandskii, B. A., Torshina, N. L., Balabanova, E. L., Nevzorova, N. I., and Kibrik, V. E. 1988. some specifics of the toxic effect of water-soluble phthalocyanine Dyes. *Gig Tr Prof Zabol.*(9): 47-48.

Unrel Kurlyandskii, B. A., Torshina, N. L., and Braude, E. V. 1987. effect of the structure of phthalocyanine dyes on their behavior in the body. *Gig Tr Prof Zabol.*(4): 49-52.

In Vit Kurz, Erhard and Goslar, Hans G. 1974. histochemical behavior of the unspecific esterases in the liver and kidney opposite some inorganic and organic compounds. enzyme toxicology. *Acta Histochem. (1974)* 48(1): 82-101 .

In Vit Kurze, Peter and Knoefler, Wolfram. anodic oxidation under spark discharge (anod) - a new coating procedure in medical technology. *Z. Klin. Med. (1986)* 41(3): 219-22.

FL Kuzin, A. N. and Shulaev, G. M. 1992. [premixes in diets of replacement sows]. <original> premiksy v ratsionakh remontnykh svinok. *Byulleten' Nauchnykh Rabot - Vsesoyuznyj Institut Zhivotnovodstva. (No.107) P. 76-78*

FL Kuznetsov, S. G. 1996. improvement of mineral nutrition for dairy cows. *Sel'Skokhozyaistvennaya Biologiya.* 0(6): 12-33.

No Dose Kuznetsov, S. G. role of mitochondria of the mucous membrane of hen oviducts in the transport of copper, iron, and calcium during egg formation. *Dokl. Vses. Akad. S-Kh. Nauk (1975)* (6): 39-41.

FL Kuznetsov, S. G. 1975. role of the mitochondria of the oviduct mucous membrane of hens in thetransport of copper, iron and calcium during egg formation. *Doklady Vsesoyuznoi Ordena Lenina Akademii Sel'Skokhozyaistvennykh Nauk* (6): 39-41.

FL Kuznetsov, S. G. 1973. subcellular distribution of copper and iron in the liver of young hens fed rations with various levels of copper. *Byull. Vses. Nauchno-Issled. Inst. Fiziol. Biokhim. Pitan. S-Kh. Zhivotn.* (4): 63-5.

Unrel Kuznetsov, S. G. 1991. sulphur and trace element requirement of young pigs. *Doklady Vsesoyuznoi Ordena Lenina i Ordena Trudovogo Krasnogo Znameni Akademii Sel'Skokhozyaistvennykh Nauk Im. V.I. Lenina* (4): 50-53.

Nut def Kuznetsov, S. G., Bataeva, A. P., and Kal'nitskii, B. 1984. zinc deficiency in piglets and bioavailability of zinc compounds. *Sel'Skokhozyaistvennaya Biologiya* (10): 107-110.

FL Kuznetsov, S. G., Bataeva, A. P., and Pustovoi, V. V. 1985. endogenous losses of trace elements in young pigs fed on semisyntheticdiets and during starvation. *Bylleten' Vsesoyuznogo Nauchno-Issledovatel'Skogo Instituta Fiziologii, Biokhimii i Pitaniya Sel'Skokhozyaistvennykh Zhivotnykh* (No 1/77): 36-39.

FL Kuznetsov, S. G. and Sycheva, N. S. 1977. activity of some metalloenzymes in hens and chicks with different dietary levels of trace elements. *Byull. Vses. Nauchno-Issled. Inst. Fiziol., Biokhim. Pitan. S-Kh. Zhivotn.* 11(1): 31-3.

FL Kuznetsov, S. G. and Volkov, D. T. 1974. activity of metalloenzymes and distribution of copper, iron, and calcium in chickens in a period of intensive egg laying with different levels of copper in the diet. *Byull. Vses. Nauchno-Issled. Inst. Fiziol., Biokhim. Pitan. S-Kh. Zhivotn.* 8(1): 68-70.

FL Kuznetsov, S. G. and Volkov, D. T. 1974. content of copper and iron and the activity of enzymes binding with them in the body of chickens at various physiological periods. *Byull. Vses. Nauchno-Issled. Inst. Fiziol. Biokhim. Pitan. S-Kh. Zhivotn.* 8(1): 65-7.

FL Kuznetsov, S. G. and Volkov, D. T. copper and iron content in the body and eggs of chickens at a varying level of copper in their ration. *Vopr. Pitan. (1974)* (6): 51-4.

FL Kuznetsov, S. G. and Volkov, D. T. 1973. effect of the level of copper in the ration on the activity of some oxidoreductases and distribution of copper and iron in young hen. *Tr. Vses. Nauchno-Issled. Inst. Fiziol., Biokhim. Pitan. S-Kh. Zhivotn.* 12: 225-31.

FL Kuznetsov, S. G. and Volkov, D. T. 1977. metal enzyme activity, copper and iron content in subcellular fractions of chick livers in different physiological periods. *Tr. Vses. Nauchno-Issled. Inst. Fiziol. Biokhim. Pitan. S-Kh. Zhivotn.* 17: 85-92.

Phys Kwiatek, W. M., Long, G. J., Pounds, J. G., Reuhl, K. R., Hanson, A. L., and Jones, K. W. 1990. trace element distribution in the rat cerebellum. *Nucl. Instrum. Methods Phys. Res. Sect. B* B49(1-4): 561-5.

Nut def Kwik-Uribe, Catherine L., Golub, Mari S., and Keen, Carl L. behavioral consequences of marginal iron deficiency during development in a murine model. *Neurotoxicol. Teratol. (1999)* 21(6): 661-672.

CP L'abbe Mary R(A) and Trick Keith D. 1994. changes in pancreatic glutathione peroxidase and superoxide dismutase activities in the prediabetic diabetes-prone bb rat. *Proceedings of the Society for Experimental Biology and Medicine* 207(2): 206-212.

Mix L'Herroux, L., Roux, S. le, Appriou, P., and Martinez, J. UBO UMR CNRS 5521 Departement de Chimie UFR Sciences 6 Avenue Le Gorgeu F-29285 Brest cedex France. 1997. behaviour of metals following intensive pig slurry applications to a natural field treatment process in brittany (france).

Environmental Pollution. V. 97(1/2) P. 119-130

Aquatic Labreche, T. M., Dietrich, A. M., Gallagher, D. L., and Shepherd, N. 2002. copper toxicity to larval mercenaria mercenaria (hard clam). *Environmental Toxicology and Chemistry / Setac, 2002 Apr, 21(4):760-6.*

FL Lacatusu, R., Rauta, C., Mihailescu, A., Neda, C., Medrea, N., Kovacsovics, B., and Lungu, M. 1988. research on the soil-plant-animal system in the influence zone of the turnu magurele, romania factory processing the pyrite Ashes. *An Inst Cercet Pedol Agrochim.* 48: 281-292.

Surv LaDelfe, C. M. 1981.*Detailed Geochemical Survey Data Release for the San Andres-Oscura Mountains Special Study Area, New Mexico. GJBX-215-81; LA-8016-MS*

Aquatic Ladizinsky, N. L. and Smith, G. J. 2000. accumulation of domoic acid by the coastal diatom pseudo-nitzschia multiseries: a possible copper complexation strategy. *Journal of Phycology [j. Phycol.]. Vol. 36, No. 3, Suppl., 41 P. Jun 2000.*

Nut def Lai, C. C., Huang, W. H., Askari, A., Wang, Y., Sarvazyan, N., Klevay, L. M., and Chiu, T. H. 1994. differential regulation of superoxide dismutase in copper-deficient rat organs. *Free Radical Biology & Medicine* 16(5): 613-20.

Nutr Lai Chih-Chia, Huang Wu-Hsiung, Askari Augusta, Klevay Leslie M, and Chiu Ted H(A). 1995. expression of glutathione peroxidase and catalase in copper-deficient rat liver and heart. *Journal of Nutritional Biochemistry* 6(5): 256-262.

No Dose Lai, J. C. K., Chan, A. W. K., Leung, T. K. C., Minski, M. J., and Lim, L. neurochemical changes in rats chronically treated with a high concentration of manganese chloride. *Neurochem. Res. (1992)* 17(9): 841-7 .

Bio Acc Laiblin, C., Xhaxhiu, D., and Terorde, H. 1998. effect of drinking water composition on trace element supply in grazing cattle. *Praktische Tierarzt.* 79(3): 251-254.

No Oral Lal, S. and Sourkes, T. L. 1971. intracellular distribution of copper in the liver during chronic administration of copper sulfate to the rat. *Toxicol Appl Pharmacol.* 18(3): 562-72.

No Oral Lal, S. and Sourkes T. L. 1971. deposition of copper in rat tissues - the effect of dose and duration of administration of copper sulfate. *Toxicol. Appl. Pharmacol.* 20(3): 269-283.

Surv Lall, D., Dixit, V. B., Chauhan, T. R., and Khanna, S. 1996. feeding practices vis a vis mineral supply to lactating buffaloes in hisar district. *Indian Journal of Animal Nutrition* 13(2): 95-100.

Mineral Lall, D., Rajan Gupta, and Gupta, V. K. 1994. blood serum levels of certain mineral elements in lactating buffaloesin relation to forages and soil content. *Indian Journal of Animal Nutrition* 11(4): 233-236.

Unrel Lall, N., Nikolova, R. V., and Bosa Ajn(A). 1999. changes in activities of superoxide dismutase, peroxidase and catalase from leaves of impatiens flanaganiae in response to light intensity. *South African Journal of Botany* 65(4): 255-259.

No Dose Lamand, M. influence of silage contamination by soil upon trace elements availability in sheep. *Annales De Recherches Veterinaires. 10 (4). 1979 (Recd. 1980). 571-574.*

Phys Lamand, M., Barlet, J. P., and Rayssiguier, Y. 1986. details of the clinical biology of minerals in ruminants. *Recl Med Vet Ec Alfort.* 162(10): 1127-1132.

FL Lamand, M. and Perigaud, S. 1973. (trace element deficiencies in ruminants in france. i. data fromveterinary practitioners). *Annales De Recherches Veterinaires* 4(No.4): 513-534.

Herp Lance, V., Joanen, T., McNease, L., and Baudo, R. 1983. selenium, vitamin e, and trace elements in the plasma of wild and farm-reared alligators during the reproductive cycle. *Can. J. Zool.* 61(8): 1744-51.

CP Landis Wayne G(A), Hughes Jane S, Lewis Michael A, <Book> Landis W G, Hughes, J. S., and Lewis, M. A: Eds. 1993. ASTM (american society for testing and materials) special technical publication, no. 1179. environmental toxicology and risk assessment; first symposium, atlantic city, new jersey, usa, april 14-16, 1991. <book> astm special technical publication; environmental toxicology and risk assessment. *ASTM Special Technical Publication.*: VI+431P.

FL Lang, F. J. 1977.*Effect of Different Amounts of Copper for Pregnant Sows on Storage of Copper in the Foetus and on Development of the Piglets.*

Surv Lang, V., Kirchgessner, M., and Voigtlaender, G. contents of trace elements in meadow fescue festuca-pratensis in relation to height development and weather conditions. *Z Acker- Pflanzenbau. 135 (3). 1972 216-225.*

FL Lang, V., Kirchgessner, M., and Voigtlander, G. 1972. trace element content of meadow fescue (festuca pratensis huds.) inrelation to growth height, development and weather. *Zeitschrift Fur Acker- Und Pflanzenbau* 135(3): 216-225.

Plant Langeland, K. A., Hill, O. N., Koschnick, T. J., and Haller, W. T. 2002. evaluation of a new formulation of reward landscape and aquatic herbicide for control of duckweed, waterhyacinth, waterlettuce, and hydrilla. *Journal of Aquatic Plant Management, 40 (2) Pp. 51-53, 2002.*

Bio Acc Langlands, J. P., Bowles, J. E., Donald, G. E., and Smith, A. J. 1984. deposition of copper, manganese, selenium and zinc in merino sheep. *Australian Journal of Agricultural Research* 35(5): 701-707.

Surv Langlands, J. P., Donald, G. E., Bowles, J. E., and Smith, A. J. 1989. selenium concentration in the blood of ruminants grazing in northern new south wales, 3. relationship between blood concentration and the response in liveweight of grazing cattle given a selenium supplement. *Australian Journal of Agricultural Research.* 40(5): 1076-1083.

No COC Langley, S. C., Rickett, G. W., Hunt, A., Kelly, F. J., Postle, A. D., and York, D. A. 1993. effects of the glucocorticoid agonist, ru28362, and the antagonist ru486 on lung phosphatidylcholine and antioxidant enzyme development in the genetically obese zucker rat. *Biochemical Pharmacology* 45(3): 543-51.

No Oral Larsen, James B., Nelson, Gordon L., Williams, Brian K., Spencer, Eric G., and Spencer, Lisa M. effects of metallic coatings on the combustion toxicity of engineering plastics. *Fire Mater. (1994)* 18(2): 121-30.

Mineral Larsen, T. and Poulsen, H. D. 1996. the relationship between mineral and nitrogen balances in growing pigsfed diets supplemented with zinc oxide. *Canadian Journal of Animal Science* 76(3): 409-415.

Mineral Larsen, Torben. dephytinization of a rat diet . consequences for mineral and trace element absorption. *Biol. Trace Elem. Res. (1993)* 39(1): 55-71.

No Dose Larson, L. L., Mabruck, H. S., and Lowry, S. R. 1980. relationship between early post partum blood

composition and reproductive performance in dairy Cattle. *J Dairy Sci.* 63(2): 283-289.

Carcin Larsson, Sture, Karlberg, Ingvar, Selin, Eva, Daneryd, Peter, and Peterson, Hans Inge. trace element changes in serum and skeletal muscle compared to tumor tissue in sarcoma-bearing rats. *In Vivo (1987)* 1(3): 131-40.

Species Lastowski-Perry, D., Otto, E., and Maroni, G. 1985. nucleotide sequence and expression of a drosophila metallothionein. *Journal of Biological Chemistry* 260(3): 1527-30.

Fate Latymer, E. A., Coates, M. E., Pittman, R. J., Thomas, J., and Mitchell, K. G. 1982. the pantothenic-acid status of pigs fed diets containing 200 milligrams of copper per kilogram. *LIVEST PROD SCI.* 9(5): 591-602.

Mix Lauer, W. C., Wolfe, G. W., and Condie, L. W. 1994. health effect studies on recycled drinking water from secondary Wastewater. *Toxicology of Chemical Mixtures: Case Studies, Mechanisms, and Novel Approaches.*
ISBN 0-12-768350-X. 63-81.

Mix Lauridsen, C. J. H. Nielsen P. Henckel and M. T. Sorensen. 1999. antiozidase and oxidative status in muscles of pigs fed rapesee oil, vitamin e, and copper. *Journal of Animal Science.* 77: 105-115.

Mix Lauridsen, C. S. Hojsgaard and M. T. Sorensen. 1999. influence of dietary rapeseed oil, vitamin e. and copper on the performance and the antioxidative status of pigs. *Journal of Animal Science.* 77: 906-916.

Surv Laurinolli, M. and Bendell-Young, L. I. 1996. copper, zinc, and cadmium concentrations in peromyscus maniculatus sampled near an abandoned copper mine. *Arch Environ Contamin Toxicol.* 30(4): 481-486.

In Vit Lawrence, G. D. and Sawyer, D. T. potentiometric titrations and oxidation reduction potentials of manganese and copper zinc super oxide dis mutases. *Biochemistry. 18 (14). 1979. 3045-3050.*

FL Lazar, V., Stavkova, J., and Klecker, D. Vysoka Skola Zemedelska Brno CSFR. 1990. physiological range of macro- and microelements in blood plasma of geese. <original> fyziologicka rozmezi makro- a mikroelementu krevni plazmy hus. *Zivocisna Vyroba - UVTIZ. V. 35(7) P. 625-633*

HHE Leake, A., Chisholm, G. D., and Habib, F. K. characterization of the prolactin receptor in human prostate. *Journal of Endocrinology. 99 (2). 1983. 321-328.*

FL Lebedeva, N. V. 1996. population ecotoxicology of Birds. *Doklady Akademii Nauk.* 351(3): 425-429.

FL Lechowski, R. and Lenarcik, M. 1994. feeding and skin diseases in dogs and cats: a review. *Medycyna Weterynaryjna.* 50(10): 477-479.

FL Lee, D. P., Honda, K., and Tatsukawa, R. 1987. comparison of tissue distributions of heavy metals in birds in japan and korea. *J Yamashina Inst Ornithol.* 19(2): 103-116.

Surv Lee, H. J. and Jones, G. B. 1976. interactions of selenium cadmium and copper in sheep. *AUST J AGRIC RES.* 27(3): 447-452.

Rev Lee, J., Masters, D. G., White, C. L., Grace, N. D., and Judson, G. J. 1999. current issues in trace element nutrition of grazing livestock inaustralia and new zealand. *Australian Journal of*

Agricultural Research 50(8): 1341-1364.

CP Lee, J., Rounce, J. R., Edwards, J. E. H., and Harris, P. M. 1995. response of trace element concentrations in plasma of sheep to chronicinfusion of a recombinant variant of igf-1. *Proceedings of the New Zealand Society of Animal Production* 55: 179-182.

Bio Acc Lee, J., Treloar, B. P., and Grace, N. D. 1994. metallothionein and trace element metabolism in sheep tissues inresponse to high and sustained zinc dosages. 2. expression ofmetallothionein m-rna. *Australian Journal of Agricultural Research* 45(2): 321-332.

FL Lee, J. S., Cho, S. Y., and Kim, Y. R. 1994. effects of dietary iron supplementation on sigma-aminolevulinic acid dehydratase activity and detoxification of the pb-administered rats. *Journal of The Korean Society of Food and Nutrition* 23(1): 7-12.

No COC Lee, J. Y., Baek, K. J., and Lee, H. S. studies on the activities of superoxide dismutase and catalase and the development of gastric mucosal lesions in diethyldithiocarbamate treated rats. *Chung-Ang Journal of Medicine. 13 (2). 1988. 225-236.*

Alt Lee, J. Y. and Lee, S. J. a. 1995. enzymatic properties of cytochrome oxidase from bovine heart and rat tissues. *Journal of Biochemistry and Molecular Biology.* 28(3): 254-260.

Nutr Lee, S. H. T. E. Engle and K. I. Hossner. 2002. effects of dietary copper on the expression of lipogenic genes and metabolic hormones in steers. *Journal of Animal Science.* 80: 1999-2005.

CP Lee, Y. H., Fox, M. R. S., Tao S-H, and Jones, J. W. bioavailability of endogenous and exogenous cadmium in a soy isolate diet. *71st Annual Meeting of the Federation of American Societies for Experimental Biology, Washington, D.C., USA, March 29-april 2, 1987. FED PROC. 46 (3). 1987. 756.*

Gene Lee, Y. J., Chen, Y. P., Wang, S. H., Chow, W. Y., and Lin, L. Y. 1996. structure and expression of metallothionein gene in ducks. *Gene.* 176(1/2): 85-92.

Mix Leeson, S. and Summers, J. D. 1983. effect of composition and storage conditions of mineral premixes onearly chick growth. *Nutrition Reports International* 28(4): 873-879.

Diss Lefevre, M. 1981.*Elastin Metabolism in Avian Lung and Aorta: Effects of Selected Nutritional Factors*

FL Legiec, A., Pasierbski, Z., Legiec, J., and Alchinowicz, M. 1979. contents of certain minerals in the liver and kidneys of bulls given adiet with dried pig wastes. *Biuletyn Informacyjny, Instytut Zootechniki, Zaklad Informacji Zootechnicznej* 17(6): 28-35.

No COC Lehning, E. J., Balaban, C. D., Ross, J. F., Reid, M. A., and LoPachin, R. M. 2002. acrylamide neuropathy i. spatiotemporal characteristics of nerve cell damage in rat cerebellum. *Neurotoxicology [Neurotoxicology]. Vol. 23, No. 3, Pp. 397-414. Sep 2002.*

Unrel Lemerle, C. and Holmes, J. H. G. 1986. sodium deficiency of grazing cattle in papua New-guinea. *Trop Anim Health Prod.* 18(3): 166-170.

Nut def Leon, A., Glenn, J. S., and Farver, T. B. 1999. copper oxide wire particles for the treatment of copper deficiency in sheep. *Small Ruminant Research.* 35(1): 7-12.

Mix Leonard, A., Deknudt, Gh., and Debackere, M. 1974. cytogenetic investigations on leucocytes of cattle intoxicated withheavy metals. *Toxicology* 2(No.3): 269-273.

Surv Lepage, P. and Parker, G. H. 1988. copper nickel and iron levels in pelage of red squirrels living near the ore smelters at sudbury ontario Canada. *Can J Zool.* 66(7): 1631-1637.

Alt Lepper, A. W. D., Embury, D. H., Anderson, D. A., and Lewis, V. M. 1989. effects of altered dietary iron intake in mycobacterium-paratuberculosis-infected dairy-cattle - sequential observations on growth, iron and copper-metabolism and development of para-tuberculosis. *Research In Veterinary Science* 46(3): 289-296.

Model Levengood, J. M. and Skowron, L. M. 2001. use of a simulated gizzard to measure bioavailability of metals and other elements to waterfowl. *Ecotoxicology [Ecotoxicology]. Vol. 10, No. 5, Pp. 299-304. Oct 2001.*

Surv Levin, M. B., Hall, A. T., Barrett, G. W., and Taylor, D. H. 1989. heavy metal concentrations during ten years of sludge treatment to an old-field Community. *J Environ Qual;* . 18(4): 411-418.

In Vit Levine, S. and Sowinski, R. tin salts prevent the plasma cell response to metallic tin in lewis rats. *Toxicology and Applied Pharmacology. 68 (1). 1983. 110-115.*

CP Levinson, W., Faras, A., Woodson, B., Jackson, J., and Bishop, J. M. 1973. inhibition of rna-dependent dna polymerase of rous sarcoma virus by thiosemicarbazones and several cations. *Proceedings of the National Academy of Sciences of the United States of*

No Dose Levkutova, M., Revajova, V., Levkut, M. Univ. Vet. Med. Kosice Slovak Republic Dep. of Pathological Anatomy, and Leng, L. Inst. of Anim. Physiology Kosice Slovak Republic. 1998. subpopulations of lymphocytes in cattle naturally infected with papillomavirus. *Acta Veterinaria Hungarica. V. 46(1) P. 13-18*

Mineral Lewis, Charles G., Michaelis, Otho E. IV, Yang, Chao Yi, and Carswell, Nancy. enzyme-specific activities and mineral concentrations of the exocrine pancreas from female shr/n-corpulent (cp) rats. *J. Am. Coll. Nutr. (1989)* 8(6): 608-16.

Alt Lewis, Charles G., Michaelis, Otho E. IV, Yang, Chao Yi, and Carswell, Nancy. exocrine pancreatic enzyme activities and mineral concentrations in shr/n-corpulent (cp) male rats . *J. Nutr. (1988)* 118(7): 834-9 .

CP Lewis, G., Anderson, P. H., and Suttle, N. F. 1983. the nature of trace element problems: delineating the field problem. (Occasional Publication No. 7): 11-16.

No Dose Lewis, N. J., Fallah-Rad, A. H., and Connor, M. L. 1997. copper toxicity in confinement-housed ram lambs. *Canadian Veterinary Journal.* 38(8): 496-498.

No Oral Lewis, S. C. acute lethality of selected heavy metals in spontaneously hypertensive rats. *Toxicology and Applied Pharmacology. 33 (1). 1975 128*

Nutr Ley, W. B., Thatcher, C. D., Swecker, W. S., and Lessard, P. N. 1990. chelated mineral supplementation in the barren mare: a preliminarytrial. *Journal of Equine Veterinary Science* 10(3): 176-181.

Nut def Li, Dan. effects of iron deficiency on iron distribution and .gamma.-aminobutyric acid (gaba) metabolism in young rat brain tissues. *Hokkaido Igaku Zasshi (1998)* 73(3): 215-225.

Nutr Li, J., Wang, A., and Shan, A. S. 1992. effects of dietary wheat bran on growth of egg type breeder cockerelsand deposition of zn, fe, mn and cu in tissues of some organs. *Chinese Journal of Animal Science* 28(2): 1-6.

Nutr Li Jie (Northeast Agricultural, Coll. Harbin China Lab. of Animal Nutrition. 1992. effect of wheat bran level on the deposition of zn, fe, mn and cu in chicken tissue. *Chinese Journal of Animal Science. V. 28(2) P. 3-6*

FL Li, Jinsong and Wu, Xunxian. influence of iron and copper on biological response to excess dietary zinc in chick. *Yingyang Xuebao (1992)* 14(3): 288-94 .

HHE Li, Lan, Zhang, Ruling, Chen, Bingran, Fang, Weitang, Ye, Ping, and Ji, Qingxian. the nutritional study of zinc, iron, copper, and cobalt status of children in kindergartens of jinan city. *Yingyang Xuebao (1990)* 12(3): 294-8 .

FL Li, Li, Wu, Xunxian, Wu, Xiaojian and others. 1993. study of cadmium-induced damage of erythrocyte membranes in rats. *Journal of Xi'an Medical University.* 14(1): 21-24.

FL Li, Li, Wu, Xunxian, and Niu, Yingdou. the preventive effect of iron, zinc and copper on chicken anemia induced by cadmium. *Yingyang Xuebao (1991)* 13(1): 39-44.

Phys Li, N., Oberley, T. D., Oberley, L. W., and Zhong, W. 1998. inhibition of cell growth in nih/3t3 fibroblasts by overexpression of manganese superoxide dismutase: mechanistic studies. *Journal of Cellular Physiology* 175(3): 359-69.

Aquatic Li, T. and Xiong, Z. 2004. a novel response of wild-type duckweed (lemna paucicostata hegelm.) to heavy metals. *Environmental Toxicology [Environ. Toxicol.]. Vol. 19, No. 2, Pp. 95-102. 2004.*

FL Li, W. F., Liu, Z. P., Ma, Z., and Wang, Y. P. 1995. influences of heavy metal pollution of the environment on the health of sheep. *Chinese Journal of Veterinary Science and Technology.* 25(10): 15-17.

Nutr Liao, Luxing, Huang, Xiaorong, Lai, Yurong, Wang, Zhangjing, and Cai, Lixin. effect of selenium supplement on the contents of se, cd, cu, zn, mn in rat tissues. *Yingyang Xuebao (1995)* 17(3): 279-83.

Gene Lichtlen, P., Wang, Y., Belser, T., Georgiev, O., Certa, U., Sack, R., and Schaffner, W. 2001. target gene search for the metal-responsive transcription factor mtf-1. *Nucleic Acids Research, 2001 Apr 1, 29(7):1514-23.*

CP Liers, E. and Anke, M. 1993. influence of the copper, manganese and zinc supply on the growth and fertility of mink. *Mengen- Spurenelem., Arbeitstag., 13th* : 196-202.

Mix Likhachev, A. I. 1989. trace elements in the etiology and prophylaxis of allergies of sheep in the caspian sea region. *Mikroelementy v SSSR.*(30): 90-93.

Nut def Lillie, R. J. and Frobish, L. T. 1978. effect of copper and iron supplements on performance and hematology of confined sows and their progeny through 4 reproductive Cycles. *J Anim Sci*. 46(3): 678-685.

Surv Limpoka, M. a, Sirivejapandu, S., and Kessank, P. 1983.*Research on Mineral Element Problems in Dairy Cattle: Research Report 1983* : 139-140.

Diss Lincer, J. L. 1973.*The Effects of Organochlorines on the American Kestrel (Falco Sparverius Linn.)*

Nutr Lindemann, M. D., Kornegay, E. T., and Moore, R. J. 1986 . digestibility and feeding value of peanut hulls for swine. *Journal of Animal Science* 62(2): 412-421.

CP Linder, G., Bollman, M., Callahan, C., Gillete, C., Nebeker, A., and Wilborn, D. 1998. bioaccumulation and food-chain analysis for evaluating ecological risksin terrestrial and wetland habitats: availability-transfer factors(atfs) in 'soil right arrow soil macroinvertebrate right arrowamphibian ' food chains. *Superfund Risk Assessment in Soil Contamination Studies: Thirdvolume. Papers Presented at the Symposium on Superfund Risk Assessment,Held at San Diego, California, USA on 11-16 January 1998.* 51-65.

Rev Linder, G., Bollman, M., Callahan, C., Gillete, C., Nebeker, A., Wilborn, D., and <Editors>. 1998. bioaccumulation and food-chain analysis for evaluating ecological risks in terrestrial and wetland habitats: availability-transfer factors(atfs) in 'soil soil macroinvertebrate amphibian' food chains. *Superfund Risk Assessment in Soil Contamination Studies: Third Volume. Papers Presented at the Symposium on Superfund Risk Assessment,Held at San Diego, California, USA on 11-16 January 1998.* 51-65 .

FL Linnepe, C. 1992. histometric investigations on thyroids and adrenals of rats after treatment with a growth-promoting substance (copper sulfate). 81 pp.

FL Lipnitskii, S. S. 1975. effect of supplementary dietary trace elements on blood biochemical values of calves. *Trudy. Belorusskii Nauchno-Issledovatel'Skii Veterinarnyi Institut.* 13: 147-149.

FL Lipnitskii, S. S. and Dovnar, N. I. 1976. the effect of trivitamine and micro-elements on some physiologicalindices of calves and on their susceptibility to parasiticinfections. <document title>dostizheniya veterinarnoi nauki i peredovogo opyta -zhivotnovodstvy. (mezhvedomstvennyi sbornik, no. 2). 38-41.

Mix Lipnitskii, S. S. and Yakubovskii, M. V. 1975. effect of additional dietary trace elements on weight gain and theoccurrence of various parasitic diseases in cattle in belorussia. *Trudy. Belorusskii Nauchno-Issledovatel'Skii Veterinarnyi Institut.* 13: 143-147.

Mineral Lisboa, J. An, Kuchembuck, M. Rg, Kohayagawa, A., Bomfim, S. Rm, Santiago, A. Mh, and Dutra, I. S. clinical pathological data and analyses of mineral elements of cattle affected by epizootic botulism in the state of sao paulo. *Pesquisa Veterinaria Brasileira; 16 (4). 1996. 91-97.*

FL Lisovets, I., Lipyanchik, V., and Zastavnyi, M. 1983. alkaline and mineral supplements to increase growth of young bulls. *Molochnoe i Myasnoe Skotovodstvo* (3): 27-28.

No Control Liu, C. C. F. and Medeiros, D. M. 1986. excess diet copper increases systolic blood pressure in rats. *Biological Trace Element Research.* 9(1): 15-24.

FL Liu, H., Huan, J., and Liu, S. 1992. effect of dietary copper levels on some enzymes and microelements in serum of growing pig. *Journal of Fujian Agricultural College.* 21(2): 198-203.

Mix Liu, J. Y. and Stemmer, K. L. 1990. interaction between aluminum and zinc or copper and its effects on the pituitary-testicular axis. ii. testicular enzyme and serum gonadotropin assay. *Biomed Environ Sci.* 3(1): 11-9.

Unrel Liu, W. K. and Wong, M. H. ultrastructural changes in gills of sarotherodon-mossambicus treated with chicken manure. *Environ Res; 40 (1). 1986. 164-171.*

Phys Liu, Wenlong, Zhao, Dinglu, and Lu, Xiaolong. trace elements in icr mice functional organs. *Guangdong Weiliang Yuansu Kexue (1995)* 2(2): 9-11.

Unrel Liu, X. H., Kato, H., Nakata, N., Kogure, K., and Kato, K. 1993. an immunohistochemical study of copper/zinc superoxide dismutase and manganese superoxide dismutase in rat hippocampus after

transient cerebral ischemia. *Brain Research* 625(1): 29-37.

FL Liu, X. Y., Ji, C., Ding , L. M., and Rong, Y. 1998. the effects of dietary selenium and copper on rat's activity of some antioxidant enzymes and lipid peroxidation products. *Journal of China Agricultural University.* 3(3): 107-112.

No Oral Liu Xiao-Hong, Kato Hiroyuki(A), Chen Ting, Kato Kanefusa, and Itoyama Yasuto. 1995. bromocriptine protects against delayed neuronal death of hippocampal neurons following cerebral ischemia in the gerbil. *Journal of the Neurological Sciences* 129(1): 9-14.

FL Liu, Yongjun, Yu, Dong, Jia, Dejun, and Zhao, Ying. effects of complex of calcium, vitamin and collagen on collagen metabolism and bone tissue of rats . *Weisheng Yanjiu (1997)* 26(6): 387-390.

Nutr Lizama, L. C., McDowell, L. R., and Marion, J. E. 1989. utilization of aquatic plants elodea canadensis and hydrillaverticillata in laying hen diets. 2. macrominerals and microminerals. *Nutrition Reports International* 39(3): 521-536.

Bio Acc Llacuna, S., Gorriz, A., Sanpera, C., and Nadal, J. 1995. metal accumulation in three species of passerine birds (emberiza cia, parus major, and turdus merula) subjected to air pollution from a coal-fired power plant. *Arch Environ Contamin Toxicol* . 28(3): 298-303.

QAC Llewellyn, G. C., Thomen, L. E., and Katzen, J. S. 1981. effects of dietary copper on developing aflatoxicosis in syrian hamsters. *J Environ Sci Health [B]*. 16(2): 211-25.

No Oral Llorens, J., Crofton, K. M., and O'Callaghan, J. P. 1993. administration of 3,3'-iminodipropionitrile to the rat results in region-dependent damage to the central nervous system at levels above the brain stem. *Journal of Pharmacology and Experimental Therapeutics* 265(3): 1492-8 .

Nut def Lloyd, D. R., Jenkins, N. K., Coates, M. E., Harrison, G. F., and Morris, T. R. 1972. pantothenic acid deficiency in chicks fed on copper-supplemented diets. *Proc Nutr Soc.* 31(1): 34A-35A.

Surv Lloyd, J. W., Rook, J. S., Braselton, W. E., and Shea, M. E. 1993. relationships between liver element concentration and cause of death in perinatal lambs in michigan, usa. *Preventive Veterinary Medicine.* 17(3/4): 183-189.

Surv Lloyd, J. W., Rook, J. S., Braselton, W. E., and Shea, M. E. 1993. relationships between liver element concentrations and age in perinatal lambs dying of natural causes in michigan, usa. *Preventive Veterinary Medicine.* 17(3/4): 175-181.

Bio Acc Lock, J. W., Thompson, D. R., Furness, R. W., and Bartle, J. A. metal concentrations in seabirds of the new zealand region. *Environ. Pollut. (1991)* Volume Date 1992, 75(3): 289-300.

Herp Lombardi, J. V., Perpetuo, T. R., Ferreira, C. M., Machado-Neto, J. G., and Marques, H. L. A. 2002. acute toxicity of the fungicide copper oxychloride to tadpoles of the bullfrog rana catesbeiana. *Bulletin of Environmental Contamination and Toxicology [Bull. Environ. Contam. Toxicol.]. Vol. 69, No. 3, Pp. 415-420. 2002.*

Mix London, J. E. 1988.*Preliminary Toxicological Study of Yttrium Barium Copper Oxide. LA-11437-MS*

Surv Long, M. I. E., Marshall, B., Ndyanabo, W. K., and Thornton, D. D. 1972. mineral status of dairy farms in eastern uganda. 2. nitrogen andmineral content of grasses and some mineral contents of bovine plasma. *Tropical Agriculture* 49(3): 227-234.

No Duration Longcore, J. R., Samson, F. B., Kreitzer, J. F., and Spann, J. W. 1971. changes in mineral composition of eggshells from black ducks and mallards fed dde in the diet. *Bull Environ Contam Toxicol.* 6(4): 345-50.

HHE Lonnerdal, B., Keen, C. L., Ohtake, M., and Tamura, T. 1983. iron, zinc, copper, and manganese in infant formulas. *American Journal Of Diseases Of Children* 137(5): 433-437.

Meth Lopez, C. E., Castro, J. M., Gonzalez, V., Perez, J., Seco, H. M., and Fernandez, J. M. determination of metal ions in algal solution samples by capillary electrophoresis. *J. Chromatogr. Sci. (1998)* 36(7): 352-356.

Mix Lopez-Guisa, J. M. and Satter, L. D. 1992. effect of copper and cobalt addition on digestion and growth in heifers fed diets containing alfalfa silage or corn crop residues . *J Dairy Sci.* 75(1): 247-256.

Phys Lopez, Hubert W., Coudray, Charles, Bellanger, Jacques, Levrat-Verny, Marie-Anne, Demigne, Christian, Rayssiguier, Yves, and Remesy, Christian. resistant starch improves mineral assimilation in rats adapted to a wheat bran diet. *Nutr. Res. (N. Y.) (1999)* Volume Date 2000, 20(1): 141-155.

Unrel Lormee, P., Lecolle, S., Septier, D., Le Denmat, D., and Goldberg, M. 1989. autometallography for histochemical visualization of rat incisor polyanions with cuprolinic blue. *Journal of Histochemistry and Cytochemistry* 37(2): 203-8.

FL Lotthammer, K.-H. and Ahlswede, L. 1973. relationship between nutrition and fertility in cows. ii. effect of the major and trace elements. *Ubersichten Zur Tierernahrung.* 1(Heft 4): 325-353.

Abstract Lovingier, D. K., Gardner, R. W., Hoopes, K. H., and Gardner, R. A. effect of trace mineral supplementation pre partum and post partum on reproductive and productive responses of holstein cows. *Journal of Dairy Science. 60 (Suppl 1). 1977 116*

Nut def Lowney, Patricia, Gershwin, M. Eric, Hurley, Lucille S., Stern, Judith S., and Keen, Carl L. the effect of variable magnesium intake on potential factors influencing endurance capacity. *Biol. Trace Elem. Res. (1988)* 16(1): 1-18.

No Dose Loyke, H. F. 1991. copper and zinc in experimental hypertension. *Biological Trace Element Research.* 29(1): 45-49.

CP Lu, Junxuan and Combs, G. F. Jr. inhibition of pancreatic exocrine function by high levels of dietary zinc. *Proc. - Cornell Nutr. Conf. Feed Manuf. (1986) 52-6*

FL Lui, Xi, Jiang, Huimin, Han, Guoan, Cui, Kewei, and Sun, Shuai. the effect of copper, zinc, manganese, on selenium content in liver, brain, blood and kidney of mice. *Zhonghua Yufang Yixue Zazhi (1991)* 25(6): 345-6.

FL Luk'yanova, L. E., Pyastolova, O. A., Luk'yanov, O. A., and Mikshevich, N. V. 1990. study of the populations of small mammals exposed to industrial pollution. *Ekologiya (Sverdl).* 0(2): 53-61.

Drug Lukac, Maja and Aegerter, Rita. influence of trace metals on growth and toxin production of microcystis aeruginosa. *Toxicon (1993)* 31(3): 293-305.

No Dose Lukaski, H. C. and Penland, J. G. 1996. functional changes appropriate for determining mineral element requirements. *J Nutr.* 126(9 Suppl): 2354S-2364S.

In Vit Lundholm, C. E. and Mathson, K. 1986. effect of some metal compounds on the calcium binding and calcium-magnesium atpase activity of eggshell gland mucosa homogenate from the domestic fowl. *Acta Pharmacol Toxicol* 59 (5): 410-415.

Unrel Luo, L. and Lee, S. R. 1990. the effect of different sources of soybean meal and dietary chloride and phosphorus on the tibial dyschondroplasia in broiler Chicks. *Sci Agric Sin.* 23(6): 75-81.

Nutr Luo, L., Tong, J. M., and Huang, J. C. 1992. effects of dietary chloride and magnesium on the incidence of tibial dyschondroplasia in chickens fed on chinese practical diets. *British Poultry Science* 33(3): 603-11.

FL Luo, X. G., Su, Q., Huang, J. C., Duan, Y. Q., and Liu, J. X. 1992. the long-term effects of manganese deficiency or excess in diets on the performances of broiler chicks. *Chinese Journal of Animal Science* 28(1): 11-13.

FL Luo Xugang, Su Qi, and Huang Junchun (Chinese Academy of Agricultural Sciences, Beijing China Inst. of Animal Sciences. 1991. the effects of manganese (mn) deficiency and excess in a practical diet on contents of other minerals and trace elements in tissues of broiler chicks. *Animal Husbandry and Veterinary Medicine. V. 23(4) P. 146-147*

Surv Lusky, K. Bohm D. Stoyke M. Hecht H. Luthardt M. Lippert A. 1992. studies in environmental contaminants in wild boars, red deer, roedeer, mouflon, and fallow deer from the schorfheide-chorin biosphererereservation. *Archiv Fur Lebensmittelhygiene.* 43(6): 131-136.

Unrel Luttrell, William E., Olajos, Eugene J., and Pleban, Patricia A. change in hen sciatic nerve calcium after a single oral dose of tri-o-tolyl phosphate. *Environ. Res. (1993)* 60(2): 290-4.

Nut def Lyakhov, S. L. effect of ascorbic acid on the level of copper and manganese in the mucosa of guinea pig gums. *Probl. Ter. Stomatol. (1969)* : No. 4, 16-21 .

In Vit Lyakhovich V V^Tsyrlov I B^Mishin V M^Weiner L M^Rumyantseva= G^Eremenko S I^Budker V G. activated forms of oxygen in the metabolism of xenobiotics catalyzed by cytochrome p-450. *Acta Biologica Et Medica Germanica. 38 (2-3). 1979. 201-206.*

Nut def Lynch, S. M. and Strain, J. J. effects of copper deficiency on hepatic and cardiac antioxidant enzyme activities in lactose- and sucrose-fed rats. *Br. J. Nutr. (1989)* 61(2): 345-54 .

Nut def Lynch, S. M. and Strain, J. J. effects of dietary lactose and copper deficiency in the Rat. *Four Hundred and Forty-first Meeting of the Nutrition Society, Cambridge, England, U.K., JULY 16-17, 1987. Proc Nutr Soc. 47 (1). 1988. 36a.*

Nut def Lynch, S. M. and Strain, J. J. effects of skimmed milk powder, whey or casein on tissue trace element status and antioxidant enzyme activities in rats fed control and copper-deficient diets.*Nutr. Res. (N. Y.) (1990)* 10(4): 449-60

Aquatic Lytle, C. M. and Smith, B. N. seasonal nutrient cycling in potamogeton pectinatus of the lower provo River. *Great Basin Naturalist; 55 (2). 1995. 164-168.*

Unrel Ma, R. chemoattraction of infective larvae of ancylostoma braziliense to rodent plasmas and to salts. *Acta Biol. Hung. (1987)* 38(2): 235-45.

FL Maciejewska, M. and Jorasz, K. 1976. influence d'une supplementation en cuivre dans les aliments sur les indices hematologiques et le metabolisme chez le Lapin. *Poznan. Tow. Przyj. Nauk, Prace Komis. Nauk Roln. Komis. Nauk Lesn.* 41: 165-170.

Drug MacKenzie, Andrew, Filippini, Silvia, and Martin, William. effects of superoxide dismutase mimetics on the activity of nitric oxide in rat aorta. *Br. J. Pharmacol. (1999)* 127(5): 1159-1164.

In Vit Mackenzie, Andrew and Martin, William. loss of endothelium-derived nitric oxide in rabbit aorta by oxidant stress: restoration by superoxide dismutase mimetics. *Br. J. Pharmacol. (1998)* 124(4): 719-728.

FL Mackova, M. and Krchnak, C. 1978. optimum amounts of cobalt in feeds for broiler ducklings. *Sbornik Vedeckych Praci Vyzkumneho Ustavu Vyzivy Zvirat, Pohorelice.* 12: 103-109.

CP Maclachlan, G. K. and Johnston, W. S. 1980. copper poisoning in orkney sheep from north ronaldsay on a diet of terrestrial herbage. *Proc. of the Second International Suymposium of Veterinary Laboratory Diagnosticians, June 24-26, 1980, Volume III* : 463-466.

Mix MacLachlan, G. K. and Johnston, W. S. 1982. copper poisoning in sheep from north ronaldsay maintained on a diet ofterrestrial herbage. *Veterinary Record* 111(13): 299-301.

Surv MacNeil, J. D., Patterson, J. R., Salisbury, C. D. C., and Tessaro, S. V. 1990. an investigation of the trace element status of bison in wood buffalonational park and of ranch-raised bison in saskatchewan, canada. *International Journal of Environmental Analytical Chemistry.* 41(3 + 4): 99-104.

Drug MacPherson, A., N.F. Suttle, and others. 1983. oral treatment of trace element deficiencies in ruminant livestock.. (Occasional Pub. 7): 93-103.

No Control Macpherson, A. and Hemingway R. G. 1969. the relative merit of various blood analyses and liver function tests in giving an early diagnosis of chronic copper poisoning in sheep. *Br. Vet. J.* 125: 213-221.

FL Madej, J. A. and Radzanowska, G. 1988. the effect of copper and selenium administration on histopathological picture of organs and accumulation of metals in hens. *Pol Arch Weter.* 28(1-2): 45-62.

FL Madrid, C., Cseh, S., Odriozola, E., Calandra, W., and Lopez, T. 1987. primary chronic copper poisoning in sheep. *Revista De Medicina Veterinaria, Argentina.* 68(5): 246-248.

CP Magee, A. and D'souza, D. growth of and mineral deposition in young rats fed saturated and unsaturated fatty acids. *75th Annual Meeting of the Federation of American Societies for Experimental Biology, Atlanta, Georgia, USA, APRIL 21-25, 1991. FASEB (FED AM SOC EXP BIOL) J. 5 (5). 1991. A1311.*

No COC Magee, A. C. and Fu, S. C. 1979. effect of the total cationic environment on trace mineral availabilityin young rats. *Nutrition Reports International* 19(5): 649-659.

Unrel Magomedov, M. Sh. and Alikhanov, M. P. 1996. silage from grape residues in diets for sheep. *Zootekhniya.*(3): 12-13.

Rev Maines, M. D., Qato, M., and Carranza, C. 1984. alteration of heme and cytochrome metabolism in the brain by metal ions. *Cellular and Molecular Neurotoxicology.* 241-256.

Acu Maiorka, P. C., Massoco, C. O., de Almeida, S. D., Gorniak, S. L., and Dagli, M. L. 1998. copper toxicosis in sheep: a case report. *Vet Hum Toxicol.* 40(2): 99-100.

FL Majewski, T., Ruda, M., and Waligora, J. influence of mineral additives and vitamins on serum level of manganese in sows. *Medycyna Weterynaryjna. 45 (7). 1989. 431-433.*

Nutr Majewski, T., Ruda, M., and Waligora, M. 1991. effect of vitamins a + d3, e and microelements cu, mn, zn on selectedblood indices of young sows during spring-summer season. *Zeszyty Naukowe Akademii Rolniczej w Krakowie, Zootechnika* 27(242): 17-25.

FL Makarova, L. A. 1978. concentration of copper, zinc and iron in serum of hens duringdevelopment. *Sbornik Nauchnykh Trudov Moskovskoi Veterinarnoi Akademii* 102: 5-8.

FL Makarova, L. A. content of copper, zinc, and iron in the blood serum of hens during ontogenesis. *Sb. Nauch. Tr. Mosk. Vet. Akad. (1978)* (102): 5-8 From: Ref. Zh., Biol. Khim. 1979, Abstr. No. 14Ts64.

FL Makarova, L. A. 1979. metalloprotein complexes in the blood serum of growing pullets. *Sbornik Nauchnykh Trudov Moskovskaya Veterinarnaya Akademiya* 106: 30-35.

FL Makartsev, N. G. 1986. premixes for young pigs. *Zhivotnovodstvo* (7): 37-40.

FL Makartsev, N. G., Khadanovich, I., and Gavrilova, O. 1986. use of premixes during the rearing of young pigs. *Svinovodstvo, Moscow* (3): 34-35.

No COC Makled, M. N., El-Gammal, A. M., and Faltas, A. A. 1977. dietary oxytetracycline and its effect on mineral retention in chickenorganism. *Assiut Veterinary Medical Journal* 4(8): 193-201.

Not Avail Makled, M. N., El-Hammady, H. Y. Assiut Univ. Egypt Faculty of Agriculture, and Osman, A. M. Assiut Univ. Egypt Faculty of Veterinary Medicine. 1974. growth and mineral content of certain organs [liver, heart, spleen, proventiculus] of chicks [local dokki 4 breed] as influenced by supplemental mn, zn and cu [manganese, zinc, copper]. *Assiut Journal of Agricultural Science. V. 5(1) P. 99-107*

No Oral Malecki, E. A., Lo, H. C., Yang, H., Davis, C. D., Ney, D. M., and Greger, J. L. 1995. tissue manganese concentrations and antioxidant enzyme activities in rats given total parenteral nutrition with and without supplemental manganese [see comments]. *JPEN. Journal of Parenteral and Enteral Nutrition* 19(3): 222-6.

Nut def Malecki, Elise A. and Greger, J. L. manganese protects against heart mitochondrial lipid peroxidation in rats fed high levels of polyunsaturated fatty acids. *J. Nutr. (1996)* 126(1): 27-33

Fate Malecki, Elise A., Huttner, Donald L., and Greger, J. L. manganese status, gut endogenous losses of manganese, and antioxidant enzyme activity in rats fed varying levels of manganese and fat. *Biol. Trace Elem. Res. (1994)* 42(1): 17-29.

Plant Malhi, C. S. 1997. prevention of bird damage at the sowing and sprouting stages of a sunflower crop. *International Pest Control.* 39(4): 127-128.

Alt Malhi, H., Bhargava, K. K., Afriyie, M. O., Volenberg, I., Schilsky, M. L., Palestro, C. J., and Gupta, S. 2002. 99mtc-mebrofenin scintigraphy for evaluating liver disease in a rat model of wilson's disease. *Journal of Nuclear Medicine : Official Publication, Society of Nuclear Medicine, 2002 Feb, 43(2):246-52.*

CP Malinee Limpoka (Kasetsart Univ., Bangkok Thailand Faculty of Veterinary Medicine. Dept. of Pharmacology, Samutra Sirivejapandu, and Prapant Kessank. 1983. research on mineral element problems in dairy cattle. <original> kan suksa panha khong rae that thi kieo khong kap kan phasom

tit yak nai khonom. research report 1983. <original> rai ngan khon khwa wichai pracham pi 2526. *P. 139-140*

FL Malinowska, A. 1988. synergistic and antagonistic effect of some macroelements and trace elements on Pigs. *Med Weter.* 44(4): 242-245.

FL Malvisi, S. J., Stracciari, G. L., Rosmini, R., Spagnesi, M., Milillo, M. A., Trocchi, V., and Merlanti, M. 1985. clinical anatomic-histopathologic and chemical observations in hares lepus-europaeus fed with diets with a high copper Content. *Ric Biol Selvaggina.*(74): 3-27.

Effl Maly, M. S. 1984. survivorship of meadow voles, microtus pennsylvanicus, from sewage sludge-treated fields. *Bull Environ Contam Toxicol.* 32(6): 724-732.

FL Man, L. Kh. and Molchanov, I. A. 1980. effect of dietary protein quality and quantity on mineral metabolism inhens. *Sbornik Nauchnykh Trudov Moskovskoi Veterinarnoi Akademii* 110: 75-80.

FL Mandak, K. 1982. effect of adding copper sulphate to feeds on growth and carcass yields of ducks. *Sbornik Vysoke Skoly Zemedelske v Praze, Fakulta Agronomicka, B.*(37): 195-209.

Nutr Manickam, R., Gopalakrishnan, C. A. , Ramanathan, G., Mookkappan, M., and Nagarajan, R. 1977. studies on the relationships between trace elements and fertility incows. *Indian Journal of Animal Research* 11(1): 23-28.

Mix Manickam, R. a and Balagopal, R. 1993. influence of copper and vitamin-a in the reproductive performance of dairy cows. *Journal of Dairying Foods & Home Sciences.* 12(3-4): 153-155.

No Dose Mankes, R., Estel, G., Abraham, R., and Skalko, R. reproductive effects of intrauterine devices in the Rat. *Toxicol Appl Pharmacol 37:125-126,1976*

No Oral Mano, M., Kimoto, I., Sakurazawa, K., Satoh, K., Takamizawa, R., Nukaga, S., Tomioka, E., Takeuchi, S., Arakawa, Y., and et al. influences of low-manganese diet on rats with stz-induced diabetes mellitus. *Biomed. Res. Trace Elem. (1992)* 3(2): 269-70.

Alt Mano, T., Sinohara, R., Sawai, Y., Oda, N., Nishida, Y., Mokuno, T., Asano, K., Ito, Y., Kotake, M., Hamada, M., Nakai, A., and Nagasaka A(A). 1995. changes in lipid peroxidation and free radical scavengers in the brain of hyper- and hypothyroid aged rats. *Journal of Endocrinology* 147(2): 361-365.

HHE Manspeaker, J. E., Robl, M. G., and Edwards, G. H. prevention of early embryonic mortality in the bovine fed metalosates. *Congress of Future Aspects in Human in Vitro Fertilization, Vienna, Austria, Apr. 2-4, 1986. J in Vitro Fert Embryo Transfer. 3 (2). 1986. 75-76.*

FL Maracek, I., Lazar, L., Korenekova, B., Choma, J., and David, V. 1998. residues of heavy metals and the prevalence of diseases in the reproductive organs of cows near a metallurgical works. *Slovensky Veterinarsky Casopis.* 23(3): 159-163.

No COC Maritz, G. S. and Windvogel, S. 2003. is maternal copper supplementation during alveolarization protecting the developing rat lung against the adverse effects of maternal nicotine exposure? a morphometric study. *Experimental Lung Research, 2003 Jun, 29(4):243-60.*

FL Mariucci, G., Ambrosini, M. V., Colarieti, L., and Bruschelli, G. 1990. differential changes in cu, zn and mn superoxide dismutase activity in developing rat brain and liver. *Experientia* 46(7): 753-5.

Drug Mark-Savage, P., Keen, C. L., and Hurley, L. S. 1983. reduction by copper supplementation of theratogenic effects ofd-penicillamine. *Journal of Nutrition* 113(3): 501-510.

FL Markiewicz, K., Depta, A., Kurska, E., and Smigielska, J. 1975. the effect of mineral fertilization of pastures and meadows on thebehaviour of some electrolytes in bovine serum and erythrocytes. *Zeszyty Naukowe Akademii Rolniczo-Technicznej w Olsztynie, Weterynaria* (5): 3-12.

Surv Markiewicz, K. and Kurski, B. 1975. serum alkaline phosphatase activity and serum calcium, phosphorus andmagnesium levels in cows ingesting feed from intensely fertilized pastures and meadows. *Zeszyty Naukowe Akademii Rolniczo-Technicznej w Olsztynie, Weterynaria.*(5): 23-32.

FL Markiewicz, K., Markiewicz, Z., and Kuleta, Z. 1975. influence of mineral fertilization of pastures and meadows on thebehaviour of bovine serum enzymic activities. *Zeszyty Naukowe Akademii Rolniczo-Technicznej w Olsztynie, Weterynaria* (5): 13-21.

Aquatic Marking, L. L., Bills, T. D., and Crowther, J. R. effects of 5 diets on sensitivity of rainbow trout salmo-gairdneri to 11 chemicals. *Progressive Fish-Culturist. 46 (1). 1984. 1-5.*

Unrel Markovits, Andres, Conejeros, Raul, Lopez, Luis, and Lutz, Mariane. evaluation of marine microalga nannochloropsis sp. as a potential dietary supplement. chemical, nutritional and short term toxicological evaluation in rats. *Nutr. Res. (N. Y.) (1992)* 12(10): 1273-84.

Nutr Maro, J. K., Kategile, J. A., and Hvidsten, H. 1980. studies on copper and cobalt in dairy calves. *British Journal of Nutrition.* 44(1): 25-31. Ref ID: 171.

FL Marois, M. and Buvet, M. 1972. action d'une administration chronique d'acetate de cuivre et d'acetate de zinc sur la fonction ovarienne du rat. *C.R. Soc. Biol.* 166(6-7): 836-839.

FL Marois, M. and Buvet, M. 1972. effect of the copper ion on gestation in rats and rabbits. *C R SOC BIOL* . 166: 1237-1240.

Prim Marriott, Bernadette M., Smith, James Jr., Jacobs, Richard M., Jones, Ann O. Lee, and Altman, Joaane D. copper, iron, manganese, and zinc content of hair from two populations of rhesus monkeys. *Biol. Trace Elem. Res. (1996)* 53(1-3): 167-183.

FL Marschang, F., Timme, A., Morscher, H., and Gutekunst, H. P. 1979. copper poisoning in cattle - considerations on a case from general practice. *Veterinary Medical Review.*(2): 162-171.

No Dose Martin, B. J., Dysko, R. C., Chrisp, C. E., and Ringler, D. H. 1988. copper poisoning in sheep. *Lab Anim Sci.* 38(6): 734-736.

Unrel Martin John H, Fitzwater Steve E, Gordon, R. Michael, Hunter Craig N, and Tanner Sara J. 1993. iron, primary production and carbon-nitrogen flux studies during the jgofs north atlantic bloom experiment. *Deep-Sea Research Part II Topical Studies in Oceanography* 40(1-2): 115-134.

FL Maruyama, Y. 1983. the effect on mice of long-term oral administration of trivalent and hexavalent chromium. *Acta Scholae Medicinalis Universitatis in Gifu* . 31(1): 25-46.

No Oral Mas, A. and Arola, L. 1985. cadmium and lead toxicity effects on zinc copper nickel and iron distribution in the developing chick embryo. *Comp. Biochem. Physiol. C, Pharmacol. Toxicol.* 80(1): 185-188.

Not Avail Masaoka, T., Anke, M., Groppel, B., and Akahori, F. 1989. effects of sulphur, molybdenum and cadmium on the growth rate and traceelements status in the ruminants and pigs. 510-525.

Unrel Masco, D., Sahibzada, N., Switzer, R., and Gale, K. 1999. electroshock seizures protect against apoptotic hippocampal cell death induced by adrenalectomy. *Neuroscience.* 91(4): 1315-9.

HHE Mascolo, N., Summa, V., and Tateo, F. 1999. characterization of toxic elements in clays for human healing use. *Appl. Clay Sci.* 15(5-6): 491-500.

No COC Masek, J., Gilka, J., and Docekalova, H. 1985. a note on an effect of sodium monensinate supplements on the level ofsome chemical elements in the organs and muscle of feedlot steers. *Animal Production* 40(3): 511-513.

Plant Maskina, M. S. and Randhawa, N. S. effect of organic manures and zinc levels on the availability of zinc iron manganese and copper to wetland rice oryza-sativa. *Indian Journal of Agricultural Sciences. 53 (1). 1983. 48-52.*

Acu Mason, R. W. and Edwards, I. R. 1989. acute toxicity of combinations of sodium dichromate, sodium arsenate and copper sulfate in the rat. *Comp. Biochem. Physiol. C: Comp. Pharmacol. Toxicol.* 93C(1): 121-5 .

No Oral Mason, R. W., Edwards, I. R., and Fisher, L. C. 1987. fetotoxicity and teratogenicity of sodium dichromate sodium arsenate and copper sulfate in Rats. *Proc Univ Otago Med Sch.* 65(3): 59-60.

No Oral Mason, R. W., Edwards, I. R., and Fisher, L. C. 1989. teratogenicity of combinations of sodium dichromate sodium arsenate and copper sulfate in the rat. *Comp Biochem Physiol C Comp Pharmacol Toxicol.* 93(2): 407-412.

Org Met Massie, H. R. and Aiello, V. R. 1984. excessive intake of copper: influence on longevity and cadmium accumulation in mice. *Mech Ageing Dev.* 26(2-3): 195-203.

An Prod Masters, D. G. and Mata, G. 1997. depression of staple strength in weaner sheep supplemented with copper. *Australian Veterinary Journal.* 75(5): 359-360.

No Oral Masters, D. G. and Peter, D. W. 1990. marginal deficiencies of cobalt and selenium in weaner sheep response to Supplementation. *Aust J Exp Agric.* 30(3): 337-342.

Mix Masters, D. G., White, C. L., Peter, D. W., Purser, D. B., Roe, S. P., and Barnes, M. J. 1992. a multi-element supplement for grazing sheep:ii. accumulation of trace elements in sheep fed different levels of supplement. *Aust J Agric Res.* 43(4): 809-817.

Nutr Mateos, C. J., Meseguer, I., Laborda, J. M., Bernao, A., Gonzalez, M. J., Para, M. C. Marinez, and Aguilar, M. V. 1998. plasma iron, copper, manganese and zinc levels in wistar rats treated with chromium picolinate. *Met. Ions Biol. Med. Proc. Int. Symp., 5th* : 238-241. Editor(s): Collery, Phillipe. Publisher: Libbey Eurotext, Montrouge, Fr..

Surv Mathews, R. C Jr, Davis, M. W., Morgan, E. L., and Mathews, T. J. 1975. impact of anakeesta formation leachate mineralized components and ph on the shovel-nosed salamander leurognathus-marmoratus of the great smoky mountains national park. *Asb (Assoc Southeast Biol) Bull.* 22(2): 68.

FL Matsuda, A., Kimura, M., Yokoi, K., Kabata, H., Itokawa, Y., Kataoka, M., and Sato, M. 1989. [effects of total parenteral nutrition containing essential trace elements on their concentrations in rats]. *Nippon Eiseigaku Zasshi* 43(6): 1140-8.

Nut def Matsuda, Akihiko, Kataoka, Mikiko, Sato, Makoto, Kimura, Meiko, and Itokawa, Yoshinori. profile of manganese deficiency in rats. *Biomed. Res. Trace Elem. (1993)* 4(1): 7-15.

FL Matsuda, Akihiko, Kumadani, Sayo, Kataoka, Mikiko, Sato, Makoto, Kimura, Mieko, and Itokawa, Yoshinori. effects of an essential trace element agent (te-5) for total parenteral nutrition on the mineral nutrition in rats fed a trace element-deficient diet. *Nippon Eiseigaku Zasshi (1992)* 47(3): 695-703.

No COC Matsuda, Y., Yonezawa, M., and Nishiyama, F. pixe analysis of the serum of mice acquired radio-resistibility by low dose x-rays. *Int. J. PIXE (1997)* Volume Date 1996, 6(1 & 2): 291-298 .

In Vit Matsumoto, H., Silverton, S. F., Debolt, K., and Shapiro, I. M. 1991. superoxide dismutase and catalase activities in the growth cartilage: relationship between oxidoreductase activity and chondrocyte maturation. *Journal of Bone and Mineral Research* 6(6): 569-74.

Unrel Matsuyama, T., Ihaku, D., Tanimukai, T., Uyama, O., and Kitada, O. 1993. [superoxide dismutase suppressed asthmatic response with inhibition of manganese superoxide induction in rat lung]. *Nihon Kyobu Shikkan Gakkai Zasshi* 31 Suppl: 139-45.

Aquatic Mattingly, K. S., Beaty, B. J. *., Mackie, R. S., McGaw, M., Carlson, J. O., and Rayms-Keller, A. 2001. molecular cloning and characterization of a metal responsive chironomus tentans alpha-tubulin cdna. *Aquatic Toxicology [Aquat. Toxicol.]. Vol. 54, No. 3-4, Pp. 249-260. 1 Oct 2001.*

Prim Mattison, D. R., Kay, H. H., Miller, R. K., and Angtuaco, T. magnetic resonance imaging a noninvasive tool for fetal and placental Physiology. *Biol Reprod; 38 (1). 1988. 39-49.*

HHE Mattsson, P., Albanus, L., and Frank, A. 1981. cadmium and some other metals in liver and kidney from elk. basis fordietary recommendations. *Var Foda.* 33(8/9): 335-345.

Bio Acc Maturova, E. T. changes of copper, zinc, and manganese contents in chick embryos during growth. *Mikroelem. Sib. (1968)* : No. 6, 93-8..

CP Maturova, E. T. 1967. trace element levels in the blood and liver of chickens, and the effect of trace element feeding on their egg yield. *Mikroelem. Biosfere Ikh Primen. Sel. Khoz. Med. Sib. Dal'Nego Vostoka, Dokl. Sib. Konf., 2nd* : 501-2.

Alt Matzuk Martin M(A), Dionne Lianna, Guo Qiuxia, Kumar, T. Rajendra, and Lebovitz Russell M. 1998. ovarian function in superoxide dismutase 1 and 2 knockout mice. *Endocrinology* 139(9): 4008-4011.

Nutr Maurice, D. V., Jones, J. E., Dillon, C. R., and Weber, J. M. chemical composition and nutritional value of brazilian elodea (egeria densa) for the chick. *Poult. Sci. (1984)* 63(2): 317-23 .

Abstract Mayo, RJ, Hauge, SM, Parker, HE, Andrews, FN, and Carrick, CW. 1956. copper tolerance of young chickens. *Poult. Sci.* 35: 1156.

FL Mazurczak, J., Harenza, T., Piotrowska, J., and Wegorzewska, G. 1975. experimental evaluation in rats of copper sulphate as a growth promoter for swine. *Zeszyty Naukowe Szkoly Glownej Gospodarstwa Wiejskiego Akademii Rolniczej w Warszawie, Weterynaria.*(6): 23-34.

Drug Mazurkiewicz, M., Jopek, Z., Madej, J. A., Kucharczak, Ewa, and Gawel, A. studies on pathomechanism in the negative interaction between tiamulin and ionophoric anticoccidials in broilers. *Colloq. INRA (1989)* 49(Coccidia Intest. Coccidiomorphs): 273-8.

Unrel Mazurkiewicz, Michal, Grys, Stanislaw, Klimentowski, Stanislaw, and Gawel, Andrzej. the effect of carotenoids on some indices of cellular immunity in slaughter cocks receiving feed of high vitamin a content. *Pol. Arch. Weter. (1990)* 30(1-2): 117-26.

No Dose McCarren, M. and Eccles, C. U. 1983. neonatal lead exposure in rats: i. effects on activity and brain metals. *Neurobehav Toxicol Teratol* 5(5): 527-31.

Alt McCarren, M. and Eccles, C. U. 1983. neonatal lead exposure in rats: ii. effects on the hippocampal afterdischarge. *Neurobehav Toxicol Teratol.* 5(5): 533-40.

No Oral McCormick, C. C. and Fleet, J. C. 1988. the toxicity of parenteral copper in the chick dependence on route of administration. *J Nutr.* 118(11): 1398-1402.

Herp McDaniel, T. V., Harris, M. L., Bishop, C. A., and Struger, J. *. 2004. development and survivorship of northern leopard frogs (rana pipiens) and green frogs (rana clamitans) exposed to contaminants in the water and sediments of the st. lawrence river near cornwall, ontario. *Water Quality Research Journal of Canada [Water Qual. Res. J. Can.]. Vol. 39, No. 3, Pp. 160-174. 2004.*

FL McDermott, B. M., Flatt, P. R., and Strain, J. J. 1994. effects of copper deficiency and experimental diabetes on tissue antioxidant enzyme levels in rats. *Annals of Nutrition & Metabolism* 38(5): 263-9.

Nutr McDermott, B. M., Strain, J. J., and Flatt, P. R. 1995. effects of dietary carbohydrate intake on antioxidant enzyme activityand copper status in the copper-deficient streptozotocin (stz) diabeticrat. *Journal of Nutritional Biochemistry* 6(12): 638-643.

Abstract Mcdonough, F. E., Wells, P., Wong, N. P., Hitchins, A. D., and Bodwell, C. E. role of vitamins and minerals in growth stimulation of rats fed yoghurt. *67th Annual Meeting of the Federation of American Societies for Experimental Biology, Chicago, ILL., USA, APRIL 10-15, 1983. FED PROC. 42 (3). 1983. Abstract 1547.*

Rev McDowell, L. R. 1985. detection of mineral status of grazing ruminants. 339-358.

CP McDowell, L. R. 1996. feeding minerals to cattle on pasture. *15th Western Nutrition Conference and the Canola Pre-Conference Seminar 13-14 September 1994 Animal Feed Science and Technology.* 60(3/4): 247-271.

Unrel Mcdowell, L. R., Morillo, D., Chicco, C. F., Perdomo, J. T., Conrad, J. H., and Martin, F. G. nutritional status of beef cattle in specific regions of venezuela ii. microminerals. *Nutrition Reports International. 40 (1). 1989. 17-32.*

No Oral McGee, Beth L., Fisher, Daniel J., Yonkos, Lance T., Ziegler, Gregory P., and Turley, Steve. assessment of sediment contamination, acute toxicity, and population viability of the estuarine amphipod leptocheirus plumulosus in baltimore harbor, maryland, usa. *Environ. Toxicol. Chem. (1999)* 18(10): 2151-2160.

Plant Mcgraw, R. L., Russelle, M. P., and Grava, J. accumulation and distribution of dry mass and nutrients in birdsfoot trefoil lotus-corniculatus. *Agronomy Journal. 78 (1). 1986. 124-131.*

Drug Mclean, C. A., Williams, R., Aviv, A., and Bogden, J. D. effect of captopril on the metabolism of some trace elements in the rat. *Trace Elements in Medicine. 2 (4). 1985 (Recd. 1986). 175-178.*

Unrel Mcnamara, A. and Williams, D. F. enzyme histochemistry of the tissue response to pure metal implants. *Journal of Biomedical Materials Research. 18 (2). 1984. 185-206.*

No Oral McNamara, A. and Williams, D. F. 1981. the response to the intramuscular implantation of pure metals. *Biomaterials* 2(1): 33-40.

Mix McNaughton, J. L. and Day, E. J. effect of dietary fe (iron) to cu (copper) ratios on hematological and growth responses of broiler chickens. *Journal Of Nutrition* Apr 1979. v. 109 (4) p. 559-564. ill.

Nutr McNaughton, James L. and Day, Elbert J. effect of dietary iron to copper ratios on hematological and growth responses of broiler chickens. *J. Nutr. (1979)* 109(4): 559-64.

Nut def McNaughton, James L., Day, Elbert J., Dilworth, Ben C., and Lott, B. D. iron and copper availability from various sources. *Poult. Sci. (1974)* 53(4): 1325-30 .

Surv McOrist, S. and Thomas, K. W. 1984. levels of trace elements in the liver and diet of free-living koalas, phascolarctos cinereus (goldfuss). *Journal of Wildlife Diseases* 20(3): 220-5.

Rev Medeiros, D. M. 1985. the copper-zinc hypothesis and cardiovascular-disease. *Biochemical Archives* 1(2): 67-73.

FL Medellin, Maria Luisa Cardenas, Saldivar, Sergio O. Serna, and De La Garza, Jesus Velazco. effect of raw and cooked nopal (opuntia ficus indica) ingestion on growth and total cholesterol, lipoproteins, and blood glucose in rats. *Arch. Latinoam. Nutr. (1998)* 48(4): 316-323.

Species Medici, John C. and Taylor, Milton Wight. interrelations among copper, zinc, and cadmium in the diet of the confused flour beetle. *J. Nutr. (1967)* 93(3): 307-9 .

Mix Medvetskii, N. S. 1985. some morphological and biochemical indicators in blood of young cattlegiven trace elements, vitamin a and ergocalciferol.: biologicheskie aktivnye veshchestva v ratsionakhsel'skokhozyaistvennykh zhivotnykh. 26-29.

Mix Medvetskii, N. S. and Koval', M. P. 1987. natural immunity in young cattle in relation to the availability of trace elements and vitamins to their mothers.: biologicheski aktivnye veshchestva v kombikormakh ibelkovo-vitaminnye podkormki v ratsionakh sel'skokhozyaistvennykhzhivotnykh. 37-40.

Surv Mee, J. F. 1994. trace elements of twin perinates: calves; correspondence. *Veterinary Record.* 134(13): 336.

Mix Mee, J. F., Rogers, P. A. M., and O'Farrell, K. J. a. 1995. effect of feeding a mineral-vitamin supplement before calving on the calving performance of a trace element deficient dairy herd. *Veterinary Record.* 137(20): 508-512.

Mix Meged', S. S. 1985. feed mixtures and concentrates for breeding ewes. *Zhivotnovodstvo.*(8): 39-41.

No Oral Mehrotra, R., Nath, P., Wahal, V., Tandon, P., and Pandey, R. K. 1985. copper induced mallory body formation in albino mice. *Indian J Pathol Microbiol.* 28(4): 341-348.

Mix Mehta, U., Mehta, S. N., Georgie, G. C., Mehta, S., Dixit, V. P., and Verma, P. C. 1989. effect of dietary zinc and copper on peripheral blood plasma cholesterol, testosterone and histomorphology of testes in rats. *Indian J Exp Biol.* 27(5): 469-71.

FL Meissner, D. 1986. manganese and arteriosclerosis. *Zeitschrift Fur Die Gesamte Innere Medizin Und Ihre Grenzgebiete* 41(4): 114-115.

CP Meissner, D. 1983. relations between zinc, copper, magnesium, manganese and arteriosclerosis. *Spurenelem.-Symp. 4th.* 205-11. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ.,

Jena, Ger. Dem. Rep.

FL Mejborn H. 1989. effect of copper addition to mink feed during the growth and moulting period on growth, skin production, and copper Retention. *Scientifur.* 13(3): 229-234.

Bio Acc Mel'chenko, A. I. 1972. concentration of some trace nutrients (copper, manganese, cobalt) in the liver of broiler chicks during the incorporation of different phosphorus additives into the ration. *Timiryazev. Sel'Skokhoz. Akad* : No. 185, 143-6 .

Minseral Mel'chenko, A. I. concentration of trace nutrients in the liver of broilers fed rations containing calcium from different sources. *Dokl. TSKHA (Timiryazev. Sel'Skokhoz. Akad) (1971)* : No. 167, 167-70.

No Dose Mel'chenko, A. I. content and distribution of trace elements (copper, zinc, manganese, and cobalt) in carcasses and soft tissues of broiler chicks. *Dokl. TSKhA (1975)* : 205, 225-9 .

FL Mel'nychuk, D. O., Lyubets'ka, T. V., and Honcharuk, V. A. 1997. [method of growing calves and the reabilit preparation for implementing it]. <original> sposib vyroshchuvannya telyat ta preparat dlya yoho zdiysnennya "reabilit". *4 P.*

No Dose Mellanby, K. 1971. sea pollution. *Chem. and Ind. (London) ; 40): 1120-1122*

CP Menino, A. R., Damron, W. S., Henry, T. E., and O'Claray, J. L. 1984. the effects of dietary copper on growth, the cardiovascular system and reproduction in swiss-webster female mice. *Proceedings of the Annual Meeting - American Society of Animal Science. Western Section.* 35: 296-299.

Nut def Menino, A. R. Jr., Damron, W. S., Henry, T. E., and O'Claray, J. L. 1986. the influence of dietary copper on reproduction, growth and the cardiovascular system in swiss-webster female mice. *Lab Anim Sci.* 36(2): 164-7 .

Unrel Menon, G. K. and Sanders, W. J. 1984. feed compositions containing copper salts of 2-hydroxypyridine-n-oxides.

Phys Mercer, J. F. and Grimes, A. 1986. variation in the amounts of hepatic copper, zinc and metallothionein mrna during development in the rat. *Biochem J* . 238(1): 23-7.

FL Merenyuk, G. V. and Burdenko, T. A. toxicology of copper-containing pesticides. *Zdravookhranenie (1969)* 12(5): 23-6.

Unrel Merry, R. H. and Tiller, K. G. 1986. the effects of contamination of soil with copper, lead and arsenic on the growth and composition of plants. i. effects of season, genotype, soil temperature, and fertilizers. *Plant and Soil* . 91: 115-128.

FL Mertin, D., Hanusova, E., Suvegova, K., and Stepanok, V. 1995. concentrations of some trace elements in the fur of greenland coypuduring ontogeny. *Zivocisna Vyroba* 40(3): 115-118.

Surv Mertin, D., Stepanok, V. V., and Georgievskij, V. I. 1992. concentrations of some mineral elements in the fur of silver fox in the period of fur maturity after addition of zinc, silicon and selenium to the diet. *Zivocisna Vyroba.* 37(9): 793-799.

FL Mertin, D., Suevegova, K., Oravcova, E., Nitra, and Sviatko, P. 1994. concentrations of some mineral elements in the mink body in the period of fur maturity: <original> koncentracia niektorych mineranlych prvkov v tele noriek v obdobi kozusinovej zrelosti. *Zivocisna Vyroba - UZPI.* 39(2): 121-`27.

Nut def Mertz, W. 1970. some aspects of nutritional trace element research. *Fed. Proc.* 29(4): 1482-1488.

Ecol Merwin, I. A. and Stiles, W. C. 1994. orchard groundcover management impacts on apple tree growth and yield,and nutrient availability and uptake. *Journal of the American Society for Horticultural Science* 119(2): 209-215.

Unrel Meyer, H. 1996. the newborn foal - everything clear? *Pferdeheilkunde* 12(3): 171-178.

FL Meyer, H., Kienzle, E., and Dammers, C. 1985. yield and composition of milk from bitches, and feed intake and weightchange pre- and post-partum. *Fortschritte in Der Tierphysiologie Und Tierernahrung* (16): 51-72.

FL Meyer, H. and Kroger, H. 1973. feeding of copper to pigs. *Ubersichten Zur Tierernahrung.* 1(1): 9-44.

FL Meyer, H., Kroger, H., and Benten, K. von. 1976. tolerance and residue formation of different cu compounds. *DTW (Dtsch Tieraerztl Wochenschr).* 83(9): 401-403.

HHE Meyer, I., Heinrich, J. *., Trepka M.J., Krause, C., Schulz, C., Meyer, E., and Lippold, U. 19980100. the effect of lead in tap water on blood lead in children in a smelter town. *Sci. Total Environ* Vol. 209, NO. 2-3: pp. 255-271.

FL Migdal, W., Koczanowski, J., Kaczmarczyk, J., Tuz, R., Klocek, C., Radecka, B., and Gaweda, A. 1993. effect of a mineral supplement, wisol t-87, on the content of zn, cu,fe, mn and mg in the liver and muscle of fatteners. *Medycyna Weterynaryjna* 49(8): 364-365.

FL Mikhailov, N. G. 1973. feeding trace element salts to young mink in the magadan region. *Tr. Dal'Nevost. Nauchno-Issled. Inst. Sel'Sk. Khoz.* 13(2): 412-14.

Surv Mikkelsen, R. L., Page, A. L., and Bingham, F. T. geochemistry and health in california: recent experiences with selenium. *Trace Subst. Environ. Health (1986)* : 20, 413-23 .

In Vit Milachowski, K. A. and Keyl, W. 1984. magnesium and trace-elements copper, manganese and zinc in normal and degenerated intervertebral tissues. *Magnesium-Bulletin* 6(3): 112-114.

Aquatic Milani, D., Reynoldson, T. B., Borgmann, U., and Kolasa, J. 2003. the relative sensitivity of four benthic invertebrates to metals in spiked-sediment exposures and application to contaminated field sediment. *Environmental Toxicology and Chemistry / Setac, 2003 Apr, 22(4):845-54.*

FL Milanov, Z. 1995. biological indication of the heavy metal pollution with the help of the hare (lepus europaeus Pall.). *Nauka Za Gorata.* 32(2): 59-65.

Unrel Millar, K. R., Meads, W. J., Albyt, A. T., Scahill, B. G., and Sheppard, A. D. 1988. the retention and efficacy of soluble-glass boluses for providing selenium, cobalt and copper to sheep. *New Zealand Veterinary Journal.* 36(1): 11-14.

Rev Miller, E. R. 1991. iron, copper, zinc, manganese, and iodine in swine nutrition. *Swine Nutrition* : 267-284.

Rev Miller, E. R., Lei, X., and Ullrey, D. E. 1991. chapter 16: trace elements in animal nutrition. 593-662.

Rev Miller, E. R., Lei, X., and Ullrey, D. E. 1991. trace elements in animal nutrition. 593-662.

Unrel Miller, J. J. a, Read, B. J., Wentz, D. J., and Heaney, D. J. 1996. major and trace element content of shallow groundwater associated with dryland saline soils in southern alberta. *Water Quality Research Journal of Canada.* 31(1): 101-117.

CP Miller, J. K. and Madsen, F. C. 1994. transition metals, oxidative status, and animal health: do alterationsin plasma fast-acting antioxidants lead to disease in livestock? *Biotechnology in the Feed Industry: Proceedings of Alltech's Tenth Annual Sumposium* : 283-301.

Abstract Miller, W. J., O Dell G D, Jones, J. B. Jr, Gentry, R. P., and Roberts, K. R. effect of high dietary nickel on trace element content of various tissues in holstein calves. *Federation Proceedings. 33 (3 Part 1). 1974 703*

Nut def Mills, C. F. 1987. biochemical and physiological indicators of mineral status in animals copper cobalt and zinc. *J Anim Sci.* 65(6): 1702-1711.

Fate Mills, C. F. 1974. trace element interactions effects of dietary composition on the development of imbalance and toxicity. *Trace Element Metabolish in Animals, No. 2 Proceedings of the Second International Symposium. Madison, WI, USA, June 18-22, 1973.*: 79-90.

Bio Acc Mills, C. F. and Dalgarno, A. C. 1972. copper and zinc status of ewes and lambs receiving increased dietary concentrations of cadmium. *Nature.* 239(5368): 171-173.

Aquatic Mills Edward L, Roseman Edward F, Rutzke Michael, Gutenmann Walter H, and Lisk Donald J(A). 1993 . contaminant and nutrient element levels in soft tissues of zebra and quagga mussels from waters of southern lake ontario. *Chemosphere* 27(8): 1465-1473.

Aquatic Millward, R. N., Carman, K. R., Fleeger, J. W., Gambrell, R. P., and Portier, R. 2004. mixtures of metals and hydrocarbons elicit complex responses by a benthic invertebrate community. *Journal of Experimental Marine Biology and Ecology [j. Exp. Mar. Biol. Ecol.]. Vol. 310, No. 1, Pp. 115-130. Oct 2004.*

Mix Milos, M., Contrea, A., and Chisu, I. 1978. changes in blood protein of chickens after use of trace elements in feed. *Lucrari Stiintifice, Institutul Agronomic Timisoara, Zootehnie.* 15: 37-39.

An Prod Milos, M., Contrea, A., Crista, N., and Rosu, Maria. 1970. effect of chelation of trace minerals (manganese, copper, and cobalt) with edta on oxygen consumption in liver tissue and the activity of some enzymes of chicken serum. *Lucr. Stiint. Inst. Agron. Timisoara, Ser. Zooteh.* 13: 59-66 .

FL Min, S. K., Namkung, H., and Paik, I. K. 1993. effects of supplementary copper complexes on the performance of broiler chickens. *Korean Journal of Animal Nutrition & Feedstuffs.* 17(5): 247-257.

FL Min, S. K., Um, J. S., and Paik, I. K. 1994. effects of supplementary methionine-copper and protein-copper complexes on the growth, mineral metabolism and intestinal microflora of broiler chickens and rats. *Korean Journal of Animal Nutrition & Feedstuffs.* 18(2): 103-113.

CP Minear, L. R. influence of copper sulfate and mold inhibitors on broiler performance. *Proc. Annu. Tex. Nutr. Conf. (1977)* : 32, 56-73.

Mix Minina, L. A. 1983. toxicological evaluation of multiple mineral premixes used for preventing the endemic diseases of sheep. *Trudy Vsesoyuznogo Instituta Eksperimental'Noi Veterinarii.* 58: 91-99.

Nutr Minson, D. J. 1984. digestibility and voluntary intake by sheep of five digitaria species.

Australian Journal of Experimental Agriculture and Animal Husbandry 24(127): 494-500.

Nutr Mirando, M. A(A), Peters, D. N., Hostetler, C. E., Becker, W. C., Whiteaker, S. S., and Rompala, R. E. 1993. dietary supplementation of proteinated trace minerals influences reproductive performance of sows. *Journal of Animal Science* 71(SUPPL. 1): 180.

No COC Mishra, U. K., Dwarkanath, P. K., and Hossain, M. I. clinical manifestation and hepatic trace minerals in growing chickens as influenced by t-2 toxin. *Indian J. Anim. Sci. (1987)* 57(10): 1069-74.

Unrel Mitchell, G. E. Jr, Little, C. O., and Skerski, G. 1968. influence of subacute levels of dietary toxins on carotene disappearance from the rat intestine. *Internationale Zeitschrift Fur Vitaminforschung. International Journal*

CP Miura, K., Nimura, E., and Imura, N. 1986. effects of methylmercury on nerve fiber outgrowth of cultured chick dorsal root ganglia. *Fourth International Congress of Toxicology*

No COC Miura, Tsutomu, Uehara, Mariko, Suzuki, Kazuharu, Kanke, Yusuke, and Goto, Shiro. 1998. long-term effect of high dietary calcium level on fecal mineral excretion in rats. *Nippon Eiyo Shokuryo Gakkaishi* 51(2): 81-86.

In Vit Miyazaki, Masahiro, Suzuki, Yasunori, Oda, Munehiro, Kawai, Akira, Bai, Liyan, and Sato, Jiro. improved maintenance of adult rat hepatocytes in a new serum-free medium in the presence or absence of barbiturates.*In Vitro Cell. Dev. Biol. (1989)* 25(9): 839-48.

Plant Miyazawa, M., Giminez, S. M. N., Yabe, M. J. S., Oliveira, E. L., and Kamogawa, M. Y. 2002. absorption and toxicity of copper and zinc in bean plants cultivated in soil treated with chicken manure. *Water, Air, and Soil Pollution, 138 (1-4) Pp. 211-222, 2002.*

No Oral Mizejewski, G. J., Antelman, D. E., Keenan, J. F., and Preiss, I. L. effects of heavy metals on alpha-fetoprotein in maternal sera and amniotic fluid of pregnant mice. *Toxicology; 64 (1). 1990. 19-32.*

Alt Mizuno, Y. changes in super oxide dis mutase catalase glutathione peroxidase and glutathione reductase activities and thio barbituric-acid reactive product levels in early stages of development in dystrophic chickens. *Experimental Neurology. 84 (1). 1984. 58-73.*

No Dose Mizuno, Y. 1984. superoxide dismutase activity in early stages of development in normal and dystrophic chickens. *Life Sciences* 34(10): 909-14.

No Control Mjor-Grimsrud, M. Soli N. E. and Norheim G. 1980. 1980. the distribution of soluble copper- and zinc-binding proteins in liver and kidney of chronic copper-poisoned goats. *Acta Vet. Scand.* 21: 578-586.

Phys Mohamed, Moustafa Moustafa. direct introduction of microvolume samples into a rotating arc plasma jet. *Indian J. Pure Appl. Phys. (1997)* 35(10): 624-635.

Mineral Mohammed R(A), Youssef, F. G(A), and Chang-Yen, I. 1994. trace mineral concentrations in cattle tissues in trinidad. *Tropical Agriculture* 71(4): 309-312.

BioAcc Mohanna, C. and Nys, Y. 1998. influence of age, sex and cross on body concentrations of trace elements (zinc, iron, copper and manganese) in chickens. *British Poultry Science* 39(4): 536-43.

Plant Mohapatra, Harapriya and Gupta, Rani. concurrent sorption of zn(ii), cu(ii) and co(ii) by oscillatoria angustissima as a function of ph in binary and ternary metal solutions. *Bioresource*

Technology. In Press, Corrected Proof

CP Mohd Hair Bejo . 1995. copper tolerance in buffalo: the potential toxic effect of copper in buffalo fed palm kernel cake [malaysia]. *Towards Corporatising the Animal and Feed Industries: Proceedings of the 17th Malaysian Society of Animal Production (MSAP) Annual Conference*

CP Mohd Hair Bejo, Davis, M. P., Fatimah, C. T. N. I., Abdul Razak Alimon, and Moonafizad, M. 1995. chronic copper toxicosis: deaths in growing sheep following dietary mineral salts supplementations [malaysia]. *Towards Corporatising the Animal and Feed Industries: Proceedings of the 17th Malaysian Society of Animal Production (MSAP) Annual Conference* : 243-245.

Plant Moilanen Mikko(A), Penttila Timo, and Issakainen Jorma. 1996. effects of fertilization on tree growth and nutrient status of norway spruce stands on drained peatlands in northern finland. *Suo (Helsinki)* 47(3): 85-94.

In Vit Mok Josephine S L, Paisley Karen, and Martin William(A). 1998. inhibition of nitrergic neurotransmission in the bovine retractor penis muscle by an oxidant stress: effects of superoxide dismutase mimetics. *British Journal of Pharmacology* 124(1): 111-118.

FL Molodtsov, G. 1985. green soya meal. *Svinovodstvo, Moscow* (3): 29-30.

FL Molodtsov, G. P. 1986. improving the system of feeding pigs on farms in far eastern regions ofthe ussr. <document title>sovershenstvovanie tekhnologii kormleniyasel'skokhozyaistvennykh zhivotnykh. 52-58.

No Dose Monies, R. J. 1997. arsenic poisoning in a dairy heifer following contamination of aredundant industrial site with a wood tanalising (preserving) compound(copper sulfate, potassium dichromate, and arsenic pentoxide). *Cattle Practice* 5(4): 307-312.

FL Monkiewicz, J. 1988.*Analysis of the Influence of the Legnica-Glogow Copper District on the Organism and Production of Cows* : 74p.

FL Monkiewicz, J., Dynarowicz, I., Jaczewski, S., and Madej, J. A. 1977. effects on rabbits of the prolonged administration of heavy metals. *Medycyna Weterynaryjna.* 33(8): 471-475.

Surv Monkiewicz, J., Jaczewski, S., and Dynarowicz, I. 1975. heavy metal content of the semen of bulls from various environments. *Medycyna Weterynaryjna.* 31(11): 684-686.

FL Monkiewicz, J., Jaczewski, S., Pawlina, E. , and Andrzejak, R. 1984. the influence of intoxication of female rabbits with pb and cu ions on their reproduction.: <original title> wplyw zatruwania krolic jonami pb i cu na ich rozrodczosc. *Med. Weter.* 40(5): 292-295.

FL Monkiewicz, J., Jaczewski, S., Pawlina, E. , and Andrzejak, R. Akademia Rolnicza wroclaw Poland Katedra Genetyki i Hodowli Ogolnej Zwierzat. 1984. effect of intoxication with pb and cu ions on the reproduction of rabbits disorders; pollutants: <original> wplyw zatruwania krolic jonami pb i cu na ich rozrodczosc. *Medycyna Weterynaryjna.* 40(5): 292-295.

FL Monkiewicz, J. Jaczewski S. Pawlina E. and Andrzejak R. 1984. 1984. effect of lead and copper intoxication on reproduction in the female rabbit (wplyw zatruwania krolic jonami pb i cu na ich rozrodczosc). *Med. Weter.* 40(5): 292-295.

No Oral Moo-Young, A. J. and Tatum H. J. 1974. copper levels in maternal and fetal tissues of rabbits bearing intrauterine copper wires. *Contraception* . 9(5): 487-496.

Nutr Moore, R. J. and Kornegay, E. T. fiber digestibility and mineral utilization in growing pigs as influenced by fiber source mineral level and duration of feeding. *Nutrition Reports International. 36 (6). 1987. 1237-1250.*

Nutr Moore, R. J., Kornegay, E. T., Grayson, R. L., and Lindemann, M. D. 1988. growth, nutrient utilization and intestinal morphology of pigs fedhigh-fiber diets. *Journal of Animal Science* 66(6): 1570-1579.

No COC Moore, R. J., Kornegay, E. T., and Lindemann, M. D. effect of dietary oat hulls or wheat bran on mineral utilization in growing pigs fed diets with or without salinomycin. *Canadian Journal of Animal Science. 66 (1). 1986. 267-276.*

BioAcc Moore, T., Sharman, I. M., Todd, J. R., and Thompson, R. H. 1972. copper and vitamin a concentrations in the blood of normal and cu- poisoned sheep. *Br. J. Nutr.* 28(1): 23-30.

Alt Moorhead, P. D. and Cross, R. F. 1970. whole blood ascorbic acid levels in chickens with experimental aplastic anemia and the effect of supplemental ascorbic acid, b 12, and minerals on mortality and pathologic manifestations. *Poultry Science* 49(4): 1065-9.

Method Moos, T. 1993. simultaneous application of timm's sulphide silver method and immunofluorescence histochemistry. *Journal of Neuroscience Methods* 48(1-2): 149-56.

BioAcc Mora, M. A. 1996. organochlorines and trace elements in four colonial waterbird species nesting in the lower laguna madre, texas. *Arch.Environ Contam Toxicol.* 31(4): 533-537.

Surv Mora, M. A., Lee, M. C., Jenny, J. P., Schultz, T. W., Sericano, J. L., and Clum, N. J. 1997. potential effects of environmental contaminants on recovery of the aplomado falcon in south texas. *J Wildl Manag.* 61(4): 1288-1296.

FL Morawiec, M., Kryska, M., and Brzozowska, A. 1991. effect of copper on protein metabolism in rats intoxicated with lead.: <original title> wplyw miedzi na metabolism bialka u szczurow zatruwanych olowiem. *Bromatol. Chem. Toksykol.* 24(3-4): 305-308.

Bio Acc Morera, M. Universitat Automona de Barcelona Bellaterra Spain, Sanpera, C., Crespo, S., Jover, L., and Ruiz, X. inter- and intraclutch variability in heavy metals and selenium levels. *Arch Environ Contam Toxicol. V33, N1, P71(5)*

Nut def Morgan, Paula N., Keen, Carl L., and Lonnerdal, Bo. effect of varying dietary zinc intake of weanling mouse pups during recovery from early undernutrition on tissue mineral concentrations, relative organ weights, hematological variables and muscle composition. *J. Nutr. (1988)* 118(6): 699-711 .

Abstract Morimoto, Hiroshi, Noro, Harunobu, Otaki, Hiroyasu, and Takagi, Hisao. influence of dietary minerals on their distribution in broilers. *Nippon Kakin Gakkaishi (1978)* 15(6): 296-301.

FL Moroz, I. G. and Leskov, A. A. 1995. effect of micronutrients on number of fetuses and milk performance in sows. <original> vliyanie mikroehlementov na mnogoplodie i molochnost' svinomatok. *Veterinariya. (No.7) P. 17-18*

Unrel Morozov, Victor N., Seeman, Nadrian C., and Kallenbach, Neville R. new methods for depositing and imaging molecules in scanning tunneling microscopy. *Scanning Microsc. (1993)* 7(3): 757-79.

FL Morozova, K. N. and Kulikov, N. E. 1985. efficiency of utilization of trace elements in pregnant

rabbits. *Sbornik Nauchnykh Trudov Nauchno-Issledovatel'Skogo Instituta Pushnogo Zverovodstva i Krolikovodstva* 32: 137-141.

FL Morozova, K. N. and Kulikov, N. E. 1980. maintenance and growth of rabbits fed mixed feed containing different amounts of iron and copper. *Nauch. Tr. NII Pushn. Zverovod. i Krolikovod.* 23: 73-80.

FL Moskalik, R. S., Bobrinskii, V. M., and Onofrash, N. I. 1985. relationship between the occurrence of bovine leukosis and the chemical composition of drinking water. *Doklady Vsesoyuznoi Akademii Sel'Skokhozyaistvennykh Nauk.*(1): 37-38.

FL Moster, M. F., Synek, S., and Pac, L. 1990. [pathogenesis of disorders of transparency of the optic Media of the eye. vi. transmission electron microscopy in chalcosis of the lens]. *Cesk Oftalmol.* 46(4): 276-84.

FL Muecke, T. sedimentpetrographische und organo-geochemische untersuchungen an ausgewaehlten oberflaechensedimenten niedersaechsischer gewaesser. (sediment-petrographic and organochemical studies on selected surface sediments of lower-saxonian water). *Govt-Reports-Announcements-&-Index-(GRA&I),-Issue-13,-1995.*

Nutr Muehlenbein, E. L. D. R. Brink G. H. Deutscher M. P. Carlson and A. B. Johnson. 2001. effects of inorganic and organic copper supplemented to first-calf cows on cow reproduction and calf health and performance. *Journal of Animal Science.* 79: 1650-1659.

Fate Mueller, L., Abel, J., and Ohnesorge, F. K. 1986. absorption and distribution of cadmium copper and zinc following oral subchronic low level administration to rats of different binding forms of cadmium cadmium acetate cadmium metallothionein cadmium glutathione. *Toxicology.* 39(2): 187-196.

FL Mukhamedyanov, M. M. and Zhukov, N. A. 1983. hydrolysed wood in diets for cattle. *Zhivotnovodstvo* (8): 39-40.

Surv Mukherjee, Suman, Mukherjee, Swati, Bhattacharyya, P., and Duttagupta, A. K. 2004. heavy metal levels and esterase variations between metal-exposed and unexposed duckweed lemna minor: field and laboratory studies. *Environment International.* 30(6): 811-814.

Herp Muller, Jean Pierre, Wouters-Tyrou, Daniele, Erraiss, Nour Eddine, Vedel, Michele, Touzet, Nicole, Mesnard, Jacqueline, Sautiere, Pierre, and Wegnez, Maurice. molecular cloning and expression of a metallothionein mrna in xenopus laevis. *DNA Cell Biol. (1993)* 12(4): 341-9 .

Mix Mullins, G. L., Martens, D. C., Miller, W. P., Kornegay, E. T., and Hallock, D. L. copper availability form and mobility in soils from 3 annual copper enriched hog manure applications. *Journal of Environmental Quality. 11 (2). 1982. 316-320.*

Mix Mullis, L. A. J. W. Speers and R. L. McCraw. 2003. effects of breed (angus vs simmental) and copper and zinc source on mineral status of steers fed high dietary iron. *Journal of Animal Science.* 81: 318-322.

CP Mundy, G. D. 1993. nutrient requirements for the growing horse. <document title>proceedings of the thirty-ninth annual convention ofthe american association of equine practitioners, san antonio, texas,usa, december 5-8, 1993. 49-55.

Unrel Munim, A., Asayama, K., Dobashi, K., Suzuki, K., Kawaoi, A., and Kato, K. 1992. immunohistochemical localization of superoxide dismutases in fetal and neonatal rat tissues.

Journal of Histochemistry and Cytochemistry 40(11): 1705-13.

CP Munim A(A), Asayama K(A), Dobashi K(A), Hayashibe H(A), Uchida N(A), Kawaoi, A., Nakazawa S(A), <Book> Asada K, and Yoshikawa T: Eds. 1994. prenatal development of glutathione peroxide (gpx) in rat tissues: comparison with those with superoxide dismutases. <book> international congress series; frontiers of reactive oxygen species in biology and medicine. *International Congress Series* (1058): 307-310.

CP Munim A(A), Asayama K(A), Dobashi K(A), Suzuki, K., Kawaoi, A., Kato K(A), <Book> Yagi K, Kondo, M., Niki, E., and Yoshikawa T: Eds. 1992. prenatal development of copper-zinc superoxide dismutase and manganese superoxide dismutase in rat. <book> international congress series; oxygen radicals. *International Congress Series* (998): 683-686.

CP Munoz, C., Chahoud, I., Elkasaby, A., Krause, C., Schwabe, R., and Dieter, H. H. 1989. uptake and distribution of different forms of copper (ii) by neonatalrats. *6th International Trace Element Symposium. Vol.2* : 541-548.

CP Munshower, Frank F. and Neuman, Dennis R. 1979. pathways and distribution of some heavy metals in a grassland ecosystem. *Manage. Control Heavy Met. Environ. Int. Conf.* 206-9 Publisher: CEP Consultants Ltd., Edinburgh, Scot..

Unrel Murillo, J. M., Cabrera, F., and Lopez, R. 1997. response of clover trifolium fragiferum l. cv. 'salina' to a heavy urban compost application. *Compost Science & Utilization* 5(4): 15-25.

Nut def Murthy, L., Highhouse, S., Levin, L., Menden, E. E., and Petering, H. G. 1975. a study of the combined toxic effects of oral cadmium and lead in rats. *Trace Subst. Environ. Health* : 9, 395-401.

Mix Murthy, L. and Petering, H. G. 1976. effect of dietary zinc and copper interrelationships on blood parameters of the rat. *J Agric Food Chem.* 24(4): 808-11.

Not Avail Murthy, L. and Petering, H. G. 1971.*Studies in Zinc Metabolism IV. Interactions of Zn and Cd. <NOTE> Annual Rept*

Mix Murthy, R. C., Lal, Shyam, Saxena, D. K., Shukla, G. S., Ali, M. Mohd, and Chandra, S. V. effect of manganese and copper interaction on behavior and biogenic amines in rats fed a 10% casein diet. *Chem.-Biol. Interact. (1981)* 37(3): 299-308 .

No Oral Murthy, R. C., Migally, N., Doye, A., and Zambernard, J. 1982. ultrastructural changes in rat alveolar macrophages exposed to oxides of copper and cadmium. *J. Submicrosc. Cytol.* 14(2): 347-353.

FL Musbah, M., Harris, G. C. Jr., and Waldroup, P. W. 1978. the effects of supplementation of drinking water with zinc, molybdenum,and copper on skin fatty acids and dermatitis in broilers. *Poultry Science* 57(4): 1174.

Mix Muscalu, G., Grumberg, R., Ganea, M., Litinski, C., and Poleac, G. 1986. improved performance of broiler chickens given chelated trace elementsin a mixed feed. *Revista De Cresterea Animalelor* 36(6): 14-20.

Unrel Musci, G., Bellenchi, G. C., and Calabrese, L. 1999. the multifunctional oxidase activity of ceruloplasmin as revealed by anion binding studies. *European Journal of Biochemistry* 265(2): 589-97.

Fate Mussa, P. P. and Ladetto, G. 1990. diet and liver disease in dogs. *Animalis Familiaris.* 5(1): 14-18.

No COC Muto, Hajime, Shinada, Masayuki, Tokuta, Kazuko, and Takizawa, Yukio. rapid changes in concentrations of essential elements in organs of rats exposed to methylmercury chloride and mercuric chloride as shown by simultaneous multielemental analysis. *Br. J. Ind. Med. (1991)* 48(6): 382-8 .

CP Mylroie, A. A. effect of ingested lead on tissue levels of copper, iron, zinc and manganese in rats. *Trace Substances In Environmental Health; ; Proceedings Of University Of Missouri's ... Annual Conference.* 1980. 1980. (14th) p. 195-202.

Rev Mylroie, A. A., Boseman, A., and Kyle, J. 1986. metabolic interactions between lead and copper in rats ingesting lead acetate. *Biol. Trace Elem. Res.* 9(4): 221-232.

Nut def Mylroie, A. A., Boseman, A., Kyle, J., and <Editors> Hemphill, D. D. 1988. further studies on the effects of dietary copper deficiency on ratpancreas. 419-428.

Fate Mylroie, A. A., Collins, H., Umbles, C., and Kyle, J. 1986. erythrocyte superoxide dismutase activity and other parameters of copper status in rats ingesting lead acetate. *Toxicol Appl Pharmacol.* 82(3): 512-20.

Nut def Mylroie, A. A., Tucker, C., Umbles, C., and Kyle, J. effects of dietary copper deficiency on rat pancreas. *Trace Substances In Environmental Health : Proceedings Of The University Of Missouri's Annual Conference On Trace Substances In Environmental Health.* 1987. (21st) p. 44-53.

Abstract Mylroie, A. A., Umbles, C., Ariyo, F., Boseman, A., and Kyle, J. 1985. induction of manganese superoxide dismutase activity in heart tissue of rats. *190th American Chemical Society National Meeting*

Phys Mylroie, A. A., Umbles, C., and Kyle, J. 1984. effects of dietary copper supplementation on erythrocyte superoxide dismutase activity, ceruloplasmin and related parameters in rats ingesting lead acetate. *Trace Subst. Environ. Health.* 18: 497-505.

Mix Mylroie, Augusta A, Ariyo, Fatayi, and Kyle, Joseph. 1987. effect of lead ingestion and copper supplementation in rats on copper. *Trace Subst in Environ Health 19th Conf, Columbia, Jun 3-6, 1985* : 317-319.

CP Mylroie, Augusta A., Boseman, Anita, and Kyle, Joseph. effect of lead ingestion on superoxide dismutase activity in rats. *Trace Subst. Environ. Health (1986)* : 20, 70-9 .

Surv Nabaglo, L. and Zielinska, M. 1976. level of certain mineral elements in the body of microtus-arvalis fed either on spring rape treated with different fertilizers or on Lucerne. *Bull Acad Pol Sci Ser Sci Biol.* 24(9): 551-558.

Surv Nadeenko, V. G., Borzunova, E. A., and Petrova, N. N. 1990. accumulation in the body of metals ingested with drinking water. *Gigiena i Sanitariya.*(6): 24-26.

FL Nadeenko, V. G., Borzunova, E. A., and Petrova, N. N. accumulation of metals administered with drinking water in animals. *Gig. Sanit. (1990)* 6: 24-6.

Unrel Nadeenko, V. G., Borzunova, E. A., Seliakina, K. P., Lenchenko, V. G., and Petrova, N. N. 1980. [standards for copper in the drinking water]. *Gig Sanit.*(3): 8-10.

FL Nadeenko, V. G., Borzunova, E. A., Selyakina, K. P., Lenchenko, V. G., and Petrova, N. N. 1980. hygienic standards for copper in drinking Water. *Gig Sanit* .(3): 8-10.

FL Nadeenko, V. G. and Lenchenko, V. G. nature of the combined action of small doses of certain elements-antagonists. *Gig Sanit (8):30-34,1977*

FL Nadeenko, V. G. and Lenchenko, V. G. 1977. (on the nature of the combined effects of small doses of some antagonists). *Gigiena I Sanitariya* No. 8: 30-34.

FL Nadeenko, V. G. and Lenchenko, V. G. regularities of the combined action of small doses of certain antagonistic elements. *Gigiena i Sanitariya. (8). 1977 30-34.*

FL Nadeenko, V. G., Lenchenko, V. G., Genkina, S. B., and Arkhipenko, T. A. effect of tungsten, molybdenum, copper and arsenic on the intrauterine development of the fetus. *Farmakol. Toksikol. (Moscow) (1978)* 41(5): 620-3.

FL Nadeenko, V. G., Lenchenko, V. G., Genkina, S. B., and Arkhipenko, T. A. 1978. [effect of wolfram, molybdenum, copper and arsenic on intrauterine fetal development]: <original> vliianie vol'frama, molibdena, medi i mysh'iaka na vnutriutrobnoe razvitie ploda. *Farmakol Toksikol.* 41(5): 620-3.

FL Nadeenko, V. G., Lenchenko, V. G., Genkina, S. B., and Arkhipenko, T. A. the influence of tungsten, molibdenum, copper and arsenic on the intrauterine development of the fetus. *Farmakol Toksikol(moscow) 41:620-623,1978*

FL Nadeenko, V. G., Lenchenko, V. G., and Krasovskii, G. N. combined effect of metals during their intake with drinking water. *Gig. Sanit. (1987)* (12): 9-12.

Bio Acc Nadir, S., Khan, N. U., Chaudhry, R. A., and Shah, F. H. College of Veterinary Sciences Lahore Pakistan Dept. of Animal Reproduction. 1988. macro and micro elements [calcium, phosphorus, copper, zinc and manganese] in female buffalo calves blood serum during various stages of growth up to maturity. *Journal of Animal Health and Production. V. 8(1-4) P. 22-25*

FL Nagai, T. and Imamura, Y. <translated> preventive effect of dietary vegetable residues and konjac mannan against food red no. 2 (amaranth) toxicity in rats fed a purified diet containing mineral mixtures complete or lacking in zn, cu, and mn (zinc, copper and manganese). *Eiyo To Shokuryo ; Journal Of Japanese Society Of Food And Nutritionnihon Eiyo Shokuryo Gakkai.* Apr 1978. v. 31 (2) p. 161-170. ill.

Nutr Nagai, T. Matsuyama Shinonome Junior Coll. Japan, Imamura, Y., Ebihara, K., and Kiriyama, S. 1978. preventive effect of dietary vegetable residues and konjac mannan against food red no.2 (amaranth) toxicity in rats fed a purified diet containing mineral mixtures completely lacking in zinc, copper, and manganese. *Journal of Japanese Society of Food and Nutrition. V. 31(2) P. 161-170*

FL Nagamatsu, Mikiichiro. 1970. effect of copper on the reproductive phenomenon in rat. *Niigata Igakkai Zasshi.* 84(6): 417-26.

No COC Naganuma, A., Satoh, M., Koyama, Y., and Imura, N. 1985. protective effect of metallothionein induced metals on lethal toxicity of cis diamminedichloroplatinum in Mice. *Toxicol Lett (Amst); 24 (2-3): 203-208.*

Nutr Nahashon, S. N., Nakaue, H. S., Snyder, S. P., and Mirosh, L. W. 1994. performance of single comb white leghorn layers fed corn-soybean mealand barley-corn-soybean meal diets supplemented with a direct-fedmicrobial. *Poultry Science* 73(11): 1712-1723.

Plant Nakagawa Julio(A), Prochnow Luiz Ignacio, Bull Leonardo Theodor(A), and Boas Roberto Lyra Villas. 1992. effects of organic composts on the lettuce crop lactuca sativa l.: series i. *Cientifica (Jaboticabal)* 20(1): 173-180.

Phys Nakagawa, Noriko. studies on changes in trace elements of the brain related to aging. *Hokkaido Igaku Zasshi (1998)* 73(2): 181-199.

Nutr Nakaue, H. S. National Technical Information Service (NTIS). nutrition as related to water quality and pollution. *FEDRIP DATABASE*

Bact Narasimhan, Chakravarthy and Miziorko, Henry M. pseudomonas mevalonii 3-hydroxy-3-methylglutaryl-coa lyase: characterization of the isolated recombinant protein and investigation of the enzyme's cation requirements. *Biochemistry (1992)* 31(45): 11224-30.

Diss Naruamon Kaewsudtipon. 1981. study on digestibility of dried cow manure in poultry feed and of dried poultry litter in sheep feed. <original> suksa kan yoi dai khong phochana nai mun kho doi kai lae nai watsadu rong phun khok kai doi kae. *96 Leaves*

Rev NAS, Subcommittee on Mineral Toxicity Committee on Animal Nutrition. 1980.: 588.

Nutr Nasi, M. nutritive value and metabolic effects of whey protein concentrate and hydrolyzed lactose for growing pigs. *Journal of Agricultural Science in Finland. 56 (3). 1984 (Recd. 1985). 227-238.*

Surv Nasolodin, V. V., Dvorkin, V. A., and Kurkova, S. D. 1994. bioavailability of trace elements and their interactions in the course of metabolism in the Body. *Gigiena I Sanitariya.* 0(9): 12-15.

Rev National Research Council (NRC). 1985.

Mineral Naveh, Y., Ben-Elisha, M., Kemp, F. W., and Bogden, J. D. tissue trace element and mineral concentrations in response to zinc-deficient diet of varying duration in the rat. *Trace Elem. Med. (1990)* 7(1): 28-32.

BioAcc Naveh, Y., Kemp, F. W., Holding, K., Bruening, K. S., and Bogden, J. D. relationships among tissue trace element and major mineral concentrations in the rat. *Trace Elements in Medicine. 5 (1). 1988. 12-15.*

CP Neal, R. H. Ministry of Agriculture and Lands Belize, Neal, R. H., and Awe, E. A. Ministry of Natural Resources Belmopan Belize Agricultural Library and Information Centre eds. 1981. a comparison of the nutrient levels of various pasture grasses and legumes as related to soil type and fertility - interim report. proceedings of the second agricultural research and development symposium. *P. 63-73*

No COC Neathery, M. W., Crowe, N. A., Miller, W. J., Crowe, C. T., Varnadoe, J. L., and Blackmon, D. M. 1990. influence of dietary aluminum and phosphorus on zinc metabolism indairy calves. *Journal of Animal Science* 68(12): 4326-4333.

Rev Neathery, M. W. and Miller, W. J. 1977. tolerance levels, toxicity of essential trace elements for livestock and poultry. i. cattle and sheep. *Feedstuffs* . 49(36): 18-20, 34.

Rev Nederbragt, H., Van Den Ingh, T. S., and Wensvoort, P. 1984. pathobiology of copper toxicity. *Vet Q.* 6(4): 179-85, 235.

CP Nedkova, L. and <Editors> Botev, N. 1996. effects of arsenic supply on the growth, health and some biochemicalparameters in pheasants (phasianus colhicus mongolicus). <. *Document*

Title>The Game and the Man. Proceedings International Unionof Game Biologists 22nd Congress Sofia, Bulgaria, 4-8 September 1995. 461-467.

Surv Negro, J. J., Donazar, J. A., Hiraldo, F., Hernandez, L. M., and Fernandez, M. A. 1993. organochlorine and heavy metal contamination in non-viable eggs and its relation to breeding success in a spanish population of lesser kestrels (falco naumanni). *Environ Pollut.* 82(2): p201-205.

No Oral Neizvestnova, E. M., Davydova, V. I., Malysheva, L. G., and Konovalova, N. E. acute and subacute toxicity of four high-temperature superconducting materials containing copper, barium, bismuth, strontium, yttrium, thallium, lanthanum and cobalt. *Curr. Toxicol. (1993)* 1(1): 39-45.

Nutr Nelson, J. L. and Alexander, J. W. 1991. multi-trace-element supplementation in enteral formulas for burned guinea pigs. *Nutrition* 7(4): 275-9.

Nutr Nelson, T. S., Kirkby, L. K., and Mahan, J. H. 1984. adding minerals and amino acids to broiler chick diets no solution to leg abnormalities. *Arkansas Farm Research* 33(5): 2.

Model Nelson Y.M., Thampy R.J., Motelin G.K., Raini J.A., DiSante C.J., and Lion L.W.*. 1998. model for trace metal exposure in filter-feeding flamingos at alkaline rift valley lake, kenya. *Environmental Toxicology and Chemistry* 17(11): pp. 2302-2309.

FL Nersisyan, S. N. 1971. effect of some trace nutrients (zinc, manganese, copper, cobalt) on the growth and decelopment of chicks. *Izv. Sel'Skokhoz. Nauk* 14(8): 93-8 .

FL Nersisyan, S. N. 1971. effect of some trace nutrients (zinc, manganese, copper, cobalt) on the growth and development of chicks. *Izv. Sel'Skokhoz. Nauk.* 14(8): 93-8.

Mix Nestorova, Yuliya a, Tsochev, Ivan a, Zunev, Penko a, and Nikolov, Ivan. 1997. influence of some minerals on the sexual reflexes and sperm production of bucks. *Zhivotnov'Dni Nauki.* 34(7-8): 98-99.

Nut def Netherlands, Commissie Onderzoek Minerale Voeding TNO. 1973.

Drug Newman, S. M. Jr. and Dumont, J. N. 1983. thio semi carbazide induced osteo lathyrism in metamorphosing xenopus-laevis. *J Exp Zool.* 3: 411-422.

In Vit Ng, T. B. and Liu, W. K. 1990. toxic effect of heavy metals on cells isolated from the rat adrenal and testis.*In Vitro Cellular & Developmental Biology* 26(1): 24-8.

Unrel Nicholson, J. W. G., St. Laurent, A-M, Mcqueen, R. E., and Charmley, E. 1991. the effect of feeding organically bound selenium and alpha tocopherol to dairy cows on susceptibility of milk to Oxidation. *Can J Anim Sci.* 71(1): 135-144.

Surv Nico(grave)tina, M. 2003. side effects of some fungicides on the population of typhlodromus exhilaratus ragusa and phytoseius finitimus ribaga sensu denmark (1966) (parasitiformes, phytoseiidae) on grapevines in tuscany. *Advances in Horticultural Science, 17 (2) Pp. 72-76, 2003.*

Phys Nie, Huiling, Qin, Linlin, Tian, Weizhi, Ni, Bangfa, Bao, Ande, and Wang, Pingsheng. preliminary study on the relationship between osteoporosis and trace elements with rat models. *Biol. Trace Elem. Res. (1999)* : 71-72, 623-628.

Surv Niederman, C. N., Beeman, K. B., and Veatch, J. K. 1987. chronic copper poisoning in a flock of suffolk sheep. *Agri-practice.* 8(3): 39-41.

Mix Niederman Caroline N(A), Blodgett Dennis, Eversole Dan, Schurig Gerhardt G, and Thatcher Craig D(A). 1994. effect of copper and iron on neutrophil function and humoral immunity of gestating beef cattle. *Journal of the American Veterinary Medical Association* 204(11): 1796-1800.

Unrel Nielsen, F. H. 1981. consideration of trace element requirements for preparation of chemically defined Media. *The Growth Requirements of Vertebrate Cells in Vitro* : 68-81.

CP Nielsen, F. H. dietary copper, cystine and methionine affects vanadium metabolism in the rat. *Proceedings Of The North Dakota Academy Of Science.* Apr 1984. v. 38 p. 57.

CP Nielsen, F. H. 1980. interactions between essential trace and ultratrace elements (nickel-iron and nickel-copper). *Spurenelem.-Symp.: Nickel 3rd* : 39-45. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep.

Nut def Nielsen, F. H. 1990. new essential trace elements for the life sciences. *Biol Trace Elem Res.* 26-27: 599-611.

Nut def Nielsen, F. H., Shuler, T. R., McLeod, T. G., and Zimmerman, T. J. 1984. nickel influences iron metabolism through physiologic, pharmacologic and toxicologic mechanisms in the rat. *Journal of Nutrition* 114(7): 1280-8.

Nut def Nielsen, F. H., Sunde, M. L., and Hoekstra, W. G. 1968. alleviation of the leg abnormality in zinc-deficient chicks by histamine and by various anti-arthritic agents. *Journal of Nutrition* 94(4): 527-33.

CP Nielsen, F. H., Uhrich, K. E., Shuler, T. R., and Uthus, E. O. 1983. influence of vanadium deprivation on hematopoiesis and other biochemical parameters in iron-deprived and -adequate rats. *Spurenelem.-Symp. 4th* : 127-34. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ., Jena, Ger. Dem. Rep.

CP Nielsen, F. H. and Zimmerman, T. J. 1982. interaction between nickel, copper, and iron in rats. *Trace Elem. Metab. Man Anim. Proc. Int. Symp., 4th* : Meeting Date 1981, 593-6. Editor(s): Gawthorne, J. M.; Howell, J. McC.; White, C. L. Publisher: Springer, Berlin, Fed. Rep. Ger.

Nut def Nielsen, F. H. and Zimmerman, T. J. 1981. interactions among nickel, copper, and iron in rats. growth, blood parameters, and organ wt/body wt ratios. *Biol. Trace Elem. Res.* 3(2): 83-98.

Abstract Nielsen, F. H., Zimmerman, T. J., and Shuler, T. R. possible interaction between nickel and zinc in the Rat. *66th Annual Meeting of the Federation of American Societies for Experimental Biology, New Orleans, La., Usa, April 15-23, 1982. Fed Proc. 41 (3). 1982. Abstract 1116.*

Bio Acc Nielsen, Forrest H. and Shuler, Terrence R. effect of form of iron on nickel deprivation in the rat . liver content of copper, iron, manganese, and zinc. *Biol. Trace Elem. Res. (1981)* 3(3): 245-56 .

Drug Nielsen, Forrest H., Uthus, Eric O., Poellot, Rhonda A., and Shuler, Terrence R. dietary vitamin b12, sulfur amino acids, and odd-chain fatty acids affect the response of rats to nickel deprivation. *Biol. Trace Elem. Res. (1993)* 37(1): 1-15.

Unrel Niemi, L. structure corrosion and biocompatibility of dental silver-palladium-copper-gold-zinc alloys. *Proc Finn Dent Soc; 82 (4). 1986 (RECD. 1987). 223-226.*

Unrel Nikai Toshiaki(A), Komori Yumiko(A), Yagihashi Satoru, Ohara Akihito(A), Ohizumi Yasushi, and Sugihara Hisayoshi(A). 1993. isolation and characterization of phospholipase a-2 from agkistrodon

bilineatus (common cantil) venom. *International Journal of Biochemistry* 25(6): 879-884.

In Vit Nikiforov, A. A. and Bresler, V. M. 1984. cadmium stimulation of sodium independent transport of organic acid in renal tubules. *Tsitologiya.* 26(1): 75-82.

FL Nikolaev, E. M. 1974. effect of biologically active substances on reproduction of mink females. *Tr. Beloruss. S-Kh. Akad.* 121: 158-61.

FL Nikolicheva, T. A., Tarakanov, B. V., Dolgov, I. A., Shavyrina, T. A., and Kuznetsov, S. G. 1978. intestinal tract microflora of laying hens fed rations containing different amounts of copper. *Byull. Vses. Nauchno-Issled. Inst. Fiziol., Biokhim. Pitan. S-Kh. Zhivotn.* 12(2): 65-8.

Fate Nikolova, P. effect of manganese on essential trace element metabolism: tissue concentrations and excretion of manganese, iron, copper, cobalt and zinc. *Trace Elem. Med. (1993)* 10(3): 141-7 .

FL Nikonorow, M. and Rozycka, D. studies on toxicity of phenylmercuric acetate (pma) in chickens. iii. studies on the levels of copper, zinc and cadmium in the liver and kidney of chickens exposed to repeated doses of pma. *Roczn. Panstw. Zakl. Hig. 27(5): 569-575; 1976.(9 References)*

FL Ninomiya, Ruriko, Koizumi, Naoko, and Tsukamoto, Toshiyuki. change of metal distribution in organs of cadmium-administered and copper-deficient rats. *Nippon Eiseigaku Zasshi (1993)* 48(5): 920-31.

Rev Nockels, C. F. 1996. antioxidants improve cattle immunity following stress. *Animal Feed Science and Technology.* 62(1): 59-68.

CP Nockels, C. F., Tufft, L., and Fettman, M. trace element changes in escherichia-coli infected chicks fed varying levels of dietary zinc. *71st Annual Meeting of the Federation of American Societies for Experimental Biology, Washington, D.c., Usa, March 29-april 2, 1987. Fed Proc. 46 (3). 1987. 596.*

Unrel Noffal Nuno, V. M. 1986. study of a locomotor syndrome in sheep in the xaltocan lake-bed zone;clinical and pathological aspects and soil-plant-disease relationship.summary of thesis. *Veterinaria, Mexico.* 17(4): 343-344.

HHE Nomiyama, K. and Nomiyama, H. 1986. modified trace element metabolism in cadmium-induced renal dysfunctions. *Acta Pharmacol Toxicol* . 59(7): 427-430.

No Oral Nomiyama, Kazuo, Nomiyama, Hiroko, Kikuchi, Toru, and Yotoriyama, Mamoru. tissue metal shifts by a single exposure to metals in rats. *J. UOEH (1987)* 9(Suppl.): 95-110.

Bio Acc Norheim G and Borch Iohnsen B. 1990. chemical and morphological studies of liver from eider (somateria mollissima) in svalbard with special reference to the distribution of Copper. *Journal of Comparative Pathology* 102. 127(4): 457-466, illustr.

Surv Norheim, G., Skaare, J. U., and Wiig, O. 1992. some heavy metals, essential elements, and chlorinated hydrocarbons in polar bear (ursus maritimus) at svalbard. *Environ Pollut.* 77(1): 51-57.

No Dose Norton, B. W., Hales, J. W., and Stockwell, T. G. H. 1990. reproduction, growth and survival of merino ewes and lambs in south-western queensland and their response to trace element supplementation. *Australian Journal of Experimental Agriculture.* 30(2): 155-163.

RP Norton, B. W., Hales, J. W., and Stockwell, T. G. H. reproduction growth and survival of merino ewes and lambs in south-western queensland australia and their response to trace element

supplementation. *Australian Journal of Experimental Agriculture. 30 (2). 1990. 155-164.*

Org met Norton, M. L., Bendell, J. F., Bendell Young, L. I., and LeBlanc, C. W. 2001. secondary effects of the pesticide bacillus thuringiensis kurstaki on chicks of spruce grouse (dendragapus canadensis). *Archives of Environmental Contamination and Toxicology [Arch. Environ. Contam. Toxicol.]. Vol. 41, No. 3, Pp. 369-373. Oct 2001.*

CP Norvell, M. J., Gable, D. A., and Thomas, M. C. 1976. effects of feeding high levels of various copper salts to broiler chickens. 457-464.

CP Norvell, M. J., Thomas, M. C., Goatcher, W. D., Gable, D. A., and Calvert, C. C. 1974. some effects of high dietary levels of various salts of copper in broiler chickens. *Proc Univ Mo Annu Conf Trace Subst Environ Health.* 8: 367-372.

CP Norvell, M. J. and Thomas M. C. 1975.: 225.

Nut def Novell, E. L., Rodrigues, N. L., Bianchi, G. S., and Ribas, B. O. 1989. influence of nickel chloride on iron-deficiency in rats. *Boletin De Estudios Medicos y Biologicos* 37(3-4): 95-9.

FL Novikov, G. V. and Zakirnichnaia, G. A. 1970. [level of protein-bound iodine of the blood serum in animals maintained on natural and synthetic diets]. <original> uroven' belkovosviazannogo ioda syvorotki krovi zhivotnykh pri soderzhanii ikh na estestvennom i sinteticheskom ratsionakh. *Voprosy Pitaniia* 29(1): 39-42.

No Dose Nunn, P. B., Obrien, P., Pettit, L. D., and Pyburn, S. I. 1989. complexes of zinc, copper, and nickel with the nonprotein amino-acid l-alpha-amino-beta-methylaminopropionic acid - a naturally-occurring neurotoxin. *Journal Of Inorganic Biochemistry* 37(2): 175-183.

Nutr Nwokolo, E. 1987. nutritional evaluation of pigeon pea meal. *Plant Foods for Human Nutrition* 37(4): 283-90.

No COC Nwokolo, E. N. and Bragg, D. B. influence of phytic acid and crude fiber on the availability of minerals from four protein supplements in growing chicks. *Can. J. Anim. Sci. (1977)* 57(3): 475-7.

Mineral Nwokolo, E. N., Bragg, D. B., and Saben, H. S. a nutritive evaluation of palm kernel meal for use in poultry rations. *Trop. Sci. (1978)* Volume Date 1977, 19(3): 147-54.

FL Nygard, T., Jordhoy, P., and Skare, J. U. 1994. environmental pollutants in merlin in norway. *Nina Forskningsrapport.*: 33p.

Surv Nyholm, Erik. 1986. uptake and effects of metals on birds and mammals in heavy metal contaminated areas. *Inst. Vatten- Luftvaardsforsk. [Publ.] B* IVL B 820, 50 pp.

Surv Nyholm, N. EI, Sawicka-Kapusta, K., Swiergosz, R., and Laczewska, B. 1995. effects of environmental pollution on breeding populations of birds in southern poland. *Water Air and Soil Pollution* . 85(2): 829-834.

Nut def O'Dell, B. L. 1993. roles of zinc and copper in the nervous system. *Progress in Clinical and Biological Research* 380: 147-62.

Bio Acc O'Dell, B. L. 1968. trace elements in embryonic development mammals birds vitamin b-12 copper zinc Iron. *Fed Proc.* 27(1): 199-204.

Nutr O'dell, B. L., Hardwick, B. C., and Reynolds, G. mineral deficiencies of milk and congenital malformations in the Rat. *J Nutr 73:151-157,1961*

Nut def O'Dell, Boyd L., Reeves, P. G., and Morgan, R. F. interrelations of tissue copper and zinc concentrations in rats nutritionally deficient in one or the other of these elements. *Trace Subst. Environ. Health (1976)* : 10, 411-21 .

HHE O Neill, I. K., Bingham, S., Povey, A. C., Brouet, I., and Bereziat, J. C. 1990. modulating effects in human diets of dietary fibre and beef, and of time and dose on the reactive microcapsule trapping of benzo(a)pyrene metabolites in the rat gastrointestinal tract. *Carcinogenesis.* 11(4): 599-607.

No Oral O'Shea, K. S. and Kaufman, M. H. 1980. copper induced micro tubule degeneration and filamentous inclusions in the neuro epithelium of the mouse embryo. *Acta Neuropathol.* 49(3): 237-240.

Nut def Oberley, T. D., Friedman, A. L., Moser, R., and Siegel, F. L. 1995. effects of lead administration on developing rat kidney. ii. functional, morphologic, and immunohistochemical studies. *Toxicol Appl Pharmacol.* 131(1): 94-107.

Unrel Oberley, T. D., Oberley, L. W., Slattery, A. F., Lauchner, L. J., and Elwell, J. H. 1990. immunohistochemical localization of antioxidant enzymes in adult syrian hamster tissues and during kidney development. *American Journal of Pathology* 137(1): 199-214.

No COC Oberley, T. D., Sempf, J. M., and Oberley, L. W. 1995. immunohistochemical localization of antioxidant enzymes during hamster kidney development. *Histochemical Journal* 27(8): 575-86.

FL Ochia, T., Usui, A., Matsumoto, K., Sekita, K., Naito, K., Kawasaki, Y., Furuya, T., and Tobe, M. 1985. oral acute and chronic feeding toxicity tests on green patina basic cupric carbonate in rats studies on the toxicity of green patina basic cupric carbonate i. *J Food Hyg Soc Jpn.* 26(6): 605-616.

Plant Oduguwa, O. O., Ikeobi, C. O. N., Oduguwa, B. O., and Oyedele, O. O. 1997. chemical evaluation of foliage of some tropical leguminous trees andshrubs as fodder. *Pertanika Journal of Tropical Agricultural Science* 20(1): 31-34.

FL Odynets, R. N. and Nigmatullina, N. K. 1971. gpt and got activity in serum and whole blood of sheep givensupplements of methionine and salts of cobalt, copper and iodine. *Fiziologo-Biokhimicheskie Osnovy Povysheniyaproduktivnosti Sel'Skokhozaistvennykh Zhivotnykh.* 85-87.

Mix Odynnets, R. N., Tokobaev, E. M., and Rubtsova, L. F. 1980. effect of vitamin e, ammonium sulphate, salts of iodine, cobalt andcopper on mineral metabolism and histology of thyroid gland of wether sheep. *Mikroelementy v Zhivodnovodstve i Rastenievodstve, Frunze, USSR.*(No 18): 25-42.

Abstract Oflaherty, E. J., Murthy, L., and Petering, H. G. the influence of dietary manganese and chromium on serum ceruloplasmin activity copper and zinc in male rats. *FED PROC. Federation Proceedings. 33 (3 Part 1). 1974 668*

CP Ogawa, T., Ohira, A., and Amemiya, T. 1995. manganese and copper zinc superoxide dismutases expression in the developing rat retina. *Investigative Ophthalmology & Visual Science* 36(4): S59.

Unrel Ogawa, T., Ohira, A., and Amemiya, T. 1997. manganese and copper-zinc superoxide dismutases in the developing rat retina. *Acta Histochemica* 99(1): 1-12.

Mix Ogden, L., Edwards, W. C., and Nail, N. A. zinc intoxication in a dog from the ingestion of copper-clad zinc pennies. *Vet Hum Toxicol; 30 (6). 1988. 577-578.*

No Dose Ogino, K., Hobara, T., Kawamoto, T. , Kobayashi, H., Iwamoto, S., Oka, S., and Okazaki, Y. mechanism of diethyldithiocarbamate-induced gastric ulcer formation in the rat. *Pharmacol Toxicol; 66 (2). 1990. 133-137.*

Alt Ogiu, T., Nishimura, M., Watanabe, F., Ukai, H., Ishii-Ohba, H., Shimada, Y., Tsuji, H., Sakurai, J., and Hino, O. 2000. absence of linkage between radiosensitivity and the predisposing atp7b gene mutation for heritable hepatitis in the lec rat. *Radiation Research, 2000 Jul, 154(1):113-6.*

Surv Ogle, M. C., Scanlon, P. F., Kirkpatrick, R. L., and Gwynn, J. V. 1985. heavy metal concentrations in tissues of mink in virginia. *Bull.Environ Contam Toxicol.* 35(1): 29-37.

Dead Ogle, M. C., Scanlon, P. F., Kirkpatrick, R. L., and Gwynn, J. V. 1985. heavy metal concentrations in tissues of mink mustela-vison in virginia usa. *Bull Environ Contam Toxicol.* 35(1): 29-27.

In Vit Oguni, M., Tanaka, O., Tamura, H., Shinohara, H., Kato, K., and Setogawa, T. 1995. ontogeny of copper-zinc and manganese superoxide dismutase in the developing rat retina: immunohistochemical and immunochemical study. *Ophthalmic Research* 27(4): 227-33.

Surv Ogunmodede, B. K. 1975. comparative effects of copper and terramycin on performance of broiler chicks and growers. *Nigerian Journal of Animal Production.* 2(2): 199-203.

FL Ogunmodede, B. K. and Legel, S. 1987. comparative investigations of the feed and nutrient consumption, growth, a nutrient efficiency of broiler chickens under different climatic conditions in nigeria. *Archiv Fur Tierernahrung* 37(12): 1127-33.

Surv Oh, S. H., Whanger, P. D., and Deagen, J. T. 1981. tissue metallothionein: dietary interaction of cadmium and zinc with copper, mercury, and silver. *J Toxicol Environ Health.* 7(3-4): 547-60.

No COC Ohchi, H., Gunshin, H., Katayama, T., and Kato, N. effect of dietary polychlorinated biphenyls on the metabolism of eight trace elements iron zinc copper manganese molybdenum chromium nickel and cobalt in rats. *Nutr Rep Int; 33 (1). 1986. 157-162.*

No Oral Ohchi, Hidehito, Gunshin, Hiromi, and Katayama, Tetsuyuki. effect of dietary pcb on the metabolism of eight trace elements (iron, zinc, copper, manganese, molybdenum, chromium, nickel and cobalt) in rats. *Nutr. Rep. Int. (1986)* 33(1): 157-62.

Unrel Ohkubo, M., Masuda, M., Ando, T., Kawamoto, N., Nishio, T., Takizawa, T., Shizuoka, Y., and Sasajima, H. load tests of a large coil. *Proc. Symp. Eng. Probl. Fusion Res. (1981)* 9th(1): 178-81.

Surv Ohlendorf, Harry M., Hothem, Roger L., Aldrich, Thomas W., and Krynitsky, Alexander J. 1987. selenium contamination of the grasslands, a major california waterfowl area. *Sci. Total Environ.* 66, 169-83.

Nut def Ohmori, S. and Takagi, Y. 1991. elemental concentrations in hair of protein malnourished rats and zinc deficient rats. *Biomed. Res. Trace Elem.* 2(2): 203-4 .

FL Okolelova, T., Badaev, E., and Eremeeva, V. 1994. the preparation uptivit (in diets for poultry). *Ptitsevodstvo* (6): 15-16.

Mix Okonski, J., Lorek, P., Elzbieciak, Z., and Zarnowski, J. 1981. relation between amounts of calcium, zinc and copper in feed and thegrowth of rats. *Roczniki Naukowe Zootechniki, Monografie i Rozprawy.*(19): 273-282.

Bio Acc Okumura, M., Asano, M., Tagami, M., Tsukiyama, K., and Fujinaga, T. 1998. serum copper and ceruloplasmin activity at the early growing stage infoals. *Canadian Journal of Veterinary Research* 62(2): 122-126.

Nut def Olin, K. L., Walter, R. M., and Keen, C. L. 1994. copper deficiency affects selenoglutathione peroxidase and selenodeiodinase activities and antioxidant defense in weanling rats. *Am J Clin Nutr.* 59(3): 654-8.

Nutr Olson, P. A., Brink, D. R., Hickok, D. T., Carlson, M. P., Schneider, N. R., Adams, D. C., Colburn, D. J., Johnson, A. B., and Deutscher, G. H. 1999. effects of supplementation of organic and inorganic combinations ofcopper, cobalt, manganese, and zinc above nutrient requirement levelson postpartum two-year-old cows. *Journal of Animal Science* 77(3): 522-532.

Abstract Olson, P. A(A), Brink, D. R(A), Hickok, D. T(A), Deutscher, G. H., and Colburn, D. J. 1996. effects of supplementing trace minerals (cu, co, zn, and mn) after calving on productivity of two-year-old cows. *Journal of Animal Science* 74(SUPPL. 1): 261.

Mix Olson, P. A. D. R. Brink D. T. Hickok M. P. Carlson N. R. Schneider G. H. Deutscher D. C. Adams D. J. Colburn and A. R. Johnson. 1999. effects of supplementation of organic and inorganic combinations of copper, cobalt, manganese and zinc above nutrient requirement levels on postaprtum two-year-old cows. *Jounal of Animal Science.* 77: 522-532.

No Control, Ae-Son, Ko, Young-Su, and Chung, Kyung-Won. toxic effects of ethanol on hepatic structure and function in rats. *Res. Commun. Alcohol Subst. Abuse (1999)* Volume Date 1998, 19(1 & 2): 11-28.

Unrel Omofoma, Matthew A. and Hampton, Andrew P. cyanide recovery in a ccd merrill-crowe circuit: pilot testwork of a cyanisorb process at the nerco delamar silver mine. *Randol Gold Forum (1992)* : 359-65 Publisher: Randol Int., Golden, Colo.

Rev Omole, T. A. 1980. copper in the nutrition of pigs and rabbits: a review. *Livest Prod Sci.* 7(3): 253-268.

Nutr Omole, T. A. and Bowland, J. P. 1974. copper, iron and managanese supplementation of pig diets containingeither soybean meal or low glucosinolate rapeseed meal. *Canadian Journal of Animal Science* 54(3): 481-493.

FL Oner, Gulsen, Senturk, Umit Kemal, and Izgut, Nimet. the effect of manganese on erythrocyte superoxide dismutase. *Turk. J. Med. Sci. (1993)* 19(3): 283-6 .

CP Onifade, A. A., Babatunde, G. M., Ademola, S. G., Odu, O., Adejumo, D. O., Odunsi, A. A., Olutunde, T. O., and Sanni-awal, A. 1999. synergistic efficacy of a mixture of three growth-promoting additives in a high-fiber diet fed to broiler chickens. *Eighty-eighth Annual Meeting of the Poultry Science Association*

Alt Ono, S. I. Koropatnick D. J. and Cherian M. G. 1997. 1977. regional brain distribution of metallothionein, zinc and copper in toxic milk mutant and transgenic mice. *Toxicology 124[1], 1-10.* 124(1): 1-10.

Alt Opsahl, W., Abbott, U., Kenney, C., and Rucker, R. 1984. scoliosis in chickens: responsiveness of severity and incidence to dietary copper. *Science* . 225(4660): 440-2.

Abstract Opsahl, W., Rucker, R., Abbott, U., Kenny, C., and Lewis, D. 1983. the effect of dietary manganese and copper on the phenotypic-expression of spinal curvature in scoliotic chickens. *Federation*

Proceedings 42: 818.

No Oral Orden, E. A., Serra, A. B., Serra, S. D., Nakamura, K., Cruz, L. C., and Fujihara T(A). 2000. direct effects of copper and selenium supplementation and its subsequent effects on other plasma minerals, body weight and hematocrit count of grazing philippine goats. *Asian-Australasian Journal of Animal Sciences.* 13(3): 323-328.

CP Osborn, D. and Young, Wendy. 1985. bird mortalities on the river mersey: laboratory studies of the toxicity and effects on essential metals of triethyl- and trimethyllead. *Trace Elem. Man Anim. -- TEMA 5 Proc. Int. Symp., 5th* : Meeting Date 1984, 870-1. Editor(s): Mills, C. F.; Bremner, I.; Chesters, J. K. Publisher: CAB, Farnham Royal, Slough, UK.

No COC Osborn, Russell G., Osweiler, G. D., and Foley, C. W. effects of zearalenone on various components of rabbit uterine tubal fluid. *Am. J. Vet. Res. (1988)* 49(8): 1382-6.

Bio Acc Osowski, S. L., Brewer, L. W., Baker, O. E., and Cobb, G. P. 1995. the decline of mink in georgia, north carolina, and south carolina: the role of contaminants. *Arch Environ Contam Toxicol.* 29(3): 418-23.

Not Avail Ostadalova, I., Babicky, A., Van Barneveld, A. A., Van den Hamer, C. J. A., and Houtman, J. P. W. 1983. cataract in rats as a model of selective toxic action of selenium: drinking water hardness, trace elements and cardiovascular diseases: influence of calcium and magnesium on metabolism of cadmium, cobalt, copper, zinc, and selenium in mice. *Trace Subst. Environ. Health.* 16: 196-204.

CP Oster, M. H., Stern, J. S., and Keen, C. L. the effect of varying diet macronutrient composition on tissue zinc copper and manganese accumulation in diabetic rats. *74th Annual Meeting of the Federation of American Societies for Experimental Biology, Part I, Washington, D.c., Usa, April 1-5, 1990. Faseb (Fed Am Soc Exp Biol) J. 4 (3). 1990. A526.*

Alt Oster, Michelle H., Llobet, Juan M., Domingo, Jose L., German, J. Bruce, and Keen, Carl L. vanadium treatment of diabetic sprgaue-dawley rats results in tissue vanadium accumulation and pro-oxidant effects. *Toxicology (1993)* 83(1-3): 115-30.

Alt Oster, Michelle H., Uriu-Hare, Janet Y., Trapp, Christine L., Stern, Judith S., and Keen, Carl L. dietary macronutrient composition influences tissue trace element accumulation in diabetic sprague-dawley rats. *Proc. Soc. Exp. Biol. Med. (1994)* 207(1): 67-75.

HHE Oster, O., <Editors> Kluthe, R., and Kasper, H. 1994. the contribution of meat to the trace element, electrolyte and mineralsupply of the german population with particular reference to selenium. *<Book>Fleisch in Der Ernahrung.* 32-43.

Nut def Oteiza, Patricia L., Olin, Katherine L., Fraga, Cesar G., and Keen, Carl L. oxidant defense systems in testes from zinc-deficient rats. *Proc. Soc. Exp. Biol. Med. (1996)* 213(1): 85-91.

Nutr Ott, E. A. and Asquith, R. L. 1989. the influence of mineral supplementation on growth and skeletaldevelopment of yearling horses. *Journal of Animal Science* 67(11): 2831-2840.

Nutr Ott, E. A. and Asquith, R. L. 1993. trace mineral supplementation of weanling foals. *Journal of Animal Science* 71(SUPPL. 1): 174.

Unrel Ott, E. A. and Asquith, R. L. 1995. trace mineral supplementation of yearling horses. *J Anim Sci.* 73(2): 466-471.

FL Ovsishcher, B. R., Uel'danov, R. N., Il'bul'din, Yu. F., and Khuzhakhmetov, Z. G. 1986. finishing

young bulls on beet pulp using biologically activesubstances. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii* (6): 147-153.

Nutr Owen, A. A., Peo, E. R. Jr., Cunningham, P. J., and Moser, B. D. 1973. chelated trace minerals for g-f swine. *Journal of Animal Science* 37(1): 95-103.

Bio Acc Owen, C. A. Jr. 1974. similarity of chronic copper toxicity in rats to copper deposition ofwilson's disease. *Mayo Clinic Proceedings.* 49(6): 368-375.

No Tox Owen, Linda M. W., Crews, Helen M., Massey, Robert C., and Bishop, Nicholas J. 1995. determination of copper, zinc and aluminum from dietary sources in the femur, brain and kidney of guinea pigs and a study of some elements in in vivo intestinal digesta by size-exclusion chromatography inductively coupled plasma mass spectrometry. *Analyst (Cambridge U. K.)* 120(3): 705-12 .

Abstract Ozawa, H., Akabane, S., Watanabe, K., and Hashimoto, K. 1979. the relationship between mortality of stroke and trace metal elements. *6th Symposium on Environmental Pollutants and Toxicology*

FL Paik, I. K., Namkung, H., and Choi, Y. J. 1991. effects of interaction between copper sulfate and fat on the performance of broiler chickens. *KOREAN J ANIM NUTR FEEDST.* 15(6): 281-286.

FL Pajovic, S., Nikezic, G., and Martinovic, J. V(A). 1993. effects of ovarian steroids on superoxide dismutase activity in the rat brain. *Experientia (Basel)* 49(1): 73-75.

FL Pajovic, S., Saicic, Z. S., Spasic, M. B., Petrovic, V. M., and Martinovic, J. V. 1996. effect of progesterone and estradiol benzoate on superoxide dismutase activity in the brain of male rats. *Experientia* 52(3): 221-4.

FL Paliev, Kh., Kanev, S., Ilieva, I., Klisurov, Kh., and Tankov, D. 1981. tests on the dry active sediment from the production of hydrolysedyeasts in mixtures for growing pigs. 1. communication. *Zhivotnov"Dni Nauki* 18(3): 62-67.

Nut def Pallauf, J. and Kirchgessner, M. 1974. (effect of different dosages of supplementary manganese or copper inzinc deficiency). *Zentralblatt Fur Veterinarmedizin* 21A(Heft 7): 562-571.

FL Pallauf, J. and Kirchgessner, M. 1974. effect of different supplements of mn or cu with insufficient zincintake. *Zentralblatt Fur Veterinarmedizin, A* 21(7): 562-571.

Nut def Pallauf, J. and Kirchgessner, M. 1974. effect of giving varying supplements of manganese and copper in zinc deficiency. *Zentralbl. Veterinaermed. Reihe A* 21(7): 562-71.

CP Pallauf, J. and Kirchgessner, M. zinc status in depletion and repletion and its relation to vitamins and trace elements. *Hoekstra, W. G. et Al. (Ed.). Trace Element Metabolism in Animals, No. 2. Proceedings of the Second International Symposium. Madison, Wis., U.s.a., June 18-22, 1973. Xxvi+775p. Illus. University Park Press: Baltimore, Md., U.s.a.; London, England. ISBN 0-8391-0696-3. 1974 534-537*

FL Pallauf, J. Giessen Univ. Germany Inst. fuer Tierernaehrung, Hoehler, D., and Rimbach, G. 1992. effect of microbial phytase supplementation to a maize-soya diet on the apparent absorption of mg, fe, cu, mn and zn and parameters of zn-status in piglets. <original> effekt einer zulage an mikrobieller phytase zu einer mais-soja-diaet auf die scheinbare absorption von mg, fe, cu, mn und zn sowie auf parameter des zinkstatus beim ferkel. *Journal of Animal Physiology and Animal Nutrition. V. 68(1) P. 1-9*

FL Pan, Fan, Li, Sihan, Yan, Wanhua, Huang, Zuoneng, Ni, Shuhua, and Liu, Xuefeng. effects of dietary zinc and copper on rat serum lipids. *Yingyang Xuebao (1996)* 18(4): 427-433 .

Mix Panemangalore, Myna. 1993. interaction among zinc, copper, and cadmium in rats: effects of low zinc and copper diets and oral cadmium exposure. *J. Trace Elem. Exp. Med.* 6(3): 125-139.

CP Panic, Bozidar, Bezbradica, L. J., Nedeljkov, N., and Istwani, A. G. 1974. some characteristics of trace element metabolism in poultry. *Trace Elem. Metab. Anim. Proc. Int. Symp., 2nd Meeting Date 1973,* 635-7. Editor(s): Hoekstra, W. G. Publisher: Univ. Park Press, Baltimore, Md.

Bio Acc Pankakoski, E., Hyvarinen, H., Jalkanen, M., and Koivisto, I. 1993. accumulation of heavy metals in the mole in finland. *Environ Pollut.* 80(1): 9-16.

Surv Pankakoski, E., Koivisto, I., Hyvarinen, H., and Terhivuo, J. 1994. shrews as indicators of heavy metal pollution. *Advances in the Biology of Shrews.*(18): 137-149.

FL Panova, M. K. 1967. effect of trace element supplements on copper levels in fur-bearing wild animals. *Uch. Zap. Petrozavodsk. Gos. Univ.* 15(4): 78-81.

FL Panteleeva, M. D. effect of trace element salts on the physiological state of chicks. *Sb. Nauchn. Rab. Sib. Nauchno-Issled. Vet. Inst. (1975)* : 24, 115-18 .

FL Panteleeva, M. D. and Kononov, Yu. V. 1973. effect of added zinc in rations on assimilation of mineral substances by chickens. *Nauchn. Tr. Sib. Nauchno-Issled. Inst. Sel'Sk. Khoz.* 5: 188-90

FL Panteleeva, M. D. and Polyakov, A. A. 1973. supplementing the feed of chicks with zinc sulfate. *Nauchn. Tr. Sib. Nauchno-Issled. Inst. Sel'Sk. Khoz.* 5: 197-9.

Herp Papadimitriou, E. and Loumbourdis, N. S. 2002. exposure of the frog rana ridibunda to copper: impact on two biomarkers, lipid peroxidation, and glutathione. *Bulletin of Environmental Contamination and Toxicology [Bull. Environ. Contam. Toxicol.]. Vol. 69, No. 6, Pp. 885-891. 2002.*

Herp Papadimitriou, E. A. and Loumbourdis, N. S. 2003. copper kinetics and hepatic metallothionein levels in the frog rana ridibunda, after exposure to cucl2. *Biometals : an International Journal on the Role of Metal Ions in Biology, Biochemistry, and Medicine, 2003 Jun, 16(2):271-7.*

FL Papasteriadis, A., Spais, A. G., Paschaleris, G., Yiantzis, N., and Koutinas, A. 1984. a study on the influence of inorganic salts in growing lambs. *Ellenike Kteniatrike* 26(4): 184-186.

Alt Papavasiliou, P. S. and Miller, S. T. 1983. generalized seizures alter the cerebral and peripheral metabolism of essential metals in mice. *Experimental Neurology* 82(1): 223-36.

FL Papesova, L. and Polasek, L. a. 1994. modern trends in horse nutrition: moderni trendy ve vyzive koni. *Veterinarstvi.* 44(12): 591.

FL Papesova, L. and Polasek, L. Biofaktory Prague Czech Republic. 1994. [modern trends in horse nutrition]. <original> moderni trendy ve vyzive koni. *Veterinarstvi. V. 44(12) P. 591*

FL Papp, L., Horvath, Z., and Kardos, Z. 1978. experimental studies on chronic copper poisoning in sheep. *Magyar Allatorvosok Lapja.* 33(7): 490-493.

FL Parada, R., Berqvist, E., and Gonzalez, S. 1985. chronic copper poisoning of cattle in the vicinity of a smelter. *Archivos De Medicina Veterinaria.* 17(1): 53-59.

FL Parada, R., Berqvist, E., and Gonzalez, S. 1985. industrial chronic copper toxicosis in beef cattle. *ARCH MED VET* . 17(1): 49-52.

Mix Parisini, P., Accorsi, P. A., Pacchioli, M. T., and Sardi, L. 1993. further experimental studies on the use of trace elements in the feeding of sows. *Rivista Di Suinicoltura.* 34(11): 43-47.

FL Park, J. H. and Kim, C. S. Korea Advanced Institute of Science and Technology Seoul Korea R. 1984. effects of over-dosed lead and its interaction with iron, copper, zinc or protein supplement in chicks. *Korean Journal of Veterinary Research. V. 24(1) P. 24-30*

FL Park, J. H. Korea Advanced Inst. of Science and Technology Seoul Korea R. and Kim, C. S. Tankook Univ. Seoul Korea R. 1985. nickel toxicity and its interaction with zinc, copper and lead in growing chicks. *Korean Journal of Veterinary Research. V. 25(2) P. 145-148*

Bio Acc Parker, G. H. 1985. copper, nickel, and iron in plumage of three upland gamebird species from non-contaminated environments. *Bull. Environ. Contam. Toxicol.* 35: 776-780.

Diss Parker, G. R. 1976.*The Effects of Dietary Phosphorous, Copper, Exercise, Pen Size and Pen Surface on Performance and Bone Characteristics of Swine.*

In Vit Parmar, P. and Daya, S. 2001. the effect of copper on (3h)-tryptophan metabolism in organ cultures of rat pineal glands. *Metabolic Brain Disease, 2001 Dec, 16(3-4):199-205.*

Mix Parris, E. C. C. and McDonald, B. E. 1969. effect of dietary protein source on copper toxicity in early weaned pigs. *CAN J ANIM SCI.* 49(2): 215-222.

Rev Parslow, J. L. F. and Jefferies, D. J. gannets and toxic chemicals. *BR BIRDS. British Birds. 70 (9). 1977 366-372*

Bio Acc Parslow, J. L. F., Thomas, G. J., and Williams, T. D. 1982. heavy metals in the livers of waterfowl from the ouse washes, england. *Environ. Pollut. Ser. A* 29(4): 317-27.

Alt Partington, B. P., Steeves, R. A., Su, S. L., Paliwal, B. R., Dubielzig, R. R., Wilson, J. W., and Brezovich, I. A. 1989. temperature distributions, microangiographic and histopathologic correlations in normal tissue heated by ferromagnetic needles. *International Journal of Hyperthermia* 5(3): 319-27.

Surv Pascoe, Gary A., Blanchet, Richard J., Linder, Greg, Palawski, Don, Brumbaugh, William G., Canfield, Tim J., Kemble, Nile E., Ingersoll, Chris G., Farag, Aida, and DalSoglio, Julie A. characterization of ecological risks at the milltown reservoir-clark fork river sediments superfund site, montana . *Environ. Toxicol. Chem. (1994)* 13(12): 2043-58.

Mineral Patel, Kavita P. and Baker, David H. supplemental iron, copper, zinc, ascorbate, caffeine and chlortetracycline do not affect riboflavin utilization in the chick. *Nutr. Res. (N. Y.) (1996)* 16(11/12): 1943-1952.

No COC Paternain, J. L. Univ of Barcelona Reus Spain, Ortega, A., Domingo, J. L., Llobet, J. M., and Corbella, J. oral meso-2,3-dimercaptosuccinic acid in pregnant sprague-dawley rats. *J Toxicol Environ Health. V30, N3, P191(7)*

Herp Patil, H. S. and Shivaraj, K. M. 1984. sub-lethal effects of copper on the blood cells of rana cyanophlyctis. *Geobios.* 11(3): 108-111.

Bact Patrick, J. W., Lee, N., Barnes, N. B., and Englesberg, E. 1971. coordination of enzyme synthesis in

the l-arabinose operon in escherichia coli. i. the effect of manganous ion on the synthesis of l-arabinose isomerase. *Journal of Biological Chemistry* 246(16): 5102-6.

Unrel Patriquin David G, Blaikie Holly, Patriquin Maria J, and Yang Chengzhi. 1993. on-farm measurements of ph, electrical conductivity and nitrate in soil extracts for monitoring coupling and decoupling of nutrient cycles. *Biological Agriculture & Horticulture* 9(3): 231-272.

Plant Patten, K. D., Neuendorff, E. W., Leonard, A. T., and Haby, V. A. mulch and irrigation placement effects on soil chemistry properties and rabbiteye blueberry plants irrigated with sodic water. *J. Am. Soc. Hortic. Sci. (1988)* 113(1): 4-8.

FL Paulicks, B. R. Technische Univ. Muenchen Freising Germany Inst. fuer Ernaehrungsphysiologie. 1991. [trace element concentrations in milk and blood of lactating cows affected by bovine growth hormone]. <original> spurenelementgehalte in milch und blutserum von laktierenden kuehen unter dem einfluss von bovinem wachstumshormon. *Journal of Animal Physiology and Animal Nutrition. V. 66(3-4) P. 166-167*

FL Paulicks, B. R. Technische Univ. Muenchen Freising Germany Inst. fuer Ernaehrungsphysiologie and Kirchgessner, M. 1991. the influence of recombinant bovine growth hormone on the concentrations of various trace elements in milk and blood of dairy cows. <original> zum einfluss von rekombinantem bovinem wachstumshormon (rbgh) auf die spurenelementgehalte in milch und blut von laktierenden kuehen. *Journal of Animal Physiology and Animal Nutrition. V. 66(2) P. 89-93*

Herp Pavel, J. and Kucera, M. 1986. accumulation of heavy metals in the frog rana-esculenta. *EKOLOGIA-CSSR.* 5(4): 431-440.

Plant Pavlov, D., Iltchev, A., Atanassova, S., and Dimanov, D. 1993. content of some trace elements in perennial legumes and prediction equation for mn, cu and sr depending on stage of vegetation. *Mengen- Spurenelem. Arbeitstag., 13th* : 203-9. Editor(s): Anke, Manfred. Publisher: Verlag MTV Hammerschmidt, Gersdorf, Germany..

FL Pawlina, E., Jaczewski, S., and Monkiewicz, J. 1988. total and productive life length and culling reasons in cows maintained in area polluted by the copper smelter. *Zeszyty Naukowe Akademii Rolniczej We Wroclawiu. Zootechnika.*(168): 87-94.

FL Paya, A. B. 1980. the effect of zn and cd on bone metabolism and their interaction. 2. *Avances En Alimentacion y Mejora Animal* 21(6/7): 273-280.

Nut def Paynter, D. I. 1980. the role of dietary copper, manganese, selenium, and vitamin e in lipid peroxidation in tissues of the rat (deficiency disorders). *Biological Trace Element Research.* 2 (2): 121-135.

No COC Paynter, D. I. the role of dietary copper, manganese, selenium, and vitamine e in lipid peroxidation in tissues of the rat. *Biol. Trace Elem. Res. (1980)* 2(2): 121-35 .

Bio Acc Paynter, D. I. and Caple, I. W. age-related changes in activities of the superoxide dismutase ec-1.15.1.1 enzymes in tissues of the sheep and the effect of dietary copper and manganese on these changes. *Journal of Nutrition. 114 (10). 1984. 1909-1916.*

Fate Paynter, D. I., Moir, R. J., and Underwood, E. J. 1979. changes in activity of the cu-zn superoxide dismutase enzyme in tissues of the rat with changes in dietary copper. *J Nutr.* 109(9): 1570-6.

Chem Meth Peisach, M., Pineda, C. A., Casimiro, E., Gulumian, M., and Pillay, A. E. 1993. studies by pixe on the removal of trace metals from the heart, liver and kidneys of the rat by chelating agents. *Nucl.*

Instrum. Methods Phys. Res. Sect. B B75(1-4): 191-4.

Bio Acc Peles, J. D. and Barrett, G. W. 1997. assessment of metal uptake and genetic damage in small mammals. *Bull Environ Contam Toxicol.* 59(2): 279(6).

Mix Pelevin, A. D., Solov'ev, L. M., Gneusheva, L. P., Galushkina, T. S., Tishkov, A. I., Lyashko, N. I., Ben'yash, E. Ya., and Kazantseva, L. M. zinc for feed. *Khim. Sel'Sk. Khoz. (1989)* (11): 73-4.

Surv Pellantova, J., Hudec, K., Kredl, F., Svobodnik, J., and Svobodova, R. 1989. organochlorine pesticides pcb and heavy metals residues in eggs of the black-headed gull larus-ridibundus in Czechoslovakia. *Folia Zool.* 38(1): 79-86.

No Oral Pencheva Ivanka(A), Kostova Irena, Konstantinov Spiro, Naidenova Elinka, Kraivanova Margarita, and Manolov Ilia . 1998. cardioprotective efficacy of new esculin metal complexes. *Acta Pharmaceutica (Zagreb)* 48(2): 127-131.

Mix Pepino, A. M., Robinson, G. A., Chou, S. T., and Liptrap, R. M. 1969. comparison of iodine-131 retention in the plasma of rabbits fed toxic quantities of cupric or molybdate ions as supplements to a commercial pelleted diet or to an oats-m alfalfa-d laboratory diet. *Can J Physiol Pharmacol.* 47(7): 635-643.

FL Perepelenko, S. D., Isakov, Kh. I., and Mavaeva, E. N. effect of excess copper and zinc on nucleic acid metabolism in rabbit organs. *Uzb. Biol. Zh. (1979)* (1): 32-4 .

FL Perez, H. A. and Lopez, L. R. 1988. chronic copper intoxication in cattle. *Veterinaria* . 19(3): 241-244.

Aquatic Perkins, E. J., Furey, J., and Davis, E. 2004. the potential of screening for agents of toxicity using gene expression fingerprinting in chironomus tentans. *Aquatic Ecosystem Health & Management [Aquat. Ecosyst. Health Manage.]. Vol. 7, No. 3, Pp. 399-405. Sep 2004.*

Mix Peron, N., Martinez, G., Iglesias, C., and Morales, J. R. 1976. effect of mineral, vitamin and protein supplements on the appearance ofoestrus in heifers fed a basic diet of sugar cane and molasses/urea. *Revista Cubana De Reproduccion Animal.* 2(2): 82-89.

Nutr Peron, N., Martinez, G., Iglesias, C., and Morales, J. R. 1976. effect of mineral, vitamin and protein supplements on the appearanceoestrus in heifers fed a basic diet of sugar cane and molasses/urea. *Revista Cubana De Reproduccion Animal* 2(2): 82-89.

Surv Perrin, D. J., Schiefer, H. B., and Blakley, B. R. 1990. chronic copper toxicity in a dairy herd. *Canadian Veterinary Journal.* 31(9): 629-632.

CP Petering, H. G. 1974. the effect of cadmium and lead on copper and zinc metabolism. *Trace Element Metabolism in Animals, No. 2. Proceedings of the Second International Symposium. Madison, Wis., U.S.A., June 18-22, 1973.*: 311-325.

Mix Petering, H. G. 1980. the influence of dietary zinc and copper on the biologic effects of orally ingested lead in the rat. *Ann. NY Acad. Sci.* 355: 298-308.

Fate Petering, H. G. 1978. some observations on the interaction of zinc, copper, and iron metabolism in lead and cadmium toxicity. *Environ Health Perspect.* 25: 141-5.

No Efct Petering, H. G., Johnson, M. A., and Stemmer, K. L. 1971. studies of zinc metabolism in the rat. i. dose-response effects of cadmium. *Arch Environ Health.* 23(2): 93-101 .

Surv Petering, H. G., Murthy, L., and Cerklewski, F. L. 1977. role of nutrition in heavy metal toxicity. *Biochemical Effects of Environmental Pollutants, Edited by S. D. Lee and B. Peirano* : pp. 365-376.

Nut def Petering, H. G. Murphy L. and O'Flaherty E. 1977. 1977 . influence of dietary copper and zinc on rat lipid metabolism. *J. Agric. Food Chem.* 25(5): 1105-1109.

Nut def Petering, Harold G., Murthy, Lalitha, and O'Flaherty, Ellen. influence of dietary copper and zinc on rat lipid metabolism. *J. Agric. Food Chem. (1977)* 25(5): 1105-9 .

Diss Peters, J. 1990.*Endocrine Changes in Rats After Feeding of Growth Promoters.*

In Vit Peters, R., Shorthouse, M., and Walshe, J. M. 1966. studies on the toxicity of copper. ii. the behaviour of microsomal membrane atpase of the pigeon's brain tissue to copper and some other metallic substances. *Proc R Soc Lond B Biol Sci.* 166(4): 285-94.

FL Petrakiev, A., Iotov, Ts., Kolev, A., and Kormanova, I. 1983. effect of breed and nutrition during different seasons on copper, zinc,manganese, lead and magnesium in cow's milk. *Zhivotnov"Dni Nauki* 20(1): 11-18.

FL Petrova, G. G. and Berestov, V. A. 1982. effect of nutrition on the physiological status of fur-bearing animals. *Fiziol. Sostoyanie Pushnykh Zverei Puti Ego Regul.* 44-54 .

No COC Petukhova, E. A., Dupak, V. V., Kazhdan, V. E., Ryazanov, G. P., and <Editors> Belov, A. D. 1992. efficiency of utilization of meprin included in complete feed mixtures for chickens, replacement pullets and hens. *<Document Title>Biologicheskie Priemy Povysheniya Produktivnostisel'Skokhozyaistvennoi Ptitsy* : 6-13.

In Vit Pfeifer, F. and Schacht, S. development and validation of genotoxicological and ecotoxicological tests for evaluating soil retention. *Forschungsverbund: Biol. Verfahren Bodensanierung (1998)* : A76-A85 Publisher: Umweltbundesamt, Berlin, Germany..

FL Pfeil, R., Georgiev, J., Duesterberg, J., and Stuckenberg, R. 1987. chronic copper poisoning in sheep kept as laboratory animals. *Praktische Tierarzt.* 68(3): 40, 42-43.

CP Phillippo, M., N.F. Suttle and others. 1983. the role of dose-response trials in predicting trace element deficiencydisorders.: trace elements in animal production and veterinarypractice. (Occasional Publicat. 7): 51-59.

CP Phillippo, M. and Suttle, N. F. 1983. the role of dose-response trials in predicting trace element deficiency disorders. (Occasional Publicat. 7): 51-59.

FL Phuah, C. H. and Hutagalung, R. I. effects of zinc, iron and copper supplementation in cassava-based diets for broiler chickens. *Pertanika (1980)* 3(2): 71-7 .

No COC Phylactos, A. C., Harbige, L. S., and Crawford, M. A. 1994. essential fatty acids alter the activity of manganese-superoxide dismutase in rat heart. *Lipids* 29(2): 111-5.

FL Piech-Schleicher, A. 1979. effect of the physical form of feeds and growth promoting substances added to the diet on performance and some physiological parameters in broiler chickens. *ROCZ Nauk Roln Ser B Zootech.* 100: 13-30.

Nutr Pignattelli, P. and Carrara, M. 1986. use of a mixture of trace elements and an amino acid pool in the feeding of hares. *Coniglicoltura* 23(7): 37-39.

Org met Pimentel, J. L., Cook, M. E., and Greger, J. L. bioavailability of zinc-methionine for chicks. *Poult. Sci. (1991)* 70(7): 1637-9 .

Org met Pimentel, J. L., Cook, M. E., and Greger, J. L. 1991. research note: bioavailability of zinc-methionine for chicks. *Poult. Sci.* 70(7): 1637-9 .

CP Pimentel, J. L., Greger, J. L., and Cook, M. E. anemia induced by high zinc intake in chicks mechanisms. *75th Annual Meeting of the Federation of American Societies for Experimental Biology, Atlanta, Georgia, Usa, April 21-25, 1991. FASEB (Fed Am Soc Exp Biol) J. 5 (5). 1991. A1312.*

Diss Pimentel, Julio Lionel. 1991. effect of zinc, copper, and iron on immunity and hematological responses of chicks. *Avail.: Univ. Microfilms Int. Order No. DA9122491 From: Diss. Abstr. Int. B 1991, 52. 4. 1792. Unavailable.* 191 pp.

In Vit Pinheiro, M. S., Barrucand, L., Ricciardi, I. D., and Tibana, A. evaluation of cefoxitin medium and the microaerophilic environment produced by a combination of iron copper and sodium bicarbonate for the culture of campylobacter-jejuni and campylobacter-coli.*Rev MICROBIOL. Revista De Microbiologia. 22 (4). 1991. 298-302.*

Bio Acc Pinowska, B. and Krasnicki, K. 1985. changes in the content of magnesium, copper, calcium, nitrogen and phosphorus in female house sparrows during the breeding cycle. *ARDEA.* 73(2): 175-182.

Bio Acc Pinowski, J., Pinowska, B., Krasnicki, K., and Tomek, T. 1983. chemical composition during growth in nestling rooks corvus-frugilegus. *ORNIS SCAND.* 14(4): 289-298.

In Vit Pinteaux Emmanuel, Copin Jean-Christophe, Ledig Marc, and Tholey Georges(A). 1996. modulation of oxygen-radical-scavenging enzymes by oxidative stress in primary cultures of rat astroglial cells. *Developmental Neuroscience* 18(5-6): 397-404.

Unrel Pinxteren Jef(A), Jimenez Del Rio Marlene, Velez Pardo Carlos, Vauquelin Guy Ebinger Georges, and De Potter Werner. 1993. soluble serotonin and catecholamine binding proteins in the bovine adrenal medulla. *Neurochemistry International* 23(4): 343-350.

Surv Pisa, J. and Cibulka, J. 1989. cadmium, lead, mercury, copper and zinc content in hair and cervical mucus in cattle kept in industrial area in czechoslovakia. *Ekologia-CSSR.* 8(4): 421-432.

FL Pisarski, R. K. 1988. effect of the amount and kind of protein and of energy value of thediet on the amount of some mineral components in the blood plasma ofbroiler chickens. *Roczniki Nauk Rolniczych. Seria B, Zootechniczna* 104(3): 105-115.

FL Pisarski, R. K. 1988. effect of the amounts of dietary minerals on the content of somemineral components in the blood plasma of broiler chickens. *Roczniki Nauk Rolniczych. Seria B, Zootechniczna* 104(3): 117-126.

FL Pisarski, R. K. Akademia Rolnicza Lublin Poland Inst. Zywienia i Higieny Zwierzat. 1988. [effect of dietary protein and energy level on plasma mineral content in broiler chicken]. <original> wplyw zawartosci i rodzaju bialka oraz wartosci energetycznej paszy na poziom niektorych skladnikow mineralnych w osoczu krwi kurczat rzeznych. *Roczniki Nauk Rolniczych. Seria B - Zootechniczna. <Subtitle>Polish Agricultural Annual. Seria B - Animal Science. V. 104(3) P. 105-115*

FL Piva, G., Morlacchini, M., Beretta, G., Cerioli, C., and Prandini, A. 1994. microbial phytase from aspergillus niger in the feeding of broilerchickens. *Rivista Di Avicoltura* 63(9): 33-38.

Nut def Planas, Jose and Frieden, Earl. serum iron and ferroxidase activity in normal, copper-deficient, and estrogenized roosters. *Amer. J. Physiol. (1973)* 225(2): 423-8.

Mix Plaur, K., Wojcik, S., Masiulanis, J., and Tyczkowski, J. 1983. effect of trace elements on fattening performance of chickens givendiets with different protein and energy contents. *Roczniki Naukowe Zootechniki.* 10(2): 231-240.

FL Plekhanov, L. A. 1976. content of phosphorus compounds in the organs and tissues of chickens and their productivity with various levels of copper in their ration. *Byull. Vses. Nauchno-Issled. Inst. Fiziol., Biokhim. Pitan. S-Kh. Zhivotn.* 10(1): 53-5.

Imm Pocino, M., Baute, L., and Malave, I. 1991. influence of the oral administration of excess copper on the immune response. *Fund.Appl.Toxicol.* 16: 249-256.

Imm Pocino, M., Malave, I., and Baute, L. 1990. zinc administration restores the impaired immune response observed in mice receiving excess copper by oral route. *Immunopharmacol Immunotoxicol.* 12(4): 697-713.

FL Podkorytov, F. M. and Kondrat, A. M. 1975. contents of iron, manganese, copper and cobalt in plants in deerpastures in the hilly taiga zone of chitinsk province. *<Document Title>Mikroelementy v Sibiri. Vypsuk 10.* 16-24.

Nut def Podkorytov, F. M., Nikitina, S. S., Kolchina, R. V., Dolenko, V. D., and Vinokurov, Yu. I. 1983. effect of a diet of reindeer moss (cladomia rangiferina) and concentrates on nutrient retention by reindeer.: diagnostika, profilaktika i terapiya bolezneizhivotnykh na krainem severe. 59-75.

FL Podletskaya, N. N. and Skukovskii, B. A. 1980. effect of vitamin nutrition on trace element metabolism in young pigs. *Doklady Vsesoyuznoi Ordena Lenina Akademii Sel'Skokhozyaistvennykh Nauk* (1): 25-27.

Nut def Podshibyakin, A. E., Sapunov, A. G., Golovskoi, I. P., and Chebotarev, I. I. 1988. use of a complex mixture of vitamin a and trace elements as apreventive against vitamin a deficiency in sheep. *Doklady Vsesoyuznoi Akademii Sel'Skokhozyaistvennykh Nauk* (2): 32-34.

Surv Polack, E. W. 1996.*Quantitative and Toxicological Assessment on Equine Motor Neuron Disease (Copper, Vitamin E)*

Unrel Polavarapu, R., Spitz, D. R., Sim, J. E., Follansbee, M. H., Oberley, L. W., Rahemtulla, A., and Nanji, A. A. 1998. increased lipid peroxidation and impaired antioxidant enzyme function is associated with pathological liver injury in experimental alcoholic liver disease in rats fed diets high in corn oil and fish oil. *Hepatology* 27(5): 1317-23.

FL Polyakova, E. P. 1984. effect of prolonged feeding of various copper salt additives on the productivity of hens and the accumulation of copper in organs and tissues. *Povysh. Produktiv. Ptitsy i Soversh. Tekhnol. Pr-Va Yaits i Myasa, M.*: 50-54.

Bio Acc Pond, W. G., Walker, E. F. Jr, and Kirtland, D. effect of dietary calcium and phosphorus levels from 40 to 100 kilogram body weight on weight gain and bone and soft tissue mineral concentrations. *Journal of Animal Science. 46 (3). 1978 686-691.*

Mix Pond, W. G., Walker, E. F. Jr., Kirtland, D., and Rounsaville, T. 1978. effect of dietary ca, cu and zn level on body weight gain and tissue mineral concentrations of growing pigs and rats. *J Anim Sci.* 47(5): 1128-34.

Dead Poole, K. G., Elkin, B. T., and Bethke, R. W. 1995. environmental contaminants in wild mink in the northwest territories canada. *Sci Total Environ* . 160-161: 473-486.

Dead Poole, K. G., Elkin, B. T., and Bethke, R. W. 1998. organochlorine and heavy metal contaminants in wild mink in western northwest territories, canada. *Arch Environ Contamin Toxicol.* 34(4): 406-413.

FL Popov, V. P. 1985. milk yield and fertility in first-calving cows given biologicallyactive compounds. <document title>sovremennye metody selektsii v promyshlennomzhivotnovodstve. 33-36.

Nutr Popov, V. P. and Mokhammad, R. 1991. a protein, vitamin and mineral supplement for intensive rearing ofheifers. *Zootekhniya* (8): 30-32.

FL Poriadkov, L. F., Aleshko-Ozhevskii, I. u. P., Narodetskaia, R. V., Makhova, N. N., and Sheviakova, L. F. 1986. [content of mineral substances in the internal organs of rats on intravenous feeding]. <original> soderzhanie mineral'nykh veshchestv vo vnutrennikh organakh krys pri vnutrivennom pitanii. *Voprosy Pitaniia* (4): 54-7.

Carc Pories, W. J., Mansour, E. G., and Strain, W. H. 1972. trace elements that act to inhibit neoplastic growth. *Annals of the New York Academy of Sciences* 199: 265-73.

Nutr Pott, E. B., Almeida, I. Ld, Brum, P. a Rd, Comastri Filho Ja, Pott, A., and Dynia, J. F. beef cattle mineral nutrition in the brazilian pantanal 2. micronutrients in central nhecolandia pantanal brazil. *Pesqui Agropecu Bras; 24 (1). 1989. 109-126.*

Surv Pott, E. B. and Pott, A. nutrient levels in browse and forb species eaten by cattle in the paiaguas subregion of the pantanal brazil. *Pesquisa Agropecuaria Brasileira. 22 (11-12). 1987. 1293-1300.*

Mix Pott, E. B., Tullio, R. R., Almeida, I. L. D., Brum, P. A. R. D., and Sousa, J. C. D. 1987. cattle reproductive performance in the paiaguas subregion of the brazilian pantanal ii. effect of mineral supplementation on heifers' reproductive rates. *Pesqui Agropecu Bras.* 22(11-12): 1265-1278.

CP Poulsen, H. D. 1998. zinc and copper as feed additives, growth factors or unwanted environmental factors. *Journal of Animal and Feed Sciences.* 7(Supp 1): 135-142.

CP Pounds, J. G., Long, G. J., Kwiatek, W. M., Jones, K. W., and Gordon, B. M. 1987.*Role of High-Energy Synchrotron Radiation in Biomedical Trace Element Research. BNL-40761; CONF-8708180-6*

Bact Powell, D. C., Bursian, S. J., Bush, C. R., Napolitano, A. C., and Aulerich, R. J. 1997. reproduction performance and kit growth in mink fed diets containing copper-treated eggs. *Scientifur.* 21(1): 59-66.

No COC Prabowo, A. and Spears, J. W. dietary silica effects on mineral metabolism in lambs. *Asian-Australasian Journal of Animal Sciences. 5 (2). 1992. 279-283.*

No COC Prabowo, A., Spears, J. W., and Goode, L. 1988. effects of dietary iron on performance and mineral utilization in lambsfed a forage-based diet. *Journal of Animal Science* 66(8): 2028-2035.

Surv Prasad, C. S., Sarma, P. V., Reddy, A. O., and Chinnaiya, G. P. 1989. trace elements and ovarian hormonal levels during different reproductive conditions in crossbred cattle. *Indian Journal of Dairy Science.* 42(3): 489-492.

Mineral Prasad, K. S. N. and Rao, S. V. N. 1997. blood mineral profile of anestrous and repeat breeder

crossbred cows -a field study. *Indian Journal of Animal Nutrition* 14(2): 135-137.

Plant Prasad, M. N. V., Malec, P., Waloszek, A., Bojko, M., and Strzalka, K. 2001. physiological responses of lemna trisulca l. (duckweed) to cadmium and copper bioaccumulation. *Plant Science, 161 (5) Pp. 881-889, 2001.*

HHE Prasad, T., Arora, S. P., and Behra, G. D. 1982. note on the dietary investigation of suspected swayback in Kids. *Indian J Anim Sci.* 52(9): 837-840.

Mineral Prasad, T., Chhabra, A., and Atreja, P. P. 1994. effect of feeding chelating agent (edta) on trace mineral balances ingoats. *Indian Journal of Dairy Science* 47(3): 219-221.

FL Preobrazhenskii, S. N., Mal'tsev, V. S., and Gorobets, A. I. 1977. influence of supplementary copper sulphate on nitrogen accumulation, liver vitamin a content, haematopoiesis and growth of chicks. *Sbornik Nauchnykh Trudov, Moskovskaya Veterinarnaya Akademiya.* 89: 101-104.

Bio Acc Prestrud, P., Norheim, G., Sivertsen, T., and Daae, H. L. 1994. levels of toxic and essential elements in arctic fox in svalbard. *Polar Biology.* 14(3): 155-159.

CP Price Lalitha T(A), Frank Lee, and Sosenko Ilene R S. 1994. does orally administered epidermal growth factor (egf) protect premature lungs in vivo from hyperoxia? *Pediatric Research* 35(4 PART 2): 349A.

Soil Prince, S. W., Senthilkumar, P. *., and Subburam, V. 2001. mulberry-silkworm food chain - a templet to assess heavy metal mobility in terrestrial ecosystems. *Environmental Monitoring and Assessment [Environ. Monit. Assess.]. Vol. 69, No. 3, Pp. 231-238. 1 Jul 2001.*

Phy Prins Gail S(A), Woodham Carl, Lepinske Mark, and Birch Lynn. 1993. effects of neonatal estrogen exposure on prostatic secretory genes and their correlation with androgen receptor expression in the separate prostate lobes of the adult rat. *Endocrinology* 132(6): 2387-2398.

Nut def Pritchard, G. C., Lewis, G., Wells, G. A. H., and Stopforth, A. 1985. zinc toxicity, copper deficiency and anaemia in swill-fed pigs. *Veterinary Record* 117(21): 545-548.

FL Prokudin, A. V., Ababkov, M. M., and Tashenov, K. participation of the digestive system in copper and manganese metabolism in sheep. *Izvestiya Akademii Nauk Kazakhskoi Ssr Seriya Biologicheskaya. 14 (4). 1976 57-62*

FL Proske, U., Kolb, E., Kleman, R., and Salomon, F. V. 1993. the concentration of iron, copper and zinc in 7 tissues in muscovy xpekin and mallard ducks in 12 different age groups during the growthperiod. *Archiv Fur Geflugelkunde* 57(3): 113-120.

Bio Acc Proske, U., Kolb, E., Nestler, K., <Editors> Anke, M., Groppel, B., Gurtler, H., Grun, M., Lombeck, I., and Schneider, H. J. 1991. iron, copper and zinc content in liver and spleen during growth of crossbred cairina (muscovy duck) and pekin ducks. *<Document Title>Mengen- Und Spurenelemente. 11. Arbeitstagung,Leipzig, 12./13. Dezember 1991* : 327-334.

FL Proske, U. Leipzig Univ. Germany Veterinaer-Physiologisch-Chemisches Inst., Kolb, E., Klemm, R., and Salomon, F. V. 1993. the content of iron, copper and zinc in 7 tissues of crossbreed-ducks (muscovy duck x peking duck) and mallard-ducks during the growth in 12 different age groups. <original> der gehalt an eisen, kupfer und zink in 7 geweben von hybridenten (moschusente x pekingente) und von stockenten im verlaufe des wachstums in 12 verschiedenen altersgruppen. *Archiv Fuer Gefluegelkunde. V. 57(3) P. 113-120*

Mix Pucheu, Sylvie, Coudray, Charles, Tresallet, Nicole, Favier, Alain, and de Leiris, Joeel. effect of dietary antioxidant trace element supply on cardiac tolerance to ischemia-reperfusion in the rat. *J. Mol. Cell. Cardiol. (1995)* 27(10): 2303-14 .

Rev Pugh, D. G., Elmore, R. G., and Hembree, T. R. 1985. a review of the relationship between mineral nutrition and reproduction in cattle. *Bovine Pract.* 20: 10-13.

Surv Puky, M. and Oertel, N. 1997. on the protective role of maternal organism in amphibians. *Opuscula Zoologica* . 29-30: 125-132.

CP Purdy, J. W., Nelson, T. S., and Kirby, L. K. the effect of zinc manganese fluorine and copper on growth and the incidence of tibial dyschondroplasia in broilers. *Eleventh Annual Meeting of the Southern Poultry Science Society. Poult Sci. 69 (Suppl. 1). 1990. 184.*

CP Qi, X. and Guy, J. 1994. immunolocalization of manganese and copper/zinc superoxide dismutases in guinea pig optic nerve. *Investigative Ophthalmology & Visual Science* 35(4): 1514.

Species Qiao, Taisheng, Tang, Huacheng, Liu, Jingxi, and Li, Li. analysis and evaluation of nutrients and proteins in oxya chinensis. *Kunchong Zhishi (1992)* 29(2): 113-17.

Nutr Querubin, L. J., Alcantara, P. F., and Princesa, A. O. chemical composition of three azolla species (a. caroliniana, a. microphylla and a. pinnata) and feeding value of azolla meal (a. microphylla) in broiler ration ii. *Philipp. Agric. (1986)* 69(4A): 479-90.

Unrel Quin, J. I., Rimington, C., and Roets, G. C. S. 463-478. studies on the photosensitisation of animals in south africa. viii. the biological formation of phylloerythrin in the digestive tracts of various domesticated animals. *Onderstepoort J Vet Sci An Indust*

In Vit Quintana, C., Olmedilla, A., Antoine, N., and Ollacarizqueta, A. the occurrence of metals aluminum iron nickel copper zinc in the nuclei of animal cells an ultrastructural in-situ x-ray microanalytical study. *Biol Cell; 61 (3). 1987. 115-120.*

Unrel Quinton, D. A. 1987. beef cattle nutrition and performance on seeded clearcuts in southern interior british columbia. *Canadian Journal of Animal Science.* 67(4): 919-928.

Nut def Rabiansky, P. A., Mcdowell, L. R A, Velasquez-Pereira, J., Wilkinson, N. S., Percival, S. S., Martin, F. G., Bates, D. B., Johnson, A. B., Batra, T. R., and Salgado-Madriz, Erika. 1999. evaluating copper lysine and copper sulfate sources for heifers. *Journal of Dairy Science* 82(12): 2642-2650.

Abstract Rader, J. I., Jones, J. W., Banks, T. A., and Fox, M. R. S. dietary carbohydrate and growth promotion by cellulose in purified diets for weanling rats. *71st Annual Meeting of the Federation of American Societies for Experimental Biology, Washington, D.c., Usa, March 29-april 2, 1987. Fed Proc. 46 (3). 1987. 756.*

CP Rader, J. I., Tao, S. H., Gaston, C. M., Wolnik, K. A., Fricke, F. L., and Fox, M. R. S. 1985. effects of phytic acid on bioavailability of trace elements in soy or casein-gelatin diets fed to weanling rats. *Trace Elem. Man Anim. -- TEMA 5 Proc. Int. Symp., 5th* : Meeting Date 1984, 458-60. Editor(s): Mills, C. F.; Bremner, I.; Chesters, J. K. Publisher: CAB, Farnham Royal, Slough, UK.

Abstract Rader, J. I., Wolnik, K. A., Gaston, C. M., Fricke, F. L., and Fox, M. R. S. effects of fiber and biotin on growth and tissue minerals in weanling long evans rats. *68th Annual Meeting of the Federation of American Societies for Experimental Biology, St. Louis, Mo., Usa, Apr. 1-6, 1984 Fed Proc. 43 (4). 1984. Abstract 4565.*

No Tox Rader, Jeanne I., Hight, Susan C., and Caper, Stephen G. copper depletion in long-evans rats fed inorganic tin. *J. Trace Elem. Exp. Med. (1990)* 3(3): 193-202.

FL Radzanowska, G. 1989. effect of lead, copper and selenium on haematological and biochemical indices of hen's blood. *Zeszyty Naukowe Akademii Rolniczej We Wroclawiu, Zootechnika.*(31): 5-27.

FL Radzanowska, G. Akademia Rolnicza Wroclaw Poland Katedra Genetyki i Ogolnej Hodowli Zwierzat. 1989. effect of lead, copper and selenium feeding on haematological and biochemical indices of hen blood. <original> wplyw podawania olowiu, miedzi i selenu na wskazniki hematologiczne i biochemiczne krwi kur. *Zeszyty Naukowe Akademii Rolniczej We Wroclawiu. Zootechnika. (No. 179) P. 5-27*

CP Rahemtulla A(A), Polavarapu, R., Follansbee, M. H., and Nanji, A. A(A). 1997. hepatic antioxidant enzymes in experimental alcoholic liver disease. *Laboratory Investigation* 76(1): 147A.

Bio Acc RAINBOW, P. S. copper, cadmium and zinc concentrations in oceanic amphipod and euphausiid crustaceans, as a source of heavy metals to pelagic seabirds. *MAR BIOL (BERL); 103 (4). 1989. 513-518.*

FL Rajcevic, M., Jazbec, I., Levstek, J., and Ilc, T. 1995. nutritional and mineral matters in rations and metabolic profile ofcows. *Krmiva* 37(6): 317-322.

FL Rajcevic, M. PS Mercator Ljubljana Slovenia and Jazbec, I. Ljubljana Univ. Slovenia Veterinary Fac. 1995. mineral supply and metabolism profile in cows during summer period. <original> oskrbljenost z mineralnimi elementi in presnovni profil krav v poletnem obdobju. *Sodobno Kmetijstvo. V. 28(12) P. 566-569*

Unrel Rajendran, K. V. and Janardana, K. P. 1993. studies on the life-cycle of tremiorchis ranarum. *Journal of Helminthology* 67(2): 95-101.

FL Rakitskii, D. 1973. mineral briquettes enriched with trace elements for weaned piglets. *Svinovodstvo* (7): 19-21.

Mix Rakova, T. N. and Kondrat'ev, Yu. N. 1978. growth of piglets from sows given a mineral supplement, and theirresistance to diarrhoea. *Veterinariya, Moscow, USSR.*(5): 90-92.

FL Rama, R., Jimenez, J., and Planas, J. iron mobilization and plasma ferroxidase factors in chickens.*Rev. Esp. Fisiol. (1981)* 37(4): 387-94

Aquatic Ramalingam, K. and Indra, D. 2002. copper sulphate (cuso sub(4)) toxicity on tissue phosphatases activity and carbohydrates turnover in achatina fulica. *Journal of Environmental Biology [j. Environ. Biol.]. Vol. 23, No. 2, Pp. 181-188. Apr 2002.* 23(2): 181-188.

FL Rambeck, Walter A. and Kollmer, Willy E. modifying cadmium retention in chickens by dietary supplements. *J. Anim. Physiol. Anim. Nutr. (1990)* 63(1/2): 66-74.

Nutr Rana, S. V. and Kumar, A. 1980. enzymological studies on the liver of rats fed with molybdenum and copper. *Toxicol Lett.* 6(3): 163-6.

CP Ranawana, S. S. E., Tilakaratne, N., Rajaratna, A. A. J. Veterinary Research Inst. Peradeniya Sri Lanka, Srikandakumar, A. Peradeniya Univ. Sri Lanka Faculty of Veterinary Medicine, and Anon. 1982. water metabolism and mineral nutrition in the water buffalo [wallowing]. workshop on water buffalo research in sri lanka, november 24-28, 1980. <subtitle> papers presented. *P. 83-90. No.*

R3:1982

Unrel Randolph, J. C. a, Cameron, G. N., and McClure, P. A. 1995. nutritional requirements for reproduction in the hispid cotton rat, sigmodon hispidus. *Journal of Mammalogy.* 76(4): 1113-1126.

Imm Rangachar, T. R. S. and Hedge, V. R. 1974. copper supplementation and antibody production in chicks. *Mysore J. Agric. Sci.* 8(1): 147-50.

Imm Rangachar, T. R. S., Jayaprakash, and Thimmaiah, K. 1978. immunological responses to copper and zinc supplementation in poultry. *Indian Journal of Poultry Science.* 13(1): 39-43.

Bio Acc Ranta, W. B. Tomassini F. D. and Nieboer E. 1978. 1978 . elevation of copper and nickel levels in primaries from black and mallard ducks collected in the sudbury district, ontario. *Can. J. Zool.* 56: 581-586.

Unrel Rao, G. A. and Larkin, E. C. 1985. inadequate intake by growing rats of essential nutrients from liquiddiets used for chronic alcohol consumption. *Nutrition Research* 5(7): 789-795.

Unrel Rao, G. A., Riley, D. E., and Larkin, E. C. 1986. lieber-decarli alcohol diet modification to enhance growth in youngrats. *Nutrition Research* 6(1): 101-105.

Mix Rao, Ghanta N. and Knapka, Joseph J. contaminant and nutrient concentrations of natural ingredient rat and mouse diet used in chemical toxicology studies. *Fundam. Appl. Toxicol. (1987)* 9(2): 329-38.

No Org Rao, P. Udayasekhara. 1987. chemical composition and biological evaluation of debittered and defatted neem (azadirachta indica) seed kernel cake. *J. Am. Oil Chem. Soc.* 64(9): 1348-51 .

Nutr Rao, P. Udayasekhara. chemical composition and nutritional evaluation of spent silk worm pupae. *J. Agric. Food Chem. (1994)* 42(10): 2201-3.

Food Rao, P. Udayasekhara. 1991. nutrient composition and biological evaluation of defatted tomato (lycopersicum esculenta) seed cake.*Plant Foods Hum. Nutr. (Dordrecht Neth.)* 41(1): 101-6

No Dose Rattner, B. A. and Jehl, J. R. Jr. 1997. dramatic fluctuations in liver mass and metal content of eared grebes (podiceps nigricollis) during autumnal migration. *Bull Environ Contam Toxicol.* 59(3): 337-43.

Food Rauch, P., Kas, J., and Ranny, M. iron bioavailability from its complex with sucrose. *Food Chem. (1990)* 36(2): 129-34

Plant Raveendran, E. Environ Protection Committee Bahrain, Grieve, Ian C., and Madany, Ismail M. effects of organic amendments and irrigation waters on the physical and. *Environ Monitor Assess. V30, N2, P177(20)*

Nutr Ravindran, V., Rajadevan, P., Goonewardene, L. A., and Rajaguru, A. S. B. 1986. effects of feeding cassava leaf meal on the growth of rabbits. *Agricultural Wastes* 17(3): 217-224.

Diss Read, H. J. 1987.*The Effects of Heavy Metal Pollution on Woodland Leaf Litter Faunal Communities* : PAGE 2547.

Herp Read, J. L. and Tyler, M. J. 1994. natural levels of abnormalities in the trilling frog neobactrachus centralis at the olympic dam mine. *Bull. Environ. Contam. Toxicol.* 53(1): 25-31.

Phys Reddy, L. Y. S. and Reddy, S. M. 1988. inter-relationship of some biochemical constituents in the blood serum of fertile and infertile Cows. *Mysore J Agric Sci.* 22(3): 359-362.

Herp Redick, M. S. and Point TWLa. 2004. effects of sublethal copper exposure on behavior and growth of rana pipiens tadpoles. *Bulletin of Environmental Contamination and Toxicology [Bull. Environ. Contam. Toxicol.]. Vol. 72, No. 4, Pp. 706-710. Apr 2004.*

Nutr Redshaw, E. S., Martin, P. J., and Laverty, D. H. iron manganese copper zinc and selenium concentrations in alberta canada grains and roughages. *Canadian Journal of Animal Science. 58 (4). 1978 (Recd. 1979). 553-558.*

Invertebrate Reed, D. H., Briscoe, D. A., and Frankham, R. 2002. inbreeding and extinction: the effect of environmental stress and lineage. *Conservation Genetics [Conserv. Genet.]. Vol. 3, No. 3, Pp. 301-307. 2002.*

Herp Reeder, A. L., Foley, G. L., Nichols, D. K., Hansen, L. G., Wikoff, B., Faeh, S., Eisold, J., Wheeler, M. B., Warner, R., Murphy, J. E., and Beasley, V. R. 1998. forms and prevalence of intersexuality and effects of environmental contaminants on sexuality in cricket frogs (acris crepitans). *Environ Health Perspect.* 106(5): 261-266.

Nut def Reeves, P. G. a, Rossow, K. L., and Johnson, L. 1994. maintenance requirements for copper in adult male mice fed ain-93m rodent diet. *Nutrition Research.* 14(8): 1219-1226.

Mix Reeves, Philip G. and Rossow, Kerry L. 1996. zinc- and/or cadmium-induced intestinal metallothionein and copper metabolism in adult rats. *J. Nutr. Biochem.* 7(3): 128-34 .

FL Regius, A., Szucs, E., Szollosi, I., and Weber, A. 1982. effect of different rations on trace element metabolism in fatteningyoung bulls. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 47(4): 169-175.

Bio Acc Regius-Mocsenyi, A., Anke, M., and El-Gandy, H. 1990. the mineral status of ruminants. i. cu-, zn- and mn contents offeedstuffs and animal organs. *Acta Agronomica Hungarica* 39(1-2): 155-166.

FL Regiusne, M. A., Anke, M., and Szenthihalyi, S. 1985. examination of mineral supply of horses. *Allattenyesz Takarmanyozas.* 34(1): 83-90.

Mix Regiusne Mocsenyi A. zinc manganese copper molybdenum nickel and cadmium supplementation of cattle sheep and horse iii. copper supplementation. *Allattenyesztes Es Takarmanyozas. 39 (6). 1990. 547-562.*

FL Regiusne Mocsenyi, A. Allattenyesztesi es Takarmanyozasi Kutatokozp. Herceghalom Hungary. 1991. the degree of supply of zinc, manganese, copper, molybdenum, nickel and cadmium at cattle, sheep and horse. 5th publication. the degree of nickel supply. <original> a szarvasmarha, a juh es a lo cink-, mangan-, rez-, molibden-, nikkel- es kadmium-ellatottsaga. 5. kozlemeny. a nikkel-ellatottsag. *Allattenyesztes Es Takarmanyozas. V. 40(2) P. 151-162*

Unrel Rehbein, S. a, Neubert, E., and Bienioschek, S. 1999. hematological and clinical chemical analysis in naturally and motherless raised fallow deer (dama dama l.): 2. part: clinical chemical study of blood plasma. *Zoologische Garten.* 69(2): 89-108 .

No Oral Rehman, S. 1984. 1984. effects of zinc, copper and lead toxicity on delta-aminolevulinic acid dehydratase activity. *Bull. Environ. Contam. Toxicol.* 33(1): 92-98.

No Oral Reichertova, E., Micek, J., Panakova, E., Koncekova, Z., and Cizmar, J. 1981. effect of dust from

magnesite works on avian embryo. *Folia Morphol(prague) 29:280-283* 29(280-283)

FL Reichlmayr-Lais, A. M. and Kirchgessner, M. 1990. content of certain elements in the milk of lead depleted rats. *Journal of Animal Physiology and Animal Nutrition* 64(1-2): 80-83.

Surv Reichlmayr-Lais, A. M. and Kirchgessner, M. 1981. contents of iron copper and zinc in new borns and in liver and spleen of growing rats in nutritional lead Deficiency. *Z Tierphysiol Tierernaehr Futtermittelkd.* 46(1): 8-14.

Nut def Reichlmayr-Lais, A. M. and Kirchgessner, M. 1993. interactions between lead and iron resulting from lead deficiency. *Met.-Met. Interact. [Symp.]* : 72-86. Editor(s): Elsenhans, Bernd; Forth, Wolfgang; Schuemann, Klaus. Publisher: Bertelsmann Found. Publ., Guetersloh, Germany.

FL Reichlmayr-Lais, A. M. and Kirchgessner, M. iron, copper, zinc, and magnesium concentrations in the offspring of lead-depleted rats. *J. Anim. Physiol. Anim. Nutr. (1988)* 59(1): 34-7.

FL Reichlmayr-Lais, Anna M. and Kirchgessner, M. effects of increasing alimentary iron supplies on the apparent digestibilities of iron, copper, zinc, and manganese and on liver and carcass contents. *J. Anim. Physiol. Anim. Nutr. (1992)* 67(2): 67-73.

FL Reichlmayr-Leis, Anna M., Taubmann, Heike, and Kirchgessner, M. platinum retention in liver and kidneys of lactating rats after alimentary application of ptcl2 and ptcl4. *Agribiol. Res. (1994)* 47(3/4): 266-72.

FL Reichrtova, E., Takac, L., Kahanec, J., Sulicova, L., and Kovacikova, Z. bioindication of magnesite emissions on the f1 generation of rabbits . iii. bioaccumulation of contaminating metals. *Cesk. Hyg. (1987)* 32(6): 350-4.

No COC Reid, R. L., Daniel, K., and Bubar, J. D. 1974. mineral relationships in sheep and goats maintained on orchardgrassfertilized with different levels of nitrogen, or nitrogen withmicro-elements, over a five-year period. 565-575.

Surv Reinstein, N. H., Lonnerdal, B., Keen, C. L., and Hurley, L. S. 1984. zinc-copper interactions in the pregnant rat: fetal outcome and maternal and fetal zinc, copper and iron. *J Nutr.* 114(7): 1266-79.

Unrel Reis, P. J. and Sahlu, T. 1994. the nutritional control of the growth and properties of mohair and woolfibers: a comparative review. *Journal of Animal Science* 72(7): 1899-1907.

Aquatic Reitsema, T. J., Thompson, J. A. J., Scholtens, P., and Spickett, J. T. 2002. further recovery of northeast pacific neogastropods from imposex related to tributyltin contamination. *Marine Pollution Bulletin [Mar. Pollut. Bull.]. Vol. 44, No. 3, Pp. 257-261. Mar 2002.*

In Vit Rest, J. R. Dep. Animal Pathology Univ. Cambridge CB3 0ES UK. 1976. the histological effects of copper and zinc on chick embryo skeletal tissues in organ culture. *British Journal of Nutrition. V. 36(2) P. 243-254*

Diss Rheaume, John. 1990. manganese nutrition in rat and swine reproduction. *Avail.: NLC Order No. DANN63525 From: Diss. Abstr. Int. B 1992. 53. 1. 15.* 318 pp.

Unrel Riar, S. S., Khanna, S. D., Nayar, H. S., Parshad, R., Jain, R. K., Kain, A. K., and Bhat, K. S. 1981. copper as a male contraceptive. *Indian J Exp Biol 19.* 19: 1121-1123.

No COC Ribiere, Catherine, Hininger, Isabelle , Rouach, Helene, and Nordmann, Roger. effects of chronic ethanol administration on free radical defense in rat myocardium. *Biochem. Pharmacol. (1992)*

44(8): 1495-500 .

Fate Rice, D. P., Murthy, L., Shirley, T., Menden, E., and Petering, H. G. the impact of low level cadmium feeding on blood chemicals in male, sprague-dawley rats. *Trace Subst. Environ. Health (1973)* : 7, 305-11 .

No Oral Rice, T. M. Clarke R. W. Godleski J. J. Al-Mutairi E. Jiang N. F. Hauser R. and Paulauskis J. D. 2001. differential ability of transition metals to induce pulmonary inflammation. *Toxicol. Appl. Pharmacol.*. 177(1): 46-53.

Acu Richard, G. and Vallier, J. P. 1969. treatment of cereal seed by the combination of carboxin with copper oxyquinolate. *Proc. Brit. Insecticide Fungicide Conf.* 1: 45-54.

CP Richards, M. P. changes in turkey liver zinc copper and iron content during embryonic and early post hatching development. *70th Annual Meeting of the Poultry Sciences Association, Inc. Poult Sci. 60 (7). 1981. 1718-1719.*

CP Richards, M. P. mineral content of and distribution in turkey eggs. *78th Annual Meeting of the Poultry Science Association, Inc. Poult Sci. 68 (Suppl. 1). 1989. 122.*

Rev Richards, M. P. 1989. recent developments in trace element metabolism and function role of metallothionein in copper and zinc metabolism. *Journal of Nutrition.* 119(7): 1062-1070.

No Dose Richards, M. P. 1997. trace mineral metabolism in the avian embryo. *Poultry Science* 76(1): 152-64.

CP Richards, M. P. and Steele, N. C. trace element metabolism in the developing avian embryo: a review. *Development Of The Avian Embryo / International Union Of Physiological Sciences Satellite Symposium, Lester B. Pearson College Of The Pacific, Victoria, B.c., July 19-22, 1987 ; Ed., J. Metcalfe, M.k. Stock, R.l. Ingermann.* p. 39-51. ill.

No Dose Richards, M. P. and Weinland, B. T. 1985. hepatic zinc, copper, and iron in the developing turkey embryo and newly hatched poult. *Biological Trace Element Research* 7(4): 269-284.

Mix Richards, M. P. USDA ARS Livestock and Poultry Services Institute Nonruminant Nutrition Laboratory Building 200 Room 201 Beltsville Agricultural Research Center-East Beltsville MD 20705 USA. 1989. influence of egg production on zinc, copper and iron metabolism in the turkey hen (meleagris gallopavo). *Comparative Biochemistry and Physiology. A, Comparative Physiology. V. 93(4) P. 811-817*

In Vit Richards, Mark P. long-term shell-less culture of turkey embryos. *Poult. Sci. (1982)* 61(10): 2089-96.

In Vit Richards, Mark P. mineral metabolism in the developing turkey embryo. i. the effects of developmental age and shell-less culture on trace element contents of selected tissues. *Comp. Biochem. Physiol.* A: Comp. Physiol. (1991): 100A(4), 1009-16.

No COC Richards, Mark P., Stock, Michael K., and Metcalfe, James. effects of brief hypoxia and hyperoxia on tissue trace element levels in the developing chick embryo. *Magnesium Trace Elem. (1993)* Volume Date 1992, 10(5-6): 305-20.

Unrel Richardson, D. C., Zicker, S. C., <Editors> Ettinger, S. J., and Feldman, E. C. 2000. developmental orthopedic disease of dogs. <book>textbook of veterinary internal medicine: diseases of the dogand cat, volumes 1 and 2. (Ed. 5): 245-251.

Mineral Richardson, D. C a and Zentek, J. 1998. nutrition and osteochondrosis. *Veterinary Clinics of North America Small Animal Practice.* 28(1): 115-135.

Aquatic Richardson, J. S. and Kiffney, P. M. 2000. responses of a macroinvertebrate community from a pristine, southern british columbia, canada, stream to metals in experimental mesocosms. *Environmental Toxicology and Chemistry [Environ. Toxicol. Chem.]. Vol. 19, No. 3, Pp. 736-743. Mar 2000.*

FL Richet, G. 1972 .*Trace Elements for Domestic Ruminants.* (Etude no. 51): 127 pp.

Nutr Richter, G., Lemser, A., and Petzold, M. 1990. use of rapeseed oilmeal for chickens and pullets of laying strain. *Tierernahrung Und Futterung.* 16: 166-173.

FL Richter, G., Meixner, B., Hennig, A., and Anke, M. 1988. studies on voluntary feed intake by broiler chicks. 2. testing various vitamins, minerals and growth promoters. *Archiv Fur Tierzucht.* 31(6): 583-592.

FL Richter, G. Leipzig Univ. Jena Germany Sektion Tierproduktion und Veterinaermedizin. Wissenschaftsbereich Tierernaehrungschemie, Lemser, A., and Petzold, M. 1990. investigations on the use of rape seed meal with chickens and pullets of the laying strain. <original> untersuchungen zum einsatz von rapsextraktionsschrot bei kueken und junghennen der legerichtung. *Tierernaehrung Und Fuetterung, Erfahrungen, Ergebnisse, Entwicklungen. (No.16) P. 166-173*

Surv Rickard, W. H. and Fitzner, R. E. 1985. mineral content of canada goose branta-canadensis-moffiti eggs and implications for environmental surveillance along the columbia river, washington, usa. *NORTHWEST SCI.* 59(1): 28-32.

No Oral Ridgway, L. P. and Karnofsky, D. A. 1952. the effects of metals on the chick embryo: toxicity and production of abnormalities in development. *Ann N Y Acad Sci.* 55: 203-215.

FL Riet-Correa, F., Oliviera, J. A., Giesta, S., Schild, A. L., and Mendez, M. C. 1989. chronic copper poisoning in sheep in rio grande do sul, southern Brazil. *Pesqui Vet Bras.* 9(3-4): 51-54.

FL Rimbach, G., Pallauf, J., Brandt, K., and Most, E. effect of phytic acid and microbial phytase on cd accumulation, zn status, and apparent absorption of ca, p, mg, fe, zn, cu, and mn in growing rats. *Ann. Nutr. Metab. (1996)* Volume Date 1995, 39(6): 361-70.

FL Ristic, M., Kormanjos, S., Delic, I., Pupavac, V., and Pejkovski, C. 1992. nutritive value of hydrolysed feathers flour. *Veterinarski Glasnik* 46(11/12): 637-643.

No COC Ritter, S. and Dinh, T. T. 1992. age-related changes in capsaicin-induced degeneration in rat brain. *Journal of Comparative Neurology* 318(1): 103-16.

Unrel Ritter, S. and Dinh, T. T. 1990. capsaicin-induced neuronal degeneration in the brain and retina of preweanling rats. *Journal of Comparative Neurology* 296(3): 447-61.

Unrel Ritter, S. and Dinh, T. T. 1988. capsaicin-induced neuronal degeneration: silver impregnation of cell bodies, axons, and terminals in the central nervous system of the adult rat. *Journal of Comparative Neurology* 271(1): 79-90.

Drug Robbins, K. R. and Baker, D. H. 1980. effect of dietary sulfur amino-acid level on copper induced growth depression in rats. *Can J Anim Sci.* 60(1): 201-202.

Nutr Robbins, K. R., Norton, H. W., and Baker, D. H. 1979. estimation of nutrient requirements from

growth data. *J Nutr.* 109(10): 1710-4.

No COC Robel, E. J. 1983. egg trace mineral levels and reproductive performance of turkey hensfed calcium disodium ethylenediaminetetraacetate. *Nutrition Reports International* 27(5): 1021-1027.

Mix Robinson, F. R. a, Sullivan, J. M. a, Brelage, D. R., Sommers, R. L., and Everson, R. J. 1999. comparison of hepatic lesions in veal calves with concentrations of copper, iron and zinc in liver and kidney. *Veterinary and Human Toxicology.* 41(3): 171-174.

FL Robles, C. A., Uzal, F. A., and Olaechea, F. V. 1993. chronic copper poisoning in dairy sheep. *Veterinaria Argentina.* 10(92): 95-97.

Surv Rodriguez, M. L., Rioperez, J., and Orozco, F. 1989. nutritional status of growing dogs fed with raw plant materials influence of mineral on osteogenesis. *AV ALIMENT MEJORA ANIM.* 29(4): 162-168.

Org met Rogers, E. H., Chernoff, N., and Kavlock, R. J. 1981. the teratogenic potential of cacodylic acid in the rat and mouse. *Drug Chem Toxicol.* 4(1): 49-61.

Mix Rojas, L. X., McDowell, L. R., Cousins, R. J., Martin, F. G., Wilkinson, N. S., Johnson, A. B., and Velasquez, J. B. 1996. interaction of different organic and inorganic zinc and copper sources fed to rats. *J Trace Elem Med Biol* . 10(3): 139-44.

Nut def Rojas, L. X., McDowell, L. R., Martin, F. G., and Wilkinson, N. S. 1993. the mineral status of the soil, pastures and beef cattle in the southeast of venezuela. a case study of paraplegia. *Zootecnia Tropical* 11(1): 27-47.

No Control Rojas, L. X., McDowell, L. R., Wilkinson, N. S., and Velasquez, J. B. 1995. development of acute copper poisoning in sheep fed organic or inorganic copper. *International Journal of Animal Sciences* 10(1): 41-45.

Unrel Rojas, L. X., Moya, A., McDowell, L. R., Martin, F. G., and Conrad, J. H. 1994. mineral status on a farm on the southwest of the llanos in venezuela. *Zootecnia Tropical.* 12(2): 161-185.

Aquatic Rojik, I., Nemcsok, J., and Boross, L. 1983. morphological and biochemical studies on liver, kidney and gill of fishes affected by pesticides. *Acta Biologica Hungarica* 34(1): 81-92.

No Oral Rollin, H. B. Theodorou P. and Kilroe-Smith T. A. 1993. 1993. changes in the concentrations of copper and zinc in body fluids and tissues of rabbits following the inhalation of low concentrations of al2o3 dust. *S. Afr. J. Sci. / S. Afr. Tydskr. Wet.* 89(5): 246-249.

Phys Rook Joseph Samuel(A), Braselton, W. Emmett, Nachriener Raymond Francis= (A), Lloyd James Walter(A), Shea Mary Ellen(A), Shelle John Edward, and Hitzler Paula Renee. 1997. multi-element assay of mammary secretions and sera from periparturient mares by inductively coupled argon plasma emission spectroscopy. *American Journal of Veterinary Research* 58(4): 376-378.

Abstract Root, E. J. and Longenecker, J. B. effect of dietary copper vitamin b-6 and essential fatty-acids on arterial elastic laminae in rats. *Federation Proceedings. 37 (3). 1978 325*

Nut def Rosa, I. V. 1993. mineral deficiencies and reproductive performance of ruminants.: circular tecnica - centro nacional de pesquisa de gadode corte. (23): 46 pp.

Nutr Rosa, I.V., C.B. Ammerman and P.R. Henry. 1986. Interrelationships of dietary copper, zinc and iron on performance and tissue mineral concentration in sheep. Nutrition Reports International.

34(5): 893-902.

Surv Rose, G. A. and Parker, G. H. 1982. effects of smelter emissions on metal levels in the plumage of ruffed grouse (bonasa umbellus) near sudbury, ontario, canada. *Can J Zool.* 60(11): 2659-2667.

Surv Rose, G. A. and Parker, G. H. 1983. metal content of body tissues, diet items and dung of ruffed grouse (bonasa umbellus) near the copper-nickel smelters at sudbury, ontario, canada.: effect of smelter emissions on metal levels in the plumage of ruffed grouse (bonasa umbellus) near sudbury, ontario, canada. *Can J Zool.* 61(3): 505-511.

Bio Acc Rose, George A. and Parker, G. H. effects of smelter emissions on metal levels in the plumage of ruffed grouse near sudbury, ontario, canada. *Can. J. Zool. (1982)* 60(11): 2659-67.

Bio Acc Rose, George A. and Parker, G. H. metal content of body tissues, diet items, and dung of ruffed grouse near the copper-nickel smelters at sudbury, ont. *Can. J. Zool. (1983)* 61(3): 505-11

Drug Rosenbaum, Judith S., Zidenberg-Cherr, Sheri, and Keen, Carl L. influence of copper status on the response to acute ethanol exposure in rats. *Alcohol (N. Y.) (1991)* 8(6): 473-9.

No Oral Rosenberg, Daniel W. and Kappas, Attallah. 1989. trace metal interactions in vivo: inorganic cobalt enhances urinary copper excretion without producing an associated zincuresis in rats. *J. Nutr.* 119(9): 1259-68 .

Fate Roserbrough, R. W., Steele, N. C., Mcmurtry, J. P., Richards, M. P., and Calvert, C. C. 1983. role of protein and energy in the regulation of energy metabolism and reproductive performance of large white turkey hens. *Poult Sci.* 62(12): 2452-2459.

Nut def Roslyakov, A. K., Baiturin, M. A., and Aryngaziev, B. 1970. reaction of ewe lambsfon the kazakh fine wooled breed to enrichment of their rations with mineral salts sodium phosphorus cobalt copper and iodine. *Tr Alma-at Zootekh-vet Inst.* 18: 73-80.

Nutr Roth, F. X. and Kirchgessner, M. 1972. the intake of trace elements (mn, cu, zn, co) by dairy cows onpastures. *Bayerisches Landwirtschaftliches Jahrbuch* 49(4): 387-391.

FL Roth, F. X., Windisch, W., and Kirchgessner, M. 1998. mineral metabolism (p, k, ca, mg, zn, mn, cu) of piglets supplied withpotassium diformate (formitm lhs). *Agribiological Research* 51(2): 177-183.

FL Roth, H. P. and Kirchgessner, M. 1977. the content of zinc, copper, iron, manganese and calcium in bone and liver of zinc depleted and repleted rats. *Zentralbl. Veterinaermed. Reihe A* 24(3): 177-88.

FL Roth, H. P. and Kirchgessner, M. CS Inst. Tierernahrung der Technischen Freising-Weihenstephan German Federal Republic. 1977. contents of zinc, copper, iron, manganese and calcium in bones andlivers of rats depleted and refed with zinc. *Zentralblatt Fur Veterinarmedizin, A* 24(3): 177-188.

FL Rothe, S., Kollmer, W. E., and Rambeck, W. A. 1992. influence of certain dietary factors on cadmium retention. *Revue De Medecine Veterinaire* 143(3): 255-260.

FL Rothuizen, J. and van den Ingh, T. S. 1998. [hepatitis in dogs; a review]. <original> hepatitis bij de hond; een overzicht. *Tijdschrift Voor Diergeneeskunde* 123(8): 246-52.

FL Rotkiewicz, T., Kleczkowski, M., and Dabrowski, M. 1993. histopathological and histochemical

examination of chosen inner organs of fattening cattle receiving fodder with a different concentration of zinc, copper, molybdenum and sulphur in the diet. *Acta Academiae Agriculturae Ac Technicae Olstenensis, Veterinaria* .(21): 205-218.

Nutr Rotter, B., Guenter, W., and Boycott, B. R. 1987. effect of dietary animal fat on the incidence of sudden death syndromein broiler chicks. *Nutrition Reports International* 36(2): 403-411.

Nutr Rotter, B., Guenter, W., and Boycott, B. R. 1988. sudden death syndrome in broilers: influence of dietary fats on theincidence and tissue composition. *Nutrition Reports International* 38(2): 369-380.

Mix Roughead, Z. K., Johnson, L. K., and Hunt, J. R. 1999. dietary copper primarily affects antioxidant capacity and dietary iron mainly affects iron status in a surface response study of female rats fed varying concentrations of iron, zinc and copper. *J Nutr.* 129(7): 1368-76.

Unrel Roux, D. J., Badenhorst, J. E., Du Preez, H. H., and Steyn, G. J. 1994. note on the occurrence of selected trace metals and organic compounds in water, sediment and biota of the crocodile river, eastern transvaal, south africa. *Water S a.* 20(4): 333-340.

No Effct Rowe, B. L. and Prince, H. H. 1983. behavioral response of mallards anas-platyrhynchos to contaminated drinking water. *Bull Environ Contam Toxicol.* 30(5): 505-510.

Herp Rowe, C. L. a, Kinney, O. M., Fiori, A. P., and Congdon, J. D. 1996. oral deformities in tadpoles (rana catesbeiana) associated with coal ash deposition: effects on grazing ability and growth. *Freshwater Biology.* 36(3): 723-730.

Aquatic Rowney A.C., Droste R.L., and MacRae C.R. 1986. sediment and ecosystem characteristics of a detention lake receiving urban Runoff. *Water Pollut. Res. J. Can* VOL. 21, NO. 4: pp. 460-473.

FL Rozputniy, O. I. Bila Tserkva State Agricultural Univ. Ukraine. 1998. [assessment of admitting heavy metals to organism of young animals of cattle over a period of growing and feeding]. <original> otsinka nadkhodzhennya vazhkykh metaliv v organizm molodnyaka velykoyi rohatoyi khudoby za period vyroshchvannya u vidhodivli. *Visnyk Agrarnoyi Nauky. (No.7) P. 39-41*

Minseral Rubio, Luis A., Grant, George, Bardocz, Susan, Dewey, Peter, and Pusztai, A. mineral excretion of rats fed on diets containing faba beans (vicia faba l.) or faba bean fractions. *Br. J. Nutr. (1992)* 67(2): 295-302.

Nut def Rucker, R. B., Parker, H. E., and Rogler, J. C. 1969. the effects of copper on collagen cross-linking. *Biochem Biophys Res Commun.* 34(1): 28-33.

Not Avail Ruda, M. 1987. the effect of prophylactic administration of vitamin a andmicroelements cu, mn and zn during reproduction in sows. <document title>zeszyty naukowe akademii rolniczej im. hugonakollataja w krakowie, rozprawa habilitacyjna. (118): 80pp.

FL Ruda, M. and Majewski, T. 1991. the influence of trace elements zn, cu, mn and vitamins a, d3, e indiets for gilts on the performance of piglets. *Annales Universitatis Mariae Curie-Sklodowska. Sectio EE Zootechnica* 9: 197-202.

FL Ruda, M., Majewski, T., and Waligora, J. influence of vitamins a plus d-3 e and trace elements copper manganese and zinc on the reproduction of sows in a litter pig sty. *Medycyna Weterynaryjna. 44 (2). 1988. 102-106.*

FL Ruda, M., Waligora, J., and Majewski, T. Akademia Rolnicza Krakow Poland. 1992. effect of

vitamin treatment and mineral diet supplementation on some blood traits in sows in different seasons of year. <original> wplyw dodatkow witaminowych i mineralnych na poziom wybranych wskaznikow biochemicznych surowicy krwi loszek w roznych porach roku. *Zeszyty Naukowe Akademii Rolniczej w Krakowie. Zootechnika. <Subtitle>Scientific Papers of the Agricultural University in Krakow. (No.266) P. 3-22*

FL Rudometkin, Y. S. 1975. activity of enzymes of the respiratory way and concentration of glutathione in the muscular tissue and liver of chickens in the conditions of feeding by salts of copper and zinc.

FL Rudometkin, Ya. S. 1975. activity of respiratory chain enzymes and glutathione concentration in the muscle tissue and liver of chicks fed copper and zinc salts. *Biol. Akt. Veshchestva (Mikroelem. Vitam. Drugie) Rastenievod., Zhivotnovod. Med.* 53-4. Editor(s): Babin, Ya. A. Publisher: Sarat. S-kh. Inst., Saratov, USSR.

FL Rudometskin, Ya. S. 1976. dynamics of erythrocytes, hemoglobin and respiratory enzyme activities of the blood of chickens fed copper and zinc salts. *Sb. Nauch. Tr. Saratov. S.-Kh. In-t.*(77): 92-5.

Unrel Ruff, M. D., <Editors> McDougald, L. R., Joyner, L. P., and Long, P. L. 1986. reasons for inadequate nutrient utilization during avian coccidiosis: areview. 169-185.

Unrel Rugerio-Vargas, C. and Hurtado, M. M. modification of the silver proteinate impregnation technique for protozoa and cultured nerve Cells. *Biotech Histochem. 66 (3). 1991. 131-135.*

Nut def Ruiz, J. A. A. M. Perez-Vendrell and E. Esteve-Garcia. 2000. effect o dietary iron and copper on performance and oxidative stability in broiler leg meat. *British Poultry Science.* 41: 163-167.

FL Rukhlova, T. 1987. variations in concentrations of zn, cu and mn and their compounds inrumen and duodenal contents of cows fed on a winter diet. <document title>aktual'nye voprosy obmena veshchestv. materialy 3konferentsii no voprosu fiziologicheskogo obmena veshchestv v organizmecheloveka i zhivotnykh, 9-11 sept., 1987. 187-188.

FL Rupic, V. 1980. influence of different amounts of copper sulphate in rations on the erythropoiesis of fattening pigs. *Poljoprivredna Znanstvena Smotra.* 53: 523-529.

Nutr Rupic, V., Huskic, L., Krsmanovic, M., and Jergovic, I. 1992. the effect of vitamin-mineral additive on production results andhaemo-biochemical values in floor- and cage-managed broilers. *Praxis Veterinaria (Zagreb)* 40(1): 25-44.

Surv Rusanov, E. and Balevska, P. 1968. distribution of orally administered copper in the organs of rats. *Izv. Inst. Fiziol., Bulg. Akad. Nauk.* 11: 125-30 .

Alt Rutjawate Taharnklaew, Wipha Wiphamaneeroj, and Peerasak Chantara-prateep (Chulalongkorn Univ., Bangkok Thailand Faculty of Veterinary Science. 1985. infertility problems in dairy cattles in phra nakhon si ayuthaya province [thailand]. <original> naeothang kan kaekhai panha phasom maitit nai khonom thi changwat phra nakhon si ayuthaya. *Journal of the Thai Veterinary Medical Association Under Royal Patronage. <Subtitle>Sattawaphate San. V. 36(3) P. 243-268*

No COC Ruvalds, I. W. 1986. effect of silicon on the productivity of fattening hens. *Spurenelem.-Symp. 5th* (Issue New Trace Elements,): 1227-32. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ. Jena, Jena, Ger. Dem. Rep..

Nut Def Ryan, T. 1991. trace elements and their role in avian nutrition. *Canine Pract.* 16(2): 30-35.

Nut def Saari, Jack T. influence of long-term marginal copper deficiency on trace element status and

cardiovascular variables in rats. *J. Trace Elem. Exp. Med. (1992)* 5(4): 205-14.

Nut def Saari, Jack T. and Medeiros, Denis M. effect of dimethyl sulfoxide on enlarged hearts of copper-deficient rats. *Biol. Trace Elem. Res. (1991)* 31(3): 249-63.

Nut def Saari, Jack T., Schuschke, Dale A., and Ackermann, Douglas M. trace elements in humans and copper-deficient rats experiencing cardiac ventricular rupture. *J. Trace Elem. Exp. Med. (1994)* 7(2): 59-67.

Bio Acc Saba, L. and Bialkowski, Z. 1988. changes in the mineral content of the blood serum and hairs of kidsduring the growth period. *Medycyna Weterynaryjna* 44(8): 505-508.

Surv Sadiek, A. H., Radwan, M. E., and Sayed, A. S. 1994. field investigations of some blood trace elements in buffalo-calvessuffering from loss of hair and skin lesions. *Assiut Veterinary Medical Journal* 32(63): 164-176.

Nutr Saenkova, R. E. and Korotenko, A. P. 1972. effect of synthetic methionine on trace element metabolism in pregnantewes. *<Document Title>Mikroelementy v Zhivotnovodstve i Rasteinievodstve.* 27-33.

FL Sahin, K., Guler, T., Sahin, N., Ertas, O. N., and Erkal, N. 1999. the effect of chromium added into basal diet on serum total protein,urea, triglyceride, cholesterol and serum and tissue chromium, zinc,copper levels in rabbits. *Turk Veterinerlik Ve Hayvancilik Dergisi.* 23(2): 109-113.

Surv Sahoo, G., Sahoo, R. K., and Mohanty-Hejmadi, P. 1996. distribution of heavy metals in the eggs and hatchlings of olive ridley sea turtle , lepidochelys olivacea, from gahirmatha, orissa. *Indian Journal of Marine Sciences.* 25(4): 371-372.

FL Saichenko, S. P. experimental evaluation of the genetic danger of metals with passage into the body with drinking water. *Probl. Gig. Tr.* Profpatol. Toksikol. Gornodobyvayushchei Metall. Prom-sti. (1985): 75-80. Editor(s): Domnin, S. G. Publisher: Mosk. Nauchno-Issled. Inst. Gig, Moscow, USSR.

In Vit Saito, K., Hagiwara, Y., Hasegawa, T., and Ozawa, E. 1982. indispensability of iron for the growth of cultured chick cells. *Development Growth & Differentiation.* 24(6): 571-580.

No COC Saito, T., Fujimura, M., Itoh, T., and Saito K(A). 1995. effects of various durations of restraint stress on the trace element metabolism in rat brain regions. *Trace Elements and Electrolytes* 12(2): 89-94.

CP Saito, T. and Saito, K. 1995. age-related changes in trace element concentrations in 7 brain regions of long-evans cinnamon (lec) rats with hereditary abnormal copper metabolism. *Journal of Neurochemistry* 65(SUPPL.): S61.

Alt Saito Takeshi(A), Itoh Toshihiro, Fujimara Morihiro, and Saito Kazuo. 1995. age-dependent and region-specific differences in the distribution of trace elements in 7 brain regions of long-evans cinnamon (lec) rats with hereditary abnormal copper metabolism. *Brain Research* 695(2): 240-244.

FL Sak, Zh. M. and Gukov, F. D. morphological changes of the rabbit intestine neural apparatus under the influence of some trace elements. *Biol. Akt. Veshchestva Zhizni Rast. Zhivotn. (1973)* 171-2. Editor: 171-2. Editor(s): Brysov, N. S.; Kudryavtsev, G. P. Publisher: Izd. "Vysheishaya Shkola", Minsk, USSR.

Alt Sakurai, H., Fukudome, A., Tawa, R., Kito, M., Takeshima, S., Kimura, M., Otaki, N., Nakajima, K., Hagino, T., and et al. unusual accumulation of copper related to induction of metallothionein in the liver of lec rats. *Biochem. Biophys. Res. Commun. (1992)* 184(3): 1393-7 .

Meth Sakurai, Hiromu, Nakajima, Katsuyuki, Kamada, Hiroko, Satoh, Hiromi, Otaki, Noriko, Kimura, Masami, Kawano, Kazuya, and Hagino, Takuroh. copper-metallothionein distribution in the liver of long-evans cinnamon rats : studies on immunohistochemical staining, metal determination, gel filtration and electron spin resonance spectroscopy. *Biochem. Biophys. Res. Commun. (1993)* 192(2): 893-8.

Alt Sakurai, Hiromu, Tsuji, Akihiro, Sano, Yoshiyuki, Masuyama, Nobuyuki, Asano, Hidetoshi , Suzuki, Keiji, and Nakajima, Katsuyuki. dietary copper (cu)- and age-dependent changes of cu-metallothionein in relation to the level of nitric oxide (no) in the liver of lec (long-evans cinnamon) rats. *J. Trace Elem. Exp. Med. (1997)* 10(2): 89-100 .

Unrel Sakurai, Jun, Fujii, Yoshio, and Nagahama, Masahiro. effect of p-chloromercuribenzoate on clostridium perfringens beta toxin. *Toxicon (1992)* 30(3): 323-30.

Nutr Salami, S. J., Martins, C. M. O. A., and Ukoha, A. I. assessment of some nigerian poultry feeds in relation to their nutritive value. *Biokemistri (1996)* 6(2): 61-71.

FL Salantiu, D., Popa, O., Bogdan, A. T., Babiuc, C., and Cristea, C. 1981. studies on the improvement of semen characters in bulls followingdietary supplements of zinc, copper and manganese. <document title>simpozionul ameliorarea, tehnologia si patologiarumegatoarelor. lucrarile sectiei de ameliorare si tehnologie decrestere la rumegatoare. cluj-napoca, 29-30 mai 1981. 105-113.

FL Salantiu, D., Popa, O., Patrascu, M., Babiuc C., Kadar, L., and Bohm, B. 1980. the concentration of some minerals in the feed, blood and semen ofbulls. <document title>lucrarile simpozionului reproductia si patologiareproductiei in cresterea intensiva a animalelor, bucuresti 8-9decembrie 1978. 140-144.

Gene Saleha Banu, B., Ishaq, Mohd., Danadevi, K., Padmavathi, P., and Ahuja, Y. R. 2004. dna damage in leukocytes of mice treated with copper sulfate. *Food and Chemical Toxicology.* 42(12): 1931-1936.

No Oral Salem, Harry Aberdeen Proving Ground MD and Katz, Sidney A. Rutgers Univ Camden NJ. speciation, bioavailability, and systemic distribution of chromium from. *Sci Total Environ. V86, N1-2, P59(6)*

Mix Salih, Y., Mcdowell, L. R., Hentges, J. F., Mason, R. M. Jr, and Wilcox, C. J. mineral content of milk colostrum and serum as affected by physiological state and mineral supplementation. *Journal of Dairy Science. 70 (3). 1987. 608-612.*

Abstract Salii, N. S. effect of diets with various copper and manganese contents on the vitamin a and c biosynthesis and on the ceruloplasmin activity. *Gig. Toksikol. (1967) 54-6 From: Ref. Zh.* Biol. Khim. 1968, Abstr. No. 9F1754.

Surv Salisbury, C. D. C., Chan, W., and Saschenbrecker, P. W. 1991. multi-element concentrations in liver and kidney tissues from five species of canadian slaughter animals. *J Assoc off Anal Chem.* 74(4): 587-591.

BioX Saloma, A. E., Creger, C., and Couch, J. R. 1970. the intermittent feeding of antibacterial and/or antifungal agents to laying hens. *Brit. Poultry Sci.* 11(3): 281-9.

HHE Saltman, P. 1983. trace elements and blood pressure. *Ann Intern Med.* 98(5 Pt 2): 823-7.

Minseral Saltman, P. D. and Strause, L. G. 1993. the role of trace minerals in osteoporosis. *Journal of the American College of Nutrition* 12(4): 384-9.

Drug Salyanik, V. U. and Salyanik, A. U. 1995. effect of fumaric acid, vitamin c and dipromonium on biochemical stateand productivity of sows. *Vestsi Akademii Agrarnykh Navuk Belarusi* (1): 62-66,125.

Mineral Samanta, A. K., Sarkar, S., Bose, S., Duttagupta, R., Senapati, P. K., and Bhowmik, M. K. 1995. influence of macro and micro minerals on anaemia related to productionand reproduction of grazing cattle. *Indian Veterinary Journal* 72(10): 1031-1034.

Mix Samoggia, G. 1987. effect of copper on the productive performance of meat rabbits. *Rivista Di Coniglicoltura.* 24(10): 41-43.

Unrel Samuelson, D. A., Armstrong, D., and Jolly, R. x-ray microprobe analysis of the retina and rpe in sheep with ovine ceroid-lipofuscinosis. *Neurobiology of Aging. 11 (6). 1990. 663-668.*

No Oral Sanchez, D. J., Colomina, M. T., Domingo, J. L., Llobet, J. M., and Corbella, J. developmental toxicity of cyclohexanediaminetetraacetic acid (cdta) in mice. *Res. Commun. Chem. Pathol. Pharmacol. (1994)* 83(3): 329-40.

Lead Shot Sanderson, G. C., Anderson, W. L., Foley, G. L., Skowron, L. M., Brawn, J. D., and Seets, J. W. acute toxicity of ingested bismuth alloy shot in game-farm mallards. *Illinois Natural History Survey Bulletin; 35 (3-4). 1997. 183-215.*

Bio Acc Sandrock, Balzer C., Kern, Sidney R., and Bryan, Sara E. the movement of zinc and copper from the fertilized egg into metallothionein-like proteins in developing chick hepatic tissue. *Biol. Trace Elem. Res. (1983)* 5(6): 503-15.

Fate Sandstead, H. H., Burk, R. F., Booth, G. H. Jr., and Darby, W. J. 1970. current concepts on trace minerals. clinical considerations. *Med Clin North Am.* 54(6): 1509-31.

Unrel Sangha, G. K(A), Sharma, R. K., and Guraya, S. S(A). 1993. distribution of trace elements in blood and ovary during the oestrous cycle and pregnancy in house rat. *Indian Journal of Animal Sciences* 63(2): 142-145.

FL Sanhueza F, Javier. 1991. [determination of the serum levels of calcium, phosphorus, manganese, zinc and copper at peripartum in holstein friesian cows in los angeles zone]. <original> determinacion de los niveles sericos de calcio, fosforo, manganeso, zinc y cobre en el periparto de vacas holstein friesian en la zona de los angeles. *62 P.*

No Oral Sankoh, F. A. R. and Boila, R. J. 1987. injectable copper and zinc for grazing yearling steers. *Canadian Journal of Animal Science* 67(4): 1033-1041.

Bio Acc Sanpera, C., Morera, M., Crespo, S., Ruiz, X., and Jover, L. 1997. trace elements in clutches of yellow-legged gulls, larus cachinnans, from the medes islands, spain. *Bulletin of Environmental Contamination and Toxicology* 59(5): 757-762.

In Vit Santamaria, A., Flores-Escartin, A., Martinez, J. C., Osorio, L., Galvan-Arzate, S., Chaverri, J. P., Maldonado, P. D., Medina-Campos, O. N., Jimenez-Capdeville, M. E., Manjarrez, J., and Rios, C. 2003. copper blocks quinolinic acid neurotoxicity in rats: contribution of antioxidant systems. *Free Radical Biology & Medicine, 2003 Aug 15, 35(4):418-27.*

CP Sappington, S. R., Calhoun, M. C., and Engdahl, G. R. 1987. effect of ionophores on copper accumulation in sheep. *79th Annual Meeting of the American Society of Animal Science (Southern Section) Nashville, Tennessee, USA, February 1-4, 1987. J Anim Sci.* 65(SUPPL. 1): 26-27.

Nutr Sara, A., Dumitrescu, I., Bogdan, A. T., Angi, E., <Editors> Salajan, G., Petre, A., Man, C., Bud, I., and Muresan, G. 1990. effect of supplementing the diet with trace elements on thyroidactivity in breeding rams. <document title>actualitati si perspective in zootehnie. 126-131.

No Control Sara, A., Salajan, G., Mierlita, D., and Odagiu, A. 1995. biochemical researches upon some microelements from rams testicular parenchyme which received in diet zinc, copper and manganese supplements. *Buletinul Universitatii De Stiinte Agricole Cluj-Napoca Seria Zootehnie Si Medicina Veterinara.* 49: 103-106.

FL Sara, A., Salajan, G., Mierlita, D., and Odagiu Antonia. 1995. researches concerning some microelements content of forages and spermatic yield in a i rams. *Buletinul Universitatii De Stiinte Agricole Cluj-Napoca Seria Zootehnie Si Medicina Veterinara* 49(0): 99-102.

No Dose Sargison, N. D., Scott, P. R., Penny, C. D., and Pirie, R. S. 1994. polioencephalomalacia associated with chronic copper poisoning in a suffolk ram lamb. *Veterinary Record.* 135(23): 556-557.

Acute Sargison, N. D. K. J. Stafford and D. M. West. 1999.*Fluoroscopic Studies of the Stimulatory Effects of Copper Sulphate and Cobalt Sulphate on the Oesophageal Groove of Sheep Small Ruminant Research.* 32: 61-67.

CP Sarkar, B. 1988. metal-protein interactions in transport accumulation and excretion of metals. *First International Meeting on Molecular Mechanisms of Metal Toxicity and Carcinogenicity*

No Dose Sarkar, S., Samanta, T. K., Biswas, U., and Bhowmik, M. K. 1996. a note on anaemia and anoestrus in cattle and therapy with cofecu plus. *Indian Journal of Animal Health* 35(1): 105-106.

Ecol Sarode, D. B., Dakshinkar, N. P., Rode, A. M., Shrikhande, G. B., and Meshram, M. D. 1999. management of helminthic infections of rural cattle. *Indian Veterinary Journal* 76(1): 13-16.

Nut def Sarraga, C. and Regueiro, J. A. Garcia. membrane lipid oxidation and proteolytic activity in thigh muscles from broilers fed different diets. *Meat Sci. (1999)* 52(2): 213-219

FL Sasaki, K. 1971. histological changes of the liver in ecks fistula dogs following copper administration with special reference to hepatic coma. *Hokkaido J Med Sci.* 46(2): 101-112.

Bio Acc Sasimowski, E., Budzynski, M., Lipecka, C., Moczybroda, J., and Kapron, M. chemical composition of the hoof shoe of thoroughbred and cold-blooded horses entered in the polish pedigree books. *Roczniki Nauk Rolniczych Seria B Zootechniczna. 103 (1). 1987. 131-147.*

FL Sasimowski, W., Budzynski, M., Lipecka, C., Moczybroda, J., and Kapron, M. Akademia Rolnicza Lublin Poland Inst. Hodowli i Technologii Produkcji Zwierzecej. 1987. chemical composition of hoof shoe of warm- and cold-blooded horses entered the polish stud books. <original> sklad chemiczny puszki kopytowej koni szlachetnych i zimnokrwistych zapisanych do polskich ksiag stadnych. *Roczniki Nauk Rolniczych. Seria B - Zootechniczna. <Subtitle>Polish Agricultural Annual. Series B - Animal Science. V. 103(1) P. 131-147*

Alt Sato, S., Shimizu, M., Hosokawa, T., Saito, T., Okabe, M., Niioka, T., and Kurasaki, M. 2000. distribution of zinc-binding metallothionein in cirrhotic liver of rats administered zinc. *Pharmacology & Toxicology, 2000 Dec, 87(6):292-6.*

In Vit Sauer, Glenn R., Adkisson, H. D., Genge, B. R., and Wuthier, R. E. regulatory effect of endogenous zinc and inhibitory action of toxic metal ions in calcium accumulation by matrix vesicles in vitro. *Bone Miner. (1989)* 7(3): 233-44.

Chem Meth Savage, I. and Haswell, S. J(A) . 1998. the development of analytical methodology for simultaneous trace elemental analysis of blood plasma samples using total reflection x-ray fluorescence spectrometry. *Journal of Analytical Atomic Spectrometry* 13(10): 1119-1122.

Rev Savage, J. E. 1968. trace minerals and avian reproduction. *Fed Proc.* 27(3): 927-31.

FL Sawada H^Hara A^Kido A^Fukumoto M. studies on metabolism of bromazepam part 4 hydroxylation of 2-2 amino-5-bromobenzoyl pyridine by liver microsomal enzymes. *Yakugaku Zasshi. 94 (8). 1974 991-997.*

An Prod Sawal, R. K., Bhatia, D. R., Bhasin, V., and Malhi, R. S. 1996. wool attributes and nutrient utilization as affected by mineral supplementation in sheep. *Indian Journal of Animal Nutrition.* 13(2): 83-86.

Alt Saxena, K. K. and Ranjhan, S. K. 1978. effect of cobalt and copper supplementation separately and in combination on the digestibility of organic nutrients and mineral balances in hariana calves. *Indian J Anim Sci.* 48(8): 566-571.

Phys Saxena, K. K., Srivastava, R. V. N., Srivastava, S. K., and Ranjhan, S. K. 1980. effect of cobalt and copper supplementation on the ruminal volatilefatty acids concentration and microbial population in hariana calves. *Indian Journal of Animal Sciences.* 50(6): 471-475.

No Org Sayato, Y., Nakamuro, K., Ueno, H., and Goto, R. identification of polycyclic aromatic hydrocarbons in mutagenic adsorbates to a copper-phthalocyanine derivative recovered from municipal river water. *Mutat-Res; VOL 300, ISS 3-4, 1993, P207-13.*

CP Saylor, W. W. and Downer, J. V. alterations in hepatic copper and zinc distribution in the developing chick. *71st Annual Meeting of the Poultry Science Association, Inc. Poult Sci. 61 (7). 1982. 1538-1539.*

No COC Saylor, William W. and Downer, Judith V. copper and zinc distribution in the liver and oviduct of estrogen- and testosterone-treated hens (gallus domesticus). *Nutr. Res. (N. Y.) (1986)* 6(2): 181-90.

No COC Scharp, D. W. 1979. effect of adding superphosphate to the drinking water on the fertilityof dairy cows. *Australian Veterinary Journal* 55(5): 240-243.

Alt Schedl, H. P., Failla, M. L., and Wilson, H. D. 1986. zinc, copper and manganese levels in tissues of the spontaneously hypertensive rat. *Nutrition Research.* 6(10): 1201-1209.

BioAcc Schee, W. van der, Assem, G. H. van den, and Berg, R. van der. 1983. breed differences in sheep with respect to the interaction between zincand the accumulation of copper in the liver. *Veterinary Quarterly* 5(4): 171-174.

Unrel Scheuhammer, A. M. and Dickson, K. M. 1996. patterns of environmental lead exposure in waterfowl in eastern Canada. *Ambio.* 25(1): 14-20.

Bio Acc Scheuhammer, A. M. and Templeton, D. M. 1990. metallothionein production: similar responsiveness of avian liver and kidney to chronic cadmium administration. *Toxicology.* 60(1-2): 151-160.

Unrel Schleger, A. V. 1970. histo pathology of melanotic sheep liver part 1 histology and non-enzymatic histochemistry . *Aust Vet j.* 46(2): 48-54.

Surv Schlesinger W and Potter G. 1974. lead, copper, and cadmium concentrations in small mammals in the hubbard brook experimental forest. *Oikos.* 25: 148-152.

Drug Schlorff, E. C., Husain, K., and Somani, S. M(A). 1999. dose and time dependent effects of ethanol on antioxidant system in rat testes. *Alcohol* 18(2-3): 203-214.

Unrel Schmalz, G. and Eurich, K. biological and physical study on a new alloy for the preparation of a .gamma.2-free amalgam. *Dtsch. Zahnaerztl. Z. (1979)* 34(12): 880-4

Bact Schneegurt, Mark A., Arieli, Boaz, McKeehen, John D., Stephens, Steven D., Nielsen, S. Suzanne, Saha, Puspa R., Trumbo, Paula R., and Sherman, Louis A. compositional and toxicological evaluation of the diazotrophic cyanobacterium, cyanothece sp. strain atcc 51142. *Aquaculture (1995)* Volume Date 1995, 134(3,4): 339-49 .

FL Schnegg, A. and Kirchgessner, M. interaction of nickel with iron, copper and zinc. *Arch. Tierernaehr. (1976)* 26(8): 543-9

FL Schnegg, A and Kirchgessner, M. zur interaktion von nickel mit eisen, kupfer und zink; interaction of nickel with iron, copper and zinc [as an essential element in the growth of rats]. *Arch Tierernahr* Aug 1976 26 (8): 543-549. Eng. sum.

Mix Schoene, F., Jahreis, G., and Meixner, B. 1989. feeding of broilers with rapeseed cake treated with copper ions with reference to the iodine supply. effect on growth and thyroid hormone status. *Nahrung.* 33(2): 221-3.

FL Schoene, F. Leipzig Univ. Jena Germany Wissenschaftsbereich Tierernaehrungschemie, Gruen, M., Kronemann, H., Winnefeld, K., Hennig, A., Anke, M., Groppel, B., Guertler, H., Gruen, M., Lombeck, I., and Schneider, H. J. 1991. assessment of rapeseed meal with different glucosinolate contents in growing pigs taking into consideration the iodine supply, 2: zn, fe and mn status as well as further biochemical parameters. <original> bewertung von rapsextraktionsschrot mit unterschiedlichem glucosinolatanteil an wachsenden schweinen unter beruecksichtigung der jodversorgung, 2: status des fe, mn, cu und zn sowie weitere biochemische parameter. [macro and trace elements]. <original> mengen- und spurenelemente. *P. 510-516*

Unrel Schoenherr, W. D. and Jewell, D. E. 1997. nutritional modification of inflammatory diseases. *Semin Vet Med Surg (Small Anim).* 12(3): 212-22.

FL Scholz, H. 1976. cu content in organs of veal calves during and after manifest excess of dietary cu. *DTW (DTSCH Tieraerztl Wochenschr).* 83(2): 61-62.

Not Avail Schone, F., Geinitz, D., Groppel, B., Grun, M., and Ludke, H. 1989. trace element and vitamin a status of growing pigs fed a rapeseed mealdiet varying in the glucosinolate and iodine content. 777-785.

Not Avail Schone, F., Jahreis, G., and Meixner, B. 1989. feeding copper-treated rapeseed meal to broilers by considering supplyof iodine - influence on growth and thyroid hormone status. *Nahrung.* 33(2): 221-223.

No COC Schone, F., Winnefeld, K., Kirchner, E., Grun, M., Ludke, H., and Hennig, A. 1990. copper and iodine in pig diets with high glucosinolate rapeseed meal.3. treatment of rapeseed meal with copper, and the effect of iodinesupplementation on trace element status and some related blood

(serum)parameters. *Animal Feed Science and Technology* 30(1-2): 143-154.

HHE Schor, R. A., Prussin, S. G., Jewett, D. L., Ludowieg, J. J., and Bhatnagar, R. S. trace levels of manganese, copper, and zinc in rib cartilage as related to age in humans and animals, both normal and dwarfed. *Clin. Orthop. Relat. Res. (1973)* : 93, 346-55..

Nut def Schottler, J. H., Boromana, A., and Williams, W. T. 1977. comparative performance of cattle and buffalo on the sepik plains papua new-guinea. *Aust J Exp Agric Anim Husb.* 17(87): 550-554.

Bio Acc Schroeder, H. A. and Nason, A. P. 1976. interactions of trace metals in mouse and rat tissues; zinc, chromium, copper, and manganese with 13 other elements. *J Nutr.* 106(2): 198-203.

Mix Schroeder, H. A. and Nason, A. P. 1974. interactions of trace metals in rat tissues. cadmium and nickel withzinc, chromium, copper, manganese. *Journal of Nutrition* 104(2): 167-178.

No COC Schroeder, H. A., Nason, A. P., and Balassa, J. J. 1967. trace metals in rat tissues as influenced by calcium in water. *Journal of Nutrition* 93(3): 331-6.

HHE Schroeder, H. A. and Tipton, I. H. 965-1978. the human body burden of lead. *Arch. Environ. Health; 17(6)*

Fate Schryver, H. F., Millis, D. L., Soderholm, L. V., Williams, J., and Hintz, H. F. 1986. metabolism of some essential minerals in ponies fed high levels of Aluminum. *Cornell Vet.* 76(4): 354-360.

FL Schwarz, F. J. and Kirchgessner, M. 1979. copper, zinc, iron and manganese levels in serum, bone and liver after copper depletion. *Zentralbl. Veterinaermed. Reihe A* 26(6): 493-6

CP Schwarz, F. J., Stangl, G. I., and Kirchgessner, M. 1998. growth and feed intake of beef cattle fed maize silage based rations without cu, zn, mn, co, and se supplementation. <original> wachstum und futteraufnahme von jungbullen bei einsatz maissilagereicher rationen mit fehlender cu-, zn-, mn-, co- und se-ergaenzung. <original> proceedings of the society of nutrition physiology berichte der gesellschaft fuer ernaehrungsphysiologie. *P. 64. No. 7*

FL Scuka, M. and D'angelo, M. 1970. effects of copper sulfate on the chick embryo. *Boll Soc Ital Biol Sper.* 46: 80-81.

CP Seaborn, C. D(A) and Nielsen, F. H. 1996. dietary silicon affects some collagen synthesizing enzymes in rats. *FASEB Journal* 10(3): A784.

Nutr Seaborn, Carol D., Cheng, Nancy, Adeleye, Bernice, Owens, Fred, and Stoecker, Barbara J. chromium and chronic ascorbic acid depletion effects on tissue ascorbate, manganese, and 14c retention from 14c-ascorbate in guinea pigs. *Biol. Trace Elem. Res. (1994)* 41(3): 279-94 .

Mineral Seaborn, Carol D., Mitchell, Earl D., and Stoecker, Barbara J. 1993. vanadium and ascorbate effects on 3-hydroxy-3-methylglutaryl coenzyme a reductase, cholesterol and tissue minerals in guinea pigs fed low-chromium diets. *Magnesium Trace Elem. (1993)* Volume Date 1992, 10(5-6): 327-38 .

Mineral Seaborn, Carol D. and Nielsen, Forrest H. boron and silicon: effects on growth , plasma lipids, urinary cyclic amp and bone and brain mineral composition of male rats. *Environ. Toxicol. Chem. (1994)* 13(6): 941-7

No COC Seaborn, Carol D. and Nielsen, Forrest H. effects of germanium and silicon on bone mineralization . *Biol. Trace Elem. Res. (1994)* 42(2): 151-64

Nutr Sebastian, S., Touchburn, S. P., Chavez, E. R., and Lague, P. C. 1996. the effects of supplemental microbial phytase on the performance and utilization of dietary calcium, phosphorus, copper, and zinc in broiler chickens fed corn-soybean diets. *Poult. Sci.* 75(6): 729-736 .

Nutr Sebastian, S., Touchburn, S. P., Chavez, E. R., and Lague, P. C. 1996. efficacy of supplemental microbial phytase at different dietary calcium levels on growth performance and mineral utilization of broiler chickens. *Poultry Science.* 75(12): 1516-1523.

FL Seekles, L. 1972. mineral trace elements and animal reproduction. <*Document Title>Riproduzione Animale e Fecondazione Artificiale.* 299-307.

Unrel Seekles, L. 1972. mineral trace elements and animal reproduction.: riproduzione animale e fecondazione artificiale. 299-307.

No Oral Seffner, W. 1994. prolonged application of copper induces intensified phagocytosis of resident peritoneal macrophages in rats and guinea pigs. *Experimental and Toxicologic Pathology.* 46(1): 15-16.

CP Seffner, W., Schiller, F., Lippold, U., and Dieter, H. 1993. experimental copper intoxication in young guinea pigs with restrictedselenium-supply. *Trace Elements in Man and Animals - TEMA 8:Proceedings of the Eighth International Symposium on Trace Elements in Man and Animals.* 985-986.

Nut def Seffner, W., Schiller, F., Lippold, U., Heinze, R., and Hofmann, A. 2000. studies on the influence of a se-restricted diet on the effects of long-term increased copper intake in guinea pigs. *Experimental and Toxicologic Pathology : Official Journal of the Gesellschaft Fur Toxikologische Pathologie, 2000 May, 52(2):161-8.*

Chem Meth Selkirk, James K., Croy, Robert G., Roller, Peter P., and Gelboin, Harry V. high-pressure liquid chromatographic analysis of benzo(a)pyrene metabolism and covalent binding and the mechanism of action of 7,8-benzoflavone and 1,2-epoxy-3,3,3-trichloropropane. *Cancer Res. (1974).* 34(12): 3474-80 .

Alt Senshu, T. 1976. copper metabolism under the disturbed circulation of the liver ecks fistula in dogs the relation between copper content and histologic changes in the brain. *Hokkaido Journal of Medical Science: 51 (3).* 51(3): 251-263.

No Dose Serman, V. changes in the hemo globin level of whole blood changes in the plasma iron and copper levels as well as the changes in the iron content of the liver and the breast muscle matter of fattening turkeys. *Veterinarski Arhiv. 45 (11/12). 1975 (Recd 1976) 321-328*

FL Setia, M. S. College of Veterinary Science Punjab India Dept. of Veterinary Physiology, Singh, R., Rattan, P. J. S., and Tiwana, M. S. 1987. distribution of trace elements in blood, plasma and erythrocytes during neonatal period in buffalo calves (bubalus bubalis). *Journal of Animal Physiology and Animal Nutrition. V. 58(3) P. 163-171*

CP Sevkovic, N., Rajic, I., Murgaski, S., and Mrvos, G. 1974. effect of copper on embryonal mortality of piglets. *Proceedings of Third International Pig Veterinary Society Congress, Lyon, June 14-14, 1974* (Section V7): 1-3.

Bio Acc Shah, B. G. and Belonje, B. marginal or excess dietary iron and rat tissue trace element levels. *Trace Elem. Med. (1991)* 8(3): 143-8 .

HHE Shah, B. G., Benns, G., Nera, E. A., Verdier, P. C., Beare-Rogers, J. L., Jones, J. D., Ohlson, R., and

Anjou, K. 1980. iodine metabolism and tissue mineral levels in rats fed rapeseedprotein concentrates supplemented with zinc. *Qualitas Plantarum Plant Foods for Human Nutrition* 30(3/4): 235-243.

Nutr Shah, B. G., Giroux, A., Belonje, B., and Jones, J. D. evaluation of rapeseed brassica-napus cultivar tower protein concentrate as a source of protein in a zinc supplemented diet for young rats. *Journal of Agricultural and Food Chemistry. 28 (1). 1980. 36-39.*

No COC Shah, B. G., Trick, K. D., and Belonje, B. effects of dietary calcium on the metabolism of trace elements in male and female rats. *J. Nutr. Biochem. (1990)* 1(11): 585-91.

Nutr Shah, Bhagwan G., Malcolm, Stephen, Belonje, Bartholomeus, Trick, Keith D., Brassard, Rene, and Mongeau, Roger. effect of dietary cereal brans on the metabolism of trace elements in a long-term rat study. *Cereal Chem. (1991)* 68(2): 190-4 .

Bio Acc Shahidi, Fereidoon and Synowiecki, Jozef. nutrient composition of mechanically separated and surimi-like seal meat. *Food Chem. (1993)* 47(1): 41-6.

Surv Shahin, Usama, Yi, Seung-Muk, Paode, Rajendra D., and Holsen, Thomas M. long-term elemental dry deposition fluxes measured around lake michigan with an automated dry deposition sampler. *Environ. Sci. Technol. (2000)* 34(10): 1887-1892 .

No Dose Shand, A. and Lewis, G. 1957. chronic copper poisoning in young calves. *The Veterinary Record.* 69: 618-620.

Fate Sharma, G., Sandhir, R., Nath, R., and Gill, K. 1991. effect of ethanol on cadmium uptake and metabolism of zinc and copper in rats exposed to cadmium. *The Journal Of Nutrition.* 121(1): 87-91.

Bio Acc Sharma, R. K. and Vats, R. 1998. biochemical changes in trace elements in antral follicles of goat. *Indian Journal of Animal Sciences* 68(4): 330-331.

Nut def Sharma, V. and Prasad, T. 1985. erythrocyte superoxide dismutase activity in goats fed on different leaves of dietary available copper: short communication. *Indian Journal of Animal Sciences.* 55(11): 967-970.

Mix Shavkun, V. E., Khavinzon, A. G., Shalovilo, S. G., and Zhminka, V. Ya. 1979. the effect of biologically active substances on reproductive function of sires. *Zhivotnovodstvo.*(11): 60-62.

FL Shavlovskii, M. M., Chebotar', N. A., Konopistseva, L. A., Zakharova, E. T., Kachurin, A. M., Vasil'ev, V. B., and Gaitskhoki, V. S. 1994. [influence of ceruloplasmin on the embryotoxic effect of silver ions]. <original> vliianie tseruloplazmina na embriotoksicheskii effekt ionov serebra. *Biokhimiia* 59(8): 1164-74.

FL Shcheglov, V. V. and Gruzdev, N. V. 1989. maintenance of cows in summer. *Zootekhniya* (6): 33-36.

Nutr Shen YinWu, Liu YongDing, Zhu YunZhi, and Song LiRong. 1999. studies on the application of anabaena powder for animal feeds. *Acta Hydrobiologica Sinica* 23(5): 425-433.

Unrel Sheng, Y. Z., Liang, M. L., Wang, Q. X., Dong, K. Y., Tang, Y. H., and Sheng, M. X. 1986. effect of methionine and trace element supplements on the rate of woolgrowth in angora rabbits. *Chinese Journal of Rabbit Farming (Zhongguo Yangtu Zazhi).*(3): 39-42.

Bio Acc Shetty, S., Shenoy, K. B., Jacob, R. T., and Hegde, S. N. mineral composition of pigeon milk.

Experientia (1990) 46(5): 449-51

Bio Acc Shevelev, N. S. 1996. specific features in metabolism and in using microelements in heifers after 6 months of age. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii* 0(2): 170-183.

FL Shevelev, N. S. and Krupatkina, N. B. 1995. metabolism and utilization of copper, zinc, manganese and iron in heifers during lactation and transitional periods of growing. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii* 0(4): 169-180.

FL Shimada, Hideaki, Kiyozumi, Morio, Honda, Toshiya, and Kojima, Shoji. studies on poisonous metals. xx. effects of chelating agents on distribution and excretion of inorganic mercury in rats. *Yakugaku Zasshi (1988)* 108(12): 1209-14.

No COC Shimada, T., Watanabe, T., and Endo, A. comparative study of the effects of mercuric compounds on the reproduction of female hamsters. *Teratology. 18 (1). 1978 146-147*

Unrel Shimoshima, Chizuko, Nishioka, Chihiro, Takiyama, Kazuyoshi, Yuge, Osamu, and Katayama, Yoshiho. influences of protein malnutrition on amino acid composition, trace metal elements and tensile strength of rat hairs. *J. Nutr. Sci. Vitaminol. (1988)* 34(1): 67-78

Unrel Shing, Y. heparin-copper biaffinity chromatography of fibroblast growth factors. *J BIOL CHEM. Journal of Biological Chemistry. 263 (18). 1988. 9059-9062.*

Phys Shivakumar, B. R., Anandatheerthavarada, H. K., and Ravindranath, V. 1991. free radical scavenging systems in developing rat brain. *International Journal of Developmental Neuroscience* 9(2): 181-5.

FL Shkunkova, Yu. and Tkachuk, V. 1984. a new premix for piglets. *Svinovodstvo, Moscow* (7): 31-32.

Mix Shkunkova, Yu. S. and Tkachuk, V. G. 1974. effect of trace elements on the growth of chickens and the productivityof hens. *Khimiya v Sel'Skom Khozyaistve* 12(8): 614-616.

No COC Shrader, R. E., Keen, C. L., Hurley, L. S., and Zeman, F. J. hematologic and trace element alterations following chronic maternal ingestion of propyl thio uracil. *Exp Hematol (Lawrence). 10 (1). 1982. 4-55.*

No COC Shrader, R. E., Keen, C. L., Hurley, L. S., and Zeman, F. J. 1982. hematologic and trace element alterations following chronic maternal ingestion of propylthiourea. *Experimental Hematology* 10(1): 44-55.

Rev Shrivastava, R. Delomenie C. Chevalier A. John G. Ekwall B. Walum E. and Massingham R. 1992. comparison of in vivo acute lethal potency and in vitro cytotoxicity of 48 chemicals. *Cell Biol. Toxicol.* 8(2): 157-170.

FL Shtenberg, A. I. and Torchinskii, A. M. 1972. composition of a mineral mixture for an artificial diet for rats. *Vestnik Akademiya Meditsinskikh Nauk SSSR* 27(2): 47-52.

Mix Shubin, A. A. 1986. the effect of biologically active substances on reproductive function and productivity of cows. *Zhivotnovodstvo.*(10): 43-44.

Nut def Shukla, A., Agarwal, K. N., and Shukla, G. S. effect of latent iron deficiency on the levels of iron, calcium, zinc, copper, manganese, cadmium and lead in liver, kidney and spleen of growing rats. *Experientia (1990)* 46(7): 751-2.

Nut def Shukla, Arti, Agarwal, K. N., and Shukla, Girja S. effect of latent iron deficiency on metal levels of rat brain regions. *Biol. Trace Elem. Res. (1989)* 22(2): 141-52.

CP Shuler, T. R. and Nielsen, F. H. 1985. interactions among vanadium, copper and sulfur amino acids affect liver trace element content. *Trace Elem. Man Anim. -- TEMA 5 Proc. Int. Symp., 5th* : Meeting Date 1984, 382-4. Editor(s): Mills, C. F.; Bremner, I.; Chesters, J. K. Publisher: CAB, Farnham Royal, Slough, UK.

No Duration Shurson, G. C., Ku, P. K., and Waxler, G. L. 1987. intestinal morphological characteristics of germ-free and conventionalpigs as influenced by feeding a diet containing 250 ppm of supplemental copper. *Research Report, Agricultural Experiment Station, University of Michigan.*(487): 90-96.

Unrel Shurson, G. C., Ku, P. K., Waxler, G. L., Yokoyama, M. T., and Miller, E. R. 1987. action of high dietary copper in promoting growth of pigs. *Research Report, Agricultural Experiment Station, University of Michigan.*(487): 87-89.

FL Shvelidze, N. E. 1981. new resources for the production of grass meal for broilers. *Vestnik Sel'Skokhozyaistvennoi Nauki, Moscow, USSR* (10): 29-33.

Mix Sidorova, M. V. and Morozova, N. N. 1986. kidney histostructure in young bulls fed with distillery grains with the use of trace elements. *Izv Timiryazev S-kh Akad.* 0(5): 155-160.

Drug Siebert, T. 1982. selection of e. coli with plasmid-coded drug resistance by metal ionsin farm animals. 118pp.

Unrel Siegel, J. M(A), Nienhuis, R., Gulyani, S., Ouyang, S., Wu, M. F., Mignot, E., Switzer, R. C., Mcmurry, G., and Cornford, M. 1999. neuronal degeneration in canine narcolepsy. *Journal of Neuroscience* 19(1): 248-257.

Alt Siewicki, T. C., Balthrop, J. E., and Sydlowski, J. S. 1983. iron metabolism of mice fed low levels of physiologically bound cadmium in oyster or cadmium chloride. *J Nutr.* 113(6): 1140-9.

Bio Acc Signorini, G. C. 1973. trace element content of hair of calves. *Rivista Di Zootecnia e Veterinaria* (5): 499-501.

Rev Sikka, P. 1992. role of minerals in reproduction - a review. *Indian Journal of Dairy Science.* 45(4): 159-167.

Nutr Silva, R. M., Neto, J. M. F., and Sampaio, I. B. M. influence of diet and intestinal parasites on trace elements in liver and pancreas of sheep. *Arquivos Da Escola De Veterinaria Universidade Federal De Minas Gerais. 30 (2). 1978. 129-142.*

FL Simek, M. 1995. recommended requirements of mineral substances and their resources in cattle and sheep: doporucene potreby mineralnich latek a jejich zdroje u skotu a ovci.

FL Simek, M. Vyzkumny Ustav Vyzivy Zvirat Pohorelice Czech Republic. 1995. recommended requirements of mineral substances and their resources in cattle and sheep. <original> doporucene potreby mineralnich latek a jejich zdroje u skotu a ovci. *59 P. No. 11*

FL Simeonov, S. 1977. clinical and biochemical features of experimental chronic copper poisoning in sheep. *Veterinarnomeditsinski Nauki.* 14(3): 105-110.

FL Simonik, I. 1991. chemical contamination of cervical mucus in cows in relation to conception and age: <original> kontaminace cervikalniho hlenu krav chemickymi prvky ve vztahu ke koncepci a

veku. *Veterinarni Medicina - UVTIZ.* 36(4): 193-202.

FL Simonik, I. a, Pavelka, J., and Kudlac, E. 1991. chemical contamination of cervical mucus in cows in relation to conception and age. *Veterinarni Medicina - UVTIZ.* 36(4): 193-202.

No Oral Simonyan, M. A(A), Karapetyan, A. V., Galstyan, D. A., Simonyan, R. M., and Babayan, M. A. 1996. superoxide-producing lipoprotein as a factor of tumor growth suppression, enhancement of leukocyte number, and acceleration of cell division in culture. *Biochemistry (Moscow)* 61(9): 1117-1120.

Abstract Simpson D., Beynon R., Ross G., Loughran M., and Haywood S. 2003. 44. copper toxicosis in sheep: a proteomics approach. *Research in Veterinary Science.* 74(Supplement 1): 15.

No Dose Simpson, D. M., Beynon, R. J., Robertson, D. H. L., Loughran, M. J., and Haywood, S. 2004. copper-associated liver disease: a proteomics study of copper challenge in a sheep model. *Proteomics [Proteomics]. Vol. 4, No. 2, Pp. 524-536. Feb 2004.*

Unrel Sinclair, Ralph Mason. 1989.*The Development of a Site Specific Water Quality Standard for Copper*

Phys Sindurani, J. A. and Rajamohan T(A). 2000. effects of different levels of coconut fiber on blood glucose, serum insulin and minerals in rats. *Indian Journal of Physiology and Pharmacology.* 44(1): 97-100.

BioAcc Singh, B. R. and Mishra, V. K. mineral content of grasses and grasslands of the himalayan region india 2. concentration of trace and major elements in grasses in relation to soil properties and climatic factors. *Soil Science.* 143(4): 241-256.

Surv Singh, J., Parkash, P., and Gupta, G. S(a). 1999. state of pregnancy modifies lead toxicity in mice. *Biological Trace Element Research.* 67(3): 205-213.

No COC Singh, Manohar and Kanwar, K. C. effect of fluoride on copper, manganese and zinc in bone and kidney. *Bull. Environ. Contam. Toxicol. (1981)* 26(3): 428-31.

Acute Singh, P. P. and Junnarkar, A. Y. 1991. behavioural and toxic profile of some essential trace metal salts in mice and rats. *Indian J Pharmacol.* 23(3): 153-159.

Fate Sinha, R. K., Nielsen, F. H., and Zimmerman, T. J. effect of dietary iron on liver iron, copper, zinc and manganese in growing rats. *J. Inst. Chem. (India) (1987)* 59(3): 135-6.

Bio Acc Sismeev, V. P., Slyusarev, A. A., and Soroka, V. R. 1972. behaviour of manganese and copper in the tissues of the liver and smallintestine in dogs infected with helminths. <. *Document Title>Problemy Parazitologii. Trudy VII NauchnoiKonferentsii Parazitologov USSR. Part II.* 254.

No COC Sjostrom, K. and Crapo, J. D. 1983. structural and biochemical adaptive changes in rat lungs after exposure to hypoxia. *Laboratory Investigation* 48(1): 68-79.

FL Skare, J. U. 1995. environmental toxicology research at a veterinary college-veterinary institute. *Norsk Veterinaertidsskrift.* 107(4): 363-376.

Nutr Sklan, David, Halevy, Orna, and Donoghue, Susan. the effect of different dietary levels of vitamin a on metabolism of copper, iron and zinc in the chick. *Int. J. Vitam. Nutr. Res. (1987)* 57(1): 11-18

FL Skorkowska-Zieleniewska, J. 1968. the effects of dietary copper and iron. *Zesz. Nauk. Szk. Gl. Gospod. Wiejsk. Warszawie, Technol. Rolno-Spozyw.* 5: 59-65.

Bio Acc Small Julie A(A), Charmley E(A), Rodd, A. V(A), and Fredeen, A. H. 1997. serum mineral concentrations in relation to estrus and conception in beef heifers and cows fed conserved forage. *Canadian Journal of Animal Science* 77(1): 55-62.

Nut def Smart, M. E. 1985. nutritional factors of lameness and metabolic bone disease in cattle. *Veterinary Clinics of North America, Food Animal Practice* 1(1): 13-23.

Abstract Smeyers-Verbeke, J. 1981. determination of trace elements in subcellular fractions. *Verh. K. Acad. Wet. Lett. Schone Kunsten Belg., Kl. Wet.* 43(167): 81 pp.

Plant Smirnova, Z. A. use of trace nutrients to increase the growth of plants and the soil germination rate of seeds of some introduced varieties. *Tr. Kaz. Nauch.-Issled. Inst. Les. Khoz. (1970)* : 7, 203-6 .

Surv Smith, G. J. and Rongstad O. J. 1981. heavy metals in mammals from two unmined copper-zinc deposits in wisconsin. *Bull. Environ. Contam. Toxicol.* 27(1): 28-33.

Alt Smith, R. M., Fraser, F. J., Russell, G. R., and Robertson, J. S. 1977. enzootic ataxia in lambs appearance of lesions in the spinal cord during fetal Development. *J Comp Pathol.* 87(1): 119-128.

Diss Snedeker, Suzanne Mary. 1982. metabolism of zinc, iron, copper and manganese of men and rats as affected by dietary protein, calcium and phosphorus. *Avail.: Univ. Microfilms Int. Order No. DA8224068 From: Diss. Abstr. Int. B 1983, 43. 8. 2502-3.* (123 pp.)

Fate Snively, W. D. Jr and Becker, B. 1968. minerals, macro and micro: dynamic nutrients. ii. the micro-minerals. *Ann Allergy.* 26(5): 233-40.

Nutr Snyder, C. S., Hornsby, Q., Welch, J., Gordon, L., and Franklin, T. 1993. effect of phosphate and poultry litter on cotton production on recentlyleveled land in lonoke county. *Research Series - Arkansas Agricultural Experiment Station* (425): 64-66.

Surv Snyder, N. F. R., Snyder, H., Lincer, J. L., and Reynolds, R. T. 1973. organochlorines, heavy metals, and the biology of north american accipiters. *BioScience.* 23(5): 300-305.

CP Soares, J. H. Jr, Madara, P. J., and Smith, J. C. Jr. high levels of dietary zinc and copper increase bone resorption in laying quail hens. *73rd Annual Meeting of the Poultry Science Association, Inc. Poult Sci. 63 (Suppl. 1). 1984. 186.*

Nutr Sobamiwa, O. and Longe, O. G. 1994. the nutritive value of alkali-treated cocoa husk meal in broiler chickdiets. *Animal Feed Science and Technology* 46(3/4): 321-330.

Mix Sobolev, N. 1995. belotin. *Ptitsevodstvo.*(5): 20.

Mix Socha, M. T. and Johnson, A. B. 1998. summary of trials conducted evaluating the effect of a combination of complexed zinc methionine, manganese methionine, copper lysine and cobalt glucoheptonate on lactation and reproductive performance of dairy cattle. *Journal of Dairy Science* 81(SUPPL. 1): 251.

Surv Sodhi, H. and Mehta, U. 1987. zinc copper interaction of low optimum and higher dietary levels its influence on growth of Rats. *Indian J Nutr Diet.* 24(8): 225-232.

Phys Soeli, N. E. and Nafstad, I. 1976. chronic copper poisoning in sheep. structural changes in erythrocytes and organs. *Acta Veterinaria Scandinavica* . 17(3): 316-327.

No Control Soeli, N. E. and Nafstad, I. 1978. effects of daily oral administration of copper to goats. *Acta Veterinaria Scandinavica.* 19(4): 561-568.

Diss Soileau, R. M., Lucas, L. C., and Gantenberg, J. B. metallic ion release and distribution from copper-based dental Alloys. *68th General Session of the International Association for Dental Research and the 19th Annual Session of the American Association for Dental Research, Cincinnati, Ohio, Usa, March 7-11, 1990. J Dent Res. 69 (Spec. Issue Mar.). 1990. 264.*

No Dose Sokol, R. J., Devereaux, M., Mierau, G. W., Hambidge, K. M., and Shikes, R. H. 1990. oxidant injury to hepatic mitochondrial lipids in rats with dietary copper overload. modification by vitamin e deficiency. *Gastroenterology.* 99(4): 1061-71.

No Dose Sokol, R. J., Devereaux, M. W., O'Brien, K., Khandwala, R. A., and Loehr, J. P. 1993. abnormal hepatic mitochondrial respiration and cytochrome c oxidase activity in rats with long-term copper overload. *Gastroenterology.* 105(1): 178-87.

FL Sokolova, O. L. 1988. chemical composition of meat of pigs fattened with belakt andprovilakt. *Veterinarnaya Nauka - Proizvodstvu* (26): 173-178.

FL Soli, N. E. 1981. chronic copper poisoning in sheep. *Ubersichten Zur Tierernahrung.* 9(2): 105-124.

No Dose Soli, N. E. and Froslie A. 1977. chronic copper poisoning in sheep. 1. the relationship of methaemoglobinemia to heinz body formation and haemolysis during the terminal crisis. *Acta Pharmacol. Toxicol.* 40: 169-177.

No Oral Soli, N. E. and Rambaek J. P. 1978. excretion of intravenously injected copper-64 in sheep. *Acta Pharmacol. Toxicol.* 43: 205-210.

Bio Acc Solly, S. R. B. Revfeim K. J. A. and Finch G. D. 1981. 1981. concentrations of cadmium, copper, slelnium, zinc, and lead in tissues of new zealand cattle, pigs, and sheep. *N. Z. J. Sci.* 24: 81-87.

HHE Solomons, N. W. 1986. trace-elements in nutrition of the elderly .2. saddis for copper, manganese, selenium, chromium, molybdenum, and fluoride. *Postgraduate Medicine* 79(6): 251&.

Unrel Sorenson, J. R. 1992. essential metalloelement metabolism and radiation protection and recovery. *Radiation Research* 132(1): 19-29.

QAC Sorenson, J. R. J(A), Soderberg, L. S. F., Chang, L. W., Willingham, W. M., Baker, M. L, Barnett, J. B., Salari H(A), and Bond K(A). 1993. copper-, iron-, manganese- and zinc-3,5-diisopropylsalicylate complexes increase survival of gamma-irradiated mice. *European Journal of Medicinal Chemistry* 28(3): 221-229.

No Oral Soroka, Marek. the behavior of iron, copper, zinc, magnesium, and calcium in blood plasma in chronic experimental poisoning with manganese. *Rocz. Pomor. Akad. Med. Im. Gen. Karola Swierczewskiego Szczecinie (1979)* 25: 277-96 .

Rev Sourkes, T. L. 1982. transition elements and the nervous system. *Iron Deficiency: Brain Biochemistry and Behavior. Illus. ISBN 0-89004-690-5.* 1-30.

Nut def Southern, L. L. and Baker, D. H. eimeria acervulina infection and the zinc-copper interrelationship in the chick. *Poult. Sci. (1983)* 62(2): 401-4

No Duration Southern, L. L. a, Watkins, K. L. , and French, D. D. 1993. effect of dietary sodium bicarbonate on

growth, liver copper concentration and incidence of gastric ulceration in pigs fed excess dietary copper. *International Journal for Vitamin and Nutrition Research.* 63(1): 45-47.

Nutr Soyars, K. E. and Fischer, J. G. 1998. iron supplementation does not affect cell proliferation or aberrant crypt foci development in the colon of sprague-dawley rats. *The Journal Of Nutrition.* 128(4): 764-770.

Surv Spalding, M. G., Steible, C. K., Sundlof, S. F., and Forrester, D. J. 1997. metal and organochlorine contaminants in tissue of nestling wading birds of (ciconiiformes) from southern florida. *Florida Field Naturalist.* 25(2): 42-50.

Imm Spallholz, J. E. and Stewart, J. R. 1989. advances in the role of minerals in immunobiology. *Biol Trace Elem Res.* 19(3): 129-51.

Nut def Spears, J. W. and Hatfield, E. E. 1985. interaction between nickel and copper in the rat. *Biological Trace Element Research* 7(3): 181-193. Ref ID: 19666

CP Spears, J. W., Hatfield, E. E., and Forbes, R. M. 1977. nickel copper interrelationship in the rat. *Proc Soc Exp Biol Med.* 156(1): 140-143.

Nutr Sperb, Clovis Oliveira, Chaves Costa, Paulo Tabajara, Zanella, Irineo, and Pinto de Toledo, Geni Salete. levels of microminerals in the diets of brown egg layers. *Rev. Bras. Zootec. (1997)* 26(5): 962-966 .

No Tox Spicer, M. T. and Stoecker, B. J. the effect of chromium depletion and streptozotocin (stz)-induced diabetes on reproductive performance, carbohydrate and lipid metabolism and trace element interactions during pregnancy. *FASEB J 1997 Feb;11(3):A405*

Soil Spiers, James M. and Braswell, John H. soil-applied sulfur affects elemental leaf content and growth of 'tifblue' rabbiteye blueberry. *J. Am. Soc. Hortic. Sci. (1992)* 117(2): 230-3.

Unrel Spitzlei, S. 1996. composition of the hoof horn of horses: influence on horn quality and the effect of diet. 208 pp.

Drug Spivey, F., Fox, M. R., and Fry, B. E. Jr. 1970. cadmium toxicity decreased by dietary ascorbic acid supplements. *Science.* 169(949): 989-91.

Nut Def Spivey Fox, M. R., Tao, S. H., Stone, C. L., and Fry, B. E. Jr. 1984. effects of zinc, iron and copper deficiencies on cadmium in tissues of japanese quail (coturnix coturnix japonica). *E H P Environmental Health Perspectives.* v. 54 : p. 57-65.

FL Splitek, M. 1982. micro-mineral nutrition of poultry: mikromineralni vyziva drubeze. *Krmivarstvi a Sluzby.* 18(11): 238-240.

FL Splitek, M. Vyzkumny Ustav Krmivarskeho Prumyslu a Sluzeb Pecky Czechoslovakia. 1982. micro-mineral nutrition of poultry. <original> mikromineralni vyziva drubeze. *Krmivarstvi a Sluzby. V. 18(11) P. 238-240*

Nut def Spoerl, R. and Kirchgessner, M. 1975. changes in cu status and in caeruloplasmin activity of mother and sucking rats given different amounts of cu. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde.* 35(2/3): 113-127.

Surv Spoerl, R. and Kirchgessner, M. 1976. [cu requirement of pregnant and lactating rats]: <original> untersuchungen zum cu-bedarf gravider und laktierender ratten. *Arch Tierernahr.* 26(1): 25-34.

Acu Sporn, Alfred and Cirstea, Adriana. determination of the concomitant action of arsenic, copper, zinc, lead, and tin; acute toxicity. *Igiena (1969)* 18(2): 81-90

FL Sporn, Alfred, Dinu, Ileana, and Stoenescu, Liana. toxicity of zinc, copper, lead, and arsenic. *Igiena (1968)* 17(12): 717-24

Mix Sporn DinnIStoenescuL, A. 1965-1973. influence of concomitant administration of arsenic, lead, copper and zinc on the activity of some hepatic enzymes and on the (sic) oxidative phosphorylation. *Rev. Roumaine Biochim.; 6(1)*

No COC Springer, L. N., Tilly, J. L., Sipes, I. G., and Hoyer, P. B. enhanced expression of bax in small preantral follicles during 4-vinylcyclohexene diepoxide-induced ovotoxicity in the rat. *Toxicology and Applied Pharmacology; 139 (2). 1996. 402-410.*

Unrel Squibb, R. L. 1982.*Biochemical Changes in Tissues During Infectious Illness: Bioenergetics of Infection and Exercise. <NOTE> Annual Progress Rept. No. 16 (Final), 1 Jan 65-30 Jun 80, 1 Jul 80-31 Mar 82*

Alt Squibb, R. L., Beisel, W. R., and Bostian, K. A. 1971. effect of newcastle disease on serum copper, zinc, cholesterol, and carotenoid values in the chick. *Applied Microbiology* 22(6): 1096-9.

Rev Squires, E. J. and Wu, J. 1992. mycotoxins, vitamin e and lipid peroxidation. 82-97.

Nut def Squires, R. A. and Budge, G. 1997.*Proceedings From the 27th Seminar of the Society of Sheep and BeefCattle Veterinarians NZVA.* (175): 1-151.

Bio Acc St Louis Vincent L(A), Breebaart Loes, Barlow Jon C, and Klaverkamp Jack F. 1993. metal accumulation and metallothionein concentrations in tree swallow nestlings near acidified lakes. *Environmental Toxicology and Chemistry* 12(7): 1203-1207.

Plant Staaland, Hans, Brattbakk, Ingvar, Ekern, Karen, and Kildemo, Kjetil. chemical composition of reindeer forage plants in svalbard and norway. *Holarctic Ecol. (1983)* 6(2): 109-22 .

Surv Stafford, Kevin J. 1997. the diet and trace element status of sambar deer (cervus unicolor) in manawatu district, new zealand. *New Zealand Journal of Zoology.* 24(4): 267-271.

Diss Stahl, James L. 1990. zinc supplementation: effects on zinc, copper, and iron metabolism in chicks and on laying hen and progeny performance. *Avail.: Univ. Microfilms Int. Order No. DA9013370 From: Diss. Abstr. Int. B 1990, 51. 1. 14. Unavailable.* 148 pp.

Nut Def Stajn, A., Zikic, R. V., Ognjanovic, B., Saicic, Z. S., Pavlovic, S. Z., Kostic, M. M., and Petrovic, V. M. 1997. effect of cadmium and selenium on the antioxidant defense system in rat kidneys. *Comparative Biochemistry and Physiology. C; Pharmacology, Toxicology & Endocrinology.* 117(2): 167-172.

Surv Stanchev, H. and Tanin, G. M. 1993. bioavailability of minerals in major feedstuffs for broiler chicks. *Ber. Bundesforschungsanst. Ernaehr. BFE-R-93-01, Bioavailability '93, Pt. 2,* 225-9

Nut def Stangl, G. I. and Kirchgessner, M. effect of nickel deficiency on various metabolic parameters of rats. *J. Anim. Physiol. Anim. Nutr. (1996)* 75(3): 164-74.

Unrel Stanojevic, Lazar. 1972.*Trans. of Arhiv Za Poljoprivredne Nauke i Tehniku (Yugoslavia).* 24(88): 115 p.

Mix Starnes, S. R., Spears, J. W., Froetschel, M. A., and Croom, W. J. Jr. 1984. influence of monensin and lasalocid on mineral metabolism and ruminalurease activity in steers. *Journal of Nutrition* 114(3): 518-525.

FL Starykh, I. L. 1979. effect of different doses of a mixture of trace element salts onnitrogen metabolism. *Trudy Vsesoyuznogo Nauchno-Issledovatel'Skogo Instituta Myasnogo Skotovodstva* 24: 116-117.

In Vit Stefanovic, Vladisav, Savic, Vojin, Vlahovic, Predrag, Ardaillou, Nicole, and Ardaillou, Raymond. ecto-5'-nucleotidase of cultured rat mesangial cells. *Renal Physiol. Biochem. (1989)* Volume Date 1988, 11(1-2): 89-102.

FL Steinhardt, M., Gratsch, U., Furcht, G., Fussel, A.-E., Pape, G., and Horugel, K. 1984. trace elements and vitamin a contents in the liver of newborn pigletsand their use as health criteria. *Tierzucht* 38(10): 455-458.

Nutr Steinsberger, Scott C., Ort, Jon F., and Shih, Jason C. H. composition and phosphorus bioavailability of a solid by-product from anaerobically digested waste from caged layer hens. *Poult. Sci. (1987)* 66(4): 634-9

FL Stelletskii, V. V. and Korkunov, Yu. P. trace element requirement of adult chickens. *Tr. Krasnoyarsk. Nauch.-Issled. Inst. Sel. Khoz. (1969)* : 5, 288-300.

No Oral Stemmer, K. L. 1976.*Investigation on the Pulmonary Effects of Intermetallic Beryllium Compounds. Progress Report, January 1--December 31, 1976*

Nutr Stepchenko, L. M., Zhorina, L. V., and Kravtsova, L. V. the effect of sodium humate on metabolism and resistance of highly productive poultry. *Biol. Nauki (Moscow) (1991)* (10): 90-5.

Nut def Stepurin, G. F., Bularga, I. A., Vranchan, V. G., and Korchevaya, L. G. 1986. interaction of energy, protein, amino acids and trace elements in pignutrition.: belkovo-aminokislotnoe pitanie sel'skokhozyaistvennykhzhivotnykh. tezisy, doklady vsesoyuznogo soveshchaniya, kaluga, 28-30may, 1986. 48-50.

FL Stepurin, G. F., Bularga, I. A., Vranchan, V. G., and Korchevaya, L. G. 1986. interaction of energy, protein, amino acids and trace elements in pignutrition. <document title>belkovo-aminokislotnoe pitanie sel'skokhozyaistvennykhzhivotnykh. tezisy, doklady vsesoyuznogo soveshchaniya, kaluga, 28-30may, 1986. 48-50.

FL Stevanovic, D. and Sevkovic, N. 1987. the influence of copper on productive and reproductive performance of laboratory mice. *Vet Glas.* 41(11-12): 876-881.

CP Stevanovic, D. J. 1997. [the investigation on the influence of different copper rates in food on the body mass changes in rats]. *Proceedings of the 3rd Conference on Drugs for Veterinary Use, Igalo [Yugoslavia], April 14-18, 1997* : 229-231.

CP Stevens, J. T., Wagner, S. R., Zemaitis, M. A., and Greene, F. E. 1973. effect of chronic dieldrin exposure on the hepatic microsomal mixed function oxidase system from male and female rats. *Toxicol. Appl. Pharmacol.* 25(3): 484.

CP Stevenson, M. H. and Jackson, N. the accumulation of copper in the liver of the domestic laying hen. *325th Meeting of the Nutrition Society, London, England, DEC. 8, 1978. PROC NUTR SOC. 38 (2). 1979. 29a.*

Nut def Stevenson, M. H. and Jackson, N. 1984. comparison of dietary hydrated copper sulphate, dietary zinc oxide anda direct method for inducing a moult in laying hens. *British Poultry Science* 25(4): 505-517.

Surv Stewart, F. M., Furness, R. W., and Monteiro, L. R. 1996. relationships between heavy metal and metallothionein concentrations in lesser black-backed gulls, larus fuscus, and cory's shearwater, calonectris diomedea. *Arch Environ Contam Toxicol.* 30(3): 299-305.

Bio Acc Stewart, F. M., Phillips, R. A., Bartle, J. A., Craig, J., and Shooter, D. 1999. influence of phylogeny, diet, moult schedule and sex on heavy metal concentrations in new zealand procellariiformes. *Vol. 178, Pp. 295-305* Marine Ecology Progress Series

Bio Acc Stewart, F. M., Thompson, D. R., Furness, R. W., and Harrison, N. seasonal variation in heavy metal levels in tissues of common guillemots, uria aalge from northwest scotland. *Arch. Environ. Contam. Toxicol. (1994)* 27(2): 168-75.

Bio Acc Stewart, Fiona M., Phillips, Richard A., Bartle, Alexander J., Craig, John, and Shooter, David. influenc of phylogeny, diet , moult schedule, and sex on heavy metal concentrations in new zealand procellariiformes. *Mar. Ecol.: Prog. Ser. (1999)* : 178, 295-305.

Gene Stich, H. F. and Stich, W. 1982. chromosome-damaging activity of saliva of betel nut and tobacco chewers. *Cancer Letters* 15(3): 193-202.

FL Stilinovic, Z., Pajalic, J., Beric, Z., and Braun, B. 1971. effect of different amounts of dietary cu and mn on alkaline phosphatase in plasma of chickens. *Poljoprivredna Znanstvena Smotra.* 27: 181-190.

FL Stilinovic, Z., Pajalic, J., Beric, Z., and Braun, B. effect of various amounts of dietary copper and manganese on the activity of alkaline phosphatase in the blood plasma of chickens. *Poljopr. Znan. Smotra (1971)* : 27, 181-90

Unrel Stino, F. K. and Washburn, K. W. 1973. genetic basis of packed erythrocyte volume in japanese quail. *Poultry Science* 52(4): 1606-10.

Anat Stino, F. K. R. and Washburn, K. W. 1973. divergent selection under two nutritional environments for packederythrocyte volume in japanese quail. *Genetics, Austin, USA* 74(2): 363-369.

FL Stoliar, V. I. 1972. [congenital disorders in the presence of nutritional microelement deficiencies]. <original> vrozhdennye narusheniia pri alimentarnom defitsite mikroelementov. *Pediatriia* 51(10): 75-8.

HHE Stoliar, V. I. 1972. congenital disorders in the presence of nutritional microelement deficiencies: vrozhdennye narusheniia pri alimentarnom defitsite mikroelementov. *Pediatriia.* 51(10): 75-8.

Drug Stoll, Claude, Dott, Beatrice, Alembik, Yves, and Koehl, Christian. maternal trace elements, vitamin b12, vitamin a, folic acid, and fetal malformations. *Reprod. Toxicol. (1999)* 13(1): 53-57.

FL Stolyarova, A. G., Manukhina, A. I., Volkov, D. T., Bataeva, A. P., Kuznetsov, S. G., and Plekhanov, L. A. 1975. morphology of the internal organs of hens with different dietary copper levels. *Byull. Vses. Nauchno-Issled. Inst. Fiziol., Biokhim. Pitan. S-Kh. Zhivotn.* 9(4): 40-2.

Surv Storey, M. L. and Greger, J. L. 1987. iron, zinc and copper interactions: chronic versus acute responses of rats. *J Nutr.* 117(8): 1434-42.

Nutr Story, C., Rasby, R., Brink, D., and Kinder, J. 1998. effect of trace mineral supplementation on ovarian and luteal function in pubertal beef heifers. *Journal of Dairy Science* 81(SUPPL. 1): 221.

No COC Stoward, P. J., Christie, K. N., and Thomson, C. dipeptidyl peptidases in the soleus muscle of the rat before and after treatment with 5-hydroxytryptamine. *Histochemistry (1988)* 89(1): 11-24 .

Acu Stowe, H. D. and Brady, P. S. 1978. effect of copper pretreatment on selenium toxicity in ponies. *Federation Proceedings.* 37(3): 324.

Acu Stowe, H. D. 1980. 1980. effects of copper pretreatment upon the toxicity of selenium in ponies. *Am. J. Vet. Res.* 41: 1925-`1928.

FL Stoyanov, M., Baykov, B., and Gugova, M. 1994. mathematical model for chemical elements contents assessment in egg-production ecotechnical systems. *Dokladi Na B"Lgarskata Akademiya Na Naukite* 47(5): 115-118.

Nut def Strause, L., Glowacki, J., and Saltman, P. 1986. the influence of dietary manganese and copper deficiencies on bone metabolism in the rat. *Journal Of Bone And Mineral Research* 1: 102.

Abstract Strause, L. and Saltman, P. 1985. biochemical-changes in rat skeleton following long-term dietary manganese and copper deficiencies. *Federation Proceedings* 44: 752.

CP Strause, L., Saltman, P., and Miller, M. 1984. the role of trace elements in the etiology of osteoporosis: results with an animal model. *Osteoporosis Proc. Copenhagen Int. Symp.* 1: 385-7. Editor(s): Christiansen, Claus. Publisher: Copenhagen Int. Symp. Osteoporosis, Glostrup, Den.

Nut def Strause, Linda, Saltman, Paul, and Glowacki, Julie. the effect of deficiencies of manganese and copper on osteoinduction and on resorption of bone particles in rats. *Calcif. Tissue Int. (1987)* 41(3): 145-50.

Nut def Strause, Linda G., Hegenauer, Jack, Saltman, Paul, Cone, Robert, and Resnick, Donald. effects of long-term dietary manganese and copper deficiency on rat skeleton. *J. Nutr. (1986)* 116(1): 135-41 .

Surv Stronkhorst, J. Rijkswaterstaat, Ysebaert, T. J., Smedes, F., Meininger, P. L., Dirksen, S., and Boudewijn, T. J. 1993. contaminants in eggs of some waterbird species from the scheldt. *Mar Pollut Bull.* 26(10): p572(7).

Unrel Strothkamp, K. G. and Lippard, S. J. anion binding to the 4 copper form of bovine erythrocyte super oxide dis mutase ec-1.15.1.1 mechanistic implications. *Biochemistry. 20 (26). 1981 (Recd. 1982). 7488-7493.*

Aquatic Stuijfzand S.C., Kraak M.H.S., Wink Y.A., and Davids, C. 1995. short-term effects of nickel on the filtration rate of the zebra mussel dreissena polymorpha. *Bull. Environ. Contam. Toxicol* VOL. 54, NO. 3: pp. 376-381.

No Oral Stuve, G., Skagemo, H., Ytrehus, B., Sivertsen, T., and <Editors> Lag, J. 1996. osteoporosis in moose (alces alces) in agder, norway. occurrence,manifestation and etiology. <book>chemical data of plant, animal and human tissues as a basis ofgeomedical investigations. 137-144.

Nut def Styrud, J., Dahlstrom, V. E., and Eriksson, U. J. 1986. induction of skeletal malformations in the offspring of rats fed a zinc deficient diet. *Upsala Journal of Medical Sciences* 91(1): 29-36.

FL Su, Qi, Jin, Yueying, Duan, Yuqin, Huang, Meiyu, Liu, Jinxu, and Lu, Zhaohai. effect of selenium

deficiency on production and diseases of livestock and poultry . *Zhongguo Nongye Kexue (Beijing) (1991)* 24(2): 69-76.

Unrel Su, Xiu-rong, Li, Tai-wu, Ding, Ming-jin, and Chien, Paul K. evaluation on nutritive value of portunus trituberculatus. *Chin. J. Oceanol. Limnol. (1997)* 15(2): 168-172 .

Aquatic Su, Xiurong, Li, Taiwu, Ouyang, Fen, and Liu, Ping. study on the nutritive compositions of portunus trituberculatus. *Yingyang Xuebao (1996)* 18(3): 342-346 .

FL Su, Y. C. and Chao, C. H. 1993. comparison of the resistance to experimental eimeria tenella infectionand iron, copper and zinc changes in local chickens, white leghorns andbroilers. *Journal of the Chinese Society of Veterinary Science* 19(4): 228-242.

FL Su, Y. C., Yang, C. L., Lu, J. J., Lin, P. H., and Lo, D. Y. 1998. the physiological response and carcass hygiene of dairy goats at different lead acetate and copper sulfate Levels. *Journal of the Chinese Society of Veterinary Science.* 24(4): 214-226.

FL Su, Yao Chi and Chao, Ching Hsien. comparison of resistance ability and alteration of iron, copper and zinc concentrations to eimeria tenella among country chickens , white leghorn and broiler. *Zhonghua Minguo Shouyi Xuehui Zazhi (1993)* 19(4): 228-42

CP Suchat Chuenprasert, Pornchai Chamnarnpood , and Aroon Noomtoom (Northern Veterinary Diagnostic Centre, Lampang Thailand. 1983. study of mineral level in dairy cows in the northern part of thailand. <original> kan suksa radap raethat nai khonom thap phaknua khong prathet thai. proceeding of the 10th annual veterinary conference. <original> pramuan ruang prachum wichakan thang sattawaphaet khrang thi 10 prachampi 2526 . *P. 69-77*

FL Suchy, P., Stanek, S. Vysoka Skola Zemedelska Brno Czechoslovakia, Jerabek, S., and Zelenka, J. 1989. dynamics in the blood picture and biochemical indicators of blood plasma in the breeder cocks during the period of sexual maturation. <original> dynamika zmen krevniho obrazu a biochemickych ukazatelu krevni plazmy u plemennych kohoutu v dobe pohlavniho dospivani. *Zivocisna Vyroba - UVTIZ. V. 34(8) P. 741-750*

Fate Sugawara, C., Sugawara, N., Ikeda, N., Okawa, H., Okazaki, T., Otaki, J., Taguchi, K., Yokokawa, K., and Miyake, H. 1987. effects of ingested 4000ppm aluminum on the essential metals, especially zinc, in intact and ethanol treated mice.*Drug Chem Toxicol.* 10(3-4): 195-207.

No Control Sugawara, N., Li, D., Sugawara, C., and Miyake, H. 1995. response of hepatic function to hepatic copper deposition in rats fed a diet containing copper. *Biol Trace Elem Res.* 49(2-3): 161-9.

Rev Sugawara, N. and Sugawara, C. 1986. changes of eight metals in mouse testis treated with cadmium and-or Selenium. *Jpn J Ind Health.* 28(6): 474-475.

Acu Sugawara, N. and Sugawara, C. 1984. comparative-study of effect of acute administration of cadmium and silver on ceruloplasmin and metallothionein - involvement of disposition of copper, iron, and zinc. *Environmental Research* 35(2): 507-515.

No Oral Sugawara, N. and Sugawara, C. 2000. competition between copper and silver in fischer rats with a normal copper metabolism and in long-evans cinnamon rats with an abnormal copper metabolism. *Archives of Toxicology [Arch. Toxicol.]. Vol. 74, No. 4/5, Pp. 190-195. 18 Jul 2000.*

No Oral Sugawara, N. Li D. Katakura M. and Sugawara C. 1994. biliary excretion of copper in fischer rats treated with copper salt and in long-evans cinnamon (lec) rats with an ingerently abnormal copper metabolism. *Biol. Trace Elem. Res. 46, 125-134.* 46: 125-134.

Gene Sugino Norihiro, Hirosawa-Takamori Mitsuko, Zhong Liping, Telleria Carlos M, Shiota Kunio, and Gibori Geula(A). 1998. hormonal regulation of copper-zinc superoxide dismutase and manganese superoxide dismutase messenger ribonucleic acid in the rat corpus luteum: induction by prolactin and placental lactogens. *Biology of Reproduction* 59(3): 599-605.

Unrel Suleiman, A., Okine, E., and Goonewardene, L. A. 1997. relevance of national research council feed composition tables in alberta. *Canadian Journal of Animal Science* 77(2): 197-203.

Unrel Suleimanov, R. A. and Galiev, M. A. 1984. [hygienic establishment of maximum permissible concentrations of nitrilotrimethylphosphonic acid and a copper-containing complex in reservoir water]. *Gig Sanit.*(2): 67-8.

Dead Sullivan, J. M., Janovitz, E. B., and Robinson, F. R. 1991. copper toxicosis in veal calves. *Journal of Veterinary Diagnostic Investigation.* 3(2): 161-164.

In Vit Sullivan, Vicki K., Burnett, Frank R., and Cousins, Robert J. metallothionein expression is increased in monocytes and erythrocytes of young men during zinc supplementation. *J. Nutr. (1998)* 128(4): 707-713.

Diss Sultana, Parvin. 1985.*Factors Affecting the Performance of Bird Control Chemicals*

Diss Sunanta Pongsamart, Surang Assawamunkong, and Naranin Markman (Chulalongkorn Univ., Bangkok Thailand. 1986. biochemical and biological evaluation of nutritional quality of mushrooms. <original> kan pramoen thang chiwakhemi lae thang chiwaphap khong khun kha thang photchanakan khong het. *132 Leaves*

Mix Sundaresan, P. R., Kaup, S. M., Wiesenfeld, P. W., Chirtel, S. J., Hight, S. C., and Rader, J. I. 1996. interactions in indices of vitamin a, zinc and copper status when these nutrients are fed to rats at adequate and increased levels. *Br J Nutr.* 75(6): 915-28.

No Control Supplee, WC. 1964. observations on the effect of copper additions to purified turkey diets. *Poult. Sci.* 43: 1599.

No Dose Surai, Peter F., Speake, Brian K., Noble, Raymond C., and Sparks, Nick H. C. tissue-specific antioxidant profiles and susceptibility to lipid peroxidation of the newly hatched chick. *Biol. Trace Elem. Res. (1999)* 68(1): 63-78.

Mix Surina, S. M. and Tabakov, N. A. 1989. the effect of balanced feed rations on milk yield, reproduction andmetabolism in cows.: intensifikatsiya zhivotnovodstva v khakassii. 61-63.

Mineral Suttle, M. and Jones, D. G. 1989. recent developments in trace element metabolism and function trace elements disease resistance and immune responsiveness in ruminants. *J Nutr.* 119(7): 1055-1061.

CP Suttle, N., Wright, C., MacPherson, A., Harkess, R., Halliday, G., Miller, K., Phillips, P., and Evans, C. 1986. how important are trace element deficiencies in lambs on improved hill pastures in scotland. *Proceedings Sixth International Conference on Production Disease in Farm Animals, September 1986, Belfast, UK* : 100-103.

Nut def Suttle, N. F. 1986. copper deficiency in ruminants; recent developments. *Vet Rec.* 119(21): 519-22.

Bio Acc Suttle, N. F. copper, iron, manganese and zinc concentrations in the carcases oflambs and calves and the relationship to trace element requirementsfor growth. *British Journal of Nutrition| SN- 0007-*

1145| PY- 1979| VO- 42| IS- 1 : 89-96| LA- English| DT- Journal article| AB-

Phys Suttle, N. F. 1986. problems in the diagnosis and anticipation of trace element deficiencies in grazing livestock. *Veterinary Record.* 119(7): 148-152.

No Resp Suttle, N. F. 1977. reducing the potential copper toxicity of concentrates to sheep by the use of molybdenum and sulphur supplements. *Animal Feed Science and Technology.* 2(3): 235-246.

Alt Suttle, N. F., Abrahams, P., and Thornton, I. 1984. the role of a soil and dietary sulfur interaction in the impairment of copper absorption by ingested soil in Sheep. *J Agric Sci.* 103(1): 81-86.

Bio Acc Suttle, N. F., Alloway, B. J., and Thornton, I. an effect of soil ingestion on the utilization of dietary copper by sheep. *Journal of Agricultural Science. 84 (2). 1975 249-254.*

CP Suttle, N. F. and Field, A. C. effects of dietary calcium and phosphorus concentrations on the fecal excretion of copper manganese and zinc in sheep. *Proceedings of the Nutrition Society. 29 (2). 1970 33a-34a*

Nut def Suttle, N. F., Gunn, R. G., Allen, W. M., Linklater, K. A., and Wiener, G. 1983.: ix + 155pp.

Imm Suttle, N. F. and Jones, D. G. 1986. copper and disease resistance in sheep a rare natural confirmation of interaction between a specific nutrient and infection. *Proc Nutr Soc.* 45(3): 317-326.

Nut def Suttle, N. F. and Price, J. 1976. the potential toxicity of copper-rich animal excreta to sheep. *ANIM PROD.* 23(2): 233-241.

Unrel Sutton, A. L., Brumm, M. C., Kelly, D. T., Henderson, C. A., and Mayrose, V. B. 1980. effect of dietary salt, arsenic and copper additions and wastemanagement systems on selected microbial organisms in swine wastes. *Journal of Animal Science* 51(4): 791-797 .

No Dose Suveges, T., Ratz, F., and Salyi, G. 1971. pathogenesis of chronic copper poisoning in lambs . *Acta Vet Acad Sci Hung.* 21(4): 383-391.

Unrel Suzuki, H., Matsumori, A., Matoba, Y., Kyu, B. S., Tanaka, A., Fujita, J., and Sasayama, S. 1993. enhanced expression of superoxide dismutase messenger rna in viral myocarditis. an sh-dependent reduction of its expression and myocardial injury. *Journal of Clinical Investigation* 91(6): 2727-33.

Nut def Suzuki, K., Baba, K., Suzuki, K., Arakawa, Y., Matsuo, Y., Mano, M., Tomioka, E., Kimoto, I., Sasaki, T., and Takeuchi, S. alteration of trace metals in fatty liver induced by choline-deficient diet in the rat. *Biomed. Res. Trace Elem. (1990)* 1(2): 185-6.

No Oral Suzuki, K. T. 1979. 1979. copper content in cadmium-exposed animal kidney metallothioneins. *Arch. Environ. Contam. Toxicol.* 8(3): 255-268.

No COC Suzuki Kazuo T. 1997. selective removal of copper accumulating in a form bound to metallothionein in the liver of lec rats by tetrathiomolybdate. *Journal of Trace Elements in Experimental Medicine* 10(2): 101-109.

In Vit Suzuki, Keiji, Kawaharada, Umeko, Tamura, Yuji, and Nakajima, Katsuyuki. 1991. effects of metals on rat glioma cells (c6). *Biomed. Res. Trace Elem* 2(2): 111-12 .

In Vitro Suzuki, M., Hiroi, M., and Takahashi, T. 1972. mechanism of copper-induced ovulation by the

incubation experiment of the anterior pituitary gland. *Endocrinol Jpn.* 19(1): 1-9.

No Oral Suzuki, M., Tnemoto, Y., and Takahashi, K. 1972. the effect of copper salts on ovulation, especially on hypothalamic ovulatory hormone releasing factor. *Tohoku J Exp Med.* 108(1): 9-18.

FL Svec, R., Mateova, Z., Kaldy, A., and Koci, S. growth effect of zinc, manganese, and copper additives in feed for goslings. *Krmivarstvi Sluzby (1978)* 14(5): 111-12.

Mix Svezhentsov, A. and Gavrish, A. 1994. a feed supplement - soevit. *Ptitsevodstvo.*(3): 25-27.

FL Sviatko, P. Slovac Academy of Sciences Kosice Slovak Republic Inst. of Animal Physiology, Chandogova, E., Federic, F., Hiscakova, M., Anke, M., Groppel, B., Guertler, H., Gruen, M., Lanbeck, I., and Schneider, H. J. 1992. modification of microelement nutrition of dairy cows and its relation to production and reproduction. macro and trace elements. *P. 26-40*

Nutr Swenson, C. K., Ansotegui, R. P., Swensson, E. J., Paterson, A., and Johnson, A. B. 1996. influence of mineral supplementation on blood serum and liver mineral concentrations in first-calf beef heifers and their calves. *Journal of Animal Science* 74(SUPPL. 1): 261.

Bio Acc Swiergosz, R., Sawicka-Kapusta, K., Nyholm, N. Ei, Zwolinska, A., and Orkisz, A. 1998. effects of environmental metal pollution on breeding populations of pied and collared flycatchers in niepolomice forest, southern poland. *Environmental Pollution* . 102(2-3): 213-220.

CP Switzer, R. C. Iii, Bogo, V., and Mickley, G. A. high energy electron and proton irradiation of rat brain induces degeneration detectable with the cupric-silver stain. *21st Annual Meeting of the Society for Neuroscience, New Orleans, Louisiana, Usa, November 10-15, 1991. Soc Neurosci Abstr. 17 (1-2). 1991. 1460.*

FL Syanchyla, R. A. and Syamenau, V. I. 1987. effect of trace elements on productivity in sows. *Vestsi Akademii Navuk BSSR, Sel'Skagaspadarchykh Navuk* (3): 99-108, 128.

No Oral Symonds, H. W. and Hall, E. D. 1983. acute manganese toxicity and the absorption and biliary excretion ofmanganese in cattle. *Research in Veterinary Science* 35(1): 5-13.

Unrel Symonds, H. W., Mather, D. L., and Hall, E. D. 1982. surgical procedure for modifying the duodenum in cattle to measure bileflow and the diurnal variation in biliary manganese, iron, copper andzinc excretion. *Research in Veterinary Science* 32(1): 6-11.

Meth Szabolcs, M. J., Windisch, A., Koller, R., and Pensch, M. 1991. axon typing of rat muscle nerves using a double staining procedure for cholinesterase and carbonic anhydrase. *Journal of Histochemistry and Cytochemistry* 39(12): 1617-25.

Bio Acc Szefer, P. and Falandysz, J. 1987. trace metals in the soft tissues of scaup ducks (aythya marila l.) wintering in gdansk bay, baltic sea . *Sci Total Environ.* 65: 203-213.

Dead Szeleszczuk, P., Borzemska, W., and Gozlinski, H. 1989. cation content of the fetal fluids of dead chick embryos from hensnaturally infected with adenoviruses. *Medycyna Weterynaryjna* 45(9-10): 535-537.

FL Szeleszczuk, P., Borzemska, W., and Gozlinski, H. Szkola Glowna Gospodarstwa Wiejskiego Akademia Rolnicza Warszawa Poland Katedra Epizootiologii. 1989. concentration of cations in foetal fluids of dead chicken embryos originating from mothers naturally infected with adenoviruses. <original> zawartosc kationow w plynach plodowych zamarlych zarodkow kurzych pochodzacych od niosek naturalnie zakazonych adenowirusami. *Medycyna Weterynaryjna. V. 45(9-10) P. 535-537*

Species Szeleszczuk, P., Karpinska, E., Borzemska, W., and Samorek-Salamonowicz, E. the content of some cations in embryonic fluids of chick embryos experimentally infected with sublethal doses of celo virus. *Medycyna Weterynaryjna. 46 (5). 1990. 137-139.*

FL Szeleszczuk, P., Karpinska, E., Borzemska, W., and Samorek-Salamonowicz, E. Szkola Glowna Gospodarstwa Wiejskiego Akademia Rolnicza Warszawa Poland Zaklad Chorob Drobiu. 1990. concentration of some cations in embryonic fluids of chicken embryos infected experimentally with sublethal doses of celo virus. <original> zawartosc wybranych kationow w plynach plodowych zarodnikow kurzych eksperymentalnie zakazonych subletalnymi dawkami wirusa celo. *Medycyna Weterynaryjna. V. 46(5) P. 137-135*

Bio Acc Szerdahelyi, P. and Kasa, P. 1983. variations in trace metal levels in rat hippocampus during ontogenetic development. *Anatomy and Embryology* 167(1): 141-9.

Alt Sziraki Istvan, Rauhala Pekka, Koh Kwang Kon, Van Bergen Patricia, and Chiueh Chuang C(A). 1999. implications for atypical antioxidative properties of manganese in iron-induced brain lipid peroxidation and copper-dependent low density lipoprotein conjugation. *Neurotoxicology (Little Rock)* 20(2-3): 455-466.

Fate Szymanska, J. A., Bem, E. M., Piotrowski, J. K., Brzeznicki, S., and Baran, T. 1989. renal binding of cadmium in the rat following intragastric exposure. *Toxicology. 55 (3): 339-348.*

BioAcc Szymkiewicz, Maria M., Niemiec, Jan, and Stepinska, Malgorzata. 1990. determination of the relation between the contents of magnesium, zinc, copper, iron and manganese in blood and feathers of rhode island red hens and the results of hatchability. *Ann. Warsaw Agric. Univ. SGGW-AR Anim. Sci.* (25): 9-14.

Ecol Tabaka Christopher S(A), Ullrey Duane E, Sikarskie James G(A), Debar Sharon R, and Ku Pao K. 1996. diet, cast composition, and energy and nutrient intake of red-tailed hawks (buteo jamaicensis), great horned owls (bubo virginianus), and turkey vultures (cathartes aura). *Journal of Zoo and Wildlife Medicine* 27(2): 187-196.

FL Taboada, M. M. C., Rebolledo, V. E., Lamas, A. M. A., and Fernandez-Otero, M. P. 1979. effects of copper as a nutritional Additive. *Acta Cient Compostelana.* 16(3-4): 197-208.

No Control Tait, R. M. Krishnamurti C. R. Gilchrist E. W. and Macdonald K. 1971. 1971. chronic copper poisoning in feeder lambs. *Can.Vet.J. V12 (3), 73-75.* 12(3): 73-75.

Unrel Takahashi S(A), Takahashi, I., Sato, H., Kubota, Y., Yoshida, S., and Muramatsu, Y. 2000. determination of major and trace elements in the liver of wistar rats by inductively coupled plasma-atomic emission spectrometry and mass spectrometry. *Laboratory Animals (London)* 34(1): 97-105.

No Oral Takeda, Atsushi, Sawashita, Jinko, and Okada, Shoji. brain distribution of essential trace metals and its relationship to neurological diseases. *Biomed. Res. Trace Elem. (1993)* 4(2): 165-6.

Nutr Takeda, Takahisa, Kimura, Mieko, Yokoi, Katsuhiko, and Itokawa, Yoshinori. effect of age and dietary protein level on tissue mineral levels in female rats. *Biol. Trace Elem. Res. (1996)* 54(1): 55-74.

FL Takeuchi, Fumiko and Iwasa, Aiko. the lethal doses of copper, zinc and manganese in mice. *Tokyo Joshi Ika Daigaku Zasshi (1978)* 48(3): 313-15.

Nut def Takeuchi, S., Mano, M., Kimoto, I., Ikeda, T., Ishikawa, H., and Yamamura, T. the physiological

significance of copper (cu) in pregnancy (1)--metal metabolism within internal organs of newborn and pregnant rats fed on low copper feed. *Biomedical Research on Trace Elements 1996;7(1):37-42*

Phys Takiguchi Shuji, Sugino Norihiro, Kashida Shiro, Yamagata Yoshiaki, Nakamura Yasuhiko, and Kato Hiroshi(A). 2000. rescue of the corpus luteum and an increase in luteal superoxide dismutase expression induced by placental luteotropins in the rat: action of testosterone without conversion to estrogen. *Biology of Reproduction* 62(2): 398-403.

Unrel Tallon, J. L., Loram, J. W., Williams, G. V. M., Cooper, J. R., Fisher, I. R., Johnson, J. D., Staines, M. P., and Bernhard, C. critical doping in overdoped high-tc superconductors. a quantum critical point?*Phys. Status Solidi B (1999)* 215(1): 531-540.

Plant Tamada, Takato. effect of manganese, copper, zinc and aluminum application rate on the growth and composition of "woodard" rabbiteye blueberry. *Acta Hortic. (1997)* 446(Sixth International Symposium on Vaccinium Culture, 1996): 497-506.

Mineral Tambe, A. S., Deopurkar, V. L., Gulavane, S. U., Puntambekar, P. M., and Patil, M. B. 1998. serum mineral profiles in different phases of reproduction (cattle). *Journal of Bombay Veterinary College* 6(1): 9-11.

No COC Tamura, Yukihiro, Seki, Hironobu, Kamimura, Hisashi, Ibe, Akihiro, Nishiyama, Yoshiko, Tabata, Setsuko, Hashimoto, Hideki, and Nishima, Taichiro. studies on modifying factors of methylmercury toxicity. iv. effect of dietary fiber on methylmercury toxicity. *Kenkyu Nenpo - Tokyo-Toritsu Eisei Kenkyusho (1988)* (39): 121-5 .

Method Tan, Yanxi, Ager, Patrick, and Marshall, William D. 1996. approaches to the determination of metallothionein(s) by high-performance liquid chromatography-quartz tube atomic absorption spectrometry. *J. Anal. At. Spectrom. (1996)* 11(12): 1183-1187 .

No Dose Tanaka Tomoaki(A) and Ichishima Eiji. 1993. molecular properties of aminopeptidase ey as a zinc-metalloenzyme. *International Journal of Biochemistry* 25(11): 1681-1688.

No COC Tandon, Aparna, Nagpaul, J. P., Bandhu, H., Singh, Nirmal, and Dhawan, D. K. effect of lithium on hepatic and serum elemental status under different dietary protein regimens. *Biol. Trace Elem. Res. (1999)* 68(1): 51-62 .

Nut def Tandon, S. K., Khandelwal, S., Jain, V. K., and Mathur, N. influence of dietary iron deficiency on acute metal intoxication. *BioMetals (1993)* 6(2): 133-8

Unrel Tanigawa, N., Sawada, S., and Kobayashi, M. 1995. reaction of the aortic wall to six metallic stent materials. *Academic Radiology* 2(5): 379-84.

No Tox Tanswell, A. K. and Freeman, B. A. 1984. pulmonary antioxidant enzyme maturation in the fetal and neonatal rat. i. developmental profiles. *Pediatric Research* 18(7): 584-7.

Alt Tariq, M. A. and Preiss, I. L. 1994. fluctuations in fe, cu, zn, br, as, se, and rb concentrations in c57l/j mice bearing bw7756 murine hepatoma using radioisotope-induced x-ray fluorescence. *Biol Trace Elem Res.* 42(2): 97-114.

No Dose Tarp, U., Thorling, E. B., Andersen, H. R., and Hansen, J. C. 1991. gold and selenium-induced changes in glutathione peroxidase and interaction of some trace elements in rats. *Trace Elem Med.* 84(4): 187-194.

Nutr Tashchilin, V. A., Gumerov, A. F., and Kovrov, G. V. 1995. the nutritive value of fish protein

concentrate for broilers. *Zootekhniya* (9): 15-16.

No Dose Tashenov, K. T., Varady, J., Bazanova, N. U., Boda, K., and Fejes, J. 1983. rumen metabolism of sheep on synthetic and classical diet. *Folia Veterinaria* 27(1): 103-112.

Rev Task Group Metal Interact, Int. 1978. factors influencing metabolism and toxicity of metals a consensus report. *Environ Health Perspect.* 25: 3-41.

FL Taucins, E., Svilane, A., and Valdmanis, A. 1969. cobalt, copper, manganese, zinc, cadmium, and molybdenum salts in chick nutrition. *Fiziol. Aktiv. Komponenty Pitan. Zhivotn. (1969)* 185-97. Editor: 185-97. Editor(s): Valdmanis, A. Publisher: Izd. "Zinatne", Riga, USSR.

FL Taucins, E, Svilane, A, Valdmanis, A, Buike, A, Zarina, R, and Fedorova, E Ya. 1969. barium, strontium, and copper salts in chick nutrition. *Fiziol. Akt. Komponenty Pitan. Zhivotn.* 199

Plant Teisseire, H. and Guy, V. 2000. copper-induced changes in antioxidant enzymes activities in fronds of duckweed (lemna minor). *Plant Science, 153 (1) Pp. 65-72, 2000.*

Alt Templeton, Douglas M. and Chaitu, Nita. effects of divalent metals on the isolated rat glomerulus. *Toxicology (1990)* 61(2): 119-33.

Mix Terapuntuwat, S. and Tasaki, I. 1986. effect of mineral composition and soybean protein/alfalfa leaf proteinconcentrate ratio of diets on chick growth. *Nutrition Reports International* 33(5): 747-752.

Surv Terrill, T. H., Allen, V. G., Fontenot, J. P., Cranford, J. A., and Foster, J. G. 1991. influence of flooded soil on chemical composition of annual rye grass and digestibility by meadow voles. *VA J SCI.* 42(1): 101-112.

Alt Tezuka, M., Momiyama, K., Edano, T., and Okada, S. 1991. protective effect of chromium-iii on acute lethal toxicity of carbon tetrachloride in rats and mice. *J Inorg Biochem.* 42(1): 1-8.

In Vit Tholey, G., Ledig, M., Kopp, P. , Sargentini-Maier, L., Leroy, M., Grippo, A. A., and Wedler, F. C. levels and sub-cellular distribution of physiologically important metal ions in neuronal cells cultured from chick embryo cerebral cortex. *Neurochemical Research. 13 (12). 1988. 1163-1168.*

Aquatic Thomas, Peter and Smith, John. binding of xenobiotics to the estrogen receptor of spotted seatrout: a screening assay for potential estrogenic effects. *Mar. Environ. Res. (1992).* Volume Date 1993, 35(1-2): 147-51.

Nutr Thompson, Donald B. and Erdman, J. W. Jr. effect of various soy protein products on retention of nonheme iron from a casein test meal or from soy-based test meals. *J. Food Sci. (1988)* 53(5): 1460-3, 1469 .

Surv Thompson, H. J. and Evans, J. L. 1977. influence of dietary copper on assimilation and distribution of copper and iron into metabolic compartments. *Nutr Rep Int.* 15(3): 287-293.

Alt Thompson, Henry J., Griminger, Paul, and Evans, Joseph L. effect of dietary copper, manganese, and zinc on nitrogen equilibrium and mineral distribution subsequent to trauma in mature rats. *J. Nutr. (1976)* 106(10): 1421-8 .

Nut def Thompson, Katherine H., Godin, David V., and Lee, Melvin. tissue antioxidant status in streptozotocin-induced diabetes in rats . effects of dietary manganese deficiency. *Biol. Trace Elem. Res. (1992)* 35(3): 213-24.

Drug Thompson, Katherine Hirsch. 1991. effect of dietary manganese and vitamin e deficiencies on tissue antioxidant status in stz-diabetic rats. *Avail.: NLC Order No. DANN72669 From: Diss. Abstr. Int. B 1993. 53. 12, Pt. 1. 6233.* 158 pp.

Rev Thompson, L. J., Hall, J. O., and Meerdink, G. L. 1991. toxic effects of trace element excess. *Veterinary Clinics of North America, Food Animal Practice.* 7(1): 277-306.

No Dose Thompson, R. H. and Todd, J. R. 1974. muscle damage in chronic copper poisoning of sheep. *Research in Veterinary Science.* 16(1): 97-99.

Nutr Thompson, S. A. and Weber, C. W. 1981. effect of dietary fiber sources on tissue mineral levels in chicks. *Poultry Science* 60(4): 840-5.

Unrel Thong, P. S. P(A), Makjanic, J., and Watt, F. 1996. a review of nuclear microscopy and applications in medicine. *Singapore Medical Journal* 37(5): 527-531.

HHE Thorn, J. M., Aggett, P. J., Delves, H. T., and Clayton, B. E. 1978. mineral and trace metal supplement for use with synthetic diets basedon comminuted chicken. *Archives of Disease in Childhood* 53(12): 931-938.

No Dose Thurston, R. J., Korn, N., Froman, D. P., and Bodine, A. B. 1993. proteolytic enzymes in seminal plasma of domestic turkey (meleagris gallopavo). *Biology of Reproduction* 48(2): 393-402.

No COC Tian, Jiarong, Wu, Huaichun, and Cheng, Hua. 1992. effect of grape seed oil on serum lipids in experimental hypercholesterolemic rats. *Yingyang Xuebao (1992)* 14(2): 130-3 .

CP Tiffany, M. E., Mcdowell, L. R., Connor, G. A. O., Nguyen, H., Martin, F. G., Wilkinson, N. S., and Cardoso, E. C. 1999. effects of pasture applied biosolids on forage and soil mineral concentrations in north florida. *Meeting of the American Society of Animal Science*

Mineral Tiffany, M. E., McDowell, L. R., O'Connor, G. A., Martin, F. G., and Wilkinson, N. S. 1999. variation of forage and extractable soil minerals over two grazingseasons in north florida. *Communications in Soil Science and Plant Analysis* 30(19/20): 2743-2754.

FL Tikhomirov, F. A., Magina, L. G., and Kiseleva, E. V. 1988. the immediate and residual effect of high concentration of copper and nickel on plants. *Vestn. Mosk. Univ. Ser. 17: Pochvoved.* (1): 30-3.

FL Tishchenko, L. G. 1983. histological studies of anoplocephalids after the action ofanthelmintics and experimental bio-control. *Byulleten' Vsesoyuznogo Instituta Gel'Mintologii Im. K.I. Skryabina* (No.35): 72-73.

Drug Tobey, R. A., Enger, M. D., Griffith, J. K., and Hildebrand, C. E. 1982. inducible protective proteins: a potentially novel approach to chemotherapy. *Govt Reports Announcements & Index (GRA&I)*

Aquatic Tochimoto, H. *., Maki, T., Afzal, M., and Tanabe, S. 2003. accumulation of trace metals in aquatic insect stenopsyche marmorata navas transferred in streams. *Ecotoxicology and Environmental Safety [Ecotoxicol. Environ. Saf.]. Vol. 56, No. 2, Pp. 256-264. Oct 2003.*

Rev Todd, J. R. 1962. chronic copper poisoning in farm animals. *The Veterinary Bulletin.* 32(9): 573-580.

Rev Todd, J. R. 1969. chronic copper toxicity of ruminants. *Proc. Nutr. Soc.* 28: 189-193.

No Control Todd, J. R., Gracey, J. F., and Thompson, R. H. 1962. studies on chronic copper poisoning: i. toxicity of copper sulphate and copper acetate in sheep. *Brit Vet J.* 118: 482-491.

No Oral Todd, J. R. and Thompson, R. H. 1965. studies on chronic copper poisoning iv: biochemistry of the toxic syndrome in the calf. *Brit Vet J.* 121: 90-97.

FL Tokarnia, C. H., Dobereiner, J., and Moraes, S. S. 1988. investigations on mineral nutrition of cattle in brazil a review. *Pesqui Vet Bras.* 8(1-2): 1-16.

FL Tokarnia, C. H., Dobereiner, J., and Moraes, S. S. 1988. investigations on the mineral nutrition of cattle in brazil. *Pesquisa Veterinaria Brasileira* 8(1-2): 1-16.

FL Tokosova, M. 1989. [the effect of growth stimulators on the levels of various trace elements in chickens]. <original> vplyv stimulatorov rastu na obsah niektorych mikroprvkov v organizme kurciat. *Veterinarni Medicina* 34(2): 107-12.

FL Tokosova, M. and Pleva, J. 1988. effect of growth stimulants on health and performance of broilerchickens. *Veterinarni Medicina* 33(5): 303-311.

FL Tokosova, M. Vojensky Veterinarny Doskolovaci Vyskumny Ustav Kosice Czechoslovakia. 1989. the effect of growth promotors on the contents of microelements in the organism of chicks. <original> vplyv stimulatorov rastu na obsah niektorych mikroprvkov v organizme kurciat. *Veterinarni Medicina - UVTIZ. V. 34(2) P. 107-111*

FL Tokosova, Maria. the effect of growth promoters on the contents of trace elements in chicks. *Vet. Med. (Prague) (1989)* 34(2): 107-12

Unrel Tolkamp, B. J. a, Ketelaars, J. J. M. H., and Hofs, P. 1994. voluntary intake of digestible organic matter and fasting heat production of west african dwarf goats and swifter sheep. *Small Ruminant Research.* 15(1): 45-54.

Nut def Tom, K., Chen, M., Goettlich-Riemann, W., Tanimoto, J., Grey, S., Wake, D., and Rucker, R. B. 1977. collagen and elastin metabolism in relation to dietary zinc and copperin the chick and rat. *Nutrition Reports International* 15(2): 191-198.

FL Tomasgard, G. 1974. effect of nutrition and environmental factors on fertility in cows. *Norsk Veterinaertidsskrift.* 86(5): 231-240.

Surv Toombs, R. E., Grotelueschen, D. M. a, Glock, R. D., Salman, M. D., King, M. E., and Odde, K. G. 1998. postnatal calf losses in beef herds: causes and epidemiological characteristics. *Large Animal Practice.* 19(4): 16, 18-20, 22-23.

In Vit Tormanen, C. D. 2001. allosteric inhibition of rat liver and kidney arginase by copper and mercury ions. *Journal of Enzyme Inhibition, 2001 Nov, 16(5):443-9.*

Nutr Tortuero, F. and Fernandez, E. 1995. effects of inclusion of microbial cultures in barley-based diets fed to laying hens. *Animal Feed Science and Technology* 53(3/4): 255-265.

FL Tortuero, F., Fernandez, E., and Martin, L. 1994. effect of different amounts of phosphorus in feeds on growth, skeletaldevelopment and mineral metabolism in chickens. *Avances En Alimentacion y Mejora Animal* 34(6): 3-7.

Mineral Tortuero, F., Rioperez, J., Cosin, C., Barrera, J., and Rodriguez, M. L. effects of dietary fiber sources on volatile fatty acid production, intestinal microflora and mineral balance in rabbits.

Anim. Feed Sci. Technol. (1994) 48(1-2): 1-14.

Nutr Tortuero, F., Rioperez, J., and Martin, L. 1993. effect of dietary sepiolite supplementation on the performance, egg composition and mineral metabolism in laying hens. *Archivos De Zootecnia* 42(159): 347-360.

Unrel Town, G. I., Phillips, G. J., Landreau, M., Louden, J., Holgate, S. T., and Kelly, F. J(A). 1993. dexamethasone treatment fails to reduce oxygen-induced lung injury in the preterm guinea pig: effects on pulmonary inflammation and antioxidant status. *Biochemical Pharmacology* 46(9): 1565-1572.

CP Tracktenberg, E., Greve, C., Abbott, U., Buhr, R., Kenney, C., and Rucker, R. role of diet gonadectomy on the expression of scoliosis in a line of genetically susceptible chicks. *69th Annual Meeting of the Federation of American Societies for Experimental Biology, Anaheim, Calif., Usa, Apr. 21-26, 1985. Fed Proc. 44 (3). 1985. 744.*

CP Travnicek, J., Kroupova, V., and Drbal, K. 1986. trace element content of the body hair and liver in the rabbit . *Spurenelem.-Symp. 5th* : Issue Trace Elements, 426-30. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ. Jena, Jena, Ger. Dem. Rep.

Diss Treuthardt, J. 1992.*Hematology, Antioxidative Trace Elements, the Related Enzyme Activities and Vitamin E in Growing Mink on Normal and Anemiogenic Fish Feeding*

Mix Tripathi, M. K., Agrawal, I. S., Sharma, S. D., and Mishra, D. P. 2001. effect of untreated, hcl treated or copper and iodine supplemented high glucosinolate mustard (brassica juncea) meal on nutrient utilization, liver enzymes, thyroid hormones and growth of calves. *Animal Feed Science and Technology.* 92(1-2): 73-85.

An Prod Troeger, K., Reuter, G., and Schneider, D. 1983. use of dried chicken manure in cattle feeding, from the aspects of meathygiene and feed technology. i. microorganisms, nutrients and residuesin battery-hen manure and maize silage used as basal feed. *Berliner Und Munchener Tierarztliche Wochenschrift* 96(11): 388-397.

Method Tronova, O. S. and Lyakov, S. L. dependence between a histological picture of gum mucosa and the amount of copper and manganese in it. *Probl. Ter. Stomatol. (1969)* : No. 4, 13-16 .

Surv Trust, K. A., Rummel, K. T., Scheuhammer, A. M., Brisbin, I. L. Jr., and Hooper, M. J. contaminant exposure and biomarker responses in spectacled eiders (somateria fischeri) from st. lawrence island, alaska. *Arch. Environ. Contam. Toxicol. (2000)* 38(1): 107-113.

No Tox Tsao, C. S. and Young, M. effect of dietary ascorbic acid on levels of serum mineral nutrients in guinea pigs. *Int. J. Vitam. Nutr. Res. (1989)* 59(1): 72-6.

No Oral Tsao, Constance S., Leung, Ping Y., and Young, May. levels of minerals in serum and urine of guinea pigs following intraperitoneal administration of ascorbate. *Int. J. Vitam. Nutr. Res. (1990)* 60(2): 121-5.

Nut def Tsuchiya, H. and Bates, C. J. 1997. vitamin c and copper interactions in guinea-pigs and a study of collagen cross-links. *Br J Nutr.* 77(2): 315-25.

No Oral Tsuchiya, H., Shima, S., Kurita, H., Ito, T., Kato, Y., Kato, Y., and Tachikawa, S. 1987. effects of maternal exposure to six heavy metals on fetal development. *Bull Environ Contam Toxicol.* 38(4): 580-7.

Phys Tsuji, Hiroshi, Sato, Hiroko, Baba, Takahiro, Gotoh, Yasuhito, and Ishikawa, Junzo. a negative ion beam application to artificial formation of neuron network in culture. *Rev. Sci. Instrum. (2000)* 71(2, Pt. 2): 797-799 .

No Oral Tsujii, H. and Hoshishima, K. 1979. effect of the administration of trace amounts of metals to pregnant mice upon the behavior and learning of their Offspring. *Shinshu Daigaku Nogakubu Kiyo(j Fac Agric Shinshu Univ)* . 16: 13-28.

Bio Acc Tsuzuki, Toshihumi, Kotani, Reiko, Hattori, Keisaku, and Inoue, Katsuhiro. environmental pollution and wild birds in hokkaido. vi. *Hokkaidoritsu Eisei Kenkyusho Ho (1976)* : 26, 125-6.

CP Tufft, L. and Nockels, C. F. 1988-1989. the effect of dietary edta on trace element kinetics in chicks. *72nd Annual Meeting of the Federation of American Societies for Experimental Biology*

Phys Tufft, L. S. and Nockels, C. F. the effects of stress, escherichia coli, dietary ethylenediaminetetraacetic acid, and their interaction of tissue trace elements in chicks. *Poult. Sci. (1991)* 70(12): 2439-49 .

No Oral Tufft, L. S., Nockels, C. F., and Fettman, M. J. 1988. effects of escherichia coli on iron, copper, and zinc metabolism inchicks. *Avian Diseases* 32(4): 779-786.

FL Turecki, T., Cibulka, J., Slamova, A., and Barcalikova, R. effect of organic and inorganic forms of dietary cadmium on cadmium, zinc, copper, iron, and manganese availability to rats. *J. Anim. Physiol. Anim. Nutr. (1998)* 78(3): 119-128.

Bio Acc Turecki, T., Ewan, R. C., and Stahr, H. M. effect of dietary phytic acid and cadmium on the availability of cadmium, zinc, copper, iron, and manganese to rats. *Bull. Environ. Contam. Toxicol. (1995)* 54(5): 760-7 .

Phys Turk, G. C. and Kingston, H. M. laser-enhanced ionization spectrometry following matrix modification by automated chelation chromatography for the analysis of biological and environmental reference materials. *Journal of Analytical Atomic Spectrometry. 5 (7). 1990. 595-602.*

Rev Turley, P. A., Fenn, R. J., and Ritter, J. C. 2000. pyrithiones as antifoulants: environmental chemistry and preliminary risk assessment. *Biofouling [Biofouling]. Vol. 15, No. 1-3, Pp. 175-182. 2000.*

Surv Turner, J. C., Solly, S. R. B., Mol-Krijnen, J. C. M., and Shanks, V. 1978. organochlorine, fluorine, and heavy-metal levels in some birds from newzealand estuaries. *New Zealand Journal of Science* 21(1): 99-102.

CP Turner, J. E., Williams, M. W., Jacobson, K. B., and Hingerty, B. E. 1984.*Correlations of Acute Toxicity of Metal Ions and the Covalent/Ionic Character of Their Bonds. CONF-8409263-1*

FL Tykina, L. V. 1979. age changes in the content of trace elements (copper, zinc, iron) inliver extracts from fowls. *Sbornik Nauchnykh Trudov Moskovskaya Veterinarnaya Akademiya* 106: 35-37.

FL Tykina, L. V. and Malakhov, A. G. age-related changes of liver extract trace element (copper, zinc, and iron) levels in hens. *Sb. Nauch. Tr. Mosk. Vet. Akad. (1979)* (106): 35-7 From: Ref. Zh., Biol. Khim. 1980, Abstr. No. 5Ts63.

CP Tyopponen, J., Smeds, E., and Lindberg, P. 1989. iron, copper, zinc, manganese and selenium in the growing mink. *6th International Trace Element Symposium. Volume 3.* 858-864.

Mix Uchida, K. P. Mandebvu C. S. Ballard C. J. Sniffen and M. P. Carter. 2001.*Effect of Feeding a Combination of Zinc, Manganese, and Copper Amino Acid Complexes, and Cobalt Gucoheptonate on Performance of Early Lactation High Producing Dairy Cows Animal Feed Science and Technology.* 93: 193-203.

Phys Uchino, E., Tsuzuki, T., and Inoue, K. the effects of age and sex on seven elements in sprague-dawley rat organs. *Lab Anim; 24 (3). 1990. 253-264.*

FL Uel'danov, R. N., Il'bul'din, Yu F., Durenkov, A. A., and Shakhtarin, G. E. 1982. effect of trace elements and amylosubtilin g3x on growth anddevelopment of cattle during fattening. *Zhivotnovodstvo* (10): 46-47 .

FL Ugnenko, V. K. 1972. effect of different ratios of iodine, copper, cobalt and manganese inthe diet on the distribution of copper and manganese in organs of rats. *Voprosy Pitaniya* 31(3): 21-24.

FL Ugnenko, V. K. 1972. [effect of various relationships of iodine, copper, cobalt and manganese in the diet on the distribution of copper and manganese in the organs of rats]. <original> vliianie razlichnogo sootnosheniia ioda, medi, kobal'ta, i margantsa v pishchevom ratsione na raspredelenie medi i margantsa v organakh krys. *Voprosy Pitaniia* 31(3): 21-4.

FL Ugnenko, V. K. effect of varying ratios of iodine, copper, cobalt, and manganese in the food ration on the distribution of copper and manganese in the organs of rats. *Vop. Pitan. (1972)* 31(3): 21-4

Mix Ulvund, M. J. 1990. ovine white-liver disease owld serum copper and effects of copper and selenium Supplementation. *Acta Vet Scand.* 31(3): 287-296.

Surv Ulvund, M. J. and Pestalozzi, M. 1990. ovine white-liver disease owld botanical and chemical composition of pasture Grass. *Acta Vet Scand.* 31(3): 257-266.

No COC Um, J. S. and Paik, I. K. effects of microbial phytase supplementation on egg production, eggshell quality, and mineral retention of laying hens fed different levels of phosphorus. *Poult. Sci. (1999)* 78(1): 75-79.

Nut def Unanian, M. D. S. and Feliciano-Silva, A. E. D. 1984. trace elements deficiency: association with early abortion in goats. *International Goat and Sheep Research* 2(2): 129-134.

Unrel Underwood, E. J. 1976. mineral imbalances in farm animals and their study and diagnosis with isotopic tracers. *Atomic Energy Review* 14(4): 591-619.

Rev Underwood, E. J. 1981.: ix + 180pp.

FL Urbanovich, N. A. and Borisenko, E. N. 1986. veterino-hygienic evaluation of products of slaughter of pigs fed withmycelium of rifamycin b. *Veterinarnaya Nauka - Proizvodstvu, Minsk, Belorussian SSR* (24): 163-167.

Alt Uriu-Hare, J. Y., Stern, J. S., and Keen, C. L. the effect of diabetes on the molecular localization of maternal and fetal zinc and copper metalloprotein in the rat. *Biological Trace Element Research.* Dec 1988. v. 18 p. 71-79.

Alt Uriu-Hare, Janet Y., Stern, Judith S., and Keen, Carl L. influence of maternal dietary zinc intake on expression of diabetes-induced teratogenicity in rats. *Diabetes (1989)* 38(10): 1282-90 .

Nut def Uthus, E. O. and Nielsen, F. H. effect of vanadium, iodine and their interaction on growth , blood variables, liver trace elements and thyroid status indexes in rats. *Magnesium Trace Elem. (1991)*

Volume Date 1990, 9(4): 219-26.

Nut def Uthus, Eric and Poellot, Rhonda. effect of methionine deficiency on arsenic deprivation in rats : growth , blood parameters, organ weight/body weight ratios, and tissue trace element concentration. *J. Trace Elem. Exp. Med. (1992)* 5(3): 153-64.

Nut def Uthus, Eric O. diethyl maleate, an in vivo chemical depletor of glutathione, affects the response of male and female rats to arsenic deprivation. *Biol. Trace Elem. Res. (1994)* 46(3): 247-59

FL Uyanik, F., Liman, B. C., and Liman, N. 1999. the effects of danofloxacin on some biochemical parameters and liver inbroilers. *Turk Veterinerlik Ve Hayvancilik Dergisi* 23(Supplement 4): 757-764.

Bio Acc Uzieblo, L., Ligocki, M., Hapanowicz, B., and Romaniszyn, K. 1993. heavy metals and fluorine content of hen's eggs derived from different place of origin. *Vol. 26, No. 2, Pp. 91-96* Bromatol. Chem. Toksykol.

FL Vadkovskaya, I. K., Vadkovskii, V. B., and Kagan, L. M. peculiarities of microelement composition of game birds. *Ekologiya (Sverdlovsk) (1988)* (4): 78-80 .

CP Valtulini, S., Corradi, A., Quintavalla, F., Lecce, R. di, Fusari, A., Cantoni, A. M., and Cabassi, E. 1993. splayleg syndrome: morphological and functional studies on spinal motor neurons. 185-192.

Mix Valyushkin, K. D. 1982. combined use of vitamins and trace elements and the reproductive function of cows. *Vyestsi Akad Navuk Bssr Syer Syel'skahaspad Navuk.* 0(2): 68-71.

Fate Van Campen, D. R. 1966. 1966. effects of zinc, cadmium, silver and mercury on the absorption and distribution of copper-64 in rats. *J. Nutr.* 88(1): 125-130.

Alt Van Campen, Darrell R. copper interference with the intestinal absorption of zinc-65 by rats. *J. Nutr. (1969)* 97(1): 104-8 .

Unrel VAn, D. E. R. Watt H Vh, Sumner, M. E., and Cabrera, M. L. bioavailability of copper, manganese, and zinc in poultry litter. *Journal of Environmental Quality; 23 (1). 1994. 43-49.*

Dead Van den Brink, N. W. and Ma, W. C. 1998. spatial and temporal trends in levels of trace metals and pcbs in the european badger meles meles (l., 1758) in the netherlands: implications for reproduction. *Sci Total Environ.* 222(1-2): 107-18.

Nutr van der Aar, P. J., Fahey, G. C. Jr, Ricke, S. C., Allen, S. E., and Berger, L. L. 1983. effects of dietary fibers on mineral status of chicks. *Journal of Nutrition* 113(3): 653-61.

Aquatic van der Geest, H. G., Greve, G. D., Kroon, A., Kuijl, S., Kraak, M. H. S., and Admiraal, W. 2000. sensitivity of characteristic riverine insects, the caddisfly cyrnus trimaculatus and the mayfly ephoron virgo, to copper and diazinon. *Environmental Pollution.* 109(2): 177-182.

Fate Van der Merwe, F. J. 1974. latest developments in the knowledge of mineral metabolism and mineralization of ruminants . *S Afr J Anim Sci.* 4(2): 271-274.

Surv Van Eeden, P. H. and Schoonbee, H. J. 1996. metal concentrations in liver, kidney, bone and blood of three species of birds from a metal-polluted wetland. *Water S A (PRETORIA).* 22(4): p351-372.

Species Van Eeden Ph and Schoonbee, H. J. 1993. metal concentrations in sediments and some organisms from a polluted wetland. *S Afr J Wildl Res* 23(1): 12-16.

Nutr Van Horn H H, Shearer, J. K., Wilcox, C. J., and De Groot W. 1994. utilization of heterogeneity of regression to delineate effects of zn-, mn-, and cu-proteinates on milk somatic cell counts, milk yields, and cow mobility in research conducted onfarm. *Journal of Dairy Science* 77(SUPPL. 1): 156.

No COC Van Leeuwen J M and Van Kluijve J J. the influence of different calcium and phosphorus supplies on the vitamin a copper and manganese status of young cattle with additional effects of growth and Season. *Neth J Agric Sci. 19 (3). 1971 189-194.*

FL Van Niekerk, F. E. and Van Niekerk, C. H. 1990. copper and selenium supplementation of ewes grazing on pastures low in copper and selenium effect on reproduction and concentration of plasma copper and blood selenium during Pregnancy. *S-afr Tydskr Veekd.* 20(4): 246-249.

Unrel Van Niekerk F E(A), Cloete, S. W. P., Van Der Merwe G D, Heine, E. W. P., and Scholtz Anna J. 1995. parenteral copper and selenium supplementation of sheep on legume-grass pastures: biochemical and production responses in lambs to maternal treatment. *Journal of the South African Veterinary Association* 66(1): 11-17.

Nutr Van Ryssen J B J. effect of monensin and its metabolites in broiler litter on sheep consuming the broiler litter. *Journal of the South African Veterinary Association. 62 (3). 1991. 94-99.*

Mix Van Ryssen, J. B. J. and Barrowman, P. R. 1987. effect of ionophores on the accumulation of copper in the livers of Sheep. *Anim Prod.* 44(2): 255-262.

BioAcc Van Ulsen, F. W. 1973. sheep swine and copper. *Neth J Vet Sci.* 5(2): 113-115.

FL van Veen, L. 1999. [aortic rupture in poultry: a review]. <original> aortaruptuur bij pluimvee: een overzicht. *Tijdschrift Voor Diergeneeskunde* 124(8): 244-7.

Mix Van Vleet, J. F. 1982. amounts of 8 combined elements required to induce selenium vitamin e deficiency in ducklings and protection by supplements of selenium and vitamin e. *Am J Vet Res.* 43(6): 1049-1055.

Mix Van Vleet, J. F. 1982. amounts of twelve elements required to induce selenium vitamin e deficiency in ducklings. *Am. J. Vet. Res.* 43(5): 851-857.

Mix Van Vleet, John F. amounts of eight combined elements required to induce selenium-vitamin e deficiency in ducklings and protection by supplements of selenium and vitamin e. *Am. J. Vet. Res. (1982)* 43(6): 1049-55.

CP Van Vleet, John F. and Boon, G. D. 1981. evaluation of the ability of dietary supplements of silver, copper, cobalt, tellurium, cadmium, zinc and vanadium to induce lesions of selenium-vitamin e deficiency in ducklings and swine. *Selenium Biol. Med., (Proc. Int. Symp.), 2nd* : 366-72.

Unrel van Walsum, J. 1979. contribution to the aetiology of synovitis in chickens, with special reference to non-infective factors. iv. *Tijdschr Diergeneeskd.* 104(8): suppl 90-6.

FL Vandergrift, B. Manna pro Corporation Perry GA USA. 1993. mineral proteinates in the animal feed industry. *Kraftfutter. (No.11) P. 548-552*

Not Avail Vanderveen, J. E. and Keener H. A. 1224-1230.

Minseral Vargas, E. and Sanchez, J. M. 1993. crude protein and mineral contents of forages in the huetar norte andatlantica regions of costa rica. ii. effect of species. *Agronomia Costarricense* 17(2): 61-70.

Nutr Vaxman, F., Chalkiadakis, G., Olender, S., Maldonado, H., Aprahamian, M., Bruch, J. F., Wittmann, T., Volkmar, P., and Grenier, J. F. 1990. improvement in the healing of colonic anastomoses by supplements ofpantothenic and ascorbic acids: experimental study in rabbits. *Annales De Chirurgie* 44(7): 512-520.

No Oral Vayenas, D. V., Repanti, M., Vassilopoulos, A., and Papanastasiou, D. A. influence of iron overload on manganese, zinc, and copper concentration in rat tissues in vivo. study of liver, spleen, and brain. *Int. J. Clin. Lab. Res. (1998)* 28(3): 183-186.

In Vit Velez-pardo, C., Jimenez, D. E. L. Rio M, Ebinger, G., and Vauquelin, G. manganese and copper promote the binding of dopamine to "serotonin binding proteins" in bovine frontal cortex. *Neurochemistry International; 26 (6). 1995. 615-622.*

No COC Veltmann, J. R. Jr. and Jensen, L. S. 1979. dietary studies on incidence of tibial dyschondroplasia in broilerchicks. *Poultry Science* 58(4): 1026-1027.

Phys Venarucci D(A), Venarucci, V., Vallese, A., Battila, L., Casado, A., De La= Torre Rosario, and Lopez Fernandez M A Encarnation. 1999. free radicals: important cause of pathologies refer to ageing. *Panminerva Medica.* 41(4): 335-339.

FL Venediktov, A. M. and Tokseitov, M. T. 1987. phosphorus supplements in the diet for young cattle. *Khimiya v Sel'Skom Khozyaistve* 25(5): 57-59.

Rev Venugopal, B. and Luckey, T. D. 1978.*Metal Toxicity in Mammals* 2

Surv Vermeer, K and Thompson, JAJ. 1992. arsenic and copper residues in waterbirds and their food down inlet from the island copper mill. *Bull Environ Contam Toxicol.* 48(5): 733-738.

FL Vibe, P. P. 1976. parasitic coenoses in sheep. *Veterinariya, Moscow* (6): 58-60.

FL Viejo, R. E. 1991. copper toxicosis in sheep. *Archivos De Medicina Veterinaria* 23(2): 109-121.

Nutr Vijchulata, Pravee, Henry, P. R., Ammerman, C. B., Potter, S. G., Palmer, A. Z., and Becker, N. H. effect of dried citrus pulp and cage layer manure in combination with monensin on performance and tissue mineral composition in finishing steers. *J. Anim. Sci. (1980)* 50(6): 1022-30.

FL Viktorov, P. I. and Tarasov, V. N. 1975. premixes from products of microbial synthesis in feeds for growingpigs. *Zhivotnovodstvo* (9): 28-30.

FL Virgens, N. C. das, Ferreira Neto, J. M., Machado, M. A., and Marques Junior, A. de P. 1981. copper, iron, manganese and zinc in the liver and pancreas of confinedand semi-confined goats. *Arquivos Da Escola De Veterinaria Da Universidade Federal De Minas Gerais* 33(2): 229-233.

Unrel Vittur F(A), Tuniz, C., Paoletti S(A), Rizzo R(A), and Jones, K. W. 1992 . elemental analysis of growth plate cartilage by synchrotron-radiation-induced x-ray emission (srixe). *Biochemical and Biophysical Research Communications* 188(3): 1010-1017.

Alt Vlad, Mariana, Bordas, E., Tomus, Rodica, Sava, Doina, Farkas, Ecterina, and Uza, G. effect of copper sulfate on experimental atherosclerosis. *Biol. Trace Elem. Res. (1993)* 38(1): 47-54.

Unrel Vleet, J. F. Van. 1982. comparative efficacy of five supplementation procedures to controlselenium-vitamin e deficiency in swine. *American Journal of Veterinary Research* 43(7): 1180-1189.

FL Vodichenska, T. S. 1988. [the biological effect of copper taken up by the body via drinking water].

Probl Khig. 13: 29-36.

FL Vodichenska, T. S. 1987. chronic effect of copper on some enzymatic indices at its introduction in organisms with drinking Water. *Khig Zdraveopaz.* 30(5): 51-58.

FL Vodichenska, Ts. and Razboinikova, F. rat organs during chronic copper poisoning. *Khig. Zdraveopaz. (1987)* 30(3): 34-40.

FL Vogler, G. 1967. [intoxication of man and animals with phytoplankton toxins from surface waters]. <original> intoxikationen von mensch und tier durch phytoplanktontoxine aus oberflachengewassern. *Archiv Fur Hygiene Und Bakteriologie* 151(1): 1-22.

Unrel Vogrin, M. a. 1998. density, nest site and breeding success of a rural population of the magpie (pica pica) in ne slovenia. *Vogelwarte.* 39(4): 293-297.

Mix Vohra, P., Gottfredson, G. D., and Kratzer, F. H. the effects of high levels of dietary edta zinc or copper on the mineral contents of some tissue of turkey poults bone liver kidney heart feather testis. *POULTRY SCI. 47 (4). 1334-1343. 1968.*

Nut def Vohra, P. and Heil, J. R. dietary interactions between zinc manganese and copper for turkey poults. *Poultry Sci. 48 (5). 1969 1686-1691.*

Plant Voigtlaender, G., Lang, V., and Kirchgessner, M. contents of trace elements in lucerne medicago-varia in relation to growth development and weather conditions in 3 years of Experiment. *Z Acker-Pflanzenbau. 135 (3). 1972 204-215.*

Unrel Volden, H. 1998. oxidized flavour in milk. *Buskap.* 50(1): 20-21.

FL Volkov, D. T., Bataeva, A. P., Kharitonova, O. V., and Tsvetkova, N. Ya. 1974. efficiency of the use of feed by layer hens under various conditions of mineral nutrition. *Byull. Vses. Nauchno-Issled. Inst. Fiziol., Biokhim. Pitan. S-Kh. Zhivotn.* 8(4): 24-6.

FL Volkov, D. T., Bataeva, A. P., Kuznetsov, S. G., Kharitonova, O. V., and Tsvetkova, N. Ya. 1976. assimilation of nitrogen and minerals by laying hens with different levels of manganese and copper in their ration. *Byull. Vses. Nauchno-Issled. Inst. Fiziol. Biokhim. Pitan. S-Kh. Zhivotn.* 10(3): 42-5.

FL Volkov, D. T., Bataeva, A. P., Kuznetsov, S. G., Kharitonova, O. V., Tsvetkova, N. Ya., Plekhanov, L. A., and Sycheva, N. S. 1976. level of mineral substances in hens, chicks, and eggs when the ration contains different amounts of trace nutrients. *Tr. Vses. Nauchno-Issled. Inst. Fiziol. Biokhim. Pitan. S-Kh. Zhivotn.* 15: 118-28.

FL Volkov, D. T. and Kuznetsov, S. G. 1976. content of copper and iron in hens and eggs after feeding rations with various trace element levels. *Byull. Vses. Nauchno-Issled. Inst. Fiziol. Biokhim. Pitan. S-Kh. Zhivotn.* 10 (2): 50-53.

FL Volkov, D. T., Kuznetsov, S. G., and Plekhanov, L. A. 1976. phosphorus compounds in hens and chicks fed rations containing different amounts of trace nutrients. *Tr. Vses. Nauchno-Issled. Inst. Fiziol. Biokhim. Pitan. S-Kh. Zhivotn.* 15: 139-48.

FL Volkova, O. I. and Kazakova, M. V. 1977. effect of copper on the morphological composition of the blood ofchicks. *Sbornik Nauchnykh Trudov Moskovskaya Veterinarnaya Akademiya.* 90: 102-105.

FL Volmer, K., Doell, G., and Herzog, A. determination of various elements in the foot horn of the mouflon ovis-ammon-musimon with healthy and fully-grown feet. *Zeitschrift Fuer*

Jagdwissenschaft. 31 (3). 1985. 140-146.

Nut def Vorob'eva, A. M. 1973. effect of dietary deficiency of copper, manganese, and zinc on assimilation of calcium and phosphorus in experimental animals. *Mikroelem. Biosfere Ikh Primen. Sel'Sk. Khoz. Med. Sib. Dal'Nego Vostoka Dokl. Sib. Konf., 4th* : Meeting Date 1972, 375-9. Editor(s): Filippov, V. R. Publisher: Akad. Nauk SSSR, Buryat. Fil., Ulan-Ude, USSR.

FL Vorob'eva, A. M. effect of low doses of copper, manganese, and zinc on animals. *Gig. Sanit. (1970)* 35(11): 96-8.

FL Vorob'eva, A. M. 1974. effect of the trace element composition of the feed on calcium andphosphorus metabolism in growing animals. *Voprosy Pitaniya* (3): 62-63.

FL Vorob'eva, A. M. 1974. [effect of trace element composition of animal feed on the phosphorus-calcium metabolism in growing animals]. <original> vliianie mikroelementnogo sostava korma na fosforno-kal'tsevyi obmen u rastushchikh zhivotnykh. *Voprosy Pitaniia* 33(3): 62-3.

FL Vorob'eva, A. M. 1973. [the importance of various dietary microelements and their combinations for the enzyme activity of the animal body]. <original> znachenie razlichnykh mikroelementov diety i ikh sovokupnostei dlia fermentativnoi aktivnosti zhivotnogo organizma. *Voprosy Pitaniia* 32(2): 86-7.

FL Vorob'eva, A. M. 1973. significance of several trace elements in the diet and theircombinations for enzyme activity in animals. *Voprosy Pitaniya* 32(2): 86-87.

FL Vorob'eva, A. M. value of various trace elements of the diet and their combinations for enzymatic activity of animals. *Voprosy Pitaniya. 32 (2). 1973 86-87.*

Unrel Vrakin, V. F., Khodyrev, A. A., Draganov, I. F., and Alekseeva, L. V. 1991. metabolism of trace elements in young bulls during fattening ondistillers' grain. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii* (4): 129-138.

FL Vrzgula, L., Bires, J., and Konrad, V. 1986. the first occurrence of industrial copper intoxication in sheep clinical and pathological aspects. *Zivocisna Vyroba.* 31(5): 463-468.

Surv Vrzgulova, M. 1993. histological and submicroscopical findings on the seminiferous parenchyma in rams after copper oxide intoxication from industrial emissions. *Functional and Developmental Morphology.* 3(2): 115-119.

No Oral Vrzgulova, M., Bires, J., and Vrzgula, L. 1993. the effect of copper from industrial emission on the seminiferous epithelium in Rams. *Reprod Domest Anim.* 28(3): 108-118.

FL Vrzgulova, M., Vrzgula, L., and Bires, J. 1995. morphological picture of the testes of breeding rams after experimental administration of copper-containing industrial emissions. *Veterinarni Medicina.* 40(4): 105-110.

Mix Vrzgulova, M. Vrzgula L. and Bires J. 1995. morphological characteristics of the testes in breeding rams after experimental loading with industrial emissions containing copper. *Vet Med 40[4], 105-110.* 40(4): 105-110.

FL Vujovic, R., Vujic, B., Sindelic, V., Kordic, B., and Curcic, M. mineral content in the uterus and gonads of cows and its role in reproduction. *Veterinaria (Sarajevo). 19 (4). 1970 541-545.*

No Oral Waalkes, M. P., Rehm, S., Kasprzak, K. S., and Issaq, H. J. 1987. inflammatory, proliferative, and neoplastic lesions at the site of metallic identification ear tags in wistar [crl:(wi)br] rats. *Cancer*

Research 47(9): 2445-50.

Nutr Waghorn, G. C., Shelton, I. D., and Sinclair, B. R. distribution of elements between solid and supernatant fractions of digesta in sheep given six diets. *New Zealand Journal of Agricultural Research. 33 (2). 1990. 259-270.*

Mix Wakefield, R. C. and Sawyer, C. D. 1986.*Use of Composted Sewage Sludge on Roadside Vegetation. <NOTE> Research Rept. CONTRIB-2353; FHWA/RI/RD-86/01B*

Nut def Wallwork, J. C., Johnson, L. K., Milne, D. B., and Sandstead, H. H. 1983. effect of interactions between dietary egg white protein and zinc on body weight bone growth and tissue trace metals in the 30 day old rat. *Journal of Nutr. 113 (7). 1983. 1307-1320.* 113(7): 1307-1320.

Nut def Wallwork, James C., Milne, David B., Sims, Rodger L., and Sandstead, Harold H. severe zinc deficiency: effects on the distribution of nine elements (potassium, phosphorus, sodium, magnesium, calcium, iron, zinc, copper and manganese) in regions of the rat brain. *J. Nutr. (1983)* 113(10): 1895-905 .

FL Wang, A. and Shan, A. S. 1992. effects of ca and zn on mineral content of serum, reproductive organsand tibia in white leghorn hens. *Chinese Journal of Animal Science* 28(6): 23-25.

FL Wang Handong, Wang Zongyuan, and Lu Xiaolong (Jiangsu Agricultural Coll., Yangzhou China Dept. of Animal Science and Veterinary Medicine. 1991. influences of supplemented dietary zinc and copper on the metabolism of copper in chickens in vivo. *Journal of Jiangsu Agricultural College. V. 12(3) P. 7-12*

In Vit Wang, T. S., Kuo, C. F., Jan, K. Y., and Huang, H. arsenite induces apoptosis in chinese hamster ovary cells by generation of reactive oxygen species. *Journal of Cellular Physiology; 169 (2). 1996. 256-268.*

Method Wapnir, R. A. 1989. protein digestion and the absorption of mineral elements. *Advances in Experimental Medicine and Biology* 249: 95-115.

No Oral Ward, G. M. and Nagy J. G. 1976. 1 97-113. 1976. chapter 7, the biology of molybdenum, molybdenum and copper in colorado forages, molybdenum toxicity in deer, and copper supplementation in cattle.

Nutr Ward, T. L., Watkins, K. L., and Southern, L. L. 1993. interactive effect of sodium zeolite a and eimeria acervulina infectionon growth and tissue minerals in chicks. *Poultry Science* 72(11): 2172-2175.

Plant Warman, P. R. the effects of pruning, fertilizers, and organic amendments on lowbush blueberry production.*Plant Soil (1987)* 101(1): 67-72

Plant Warman, P. R. 1990. fertilization with manures and legume intercrops and their influence onbrassica and tomato growth, and on tissue and soil copper, manganeseand zinc. *Biological Agriculture & Horticulture* 6(4): 325-335.

Surv Warren, R. J., Wallace, B. M., Bush, P. B., Madej, J. A., and Radzanowska, G. 1990. trace elements in migrating blue-winged teal: seasonal-, sex- and age-class variations.: the effect of copper and selenium administration on histopathological picture of organs and accumulation of metals in hens. *Environ Toxicol Chem.* 9(4): 521-528.

No Oral Wasfi, I. A. and Adam S. E. I. 1976. the effects of intravenous injection of small amounts of copper

sulphate in nubian goats. *J. Comp. Path.* 86: 387-291.

Nut def Washburn, K. W. 1969. hematological response of different stocks of chickens to iron-copper deficient diet. *Poultry Science* 48(1): 204-9.

Nut def Washburn, K. W. and Lowe, R. W. hematological and growth response of japanese quail fed an iron-copper deficient diet. *Poult. Sci. (1974)* 53(6): 2101-7.

Nut def Washburn, K. W. and Stino, F. K. R. changes in reproductive traits associated with selection for packed erythrocyte volume in japanese quail. *Poult. Sci. (1973)* 52(6): 2147-52.

Nut def Washburn, Kenneth W. and Edwards, Hardy M. Jr. variability in hematological response of chicks fed an iron-copper deficient diet. *Poultry Sci. (1970)* 49(1): 122-7.

Herp Wasser, J. S. 1985.*Hibernation in the Northern Water Snake, Nerodia Sipedon: Seasonal Variations in Plasma and Tissue Chemistry (Plasma Spectrometry, Ectotherm)*

In Vit Wasserman, R. H. 1979.*Molecular Mechanisms of the Epithelial Transport of Toxic Metal Ions, Particularly Mercury, Cadmium, Lead, Arsenic, Zinc, and Copper. Progress Report, January 1, 1979-December 31, 1979*

Nutr Watanabe, Yoshito, Nishimura, Yoshikazu, and Yukawa, Masae. 1995. effect on trace elements in rats after long-term administration of chitosan- diet. *Kichin Kitosan Kenkyu* 1(2):

CP Watkin, E. M. 1978. practical economic aspects of acid sulphide tailings reclamation. *Third Annual General Meeting Canadian Land Reclamation Association: Abstracts. In Reclamation Review* 1(3-4): 170.

CP Watkins, K., Southern, L., Craig, W., and Engstrom, M. efficacy of chelated copper and zinc compounds in uninfected and eimeria-acervulina infected chicks. *72nd Annual Meeting of the Federation of American Societies for Experimental Biology, Las Vegas, Nevada, Usa, May 1-5, 1988. Faseb (Fed Am Soc Exp Biol) J. 2 (5). 1988. Abstract 4696.*

Nutr Watkins, Kevin L. and Southern, L. Lee. 1993. effect of dietary sodium zeolite a on zinc utilization by chicks. *Poult. Sci.* 72(2): 296-305.

Drug Watts, M. E. and Mark, R. F. 1971. drug inhibition of memory formation in chickens. ii. short-term memory. *Proc. Roy. Soc.* 178(1053): 455-64.

Gene Waxman Aaron B, Einarsson Oskar, Seres Tamas, Knickelbein Roy G, Warshaw Joseph B, Johnston Robert, Homer Robert J, and Elias Jack A(A). 1998. targeted lung expression of interleukin-11 enhances murine tolerance of 100 percent oxygen and diminishes hyperoxia-induced dna fragmentation. *Journal of Clinical Investigation* 101(9): 1970-1982.

FL Wayss, K., Volm, M., Wesch, H., and Zimmerer, J. relation between the alteration of the copper level in plasma and the growth of morris hepatoma no. 3924. *Z. Naturforsch. B (1972)* 27(7): 846-9

Unrel Wee, Siowfong and Grogan, W. Mclean a. 1993. testicular temperature-labile cholesteryl ester hydrolase: relationship to isoenzymes from other tissues, correlation with spermatogenesis, and inhibition by physiological concentrations of divalent cations. *Journal of Biological Chemistry.* 268(11): 8158-8163.

BioX Weekley, L. B., Kimbrough, T. D., and Llewellyn, G. C. 1981. dietary aflatoxin and copper acetate effects on various blood parameters in rats. *Drug Chem Toxicol.* 4(2): 113-22.

CP Weekley, L. B. a, Kimbrough, T. D., O'Rear, C. E., and Llewellyn, G. C. 1994. disturbances in tryptophan metabolism following chronic ingestion of a high copper diet by male rats.: <book> . *Bodeterioration Research 4 Mycotoxins, Wood Decay, Plant Stress, Biocorrosion, and General Biodeterioration* : 659-670.

Gene Wei, Deyue and Andrews, Glen K. molecular cloning of chicken metallothionein. deduction of the complete amino acid sequence and analysis of expression using cloned cdna. *Nucleic Acids Res. (1988)* 16(2): 537-53.

Alt Wei, Yuan-Yaw and Chung, Chien. analysis of elemental absorption and excretion in mice bearing malignant ascites. *Biol. Trace Elem. Res. (1994)* : 43-45, 397-403 .

In Vit Weisiger, R. A. and Fridovich, I. 1973. mitochondrial superoxide simutase. site of synthesis and intramitochondrial localization. *Journal of Biological Chemistry* 248(13): 4793-6.

FL Weiss, E and Baur, P. 1968. [experimental studies on chronic copper poisoning in the calf]. *Zentralbl. Veterinaermed.* 15: 156.

Nutr Weiss, F. G. and Scott, M. L. 1979. effects of dietary fiber, fat and total energy upon plasma cholesteroland other parameters in chickens. *Journal of Nutrition* 109(4): 693-701.

Mineral Wendler, C. 1995. possibility of mineral supply for canaries (serinus canaria) withcommercially available feeds. 115 pp.

Alt Wenk, Gary Lee. 1981.*The Influence of Dietary Trace Metals Upon the Enzymatic, Neurochemical, and Neuropathological Expression of Aluminum Neurotoxicity*

Mix Wennig, R. local environmental loading by rare heavy metals. *Anorg. Stoffe Toxikol. Krim.* Symp. (1983): 181-5 Publisher: Verlag Dr. Dieter Helm, Heppenheim, Fed. Rep. Ger..

Surv Wenning, R. J_(A)^Bonnevie N L^Huntley S L. 1994. accumulation of metals, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons in sediments from the lower passaic river, new jersey. *Archives of Environmental Contamination and Toxicology.* 27(1): 64-81.

Surv Wenzel, C. and Adelung, D. 1996. the suitability of oiled guillemots (uria aalge) as monitoring organisms for geographical comparisons of trace element contaminants. *Archives of Environmental Contamination and Toxicology* 31(3): 368-77.

Surv Wenzel, C., Adelung, D., and Theede, H. 1996. distribution and age-related changes of trace elements in kittiwake rissa tridactyla nestling from an isolated colony in the german bight, north sea. *Science of the Total Environment.* 193(1): 13-26.

Bio Acc Wenzel, C. and Gabrielsen, G. W. 1995. trace element accumulation in three seabird species from hornoya, norway. *Vol. 29, No. 2, Pp. 198-206* Arch. Environ. Contam. Toxicol.

Bio Acc Wenzel, Christine Institut fur Meereskunde Kiel Germany, Adelung, Dieter, and Theede, Hans. distribution and age-related changes of trace elements in kittiwake. *Sci Total Environ. V193, N1, P13(14)*

FL Wermuth, J. F., Weiser, H., and Rambeck, W. A. 1993. influence of vitamin c on cadmium retention in japanese quails. <original title> influence de la vitamine c sur la retention du cadmium chez la caille japonaise. *Vol. 144, No. 1, Pp. 39-42* Rev. Med. Vet.

Nutr Wertz, A. E(A), Berger, L. L(A), Dvorak, R. A., and Jacques, K. A. 1997. effects of mineral source

on the hoof durability, reproductive, and feedlot performance of heifers. *Journal of Animal Science* 75(SUPPL. 1): 251.

Unrel Westing, T. W., Fontenot, J. P., McClure, W. H., Kelly, R. F., and Webb, K. E. Jr. 1985. characterization of mineral element profiles in animal waste andtissues from cattle fed animal waste. 1. heifers fed broiler litter. *Journal of Animal Science* 61(3): 670-681.

Mix Westing, T. W., Fontenot, J. P., and Webb, K. E. Jr. 1985. characterization of mineral element profiles in animal waste and tissues from cattle fed waste. 2. steers fed cattle feedlot waste. *Journal of Animal Science.* 61(3): 682-691.

Meth Weston, Andrea, Brown, Phyllis R., Heckenberg, Allan L., Jandik, Petr, and Jones, William R. effect of electrolyte composition on the separation of inorganic metal cations by capillary ion electrophoresis. *J. Chromatogr. (1992)* 602(1-2): 249-56.

FL Wetzel, R. and Menke, K. H. 1978. behaviour of the trace elements copper, zinc and manganese in theof cattle. 2. rate of transit and course of trace elementconcentration in the rumen under the influence of copper sulphate. *Archiv Fur Tierernahrung* 28(7): 459-470.

Bio Acc Whelton, B. D., Peterson, D. P., Moretti, E. S., Mauser, R. W., and Bhattacharyya, M. H. 1997. hepatic levels of cadmium, zinc and copper in multiparous, nulliparous and ovariectomized mice fed either a nutrient-sufficient or -deficient diet containing cadmium. *Toxicology.* 119(2): 141-53.

Abstract Whitaker, D. A. 1997. copper toxicosis in sheep. *Veterinary Record.* 141(21): 556.

Unrel Whitaker, D. A. 1999. trace elements - the real role in dairy cow fertility? *Cattle Practice* 7(3): 239-241.

Mix White, C. L., Cadwalader, T. K., Hoekstra, W. G., and Pope, A. L. 1989. the metabolism of 75se-selenomethionine in sheep given supplementary copper and molybdenum. *J. Anim. Sci.* 67(9): 2400-2408.

Mix White, C. L., Masters, D. G., Paynter, D. I., Howell, J. M. C., Roe, S. P., Barnes, M. J., and Allen, J. G. 1994. the effects of supplementary copper and a mineral mix on the development of lupinosis in sheep. *Australian Journal of Agricultural Research* 45(2): 279-291.

Nut def Wiederanders, R. E., McCoy, F. E., and Evans, G. W. 1968. dietary influences on copper and calcium metabolism in the rat. *J Lancet.* 88(4): 99-103.

Surv Wiemeyer, S. N., Jurek, R. M., and Moore, J. F. 1986. environmental contaminants in surrogates foods and feathers of california condors gymnogyps-californianus. *Environ Monit Assess.* 6(1): p91-111.

Surv Wiemeyer, Stanley N., Schmeling, Sheila K., and Anderson, Allen. 1987. environmental pollutant and necropsy data for ospreys from the eastern united states, 1975-1982. *J. Wildl. Dis.* 23(2): 279-91 .

Surv Wiener, G., Field, A. C., and Smith, C. 1977. deaths from copper toxicity of sheep at pasture and the use of fresh seaweed. *Veterinary Record.* 101(21): 424-425.

Unrel Wiener, G., Sales, D. I., and Field, A. C. 1976. libido and fertility in rams in relation to plasma copper levels. *Veterinary Record.* 98(6): 115-116.

No Oral Wight, P. A. L., Dewar, W. A., Saunderson, C. L., Wiemeyer, S. N., Jurek, R. M., and Moore, J. F. 1986. zinc toxicity in the fowl ultrastructural pathology and relationship to selenium lead and copper:

environmental contaminants in surrogates foods and feathers of california condors gymnogyps-californianus. *Avian Pathol.* 15(1): 23-38.

Species Williams, Phillip L. and Dusenbery, David B. 1988. using the nematode caenorhabditis elegans to predict mammalian acute lethality to metallic salts. *Toxicol. Ind. Health (1988)* 4(4): 469-78 .

Drug Wilson, C. L. 1970. experimental attempts to stimulate bone growth. *Journal of Bone and Joint Surgery* 52(5): 1033-40.

Nutr Wilson, K. A., Cook, R. M., and Rihs, T. use of high altitude grasslands in ecuador for cattle production. *Journal of Animal Science. 43 (1). 1976 338*

No Dose Wilson, P. R. 1989. bodyweight and serum copper concentrations of farmed red deer stags following oral copper oxide wire administration. *N.Z.Vet.J.* 37: 94-97.

FL Windisch, W. and Kirchgessner, M. effect of phytase on apparent digestibility and gross utilization of fe, cu, zn, and mn at different levels of calcium supply in piglets and broilers. *Agribiol. Res. (1996)* 49(1): 23-9.

FL Windisch, W. M., Gotterbarm, G. G., and Roth, F. X. 2001. effect of potassium diformate in combination with different amounts and sources of excessive dietary copper on production performance in weaning piglets. *Archiv Fur Tierernahrung, 2001, 54(2):87-100.*

Sed Winger, P. V., Lasier, P. J., White, D. H., and Seginak, J. T. 2000. effects of contaminants in dredge material from the lower savannah river . *Arch. Environ. Contam. Toxicol.* 38(1): 128-136 .

Nut Def Winter, W. H., Siebert, B. D., and Kuchel, R. E. 1977. cobalt deficiency of cattle grazing improved pastures in northern cape york peninsula. *Aust J Exp Agric Anim Husb.* 17(84): 10-15.

Nut def Wisniewski, E., Juszkiewicz, T., Lachowski, A., Janiszewski, A., and Janiszewski, J. 1994. environmental pollution as possible cause of osteochondrosis in foals. *Zycie Weterynaryjne.* 69(5): 212-216.

FL Wittmann, M., Roth, F. X., and Kirchgessner, M. 1994. self-selection of lead supplemented diets by broilers. 1. effects oflead on performance of broilers. *Archiv Fur Geflugelkunde.* 58(1): 38-45.

FL Wittmann, M., Roth, F. X., and Kirchgessner, M. 1994. self-selection of lead supplemented diets by chicks. 1. effects of lead on performance of chicks. *Arch. Gefluegelkd.* 58(1): 38-45 .

Surv WLostowski, T. 1992. postnatal changes in subcellular distribution of copper, zinc and metallothionein in the liver of bank vole (clethrionomys glareolus): a possible involvement of metallothionein and copper in cell proliferation. *Comp Biochem Physiol C.* 103(2): 285-90.

Surv Wlostowski, T. and Chetnicki, W. 1994. the effect of supplementary food in winter on growth, maturation and tissue zn, cu, fe and ca concentrations in the bank vole, clethrionomys glareolus (schreber, 1870). *Polish Ecological Studies.* 20(1-2): 17-32.

CP Wolf, B. W., Firkins, J. L., and Zhang, S. 1997. effect of fructooligosaccharides (fos) on apparent mineral digestibility and retention in normal rats. *FASEB Journal* 11(3): A404.

Mineral Wolf, Bryan W., Firkins, Jeffrey L., and Zhang, Xiaosong. varying dietary concentrations of fructooligosaccharides affect apparent absorption and balance of minerals in growing rats. *Nutr. Res. (N. Y.) (1998)* 18(10): 1791-1806.

FL Wolf, P., Bayer, G., Kamphues, J., and Pallauf, J. ed. 1997. investigations on the nutritive value of typical seeds and ingredients for small pet birds. <original> futtermittelkundliche untersuchungen zu den wichtigsten saemereien und saaten fuer ziervoegel. proceedings of the society of nutrition physiology. <original> berichte der gesellschaft fuer ernaehrungsphysiologie. *P. 114. No. 6*

FL Wolf, P., Bayer, G., Wendler, C., and Kamphues, J. mineral deficiency in pet birds. *J. Anim. Physiol. Anim. Nutr. (1998)* 80(2-5): 140-146.

Rev Wolter, R. nutrition of sport animals. *Science & Sports. 2 (2). 1987. 63-94.*

Species Wong, M. H., Chan, K. M., and Liu, W. K. trace metal concentrations in tilapia fed with pig and chicken manure. *Conserv. Recycl. (1984)* 7(2-4): 351-60.

Plant Wong, M. H., Cheung, Y. H., and Cheung, C. L. the effects of ammonia and ethylene oxide in animal manure and sewage sludge on the seed germination and root elongation of brassica parachinensis. *Environ Pollut Ser a Ecol Biol; 30 (2). 1983. 109-124.*

Mix Wood, B. H., Wood, C. W., Yoo, K. H., Yoon, K. S., and Delaney, D. P. nutrient accumulation and nitrate leaching under broiler litter amended corn fields. *Commun. Soil Sci. Plant Anal. (1996)* 27(15-17): 2875-2894

Unrel Wood, C. W. and Hall, B. M. impact of drying method on broiler litter analyses. *Commun Soil Sci Plant Anal; 22 (15-16). 1991. 1677-1688.*

Mineral Wood, Frederick E. and Stoll, Sally J. the effect of dietary guar gum and cellulose on mineral excretion and status in young male fischer 344 rats.*Nutr. Res. (N. Y.) (1991)* 11(6): 621-32

Bio Acc Wooliams, J. A., Suttle, N. F., Weiner, G., and et al. the long-term accumulation and depletion of copper in the liver of different breeds of sheep fed diets of differing copper content. *Journal of Agricultural Science.* 100: 441-449.

Bio Acc Woolliams, J. A., Suttle, N. F., Wiener, G., Field, A. C., and Woolliams, C. 1982. the effect of breed of sire on the accumulation of copper in lambs with particular reference to copper toxicity. *ANIM PROD.* 35(3): 299-308.

Rev Worth, J. hazardous waste: a health hazard for our wildlife. *The-Conservationist-39(4):43-47; 1985. 1985.*

Unrel Wranicz, Mariusz and Guttowa, Alicja. x-ray microanalysis of distribution and concentration of elements in mouse skeletal muscle fibers and in the larvae l1 of the nematode trichinella pseudospiralis. *Bull. Pol. Acad. Sci.: Biol. Sci. (1992)* 40(4): 287-92.

Dead Wren, C. D. 1984. distribution of metals in tissues of beaver, raccoon and otter from ontario, canada. *Sci Total Environ.* 34(1-2): 177-184.

Nut def Wu, B. N., Medeiros, D. M., Lin, K. N., and Thorne, B. M. 1984. long term effects of dietary copper and sodium upon blood pressure in the long-evans rat. *Nutrition Research.* 4 (2): 305-314.

FL Wu, C. L. and Yeh, C. H. 1995. effect of excess dietary copper on the growth performance of mule ducklings. *Kexue Nongye.* 43(3-4): 120-1.

FL Wu, F. M. 1988. case report of sheep copper Poisoning. *J Chin Soc Vet Sci.* 13(4): 311-318.

FL Wu Juewen . 1997. preliminary studies on feeding broiler with high level copper sulphate diet.

Journal of South China Agricultural University. 18(Suppl): 122-124.

No COC Wu, M. S. W., Cook, M. E., and Smalley, E. B. 1990. prevention of thiram-induced dyschondroplasia by copper. *Nutrition Research* 10(5): 555-566.

No COC Wu, W., Cook, M. E., Chu, A., and Smalley, E. B. 1993. tibial dyschondroplasia of chickens induced by fusarochromanone, a mycotoxin. *Avian Diseases.* 37(2): 302-309.

In Vit Wyler, R. and Wiesendanger, W. 1975. the enhancing effect of copper, nickel, and cobalt ions on plaque formation by semliki forest virus (sfv) in chicken embryo fibroblasts. *Archives of Virology* 47(1): 57-69.

Unrel Xi, D., Peng, Y., and Ramsdell, J. S. 1997. domoic acid is a potent neurotoxin to neonatal rats. *Natural Toxins.* 5(2): 74-79.

Nutr Xia, M. S., Hu, C. H., and Xu, Z. R. 2005. effects of copper bearing montmorillonite on the growth performance, intestinal microflora and morphology of weanling pigs. *Animal Feed Science and Technology.* 118(3-4): 307-317.

Unrel Xu, Xiuju, Xiao, Menglan, Li, Feng, Wang, Xiaoning, and Li, Meixian. nutritional and safety evaluation of delipidized castor bean proteins. *Shipin Kexue (Beijing) (1990)* : 122, 8-9.

Minseral Yadav, P. S., Mandal, A. B., Vanita Kapoor, Sunaria, K. R., and Mann, N. S. 1998. mineral status of cows and buffaloes in rewari district of haryana. *Indian Journal of Animal Sciences* 68(10): 1059-1061.

FL Yakusheva, O. V. and <Editors> N.I. Stepanova. pathogenesis of experimental theileriosis (theileria annulatainfection) in cattle. *<Document Title>Arakhnozy i Protozoinye Bolezni Sel'Skokhoz.Zhivotnykh (Arachnid Infestations and Protozoal Diseases of Farmanimals)*

Acute Yamaguchi, M., Inamoto, K., and Suketa, Y. 1986. effect of essential trace metals on bone metabolism in weanling rats: comparison with zinc and other metals' actions. *Res Exp Med (Berl).* 186(5): 337-42.

Unrel Yamaguchi, M. and Yamaguchi, R. 1986. action of zinc on bone metabolism in rats. increases in alkaline phosphatase activity and dna content. *Biochem Pharmacol.* 35(5): 773-7.

No Oral Yamamoto, T., Kosugi, T., and Kawamura, Y. 1978. taste preference and taste nerve responses of rats under copper toxicosis. *Pharmacol. Biochem. Behav.* 9(6): 799-807.

Chem Meth Yamamura, T., Hagiwara, S., Nakazato, K., and Satake, K. 1984. copper complexes at n- and c-site of ovotransferrin: quantitative determination and visible absorption spectrum of each complex. *Biochemical and Biophysical Research Communications* 119(1): 298-304.

No COC Yamane, Yasuhiro and Sakai, Kazuo. effect of basic cupric acetate on biochemical changes in the liver of the rat fed carcinogenic aminoazo dye. iii. effect of copper compared with some other metals, phenobarbital, and 3-methylcholanthrene on the metabolism of 4-dimethylaminoazobenzene. *Chem. Pharm. Bull. (1974)* 22(5): 1126-32.

CP Yamani, K. A. O. Zagazig Univ. Egypt Faculty of Agriculture, Rashwan, A. A., and Magdy, M. M. 1997. effects of copper, zinc and tafla dietary supplementation on broiler performance. the proceedings of the international conference on animal... and health. *P. 457-463*

In Vit Yamashita, H., Horie, K., Yamamoto, T., Katagiri, H., Asano, T., Hirano, T., Nagano, T., and Oka, Y.

1994. superoxide dismutase in developing mouse retina. *Japanese Journal of Ophthalmology* 38(2): 148-61.

FL Yan Xianghua, Hu Jian, and Zhang Guangsheng (Veterinary Coll. of PLA, Changchun China. 1989. effects of dietary manganese and copper levels on growth and tibias in broilers. *Bulletin of Veterinary College of PLA. V. 9(2) P. 181-185*

Acute Yang, M. S., Lai, K. P., Cheng, K. Y., and Wong, C. K. C. 2000. changes in endogenous zn and cu distribution in different cytosolic protein fractions in mouse liver after administration of a single sublethal dose of cdcl sub(2). *Toxicology [Toxicology]. Vol. 154, No. 1-3, Pp. 103-111. 23 Nov 2000.*

No COC Yang, Meiling T. and Yang, Shiang P. effect of molybdenum supplementation on hepatic trace elements and enzymes of female rats. *J. Nutr. (1989)* 119(2): 221-7.

Plant Yang ShangShyng, Chung RenShih, and Swei WanJin. 1994. metal content and effect of organic fertilizer on crop growth. *Environmental Geochemistry and Health* (Special issue): 441-454.

Bio Acc Yang, Zhixiao, Wang, Hongcun, and Yu, Min. manufacture and trace element analysis in trace element-rich nutrient powder. *Shipin Kexue (Beijing) (1991)* : 137, 34-5.

No COC Yano, H., Matsui, H., and Kawashima, R. 1979. effects of supplemental calcium carbonate on the distribution of iron,copper, zinc and manganese in digestive tract of sheep. *Japanese Journal of Zootechnical Science* 50(7): 465-470.

No COC Yano, H., Nokata, M., and Kawashima, R. 1978. effects of supplemental calcium carbonate on the metabolism of iron,copper, zinc and manganese in sheep. *Japanese Journal of Zootechnical Science* 49(8): 625-631.

Unrel Yao, S. K., Ober, J. C., Gonenne, A., Clubb, F. J. Jr, Krishnaswami, A., Ferguson, J. J., Anderson, H. V., Gorecki, M., Buja, L. M., and Willerson, J. T. 1993. active oxygen species play a role in mediating platelet aggregation and cyclic flow variations in severely stenosed and endothelium-injured coronary arteries. *Circulation Research* 73(5): 952-67.

FL Yarov, I. I. 1987. use of paprin in pig production. *Zhivotnovodstvo* (4): 36-40.

Bio Acc Yasui, Masayuki, Ota, Kiichio, and Sasajima, Kazuhisa. 1995. neutron activation analysis in the central nervous system tissues of neurological diseases and rats maintained on minerally unbalanced diets. *Kyoto Daigaku Genshiro Jikkensho Gakujutsu Koenkai Hobunshu* 29: 305-16 .

HHE Yazaki, M., Yoshida, K., Nakamura, A., Furihata, K., Yonekawa, M., Okabe, T., Yamashita, N., Ohta, M., and Ikeda, S. I. 1998. a novel splicing mutation in the ceruloplasmin gene responsible for hereditary ceruloplasmin deficiency with hemosiderosis. *Journal of the Neurological Sciences* 156(1): 30-34.

Alt Yen, H. C., Oberley, T. D., Vichitbandha, S., Ho, Y. S., and St Clair, D. K. 1996. the protective role of manganese superoxide dismutase against adriamycin-induced acute cardiac toxicity in transgenic mice [published erratum appears in j clin invest 1997 mar 1;99(5):1141]. *Journal of Clinical Investigation* 98(5): 1253-60.

Unrel Yessein, S., Shawki, H., Bashandy, M. M., Essawy, S., and Abdallah, I. 1995. clinicopathological studies in female infertile buffaloes. *Buffalo Journal.* 11(1): 83-89.

Unrel Yohe, H. C., Saito, M., Ledeen, R. W., Kunishita, T., Sclafani, J. R., and Yu, R. K. further evidence for an intrinsic neuraminidase in central nervous system myelin. *Journal of Neurochemistry. 46 (2).*

1986. 623-629.

FL Yokoi, K., Kimura, M., Matsuda, A., Kabata, H., Itokawa, Y., Kataoka, M., and Sato, M. 1989. [supplementation of essential trace elements during total parenteral nutrition--effects on trace element-deficient rats]. *Nippon Eiseigaku Zasshi* 44(4): 831-8.

Nut def Yokoi, Katsuhiko, Kumura, Mieko, and Itokawa, Yoshinori. effect of dietary iron deficiency on mineral levels in tissues of rats. *Biol. Trace Elem. Res. (1991)* 29(3): 257-65.

Unrel Yokoyama, A., Hosotani, T., Arano, Y., and Horiuchi, K. development of neutral and bifunctional radiopharmaceuticals using copper-62-dithiosemicarbazone chelate basic studies on copper-64 chelates. *Radioisotopes. 35 (5). 1986. 249-255.*

Alt Yoneyama, Yoshiki, Nagashima, Katsuhiro, Hasegawa, Ritsuko, Haranaka, Ruriko, Nakagawa, Shigeki, Fukui, Noriko, and Takeuchi, Shigeo. changes of trace elements in chronic renal failure (crf). *Biomed. Res. Trace Elem. (1992)* 3(1): 23-8.

Acu Yoshikawa, Hiroshi. preventive effect of pretreatment with low dose of metals on the acute toxicity of metals in mice. *Ind. Health (1970)* 8(4): 184-91.

No Oral Yoshimura Noriaki(A), Kida Kazuyuki, Usutani Saburo, and Nishimura Masahiko. 1995. histochemical localization of copper in various organs of brindled mice after copper therapy. *Pathology International* 45(1): 10-18.

Unrel Youdim, M. B., Ben-Shachar, D., and Riederer, P. 1991. iron in brain function and dysfunction with emphasis on parkinson's disease. *European Neurology* 31 Suppl 1: 34-40.

Bio Acc Ytrehus, B., Skagemo, H., Stuve, G., Sivertsen, T., Handeland, K., and Vikoren, T. 1999. osteoporosis, bone mineralization, and status of selected traceelements in two populations of moose calves in norway. *Journal of Wildlife Diseases* 35(2): 204-211.

Unrel Yu, Ping, Yan, Jinling, and Huang, Meng. extraction of the active constituents of fugus ovary and their properties. *Tianran Chanwu Yanjiu Yu Kaifa (1999)* 11(5): 51-54.

CP Yu, S. and Beynen, A. C. 1993. hepatic copper accumulation in jaundiced rats after feeding a high-copper diet. *Trace Elelments in Mand and Animals - TEMA 8: Proceedings of the Eighth* : 390-391.

FL Yu, S. and Beynen, A. C(A). 1994. high zinc intake reduces biliary copper excretion in rats. *Journal of Animal Physiology and Animal Nutrition* 72(4-5): 169-175.

Mix Yu, Shiguang. 1993?*Copper Metabolism and Its Interactions With Dietary Iron, Zinc, Tin and Selenium in Rats / Shiguang Yu* 169 p

An Prod Yuan H., Yi H., and Wan G. 1991. effect of supplemental different levels of zn, se, cu in cow diet on milk yield, milk quality and relative serum enzyme. *Journal of Hunan Agricultural College.* 17(4): 725-729.

No Dose Yuan Hai Tao, Bingle Colin D, and Kelly Frank J(A). 1996. differential patterns of antioxidant enzyme mrna expression in guinea pig lung and liver during development. *Biochimica Et Biophysica Acta* 1305(3): 163-171.

FL Yuan, Hongbing and Zhang, Gong. combined effects of lead, cadmium and arsenic on renal trace element levels in mice. *Gongye Weisheng Yu Zhiyebing (1991)* 17(2): 70-2 .

CP Zaghloul, A. H., Nassar, A. Y., and El-Saedani, M. 1991. the effect of copper (i)-nicotinic acid complex on sexual behaviour and semen picture of bulls. *Proceedings, First Scientific Congress of the Egyptian Society for Cattle Diseases, 1-3 Dec. 1991, Assiut, Egypt.* 9-16.

Unrel Zagrebel'nyi, S. V. 1993. pelage of sea otter enhydra lutris (carnivora, mustelidae): hair structure, topography, and some adaptive features. *Zoologicheskii Zhurnal.* 72(2): 129-140.

FL Zakharenko, N. A., Zasekin, D. A., Shabel'nik, N. M., Mel'nikova, N. N., and Mel'nichuk, D. A. 1992. electrolyte composition of cow and calf tissues in norm and at acute digestive disturbances. *Ukrainskii Biokhimicheskii Zhurnal* 64(5): 70-77.

No COC Zaki K(A), Elwa, S. M(A), Mossaad, M. M., Nasr, F. I., and El Kholy S M. 1995. changes of some electrolytes and trace elements in serum and atrial tissue of rat under different doses of sodium chloride intake. *Journal of the Medical Research Institute* 16(1): 34-46.

Unrel Zamri-Saad, M., Shariff, H., and Rahman, M. Ya. 1989. preliminary observation on the disease pattern in fattening sheep fed with oil palm by-products. *Pertanika.* 12(2): 187-188.

FL Zankevich, A. 1988. premixes for boars. *Svinovodstvo, Moscow* (3): 27-28.

FL Zapadniuk, V. I. 1969. [appearance of "phenamine stereotypy" in rats following serial administration of biotic doses of copper and manganese]. <original> proiavlenie "genaminovoi stereotipii" u krys posle krusovogo vvedeniia bioticheskikh doz medi i margantsa. *Farmakologiia i Toksikologiia* 32(1): 38-40.

Drug Zapadnyuk, V. I. 1969. "phenamine stereotypy" in rats after administration of copper and manganese. *Farmakol. Toksikol.* 32(1): 38-40.

FL Zapadnyuk, V. I., Stepanenko, P. Z., Savluk, O. S., and Elmuratov, S. N. biological role of copper and silver and their effect on the passive defense reactions of white rats. *Vodopodgot. Ochistka Prom. Stokov (1973)* : 10, 91-9 .

FL Zapadnyuk, V. I. and Zaika, M. U. effect of recurrent course-wise adminstration of biotic doses of copper, manganese, and their combination on some biochemical indices in rats. *Farmakol. Toksikol. (Moscow) (1970)* 33(5): 606-7.

FL Zapadnyuk, V. I., Zaika, M. U., Kuprash, L. P., and Mirskikh, Z. M. effect of repeated administration of trace amounts of copper, manganese, and their combinations on the general state and some metabolic indexes of rats. *Mikroelem. Sel. Khoz. Med. (1969)* : No. 5, 175-81 .

Mineral Zapata, J. F. F., Almeida, M. M. M., Martins, C. B., and Maia, G. A. 1998. effect of dietary calcium phosphate supplements on centesimalcomposition and selected minerals in goat meat. *Boletim Da Sociedade Brasileira De Ciencia e Tecnologia De Alimentos* 32(1): 25-29.

Mix Zasadowski, A., Barski, D., and Spodniewska, A. 1996. influence of dietary selenium on tissue concentrations of cd, cu and znin rats exposed to cadmium chloride. *Acta Academiae Agriculturae Ac Technicae Olstenensis, Veterinaria.*(24): 163-175.

Bio Acc Zatta, P., Cervellin, D., Favarato, M., Gerotto, M., and Mattiello, G. microelemental concentration in the ontogenesis of rat brain. *Trace Elem. Electrolytes (1994)* 11(3): 143-7.

Mineral Zdunczyk, Z., Frejnagel, S., Godycka, I., Krefft, B., Juskiewicz, J., and Markiewicz, K. effect of protein source on the level of trace minerals in rat liver. *Ber. Bundesforschungsanst. Ernaehr. (1993) (BFE-R-93-01, Bioavailability '93 Pt. 1)* : 214-317.

Nutr Zdunczyk, Z., Juskiewicz, J., Flis, M., Markiewicz, K., <Editors> Gediga, K., and Ciesla, G. 1996. the manganese content in white lupin seeds: effect on feed intake,growth and retention of trace elements in rats. *Zeszyty Problemowe Postepow Nauk Rolniczych* 434(II): 729-734.

Abstract Zeman, F. J., Keen, C. L., Hurley, L. S., and Shrader, R. E. 1981. hematologic and trace element alterations following chronic maternal ingestion of propyl thio urea. *65th Annual Meeting of the Federation of American Societies for Experimental Biology*

Unrel Zentek, J. 1996. current situation of mineral supply of cattle. *Ubersichten Zur Tierernahrung.* 24(1): 76-82.

FL Zentek, J. 1995. observations on the apparent digestibility of copper, iron, zinc, and manganese in dogs. *Dtsch. Tieraerztl. Wochenschr.* 102(8): 310-15

FL Zentek, J., Pfannes, K., and Kamphues, J. 1999. copper intoxication in piglets. *DTW (DTSCH Tieraerztl Wochenschr).* 106(7): 288-291.

Mineral Zentek, J., Ulrich, B., Hebeler, D., and Heyer, H. 1996. investigations on the mineral and trace element content of limb bonesin fetuses and newborn foals. *Pferdeheilkunde* 12(3): 363-366.

FL Zernov, V. 1986. utilization of feed meal from hatchery wastes. *Svinovodstvo, Moscow* (6): 18-19.

Bio Acc Zervas, G. 1988. trace element concentrations in biological materials of sheep and goatsof thessaly area. *Epitheorese Zootehnikes Epistemes* (7): 49-63.

Mix Zervas, G. 1988. treatment of dairy sheep with soluble glass boluses containing copper cobalt and selenium. *Anim Feed Sci Technol.* 19(1-2): 79-84.

Mix Zervas, G., Telfer, S. B., Al-Tekrity, A., and Jones, D. 1987. prevention of trace element deficiencies in grazing ruminants. ii.sheep. *Deltion Tes Ellenikes Kteniatrikes Etaireias = Bulletin of the Hellenic Veterinary Medical Society.* 38(4): 258-263.

Mix Zervas, G., Telfer, S. B., Carlos, G., and Anderson, P. 1988. the effect of soluble-glass boluses containing copper, cobalt and selenium on the blood composition of ewes. *Animal Feed Science and Technology.* 21(1): 23-29.

Nutr Zervas, G., Nikolaou, E., and Mantzios, A. 1990. comparative study of chronic copper poisoning in lambs and young goats. *Anim Prod.* 50(3): 497-506.

Mix Zeyuan, Deng, Bingying, Tao, Xiaolin, Li, Jinming, He, and Yifeng, Chen. effect of green tea and black tea on the metabolisms of mineral elements in old rats. *Biol. Trace Elem. Res. (1998)* 65(1): 75-86

FL Zhang, D., Chen, S., Chen, J., Wang, N., Tai, M., He, G., and Feng, W. 1991. relations between disease and trace elements in giant panda Hair. *Zool Res.* 12(1): 73-78.

Nut def Zhang, Jianxin, Kawamura, Ken, Odagiri, Youichi, Karube, Toshiaki, Adachi, Shuichi, and Takemoto, Kazuo. sister chromatid exchanges in the bone marrow cells of rats fed manganese- and copper-deficient or iron-deficient diets. *Biomed. Res. Trace Elem. (1993)* 4(3): 243-6.

FL Zhang Jianyun (Neimenggu Coll. of Agriculture and Animal Husbandry, Hohhot China Dept. of Animal Science. 1996. the effects of dietary manganese on fertility and hatchibility and on the contents of manganese copper and zinc in eggs. *Acta Zoonutrimenta Sinica. V. 8(1) P. 6-11*

Alt Zhang, Shantong, Cui, Kewei, Cao, Shouwei, Li, Jingcun, Lu, Fanghong, Wu, Jianmei, Wu, Licun, Zhang, Jie, Yang, Xiaochun, and Zhang, Jianhua. influence of experimental atherosclerosis on serum copper, zinc, chromium, manganese, and selenium. *Yingyang Xuebao (1989)* 11(4): 344-9.

FL Zhang, W. R. 1986. effects of high level of copper feeding on plasma trace element concentration and enzyme activities. *Chinese Journal of Animal Science.*(4): 5-7.

Nut def Zhang YiYian, Liu XueWen, He ShengHu, Zhang XueJun, Ma YuanZheng, Huang XiaoXing, Yun Chao, Wang JianHua, Hou RangMin, and Wang LiXin. 1994. relationship between se and i deficiency and infertility or abortion ingoats. *Chinese Journal of Veterinary Science and Technology* 24(5): 14-15.

Mix Zhao, X. H., Li, D. F., Tian, F., Yang, H. C., and Yang, T. B. 1999. effect of high level of zinc and copper on piglet growth performance, immune response and blood antioxidative enzyme activities in blood. *Journal of China Agricultural University.* 4(1): 91-96.

Meth Zhao, Z., Malik, A., Lee, M. L., and Watt, G. D. a capillary electrophoresis method for studying apo, holo, recombinant, and subunit dissociated ferritins. *Anal. Biochem. (1994)* 218(1): 47-54.

Mix Zharkina, T. A. 1979. effect of mineral premix on protein spectrum of blood plasma in pigs. *Sbornik Trudov, Belorusskii Nauchno-Issledovatel'Skii Institut Zhivotnovodstva* (20): 84-86.

FL Zharova, E. P. 1970. age dynamics of the levels of copper, zinc, manganese, and cobalt in the muscles of white russian chickens. *Timiryazev. Sel'Skokhoz. Akad* : No. 157, 247-50 .

FL Zherebtsov, P. I., Shevelev, N. S., and Susova, N. I. 1973. changes in blood morphology and biochemistry of cattle on rations withdifferent cobalt, copper, manganese and zinc contents. *Izvestiya Timiryazevskoi Sel'Skokhozyaistvennoi Akademii* (2): 154-163.

Gene Zhizhina, G. P. and Blyukhterova, N. V. 1997. effect of metal ions and xenobiotics on endogenous oxidation of dna. *Biochemistry* . 62(1): 88-94.

Mix Zhou, M., Li, X. Q., and Ding, Y. S. 1998. effect of iron and zinc levels in diet containing super-dosage copperon blood parameters and productive performance of swine. *Chinese Journal of Veterinary Science.* 18(4): 407-409.

FL Zhou, M. R., Wang, J. F., Wang, Z. Y., and Shao, K. M. 1993. study on the effect of copper, zinc, manganese and selenium on growthperformance and some blood physiological and biochemical parameters inbroiler chicks. *Acta Veterinaria Et Zootechnica Sinica* 24(5): 412-422.

Mix Zhou, M. R., Wang, J. F., Wang, Z. Y., Shao, K. M., Abdallah, A. G., Harms, R. H., Wilson, H. R., and El-Husseiny, O. 1993. study on the effect of copper, zinc, manganese and selenium on growth performance and some blood physiological and biochemical parameters in broiler chicks.: effect of removing trace minerals from the diet of hens laying eggs with heavy or light shell weight. *Acta Veterinaria Et Zootechnica Sinica.* 24(5): 412-422.

Not Avail Zhou Ming and Li Xiangqiong (Anhui Agricultural Univ., Hefei China Dept. of Animal Science. 1996. effect of dietary copper levels on biological value of iron and zinc. *Journal of Anhui Agricultural University. V. 23(2) P. 137-140*

FL Zhou Mingrong . 1993. study on the effect of copper, zinc, manganese and selenium on growth performance and some blood physiological and biochemical parameters of broiler chicks. *Acta Veterinaria Et Zootechnica Sinica.* 24(5): 412-422.

Mix Zhou, W., Swinkels, J. W. G. M., Risley, C. R., and Kornegay, E. T. 1992. ability of cobalt to reduce copper deposition in selected tissues of weanling pigs fed growth promoting level of copper. *Animal Science Research Report, Virginia Agricultural Experiment Station.*(10): 44-46.

Minseral Zhu, Zongjian, Kimura, Mieko, and Itokawa, Yoshinori. mineral status in selenium-deficient rats compared to selenium-sufficient rats fed vitamin-free casein-based or torula yeast-based diet. *Biol. Trace Elem. Res. (1993)* 37(2-3): 219-3.

Unrel Zhumatov, U. Zh. 1996. elementary compositions of the fruits of morus nigra and zizyphusjujuba and their biological activities. *Chemistry of Natural Compounds* 32(1): 100-101.

FL Zicarelli, L., Macri, A., Vittoria, A., Padula, P., Costantini, S., Rania, V., and Giordano, R. 1981. copper poisoning in buffalo calves. *Rivista Di Zootecnia e Veterinaria.* 9(4): 246-251.

No COC Zidenberg-Cherr, S., Keen, C. L., Lonnerdal, B., and Hurley, L. S. 1983. dietary superoxide dismutase does not affect tissue levels. *American Journal of Clinical Nutrition* 37(1): 5-7.

Unrel Zidenberg-Cherr, Sheri, Benak, Peggy A., Hurley, Lucille S., and Keen, Carl L. altered mineral metabolism: a mechanism underlying the fetal alcohol syndrome in rats.*Drug-Nutr. Interact. (1988)* 5(4): 257-74

Nut def Zidenberg-Cherr, Sheri, Han, Bin, Dubick, Michael A., and Keen, Carl L. influence of dietary - induced copper and manganese deficiency on ozone-induced changes in lung and liver antioxidant systems. *Toxicol. Lett. (1991)* 57(1): 81-90.

Nut def Zidenberg-Cherr, Sheri, Keen, Carl L., Casey, Sharon M., and Hurley, Lucille S. developmental changes affected by manganese deficiency. manganese-superoxide dismutase, copper-zinc-superoxide dismutase, manganese, copper, iron and zinc in mouse tissues. *Biol. Trace Elem. Res. (1985)* 7(4): 209-22 .

Mix Zikic, R. V., Stajn, A. S., Ognjanovic, B. I., Saicic, Z. S., Kostic, M. M., Pavlovic, S. Z., and Petrovic, V. M. 1998. the effect of cadmium and selenium on the antioxidant enzyme activities in rat heart. *J Environ Pathol Toxicol Oncol.* 17(3-4): 259-64.

FL Zilincar, J., Bystrica, B., Zvada, P., Kubin, D., and Hell, P. 1992. the presence of heavy metals in brown bears in the west carpathian Mountains. *Z Jagdwiss.* 38(4): 235-243.

CP Zimmerer, J., Volm, M., Wayss, K., and Wesch, H. 1971. influence of tumor growth on the copper and manganese levels in organs of host animals. investigations with the help of neutron activation analysis. *Aktuel. Probl. Geb. Cancerol. Heidelberg. Symp., 3rd* : Meeting Date 1970, 119-23. Editor(s): Lettre, H. Publisher: Springer, Berlin, Ger.

Unrel Zimmermann Nickolas G and Douglass Larry. 1998. a survey of drinking water quality and it' effects of broiler growth performance on delmarva. *Poultry Science* 77(SUPPL. 1): 121.

No Oral Zipper, J., Medel, M., and Prager, R. 1969. suppression of fertility by intrauterine copper and zinc in rabbits. a new approach to intrauterine contraception. *American Journal of Obstetrics and Gynecology* 105(4): 529-34.

CP Zipper, J., Mendel, M., and Prager, R. 1970. experimental suppression of fertility by intrauterine copper and zinc in rabbits. *Proc. World Congr. Fert. Steril. 6th.* Meeting Date 1968, 380-5 Publisher: Isr. Acad. Sci. Humanities, Jerusalem, Israel.

No Oral Zissu, D., Cavelier, C., and De Ceaurriz, J. 1987. experimental sensitization of guinea-pigs to nickel

and patch testing with metal samples. *Food and Chemical Toxicology* 25(1): 83-5.

FL Zivkovic, R., Kostic, V., and Velickovic, G. 1972. effect of trace elements (cu, co) on production and reproduction of ewes. *Savremena Poljoprivreda.* 20(2): 5-12.

Drug Zivkovic, S. and Zlatic, H. 1979. a review of ten years of experience in feed additives in pig diets on large-scale farms in yugoslavia. *Livestock Production Science.* 6(1): 61-66.

FL Zmudzki, J. and Szkoda, J. trace elements content of hen eggs in poland. *Bromatologia I Chemia Toksykologiczna; 29 (1). 1996. 55-57.*

No COC Zou, J. Y., Martinez, D. B., Neafsey, E. J., and Collins, M. A. binge ethanol-induced brain damage in rats: effect of inhibitors of nitric oxide Synthase. *Alcoholism Clinical and Experimental Research; 20 (8). 1996. 1406-1411.*

FL Zyan'kou, A. S., Zharkina, T. A., and Kozyr, G. S. 1981. free amino acids in the liver of pigs given diets enriched with traceelement salts. *Vestsi Akademii Navuk BSSR, Sel'Skagaspadarchykh Navuk* (4): 93-96, 143.

No COC Zylka, C. A., Fontenot, J. P., and Allen, V. G. 1988-1989. digestibility and nitrogen and mineral metabolism by sheep fed ensiledtall fescue with different levels of endophyte infection. *Animal Science Research Report, Virginia Agricultural Experiment Station* (8): 92-97.

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ABSTRACT (Abstract)	Abstracts of journal publications or conference presentations.	Wildlife Plants and Soil Invertebrates
ACUTE STUDIES (Acu)	Single oral dose or exposure duration of three days or less.	Wildlife
AIR POLLUTION (Air P)	Studies describing the results for air pollution studies.	Wildlife Plants and Soil Invertebrates
ALTERED RECEPTOR (Alt)	Studies that describe the effects of the contaminant on surgically-altered or chemically-modified receptors (e.g., right nephrectomy, left renal artery ligature, hormone implant, etc.).	Wildlife
AQUATIC STUDIES (Aquatic)	Studies that investigate toxicity in aquatic organisms.	Wildlife Plants and Soil Invertebrates
ANATOMICAL STUDIES (Anat)	Studies of anatomy. Instance where the contaminant is used in physical studies (e.g., silver nitrate staining for histology).	Wildlife
BACTERIA (Bact)	Studies on bacteria or susceptibility to bacterial infection.	Wildlife Plants and Soil Invertebrates
BIOACCUMULATION SURVEY (Bio Acc)	Studies reporting the measurement of the concentration of the contaminant in tissues.	Wildlife Plants and Soil Invertebrates
BIOLOGICAL PRODUCT (BioP)	Studies of biological toxicants, including venoms, fungal toxins, *Bacillus thuringiensis*, other plant, animal, or microbial extracts or toxins.	Wildlife Plants and Soil Invertebrates
BIOMARKER (Biom)	Studies reporting results for a biomarker having no reported association with an adverse effect and an exposure dose (or concentration).	Wildlife
CARCINOGENICITY STUDIES (Carcin)	Studies that report data only for carcinogenic endpoints such as tumor induction. Papers that report systemic toxicity data are retained for coding of appropriate endpoints.	Wildlife Plants and Soil Invertebrates
CHEMICAL METHODS (Chem Meth)	Studies reporting methods for determination of contaminants, purification of chemicals, etc. Studies describing the preparation and analysis of the contaminant in the tissues of the receptor.	Wildlife Plants and Soil Invertebrates
CONFERENCE PROCEEDINGS (CP)	Studies reported in conference and symposium proceedings.	Wildlife Plants and Soil Invertebrates
DEAD (Dead)	Studies reporting results for dead organisms. Studies reporting field mortalities with necropsy data where it is not possible to establish the dose to the organism.	Wildlife Plants and Soil Invertebrates
DISSERTATIONS (Diss)	Dissertations are excluded. However, dissertations are flagged for possible future use.	Wildlife
DRUG (Drug)	Studies reporting results for testing of drug and therapeutic effects and side-effects. Therapeutic drugs include vitamins and minerals. Studies of some minerals may be included if there is potential for adverse effects.	Wildlife Plants and Soil Invertebrates
DUPLICATE DATA (Dup)	Studies reporting results that are duplicated in a separate publication. The publication with the earlier year is used.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ECOLOGICAL INTERACTIONS (Ecol)	Studies of ecological processes that do not investigate effects of contaminant exposure (e.g., studies of "silver" fox natural history; studies on ferrets identified in iron search).	Wildlife Plants and Soil Invertebrates
EFFLUENT (Effl)	Studies reporting effects of effluent, sewage, or polluted runoff.	Wildlife Plants and Soil Invertebrates
ECOLOGICALLY RELEVANT ENDPOINT (ERE)	Studies reporting a result for endpoints considered as ecologically relevant but is not used for deriving Eco-SSLs (e.g., behavior, mortality).	Plants and Soil Invertebrates
CONTAMINANT FATE/METABOLISM (Fate)	Studies reporting what happens to the contaminant, rather than what happens to the organism. Studies describing the intermediary metabolism of the contaminant (e.g., radioactive tracer studies) without description of adverse effects.	Wildlife Plants and Soil Invertebrates
FOREIGN LANGUAGE (FL)	Studies in languages other than English.	Wildlife Plants and Soil Invertebrates
FOOD STUDIES (Food)	Food science studies conducted to improve production of food for human consumption.	Wildlife
FUNGUS (Fungus)	Studies on fungus.	Wildlife Plants and Soil Invertebrates
GENE (Gene)	Studies of genotoxicity (chromosomal aberrations and mutagenicity).	Wildlife Plants and Soil Invertebrates
HUMAN HEALTH (HHE)	Studies with human subjects.	Wildlife Plants and Soil Invertebrates
IMMUNOLOGY (IMM)	Studies on the effects of contaminants on immunological endpoints.	Wildlife Plants and Soil Invertebrates
INVERTEBRATE (Invert)	Studies that investigate the effects of contaminants on terrestrial invertebrates are excluded.	Wildlife
IN VITRO (In Vit)	*In vitro* studies, including exposure of cell cultures, excised tissues and/or excised organs.	Wildlife Plants and Soil Invertebrates
LEAD SHOT (Lead shot)	Studies administering lead shot as the exposure form. These studies are labeled separately for possible later retrieval and review.	Wildlife
MEDIA (Media)	Authors must report that the study was conducted using natural or artificial soil. Studies conducted in pore water or any other aqueous phase (e.g., hydroponic solution), filter paper, petri dishes, manure, organic or histosoils (e.g., peat muck, humus), are not considered suitable for use in defining soil screening levels.	Plants and Soil Invertebrates
METHODS (Meth)	Studies reporting methods or methods development without usable toxicity test results for specific endpoints.	Wildlife Plants and Soil Invertebrates
MINERAL REQUIREMENTS (Mineral)	Studies examining the minerals required for better production of animals for human consumption, unless there is potential for adverse effects.	Wildlife
MIXTURE (Mix)	Studies that report data for combinations of single toxicants (e.g. cadmium and copper) are excluded. Exposure in a field setting from contaminated natural soils or waste application to soil may be coded as Field Survey.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
MODELING (Model)	Studies reporting the use of existing data for modeling, i.e., no new organism toxicity data are reported. Studies which extrapolate effects based on known relationships between parameters and adverse effects.	Wildlife Plants and Soil Invertebrates
NO CONTAMINANT OF CONCERN (No COC)	Studies that do not examine the toxicity of Eco-SSL contaminants of concern.	Wildlife Plants and Soil Invertebrates
NO CONTROL (No Control)	Studies which lack a control or which have a control that is classified as invalid for derivation of TRVs.	Wildlife Plants and Soil Invertebrates
NO DATA (No Data)	Studies for which results are stated in text but no data is provided. Also refers to studies with insufficient data where results are reported for only one organism per exposure concentration or dose (wildlife).	Wildlife Plants and Soil Invertebrates
NO DOSE or CONC (No Dose)	Studies with no usable dose or concentration reported, or an insufficient number of doses/concentrations are used based on Eco-SSL SOPs. These are usually identified after examination of full paper. This includes studies which examine effects after exposure to contaminant ceases. This also includes studies where offspring are exposed in utero and/or lactation by doses to parents and then after weaning to similar concentrations as their parents. Dose cannot be determined.	Wildlife Plants and Soil Invertebrates
NO DURATION (No Dur)	Studies with no exposure duration. These are usually identified after examination of full paper.	Wildlife Plants and Soil Invertebrates
NO EFFECT (No Efct)	Studies with no relevant effect evaluated in a biological test species or data not reported for effect discussed.	Wildlife Plants and Soil Invertebrates
NO ORAL (No Oral)	Studies using non-oral routes of contaminant administration including intraperitoneal injection, other injection, inhalation, and dermal exposures.	Wildlife
NO ORGANISM (No Org) or NO SPECIES	Studies that do not examine or test a viable organism (also see in vitro rejection category).	Wildlife Plants and Soil Invertebrates
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	Wildlife Plants and Soil Invertebrates
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	Wildlife Plants and Soil Invertebrates
NO TOXICANT (No Tox)	No toxicant used. Publications often report responses to changes in water or soil chemistry variables, e.g., pH or temperature. Such publications are not included.	Wildlife Plants and Soil Invertebrates
NO TOX DATA (No Tox Data)	Studies where toxicant used but no results reported that had a negative impact (plants and soil invertebrates).	Plants and Soil Invertebrates
NUTRIENT (Nutrient)	Nutrition studies reporting no concentration related negative impact.	Plants and Soil Invertebrates
NUTRIENT DEFICIENCY (Nut def)	Studies of the effects of nutrient deficiencies. Nutritional deficient diet is identified by the author. If reviewer is uncertain then the administrator should be consulted. Effects associated with added nutrients are coded.	Wildlife
NUTRITION (Nut)	Studies examining the best or minimum level of a chemical in the diet for improvement of health or maintenance of animals in captivity.	Wildlife
OTHER AMBIENT CONDITIONS (OAC)	Studies which examine other ambient conditions: pH, salinity, DO, UV, radiation, etc.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
OIL (Oil)	Studies which examine the effects of oil and petroleum products.	Wildlife Plants and Soil Invertebrates
OM, pH (OM, pH)	Organic matter content of the test soil must be reported by the authors, but may be presented in one of the following ways; total organic carbon (TOC), particulate organic carbon (POC), organic carbon (OC), coarse particulate organic matter (CPOM), particulate organic matter (POM), ash free dry weight of soil, ash free dry mass of soil, percent organic matter, percent peat, loss on ignition (LOI), organic matter content (OMC). With the exception of studies on non-ionizing substances, the study must report the pH of the soil, and the soil pH should be within the range of $4 and #8.5. Studies that do not report pH or report pH outside this range are rejected.	Plants and Soil Invertebrates
ORGANIC METAL (Org Met)	Studies which examine the effects of organic metals. This includes tetraethyl lead, triethyl lead, chromium picolinate, phenylarsonic acid, roxarsone, 3-nitro-4-phenylarsonic acid,, zinc phosphide, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), trimethylarsine oxide (TMAO), or arsenobetaine (AsBe) and other organo metallic fungicides. Metal acetates and methionines are not rejected and are evaluated.	Wildlife
LEAD BEHAVIOR OR HIGH DOSE MODELS (Pb Behav)	There are a high number of studies in the literature that expose rats or mice to high concentrations of lead in drinking water (0.1, 1 to 2% solutions) and then observe behavior in offspring, and/or pathology changes in the brain of the exposed dam and/or the progeny. Only a representative subset of these studies were coded. Behavior studies examining complex behavior (learned tasks) were also not coded.	Wildlife
PHYSIOLOGY STUDIES (Phys)	Physiology studies where adverse effects are not associated with exposure to contaminants of concern.	Wildlife
PLANT (Plant)	Studies of terrestrial plants are excluded.	Wildlife
PRIMATE (Prim)	Primate studies are excluded.	Wildlife
PUBL AS (Publ as)	The author states that the information in this report has been published in another source. Data are recorded from only one source. The secondary citation is noted as Publ As.	Wildlife Plants and Soil Invertebrates
QSAR (QSAR)	Derivation of Quantitative Structure-Activity Relationships (QSAR) is a form of modeling. QSAR publications are rejected if raw toxicity data are not reported or if the toxicity data are published elsewhere as original data.	Wildlife Plants and Soil Invertebrates
REGULATIONS (Reg)	Regulations and related publications that are not a primary source of data.	Wildlife Plants and Soil Invertebrates
REVIEW (Rev)	Studies in which the data reported in the article are not primary data from research conducted by the author. The publication is a compilation of data published elsewhere. These publications are reviewed manually to identify other relevant literature.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SCORE (Score)	Papers in which all studies had data evaluation scores at or lower then the acceptable cut-off (#10 of 18) for plants and soil invertebrates).	Plants and Soil Invertebrates
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SLUDGE	Studies on the effects of ingestion of soils amended with sewage sludge.	Wildlife Plants and Soil Invertebrates
SOIL CONC (Soil)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in soil.	Wildlife
SPECIES	Studies in which the species of concern was not a terrestrial invertebrate or plant or mammal or bird.	Plants and Soil Invertebrates Wildlife
STRESSOR (QAC)	Studies examining the interaction of a stressor (e.g., radiation, heat, etc.) and the contaminant, where the effect of the contaminant alone cannot be isolated.	Wildlife Plants and Soil Invertebrates
SURVEY (Surv)	Studies reporting the toxicity of a contaminant in the field over a period of time. Often neither a duration nor an exposure concentration is reported.	Wildlife Plants and Soil Invertebrates
REPTILE OR AMPHIBIAN (Herp)	Studies on reptiles and amphibians. These papers flagged for possible later review.	Wildlife Plants and Soil Invertebrates
UNRELATED (Unrel)	Studies that are unrelated to contaminant exposure and response and/or the receptor groups of interest.	Wildlife
WATER QUALITY STUDY (Wqual)	Studies of water quality.	Wildlife Plants and Soil Invertebrates
YEAST (Yeast)	Studies of yeast.	Wildlife Plants and Soil Invertebrates

This Page Intentionally Left Blank

Appendix 5-1

Avian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Copper

---

February 2007

This page intentionally left blank

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 1 of 9

| Ref | | | Exposure | | |

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 2 of 9

Ref			Exposure																								Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Endpoint Number	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
55	5617	Pimentel et al, 1992	Copper	100	Chicken (*Gallus domesticus*)	1	2	0/211.6	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	B	C	COM	2	BEH	FDB	FCNS	WO	211.6		Y	0.1103	Y	0.0109	20.9		10	10	5	4	7	4	4	8	10	4	66
56	2221	Miles et al 1998	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/175/341/529	mg/kg diet	N	N	ADL	M	FD	21	d	1	d	JV	B	C	NR	1	BEH	FDB	FCNS	WO	341	529	Y	0.568	Y	0.03652	21.9	34.0	10	10	10	10	7	4	10	10	10	4	85
57	2172	Kassim and Suwanpradit, 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	COM	2	BEH	FDB	FCNS	WO	250	375	N	0.564	Y	0.05127	22.7	34.1	10	10	5	10	6	4	10	10	10	4	79
58	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/23.5/43.84/56.47/60.43	mg/org/d	N	N	ADL	U	FD	224	d	17	w	SM	F	C	NR	3	BEH	FDB	FCNS	WO	43.84	56.47	Y	1.886	Y	0.10957	23.2	29.9	10	10	5	10	7	4	10	10	10	4	80
59	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/440	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	SM	F	C	NR	3	BEH	FDB	FCNS	WO	440		Y	1.4	Y	0.07619	23.9		10	10	10	10	7	4	4	1	10	4	70
60	2194	Ledoux, et.al. 1987	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/400/800	mg/kg diet	N	N	ADL	UX	FD	21	d	1	d	JV	F	C	NR	2	BEH	FDB	FCNS	WO	400	800	N	0.564	Y	0.0363	25.7	51.5	10	10	10	10	6	4	10	10	10	4	84
61	2050	Chiou et al, 1997	Copper (II) sulfate	100	Chicken (*Gallus domesticus*)	1	5	0/195/405/598/758	ug/g diet	N	N	ADL	M	FD	4	w	28	w	SM	F	C	COM	1	BEH	FDB	FCNS	WO	405	598	Y	1.427	Y	0.097	27.5	40.6	10	10	10	10	7	4	10	10	10	4	85
62	2157	Jackson, 1977	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/0.01486/0.02857/0.04828/0.07886/0.08657	g/org/d	N	N	ADL	U	FD	35	d	NR	NR	SM	F	C	NR	3	BEH	FDB	FCNS	WO	0.0483	0.079	Y	1.66	Y	0.1009	29.1	47.5	10	10	5	10	7	4	10	10	10	4	80
63	2221	Miles et al 1998	Tribasic copper chloride	100	Chicken (*Gallus domesticus*)	2	4	0/161/305/468	mg/kg diet	N	N	ADL	M	FD	21	d	1	d	JV	B	C	NR	1	BEH	FDB	FCNS	WO	468		Y	0.619	Y	0.03905	29.5		10	10	10	10	7	4	4	10	10	4	79
64	5734	Hill, 1990	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/100/200/400	mg/kg diet	N	N	ADL	U	FD	19	d	1	d	JV	F	C	DOM	2	BEH	FDB	FCNS	WO	400		N	0.564	N	0.04291	30.4		10	10	5	10	5	4	4	10	10	4	72
65	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/920	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	JV	F	C	NR	2	BEH	FDB	FCNS	WO	920		Y	1.41	Y	0.04667	30.4		10	10	10	10	7	4	4	1	10	4	70
66	2049	Chiou et al, 1998	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/400/500/600	mg/kg diet	N	N	ADL	U	FD	4	w	38	w	SM	F	C	COM	1	BEH	FDB	FCNS	WO	500	600	Y	1.464	Y	0.0978	33.4	40.1	10	10	5	10	7	4	10	10	10	4	80
67	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	2	0/1830	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	JV	F	C	NR	2	BEH	FDB	FCNS	WO	1830		Y	1.41	Y	0.02714	35.2		10	10	10	10	7	4	4	1	10	4	70
68	2099	Funk and Baker 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/2.67/5.22/10.36/18.79	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	1	BEH	FDB	FCNS	WO	10.36	18.79	Y	0.294	Y	0.0235	35.2	63.9	10	10	5	10	7	4	10	10	10	4	80
69	2099	Funk and Baker 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	3	0/5.78/11.51	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	2	BEH	FDB	FCNS	WO	11.51		Y	0.317	Y	0.02886	36.3		10	10	5	10	7	4	4	10	10	4	74
70	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	6	5	0/2.1/9.9/50.15/250.85	mg/L	N	N	DLY	M	DR	14	d	4	d	JV	NR	C	COM	2	BEH	FDB	WCON	WO	50.2	250.9	Y	0.2379	Y	0.245	51.6	258	10	5	10	10	7	4	8	10	10	4	78
71	6170	Stevenson et al, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/25.5/52.0/100.0	mg/d	N	N	DLY	U	GV	5	d	27	w	SM	F	C	COM	3	BEH	FDB	FCNS	WO	100		Y	1.53	Y	0.1	65.4		10	8	10	10	7	4	4	1	10	4	68
72	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	2	2	0/503.4	mg/kg diet	N	N	DLY	M	FD	35	d	3	d	JV	NR	C	COM	2	BEH	FDB	FCNS	WO	503.4		Y	0.8668	Y	0.13002	75.5		10	10	10	10	7	4	4	3	10	4	72
73	18769	Foster, 1999	Cupric acetate monohydrate	100	Duck (*Anas platyrhynchos*)	3	2	0/1024.8	mg/kg diet	N	N	DLY	M	FD	35	d	3	d	JV	NR	C	COM	2	BEH	FDB	FCNS	WO	1024.8		Y	0.9584	Y	0.13418	143		10	10	10	5	7	4	4	3	10	4	67
74	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	1	4	0/218.5/420/1024	mg/kg diet	N	N	DLY	M	FD	35	d	3	d	JV	NR	C	COM	2	BEH	FDB	FCNS	WO	1024		Y	0.7181	Y	0.17234	246		10	10	10	10	7	4	4	3	10	4	72
75	2181	Ko et al, 1985	Copper carbonate	100	Chicken (*Gallus domesticus*)	2	4	0/42/76/98	mg/kg diet	N	N	ADL	U	FD	3	w	3	d	JV	M	C	COM	3	BEH	FDB	FCNS	WO		42	Y	0.2039	Y	0.01304		2.69	10	10	5	10	7	4	4	10	10	4	74
76	2107	Gill et al, 1995	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	4	0/0.05/0.1/0.5	% in diet	N	N	DLY	U	FD	4	w	4	w	JV	M	C	DOM	2	BEH	FDB	FCNS	WO		0.05	Y	0.348	Y	0.01397		7.99	10	10	5	10	7	4	4	10	10	4	74
77	2112	Griminger 1977	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	5	0/0.1/0.2/0.3/0.4	% in diet	N	N	DLY	U	FD	2	w	7	mo	SM	F	C	NR	2	BEH	FDB	FCNS	WO		0.1	N	1.6	Y	0.09		22.4	10	10	5	10	6	4	4	10	10	4	73
78	2293	Stevenson and Jackson 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	8	w	24	w	SM	F	C	NR	2	BEH	FDB	FCNS	WO		500	N	1.6	Y	0.07229		22.6	10	10	5	10	6	4	4	10	10	4	73
79	2333	Yannakopoulos et al., 1990	copper sulfate pentahydrate	100	Japanese quail (*Coturnix japonica*)	1	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	34	d	7	d	JV	B	C	NR	2	BEH	FDB	FCNS	WO		200	Y	0.1865	Y	0.0256		27.5	10	10	5	10	7	4	4	10	10	4	74
80	2118	Harms and Buresh 1987	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/500/750	mg/kg diet	N	N	DLY	U	FD	21	d	1	d	JV	B	C	NR	2	BEH	FDB	FCNS	WO		500	Y	0.3615	Y	0.02225		30.8	10	10	5	10	7	4	4	10	10	4	74
81	2052	Christmas and Harms, 1979	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/500/750	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	B	C	DOM	2	BEH	FDB	FCNS	WO		500	Y	0.365	Y	0.0229		31.4	10	10	5	10	7	4	4	10	10	4	74
82	2165	Jensen and Maurice 1978	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	3	0/500/750	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	BEH	FDB	FEFF	WO		500	Y	0.592	N	0.04137		34.9	10	10	5	10	6	4	4	10	10	4	73
83	1403	Jensen, 1975	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/1000	mg/kg diet	N	N	ADL	U	FD	14	d	1	d	JV	M	C	NR	3	BEH	FDB	FCNS	WO		1000	Y	0.141	Y	0.0131		92.9	10	10	5	10	7	4	4	10	10	4	74
Physiology																																																
84	2259	Rangachar and Hegde 1975	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	3	0/100/200	mg/kg diet	N	N	DLY	U	FD	120	d	1	d	JV	F	C	COM	1	PHY	PHY	PROT	PL	200		N	1.6	N	0.07903	3.93		10	10	5	10	5	4	4	10	10	4	72
85	2006	Ankari et al, 1998	Copper	100	Chicken (*Gallus domesticus*)	1	4	0/50/150/250	mg/kg diet	N	N	ADL	U	FD	84	d	25	w	SM	F	C	DOM	6	PHY	PHY	FDCV	WO	50	150	Y	1.5161	Y	0.12278	4.05	12.1	10	10	5	4	7	4	10	10	10	4	74
86	2244	Pesti and Bakalli 1996	Cupric citrate	100	Chicken (*Gallus domesticus*)	6	4	0/50/75/100	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	100		N	2.19	N	0.09695	4.43		10	10	5	10	5	4	4	10	10	4	72
87	2244	Pesti and Bakalli 1996	Cupric citrate	100	Chicken (*Gallus domesticus*)	4	3	0/63/125	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	125		N	2.155	N	0.09594	5.56		10	10	5	10	5	4	4	10	10	4	72
88	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	125	250	N	1.884	N	0.0879	5.83	11.7	10	10	5	10	5	4	4	10	10	4	78
89	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	7	2	0/187	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	187		N	2.26	N	0.09896	8.19		10	10	5	10	5	4	4	10	10	4	72
90	25969	Skrivan et al, 2000	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/208	mg/kg diet	N	N	ADL	M	FD	39	d	1	d	JV	B	C	COM	4	PHY	PHY	FDCV	WO	208		Y	1.876	N	0.08766	9.72		10	10	10	10	6	4	4	1	10	4	69
91	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	5	0/63/125/185/250	mg/kg diet	N	N	ADL	U	FD	35	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	250		N	1.789	N	0.08499	11.9		10	10	5	10	5	4	4	10	10	4	72
92	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/23.5/43.84/56.47/60.43	mg/org/d	N	N	ADL	U	FD	224	d	17	w	SM	F	C	NR	7	PHY	PHY	FDCV	WO	23.5	43.84	Y	1.886	Y	0.11348	12.5	23.2	10	10	5	10	7	4	10	10	10	4	80
93	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	6	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	4	10	10	10	4	78
94	2221	Miles et al 1998	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	B	C	NR	4	PHY	PHY	FDCV	WO	400	600	Y	1.986	Y	0.08176	16.5	24.7	10	10	5	10	7	4	10	10	10	4	80
95	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	4	PHY	PHY	FDCV	WO	300	450	Y	2.03	Y	0.11491	17.0	25.5	10	10	5	10	7	4	10	10	10	4	80
96	2221	Miles et al 1998	Tribasic copper chloride	100	Chicken (*Gallus domesticus*)	4	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	B	C	NR	4	PHY	PHY	FDCV	WO	400	600	Y	1.966	Y	0.08452	17.2	25.8	10	10	5	10	7	4	10	10	10	4	80
97	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	7	PHY	PHY	FDCV	WO	300	450	Y	1.62	Y	0.0968	17.9	26.9	10	10	5	10	7	4	10	10	10	4	80
98	6788	Ward et al, 1995	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/6.34	mg/org/d	N	N	ADL	M	FD	10	d	5	d	JV	M	C	DOM	3	PHY	PHY	FDCV	WO	6.34		Y	0.3465	Y	0.0351	18.3		10	10	10	10	7	4	4	1	10	4	70
99	2166	Jensen and Maurice 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/250/500/750	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	250	500	Y	0.5	N	0.03706	18.5	37.1	10	10	5	10	6	4	10	10	10	4	79
100	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	3	3	0/250/500	mg/kg diet	N	N	DLY	U	FD	14	d	8	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	250	500	Y	0.334	N	0.0285	21.3	42.7	10	10	5	10	6	4	10	10	10	4	79
101	6474	Ekperigin and Vohra 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/250	mg/kg diet	N	N	NR	U	FD	8	d	7	d	JV	NR	C	DOM	2	PHY	PHY	FDCV	WO	250		N	0.328	N	0.0282	21.5		10	10	5	10	5	4	4	10	10	4	72
102	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	5	PHY	PHY	FDCV	WO	600	750	Y	1.78	Y	0.0751	25.3	31.6	10	10	5	10	7	4	10	10	10	4	80
103	2266	Robbins and Baker, 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/250/500	mg/kg diet	N	N	NR	U	FD	8	d	8	d	JV	M	C	NR	2	PHY	PHY	FDCV	WO	250	500	Y	0.181	N	0.01913	26.4	52.8	10	10	5	10	6	4	10	10	10	4	79
104	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	w	26	w	SM	F	C	NR	5	PHY	PHY	FDCV	WO	450	600	Y	1.55	Y	0.09361	27.2	36.2	10	10	5	10	7	4	10	10	10	4	80
105	2048	Chiou et al, 1999	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/100/250/500	mg/kg diet	N	N	NR	U	FD	3	w	3	w	JV	NR	C	DOM	5	PHY	PHY	FDCV	WO	500		Y	1.819	Y	0.1035	28.4		10	10	5	10	7	4	4	10	10	4	74
106	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/125/250/500/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	500	1000	N	1.042	N	0.05978	28.7	57.4	10	10	5	10	5	4	10	10	10	4	78
107	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	7	4	0/250/500/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	500	1000	N	1.042	N	0.05978	28.7	57.4	10	10	5	10	5	4	10	10	10	4	78
108	2319	Wang et al 1987	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	500		N	0.564	N	0.04009	35.5		10	10	5	10	5	4	4	10	10	4	72
109	2319	Wang et al 1987	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	500		N	0.564	N	0.04009	35.5		10	10	5	10	5	4	4	10	10	4	72

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 3 of 9

Ref			Exposure																								Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Endpoint Number	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
110	2194	Ledoux, et.al. 1987	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/400/800	mg/kg diet	N	N	ADL	UX	FD	21	d	1	d	JV	F	C	NR	3	PHY	PHY	FDCV	WO	800		N	0.564	Y	0.032	45.4		10	10	10	10	6	4	4	10	10	4	78
111	2099	Funk and Baker 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/2.49/4.71/7.33/8.42	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	3	PHY	PHY	FDCV	WO	7.33	8.42	Y	0.157	Y	0.0105	46.7	53.6	10	10	5	10	7	4	10	10	10	4	80
112	2333	Yannakopoulos et al., 1990	copper sulfate pentahydrate	100	Japanese quail (*Coturnix japonica*)	1	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	34	d	7	d	JV	B	C	NR	4	PHY	PHY	FDCV	WO	600		Y	0.1764	Y	0.0241	82.0		10	10	5	10	7	4	4	10	10	4	74
113	22	Mehring et al, 1960	Copper oxide	100	Chicken (*Gallus domesticus*)	1	5	0/403/570/749/1180	mg/kg diet	N	N	NR	M	FD	10	w	1	d	JV	B	C	NR	3	PHY	PHY	FDCV	WO	1180		Y	0.5556	N	0.0397	84.3		10	10	10	10	6	4	4	1	10	4	69
114	2181	Ko et al, 1985	Copper carbonate	100	Chicken (*Gallus domesticus*)	2	4	0/42/76/98	mg/kg diet	N	N	ADL	U	FD	3	w	3	d	JV	M	C	COM	4	PHY	PHY	FDCV	WO		42	Y	0.2039	Y	0.01304		2.69	10	10	5	10	7	4	4	10	10	4	74
115	2244	Pesti and Bakalli 1996	Cupric citrate	100	Chicken (*Gallus domesticus*)	8	2	0/63	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO		63	N	2.393	N	0.10271		2.70	10	10	5	10	5	4	4	10	10	4	72
116	2171	Kashani et al., 1986	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/120	mg/kg diet	N	N	ADL	U	FD	8	w	1	d	JV	M	C	NR	2	PHY	PHY	FDCV	WO		120	Y	2.8	N	0.11377		4.88	10	10	5	10	6	4	4	10	10	4	73
117	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	9	2	0/125	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO		125	N	2.309	N	0.10035		5.43	10	10	5	10	5	4	4	10	10	4	72
118	2164	Jensen and Maurice 1978	Copper	100	Chicken (*Gallus domesticus*)	3	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	3	PHY	PHY	GPHY	WO		125	Y	0.476	N	0.0359		9.43	10	10	5	4	6	4	4	10	10	4	67
119	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/250	mg/kg diet	N	N	ADL	U	FD	42	d	21	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO		250	N	1.963	N	0.09028		11.5	10	10	5	10	5	4	4	10	10	4	72
120	2226	Nam et al 1984	Copper carbonate	51.43	Chicken (*Gallus domesticus*)	1	3	0/0.05/0.10	% in diet	N	N	ADL	U	FD	4	w	3	d	JV	NR	C	COM	4	PHY	PHY	FDCV	WO		0.05	N	1.042	Y	0.0543		13.4	10	10	5	10	6	4	4	10	10	4	73
121	3717	Bakalli et al, 1995	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	41	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO		250	N	1.042	N	0.05978		14.3	10	10	5	10	5	4	4	10	10	4	72
122	2164	Jensen and Maurice 1978	Copper	100	Chicken (*Gallus domesticus*)	1	2	0/240	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	PHY	PHY	IRRI	FE		240	Y	0.606	N	0.04201		16.6	10	10	5	4	6	4	4	10	10	4	67
123	2164	Jensen and Maurice 1978	Copper carbonate	100	Chicken (*Gallus domesticus*)	7	2	0/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	3	PHY	PHY	GPHY	DT		250	Y	0.53	N	0.0385		18.2	10	10	5	10	6	4	4	10	10	4	73
124	2164	Jensen and Maurice 1978	Copper chloride	100	Chicken (*Gallus domesticus*)	5	2	0/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	3	PHY	PHY	GPHY	DT		250	Y	0.516	N	0.03783		18.3	10	10	5	10	6	4	4	10	10	4	73
125	2164	Jensen and Maurice 1978	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	2	0/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	3	PHY	PHY	GPHY	DT		250	Y	0.513	N	0.03769		18.4	10	10	5	10	6	4	4	10	10	4	73
126	2164	Jensen and Maurice 1978	Copper oxide	100	Chicken (*Gallus domesticus*)	6	2	0/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	3	PHY	PHY	GPHY	DT		250	Y	0.496	N	0.03687		18.6	10	10	5	10	6	4	4	10	10	4	73
127	2112	Griminger 1977	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	5	0/0.1/0.2/0.3/0.4	% in diet	N	N	DLY	U	FD	2	w	7	mo	SM	F	C	NR	3	PHY	PHY	IRRI	FE		0.1	N	1.6	Y	0.09		22.4	10	10	5	10	6	4	4	10	10	4	73
128	2266	Robbins and Baker, 1980	Copper carbonate	100	Chicken (*Gallus domesticus*)	3	3	0/250/500	mg/kg diet	N	N	NR	U	FD	8	d	8	d	JV	M	C	NR	2	PHY	PHY	FDCV	WO		250	Y	0.181	N	0.01913		26.4	10	10	5	10	6	4	4	10	10	4	73
129	2166	Jensen and Maurice 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PHY	PHY	FDCV	WO		500	Y	0.519	N	0.03797		36.6	10	10	5	10	6	4	4	10	10	4	73
130	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	DLY	U	FD	12	d	8	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO		500	Y	0.211	N	0.02114		50.1	10	10	5	10	6	4	4	10	10	4	73
131	2266	Robbins and Baker, 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	NR	U	FD	8	d	8	d	JV	M	C	NR	2	PHY	PHY	FDCV	WO		500	Y	0.16	N	0.01765		55.2	10	10	5	10	6	4	4	10	10	4	73
132	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	4	2	0/500	mg/kg diet	N	N	DLY	U	FD	8	d	8	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO		500	Y	0.144	N	0.01648		57.2	10	10	5	10	6	4	4	10	10	4	73
133	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	DLY	U	FD	12	d	8	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO		500	Y	0.132	N	0.01557		59.0	10	10	5	10	6	4	4	10	10	4	73
Pathology																																																
134	2114	Guenthner et al, 1978	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/120	mg/kg diet	N	N	ADL	U	FD	24	w	1	d	JV	M	C	DOM	3	PTH	HIS	GHIS	HE	120		Y	11.61	N	0.28716	2.97		10	10	5	10	6	4	4	10	10	4	73
135	2007	Hoda and Maha, 1995	Copper carbonate	100	Chicken (*Gallus domesticus*)	1	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	M	C	LAB	4	PTH	ORW	SMIX	AT	75	150	Y	1.2861	Y	0.06186	3.61	7.21	10	10	5	10	7	4	10	10	10	4	80
136	2048	Chiou et al, 1999	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/100/250/500	mg/kg diet	N	N	NR	U	FD	3	w	3	w	JV	NR	C	DOM	3	PTH	HIS	GHIS	DT	100	250	Y	1.997	Y	0.1144	5.73	14.3	10	10	5	10	7	4	10	10	10	4	80
137	2007	Hoda and Maha, 1995	Copper oxide	80	Chicken (*Gallus domesticus*)	2	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	NR	C	LAB	4	PTH	ORW	SMIX	LI	150		Y	1.0887	Y	0.05698	6.28		10	10	5	10	7	4	4	3	10	4	67
138	2163	Jensen et al, 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/120/240/480	mg/kg diet	N	N	NR	U	FD	3	w	1	d	JV	M	C	COM	3	PTH	HIS	GLSN	XX	120	240	Y	0.589	N	0.04124	8.40	16.8	10	10	5	10	6	4	10	10	10	4	79
139	2250	Poupoulis and Jensen 1976	Copper chloride dihydrate	100	Chicken (*Gallus domesticus*)	11	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ	250	500	N	1.6	N	0.07903	12.3	24.7	10	10	5	10	5	4	10	10	10	4	78
140	2294	Pearce et al 1983	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/250/500/1000	mg/kg diet	N	N	ADL	U	FD	5	d	27	w	JV	F	C	NR	1	PTH	ORW	SMIX	LI	250	500	N	1.6	N	0.07903	12.3	24.7	10	10	5	10	5	4	10	10	10	4	78
141	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/250/500/750/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	4	10	10	10	4	78
142	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	7	4	0/250/500/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	4	10	10	10	4	78
143	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/125/250/500/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	4	10	10	10	4	78
144	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	9	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	4	10	10	10	4	78
145	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	5	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	4	10	10	10	4	78
146	2325	Wideman et al 1996	Copper	100	Chicken (*Gallus domesticus*)	1	5	0/118/191/259/264	mg/kg diet	N	N	ADL	M	FD	2	w	1	d	JV	M	C	NR	1	PTH	HIS	GHIS	PR	191	259	Y	0.374	N	0.03068	15.7	21.2	10	10	10	4	6	4	10	10	10	4	78
147	2294	Pearce et al 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/250/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	12	d	26	w	SM	F	C	NR	3	PTH	ORW	SMIX	LI	250	500	N	1.6	Y	0.101	15.8	31.6	10	10	5	10	6	4	10	10	10	4	79
148	2165	Jensen and Maurice 1978	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PTH	HIS	USTR	GZ	250	500	Y	0.564	N	0.04009	17.8	35.5	10	10	5	10	6	4	10	10	10	4	79
149	6170	Stevenson et al, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/25.8/40.0/45.0	mg/org/d	N	N	ADL	U	FD	5	d	27	w	SM	F	C	COM	4	PTH	ORW	SMIX	LI	25.8	40	Y	1.43	Y	0.103	18.0	28.0	10	10	5	10	7	4	10	10	10	4	80
150	36216	Wood and Worden, 1973	Copper sulfate	100	Duck (*Anas platyrhynchos*)	3	2	0/135	mg/kg diet	N	N	ADL	U	FD	16	d	2	d	JV	B	C	COM	1	PTH	ITX	GITX	WO	135		N	0.092	N	0.01231	18.1		10	10	5	10	5	4	4	10	10	4	72
151	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/23.5/43.84/56.47/60.43	mg/org/d	N	N	ADL	U	FD	232	d	17	w	SM	F	C	NR	5	PTH	ORW	ORWT	LI	43.84	56.47	Y	1.886	Y	0.10957	23.2	29.9	10	10	5	10	7	4	10	10	10	4	80
152	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	6	PTH	ORW	ORWT	LI	600	750	Y	1.82	Y	0.072	23.7	29.7	10	10	5	10	7	4	10	10	10	4	80
153	2292	Stevenson and Jackson 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/250/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	6	d	24	w	SM	F	C	NR	5	PTH	ORW	SMIX	LI	500	1000	N	1.6	Y	0.087	27.2	54.4	10	10	5	10	6	4	10	10	10	4	79
154	2050	Chiou et al, 1997	Copper (II) sulfate	100	Chicken (*Gallus domesticus*)	1	5	0/195/405/598/758	ug/g diet	N	N	ADL	M	FD	4	w	28	w	SM	F	C	COM	5	PTH	HIS	GHIS	LI	598	758	Y	1.395	Y	0.065	27.9	35.3	10	10	10	10	7	4	10	10	10	4	85
155	6170	Stevenson et al, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/25.5/52.0/100.0	mg/org/d	N	N	DLY	U	GV	5	d	27	w	SM	F	C	COM	4	PTH	ORW	SMIX	LI	52	100	Y	1.53	Y	0.104	34.0	65.4	10	8	10	10	7	4	10	10	10	4	83
156	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	6	PTH	ORW	SMIX	GZ	600	750	Y	1.41	Y	0.08286	35.3	44.1	10	10	5	10	7	4	10	10	10	4	80
157	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	6	PTH	ORW	ORWT	GZ	600	750	Y	1.77	Y	0.118	40.0	50.0	10	10	5	10	7	4	10	10	10	4	80
158	2194	Ledoux, et.al. 1987	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/400/800	mg/kg diet	N	N	ADL	UX	FD	21	d	1	d	JV	F	C	NR	4	PTH	ORW	SMIX	LI	800		N	0.564	Y	0.032	45.4		10	10	10	10	6	4	4	10	10	4	78
159	2157	Jackson, 1977	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/0.01486/0.02857/0.04828/0.07886/0.08657	g/org/d	N	N	ADL	U	FD	35	d	NR	NR	SM	F	C	NR	5	PTH	ORW	ORWT	LI	0.0789	0.087	Y	1.58	Y	0.082	49.9	54.8	10	10	5	10	7	4	10	10	10	4	80
160	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	6	5	0/2.1/9.9/50.15/250.85	mg/L	N	N	DLY	M	DR	14	d	4	d	JV	NR	C	COM	4	PTH	HIS	GLSN	WO	50.2	250.9	Y	0.2379	Y	0.245	51.6	258	10	5	10	10	7	4	8	10	10	4	78
161	80	Van Vleet et al, 1981	Copper sulfate	100	Duck (*Anas platyrhynchos*)	2	2	0/1500	mg/kg diet	N	N	ADL	U	FD	28	d	1	d	JV	M	C	COM	2	PTH	HIS	NCRO	GZ	1500		N	0.092	N	0.01231	201		10	10	5	10	5	4	4	10	10	4	72
162	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	1	4	0/218.5/420/1024	mg/kg diet	N	N	DLY	M	FD	35	d	3	d	JV	NR	C	COM	4	PTH	HIS	GLSN	LI	1024		Y	0.7181	Y	0.208	297		10	10	10	10	7	4	4	1	10	4	70
163	3727	Shivanandappa et al., 1983	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	6	0/200/600/800/1200/1600	mg/kg bw	N	N	DLY	U	OR	3	w	25	w	JV	M	V	NR	4	PTH	ORW	ORWT	LI	1600		Y	1.7	N	0.08221	637		10	8	5	10	10	4	4	1	10	4	66
164	2007	Hoda and Maha, 1995	Copper sulfate	25	Chicken (*Gallus domesticus*)	3	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	M	C	LAB	4	PTH	ORW	SMIX	AT		75	Y	1.0704	Y	0.05833		1.02	10	10	5	10	7	4	4	10	10	4	74

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 4 of 9

Ref			Exposure																								Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Endpoint Number	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
165	36216	Wood and Worden, 1973	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/50	mg/kg diet	N	N	ADL	U	FD	21	d	2	d	JV	B	C	COM	1	PTH	ORW	ORWT	LI		50	N	0.564	N	0.04009		3.55	10	10	5	10	5	4	4	10	10	4	72
166	2177	King, 1975	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	1	2	0/100	mg/kg diet	N	N	ADL	U	FD	56	d	8	d	JV	B	C	COM	2	PTH	ORW	SMIX	IN		100	N	2.644	N	0.1096		4.15	10	10	5	10	5	4	4	10	10	4	72
167	2178	King, 1972	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/100	mg/kg diet	N	N	ADL	U	FD	9	w	1	d	JV	B	C	COM	2	PTH	ORW	SMIX	IN		100	N	1.8966	N	0.08828		4.65	10	10	5	10	5	4	4	10	10	4	72
168	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/10.39/21.31/31.52/39.91	mg/org/d	N	N	ADL	U	FD	336	d	17	w	SM	F	C	NR	6	PTH	ORW	ORWT	LI		10.39	Y	2.032	Y	0.104		5.11	10	10	5	10	7	4	4	10	10	4	74
169	2164	Jensen and Maurice 1978	copper	100	Chicken (*Gallus domesticus*)	2	3	0/120/240	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	ORW	SMIX	LI		120	Y	0.709	N	0.04653		7.87	10	10	5	4	6	4	4	10	10	4	67
170	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	3	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	7	PTH	ORW	ORWT	GZ		150	Y	2.23	Y	0.12753		8.58	10	10	5	10	7	4	4	10	10	4	74
171	2325	Wideman et al 1996	Copper (II) sulfate	100	Chicken (*Gallus domesticus*)	2	4	0/250/500/750	mg/kg diet	N	N	ADL	U	FD	2	w	1	d	JV	M	C	NR	1	PTH	HIS	GHIS	PR		250	N	1.3	N	0.06904		13.3	10	10	5	10	5	4	4	10	10	4	72
172	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	2	0/250	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ		250	N	1.042	N	0.05978		14.3	10	10	5	10	5	4	4	10	10	4	72
173	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	8	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ		250	N	1.042	N	0.05978		14.3	10	10	5	10	5	4	4	10	10	4	72
174	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	6	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ		250	N	1.042	N	0.05978		14.3	10	10	5	10	5	4	4	10	10	4	72
175	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	10	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ		250	N	1.042	N	0.05978		14.3	10	10	5	10	5	4	4	10	10	4	72
176	2164	Jensen and Maurice 1978	Copper	100	Chicken (*Gallus domesticus*)	1	2	0/240	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ		240	Y	0.606	N	0.04201		16.6	10	10	5	4	6	4	4	10	10	4	67
177	2191	Latymer and Coates, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	24	d	1	d	JV	B	V	COM	4	PTH	ORW	ORWT	LI		250	Y	0.335	N	0.02856		21.3	10	10	5	10	6	4	4	10	10	4	73
178	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	3	3	0/250/500	mg/kg diet	N	N	DLY	U	FD	14	d	8	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ		250	Y	0.334	N	0.0285		21.3	10	10	5	10	6	4	4	10	10	4	73
179	2293	Stevenson and Jackson 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	8	w	24	w	SM	F	C	NR	5	PTH	ORW	SMIX	LI		500	N	1.6	Y	0.07229		22.6	10	10	5	10	6	4	4	10	10	4	73
180	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/440	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	SM	F	C	NR	5	PTH	ORW	ORWT	KI		440	Y	1.4	Y	0.07619		23.9	10	10	10	10	7	4	4	10	10	4	79
181	2284	Smith 1969	Cupric sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/350	mg/kg diet	N	N	ADL	U	FD	25	d	1	d	JV	M	C	COM	3	PTH	ORW	ORWT	LI		350	Y	0.32	N	0.02772		30.3	10	10	5	10	6	4	4	10	10	4	73
182	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/920	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	JV	F	C	NR	5	PTH	ORW	ORWT	KI		920	Y	1.41	Y	0.04667		30.4	10	10	10	10	7	4	4	10	10	4	79
183	2052	Christmas and Harms, 1979	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/500/750	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	B	C	DOM	4	PTH	HIS	USTR	GZ		500	Y	0.365	Y	0.0229		31.4	10	10	5	10	7	4	4	10	10	4	74
184	2165	Jensen and Maurice 1978	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	3	0/500/750	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	ORW	SMIX	GZ		500	Y	0.592	N	0.04137		34.9	10	10	5	10	6	4	4	10	10	4	73
185	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	2	0/1830	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	JV	F	C	NR	4	PTH	ORW	ORWT	KI		1830	Y	1.41	Y	0.02714		35.2	10	10	10	10	7	4	4	10	10	4	79
186	2166	Jensen and Maurice 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PTH	ORW	SMIX	SP		500	Y	0.519	N	0.03797		36.6	10	10	5	10	6	4	4	10	10	4	73
187	80	Van Vleet et al, 1981	Copper sulfate	100	Duck (*Anas platyrhynchos*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	15	d	1	d	JV	M	C	COM	1	PTH	HIS	NCRO	GZ		1500	N	0.092	N	0.01231		201	10	10	5	10	5	4	4	10	10	4	72
188	3727	Shivanandappa et al., 1983	Copper oxychloride	59.51	Chicken (*Gallus domesticus*)	2	5	0/900/1200/1500/1800	mg/kg bw	N	N	DLY	U	OR	3	w	25	w	JV	M	V	NR	2	PTH	ORW	ORWT	LI		900	Y	1.7	N	0.08221		536	10	8	5	10	10	4	4	10	10	4	75
Reproduction																																																
189	2006	Ankari et al, 1998	Copper	100	Chicken (*Gallus domesticus*)	1	4	0/50/150/250	mg/kg diet	N	N	ADL	U	FD	84	d	25	w	LB	F	C	DOM	1	REP	REP	EGPN	WO	50	150	Y	1.5161	Y	0.12278	4.05	12.1	10	10	5	4	7	10	10	10	10	4	80
190	2117	Harms and Buresh 1986	Copper sulfate - anhydrous	100	Chicken (*Gallus domesticus*)	1	3	0/22.3/31.2	mg/org/d	N	N	DLY	U	FD	6	w	64	w	LB	F	C	NR	1	REP	REP	EGPN	WO	22.3	31.2	N	1.6	Y	0.0999	13.9	19.5	10	10	5	10	6	10	10	10	10	4	85
191	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	LB	F	C	NR	3	REP	EGG	EGWT	EG	300	450	Y	2.16	Y	0.112	15.6	23.3	10	10	5	10	7	10	10	10	10	4	86
192	6170	Stevenson et al, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/25.5/52.0/100.0	mg/org/d	N	N	DLY	U	GV	5	d	27	w	LB	F	C	COM	2	REP	REP	PROG	WO	25.5	52	Y	1.53	Y	0.104	16.7	34.0	10	8	10	10	7	10	10	10	10	4	89
193	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	LB	F	C	NR	3	REP	REP	EGPN	WO	300	450	Y	2.03	Y	0.11491	17.0	25.5	10	10	5	10	7	10	10	10	10	4	86
194	6170	Stevenson et al, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/25.8/40.0/45.0	mg/org/d	N	N	ADL	U	FD	5	d	27	w	LB	F	C	COM	2	REP	REP	PROG	WO	25.8	40	Y	1.43	Y	0.103	18.0	28.0	10	10	5	10	7	10	10	10	10	4	86
195	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	LB	F	C	NR	3	REP	EGG	EGWT	EG	300	450	Y	1.5	Y	0.0968	19.4	29.0	10	10	5	10	7	10	10	10	10	4	86
196	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	LB	F	C	NR	3	REP	REP	EGPN	WO	300	450	Y	1.6	Y	0.10908	20.5	30.7	10	10	5	10	7	10	10	10	10	4	86
197	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/10.39/21.31/31.52/39.91	mg/org/d	N	N	ADL	U	FD	336	d	17	w	LB	F	C	NR	3	REP	REP	EGPN	WO	39.9		Y	1.85	Y	0.0997	21.6		10	10	5	10	7	10	4	1	10	4	71
198	2112	Griminger 1977	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	5	0/0.1/0.2/0.3/0.4	% in diet	N	N	DLY	U	FD	2	w	7	mo	LB	F	C	NR	4	REP	EGG	ESTH	EG	0.1	0.2	N	1.6	Y	0.09	22.4	44.8	10	10	5	10	6	10	10	10	10	4	85
199	2294	Pearce et al 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/250/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	12	d	26	w	LB	F	C	NR	2	REP	REP	EGPN	WO	500	1000	N	1.6	Y	0.072	22.5	45.0	10	10	5	10	6	10	10	10	10	4	85
200	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/23.5/43.84/56.47/60.43	mg/org/d	N	N	ADL	U	FD	232	d	17	w	LB	F	C	NR	4	REP	REP	EGPN	WO	43.8	56.47	Y	1.886	Y	0.10957	23.2	29.9	10	10	5	10	7	10	10	10	10	4	86
201	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/440	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	LB	F	C	NR	4	REP	REP	EGPN	WO	440		Y	1.4	Y	0.07619	23.9		10	10	10	10	7	10	4	1	10	4	76
202	2292	Stevenson and Jackson 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/250/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	6	d	24	w	LB	F	C	NR	3	REP	REP	EGPN	WO	500	1000	N	1.6	Y	0.087	27.2	54.4	10	10	5	10	6	10	10	10	10	4	85
203	2050	Chiou et al, 1997	Copper (II) sulfate	100	Chicken (*Gallus domesticus*)	1	5	0/195/405/598/758	ug/g diet	N	N	ADL	M	FD	4	w	28	w	LB	F	C	COM	3	REP	REP	EGPN	WO	405	598	Y	1.427	Y	0.097	27.5	40.6	10	10	10	10	7	10	10	10	10	4	91
204	2157	Jackson, 1977	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/0.01486/0.02857/0.04828/0.07886/0.08657	g/org/d	N	N	ADL	U	FD	35	d	NR	NR	LB	F	C	NR	4	REP	REP	PROG	WO	0.0483	0.079	Y	1.66	Y	0.01009	29.1	47.5	10	10	5	10	7	10	10	10	10	4	86
205	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/920	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	LB	F	C	NR	3	REP	REP	EGPN	WO	920		Y	1.41	Y	0.04667	30.4		10	10	10	10	7	10	4	1	10	4	76
206	2049	Chiou et al, 1998	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/400/500/600	mg/kg diet	N	N	ADL	U	FD	4	w	38	w	LB	F	C	COM	2	REP	REP	EGPN	WO	500	600	Y	1.464	Y	0.0978	33.4	40.1	10	10	5	10	7	10	10	10	10	4	86
207	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	2	0/1830	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	LB	F	C	NR	3	REP	REP	EGPN	WO	1830		Y	1.41	Y	0.02714	35.2		10	10	10	10	7	10	4	1	10	4	76
208	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	LB	F	C	NR	4	REP	REP	ORWT	OV	600	750	Y	1.77	Y	0.118	40.0	50.0	10	10	5	10	7	10	10	10	10	4	86
209	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	3	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	LB	F	C	NR	3	REP	REP	EGPN	WO	750		Y	2.13	Y	0.123	43.3		10	10	5	10	7	10	4	1	10	4	71
210	3727	Shivanandappa et al., 1983	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	6	0/200/600/800/1200/1600	mg/kg bw	N	N	DLY	U	OR	3	w	25	w	JV	M	V	NR	1	REP	REP	SPCV	TE	600	800	Y	1.7	N	0.08221	239	318	10	8	5	10	10	10	10	10	10	4	87
211	11876	Kadirvel and Kothandaraman, 1978	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/0.05	% in diet	N	N	ADL	U	FD	28	w	12	w	LB	F	C	COM	2	REP	EGG	EGWT	WO		0.05	Y	1.4976	Y	0.0591		19.7	10	10	5	10	7	10	4	10	10	4	80
212	2293	Stevenson and Jackson 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	8	w	24	w	LB	F	C	NR	3	REP	REP	EGPN	WO		500	N	1.6	Y	0.07229		22.6	10	10	5	10	6	10	4	10	10	4	79
213	3727	Shivanandappa et al., 1983	Copper oxychloride	59.51	Chicken (*Gallus domesticus*)	2	5	0/900/1200/1500/1800	mg/kg bw	N	N	DLY	U	OR	3	w	25	w	JV	M	V	NR	3	REP	REP	SPCV	TE		900	Y	1.7	N	0.08221		536	10	8	5	10	10	10	4	10	10	4	81
Growth																																																
214	2007	Hoda and Maha, 1995	Copper sulfate	25	Chicken (*Gallus domesticus*)	3	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	M	C	LAB	1	GRO	GRO	BDWT	WO	150		Y	1.1273	Y	0.05786	1.92		10	10	5	10	7	8	4	10	10	4	78
215	2171	Kashani et al., 1986	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	2	4	0/60/120/240	mg/kg diet	N	N	ADL	U	FD	8	w	1	d	JV	M	C	NR	1	GRO	GRO	BDWT	WO	60	120	Y	3.14	N	0.12258	2.34	4.68	10	10	5	10	6	8	10	10	10	4	83
216	2244	Pesti and Bakalli 1996	Cupric citrate	100	Chicken (*Gallus domesticus*)	8	2	0/63	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	63		N	2.393	N	0.10271	2.70		10	10	5	10	5	8	4	10	10	4	76
217	1369	Hill, 1974	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/32	mg/kg diet	N	N	ADL	U	FD	2	w	1	d	JV	B	C	COM	1	GRO	GRO	BDWT	WO	32		N	0.328	N	0.02817	2.75		10	10	5	10	5	8	4	10	10	4	76
218	2114	Guenthner et al, 1978	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/120	mg/kg diet	N	N	ADL	U	FD	24	w	1	d	JV	M	C	DOM	1	GRO	GRO	BDWT	WO	120		Y	11.61	N	0.28716	2.97		10	10	5	10	6	8	4	1	10	4	68

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 5 of 9

Ref			Exposure																								Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Endpoint Number	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
219	14453	McGhee et al, 1965	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/20/40/80/160	mg/kg diet	N	N	NR	U	FD	4	w	NR	NR	JV	NR	C	NR	2	GRO	GRO	BDWT	WO	40	80	Y	0.2393	N	0.02294	3.83	7.67	10	10	5	10	6	8	10	10	10	4	83
220	2177	King, 1975	copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	1	2	0/100	mg/kg diet	N	N	ADL	U	FD	56	d	8	d	JV	B	C	COM	1	GRO	GRO	BDWT	WO	100		N	2.644	N	0.1096	4.15		10	10	5	10	5	8	4	10	10	4	76
221	2244	Pesti and Bakalli 1996	Cupric citrate	100	Chicken (*Gallus domesticus*)	6	4	0/50/75/100	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	100		N	2.19	N	0.09695	4.43		10	10	5	10	5	8	4	10	10	4	76
222	2178	King, 1972	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/100	mg/kg diet	N	N	ADL	U	FD	9	w	1	d	JV	B	C	COM	1	GRO	GRO	BDWT	WO	100		N	1.8966	N	0.08828	4.65		10	10	5	10	5	8	4	1	10	4	67
223	5149	Kayongo-Male and Palmer, 1998	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/8/75	mg/kg diet	N	N	ADL	U	FD	4	w	NR	NR	JV	NR	C	DOM	1	GRO	GRO	BDWT	WO	75		Y	0.787	N	0.0498	4.75		10	10	5	10	6	8	4	1	10	4	68
224	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	9	2	0/125	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	125		N	2.309	N	0.10035	5.43		10	10	5	10	5	8	4	10	10	4	76
225	2244	Pesti and Bakalli 1996	Cupric citrate	100	Chicken (*Gallus domesticus*)	4	3	0/63/125	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	125		N	2.155	N	0.09594	5.56		10	10	5	10	5	8	4	10	10	4	76
226	14405	Waibel et al, 1964	Cupric carbonate	100	Turkey (*Melagris gallopavo*)	1	3	0/100/800	mg/kg diet	N	N	NR	U	FD	3	w	7	d	JV	NR	C	DOM	1	GRO	GRO	BDWT	WO	100	800	N	1	N	0.0582	5.82	46.6	10	10	5	5	5	8	8	10	10	4	75
227	2007	Hoda and Maha, 1995	Copper oxide	80.0	Chicken (*Gallus domesticus*)	2	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	NR	C	LAB	1	GRO	GRO	BDWT	WO	150		Y	1.0887	Y	0.05698	6.28		10	10	5	10	7	8	4	10	10	4	78
228	2007	Hoda and Maha, 1995	Copper carbonate	100	Chicken (*Gallus domesticus*)	1	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	NR	C	LAB	1	GRO	GRO	BDWT	WO	150		Y	1.2283	Y	0.06186	7.55		10	10	5	10	7	8	4	10	10	4	78
229	92	Hill, 1974	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/100	mg/kg diet	N	N	ADL	U	FD	2	w	1	d	JV	B	C	COM	1	GRO	GRO	BDWT	WI	100		N	0.46	N	0.03511	7.63		10	10	5	10	5	8	4	10	10	4	76
230	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	7	2	0/187	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	187		N	2.26	N	0.09896	8.19		10	10	5	10	5	8	4	10	10	4	76
231	2181	Ko et al, 1985	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/54/94/134	mg/kg diet	N	N	ADL	U	FD	3	w	3	d	JV	M	C	COM	2	GRO	GRO	BDWT	WO	134		Y	0.6283	Y	0.0394	8.40		10	10	5	10	7	8	4	1	10	4	69
232	6474	Ekperigin and Vohra 1981	Copper carbonate	100	Chicken (*Gallus domesticus*)	4	4	0/100/500/1000	mg/kg diet	N	N	NR	U	FD	7	d	6	d	JV	NR	C	DOM	1	GRO	GRO	BDWT	WO	100	500	N	0.328	N	0.0282	8.59	42.9	10	10	5	10	5	8	8	10	10	4	80
233	6474	Ekperigin and Vohra 1981	Copper chloride dihydrate	100	Chicken (*Gallus domesticus*)	3	3	0/100/500/1000	mg/kg diet	N	N	NR	U	FD	7	d	7	d	JV	NR	C	DOM	1	GRO	GRO	BDWT	WO	100	500	N	0.328	N	0.0282	8.59	42.9	10	10	5	10	5	8	8	10	10	4	80
234	2107	Gill et al, 1995	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	4	0/0.05/0.1/0.5	% in diet	N	N	DLY	U	FD	3	w	4	w	JV	M	C	DOM	1	GRO	GRO	BDWT	WO	0.05	0.1	Y	0.292	Y	0.01397	9.52	19.0	10	10	5	10	7	8	10	10	10	4	84
235	25969	Skrivan et al, 2000	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/208	mg/kg diet	N	N	ADL	M	FD	38	d	1	d	JV	B	C	COM	1	GRO	GRO	BDWT	WO	208		Y	1.876	N	0.08766	9.72		10	10	10	10	6	8	4	10	10	4	82
236	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	6	5	0/2.1/9.9/50.15/250.85	mg/L	N	N	DLY	M	DR	14	d	4	d	JV	NR	C	COM	1	GRO	GRO	BDWT	WO	9.9	50.15	Y	0.2379	Y	0.245	10.2	51.6	10	5	10	10	7	8	8	10	10	4	82
237	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	5	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	250		N	2.148	N	0.09574	11.1		10	10	5	10	5	8	4	10	10	4	76
238	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/250	mg/kg diet	N	N	ADL	U	FD	42	d	21	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	250		N	1.963	N	0.09028	11.5		10	10	5	10	5	8	4	1	10	4	67
239	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	5	0/63/125/185/250	mg/kg diet	N	N	ADL	U	FD	35	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	250		N	1.789	N	0.08499	11.9		10	10	5	10	5	8	4	10	10	4	76
240	2226	Nam et al 1984	Copper carbonate	51.43	Chicken (*Gallus domesticus*)	1	3	0/0.05/0.10	% in diet	N	N	ADL	U	FD	4	w	3	d	JV	NR	C	COM	1	GRO	GRO	BDWT	WO	0.05	0.1	N	1.042	Y	0.04922	12.2	24.3	10	10	5	10	6	8	10	10	10	4	83
241	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	7	2	0/52.4	mg/L	N	N	DLY	M	DR	14	d	4	d	JV	NR	C	COM	1	GRO	GRO	BDWT	WO	52.4		Y	0.2594	Y	0.06226	12.6		10	5	10	10	7	8	4	10	10	4	78
242	2048	Chiou et al, 1999	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/100/250/500	mg/kg diet	N	N	NR	U	FD	3	w	3	w	JV	NR	C	DOM	1	GRO	GRO	BDWT	WO	250	500	Y	1.945	Y	0.1135	13.3	26.6	10	10	5	10	7	8	10	10	10	4	84
243	2162	Jenkins et al, 1970	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/229	mg/kg diet	N	N	ADL	M	FD	6	w	1	d	JV	B	C	COM	2	GRO	GRO	BDWT	WO	229		Y	0.986	N	0.05767	13.4		10	10	10	10	6	8	4	1	10	4	73
244	25968	Marron, et al, 2001	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	21	d	7	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	250		N	0.564	Y	0.08020	14.2		10	10	5	10	6	8	4	1	10	4	68
245	5734	Hill, 1990	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	5	0/25/50/100/200	mg/kg diet	N	N	ADL	U	FD	19	d	1	d	JV	F	C	DOM	1	GRO	GRO	BDWT	WO	200		N	0.564	N	0.04009	14.2		10	10	5	10	5	8	4	10	10	4	76
246	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	8	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	8	10	10	10	4	82
247	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/125/250/500/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	8	10	10	10	4	82
248	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	5	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	8	10	10	10	4	82
249	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/250/500/750/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	8	10	10	10	4	82
250	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	6	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	8	10	10	10	4	82
251	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	2	0/250	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250		N	1.042	N	0.05978	14.3		10	10	5	10	5	8	4	1	10	4	67
252	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	2	0/250	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250		N	1.042	N	0.05978	14.3		10	10	5	10	5	8	4	1	10	4	67
253	3717	Bakalli et al, 1995	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	41	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	250		N	1.042	N	0.05978	14.3		10	10	5	10	5	8	4	10	10	4	76
254	2099	Funk and Baker 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	3	0/5/8.23	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	1	GRO	GRO	BDWT	WO	5	8.23	Y	0.319	Y	0.025	15.7	25.8	10	10	5	10	7	8	10	10	10	4	84
255	2221	Miles et al 1998	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	B	C	NR	2	GRO	GRO	BDWT	WO	400	600	Y	1.986	Y	0.08176	16.5	24.7	10	10	5	10	7	8	10	10	10	4	84
256	2292	Stevenson and Jackson 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/250/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	6	d	24	w	SM	F	C	NR	2	GRO	GRO	BDWT	WO	250	500	N	1.6	Y	0.107	16.7	33.4	10	10	5	10	6	8	10	10	10	4	83
257	2221	Miles et al 1998	Tribasic copper chloride	100	Chicken (*Gallus domesticus*)	4	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	B	C	NR	2	GRO	GRO	BDWT	WO	400	600	Y	1.966	Y	0.08452	17.2	25.8	10	10	5	10	7	8	10	10	10	4	84
258	2244	Pesti and Bakalli 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	375		N	1.884	N	0.0879	17.5		10	10	5	10	5	8	4	10	10	4	76
259	2284	Smith 1969	Cupric sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/350	mg/kg diet	N	N	ADL	U	FD	25	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	200	350	Y	0.2982	N	0.02647	17.8	31.1	10	10	5	10	6	8	10	10	10	4	83
260	2319	Wang et al 1987	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	250	500	N	0.564	N	0.04009	17.8	35.5	10	10	5	10	5	8	10	10	10	4	82
261	6170	Stevenson et al, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/25.8/40.0/45.0	mg/org/d	N	N	ADL	U	FD	5	d	27	w	SM	F	C	COM	1	GRO	GRO	BDWT	WO	25.8	40	Y	1.43	Y	0.103	18.0	28.0	10	10	5	10	7	8	10	10	10	4	84
262	2164	Jensen and Maurice 1978	Copper carbonate	100	Chicken (*Gallus domesticus*)	7	2	0/250	mg/kg diet	N	N	ADL	M	FD	3	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250		Y	0.53	N	0.0385	18.2		10	10	5	10	6	8	4	1	10	4	68
263	6788	Ward et al, 1995	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/6.34	mg/org/d	N	N	ADL	M	FD	10	d	5	d	JV	M	C	DOM	1	GRO	GRO	BDWT	WO	6.34		Y	0.3465	Y	0.116	18.3		10	10	10	10	7	8	4	1	10	4	74
264	2164	Jensen and Maurice 1978	Copper chloride	100	Chicken (*Gallus domesticus*)	5	2	0/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250		Y	0.516	N	0.03783	18.3		10	10	5	10	6	8	4	1	10	4	68
265	2164	Jensen and Maurice 1978	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	2	0/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250		Y	0.513	N	0.03769	18.4		10	10	5	10	6	8	4	1	10	4	68
266	2166	Jensen and Maurice 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/250/500/750	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250	500	Y	0.5	N	0.03706	18.5	37.1	10	10	5	10	6	8	10	10	10	4	83
267	2164	Jensen and Maurice 1978	Copper oxide	100	Chicken (*Gallus domesticus*)	6	2	0/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250		Y	0.496	N	0.03687	18.6		10	10	5	10	6	8	4	1	10	4	68
268	2099	Funk and Baker 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/2.49/4.71/7.33/8.42	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	2	GRO	GRO	BDWT	WO	4.71	7.33	Y	0.24	Y	0.0183	19.6	30.5	10	10	5	10	7	8	10	10	10	4	84
269	11876	Kadirvel and Kothandaraman, 1978	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/0.05	% in diet	N	N	ADL	U	FD	28	w	12	w	SM	F	C	COM	1	GRO	GRO	BDWT	WO	0.05		Y	1.4976	Y	0.0591	19.7		10	10	5	10	7	8	4	1	10	4	69
270	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	300	450	Y	1.6	Y	0.10908	20.5	30.7	10	10	5	10	7	8	10	10	10	4	84
271	5617	Pimentel et al, 1992	Copper	100	Chicken (*Gallus domesticus*)	1	2	0/211.6	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	B	C	COM	1	GRO	GRO	BDWT	WO	211.6		Y	0.1103	Y	0.0109	20.9		10	10	5	4	7	8	4	6	10	4	68
272	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	3	3	0/250/500	mg/kg diet	N	N	DLY	U	FD	14	d	8	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250	500	Y	0.334	N	0.0285	21.3	42.7	10	10	5	10	6	8	10	10	10	4	83
273	6474	Ekperigin and Vohra 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/100/250/500/1000	mg/kg diet	N	N	NR	U	FD	7	d	9	d	JV	NR	C	DOM	1	GRO	GRO	BDWT	WO	250	500	N	0.328	N	0.0282	21.5	42.9	10	10	5	10	5	8	10	10	10	4	82
274	6474	Ekperigin and Vohra 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/250	mg/kg diet	N	N	NR	U	FD	8	d	9	d	JV	NR	C	DOM	1	GRO	GRO	BDWT	WO	250		N	0.328	N	0.0282	21.5		10	10	5	10	5	8	4	10	10	4	76

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 6 of 9

Ref			Exposure																										Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Endpoint Number	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
275	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/10.39/21.31/31.52/39.91	mg/org/d	N	N	ADL	U	FD	336	d	17	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	39.91		N	1.85	Y	0.0997	21.6		10	10	5	10	6	8	4	1	10	4	68
276	2325	Wideman et al 1996	Copper	100	Chicken (*Gallus domesticus*)	1	5	0/118/191/259/264	mg/kg diet	N	N	ADL	M	FD	2	w	1	d	JV	M	C	NR	2	GRO	GRO	BDWT	WO	264		Y	0.374	N	0.03068	21.7		10	10	10	4	6	8	4	10	10	4	76
277	2221	Miles et al 1998	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/175/341/529	mg/kg diet	N	N	ADL	M	FD	21	d	1	d	JV	B	C	NR	2	GRO	GRO	BDWT	WO	341	529	Y	0.568	Y	0.03652	21.9	34.0	10	10	10	10	7	8	10	10	10	4	89
278	2112	Griminger 1977	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	5	0/0.1/0.2/0.3/0.4	% in diet	N	N	DLY	U	FD	2	w	7	mo	SM	F	C	NR	1	GRO	GRO	BDWT	WO	0.1	0.2	N	1.6	Y	0.09	22.4	44.8	10	10	5	10	6	8	10	10	10	4	83
279	2172	Kassim and Suwanpradit, 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	250	375	N	0.564	Y	0.05127	22.7	34.1	10	10	5	10	6	8	10	10	10	4	83
280	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	450	600	Y	1.62	Y	0.0829	23.0	30.7	10	10	5	10	7	8	10	10	10	4	84
281	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/23.5/43.84/56.47/60.43	mg/org/d	N	N	ADL	U	FD	232	d	17	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	43.84	56.47	Y	1.886	Y	0.10957	23.2	29.9	10	10	5	10	7	8	10	10	10	4	84
282	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	450	600	Y	1.96	Y	0.10128	23.3	31.0	10	10	5	10	7	8	10	10	10	4	84
283	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/440	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	440		Y	1.4	Y	0.07619	23.9		10	10	10	10	7	8	4	1	10	4	74
284	2250	Poupoulis and Jensen 1976	Copper chloride dihydrate	100	Chicken (*Gallus domesticus*)	11	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	500		N	1.6	N	0.07903	24.7		10	10	5	10	5	8	4	1	10	4	67
285	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	450	600	Y	1.91	Y	0.0853	26.4	35.2	10	10	5	10	7	8	10	10	10	4	84
286	6788	Ward et al, 1995	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	2	2	0/10.33	mg/org/d	N	N	ADL	M	DR	10	d	5	d	JV	M	C	DOM	1	GRO	GRO	BDWT	WO	10.33		Y	0.389	Y	0.116	26.6		10	5	10	10	7	8	4	1	10	4	69
287	5812	Ledoux et al, 1989	Copper acetate monohydrate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/300	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	DOM	2	GRO	GRO	BDWT	WO	200	300	N	0.564	Y	0.07589	26.9	40.4	10	10	5	5	6	8	10	10	10	4	78
288	2050	Chiou et al, 1997	Copper (II) sulfate	100	Chicken (*Gallus domesticus*)	1	5	0/195/405/598/758	ug/g diet	N	N	ADL	M	FD	28	d	28	w	SM	F	C	COM	4	GRO	GRO	BDWT	WO	598	758	Y	1.395	Y	0.065	27.9	35.3	10	10	10	10	7	8	10	10	10	4	89
289	7091	Hill, 1989	Copper	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/400	mg/kg diet	N	N	NR	U	FD	19	d	NR	NR	JV	NR	C	DOM	1	GRO	GRO	BDWT	WO	400		N	0.564	N	0.04009	28.4		10	10	5	4	5	8	4	10	10	4	70
290	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	7	4	0/250/500/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	500	1000	N	1.042	N	0.05978	28.7	57.4	10	10	5	10	5	8	10	10	10	4	82
291	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	9	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	8	4	1	10	4	67
292	2221	Miles et al 1998	Tribasic copper chloride	100	Chicken (*Gallus domesticus*)	2	4	0/161/305/468	mg/kg diet	N	N	ADL	M	FD	21	d	1	d	JV	B	C	NR	2	GRO	GRO	BDWT	WO	468		Y	0.619	Y	0.03905	29.5		10	10	10	10	7	8	4	10	10	4	83
293	14404	Vohra and Kratzer, 1968	Copper sulfate pentahydrate	100	Turkey (*Melagris gallopavo*)	1	3	0/400/800	mg/kg diet	N	N	ADL	U	FD	21	d	NR	NR	JV	B	C	COM	1	GRO	GRO	BDWT	WO	400	800	N	0.5	N	0.0371	29.7	59.3	10	10	5	10	5	8	10	10	10	4	82
294	5734	Hill, 1990	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/100/200/400	mg/kg diet	N	N	ADL	U	FD	19	d	1	d	JV	F	C	DOM	1	GRO	GRO	BDWT	WO	400		N	0.564	N	0.04291	30.4		10	10	5	10	5	8	4	10	10	4	76
295	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/920	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	JV	F	C	NR	1	GRO	GRO	BDWT	WO	920		Y	1.4	Y	0.04667	30.7		10	10	10	10	7	8	4	1	10	4	74
296	22	Mehring et al, 1960	Copper oxide	100	Chicken (*Gallus domesticus*)	1	5	0/403/570/749/1180	mg/kg diet	N	N	NR	M	FD	10	w	1	d	JV	B	C	NR	2	GRO	GRO	BDWT	WO	570	749	Y	1.0166	N	0.05883	33.0	43.3	10	10	10	10	6	8	10	10	10	4	88
297	2163	Jensen et al, 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/120/240/480	mg/kg diet	N	N	NR	U	FD	3	w	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	480		Y	0.567	N	0.04023	34.1		10	10	5	10	6	8	4	1	10	4	68
298	2118	Harms and Buresh 1987	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/500/750	mg/kg diet	N	N	DLY	U	FD	21	d	1	d	JV	B	C	NR	1	GRO	GRO	BDWT	WO	500	750	Y	0.3217	Y	0.02225	34.6	51.9	10	10	5	10	7	8	10	10	10	4	84
299	2099	Funk and Baker 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/2.67/5.22/10.36/18.79	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	2	GRO	GRO	BDWT	WO	10.36	18.79	Y	0.294	Y	0.0235	35.2	63.9	10	10	5	10	6	8	10	10	10	4	83
300	2517	Bafundo et al, 1984	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	1	GRO	GRO	BDWT	WO	500		N	0.564	N	0.04009	35.5		10	10	5	10	5	8	4	1	10	4	67
301	5734	Hill, 1990	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	19	d	1	d	JV	F	M	DOM	1	GRO	GRO	BDWT	WO	500		N	0.564	N	0.04009	35.5		10	10	5	10	5	8	4	10	10	4	76
302	2099	Funk and Baker 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	3	0/5.78/11.51	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	1	GRO	GRO	BDWT	WO	11.51		Y	0.317	Y	0.02886	36.3		10	10	5	10	7	8	4	10	10	4	78
303	2166	Jensen and Maurice 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	500		Y	0.519	N	0.03797	36.6		10	10	5	10	6	8	4	10	10	4	77
304	1278	Davis et al, 1996	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	21	d	14	d	JV	M	C	LAB	1	GRO	GRO	BDWT	WO	500		Y	0.484	Y	0.0359	37.1		10	10	5	10	7	8	4	1	10	4	69
305	2049	Chiou et al, 1998	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/400/500/600	mg/kg diet	N	N	ADL	U	FD	4	w	38	w	SM	F	C	COM	5	GRO	GRO	BDWT	WO	600		Y	1.464	Y	0.0978	40.1		10	10	5	10	7	8	4	1	10	4	69
306	6368	Southern and Baker, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	14	d	8	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	500		Y	0.374	N	0.0307	41.0		10	10	5	10	6	8	4	1	10	4	68
307	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	3	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	750		Y	2.13	Y	0.123	43.3		10	10	5	10	7	8	4	1	10	4	69
308	2172	Kassim and Suwanpradit, 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	3	w	3	w	JV	M	C	COM	1	GRO	GRO	BDWT	WO	250	375	N	0.564	Y	0.11161	49.5	74.2	10	10	5	10	6	8	10	10	10	4	83
309	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO	750		Y	1.77	Y	0.118	50.0		10	10	5	10	7	8	4	1	10	4	69
310	14404	Vohra and Kratzer, 1968	Copper sulfate pentahydrate	100	Turkey (*Melagris gallopavo*)	2	3	0/338/676	mg/kg diet	N	N	ADL	U	FD	21	d	NR	NR	JV	B	C	COM	1	GRO	GRO	BDWT	WO	676		N	0.5	N	0.0371	50.1		10	10	5	10	5	8	4	10	10	4	76
311	2157	Jackson, 1977	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/0.01486/0.02857/0.04828/0.07886/0.08657	g/org/d	N	N	ADL	U	FD	35	d	1	yr	SM	F	C	NR	1	GRO	GRO	BDWT	WO	0.0789	0.087	Y	1.55	Y	0.082	50.9	55.9	10	10	5	10	7	8	10	10	10	4	84
312	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	1	4	0/218.5/420/1024	mg/kg diet	N	N	DLY	M	FD	35	d	3	d	JV	NR	C	COM	1	GRO	GRO	BDWT	WO	218.5	420	Y	0.8	Y	0.208	56.8	109	10	10	10	10	7	8	10	10	10	4	89
313	14404	Vohra and Kratzer, 1968	Copper sulfate pentahydrate	100	Turkey (*Melagris gallopavo*)	3	5	0/810/1620/2430/3240	mg/kg diet	N	N	ADL	U	FD	21	d	NR	NR	JV	B	C	COM	1	GRO	GRO	BDWT	WO	810	1620	N	0.5	N	0.0371	60.0	120	10	10	5	10	5	8	10	10	10	4	82
314	6170	Stevenson et al, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/25.5/52.0/100.0	mg/org/d	N	N	DLY	U	GV	5	d	27	w	SM	F	C	COM	1	GRO	GRO	BDWT	WO	100		Y	1.53	Y	0.1	65.4		10	8	10	10	7	8	4	1	10	4	72
315	2333	Yannakopoulos et al., 1990	Copper sulfate pentahydrate	100	Japanese quail (*Coturnix japonica*)	1	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	34	d	7	d	JV	B	C	NR	1	GRO	GRO	BDWT	WO	600		Y	0.1764	Y	0.0241	82.0		10	10	5	10	7	8	4	10	10	4	78
316	2196	Leeson and Summers, 1982	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/20/40/80	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO	80		N	0.564	Y	0.7271	103		10	10	5	10	6	8	4	1	10	4	68
317	18769	Foster, 1999	Cupric acetate monohydrate	100	Duck (*Anas platyrhynchos*)	3	2	0/1024.8	mg/kg diet	N	N	DLY	M	FD	35	d	3	d	JV	NR	C	COM	1	GRO	GRO	BDWT	WO	1024.8		Y	0.9584	Y	0.13418	143		10	10	10	5	7	8	4	10	10	4	78
318	2181	Ko et al, 1985	Copper carbonate	100	Chicken (*Gallus domesticus*)	2	4	0/42/76/98	mg/kg diet	N	N	ADL	U	FD	3	w	3	d	JV	M	C	COM	2	GRO	GRO	BDWT	WO		42	Y	0.2039	Y	0.01304		2.69	10	10	5	10	7	8	4	10	10	4	78
319	2171	Kashani et al., 1986	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/120	mg/kg diet	N	N	ADL	U	FD	8	w	1	d	JV	M	C	NR	1	GRO	GRO	BDWT	WO		120	Y	2.8	N	0.11377		4.88	10	10	5	10	6	8	4	10	10	4	77
320	9234	Harms and Eberst 1974	Copper (II) sulfate pentahydrate	25.45	Turkey (*Meleagris gallopavo*)	1	2	0/0.05	% in diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	DOM	1	GRO	GRO	GGRO	WO		0.05	Y	0.389	N	0.03148		10.3	10	10	5	10	6	8	4	10	10	4	77
321	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	10	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO		250	N	1.042	N	0.05978		14.3	10	10	5	10	5	8	4	10	10	4	76
322	2165	Jensen and Maurice 1978	copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO		250	Y	0.591	N	0.04133		17.5	10	10	5	10	6	8	4	10	10	4	77
323	2191	Latymer and Coates, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	24	d	1	d	JV	B	V	COM	2	GRO	GRO	BDWT	WO		250	Y	0.335	N	0.02856		21.3	10	10	5	10	6	8	4	10	10	4	77
324	2293	Stevenson and Jackson 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/500/1000/2000	mg/kg diet	N	N	ADL	U	FD	8	w	24	w	SM	F	C	NR	1	GRO	GRO	BDWT	WO		500	N	1.6	Y	0.07229		22.6	10	10	5	10	6	8	4	10	10	4	77
325	2194	Ledoux, et.al. 1987	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/400/800	mg/kg diet	N	N	ADL	UX	FD	21	d	1	d	JV	F	C	NR	1	GRO	GRO	BDWT	WO		400	N	0.564	Y	0.032		22.7	10	10	10	10	6	8	4	10	10	4	82
326	2266	Robbins and Baker, 1980	Copper carbonate	100	Chicken (*Gallus domesticus*)	3	3	0/250/500	mg/kg diet	N	N	NR	U	FD	8	d	8	d	JV	M	C	NR	1	GRO	GRO	BDWT	WO		250	Y	0.181	N	0.01913		26.4	10	10	5	10	6	8	4	10	10	4	77
327	2266	Robbins and Baker, 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/250/500	mg/kg diet	N	N	NR	U	FD	8	d	8	d	JV	M	C	NR	1	GRO	GRO	BDWT	WO		250	Y	0.181	N	0.01913		26.4	10	10	5	10	6	8	4	10	10	4	77
328	1369	Hill, 1974	Copper sulfate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	5	w	1	d	JV	B	C	COM	1	GRO	GRO	BDWT	WO		500	N	1.042	N	0.05978		28.7	10	10	5	10	5	8	4	10	10	4	76
329	2052	Christmas and Harms, 1979	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/500/750	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	B	C	DOM	1	GRO	GRO	BDWT	WO		500	Y	0.365	Y	0.0229		31.4	10	10	5	10	7	8	4	10	10	4	78
330	2165	Jensen and Maurice 1978	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	3	0/500/750	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO		500	Y	0.592	N	0.04137		34.9	10	10	5	10	6	8	4	10	10	4	77

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 7 of 9

Ref			Exposure																						Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Endpoint Number	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
331	2291	Stevenson and Jackson 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	2	0/1830	mg/kg diet	N	N	ADL	M	FD	6	w	24	w	JV	F	C	NR	1	GRO	GRO	BDWT	WO		1830	Y	1.41	Y	0.02714		35.2	10	10	10	10	7	8	4	10	10	4	83
332	2084	Ekperigin and Vohra 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	3	0/500/1000	mg/kg diet	N	N	DLY	U	FD	1	w	12	d	JV	B	C	NR	1	GRO	GRO	BDWT	WO		500	N	0.564	N	0.04009		35.5	10	10	5	10	5	8	4	10	10	4	76
333	2319	Wang et al 1987	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	COM	1	GRO	GRO	BDWT	WO		500	N	0.564	N	0.04009		35.5	10	10	5	10	5	8	4	10	10	4	76
334	92	Hill, 1974	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/500/1000/1500/2000/2500	mg/kg diet	N	N	ADL	U	FD	2	w	1	d	JV	B	C	COM	1	GRO	GRO	BDWT	WO		500	N	0.328	N	0.02817		42.9	10	10	5	10	5	8	4	10	10	4	76
335	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	DLY	U	FD	12	d	8	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO		500	Y	0.211	N	0.02114		50.1	10	10	5	10	6	8	4	10	10	4	77
336	2266	Robbins and Baker, 1980	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	NR	U	FD	8	d	8	d	JV	M	C	NR	1	GRO	GRO	BDWT	WO		500	Y	0.16	N	0.01765		55.2	10	10	5	10	6	8	4	10	10	4	77
337	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	4	2	0/500	mg/kg diet	N	N	DLY	U	FD	8	d	8	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO		500	Y	0.144	N	0.01648		57.2	10	10	5	10	6	8	4	10	10	4	77
338	2267	Robbins and Baker 1980	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	DLY	U	FD	12	d	8	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO		500	Y	0.132	N	0.01557		59.0	10	10	5	10	6	8	4	10	10	4	77
339	14404	Vohra and Kratzer, 1968	Copper sulfate pentahydrate	100	Turkey (*Melagris gallopavo*)	4	4	0/810/910/1000	mg/kg diet	N	N	ADL	U	FD	21	d	NR	NR	JV	B	C	COM	1	GRO	GRO	BDWT	WO		810	N	0.5	N	0.0371		60.0	10	10	5	10	5	8	4	10	10	4	76
340	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	2	2	0/503.4	mg/kg diet	N	N	DLY	M	FD	35	d	3	d	JV	NR	C	COM	1	GRO	GRO	BDWT	WO		503.4	Y	0.8668	Y	0.13002		75.5	10	10	10	10	7	8	4	10	10	4	83
341	1370	Hill, 1979	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/1000	mg/kg diet	N	N	ADL	U	FD	2	w	1	d	JV	NR	C	COM	1	GRO	GRO	BDWT	WO		1000	N	0.328	N	0.02817		85.9	10	10	5	10	5	8	4	10	10	4	76
342	1403	Jensen, 1975	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/1000	mg/kg diet	N	N	ADL	U	FD	14	d	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO		1000	Y	0.141	Y	0.0131		92.9	10	10	5	10	7	8	4	10	10	4	78
343	395	Hill, 1980	Copper	100	Chicken (*Gallus domesticus*)	1	2	0/1000	mg/kg diet	N	N	NR	U	FD	1	w	1	d	JV	F	C	DOM	1	GRO	GRO	BDWT	WO		1000	N	0.084	N	0.0116		138	10	10	5	4	5	8	4	10	10	4	70
Survival																																															
344	1369	Hill, 1974	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/32	mg/kg diet	N	N	ADL	U	FD	2	w	NR	NR	JV	B	C	COM	2	MOR	MOR	MORT	WO	32		N	0.328	N	0.02817	2.75		10	10	5	10	5	9	4	3	10	4	70
345	36216	Wood and Worden, 1973	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/50	mg/kg diet	N	N	ADL	U	FD	49	d	2	d	JV	B	C	COM	2	MOR	MOR	MORT	WO	50		N	0.564	N	0.04009	3.55		10	10	5	10	5	9	4	10	10	4	77
346	36216	Wood and Worden, 1973	Copper sulfate	100	Duck (*Anas platyrhynchos*)	2	2	0/50	mg/kg diet	N	N	ADL	U	FD	49	d	2	d	JV	B	C	COM	2	MOR	MOR	MORT	WO	50		N	0.092	N	0.01231	6.69		10	10	5	10	5	9	4	10	10	4	77
347	92	Hill, 1974	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	2	0/100	mg/kg diet	N	N	ADL	U	FD	5	w	1	d	JV	B	C	COM	2	MOR	MOR	MORT	WO	100		N	0.46	N	0.03511	7.63		10	10	5	10	5	9	4	1	10	4	68
348	14453	McGhee et al, 1965	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/20/40/80/160	mg/kg diet	N	N	NR	U	FD	4	w	NR	NR	JV	NR	C	NR	1	MOR	MOR	MORT	WO	80	160	Y	0.2019	N	0.02054	8.14	16.3	10	10	5	10	6	9	10	10	10	4	84
349	2181	Ko et al, 1985	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/54/94/134	mg/kg diet	N	N	ADL	U	FD	3	w	3	d	JV	M	C	COM	1	MOR	MOR	MORT	WO	134		Y	0.6283	Y	0.0394	8.40		10	10	5	10	7	9	4	10	10	4	79
350	25969	Skrivan et al, 2000	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/208	mg/kg diet	N	N	ADL	M	FD	38	d	1	d	JV	B	C	COM	2	MOR	MOR	MORT	WO	208		Y	1.876	N	0.08766	9.72		10	10	10	10	6	9	4	1	10	4	74
351	2250	Poupoulis and Jensen 1976	Copper chloride dihydrate	100	Chicken (*Gallus domesticus*)	11	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	5	MOR	MOR	MORT	WO	500		N	1.6	N	0.07903	11.7		10	10	5	10	5	9	4	1	10	4	68
352	2162	Jenkins et al, 1970	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/229	mg/kg diet	N	N	ADL	M	FD	6	w	1	d	JV	B	C	COM	1	MOR	MOR	MORT	WO	229		Y	0.986	N	0.05767	13.4		10	10	10	10	6	9	4	10	10	4	83
353	25968	Marron, et al, 2001	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	21	d	7	d	JV	M	C	COM	4	MOR	MOR	MORT	WO	250		N	0.564	Y	0.08020	14.2		10	10	5	10	6	9	4	10	10	4	78
354	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/250/500/750/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	MOR	MOR	MORT	WO	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	9	10	10	10	4	83
355	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	5	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	MOR	MOR	MORT	WO	250	500	N	1.042	N	0.05978	14.3	28.7	10	10	5	10	5	9	10	10	10	4	83
356	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	2	0/250	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	MOR	MOR	MORT	WO	250		N	1.042	N	0.05978	14.3		10	10	5	10	5	9	4	10	10	4	77
357	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	2	0/250	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	MOR	MOR	MORT	WO	250		N	1.042	N	0.05978	14.3		10	10	5	10	5	9	4	10	10	4	77
358	36216	Wood and Worden, 1973	Copper sulfate	100	Duck (*Anas platyrhynchos*)	3	2	0/135	mg/kg diet	N	N	ADL	U	FD	16	d	2	d	JV	B	C	COM	2	MOR	MOR	MORT	WO	135		N	0.092	N	0.01231	18.1		10	10	5	10	5	9	4	10	10	4	77
359	6788	Ward et al, 1995	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/6.34	mg/org/d	N	N	ADL	M	FD	10	d	5	d	JV	M	C	DOM	5	MOR	MOR	MORT	WO	6.34		Y	0.3465	Y	0.0351	18.3		10	10	10	10	7	9	4	10	10	4	84
360	2006	Ankari et al, 1998	Copper	100	Chicken (*Gallus domesticus*)	1	4	0/50/150/250	mg/kg diet	N	N	ADL	U	FD	84	d	25	w	SM	F	C	DOM	3	MOR	MOR	MORT	WO	250		Y	1.5315	Y	0.12176	19.9		10	10	5	4	7	9	4	10	10	4	73
361	2191	Latymer and Coates, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	24	d	1	d	JV	B	V	COM	1	MOR	MOR	MORT	WO	250		Y	0.335	N	0.02856	21.3		10	10	5	10	6	9	4	1	10	4	69
362	2160	Jackson, et. al., 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/10.39/21.31/31.52/39.91	mg/org/d	N	N	ADL	U	FD	336	d	17	w	SM	F	C	NR	2	MOR	MOR	MORT	WO	39.91		Y	1.85	Y	0.0997	21.6		10	10	5	10	7	9	4	10	10	4	79
363	6788	Ward et al, 1995	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	2	2	0/10.33	mg/org/d	N	N	ADL	M	DR	10	d	5	d	JV	M	C	DOM	5	MOR	MOR	MORT	WO	10.33		Y	0.389	Y	0.116	26.6		10	5	10	10	7	9	4	10	10	4	79
364	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	7	4	0/250/500/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	MOR	MOR	MORT	WO	500	1000	N	1.042	N	0.05978	28.7	57.4	10	10	5	10	5	9	10	10	10	4	83
365	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/125/250/500/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	MOR	MOR	MORT	WO	500	1000	N	1.042	N	0.05978	28.7	57.4	10	10	5	10	5	9	10	10	10	4	83
366	1369	Hill, 1974	Copper sulfate	100	Chicken (*Gallus domesticus*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	5	w	1	d	JV	M	C	COM	2	MOR	MOR	MORT	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	9	4	3	10	4	70
367	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	8	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	MOR	MOR	MORT	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	9	4	10	10	4	77
368	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	6	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	MOR	MOR	MORT	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	9	4	10	10	4	77
369	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	9	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	5	MOR	MOR	MORT	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	9	4	10	10	4	77
370	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	10	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	5	MOR	MOR	MORT	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	9	4	10	10	4	77
371	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	2	MOR	MOR	MORT	WO	750		Y	1.82	Y	0.072	29.7		10	10	5	10	7	9	4	10	10	4	79
372	2221	Miles et al, 1998	Tribasic copper chloride	100	Chicken (*Gallus domesticus*)	4	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	B	C	NR	3	MOR	MOR	MORT	WO	600		Y	1.335	Y	0.06617	29.7		10	10	5	10	7	9	4	10	10	4	79
373	2221	Miles et al, 1998	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	42	d	1	d	JV	B	C	NR	3	MOR	MOR	MORT	WO	600		Y	1.543	Y	0.07917	30.8		10	10	5	10	7	9	4	1	10	4	70
374	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	2	MOR	MOR	MORT	WO	750		Y	1.78	Y	0.0751	31.6		10	10	5	10	7	9	4	10	10	4	79
375	22	Mehring et al, 1960	Copper oxide	100	Chicken (*Gallus domesticus*)	1	5	0/403/570/749/1180	mg/kg diet	N	N	NR	M	FD	10	w	1	d	JV	B	C	NR	1	MOR	MOR	MORT	WO	570	749	Y	1.0166	N	0.05883	33.0	43.3	10	10	10	10	6	9	10	10	10	4	89
376	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	2	MOR	MOR	MORT	WO	750		Y	1.33	Y	0.0624	35.2		10	10	5	10	7	9	4	10	10	4	79
377	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	2	MOR	MOR	MORT	WO	750		Y	1.5	Y	0.0708	35.4		10	10	5	10	7	9	4	10	10	4	79
378	2160	Jackson et al, 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/23.5/43.84/56.47/60.43	mg/org/d	N	N	ADL	U	FD	232	d	17	w	SM	F	C	NR	2	MOR	MOR	MORT	WO	60.43		Y	1.704	Y	0.07556	35.5		10	10	5	10	7	9	4	10	10	4	79
379	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	3	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	2	MOR	MOR	MORT	WO	750		Y	2.13	Y	0.123	43.3		10	10	5	10	7	9	4	10	10	4	79
380	14405	Waibel et al, 1964	Cupric carbonate	100	Turkey (*Melagris gallopavo*)	1	3	0/100/800	mg/kg diet	N	N	NR	U	FD	3	w	7	d	JV	NR	C	DOM	2	MOR	MOR	SURV	WO	800		N	1	N	0.0582	46.6		10	10	5	5	9	4	10	10	4	72
381	2052	Christmas and Harms, 1979	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/500/750	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	B	C	DOM	3	MOR	MOR	MORT	WO	750		Y	0.32	Y	0.0206	48.3		10	10	5	10	7	9	4	10	10	4	79
382	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	2	MOR	MOR	MORT	WO	750		Y	1.77	Y	0.118	50.0		10	10	5	10	7	9	4	10	10	4	79
383	14404	Vohra and Kratzer, 1968	Copper sulfate pentahydrate	100	Turkey (*Melagris gallopavo*)	3	5	0/810/1620/2430/3240	mg/kg diet	N	N	ADL	U	FD	21	d	NR	NR	JV	B	C	COM	2	MOR	MOR	MORT	WO	810	1620	N	0.5	N	0.0371	60.0	120	10	10	5	10	5	9	10	10	10	4	83
384	2157	Jackson, 1977	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/0.01486/0.02857/0.04828/0.07886/0.08657	g/org/d	N	N	ADL	U	FD	35	d	NR	NR	SM	F	C	NR	2	MOR	MOR	MORT	WO	0.0866		N	1.38	Y	0.045	62.7		10	10	5	10	6	9	4	10	10	4	78
385	92	Hill, 1974	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/500/1000/1500/2000/2500	mg/kg diet	N	N	ADL	U	FD	5	w	1	d	JV	F	C	COM	2	MOR	MOR	MORT	WO	1000	1500	N	0.38	N	0.031	81.6	122	10	10	5	10	5	9	10	10	10	4	83

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 8 of 9

Ref			Exposure																								Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Endpoint Number	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
386	1370	Hill, 1979	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/1000	mg/kg diet	N	N	ADL	U	FD	2	w	1	d	JV	B	C	COM	2	MOR	MOR	MORT	WO	1000		N	0.328	N	0.02817	85.9		10	10	5	10	5	9	4	10	10	4	77
387	1403	Jensen, 1975	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/1000	mg/kg diet	N	N	ADL	U	FD	14	d	1	d	JV	NR	C	NR	2	MOR	MOR	MORT	WO	1000		Y	0.141	Y	0.0131	92.9		10	10	5	10	7	9	4	10	10	4	79
388	80	Van Vleet et al, 1981	Copper sulfate	100	Duck (*Anas platyrhynchos*)	2	2	0/1500	mg/kg diet	N	N	ADL	U	FD	15	d	1	d	JV	M	C	COM	1	MOR	MOR	MORT	WO	1500		N	0.092	N	0.01231	201		10	10	5	10	5	9	4	10	10	4	77
389	2181	Ko et al, 1985	Copper carbonate	100	Chicken (*Gallus domesticus*)	2	4	0/42/76/98	mg/kg diet	N	N	ADL	U	FD	3	w	3	d	JV	M	C	COM	1	MOR	MOR	MORT	WO		42	Y	0.2039	Y	0.01304		2.69	10	10	5	10	7	9	4	10	10	4	79
390	18769	Foster, 1999	Copper sulfate pentahydrate	100	Duck (*Anas platyrhynchos*)	4	2	0/605.4	mg/L	N	N	DLY	M	DR	4	d	4	d	JV	NR	C	COM	1	MOR	MOR	MORT	WO		605.4	N	0.092	N	0.01193		78.5	10	5	10	10	5	9	4	10	10	4	77
391	3727	Shivanandappa et al., 1983	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	6	0/200/600/800/1200/1600	mg/kg bw	N	N	DLY	U	OR	3	w	25	w	JV	M	V	NR	3	MOR	MOR	MORT	WO		200	Y	1.7	N	0.08221		79.6	10	8	5	10	10	9	4	10	10	4	80
392	80	Van Vleet et al, 1981	Copper sulfate	100	Duck (*Anas platyrhynchos*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	15	d	1	d	JV	M	C	COM	3	MOR	MOR	MORT	WO		1500	N	0.092	N	0.01231		201	10	10	5	10	5	9	4	10	10	4	77
393	3727	Shivanandappa et al, 1983	Copper oxychloride	59.51	Chicken (*Gallus domesticus*)	2	5	0/900/1200/1500/1800	mg/kg bw	N	N	DLY	U	OR	4	d	25	w	JV	M	V	NR	1	MOR	MOR	MORT	WO		900	Y	1.7	N	0.08221		536	10	8	5	10	10	9	4	10	10	4	80
Data Not Used to Derive TRV																																																
394	2007	Hoda and Maha, 1995	Copper sulfate	25	Chicken (*Gallus domesticus*)	3	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	NR	C	LAB	3	PHY	PHY	FDCV	WO	150		Y	1.1273	Y	0.05786	1.92		10	10	5	10	7	4	4	1	10	4	65
395	2160	Jackson et al, 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/10.39/21.31/31.52/39.91	mg/org/d	N	N	ADL	U	FD	336	d	17	w	SM	F	C	NR	4	BEH	FDB	FCNS	WO	39.91		Y	18.5	Y	0.0997	2.16		10	10	5	10	7	4	4	1	10	4	65
396	2329	Wilson et al, 1975	Copper sulfate	39.81	Chicken (*Gallus domesticus*)	1	3	0/48/96	mg/L	N	N	ADL	U	DR	6	w	1	d	JV	M	C	NR	3	PTH	HIS	GHIS	MT	96		N	1.042	Y	0.0712	2.61		10	5	5	10	6	4	4	1	10	4	59
397	2329	Wilson et al, 1975	Copper sulfate	39.81	Chicken (*Gallus domesticus*)	1	3	0/48/96	mg/L	N	N	ADL	U	DR	6	w	1	d	JV	M	C	NR	4	PHY	PHY	FDCV	WO	96		N	1.042	Y	0.0712	2.61		10	5	5	10	6	4	4	1	10	4	59
398	2329	Wilson et al, 1975	Copper sulfate	39.81	Chicken (*Gallus domesticus*)	1	3	0/48/96	mg/L	N	N	ADL	U	DR	6	w	1	d	JV	M	C	NR	2	GRO	GRO	BDWT	WO	96		N	1.042	Y	0.0712	2.61		10	5	5	10	6	8	4	1	10	4	63
399	2329	Wilson et al, 1975	Copper sulfate	39.81	Chicken (*Gallus domesticus*)	1	3	0/48/96	mg/L	N	N	ADL	U	DR	6	w	1	d	JV	M	C	NR	1	BEH	FDB	WCON	WO	96		N	1.042	Y	0.0712	2.61		10	5	5	10	6	4	4	1	10	4	59
400	2114	Guenthner et al, 1978	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/120	mg/kg diet	N	N	ADL	U	FD	24	w	1	d	JV	F	C	DOM	2	PHY	PHY	FDCV	WO	120		Y	11.61	N	0.28716	2.97		10	10	5	10	6	4	4	1	10	4	64
401	5149	Kayongo-Male and Palmer, 1998	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/8/75	mg/kg diet	N	N	ADL	U	FD	4	w	NR	NR	JV	NR	C	DOM	3	PTH	ORW	SMIX	LI	75		Y	0.787	N	0.0498	4.75		10	10	5	10	6	4	4	1	10	4	64
402	5149	Kayongo-Male and Palmer, 1998	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/8/75	mg/kg diet	N	N	ADL	U	FD	4	w	NR	NR	JV	NR	C	DOM	2	BIO	CHM	HMCT	BL	75		Y	0.787	N	0.0498	4.75		10	10	5	10	6	1	4	1	10	4	61
403	2171	Kashani et al, 1986	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	2	4	0/60/120/240	mg/kg diet	N	N	ADL	U	FD	24	w	1	d	JV	M	C	NR	2	PHY	PHY	FDCV	WO	240		Y	13.64	N	0.31892	5.61		10	10	5	10	6	4	4	1	10	4	64
404	2007	Hoda and Maha, 1995	Copper oxide	80.0	Chicken (*Gallus domesticus*)	2	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	M	C	LAB	3	PHY	PHY	FDCV	WO	150		Y	1.0887	Y	0.05698	6.28		10	10	5	10	7	4	4	1	10	4	65
405	2007	Hoda and Maha, 1995	Copper oxide	80.0	Chicken (*Gallus domesticus*)	2	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	M	C	LAB	2	BEH	FDB	FCNS	WO	150		Y	1.0887	Y	0.05698	6.28		10	10	5	10	7	4	4	1	10	4	65
406	36216	Wood and Worden, 1973	Copper sulfate	100	Duck (*Anas platyrhynchos*)	2	2	0/50	mg/kg diet	N	N	ADL	U	FD	49	d	2	d	JV	B	C	COM	1	PTH	ORW	ORWT	LI	50		Y	0.092	N	0.01231	6.69		10	10	5	10	6	4	4	1	10	4	64
407	2007	Hoda and Maha, 1995	Copper carbonate	100	Chicken (*Gallus domesticus*)	1	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	NR	C	LAB	3	PHY	PHY	FDCV	WO	150		Y	1.2283	Y	0.06186	7.55		10	10	5	10	7	4	4	1	10	4	65
408	2007	Hoda and Maha, 1995	Copper carbonate	100	Chicken (*Gallus domesticus*)	1	3	0/75/150	mg/kg diet	N	N	ADL	U	FD	6	w	1	d	JV	NR	C	LAB	2	BEH	FDB	FCNS	WO	150		Y	1.2283	Y	0.06186	7.55		10	10	5	10	7	4	4	1	10	4	65
409	2181	Ko et al, 1985	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/54/94/134	mg/kg diet	N	N	ADL	U	FD	3	w	3	d	JV	M	C	COM	4	PHY	PHY	FDCV	WO	134		Y	0.6283	Y	0.0394	8.40		10	10	5	10	7	4	4	1	10	4	65
410	2181	Ko et al, 1985	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/54/94/134	mg/kg diet	N	N	ADL	U	FD	3	w	3	d	JV	M	C	COM	3	BEH	FDB	FCNS	WO	134		Y	0.6283	Y	0.0394	8.40		10	10	5	10	7	4	4	1	10	4	65
411	2282	Shajahan and Coligado, 1982	Copper	100	Chicken (*Gallus domesticus*)	1	2	0/200	mg/kg diet	N	N	DLY	U	FD	6	w	1	d	JV	NR	C	NR	1	PTH	ORW	ORWT	IN	200		N	1.04	N	0.05971	11.5		10	10	5	4	5	4	4	1	10	4	57
412	2250	Poupoulis and Jensen, 1976	Copper chloride dihydrate	100	Chicken (*Gallus domesticus*)	11	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	BIO	CHM	PHPH	GZ	500		N	1.6	N	0.07903	11.7		10	10	5	10	5	1	4	1	10	4	60
413	2250	Poupoulis and Jensen, 1976	Copper chloride dihydrate	100	Chicken (*Gallus domesticus*)	11	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	BEH	FDB	FEFF	WO	500		N	1.6	N	0.07903	11.7		10	10	5	10	5	4	4	1	10	4	63
414	25968	Marron et al, 2001	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	21	d	7	d	JV	M	C	COM	3	PHY	PHY	FDCV	WO	250		N	0.564	Y	0.08020	14.2		10	10	5	10	6	4	4	1	10	4	64
415	25968	Marron et al, 2001	Copper (II) sulfate	39.81	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	21	d	7	d	JV	M	C	COM	2	BEH	FDB	FCNS	WO	250		N	0.564	Y	0.08020	14.2		10	10	5	10	6	4	4	1	10	4	64
416	5734	Hill, 1990	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	5	0/25/50/100/200	mg/kg diet	N	N	ADL	U	FD	19	d	1	d	JV	F	C	DOM	2	BIO	CHM	GBCM	LI	200		N	0.564	N	0.04009	14.2		10	10	5	10	5	1	4	6	10	4	65
417	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	2	0/250	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	3	PTH	HIS	GHIS	GZ	250		N	1.042	N	0.05978	14.3		10	10	5	10	5	4	4	1	10	4	63
418	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	2	0/250	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	250		N	1.042	N	0.05978	14.3		10	10	5	10	5	4	4	1	10	4	63
419	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	2	0/250	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	250		N	1.042	N	0.05978	14.3		10	10	5	10	5	4	4	1	10	4	63
420	2164	Jensen and Maurice, 1978	Copper	100	Chicken (*Gallus domesticus*)	2	3	0/120/240	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	PHY	PHY	FDCV	WO	240		Y	0.709	N	0.04653	15.7		10	10	5	4	6	4	4	1	10	4	58
421	2164	Jensen and Maurice, 1978	Copper	100	Chicken (*Gallus domesticus*)	2	3	0/120/240	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	240		Y	0.709	N	0.04653	15.7		10	10	5	4	6	8	4	1	10	4	62
422	2164	Jensen and Maurice, 1978	Copper	100	Chicken (*Gallus domesticus*)	1	2	0/240	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	240		Y	0.606	N	0.04201	16.6		10	10	5	4	6	8	4	1	10	4	62
423	2164	Jensen and Maurice, 1978	Copper	100	Chicken (*Gallus domesticus*)	3	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	NR	C	NR	1	GRO	GRO	BDWT	WO	250		Y	0.476	N	0.0359	18.9		10	10	5	4	6	8	4	1	10	4	62
424	11876	Kadirvel and Kothandaraman, 1978	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/0.05	% in diet	N	N	ADL	U	FD	8	w	12	w	SM	F	C	COM	3	BEH	FDB	FCNS	WO	0.05		Y	1.4976	Y	0.0591	19.7		10	10	5	10	7	4	4	1	10	4	65
425	2006	Ankari et al, 1998	Copper	100	Chicken (*Gallus domesticus*)	1	4	0/50/150/250	mg/kg diet	N	N	ADL	U	FD	84	d	25	w	SM	F	C	DOM	4	GRO	GRO	BDWT	WO	250		Y	1.5315	Y	0.12176	19.9		10	10	5	4	7	8	4	1	10	4	63
426	2006	Ankari et al, 1998	Copper	100	Chicken (*Gallus domesticus*)	1	4	0/50/150/250	mg/kg diet	N	N	ADL	U	FD	84	d	25	w	SM	F	C	DOM	2	BEH	FDB	FCNS	WO	250		Y	1.5315	Y	0.12176	19.9		10	10	5	4	7	4	4	1	10	4	59
427	11876	Kadirvel and Kothandaraman, 1978	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/0.05	% in diet	N	N	ADL	U	FD	8	w	12	w	SM	F	C	COM	4	PHY	PHY	FDCV	WO	0.05		Y	1.4976	Y	0.0591	19.7		10	10	5	10	7	4	4	1	10	4	65
428	5812	Ledoux et al, 1989	Copper acetate monohydrate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/300	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	DOM	3	PHY	PHY	FDCV	WO	300		N	0.564	Y	0.0383	20.4		10	10	5	5	6	4	4	1	10	4	59
429	5617	Pimentel et al, 1992	Copper	100	Chicken (*Gallus domesticus*)	1	2	0/211.6	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	B	C	COM	3	BIO	CHM	HMGL	BL	211.6		Y	0.1103	Y	0.0109	20.9		10	10	5	4	7	1	4	6	10	4	61
430	2191	Latymer and Coates, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	24	d	1	d	JV	M	V	COM	3	BIO	CHM	GBCM	LI	250		Y	0.335	N	0.02856	21.3		10	10	5	10	6	1	4	3	10	4	63
431	5824	Ledoux et al, 1989	Cupric acetate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/300	mg/kg diet	N	N	ADL	U	FD	22	d	1	d	JV	M	C	NR	2	GRO	GRO	BDWT	WO	300		N	0.564	N	0.04009	21.3		10	10	5	5	5	8	4	1	10	4	62
432	5824	Ledoux et al, 1989	Cupric acetate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/300	mg/kg diet	N	N	ADL	U	FD	22	d	1	d	JV	M	C	NR	3	BIO	CHM	CALC	LI	300		N	0.564	N	0.04009	21.3		10	10	5	5	5	1	4	10	10	4	64
433	5824	Ledoux et al, 1989	Cupric acetate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/300	mg/kg diet	N	N	ADL	U	FD	22	d	1	d	JV	M	C	NR	1	BEH	FDB	FCNS	WO	300		N	0.564	N	0.04009	21.3		10	10	5	5	5	4	4	1	10	4	58
434	2160	Jackson et al, 1979	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/10.39/21.31/31.52/39.91	mg/org/d	N	N	ADL	U	FD	336	d	17	w	SM	F	C	NR	7	PHY	PHY	FDCV	WO	39.91		N	1.85	Y	0.0997	21.6		10	10	5	10	6	4	4	1	10	4	64
435	2099	Funk and Baker, 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	3	3	0/5/8.23	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	3	PHY	PHY	FDCV	WO	8.23		Y	0.319	Y	0.025	25.8		10	10	5	10	7	4	4	1	10	4	65
436	6788	Ward et al, 1995	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	2	2	0/10.33	mg/org/d	N	N	ADL	M	DR	10	d	5	d	JV	M	C	DOM	3	PHY	PHY	FDCV	WO	10.33		Y	0.389	Y	0.116	26.6		10	5	10	10	7	4	4	1	10	4	65
437	6788	Ward et al, 1995	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	2	2	0/10.33	mg/org/d	N	N	ADL	M	DR	10	d	5	d	JV	M	C	DOM	2	BEH	FDB	FCNS	WO	10.33		Y	0.389	Y	0.116	26.6		10	5	10	10	7	4	4	1	10	4	65
438	6788	Ward et al, 1995	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	2	2	0/10.33	mg/org/d	N	N	ADL	M	DR	10	d	5	d	JV	M	C	DOM	4	BIO	CHM	HMGL	BL	10.33		Y	0.389	Y	0.116	26.6		10	5	10	10	7	1	4	1	10	4	62
439	2226	Nam et al 1984	Copper carbonate	51.43	Chicken (*Gallus domesticus*)	1	3	0/0.05/0.10	% in diet	N	N	ADL	U	FD	4	w	3	d	JV	NR	C	COM	2	BEH	FDB	FCNS	WO	0.1		N	1.042	Y	0.0543	26.8		10	10	5	10	6	4	4	1	10	4	64
440	14398	Goldberg et al, 1956	Copper acetate	100	Chicken (*Gallus domesticus*)	1	2	0/50	mg/d	N	N	DLY	U	OR	7	d	NR	NR	AD	F	C	DOM	1	BIO	CHM	HMGL	BL	50		Y	1.8	N	0.0853	27.8		10	8	5	5	6	1	4	1	3	4	47

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 9 of 9

Ref			Exposure																								Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Endpoint Number	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
441	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	8	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	4	4	1	10	4	63
442	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	9	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	4	4	1	10	4	63
443	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	5	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	4	4	1	10	4	63
444	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	10	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	4	4	1	10	4	63
445	2250	Poupoulis and Jensen, 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	10	3	0/250/500	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	4	BIO	CHM	PHPH	GZ	500		N	1.042	N	0.05978	28.7		10	10	5	10	5	1	4	1	10	4	60
446	2159	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	5	BIO	CHM	LIPD	LI	750		Y	1.82	Y	0.072	29.7		10	10	5	10	7	1	4	1	10	4	62
447	2284	Smith, 1969	Cupric sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/350	mg/kg diet	N	N	ADL	U	FD	25	d	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	350		Y	0.2982	N	0.02647	31.1		10	10	5	10	6	4	4	1	10	4	64
448	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	4	PTH	ORW	ORWT	LI	750		Y	1.78	Y	0.0751	31.6		10	10	5	10	7	4	4	1	10	4	65
449	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	7	BIO	CHM	LIPD	LI	750		Y	1.78	Y	0.0751	31.6		10	10	5	10	7	1	4	1	10	4	62
450	2172	Kassim and Suwanpradit, 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	3	w	1	d	JV	M	C	COM	3	PHY	PHY	FDCV	WO	375		N	0.564	Y	0.04827	32.1		10	10	5	10	6	4	4	1	10	4	64
451	2052	Christmas and Harms, 1979	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/500/750	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	NR	C	DOM	5	PHY	PHY	FDCV	WO	750		Y	0.459	Y	0.0206	33.7		10	10	5	10	7	4	4	1	10	4	65
452	2163	Jensen et al, 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/120/240/480	mg/kg diet	N	N	NR	U	FD	3	w	1	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	480		Y	0.567	N	0.04023	34.1		10	10	5	10	6	4	4	1	10	4	64
453	2158	Jackson and Stevenson, 1981	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	280	d	18	w	SM	F	C	NR	5	PTH	ORW	ORWT	LI	750		Y	1.5	Y	0.0708	35.4		10	10	5	10	7	4	4	1	10	4	65
454	2517	Bafundo et al, 1984	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	2	PHY	PHY	FDCV	WO	500		N	0.564	N	0.04009	35.5		10	10	5	10	5	4	4	1	10	4	63
455	2517	Bafundo et al, 1984	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	3	BIO	ENZ	ALPH	BL	500		N	0.564	N	0.04009	35.5		10	10	5	10	5	1	4	1	10	4	60
456	2099	Funk and Baker, 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	4	3	0/5.78/11.51	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	3	PHY	PHY	FDCV	WO	11.51		Y	0.317	Y	0.02886	36.3		10	10	5	10	7	4	4	1	10	4	65
457	1278	Davis et al, 1996	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	21	d	14	d	JV	M	C	LAB	3	PTH	ORW	ORWT	LI	500		Y	0.484	Y	0.0359	37.1		10	10	5	10	7	4	4	1	10	4	65
458	1278	Davis et al, 1996	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	21	d	14	d	JV	M	C	LAB	4	PHY	PHY	FDCV	WO	500		Y	0.484	Y	0.0359	37.1		10	10	5	10	7	4	4	1	10	4	65
459	1278	Davis et al, 1996	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	21	d	14	d	JV	M	C	LAB	2	BEH	FDB	FCNS	WO	500		Y	0.484	Y	0.0359	37.1		10	10	5	10	7	4	4	1	10	4	65
460	2049	Chiou et al, 1998	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/400/500/600	mg/kg diet	N	N	ADL	U	FD	4	w	38	w	SM	F	C	COM	3	PTH	ORW	ORWT	LI	600		Y	1.464	Y	0.0978	40.1		10	10	5	10	7	4	4	1	10	4	65
461	6368	Southern and Baker, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	14	d	8	d	JV	M	C	COM	2	PHY	PHY	FDCV	WO	500		Y	0.374	N	0.0307	41.0		10	10	5	10	6	4	4	1	10	4	64
462	6368	Southern and Baker, 1983	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	14	d	8	d	JV	M	C	COM	3	BIO	CHM	HMGL	BL	500		Y	0.374	N	0.0307	41.0		10	10	5	10	6	1	4	1	10	4	61
463	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	3	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	5	PHY	PHY	FDCV	WO	750		Y	2.13	Y	0.123	43.3		10	10	5	10	7	4	4	1	10	4	65
464	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	3	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	4	BIO	CHM	LIPD	LI	750		Y	2.13	Y	0.123	43.3		10	10	5	10	7	1	4	1	10	4	62
465	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	3	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	8	BEH	FDB	FCNS	WO	750		Y	2.13	Y	0.123	43.3		10	10	5	10	7	4	4	1	10	4	65
466	14405	Waibel et al, 1964	Cupric carbonate	100	Turkey (*Melagris gallopavo*)	1	3	0/100/800	mg/kg diet	N	N	NR	U	FD	3	w	7	d	JV	NR	C	DOM	3	BIO	CHM	HMGL	BL	800		N	1	N	0.0582	46.6		10	10	5	5	5	1	4	1	10	4	55
467	2118	Harms and Buresh, 1987	Copper sulfate pentahydrate	100	Turkey (*Meleagris gallopavo*)	1	3	0/500/750	mg/kg diet	N	N	DLY	U	FD	21	d	1	d	JV	B	C	NR	3	PHY	PHY	FDCV	WO	750		Y	0.2877	Y	0.0186	48.5		10	10	5	10	7	4	4	1	10	4	65
468	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	5	PHY	PHY	FDCV	WO	750		Y	1.77	Y	0.118	50.0		10	10	5	10	7	4	4	1	10	4	65
469	2159	Jackson and Stevenson, 1981	Copper oxide	100	Chicken (*Gallus domesticus*)	1	6	0/150/300/450/600/750	mg/kg diet	N	N	ADL	U	FD	336	d	26	w	SM	F	C	NR	3	BEH	FDB	FCNS	WO	750		Y	1.77	Y	0.118	50.0		10	10	5	10	7	4	4	1	10	4	65
470	5824	Ledoux et al, 1989	Cupric acetate	100	Chicken (*Gallus domesticus*)	1	4	0/100/200/300	mg/kg diet	N	N	ADL	U	FD	22	d	1	d	JV	M	C	NR	1	BEH	FDB	FCNS	WO	300		N	0.564	N	0.04009	53.8		10	10	5	5	5	4	4	1	10	4	58
471	2250	Poupoulis and Jensen 1976	Copper (II) sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	5	0/250/500/750/1000	mg/kg diet	N	N	ADL	U	FD	4	w	1	d	JV	NR	C	NR	2	PHY	PHY	FDCV	WO	1000		N	1.042	N	0.05978	57.4		10	10	5	10	5	4	4	1	10	4	63
472	2099	Funk and Baker 1991	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	1	5	0/2.67/5.22/10.36/18.79	mg/org/d	N	N	ADL	U	FD	14	d	8	d	JV	M	C	NR	3	PHY	PHY	FDCV	WO	18.79		N	0.294	Y	0.0235	63.9		10	10	5	10	6	4	4	1	10	4	64
473	2172	Kassim and Suwanpradit, 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	3	w	3	w	JV	M	C	COM	3	PHY	PHY	FDCV	WO	375		N	0.564	Y	0.10858	72.2		10	10	5	10	6	4	4	1	10	4	64
474	2172	Kassim and Suwanpradit, 1996	Copper sulfate pentahydrate	100	Chicken (*Gallus domesticus*)	2	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	3	w	3	w	JV	M	C	COM	2	BEH	FDB	FCNS	WO	375		N	0.564	Y	0.10858	72.2		10	10	5	10	6	4	4	1	10	4	64
475	2333	Yannakopoulos et al, 1990	Copper sulfate pentahydrate	100	Japanese quail (*Coturnix japonica*)	1	4	0/200/400/600	mg/kg diet	N	N	ADL	U	FD	34	d	7	d	JV	B	C	NR	3	PTH	ORW	ORWT	BT	600		Y	0.1764	Y	0.0241	82.0		10	10	5	10	7	4	4	1	10	4	65
476	5619	Pimentel et al, 1992	Copper	100	Chicken (*Gallus domesticus*)	1	3	0/222.39/529.92	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	B	C	COM	1	BIO	CHM	HMGL	BL	529.92		N	0.0397	N	0.00712	95.1		10	10	5	4	5	1	4	10	10	4	63
477	2196	Leeson and Summers, 1982	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/20/40/80	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	M	C	COM	3	PHY	PHY	FDCV	WO	80		N	0.564	Y	0.7271	103		10	10	5	10	6	4	4	1	10	4	64
478	2196	Leeson and Summers, 1982	Copper sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/20/40/80	mg/kg diet	N	N	ADL	U	FD	21	d	1	d	JV	M	C	COM	2	BEH	FDB	FDNG	WO	80		N	0.564	Y	0.7271	103		10	10	5	10	6	4	4	1	10	4	64
479	18769	Foster, 1999	Cupric acetate monohydrate	100	Duck (*Anas platyrhynchos*)	3	2	0/1024.8	mg/kg diet	N	N	DLY	M	FD	35	d	3	d	JV	NR	C	COM	3	BIO	CHM	HEMT	BL	1024.8		Y	0.9584	Y	0.13418	143		10	10	10	5	7	1	4	3	10	4	64
480	80	Van Vleet et al, 1981	Copper sulfate	100	Duck (*Anas platyrhynchos*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	15	d	1	d	JV	M	C	COM	2	BIO	ENZ	GLPX	BL	1500		N	0.092	N	0.01231	201		10	10	5	10	5	1	4	3	10	4	62
481	2006	Ankari et al, 1998	Copper	100	Chicken (*Gallus domesticus*)	1	4	0/50/150/250	mg/kg diet	N	N	ADL	U	FD	84	d	25	w	SM	F	C	DOM	5	BIO	CHM	CHOL	PL		50	Y	1.5161	Y	0.12278		4.05	10	10	5	4	7	1	4	10	10	4	65

All abbreviations and definitions are used in coding stuides are available from Attachment 4-3 of the Eco-SSL guidance(U.S. EPA 2003).

Duplicate values for NOAELs and LOAELs for the same reference represent results from different experimental designs and are identified by different Phase numbers.

Appendix 6-1

Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Copper

---

February 2007

This page intentionally left blank

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 1 of 7

Ref			Exposure																									Effects						Conversion to mg/kg bw/day					Result		Data Evaluation Score										
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
Biochemical																																																	
1	2625	Cerklewski and Forbes, 1977	Copper chloride	100	Rat (*Rattus norvegicus*)	1	2	0/20	mg/kg diet	N	N	DLY	U	FD	1	w	NR	NR	JV	M	C	LAB	BIO	CHM	HMGL	UR	20		Y	0.196	Y	0.0150	1.53		10	10	5	10	7	1	4	10	10	4	71
2	36349	Uthus, 2001	Cupric carbonate	100	Rat (*Rattus norvegicus*)	1	2	0/25	ug/g diet	N	N	ADL	U	FD	62	d	NR	NR	JV	M	C	LAB	BIO	CHM	HMGL	BL	25		Y	0.351	N	0.0291	2.07		10	10	5	10	6	1	4	10	10	4	70
3	10086	Amer, et al, 1973	Copper sulfate pentahydrate	100	Cattle (*Bos taurus*)	1	3	0/107/201	mg/kg diet	N	N	ADL	M	FD	4	w	3	d	JV	M	C	COM	BIO	ENZ	GENZ	BL	107	201	N	220	N	5.79	2.71	5.09	10	10	10	10	5	1	10	10	4	80
4	36240	Miranda et al, 1981	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/55.1	ug/g diet	N	N	ADL	M	FD	5	w	NR	NR	JV	M	C	LAB	BIO	ENZ	ASAT	PL	55.1		Y	0.225	Y	0.0147	3.60		10	10	10	10	7	1	4	8	10	4	74
5	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	4	6	0/500/1000/2000/4000/8000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	B	C	LAB	BIO	ENZ	AATT	BL	500	1000	Y	0.36	Y	0.0170	6.02	12.0	10	10	5	10	7	1	10	10	4	77
6	21243	Irie,M., 1990	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/20/200	mg/kg diet	N	N	ADL	U	FD	8	w	4	mo	JV	NR	C	DOM	BIO	CHM	FFTA	WO	200		Y	98.6	N	2.99	6.07		10	10	5	10	6	1	4	10	10	4	70
7	2304	Thacker, 1991	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	7	d	NR	NR	GE	F	C	NR	BIO	CHM	PRTL	MK	250		Y	232	N	6.04	6.51		10	10	5	10	6	1	4	10	10	4	70
8	20975	Kline et al, 1971	Copper sulfate	100	Pig (*Sus scrofa*)	1	4	0/151/197/246	mg/kg diet	N	N	ADL	M	FD	88	d	69	d	JV	NR	C	DOM	BIO	CHM	HMGL	BL	246		Y	87.232	N	2.71	7.63		10	10	10	10	6	1	4	1	10	4	66
9	2182	Kornegay, et al, 1986	Copper	100	Pig (*Sus scrofa*)	1	3	0/200/400	mg/kg diet	N	N	ADL	U	FD	25	d	NR	NR	JV	B	C	COM	BIO	CHM	HMGL	BL	200	400	Y	18.4	Y	0.790	8.59	17.2	10	10	5	4	7	1	10	10	4	71
10	2033	Brandt, 1983	Copper (II) sulfate	100	Mink (*Mustela vision*)	1	3	0/166/320	mg/kg diet	N	Y	ADL	M	FD	4	mo	90	d	JV	M	C	NR	BIO	CHM	HMGL	PL	166	320	Y	1.92	N	0.11744	10.2	19.6	10	10	10	10	6	1	10	10	4	81
11	3757	Suttle and Mills, 1966	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/250/425	mg/kg diet	N	N	NR	U	FD	34	d	NR	NR	JV	F	C	DOM	BIO	ENZ	ASAT	SR	250	425	Y	30	Y	1.43	11.9	20.3	10	10	5	10	7	1	10	10	4	77
12	3756	Smith et al, 1975	Cupric carbonate	100	Horse - Shetland pony (*Equus caballus*)	1	4	0/691.7/1209.1/2088.2	mg/org/d	N	N	ADL	M	FD	84	d	NR	NR	JV	NR	C	DOM	BIO	CHM	PCLV	BL	2088.2		Y	151.8	Y	2.64	13.8		10	10	10	10	7	1	4	1	10	4	67
13	12718	Moffitt and Murphy, 1973	Copper sulfate pentahydrate	100	Rat (*Rattus norvegicus*)	1	4	0/50/150/450	mg/L	N	N	ADL	U	DR	15	d	NR	NR	JV	B	C	LAB	BIO	ENZ	AHDX	LI	150	450	Y	0.25	N	0.0284	17.1	51.2	10	5	5	10	6	1	10	10	4	71
14	2020	Bassuny, 1991	Copper sulfate pentahydrate	25.45	Rabbit (*Oryctolagus cuniculus*)	1	5	0/75/150/300/450	mg/kg diet	N	N	NR	U	FD	7	w	35	d	JV	M	C	NR	BIO	CHM	PRTL	BL		75	Y	2.224	Y	0.0883		0.758	10	10	5	10	7	1	4	10	10	4	71
15	36748	Solaiman, et al, 2001	Copper sulfate pentahydrate	100	Goat (*Capra hircus*)	1	3	0/50/100	mg/org/d	N	N	DLY	U	GV	9	w	7-8	mo	JV	F	C	DOM	BIO	ENZ	GGTR	PL		50	Y	34.06	N	1.2487		1.47	10	8	10	10	6	1	4	10	10	4	73
16	36231	Kakela et al, 1999	Copper sulfate	100	Mink (*Mustela vision*)	1	2	0/62	mg/kg diet	N	N	NR	U	FD	28	d	6	mo	JV	F	C	NR	BIO	CHM	VTMA	PL		62	Y	1.4	N	0.0906		4.01	10	10	5	10	6	1	4	10	10	4	70
17	36248	Kakela and Hyvarinen, 1999	Copper sulfate	100	Mink (*Mustela vision*)	1	2	0/62	mg/kg diet	N	N	NR	U	FD	28	d	6	mo	JV	F	C	NR	BIO	CHM	FFTA	LD		62	Y	1.4	N	0.0906		4.01	10	10	5	10	6	1	4	10	10	4	70
18	3752	Adam et al, 1977	Copper (II) sulfate pentahydrate	25.45	Goat (*Capra hircus*)	1	4	0/20/40/80	mg/kg bw/d	Y	N	DLY	U	GV	144	d	12	mo	AD	B	C	NR	BIO	CHM	GLYC	LI		20	N	82.5	N	2.58		5.36	10	8	10	10	10	1	4	10	6	4	73
19	2064	DeGoey et al 1971	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	98	d	NR	mo	JV	NR	C	NR	BIO	CHM	HMGL	BL		250	Y	90.5	Y	2.70		7.46	10	10	5	10	7	1	4	10	10	4	71
20	14396	Gipp et al, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	12	w	NR	NR	JV	F	C	COM	BIO	CHM	HMGL	BL		250	Y	93.2	N	2.86		7.66	10	10	5	10	6	1	4	10	10	4	70
21	12809	Myres and Bowland, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	10	w	70	d	JV	B	C	COM	BIO	CHM	FFTA	LD		250	Y	64.7	Y	2.03		7.84	10	10	5	10	7	1	4	10	10	4	71
22	14402	Ritchie et al, 1963	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	w	7	w	JV	NR	C	COM	BIO	CHM	HMGL	WO		250	Y	69.31	N	2.24		8.08	10	10	5	10	6	1	4	10	10	4	70
23	2237	Onifade and Abu 1998	Copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	70	d	7	w	JV	NR	C	LAB	BIO	CHM	TWBC	BL		125	Y	0.5768	N	0.043704		9.47	10	10	5	10	6	1	4	10	10	4	70
24	14397	Gipp, et al, 1974	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	35	d	3	w	JV	B	C	COM	BIO	CHM	HMGL	BL		250	Y	21.9	Y	0.870		9.93	10	10	5	10	7	1	4	10	10	4	71
25	2255	Radecki et al 1992	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	DLY	U	FD	14	d	21	d	JV	B	C	NR	BIO	ENZ	G6PD	GT		250	Y	7.384	N	0.355		12.0	10	10	5	10	6	1	4	10	10	4	70
26	2064	DeGoey et al 1971	Copper sulfate	100	Pig (*Sus scrofa*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	23	d	NR	mo	JV	NR	C	NR	BIO	CHM	HMGL	BL		500	Y	89	N	2.75		15.5	10	10	5	10	6	1	4	10	10	4	70
27	2256	Rana and Kumar 1980	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/100	mg/kg bw	N	N	DLY	U	GV	20	d	90	d	JV	M	C	LAB	BIO	CHM	RBCE	BL		100	Y	0.101	N	0.010435		39.8	10	8	10	10	10	1	4	10	10	4	77
28	2186	Kumar et al, 1987	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/0.1	g/kg bw/d	N	N	DLY	U	GV	45	d	90	d	JV	M	C	LAB	BIO	CHM	PRTL	KI		0.1	Y	0.103	N	0.010605		39.8	10	8	10	10	10	1	4	10	10	4	77
29	36346	Gautam et al, 2001	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/0.1	g/kg bw	N	N	ADL	U	FD	2	w	NR	NR	JV	NR	C	WLD	BIO	CHM	CALC	LI		0.1	Y	0.06	N	0.006801		39.8	10	10	5	10	10	1	4	10	10	4	74
30	10891	DeVries et al, 1986	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/12	mg/org/d	N	N	NR	U	DR	11	mo	3	w	JV	F	C	LAB	BIO	HRM	GHRM	BR		12	Y	0.262	Y	0.0250		45.8	10	5	5	10	7	1	4	10	10	4	66
31	25964	Aburto, et al, 2001	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/500	ug/g diet	N	N	ADL	U	FD	6	mo	10	w	JV	M	C	LAB	BIO	CHM	GCHM	LI		500	Y	0.14	N	0.0136		48.7	10	10	5	10	6	1	4	10	10	4	70
32	23825	Pribyl et al, 1980	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/12.7	mg/org/d	N	N	ADL	U	FD	4	d	NR	NR	JV	M	C	LAB	BIO	ENZ	GENZ	SR		12.7	Y	0.2	N	0.018298		63.5	10	10	5	10	6	1	4	10	10	4	70
33	36247	Rana and Verma, 1997	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/75	mg/kg bw/d	N	N	EOD	U	FD	30	d	NR	NR	JV	M	C	LAB	BIO	CHM	GLTH	LI		75	Y	0.14	N	0.0136		75.0	10	10	10	10	10	1	4	10	10	4	79
34	36389	Tatum et al, 2000	Copper chloride	100	Rat (*Rattus norvegicus*)	1	2	0/800	mg/kg diet	N	N	ADL	U	FD	6	w	NR	NR	JV	F	C	LAB	BIO	ENZ	GENZ	PL		800	Y	0.165	N	0.0156		75.7	10	10	5	10	6	1	4	10	10	4	70
35	13236	Rana et. al, 1985	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/0.1	g/kg bw/d	N	N	DLY	U	GV	30	d	90	d	JV	M	C	LAB	BIO	CHM	GLYC	LI		0.1	Y	0.1	N	0.0104		100	10	8	10	10	10	1	4	10	10	4	77
36	36364	Fuentealba et al, 2000	Copper sulfate	100	Rat (*Rattus norvegicus*)	2	2	0/1500	mg/kg diet	N	N	ADL	U	FD	12	w	21	d	JV	B	C	LAB	BIO	ENZ	AATT	LI		1500	N	0.38	N	0.0310		122	10	10	5	10	5	1	4	10	10	4	69
37	36364	Fuentealba et al, 2000	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	18	w	NR	NR	GE	F	C	LAB	BIO	ENZ	AATT	LI		1500	N	0.25	N	0.0220		132	10	10	5	10	5	1	4	10	10	4	69
38	2097	Fuentealba et al 1993	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	1	w	NR	mo	JV	M	C	NR	BIO	CHM	GBCM	LI		1500	N	0.217	N	0.01957		135	10	10	5	10	5	1	4	10	10	4	69
39	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	8	4	0/129/259/551	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	M	C	COM	BIO	ENZ	AATT	BL		129	N	0.352	N	0.0291		146	10	10	5	10	5	1	4	10	10	4	69
40	2123	Haywood and Comerford 1980	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/2000	mg/kg diet	N	N	DLY	U	FD	1	w	NR	mo	JV	M	C	NR	BIO	ENZ	AATT	BL		2000	N	0.235	N	0.0209		178	10	10	5	10	5	1	4	10	10	4	69
41	36355	Zhang et al, 2000	Copper sulfate pentahydrate	100	Rat (*Rattus norvegicus*)	1	2	0/357	mg/kg bw/d	N	N	5 per w	U	GV	8	w	8	w	JV	B	C	LAB	BIO	ENZ	GENZ	SR		357	N	0.217	N	0.0196		357	10	10	10	10	10	1	4	10	10	4	79
42	36374	Pettersen, et al, 2002	Copper chloride	100	Mouse (*Mus musculus*)	1	3	0/3.5/7	g/kg diet	N	N	ADL	U	FD	3	w	4	w	JV	B	C	LAB	BIO	CHM	NACO	HE		3.5	Y	0.0175	N	0.00247		494	10	10	5	10	6	1	4	10	10	4	70
43	36200	Gooneratne and Howell, 1980	Copper sulfate pentahydrate	25.45	Sheep (*Ovis aries*)	1	2	0/7.14	g/kg bw/d	N	N	5 per w	U	DR	66	d	9-12	mo	JV	M	C	COM	BIO	ENZ	GLPX	LI		7.14	N	65.1	N	4.24		1817	10	5	5	10	10	1	4	10	10	4	69
44	36234	Sansinanea et al, 1996	Copper sulfate pentahydrate	100	Sheep (*Ovis aries*)	1	2	0/7.14	g/kg bw/d	N	N	5 per w	U	OR	14	w	12	mo	JV	F	C	DOM	BIO	CHM	GLUC	SR		7.14	N	80	N	2.52		7140	10	8	10	10	10	1	4	10	10	4	77
Behavior																																																	
45	36240	Miranda et al, 1981	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/55.1	ug/g diet	N	N	ADL	M	FD	5	w	NR	NR	JV	M	C	LAB	BEH	FDB	FCNS	WO	55.1		Y	0.225	Y	0.0147	3.60		10	10	10	10	7	4	4	6	10	4	75
46	2010	Anugwa et al, 1984	Copper (II) sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	3	0/122.2/223.67	mg/kg diet	N	N	ADL	M	FD	8	w	8	w	JV	B	C	NR	BEH	FDB	FCNS	WO	122.2	223.67	Y	1.787	Y	0.05326	3.64	6.67	10	10	10	10	7	4	10	10	4	85
47	2020	Bassuny, 1991	Copper sulfate pentahydrate	25.45	Rabbit (*Oryctolagus cuniculus*)	1	5	0/75/150/300/450	mg/kg diet	N	N	NR	U	FD	7	w	35	d	JV	M	C	NR	BEH	FDB	FCNS	WO	450		Y	2.218	Y	0.0823	4.25		10	10	5	10	7	4	4	10	10	4	74
48	1888	Ward, et al, 1991	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/199	mg/kg diet	N	N	ADL	M	FD	144	d	31	d	JV	B	C	NR	BEH	FDB	FDNG	WO	199		Y	108	Y	2.37	4.37		10	10	10	10	7	4	4	1	10	4	70
49	14387	Allcroft et al, 1961	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	4	0/380/560/934	mg/org/d	N	N	ADL	M	FD	4	w	8-10	w	JV	B	C	DOM	BEH	FDB	FCNS	WO	560	934	N	100	Y	2.36	5.60	9.34	10	10	10	10	6	4	10	10	4	84
50	136	Gershbein et al 1983	Copper (II) sulfate pentahydrate	100	Rat (*Rattus norvegicus*)	1	2	0/75	mg/kg diet	N	N	ADL	U	FD	80	d	44	d	JV	M	C	NR	BEH	BEH	NMVM	WO	75		Y	0.47	N	0.03693	5.89		10	10	5	10	6	4	4	3	10	4	66
51	2304	Thacker, 1991	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	35	d	NR	NR	LC	F	C	NR	BEH	FDB	FCNS	WO	250		Y	213	Y	5.7	6.69		10	10	5	10	7	4	4	10	10	4	74
52	25922	Apgar et al, 1995	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	4	0/115/156/242	mg/kg diet	N	N	ADL	M	FD	5	w	31	d	JV	B	C	COM	BEH	FDB	FCNS	WO	242		Y	20.4	Y	0.582	6.90		10	10	10	10	7	4	4	1	10	4	70
53	25930	Cromwell et al, 1998	Copper chloride - tribasic	100	Pig (*Sus scrofa*)	1	2	0/116/218	mg/kg diet	N	N	ADL	M	FD	28	d	29	d	JV	B	C	COM	BEH	FDB	FCNS	WO	218		Y	17.7	Y	0.598	7.37		10	10	10	10	7	4	4	1	10	4	70
54	25930	Cromwell et al, 1998	Copper chloride - tribasic	100	Pig (*Sus scrofa*)	1	2	0/116/218	mg/kg diet	N	N	ADL	M	FD	28	d	29	d	JV	B	C	COM	BEH	FDB	FCNS	WO	218		Y	17.7	Y	0.598	7.37		10	10	10	10	7	4	4	1	10	4	70
55	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	4	2	0/231	mg/kg diet	N	N	ADL	M	FD	28	d	30	d	JV	B	C	COM	BEH	FDB	FCNS	WO	231		Y	20.8	Y	0.739	8.21		10	10	10	10	7	4	4	1	10	4	70
56	14387	Allcroft et al, 1961	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	2	4	0/345/579/843	mg/org/d	N	N	ADL	M	FD	19	w	8-10	w	JV	B	C	DOM	BEH	FDB	FCNS	WO	843		N	100	Y	2.15	8.43		10	10	10	10	6	4	4	1	10	4	69

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 2 of 7

Ref			Exposure																							Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
57	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	2	3	0/117/226	mg/kg diet	N	N	ADL	M	FD	28	d	29	d	JV	B	C	COM	BEH	FDB	FCNS	WO	226		Y	17.7	Y	0.666	8.50		10	10	10	10	7	4	4	1	10	4	70
58	2061	Cromwell et al 1989	Copper sulfate	100	Pig (*Sus scrofa*)	5	5	0/125/250/375/500	mg/kg diet	N	N	ADL	U	FD	33	d	28	d	JV	B	C	NR	BEH	FDB	FCNS	WO	250	375	Y	18	Y	0.73	8.67	13.0	10	10	5	10	7	4	10	10	10	4	80
59	25930	Cromwell et al, 1998	Copper chloride	100	Pig (*Sus scrofa*)	3	4	0/124/167/241	mg/kg diet	N	N	ADL	M	FD	28	d	30	d	JV	B	C	COM	BEH	FDB	FCNS	WO	241		Y	20.8	Y	0.749	8.68		10	10	10	10	7	4	4	1	10	4	70
60	2061	Cromwell et al 1989	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	3	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	BEH	FDB	FCNS	WO	250	500	Y	12.2	Y	0.486	10.0	19.9	10	10	5	10	7	4	10	10	10	4	80
61	2075	Edmonds and Baker 1986	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/250/650	mg/kg diet	N	N	ADL	U	FD	28	d	4	w	JV	NR	C	NR	BEH	FDB	FCNS	WO	250	650	Y	17.53	Y	0.725	10.3	26.9	10	10	5	10	7	4	10	10	10	4	80
62	25928	Apgar and Kornegay, 1996	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/16.5	mg/kg bw/d	N	N	2 per d	M	FD	14	d	NR	NR	JV	M	C	COM	BEH	FDB	FCNS	WO	16.5		Y	81.4	Y	0.066	16.5		10	10	10	10	10	4	4	1	10	4	73
63	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	1	6	0/300/1000/3000/10000/30000	mg/L	N	N	ADL	U	DR	15	d	6	w	JV	B	C	LAB	BEH	FDB	WCON	WO	1000	3000	Y	0.174	Y	0.01176	17.2	51.6	10	5	5	10	7	4	10	10	10	4	75
64	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	6	6	0/55.9/121.5/199.2/498.1/821.6	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	BEH	FDB	FCNS	WO	498.1	821.6	Y	1.6024	Y	0.0892	27.7	45.7	10	10	10	10	7	4	10	10	10	4	85
65	2043	Bush et al., 1995	Copper sulfate pentahydrate	100	Mink (*Mustela vision*)	1	3	0/308/568	mg/kg diet	N	N	ADL	M	FD	132	d	10	w	JV	B	C	COM	BEH	FDB	FCNS	WO	568		Y	2.403	N	0.141233	33.4		10	10	10	10	6	4	4	1	10	4	69
66	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	2	6	0/300/1000/3000/10000/30000	mg/L	N	N	ADL	U	DR	15	d	6	w	JV	B	C	LAB	BEH	FDB	WCON	WO	1000	3000	Y	0.0211	Y	0.0028	33.8	101	10	5	5	10	7	4	10	10	10	4	75
67	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	4	6	0/500/1000/2000/4000/8000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	B	C	LAB	BEH	FDB	FCNS	WO	4000	8000	Y	0.338	Y	0.0165	49.7	99.4	10	10	5	10	7	4	10	10	10	4	80
68	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	5	6	0/50.9/99.1/176.9/504.5/901.5	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	BEH	FDB	FCNS	WO	901.5		Y	1.6276	Y	0.1066	59.0		10	10	10	10	7	4	4	1	10	4	70
69	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	3	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	7	d	6	w	JV	B	C	LAB	BEH	FDB	FCNS	WO	8000	16000	Y	0.151	Y	0.0133	179	359	10	10	5	10	7	4	10	10	10	4	80
70	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	5	0/41/113/175/140	mg/org/d	N	N	ADL	U	DR	2	w	6	w	JV	M	C	COM	BEH	FDB	WCON	WO	113	175	Y	0.174	N	0.020518	259	400	10	5	5	10	6	4	10	10	10	4	74
71	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	2	5	0/41/95/226/524	mg/org/d	N	N	ADL	U	DR	2	w	6	w	JV	M	C	COM	BEH	FDB	WCON	WO	41	95	Y	0.0277	N	0.003925	589	1365	10	5	5	10	6	4	10	10	10	4	74
72	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	3	6	0/92/180/363/777/1275	mg/org/d	N	N	ADL	U	FD	15	d	6	w	JV	M	C	COM	BEH	FDB	FCNS	WO	777	1275	Y	0.151	N	0.014524	2049	3361	10	10	5	10	6	4	10	10	10	4	79
73	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	4	6	0/168/362/773/1154/2817	mg/org/d	N	N	ADL	U	FD	15	d	6	w	JV	B	C	COM	BEH	FDB	FCNS	WO	773	1154	Y	0.0246	N	0.003268	12509	18675	10	10	5	10	6	4	10	10	10	4	79
74	36759	Ortolani et al, 2003	Copper sulfate pentahydrate	100	Sheep (*Ovis aries*)	1	2	0/3	mg/kg bw/d	N	N	ADL	U	DR	14	d	6	mo	JV	M	C	COM	BEH	FDB	FCNS	WO		3	Y	31.6	Y	0.5000		3.00	10	5	5	10	10	4	4	10	10	4	72
75	2640	Freundt and Ibrahim, 1990	Cuprous chloride	64.18	Rat (*Rattus norvegicus*)	1	2	0/100	mg/L	N	N	ADL	U	DR	91	d	NR	NR	JV	F	C	NR	BEH	FDB	WCON	WO		100	Y	0.278	N	0.031281		5.78	10	5	5	10	6	4	4	10	10	4	68
76	2064	DeGoey et al 1971	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	98	d	NR	NR	JV	NR	C	NR	BEH	FDB	FCNS	WO		250	Y	90.5	Y	2.70		7.46	10	10	5	10	7	4	4	10	10	4	74
77	2237	Onifade and Abu 1998	Copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	70	d	7	w	JV	NR	C	LAB	BEH	FDB	FCNS	WO		125	Y	0.5768	N	0.043704		9.47	10	10	5	10	6	4	4	10	10	4	73
78	14653	Boyden, 1938	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	5	0/5.1/5.05/8.2/9.8/11.8/7.6	mg/org/d	N	N	ADL	U	FD	4	w	28	d	JV	B	C	DOM	BEH	FDB	FCNS	WO		5.1	N	0.217	Y	0.0101		23.5	10	10	5	10	6	4	4	10	10	4	73
79	12079	Komulainen, 1983	Copper chloride	100	Rat (*Rattus norvegicus*)	1	4	0/28/50/64	mg/kg bw/d	N	N	ADL	U	DR	3	w	4	w	JV	M	C	COM	BEH	FDB	WCON	WO		28	Y	0.194	Y	0.00021		28.0	10	5	5	10	10	4	4	10	10	4	72
Physiology																																																
80	25941	Bailey et al, 2001	Copper sulfate	100	Cattle (*Bos taurus*)	1	3	0/28/55.31	mg/kg diet	N	N	ADL	M	FD	112	d	NR	NR	JV	NR	C	DOM	PHY	PHY	FDCV	WO	55.31		Y	363.4	N	8.742	1.33		10	10	10	10	6	4	4	1	10	4	69
81	2012	Arthur, 1965	Copper sulfate pentahydrate	100	Guinea pig (*Cavia porcellus*)	1	3	0/10/20	mg/kg diet	N	N	ADL	U	FD	8	w	NR	NR	JV	B	C	NR	PHY	PHY	GPHY	HA	20		Y	0.662	N	0.048944	1.48		10	10	5	10	6	4	4	10	10	4	73
82	43456	Omole, et al, 1976	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/125/200	mg/kg diet	N	N	ADL	U	FD	127	d	NR	NR	NR	B	C	COM	PHY	PHY	FDCV	WO	125	200	Y	90.2	Y	2.0	2.77	4.43	10	10	5	10	7	4	10	10	6	4	76
83	36748	Solaiman, et al, 2001	Copper sulfate pentahydrate	100	Goat (*Capra hircus*)	1	3	0/50/100	mg/org/d	Y	N	DLY	U	GV	9	w	7-8	mo	JV	F	C	DOM	PHY	PHY	FDCV	WO	100		Y	33.57	N	1.2339	3.14		10	8	10	10	6	4	4	3	10	4	69
84	2010	Anugwa et al, 1984	Copper (II) sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	3	0/122.2/223.67	mg/kg diet	N	N	ADL	M	FD	8	w	8	w	JV	B	C	NR	PHY	PHY	DIFD	WO	122.2	223.67	Y	1.787	Y	0.05326	3.64	6.67	10	10	10	10	7	4	10	10	10	4	85
85	1888	Ward, et al, 1991	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/199	mg/kg diet	N	N	ADL	M	FD	144	d	31	d	JV	B	C	NR	PHY	PHY	FDCV	WO	199		Y	108	Y	2.37	4.37		10	10	10	10	7	4	4	1	10	4	70
86	25922	Apgar et al, 1995	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	4	0/115/156/242	mg/kg diet	N	N	ADL	M	FD	5	w	31	d	JV	B	C	COM	PHY	PHY	FDCV	WO	242		Y	20.4	Y	0.582	6.90		10	10	10	10	7	4	4	1	10	4	70
87	25930	Cromwell et al, 1998	Copper chloride - tribasic	100	Pig (*Sus scrofa*)	1	2	0/116/218	mg/kg diet	N	N	ADL	M	FD	28	d	29	d	JV	B	C	COM	PHY	PHY	FDCV	WO	218		Y	17.7	Y	0.598	7.37		10	10	10	10	7	4	4	1	10	4	70
88	20975	Kline et al, 1971	Copper sulfate	100	Pig (*Sus scrofa*)	1	4	0/151/197/246	mg/kg diet	N	N	ADL	M	FD	88	d	69	d	JV	NR	C	DOM	PHY	PHY	FDCV	WO	246		Y	87.232	N	2.71	7.63		10	10	10	10	6	4	4	1	10	4	69
89	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	4	2	0/231	mg/kg diet	N	N	ADL	M	FD	28	d	30	d	JV	B	C	COM	PHY	PHY	FDCV	WO	231		Y	20.8	Y	0.739	8.21		10	10	10	10	7	4	4	1	10	4	70
90	2034	Braude and Ryder, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	4	0/147/194/240	mg/kg diet	Y	N	DLY	M	FD	112	d	9	w	JV	NR	C	DOM	PHY	PHY	FDCV	WO	240		Y	87.5	N	2.71	8.29		10	10	10	10	6	4	4	1	10	4	69
91	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	2	3	0/117/226	mg/kg diet	N	N	ADL	M	FD	28	d	29	d	JV	B	C	COM	PHY	PHY	FDCV	WO	226		Y	17.7	Y	0.666	8.50		10	10	10	10	7	4	4	1	10	4	70
92	25930	Cromwell et al, 1998	Copper chloride	100	Pig (*Sus scrofa*)	3	4	0/124/167/241	mg/kg diet	N	N	ADL	M	FD	28	d	30	d	JV	B	C	COM	PHY	PHY	FDCV	WO	241		Y	20.8	Y	0.749	8.68		10	10	10	10	7	4	4	1	10	4	70
93	2061	Cromwell et al 1989	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	3	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	PHY	PHY	FDCV	WO	250	500	Y	12.2	Y	0.434	8.89	17.8	10	10	5	10	7	4	10	10	10	4	80
94	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	6	6	0/55.9/121.5/199.2/498.1/821.6	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	PHY	PHY	FDCV	WO	199.2	498.1	Y	1.86	Y	0.1237	9.45	23.6	10	10	10	10	7	4	10	10	10	4	85
95	2075	Edmonds and Baker 1986	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/250/650	mg/kg diet	N	N	ADL	U	FD	28	d	4	w	JV	NR	C	NR	PHY	PHY	FDCV	WO	250	650	Y	17.53	Y	0.725	10.3	26.9	10	10	5	10	7	4	10	10	10	4	80
96	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	5	6	0/50.9/99.1/176.9/504.5/901.5	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	PHY	PHY	FDCV	WO	504.5	901.5	Y	1.86	Y	0.1237	33.6	59.0	10	10	10	10	7	4	10	10	10	4	85
97	11928	Keen et al, 1982	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	4	0/100/1000/2000	ug/g diet	N	N	ADL	U	FD	7	w	NR	NR	JV	F	C	COM	PHY	PHY	GPHY	PL	2000		Y	0.167	N	0.015777	189		10	10	5	10	6	4	4	3	10	4	66
98	2020	Bassuny, 1991	Copper sulfate pentahydrate	25.45	Rabbit (*Oryctolagus cuniculus*)	1	5	0/75/150/300/450	mg/kg diet	N	N	NR	U	FD	7	w	35	d	JV	M	C	NR	PHY	PHY	FDCV	WO		75	Y	2.224	Y	0.0883		0.758	10	10	5	10	7	4	4	10	10	4	74
99	2061	Cromwell et al 1989	Copper sulfate	100	Pig (*Sus scrofa*)	5	5	0/125/250/375/500	mg/kg diet	N	N	ADL	U	FD	33	d	28	d	JV	B	C	NR	PHY	PHY	FDCV	WO		125	Y	18	Y	0.59		4.10	10	10	5	10	7	4	4	10	10	4	74
100	2061	Cromwell et al 1989	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	PHY	PHY	FDCV	WO		125	Y	15.6	Y	0.61		4.89	10	10	5	10	7	4	4	10	10	4	74
101	2064	DeGoey et al 1971	Copper sulfate	100	Pig (*Sus scrofa*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	23	d	NR	mo	JV	NR	C	NR	PHY	PHY	IRRI	SK		500	Y	89	N	2.750143		15.5	10	10	5	10	6	4	4	10	10	4	73
102	2256	Rana and Kumar 1980	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/100	mg/kg bw	N	N	DLY	U	GV	20	d	90	d	JV	M	C	LAB	PHY	PHY	IRRI	FO		100	Y	0.101	N	0.010435		39.8	10	8	10	10	10	4	4	10	10	4	80
Pathology																																																
103	36349	Uthus, 2001	Cupric carbonate	100	Rat (*Rattus norvegicus*)	1	2	0/25	ug/g diet	N	N	ADL	U	FD	62	d	NR	NR	JV	M	C	LAB	PTH	ORW	ORWT	KI	25		Y	0.351	N	0.029054	2.07		10	10	5	10	6	4	4	10	10	4	73
104	36240	Miranda et al, 1981	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/55.1	ug/g diet	N	N	ADL	M	FD	5	w	NR	NR	JV	M	C	LAB	PTH	ORW	SMIX	LI	55.1		Y	0.225	Y	0.0147	3.60		10	10	10	10	7	4	4	10	10	4	79
105	36762	Humann-Ziehank et al, 2001	Copper sulfate	100	Sheep (*Ovis aries*)	1	2	0/3.7	mg/kg bw/d	N	N	2 per d	U	FD	84	d	1	yr	AD	M	C	COM	PTH	ITX	GITX	WO	3.7		Y	2.5	N	0.145903	3.70		10	10	5	10	10	4	4	10	3	4	70
106	1888	Ward, et al, 1991	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/199	mg/kg diet	N	N	ADL	M	FD	144	d	31	d	JV	B	C	NR	PTH	HIS	GHIS	GT	199		Y	108	Y	2.37	4.37		10	10	10	10	7	4	4	1	10	4	70
107	3752	Adam et al, 1977	Copper (II) sulfate pentahydrate	25.45	Goat (*Capra hircus*)	1	4	0/20/40/80	mg/kg bw/d	Y	N	DLY	U	GV	144	d	12	mo	AD	B	C	NR	PTH	HIS	GHIS	LI	20	40	N	82.5	N	2.583937	5.35	10.7	10	8	10	10	10	4	10	10	6	4	82
108	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	2	6	0/300/1000/3000/10000/30000	mg/L	N	N	ADL	U	DR	15	d	6	w	JV	F	C	LAB	PTH	ORW	ORWT	TS	300	1000	Y	0.0265	Y	0.00192	5.53	18.4	10	5	5	10	7	4	8	10	10	4	73
109	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	4	6	0/500/1000/2000/4000/8000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	F	C	LAB	PTH	HIS	GLSN	KI	500	1000	Y	0.36	Y	0.017	6.01	12.0	10	10	5	10	7	4	10	10	10	4	80
110	2304	Thacker, 1991	copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	7	d	NR	NR	GE	F	C	NR	PTH	GRS	BDWT	WO	250		N	232	N	6.044882	6.51		10	10	5	10	5	4	4	10	10	4	72
111	2010	Anugwa et al, 1984	Copper (II) sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	3	0/122.2/223.67	mg/kg diet	N	N	ADL	M	FD	8	w	8	w	JV	B	C	NR	PTH	ORW	SMIX	LI	223.67		Y	1.787	Y	0.05326	6.67		10	10	10	10	7	4	4	1	10	4	70
112	14402	Ritchie et al, 1963	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	w	7	w	JV	NR	C	COM	PTH	ORW	ORWT	LI	250		Y	69.31	N	2.24	8.08		10	10	5	10	6	4	4	6	10	4	69

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 3 of 7

Ref			Exposure																						Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score												
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
113	2237	Onifade and Abu 1998	Copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	70	d	7	w	JV	NR	C	LAB	PTH	ORW	SMIX	BR	125	250	Y	0.5776	N	0.043754	9.47	18.9	10	10	5	10	6	4	10	10	10	4	79
114	36230	Howell et al, 1991	Copper sulfate pentahydrate	100	Sheep (*Ovis aries*)	1	2	0/14.3	mg/kg bw/d	N	N	5 per wk	U	GV	19	w	6-9	mo	JV	M	C	COM	PTH	HIS	CTYP	LI	14.3		N	65.1	N	2.126769	14.3		10	8	10	10	10	4	4	3	10	4	73
115	2253	Prince et al 1979	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	63	d	53	d	JV	NR	C	NR	PTH	ITX	GITX	WO	500		Y	61	N	2.016034	16.5		10	10	5	10	6	4	4	10	10	4	73
116	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	1	6	0/300/1000/3000/10000/30000	mg/L	N	N	ADL	U	DR	15	d	6	w	JV	B	C	LAB	PTH	ITX	GITX	WO	1000	3000	Y	0.174	Y	0.01176	17.2	51.6	10	5	5	10	7	4	10	10	10	4	75
117	2043	Bush et al., 1995	Copper sulfate pentahydrate	100	Mink (*Mustela vision*)	1	3	0/308/568	mg/kg diet	N	N	ADL	M	FD	132	d	10	w	JV	B	C	COM	PTH	HIS	NCRO	LI	568		Y	2.403	N	0.141233	33.4		10	10	10	10	6	4	4	10	10	4	78
118	2186	Kumar et al, 1987	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/0.1	g/kg bw/d	N	N	DLY	U	GV	45	d	90	d	JV	M	C	LAB	PTH	ORW	ORWT	KI	0.1		Y	0.103	N	0.010605	39.8		10	8	10	10	10	4	4	6	10	4	76
119	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	3	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	15	d	6	w	JV	B	C	LAB	PTH	ORW	ORWT	LI	2000	4000	Y	0.183	Y	0.0147	40.9	81.8	10	10	5	10	7	4	10	10	10	4	80
120	10891	DeVries et al, 1986	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/12	mg/org/d	N	N	NR	U	DR	11	mo	3	w	JV	F	C	LAB	PTH	ORW	ORWT	LI	12		Y	0.262	Y	0.025	45.8		10	5	5	10	7	4	4	10	10	4	69
121	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	7	5	0/64/129/259/551	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	M	C	COM	PTH	HIS	HYPL	SH	64	129	Y	0.362	N	0.0298	70.4	142	10	10	5	10	6	4	10	10	10	4	79
122	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	6	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	B	C	LAB	PTH	ORW	ORWT	LI	2000	4000	Y	0.0295	Y	0.0048	82.8	166	10	10	5	10	7	4	10	10	10	4	80
123	11928	Keen et al, 1982	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	4	0/100/1000/2000	ug/g diet	N	N	ADL	U	FD	7	w	NR	NR	JV	F	C	COM	PTH	HIS	GHIS	MT	1000	2000	Y	0.198	N	0.018147	91.7	183	10	10	5	10	6	4	10	10	10	4	79
124	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	5	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	15	d	6	w	JV	M	C	LAB	PTH	ORW	ORWT	LI	2000	4000	Y	0.0246	Y	0.0047	97.2	194	10	10	5	10	7	4	10	10	10	4	80
125	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	3	6	0/92/180/363/777/1275	mg/org/d	N	N	ADL	U	FD	15	d	6	w	JV	B	C	COM	PTH	HIS	HYPL	SH	92	180	Y	0.186	N	0.017238	197	385	10	10	5	10	6	4	10	10	10	4	79
126	2069	Dodds-Smith et al., 1992	Copper chloride	100	Common shrew (*Sorex araneus*)	1	2	0/2.13	mg/org/d	N	N	DLY	U	FD	12	w	NR	NR	JV	B	C	NR	PTH	ORW	ORWT	KI	2.13		Y	0.0085	N	0.001364	251		10	10	5	10	6	4	4	6	10	4	69
127	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	5	0/41/113/175/140	mg/org/d	N	N	ADL	U	DR	2	w	6	w	JV	B	C	COM	PTH	ITX	GITX	WO	113	175	Y	0.174	N	0.020518	259	400	10	5	5	10	6	4	10	10	10	4	74
128	2121	Haywood 1985	Copper	100	Rat (*Rattus norvegicus*)	1	5	0/3000/4000/5000/6000	mg/kg diet	N	N	ADL	U	FD	1	w	NR	NR	JV	M	C	NR	PTH	HIS	NCRO	LI	3000	4000	Y	0.202	N	0.018448	274	365	10	10	5	4	6	4	10	10	10	4	73
129	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	2	5	0/41/95/226/524	mg/org/d	N	N	ADL	U	DR	2	w	6	w	JV	B	C	COM	PTH	ITX	GITX	WO	95	226	Y	0.0265	N	0.003772	1427	3395	10	5	5	10	6	4	10	10	10	4	74
130	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	10	5	0/382/736/1563/3201	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	B	C	COM	PTH	ITX	GITX	WO	3201		Y	0.0264	N	0.003464	48270		10	10	5	10	6	4	4	10	10	4	73
131	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	5	6	0/50.9/99.1/176.9/504.5/901.5	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	PTH	ORW	ORWT	DT		50.9	Y	1.8572	Y	0.1241		3.40	10	10	10	10	7	4	4	10	10	4	79
132	2148	Howell et al, 1974	Copper sulfate pentahydrate	25.45	Sheep (*Ovis aries*)	1	3	0/20/30	mg/kg bw/d	N	N	DLY	U	GV	37	w	6-12	mo	JV	B	C	DOM	PTH	HIS	GHIS	BR		20	N	65.1	N	2.1267		5.09	10	8	10	10	10	4	4	10	10	4	80
133	36202	Gopinath et al, 1974	Copper sulfate pentahydrate	25.45	Sheep (*Ovis aries*)	1	2	0/20	mg/kg bw/d	N	N	DLY	U	DR	10	w	6	mo	JV	F	C	COM	PTH	HIS	GHIS	KI		20	N	59.1	N	3.891024		5.09	10	5	5	10	10	4	4	10	10	4	72
134	2179	King, 1975	copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	2	0/100	mg/kg diet	N	N	ADL	U	FD	6	w	5	w	JV	B	C	COM	PTH	ORW	SMIX	IN		100	N	3.76	N	0.204062		5.43	10	10	5	10	5	4	4	10	10	4	72
135	2155	Ishmael et al 1971	Copper sulfate pentahydrate	25.45	Sheep (*Ovis aries*)	1	2	0/0.714	g/org/d	N	N	5 per w	U	OR	88	d	6	mo	JV	F	C	NR	PTH	ORW	SMIX	LI		0.714	N	24	N	0.936463		7.57	10	8	5	10	5	4	4	10	10	4	70
136	2179	King, 1975	copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	2	2	0/200	mg/kg diet	N	N	ADL	U	FD	6	w	5	w	JV	B	C	COM	PTH	ORW	SMIX	IN		200	N	3.76	N	0.204062		10.9	10	10	5	10	5	4	4	10	10	4	72
137	2255	Radecki et al 1992	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	DLY	U	FD	14	d	21	d	JV	B	C	NR	PTH	HIS	GHIS	GT		250	Y	7.384	N	0.35538		12.0	10	10	5	10	6	4	4	10	10	4	73
138	2064	DeGoey et al 1971	Copper sulfate	100	Pig (*Sus scrofa*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	23	d	NR	mo	JV	NR	C	NR	PTH	HIS	NCRO	LI		500	Y	89	N	2.750143		15.5	10	10	5	10	6	4	4	10	10	4	73
139	14653	Boyden, 1938	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	5	0/5.1/5.05/8.2/9.8/11.8/7.6	mg/org/d	N	N	ADL	U	FD	4	w	28	d	JV	B	C	DOM	PTH	ORW	ORWT	SP		5.1	N	0.217	Y	0.0101		23.5	10	10	5	10	6	4	4	10	10	4	73
140	2256	Rana and Kumar 1980	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/100	mg/kg bw	N	N	DLY	U	GV	20	d	90	d	JV	M	C	LAB	PTH	HIS	NCRO	LI		100	Y	0.101	N	0.010435		39.8	10	8	10	10	10	4	4	10	10	4	80
141	2257	Rana and Kumar 1985	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/0.1	g/kg bw/d	N	N	DLY	U	GV	20	d	90	d	AD	M	C	LAB	PTH	HIS	GHIS	LI		0.1	Y	0.1	N	0.01035		39.8	10	8	10	10	10	4	4	10	10	4	80
142	25964	Aburto, et al, 2001	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/500	ug/g diet	N	N	ADL	U	FD	12	mo	10	w	JV	M	C	LAB	PTH	HIS	GHIS	LI		500	Y	0.14	N	0.0136		48.7	10	10	5	10	6	4	4	10	10	4	73
143	2047	Chesta et al., 1989	Copper (II) sulfate	39.81	Guinea pig (*Cavia porcellus*)	1	2	0/0.185	% in diet	N	N	NR	U	DR	45	d	NR	NR	GE	F	C	LAB	PTH	HIS	GHIS	LI		0.185	N	0.9	N	0.090044		73.7	10	5	5	10	5	4	4	10	10	4	67
144	13236	Rana et. al, 1985	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/0.1	g/kg bw/d	N	N	DLY	U	GV	30	d	90	d	JV	M	C	LAB	PTH	ORW	SMIX	LI		0.1	Y	0.1	N	0.01035		100	10	8	10	10	10	4	4	6	10	4	80
145	36364	Fuentealba et al, 2000	Copper sulfate	100	Rat (*Rattus norvegicus*)	2	2	0/1500	mg/kg diet	N	N	ADL	U	FD	12	w	21	d	JV	B	C	LAB	PTH	HIS	NCRO	LI		1500	N	0.38	N	0.031013		122	10	10	5	10	5	4	4	10	10	4	72
146	36364	Fuentealba et al, 2000	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	18	w	NR	NR	GE	F	C	LAB	PTH	HIS	NCRO	LI		1500	N	0.25	N	0.021982		132	10	10	5	10	5	4	4	10	10	4	72
147	2095	Fuentealba et al 1989	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	4	w	6	w	JV	M	C	NR	PTH	HIS	USTR	LI		1500	N	0.217	N	0.019567		135	10	10	5	4	5	4	4	10	10	4	66
148	2096	Fuentealba et al 1989	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	16	w	NR	mo	JV	M	C	NR	PTH	HIS	HYPL	BI		1500	N	0.217	N	0.019567		135	10	10	5	4	5	4	4	10	10	4	66
149	2097	Fuentealba et al 1993	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	10	w	NR	mo	JV	M	C	NR	PTH	HIS	HYPL	BI		1500	N	0.217	N	0.01957		135	10	10	5	10	5	4	4	10	10	4	72
150	2098	Fuentealba et al 1989	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	3	w	6	w	JV	M	C	NR	PTH	HIS	GHIS	KI		1500	N	0.217	N	0.023489		135	10	10	5	4	5	4	4	10	10	4	66
151	2094	Fuentealba and Haywood 1988	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/1500	mg/kg diet	N	N	ADL	U	FD	1	w	6	w	JV	M	C	NR	PTH	HIS	GHIS	LI		1500	N	0.217	N	0.023489		135	10	10	5	4	5	4	4	10	10	4	66
152	2122	Haywood 1980	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/2000	mg/kg diet	N	N	ADL	U	FD	15	w	NR	mo	JV	M	C	NR	PTH	HIS	HYPL	BI		2000	N	0.4702	N	0.036946		157	10	10	5	10	5	4	4	10	10	4	72
153	2125	Haywood et al 1985	copper	100	Rat (*Rattus norvegicus*)	1	2	0/3	g/kg diet	N	N	ADL	U	FD	5	w	NR	mo	AD	M	C	NR	PTH	HIS	NCRO	KI		3	N	0.5	N	0.038861		233	10	10	5	4	5	4	4	10	10	4	66
154	2124	Haywood and Loughran 1985	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	5	0/3000/4000/5000/6000	mg/kg diet	N	N	DLY	U	FD	6	w	NR	mo	JV	M	C	NR	PTH	HIS	NCRO	LI		3000	Y	0.162	N	0.015388		285	10	10	5	10	6	4	4	10	10	4	73
155	36200	Gooneratne and Howell, 1980	Copper sulfate pentahydrate	25.45	Sheep (*Ovis aries*)	1	2	0/7.14	g/kg bw/d	N	N	5 per w	U	DR	63	d	6-9	mo	JV	M	C	COM	PTH	HIS	GHIS	MU		7.14	N	65.1	N	4.244808		1817	10	5	5	10	10	4	4	10	10	4	72
Reproduction																																																
156	2013	Aulerich et al 1982	Copper sulfate pentahydrate	100	Mink (*Mustela vision*)	1	5	0/25/50/100/200	mg/kg diet	N	N	ADL	U	FD	357	d	NR	mo	JV	F	C	NR	REP	REP	PROG	WO	50	100	Y	1.068	N	0.072517	3.40	6.79	10	10	5	10	6	10	10	10	10	4	85
157	2304	Thacker, 1991	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	7	d	NR	NR	GE	F	C	NR	REP	REP	PROG	WO	250		Y	232	N	6.044882	6.51		10	10	5	10	6	10	4	10	10	4	79
158	823	Webster, 1979	Copper chloride	100	Mouse (*Mus musculus*)	1	4	0/30/100/400	mg/kg diet	N	N	ADL	U	FD	19	d	4	mo	GE	F	C	LAB	REP	REP	PRWT	WO	400		Y	0.032	N	0.004057	50.7		10	10	5	10	6	10	4	10	10	4	79
159	2193	Lecyk, 1980	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	2	7	0/0/5/1.0/1.5/2.0/3.0/4.0	g/kg diet	N	N	ADL	U	FD	49	d	NR	NR	GE	B	C	LAB	REP	REP	PROG	WO	2	3	Y	0.0575	N	0.006568	90.9	136	10	10	5	10	5	10	10	10	10	4	84
160	2193	Lecyk, 1980	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	1	7	0/0.5/1.0/1.5/2.0/3.0/4.0	g/kg diet	N	N	ADL	U	FD	49	d	NR	NR	GE	B	C	LAB	REP	REP	PROG	WO	2	3	N	0.0575	N	0.006568	90.9	136	10	10	5	10	5	10	10	10	10	4	84
161	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	4	6	0/500/1000/2000/4000/8000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	M	C	LAB	REP	REP	SPCL	SM	8000		Y	0.275	Y	0.0144	107		10	10	5	10	7	10	4	10	10	4	80
162	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	9	4	0/32/129/259	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	M	C	COM	REP	REP	SPCL	SM	259		Y	0.339	N	0.028235	304		10	10	5	10	6	10	4	1	10	4	70
163	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	6	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	M	C	LAB	REP	REP	SPCL	SM	8000		Y	0.029	Y	0.0051	358		10	10	5	10	7	10	4	6	10	4	76
164	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	11	4	0/173/736/3201	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	M	C	COM	REP	REP	SPCL	SM	3201		Y	0.0264	N	0.003464	48270		10	10	5	10	6	10	4	1	10	4	70
165	2062	Cromwell et al 1993	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	783	d	10	mo	GE	F	C	NR	REP	REP	RSUC	WO		250	Y	152	Y	3.35		5.51	10	10	5	10	7	10	4	10	10	4	80
166	1717	Bataineh et al., 1998	Copper chloride dihydrate	37.28	Rat (*Rattus norvegicus*)	1	2	0/1000	mg/L	N	N	ADL	U	DR	12	w	NR	NR	AD	M	V	LAB	REP	REP	TEWT	TE		1000	Y	0.33067	N	0.036567		41.2	10	5	5	10	6	10	4	10	3	4	67

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 4 of 7

Ref			Exposure																										Effects						Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
Growth																																																			
167	25940	Engle and Spears, 2001	Copper sulfate	100	Cattle (*Bos taurus*)	1	2	0/40	mg/kg diet	N	N	ADL	U	FD	239	d	NR	NR	JV	M	C	COM	GRO	GRO	BDWT	WO	40		Y	430	Y	8.730	0.812		10	10	5	10	7	8	4	1	10	4	69
168	25935	Engle et al, 2000	Copper chloride - tribasic	100	Cattle (*Bos taurus*)	1	2	0/40	mg/kg diet	N	N	ADL	U	FD	154	d	NR	NR	JV	M	C	COM	GRO	GRO	BDWT	WO	40		Y	400.1	Y	8.520	0.852		10	10	5	10	7	8	4	1	10	4	69
169	25941	Bailey et al, 2001	Copper sulfate	100	Cattle (*Bos taurus*)	1	3	0/28/55.31	mg/kg diet	N	N	ADL	M	FD	112	d	NR	NR	JV	NR	C	DOM	GRO	GRO	BDWT	WO	55.31		Y	361.2	N	8.698	1.33		10	10	10	10	6	8	4	1	10	4	73
170	2012	Arthur, 1965	Copper sulfate pentahydrate	100	Guinea pig (*Cavia porcellus*)	1	3	0/10/20	mg/kg diet	N	N	ADL	U	FD	8	w	NR	NR	JV	B	C	NR	GRO	GRO	BDWT	WO	20		Y	0.662	N	0.048944	1.48		10	10	5	10	6	8	4	3	10	4	70
171	36349	Uthus, 2001	Cupric carbonate	100	Rat (*Rattus norvegicus*)	1	2	0/25	ug/g diet	N	N	ADL	U	FD	62	d	NR	NR	JV	M	C	LAB	GRO	GRO	BDWT	WO	25		Y	0.351	N	0.029054	2.07		10	10	5	10	6	8	4	10	10	4	77
172	36240	Miranda et al, 1981	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/55.1	ug/g diet	N	N	ADL	M	FD	5	w	NR	NR	JV	M	C	LAB	GRO	GRO	BDWT	WO	55.1		Y	0.225	Y	0.0147	3.60		10	10	10	10	7	8	4	8	10	4	81
173	2020	Bassuny, 1991	Copper sulfate pentahydrate	25.45	Rabbit (*Oryctolagus cuniculus*)	1	5	0/75/150/300/450	mg/kg diet	N	N	NR	U	FD	7	w	35	d	JV	M	C	NR	GRO	GRO	BDWT	WO	450		Y	2.218	Y	0.0823	4.25		10	10	5	10	7	8	4	10	10	4	78
174	1888	Ward, et al, 1991	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/199	mg/kg diet	N	N	ADL	M	FD	144	d	31	d	JV	B	C	NR	GRO	GRO	BDWT	WO	199		Y	108	Y	2.37	4.37		10	10	10	10	7	8	4	1	10	4	74
175	2179	King, 1975	copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	2	0/100	mg/kg diet	N	N	ADL	U	FD	8	w	5	w	JV	B	C	COM	GRO	GRO	BDWT	WO	100		N	3.76	N	0.204062	5.43		10	10	5	10	5	8	4	10	10	4	76
176	2062	Cromwell et al 1993	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	783	d	10.3	mo	GE	F	C	NR	GRO	GRO	BDWT	WO	250		Y	152	Y	3.35	5.51		10	10	5	10	7	8	4	1	10	4	69
177	14387	Allcroft et al, 1961	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	4	0/380/560/934	mg/org/d	N	N	ADL	M	FD	4	w	8-10	w	JV	B	C	DOM	GRO	GRO	BDWT	WO	560	934	N	100	Y	2.36	5.6	9.34	10	10	10	10	6	8	10	10	10	4	88
178	136	Gershbein et al 1983	Copper (II) sulfate pentahydrate	100	Rat (*Rattus norvegicus*)	1	2	0/75	mg/kg diet	N	N	ADL	U	FD	80	d	44	d	JV	M	C	NR	GRO	GRO	BDWT	WO	75		Y	0.47	N	0.036934	5.89		10	10	5	10	6	8	4	1	10	4	68
179	2010	Anugwa et al, 1984	Copper (II) sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	3	0/122.2/223.67	mg/kg diet	N	N	ADL	M	FD	8	w	8	w	JV	B	C	NR	GRO	GRO	BDWT	WO	223.67		Y	1.787	Y	0.05326	6.67		10	10	10	10	7	8	4	1	10	4	74
180	25922	Apgar et al, 1995	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	4	0/115/156/242	mg/kg diet	N	N	ADL	M	FD	5	w	31	d	JV	B	C	COM	GRO	GRO	BDWT	WO	242		Y	20.4	Y	0.582	6.90		10	10	10	10	7	8	4	1	10	4	74
181	25930	Cromwell et al, 1998	Copper chloride	100	Pig (*Sus scrofa*)	5	4	0/100/150/200	mg/kg diet	N	N	ADL	U	FD	28	d	26-32	d	JV	B	C	COM	GRO	GRO	BDWT	WO	200		Y	25.5	Y	0.917	7.19		10	10	5	10	7	8	4	1	10	4	69
182	12977	Omole, 1977	Copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	4	0/100/150/200	mg/kg diet	N	N	ADL	U	FD	8	w	6	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	200		Y	1.724	Y	0.0633	7.34		10	10	5	10	7	8	4	1	10	4	69
183	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	6	2	0/200	mg/kg diet	N	N	ADL	U	FD	28	d	26-32	d	JV	B	C	COM	GRO	GRO	BDWT	WO	200		Y	25.5	Y	0.939	7.36		10	10	5	10	7	8	4	1	10	4	69
184	25930	Cromwell et al, 1998	Copper chloride - tribasic	100	Pig (*Sus scrofa*)	1	2	0/116/218	mg/kg diet	N	N	ADL	M	FD	28	d	29	d	JV	B	C	COM	GRO	GRO	BDWT	WO	218		Y	17.7	Y	0.598	7.37		10	10	10	10	7	8	4	1	10	4	74
185	20975	Kline et al, 1971	Copper sulfate	100	Pig (*Sus scrofa*)	1	4	0/151/197/246	mg/kg diet	N	N	ADL	M	FD	88	d	69	d	JV	NR	C	DOM	GRO	GRO	BDWT	WO	246		Y	87.232	N	2.705156	7.63		10	10	10	10	6	8	4	1	10	4	73
186	14396	Gipp et al, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	12	w	NR	NR	JV	F	C	COM	GRO	GRO	BDWT	WO	250		Y	93.2	N	2.856384	7.66		10	10	5	10	6	8	4	1	10	4	68
187	2061	Cromwell et al 1989	Copper oxide	100	Pig (*Sus scrofa*)	2	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	GRO	GRO	BDWT	WO	250		Y	17.8	Y	0.547	7.68		10	10	5	10	7	8	4	1	10	4	69
188	25929	Luo and Dove, 1996	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	d	26	d	JV	M	C	COM	GRO	GRO	BDWT	WO	250		Y	10.1	Y	0.312	7.72		10	10	5	10	7	8	4	1	10	4	69
189	12809	Myres and Bowland, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	10	w	70	d	JV	B	C	COM	GRO	GRO	BDWT	WO	250		Y	64.7	Y	2.03	7.84		10	10	5	10	7	8	4	1	10	4	69
190	14402	Ritchie et al, 1963	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	w	7	w	JV	NR	C	COM	GRO	GRO	BDWT	WO	250		Y	69.31	N	2.24	8.08		10	10	5	10	6	8	4	1	10	4	68
191	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	4	2	0/231	mg/kg diet	N	N	ADL	M	FD	28	d	30	d	JV	B	C	COM	GRO	GRO	BDWT	WO	231		Y	20.8	Y	0.739	8.21		10	10	10	10	7	8	4	1	10	4	74
192	2034	Braude and Ryder, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	4	0/147/194/240	mg/kg diet	Y	Y	DLY	M	FD	112	d	9	w	JV	NR	C	DOM	GRO	GRO	BDWT	WO	240		Y	87.5	N	2.711985	8.29		10	10	10	10	6	8	4	1	10	4	73
193	14387	Allcroft et al, 1961	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	2	4	0/345/579/843	mg/org/d	N	N	ADL	M	FD	19	w	8-10	w	JV	B	C	DOM	GRO	GRO	BDWT	WO	843		N	100	Y	2.15	8.43		10	10	10	10	6	8	4	1	10	4	73
194	2253	Prince et al 1979	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	59	d	64	d	JV	NR	C	NR	GRO	GRO	BDWT	WO	250		Y	54	N	1.82383	8.44		10	10	5	10	6	8	4	1	10	4	68
195	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	2	3	0/117/226	mg/kg diet	N	N	ADL	M	FD	28	d	29	d	JV	B	C	COM	GRO	GRO	BDWT	WO	226		Y	17.7	Y	0.666	8.50		10	10	10	10	7	8	4	1	10	4	74
196	25930	Cromwell et al, 1998	Copper chloride	100	Pig (*Sus scrofa*)	3	4	0/124/167/241	mg/kg diet	N	N	ADL	M	FD	28	d	30	d	JV	B	C	COM	GRO	GRO	BDWT	WO	241		Y	20.8	Y	0.749	8.68		10	10	10	10	7	8	4	1	10	4	74
197	2061	Cromwell et al 1989	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	GRO	GRO	BDWT	WO	250		Y	15.6	Y	0.599	9.60		10	10	5	10	7	8	4	1	10	4	69
198	14397	Gipp, et al, 1974	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	35	d	3	w	JV	B	C	COM	GRO	GRO	BDWT	WO	250		Y	21.9	Y	0.87	9.93		10	10	5	10	7	8	4	1	10	4	69
199	2033	Brandt, 1983	Copper (II) sulfate	100	Mink (*Mustela vision*)	1	3	0/166/320	mg/kg diet	N	N	ADL	M	FD	4	mo	90	d	JV	M	C	NR	GRO	GRO	BDWT	WO	166	320	Y	1.92	N	0.117444	10.2	19.6	10	10	10	10	6	8	10	10	10	4	88
200	2075	Edmonds and Baker 1986	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/250/650	mg/kg diet	N	N	ADL	U	FD	28	d	4	w	JV	NR	C	NR	GRO	GRO	BDWT	WO	250	650	Y	17.53	Y	0.725	10.3	26.9	10	10	5	10	7	8	10	10	10	4	84
201	2255	Radecki et al 1992	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	DLY	U	FD	14	d	21	d	JV	B	C	NR	GRO	GRO	BDWT	WO	250		Y	7.384	N	0.35538	12.0		10	10	5	10	6	8	4	1	10	4	68
202	2013	Aulerich et al 1982	Copper sulfate pentahydrate	100	Mink (*Mustela vision*)	1	5	0/25/50/100/200	mg/kg diet	N	N	ADL	U	FD	20	w	NR	mo	JV	B	C	NR	GRO	GRO	BDWT	WO	200		Y	1.753	N	0.10898	12.4		10	10	5	10	6	8	4	1	10	4	68
203	3760	Felsman et al., 1973	Copper sulfate	100	Cattle (*Bos taurus*)	1	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	98	d	6	w	JV	M	C	NR	GRO	GRO	BDWT	WO	500		Y	269	N	6.826736	12.7		10	10	5	10	6	8	4	1	10	4	68
204	3756	Smith et al, 1975	Cupric carbonate	100	Horse - Shetland pony (*Equus caballus*)	1	4	0/691.7/1209.1/2088.2	mg/org/d	N	N	ADL	M	FD	84	d	NR	NR	JV	NR	C	DOM	GRO	GRO	BDWT	WO	2088.2		Y	151.8	Y	2.64	13.8		10	10	10	10	7	8	4	1	10	4	74
205	3757	Suttle and Mills, 1966	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/250/425	mg/kg diet	N	N	NR	U	FD	14	d	NR	NR	JV	F	C	DOM	GRO	GRO	BDWT	WO	250	425	Y	22	Y	1.43	16.2	27.6	10	10	5	10	7	8	10	10	10	4	84
206	2061	Cromwell et al 1989	Copper sulfate	100	Pig (*Sus scrofa*)	5	5	0/125/250/375/500	mg/kg diet	N	N	ADL	U	FD	33	d	28	d	JV	B	C	NR	GRO	GRO	BDWT	WO	500		Y	18	Y	0.59	16.4		10	10	5	10	7	8	4	1	10	4	69
207	25928	Apgar and Kornegay, 1996	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/16.5	mg/kg bw/d	N	N	2 per d	M	FD	14	d	NR	NR	JV	M	C	COM	GRO	GRO	BDWT	WO	16.5		Y	81.4	Y	0.066	16.5		10	10	10	10	10	8	4	1	10	4	77
208	2061	Cromwell et al 1989	Copper oxide	100	Pig (*Sus scrofa*)	4	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	GRO	GRO	BDWT	WO	500		Y	13.2	Y	0.441	16.7		10	10	5	10	7	8	4	1	10	4	69
209	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	1	6	0/300/1000/3000/10000/30000	mg/L	N	N	ADL	U	DR	15	d	6	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	1000	3000	Y	0.174	Y	0.01176	17.2	51.6	10	5	5	10	7	8	10	10	10	4	79
210	2189	Lalich,, et. al., 1965	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/0.5	g/kg diet	N	N	ADL	U	FD	42	d	NR	NR	JV	M	C	NR	GRO	GRO	BDWT	WO	0.5		Y	0.2509	N	0.022047	17.5		10	10	5	10	6	8	4	1	10	4	68
211	2061	Cromwell et al 1989	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	3	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	GRO	GRO	BDWT	WO	500		Y	12.2	Y	0.434	17.8		10	10	5	10	7	8	4	1	10	4	69
212	3760	Felsman et al., 1973	Copper sulfate	100	Cattle (*Bos taurus*)	2	4	0/300/600/900	mg/kg diet	N	N	ADL	U	FD	98	d	6	w	JV	M	C	NR	GRO	GRO	BDWT	WO	900		Y	263	N	6.70132	22.9		10	10	5	10	6	8	4	1	10	4	68
213	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	6	6	0/55.9/121.5/199.2/498.1/821.6	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	GRO	GRO	BDWT	WO	498.1	821.6	Y	1.6024	Y	0.0892	27.7	45.7	10	10	10	10	7	8	10	10	10	4	89
214	2237	Onifade and Abu 1998	Copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	4	0/125/250/375	mg/kg diet	N	N	ADL	U	FD	70	d	7	w	JV	NR	C	LAB	GRO	GRO	BDWT	WO	375		Y	0.5761	N	0.04366	28.4		10	10	5	10	6	8	4	10	10	4	77
215	2043	Bush et al., 1995	Copper sulfate pentahydrate	100	Mink (*Mustela vision*)	1	3	0/308/568	mg/kg diet	N	N	ADL	M	FD	132	d	10	w	JV	B	C	COM	GRO	GRO	BDWT	WO	568		Y	2.403	N	0.141233	33.4		10	10	10	10	6	8	4	10	10	4	82
216	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	2	6	0/300/1000/3000/10000/30000	mg/L	N	N	ADL	U	DR	8	d	6	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	1000	3000	N	0.0211	Y	0.0028	33.8	101	10	5	5	10	6	8	10	10	10	4	78
217	2179	King, 1975	copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	2	2	0/200	mg/kg diet	N	N	ADL	U	FD	6	w	5	w	JV	B	C	COM	GRO	GRO	BDWT	WO	200		N	3.76	N	0.204062	37.1		10	10	5	10	5	8	4	1	10	4	67
218	2324	White et al, 1985	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	50	d	21	d	JV	M	C	NR	GRO	GRO	BDWT	WO	500		Y	0.280	N	0.024128	43.1		10	10	6	10	5	8	4	1	10	4	68
219	10891	DeVries et al, 1986	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/12	mg/org/d	N	N	NR	U	DR	11	mo	3	w	JV	F	C	LAB	GRO	GRO	BDWT	WO	12		Y	0.262	Y	0.025	45.8		10	5	5	10	7	8	4	10	10	4	73
220	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	4	6	0/500/1000/2000/4000/8000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	4000	8000	Y	0.338	Y	0.0165	49.8	99.6	10	10	5	10	7	8	10	10	10	4	84
221	12079	Komulainen, 1983	Copper chloride	100	Rat (*Rattus norvegicus*)	1	4	0/28/50/64	mg/kg bw/d	N	N	ADL	U	DR	1	w	4	w	JV	M	C	COM	GRO	GRO	BDWT	WO	50	64	Y	0.112	Y	0.00019	50.0	64.0	10	5	5	10	10	8	10	10	10	4	82
222	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	5	6	0/50.9/99.1/176.9/504.5/901.5	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	GRO	GRO	BDWT	WO	901.5		Y	1.6276	Y	0.1066	59.0		10	10	10	10	7	8	4	1	10	4	74
223	2225	Myers et al, 1993	Copper (I) acetate	51.84	Rat (*Rattus norvegicus*)	1	2	0/0.125	% in diet	N	N	DLY	U	DR	6	w	NR	mo	JV	M	C	LAB	GRO	GRO	BDWT	WO	0.125		Y	0.261	N	0.029554	73.4		10	5	5	5	6	8	4	10	10	4	67

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 5 of 7

Ref			Exposure																								Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score												
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
224	36389	Tatum et al, 2000	Copper chloride	100	Rat (*Rattus norvegicus*)	1	2	0/800	mg/kg diet	N	N	ADL	U	FD	6	w	NR	NR	JV	F	C	LAB	GRO	GRO	BDWT	WO	800		Y	0.165	N	0.015622	75.7		10	10	5	10	6	8	4	1	10	4	68
225	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	3	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	15	d	6	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	4000	8000	Y	0.178	Y	0.0144	82.5	165	10	10	5	10	7	8	10	10	10	4	84
226	11928	Keen et al, 1982	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	4	0/100/1000/2000	ug/g diet	N	N	ADL	U	FD	7	w	NR	NR	JV	F	C	COM	GRO	GRO	BDWT	WO	1000	2000	Y	0.198	N	0.018147	91.7	183	10	10	5	10	6	8	10	10	10	4	83
227	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	5	6	0/32/64/129/259/551	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	M	C	COM	GRO	GRO	BDWT	WO	129	259	Y	0.352	N	0.029122	146	293	10	10	5	10	6	8	10	10	10	4	83
228	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	6	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	4000	8000	Y	0.029	Y	0.0051	179	358	10	10	5	10	7	8	10	10	10	4	84
229	440	Dodds-Smith et al., 1992	Copper chloride	100	Common shrew (*Sorex araneus*)	1	2	0/2.11	mg/org/d	N	N	DLY	U	FD	12	w	NR	NR	JV	B	C	NR	GRO	GRO	BDWT	WO	2.11		Y	0.0092	N	0.001456	229		10	10	5	10	6	8	4	10	10	4	77
230	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	5	0/41/113/175/140	mg/org/d	N	N	ADL	U	DR	2	w	6	w	JV	M	C	COM	GRO	GRO	BDWT	WO	113	175	Y	0.174	N	0.020518	259	400	10	5	5	10	6	8	10	10	10	4	78
231	36374	Pettersen, et al, 2002	Copper chloride	100	Mouse (*Mus musculus*)	1	3	0/3.5/7	g/kg diet	N	N	ADL	U	FD	3	w	4	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	3.5	7	Y	0.0175	N	0.00247	494	988	10	10	5	10	6	8	10	10	10	4	83
232	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	5	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	15	d	6	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	16000		Y	0.0236	Y	0.004	690		10	10	5	10	7	8	4	1	10	4	69
233	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	3	6	0/92/180/363/777/1275	mg/org/d	N	N	ADL	U	FD	15	d	6	w	JV	M	C	COM	GRO	GRO	BDWT	WO	363	777	Y	0.178	N	0.016627	812	1738	10	10	5	10	6	8	10	10	10	4	83
234	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	2	5	0/41/95/226/524	mg/org/d	N	N	ADL	U	DR	2	w	6	w	JV	M	C	COM	GRO	GRO	BDWT	WO	95	226	Y	0.0265	N	0.003772	1427	3395	10	5	5	10	6	8	10	10	10	4	78
235	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	6	6	0/173/382/736/1563/3201	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	M	C	COM	GRO	GRO	BDWT	WO	173	382	Y	0.0326	N	0.004119	2113	4665	10	10	5	10	6	8	10	10	10	4	83
236	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	4	6	0/168/362/773/1154/2817	mg/org/d	N	N	ADL	U	FD	15	d	6	w	JV	F	C	COM	GRO	GRO	BDWT	WO	1154	2817	Y	0.0236	N	0.003159	19466	47519	10	10	5	10	6	8	10	10	10	4	83
237	36748	Solaiman, et al, 2001	Copper sulfate pentahydrate	100	Goat (*Capra hircus*)	1	3	0/50/100	mg/org/d	N	N	DLY	U	GV	9	w	7-8	mo	JV	F	C	DOM	GRO	GRO	BDWT	WO		50	Y	34.06	N	1.2487		1.47	10	8	10	10	6	8	4	10	10	4	80
238	36759	Ortolani et al, 2003	Copper sulfate pentahydrate	100	Sheep (*Ovis aries*)	1	2	0/3	mg/kg bw/d	N	N	ADL	U	DR	35	d	6	mo	JV	M	C	COM	GRO	GRO	BDWT	WO		3	Y	33.1	Y	0.5		3.00	10	5	5	10	10	8	4	10	10	4	76
239	2640	Freundt and Ibrahim, 1990	Cuprous chloride	64.18	Rat (*Rattus norvegicus*)	1	2	0/100	mg/L	N	N	ADL	U	DR	91	d	NR	NR	JV	F	C	NR	GRO	GRO	BDWT	WO		100	Y	0.278	N	0.031281		5.78	10	5	5	10	6	8	4	10	10	4	72
240	2064	DeGoey et al 1971	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	98	d	NR	NR	JV	B	C	NR	GRO	GRO	BDWT	WO		250	Y	90.5	Y	2.7		7.46	10	10	5	10	7	8	4	10	10	4	78
241	2064	DeGoey et al 1971	Copper sulfate	100	Pig (*Sus scrofa*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	23	d	NR	NR	JV	NR	C	NR	GRO	MPH	MUSC	MU		500	Y	89	N	2.750143		15.5	10	10	5	10	6	8	4	10	10	4	77
242	14653	Boyden, 1938	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	5	0/5.1/5.05/8.2/9.8/11.8/7.6	mg/org/d	N	N	ADL	U	FD	4	w	28	d	JV	B	C	DOM	GRO	GRO	BDWT	WO		5.1	N	0.217	Y	0.0101		23.5	10	10	5	10	6	8	4	10	10	4	77
243	2186	Kumar et al, 1987	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/0.1	g/kg bw/d	N	N	DLY	U	GV	45	d	90	d	JV	M	C	LAB	GRO	GRO	BDWT	WO		0.1	Y	0.103	N	0.010605		39.8	10	8	10	10	10	8	4	10	10	4	84
244	2256	Rana and Kumar 1980	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/100	mg/kg bw	N	N	DLY	U	GV	20	d	90	d	JV	M	C	LAB	GRO	GRO	BDWT	WO		100	Y	0.101	N	0.010435		39.8	10	8	10	10	10	8	4	10	10	4	84
245	2203	Llewellyn et al, 1985	Copper acetate	51.84	Rat (*Rattus norvegicus*)	1	2	0/2600	mg/kg diet	N	N	ADL	U	FD	21	w	NR	NR	JV	M	C	LAB	GRO	GRO	BDWT	WO		2600	N	0.4702	N	0.036946		106	10	10	5	5	5	8	4	10	10	4	71
246	36364	Fuentealba et al, 2000	Copper sulfate	100	Rat (*Rattus norvegicus*)	2	2	0/1500	mg/kg diet	N	N	ADL	U	FD	12	w	21	d	JV	B	C	LAB	GRO	GRO	BDWT	WO		1500	N	0.38	N	0.031013		122	10	10	5	10	5	8	4	10	10	4	76
247	2121	Haywood 1985	Copper	100	Rat (*Rattus norvegicus*)	1	5	0/3000/4000/5000/6000	mg/kg diet	N	N	ADL	U	FD	15	w	NR	NR	JV	M	C	NR	GRO	GRO	BDWT	WO		3000	Y	0.202	N	0.018448		274	10	10	5	4	6	8	4	10	10	4	71
248	2124	Haywood and Loughran 1985	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	5	0/3000/4000/5000/6000	mg/kg diet	N	N	DLY	U	FD	6	w	NR	mo	JV	M	C	NR	GRO	GRO	BDWT	WO		3000	Y	0.162	N	0.015388		285	10	10	5	10	6	8	4	10	10	4	77
Survival																																																		
249	2020	Bassuny, 1991	Copper sulfate pentahydrate	25.45	Rabbit (*Oryctolagus cuniculus*)	1	5	0/75/150/300/450	mg/kg diet	N	N	NR	U	FD	7	w	35	d	JV	M	C	NR	MOR	MOR	MORT	WO	450		Y	2.218	Y	0.0823	4.25		10	10	5	10	7	9	4	10	10	4	79
250	2062	Cromwell et al 1993	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	783	d	10.3	mo	GE	F	C	NR	MOR	MOR	MORT	WO	250		Y	152	Y	3.35	5.51		10	10	5	10	7	9	4	1	10	4	70
251	14387	Allcroft et al, 1961	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	4	0/380/560/934	mg/org/d	N	N	ADL	M	FD	4	w	8-10	w	JV	B	C	DOM	MOR	MOR	MORT	WO	560	934	N	100	Y	2.36	5.6	9.34	10	10	10	10	6	9	10	10	10	4	89
252	2033	Brandt, 1983	Copper (II) sulfate	100	Mink (*Mustela vision*)	1	3	0/166/320	mg/kg diet	N	N	ADL	M	FD	4	mo	90	d	JV	M	C	NR	MOR	MOR	MORT	WO	166	320	Y	1.92	N	0.117444	10.2	19.6	10	10	10	10	6	9	10	10	10	4	89
253	48117	Jenkins, 1989	Copper	100	Cattle (*Bos taurus*)	1	5	0/50/200/500/1000	mg/kg diet	N	N	ADL	U	FD	6	w	3	d	JV	M	C	DOM	MOR	MOR	MORT	WO	500	1000	N	67	N	2.177661	16.3	32.5	10	10	5	4	5	9	10	10	10	4	77
254	14653	Boyden, 1938	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	5	0/5.1/5.05/8.2/9.8/11.8/7.6	mg/org/d	N	N	ADL	U	FD	1	w	28	d	JV	B	C	DOM	MOR	MOR	MORT	WO	5.05	7.6	N	0.217	Y	0.0059	23.3	35.0	10	10	5	10	6	9	10	10	10	4	84
255	2075	Edmonds and Baker 1986	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/250/650	mg/kg diet	N	N	ADL	U	FD	28	d	4	w	JV	NR	C	NR	MOR	MOR	MORT	WO	650		Y	15.71	Y	0.626	25.9		10	10	5	10	7	9	4	10	10	4	79
256	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	1	6	0/300/1000/3000/10000/30000	mg/L	N	N	ADL	U	DR	15	d	6	w	JV	B	C	LAB	MOR	MOR	MORT	WO	3000	10000	Y	0.088	Y	0.00384	33.3	111	10	5	5	10	7	9	8	10	10	4	78
257	2043	Bush et al., 1995	Copper sulfate pentahydrate	100	Mink (*Mustela vision*)	1	3	0/308/568	mg/kg diet	N	N	ADL	M	FD	132	d	10	w	JV	B	C	COM	MOR	MOR	MORT	WO	568		Y	2.403	N	0.141233	33.4		10	10	10	10	6	9	4	10	10	4	83
258	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	2	6	0/300/1000/3000/10000/30000	mg/L	N	N	ADL	U	DR	15	d	6	w	JV	F	C	LAB	MOR	MOR	MORT	WO	1000	3000	Y	0.0211	Y	0.0028	33.8	101	10	5	5	10	7	9	10	10	10	4	80
259	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	6	6	0/55.9/121.5/199.2/498.1/821.6	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	MOR	MOR	MORT	WO	821.6		Y	1.2328	Y	0.0683	45.5		10	10	10	10	7	9	4	1	10	4	75
260	2113	Grobner et al, 1986	Anhydrous Copper sulfate	100	Rabbit (*Oryctolagus cuniculus*)	5	6	0/50.9/99.1/176.9/504.5/901.5	mg/kg diet	N	N	ADL	M	FD	28	d	28	d	JV	NR	C	NR	MOR	MOR	MORT	WO	901.5		Y	1.6276	Y	0.1066	59.0		10	10	10	10	7	9	4	1	10	4	75
261	11928	Keen et al, 1982	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	4	0/100/1000/2000	ug/g diet	N	N	ADL	U	FD	7	w	NR	NR	JV	F	C	COM	MOR	MOR	MORT	WO	1000	2000	N	0.198	N	0.018147	91.7	183	10	10	5	10	6	9	10	10	10	4	84
262	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	4	6	0/500/1000/2000/4000/8000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	B	C	LAB	MOR	MOR	MORT	WO	8000		Y	0.275	Y	0.0144	107		10	10	5	10	7	9	4	10	10	4	79
263	440	Dodds-Smith et al., 1992	Copper chloride	100	Common shrew (*Sorex araneus*)	1	2	0/2.11	mg/org/d	N	N	DLY	U	FD	12	w	NR	NR	JV	B	C	NR	MOR	MOR	MORT	WO	2.11		Y	0.0092	N	0.001456	229		10	10	5	10	6	9	4	10	10	4	78
264	2127	Hebert et al 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	5	0/41/113/175/140	mg/org/d	N	N	ADL	U	DR	2	w	6	w	JV	M	C	COM	MOR	MOR	MORT	WO	113	175	Y	0.174	N	0.020518	259	400	10	5	5	10	6	9	10	10	10	4	79
265	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Rat (*Rattus norvegicus*)	3	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	15	d	6	w	JV	B	C	LAB	MOR	MOR	MORT	WO	16000		Y	0.122	Y	0.0092	307		10	10	5	10	7	9	4	10	10	4	79
266	2121	Haywood 1985	Copper	100	Rat (*Rattus norvegicus*)	1	5	0/3000/4000/5000/6000	mg/kg diet	N	N	ADL	U	FD	2	w	NR	NR	JV	M	C	NR	MOR	MOR	MORT	WO	5000	6000	Y	0.202	N	0.018448	457	548	10	10	5	4	6	9	10	10	10	4	78
267	2126	Hebert 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	5	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	15	d	6	w	JV	B	C	LAB	MOR	MOR	MORT	WO	16000		Y	0.0236	Y	0.004	690		10	10	5	10	7	9	4	1	10	4	70
268	2126	Hebert,1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	6	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	B	C	LAB	MOR	MOR	MORT	WO	16000		Y	0.0268	Y	0.005	760		10	10	5	10	7	9	4	10	10	4	79
269	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	5	6	0/32/64/129/259/551	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	B	C	COM	MOR	MOR	MORT	WO	551		Y	0.275	N	0.023773	798		10	10	5	10	6	9	4	10	10	4	78
270	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	2	5	0/41/95/226/524	mg/org/d	N	N	ADL	U	DR	2	w	6	w	JV	B	C	COM	MOR	MOR	MORT	WO	95	226	Y	0.0265	N	0.003772	1427	3395	10	5	5	10	6	9	10	10	10	4	79
271	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	3	6	0/92/180/363/777/1275	mg/org/d	N	N	ADL	U	FD	15	d	6	w	JV	M	C	COM	MOR	MOR	MORT	WO	1275		Y	0.122	N	0.012188	4160		10	10	5	10	6	9	4	10	10	4	78
272	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	4	6	0/168/362/773/1154/2817	mg/org/d	N	N	ADL	U	FD	15	d	6	w	JV	B	C	COM	MOR	MOR	MORT	WO	2817		Y	0.0236	N	0.003159	47519		10	10	5	10	6	9	4	10	10	4	78
273	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	6	6	0/173/382/736/1563/3201	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	B	C	COM	MOR	MOR	MORT	WO	3201		Y	0.0264	N	0.003464	48270		10	10	5	10	6	9	4	10	10	4	78
274	36202	Gopinath et al, 1974	Copper sulfate pentahydrate	25.45	Sheep (*Ovis aries*)	1	2	0/20	mg/kg bw/d	N	N	DLY	U	DR	10	w	6	mo	JV	F	C	COM	MOR	MOR	MORT	WO		20	N	59.1	N	3.891024		5.09	10	5	5	10	10	9	4	10	10	4	77
275	2155	Ishmael et al, 1971	Copper sulfate pentahydrate	25.45	Sheep (*Ovis aries*)	1	2	0/0.714	g/org/d	N	N	5 per w	U	OR	31	d	6	mo	JV	F	C	NR	MOR	MOR	MORT	WO		0.714	N	24	N	0.936463		7.57	10	8	5	10	5	9	4	10	10	4	75
276	14402	Ritchie et al, 1963	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	w	7	w	JV	NR	C	COM	MOR	MOR	MORT	WO		250	Y	69.31	N	2.24		8.08	10	10	5	10	6	9	4	10	10	4	78
277	2064	DeGoey et al, 1971	Copper sulfate	100	Pig (*Sus scrofa*)	2	2	0/500	mg/kg diet	N	N	ADL	U	FD	23	d	NR	NR	JV	NR	C	NR	MOR	MOR	MORT	WO		500	Y	89	N	2.750143		15.5	10	10	5	10	6	9	4	10	10	4	78
278	2216	McNatt et al, 1971	Copper (I) acetate	51.84	Rat (*Rattus norvegicus*)	1	2	0/0.2	% in diet	N	N	ADL	U	DR	3	w	4-11	mo	JV	M	C	COM	MOR	MOR	MORT	WO		0.200	Y	0.356	N	0.039079		114	10	5	5	5	6	9	4	10	10	4	68
Data Not Used to Derive TRV																																																	
279	25940	Engle and Spears, 2001	Copper sulfate	100	Cattle (*Bos taurus*)	1	2	0/40	mg/kg diet	N	N	ADL	U	FD	239	d	NR	NR	JV	M	C	COM	PHY	PHY	FDCV	WO	40		Y	430	Y	8.730	0.812		10	10	5	10	7	4	4	1	10	4	65

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 6 of 7

Ref			Exposure																								Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
280	25940	Engle and Spears, 2001	Copper sulfate	100	Cattle (*Bos taurus*)	1	2	0/40	mg/kg diet	N	N	ADL	U	FD	239	d	NR	NR	JV	M	C	COM	BEH	FDB	FCNS	WO	40		Y	430	Y	8.730	0.812		10	10	5	10	7	4	4	1	10	4	65
281	25940	Engle and Spears, 2001	Copper sulfate	100	Cattle (*Bos taurus*)	1	2	0/40	mg/kg diet	N	N	ADL	U	FD	239	d	NR	NR	JV	M	C	COM	BIO	CHM	CHOL	PL	40		Y	430	Y	8.730	0.812		10	10	5	10	7	1	4	1	10	4	62
282	25935	Engle et al, 2000	Copper chloride - tribasic	100	Cattle (*Bos taurus*)	1	2	0/40	mg/kg diet	N	N	ADL	U	FD	154	d	NR	NR	JV	M	C	COM	BEH	FDB	FCNS	WO	40		Y	400.1	Y	8.520	0.852		10	10	5	10	7	4	4	1	10	4	65
283	25935	Engle et al, 2000	Copper chloride - tribasic	100	Cattle (*Bos taurus*)	1	2	0/40	mg/kg diet	N	N	ADL	U	FD	112	d	NR	NR	JV	M	C	COM	BIO	CHM	CHOL	SR	40		Y	400.1	Y	8.520	0.852		10	10	5	10	7	1	4	1	10	4	62
284	36762	Humann-Ziehank et al, 2001	Copper sulfate	100	Sheep (*Ovis aries*)	1	2	0/3.7	mg/kg bw/d	N	N	2 per d	U	FD	84	d	1	yr	AD	M	C	COM	GRO	GRO	BDWT	WO	3.7		Y	2.5	N	0.145903	3.70		10	10	5	10	10	8	4	1	3	4	65
285	43456	Omole et al, 1976	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/125/200	mg/kg diet	N	N	ADL	U	FD	127	d	NR	NR	NR	B	C	COM	GRO	GRO	BDWT	WO	200		Y	90.2	Y	2	4.43		10	10	5	10	7	8	4	1	6	4	65
286	43456	Omole et al, 1976	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/125/200	mg/kg diet	N	N	ADL	U	FD	127	d	NR	NR	NR	B	C	COM	BEH	FDB	FCNS	WO	200		Y	90.2	Y	2	4.43		10	10	5	10	7	4	4	1	6	4	61
287	2062	Cromwell et al, 1993	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	783	d	10	mo	GE	F	C	NR	BEH	FDB	FCNS	WO	250		Y	152	Y	3.35	5.51		10	10	5	10	7	4	4	1	10	4	65
288	757	Mercado and Bibby, 1973	Copper chloride dihydrate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	N	N	ADL	U	DR	50	d	23	d	JV	M	C	NR	PHY	PHY	GPHY	TH	50		N	0.267	N	0.03016	5.65		10	5	5	10	5	4	4	1	10	4	58
289	757	Mercado and Bibby, 1973	Copper chloride dihydrate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	N	N	ADL	U	DR	50	d	23	d	JV	M	C	NR	GRO	GRO	BDWT	WO	50		N	0.267	N	0.03016	5.65		10	5	5	10	5	8	4	1	10	4	62
290	136	Gershbein et al, 1983	Copper (II) sulfate pentahydrate	100	Rat (*Rattus norvegicus*)	1	2	0/75	mg/kg diet	N	N	ADL	U	FD	80	d	44	d	JV	M	C	NR	PTH	HIS	GHIS	MT	75		Y	0.47	N	0.036934	5.89		10	10	5	10	6	4	4	1	10	4	64
291	41706	Omole and Bowland, 1974	Copper	100	Pig (*Sus scrofa*)	1	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	99	d	NR	NR	JV	B	C	COM	PHY	PHY	FDCV	WO	200		Y	77.1	Y	2.41	6.25		10	10	5	4	7	4	4	1	10	4	59
292	41706	Omole and Bowland, 1974	Copper	100	Pig (*Sus scrofa*)	1	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	99	d	NR	NR	JV	B	C	COM	GRO	GRO	BDWT	WO	200		Y	77.1	Y	2.41	6.25		10	10	5	4	7	8	4	1	10	4	63
293	41706	Omole and Bowland, 1974	Copper	100	Pig (*Sus scrofa*)	1	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	99	d	NR	NR	JV	B	C	COM	BEH	FDB	FDNG	WO	200		Y	77.1	Y	2.41	6.25		10	10	5	4	7	4	4	1	10	4	59
294	25930	Cromwell et al, 1998	Copper chloride	100	Pig (*Sus scrofa*)	5	4	0/100/150/200	mg/kg diet	N	N	ADL	U	FD	28	d	26-32	d	JV	B	C	COM	PHY	PHY	FDCV	WO	200		Y	25.5	Y	0.917	7.19		10	10	5	10	7	4	4	1	10	4	65
295	25930	Cromwell et al, 1998	Copper chloride	100	Pig (*Sus scrofa*)	5	4	0/100/150/200	mg/kg diet	N	N	ADL	U	FD	28	d	26-32	d	JV	B	C	COM	BEH	FDB	FCNS	WO	200		Y	25.5	Y	0.917	7.19		10	10	5	10	7	4	4	1	10	4	65
296	12977	Omole, 1977	Copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	4	0/100/150/200	mg/kg diet	N	N	ADL	U	FD	8	w	6	w	JV	B	C	LAB	PHY	PHY	FDCV	WO	200		Y	1.724	Y	0.0633	7.34		10	10	5	10	7	4	4	1	10	4	65
297	12977	Omole, 1977	Copper sulfate pentahydrate	100	Rabbit (*Oryctolagus cuniculus*)	1	4	0/100/150/200	mg/kg diet	N	N	ADL	U	FD	8	w	6	w	JV	B	C	LAB	BEH	FDB	FCNS	WO	200		N	1.724	Y	0.0633	7.34		10	10	5	10	7	4	4	1	10	4	65
298	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	6	2	0/200	mg/kg diet	N	N	ADL	U	FD	28	d	26-32	d	JV	B	C	COM	PHY	PHY	FDCV	WO	200		Y	25.5	Y	0.939	7.36		10	10	5	10	7	4	4	1	10	4	65
299	25930	Cromwell et al, 1998	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	6	2	0/200	mg/kg diet	N	N	ADL	U	FD	28	d	26-32	d	JV	B	C	COM	BEH	FDB	FCNS	WO	200		Y	25.5	Y	0.939	7.36		10	10	5	10	7	4	4	1	10	4	65
300	2064	DeGoey et al, 1971	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	98	d	NR	NR	JV	NR	C	NR	PHY	PHY	IRRI	SK	250		Y	90.5	Y	2.7	7.46		10	10	5	10	7	4	4	1	10	4	65
301	14396	Gipp et al, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	12	w	NR	NR	JV	F	C	COM	PHY	PHY	FDCV	WO	250		Y	93.2	N	2.856384	7.66		10	10	5	10	6	4	4	1	10	4	64
302	2061	Cromwell et al, 1989	Copper oxide	100	Pig (*Sus scrofa*)	2	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	PHY	PHY	FDCV	WO	250		Y	17.8	Y	0.547	7.68		10	10	5	10	7	4	4	1	10	4	65
303	2061	Cromwell et al, 1989	Copper oxide	100	Pig (*Sus scrofa*)	2	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	BEH	FDB	FCNS	WO	250		Y	17.8	Y	0.547	7.68		10	10	5	10	7	4	4	1	10	4	65
304	25929	Luo and Dove, 1996	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	d	26	d	JV	M	C	COM	PHY	PHY	FDCV	WO	250		Y	10.1	Y	0.312	7.72		10	10	5	10	7	4	4	1	10	4	65
305	25929	Luo and Dove, 1996	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	d	26	d	JV	M	C	COM	BIO	ENZ	GENZ	IN	250		Y	10.1	Y	0.312	7.72		10	10	5	10	7	1	4	1	10	4	62
306	25929	Luo and Dove, 1996	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	d	26	d	JV	M	C	COM	BEH	FDB	FCNS	WO	250		Y	10.1	Y	0.312	7.72		10	10	5	10	7	4	4	1	10	4	65
307	12809	Myres and Bowland, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	10	w	70	d	JV	B	C	COM	PTH	ORW	ORWT	LI	250		Y	64.7	Y	2.03	7.84		10	10	5	10	7	4	4	1	10	4	65
308	12809	Myres and Bowland, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	10	w	70	d	JV	B	C	COM	PHY	PHY	FDCV	WO	250		Y	64.7	Y	2.03	7.84		10	10	5	10	7	4	4	1	10	4	65
309	12809	Myres and Bowland, 1973	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	10	w	70	d	JV	B	C	COM	BEH	FDB	FCNS	WO	250		Y	64.7	Y	2.03	7.84		10	10	5	10	7	4	4	1	10	4	65
310	14402	Ritchie et al, 1963	Copper sulfate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	15	w	7	w	JV	NR	C	COM	PHY	PHY	FDCV	WO	250		Y	69.31	N	2.24	8.08		10	10	5	10	6	4	4	1	10	4	64
311	3755	Olson et al, 1984	Copper	100	Sheep (*Ovis aries*)	1	2	0/257	mg/kg diet	N	N	DLY	M	FD	140	d	4-13	yr	AD	F	C	DOM	PTH	ITX	GITX	WO	257		N	65.1	N	2.126769	8.40		10	10	10	4	5	4	4	10	3	4	64
312	2253	Prince et al, 1979	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	59	d	64	d	JV	NR	C	NR	BEH	FDB	FEFF	WO	250		Y	54	N	1.82383	8.44		10	10	5	10	6	4	4	1	10	4	64
313	2061	Cromwell et al, 1989	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/125/250	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	BEH	FDB	FCNS	WO	250		Y	15.6	Y	0.599	9.60		10	10	5	10	7	4	4	1	10	4	65
314	14397	Gipp et al, 1974	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	2	0/250	mg/kg diet	N	N	ADL	U	FD	35	d	3	w	JV	B	C	COM	BEH	FDB	FCNS	WO	250		Y	21.9	Y	0.870	9.93		10	10	5	10	7	4	4	1	10	4	65
315	2013	Aulerich et al, 1982	Copper sulfate pentahydrate	100	Mink (*Mustela vision*)	1	5	0/25/50/100/200	mg/kg diet	N	N	ADL	U	FD	153	d	NR	mo	JV	M	C	NR	PTH	ORW	SMIX	LI	200		Y	1.753	N	0.10898	12.4		10	10	5	10	6	4	4	1	10	4	64
316	2013	Aulerich et al, 1982	Copper sulfate pentahydrate	100	Mink (*Mustela vision*)	1	5	0/25/50/100/200	mg/kg diet	N	N	ADL	U	FD	357	d	NR	mo	JV	B	C	NR	BIO	CHM	HMGL	BL	200		Y	1.753	N	0.10898	12.4		10	10	5	10	6	1	4	1	10	4	61
317	3760	Felsman et al, 1973	Copper sulfate	100	Cattle (*Bos taurus*)	1	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	98	d	6	w	JV	M	C	NR	BEH	FDB	FCNS	WO	500		Y	269	N	6.826736	12.7		10	10	5	10	6	4	4	1	10	4	64
318	3760	Felsman et al, 1973	Copper sulfate	100	Cattle (*Bos taurus*)	1	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	98	d	6	w	JV	M	C	NR	BIO	CHM	HMGL	BL	500		Y	269	N	6.826736	12.7		10	10	5	10	6	1	4	1	10	4	61
319	36756	Zacharias et al, 2003	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/80/175	mg/kg diet	N	N	CON	U	FD	60	d	NR	NR	NR	M	C	COM	GRO	GRO	BDWT	WO	175		Y	55	Y	4.456	14.2		10	10	5	10	7	8	4	1	6	4	65
320	36756	Zacharias et al, 2003	Copper sulfate pentahydrate	100	Pig (*Sus scrofa*)	1	3	0/80/175	mg/kg diet	N	N	CON	U	FD	60	d	NR	NR	NR	M	C	COM	BIO	CHM	CALC	BO	175		Y	55	Y	4.456	14.2		10	10	5	10	7	1	4	1	6	4	58
321	2085	Elliot and Bowland, 1972	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/250	mg/kg diet	N	N	DLY	U	FD	8	w	3	w	JV	B	C	LAB	PHY	PHY	FDCV	WO	250		N	0.267	Y	0.0175	16.4		10	10	5	10	6	4	4	1	10	4	64
322	2085	Elliot and Bowland, 1972	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/250	mg/kg diet	N	N	DLY	U	FD	8	w	3	w	JV	B	C	LAB	BIO	CHM	FFTA	WO	250		Y	0.267	Y	0.0175	16.4		10	10	5	4	7	1	4	1	10	4	56
323	2085	Elliot and Bowland, 1972	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/250	mg/kg diet	N	N	DLY	U	FD	8	w	3	w	JV	B	C	LAB	GRO	GRO	BDWT	WO	250		N	0.267	Y	0.0175	16.4		10	10	5	4	6	8	4	1	10	4	62
324	2085	Elliot and Bowland, 1972	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/250	mg/kg diet	N	N	DLY	U	FD	4	w	3	w	JV	B	C	LAB	BEH	FDB	FCNS	WO	250		N	0.267	Y	0.0175	16.4		10	10	5	4	6	4	4	1	10	4	58
325	2061	Cromwell et al, 1989	Copper oxide	100	Pig (*Sus scrofa*)	4	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	PHY	PHY	FDCV	WO	500		Y	13.2	Y	0.441	16.7		10	10	5	10	7	4	4	1	10	4	65
326	2061	Cromwell et al, 1989	Copper oxide	100	Pig (*Sus scrofa*)	4	4	0/125/250/500	mg/kg diet	N	N	ADL	U	FD	28	d	28	d	JV	B	C	NR	BEH	FDB	FCNS	WO	500		Y	13.2	Y	0.441	16.7		10	10	5	10	7	4	4	1	10	4	65
327	2189	Lalich et al, 1965	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/0.5	g/kg diet	N	N	ADL	U	FD	42	d	NR	NR	JV	M	C	NR	PTH	HIS	GHIS	BO	0.5		Y	0.2509	N	0.022047	17.5		10	10	5	10	6	4	4	1	10	4	64
328	2182	Kornegay et al, 1986	Copper	100	Pig (*Sus scrofa*)	1	3	0/200/400	mg/kg diet	N	N	ADL	U	FD	5	w	NR	NR	JV	B	C	COM	PHY	PHY	FDCV	WO	400		Y	17.5	Y	0.79	18.1		10	10	5	4	7	4	4	1	10	4	59
329	2182	Kornegay et al, 1986	Copper	100	Pig (*Sus scrofa*)	1	3	0/200/400	mg/kg diet	N	N	ADL	U	FD	5	w	NR	NR	JV	B	C	COM	GRO	GRO	BDWT	WO	400		Y	17.5	Y	0.79	18.1		10	10	5	4	7	8	4	1	10	4	63
330	2182	Kornegay et al, 1986	Copper	100	Pig (*Sus scrofa*)	1	3	0/200/400	mg/kg diet	N	N	ADL	U	FD	5	w	NR	NR	JV	B	C	COM	BEH	FDB	FCNS	WO	400		Y	17.5	Y	0.79	18.1		10	10	5	4	7	4	4	1	10	4	59
331	3760	Felsman et al, 1973	Copper sulfate	100	Cattle (*Bos taurus*)	2	4	0/300/600/900	mg/kg diet	N	N	ADL	U	FD	98	d	6	w	JV	M	C	NR	BIO	CHM	HMGL	BL	900		Y	266	N	6.764091	22.9		10	10	5	10	6	1	4	1	10	4	61
332	3760	Felsman et al, 1973	Copper sulfate	100	Cattle (*Bos taurus*)	2	4	0/300/600/900	mg/kg diet	N	N	ADL	U	FD	98	d	6	w	JV	M	C	NR	BEH	FDB	FCNS	WO	900		Y	266	N	6.764091	22.9		10	10	5	10	6	4	4	1	10	4	64
333	12718	Moffitt and Murphy, 1973	Copper sulfate pentahydrate	100	Rat (*Rattus norvegicus*)	1	4	0/50/150/450	mg/L	N	N	ADL	U	DR	30	d	NR	NR	JV	B	C	LAB	BEH	FDB	WCON	WO	450		Y	250	N	14.2489	25.6		10	5	5	10	6	4	4	1	10	4	59
334	13235	Rana and Kumar, 1979	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	1	2	0/0.100	g/kg bw	N	N	ADL	U	FD	20	d	NR	NR	JV	B	C	LAB	BIO	ENZ	ALPH	KI	0.1		Y	0.11	N	0.011194	39.8		10	10	5	10	10	1	4	1	10	4	65
335	2324	White et al, 1985	Copper sulfate	100	Rat (*Rattus norvegicus*)	1	2	0/500	mg/kg diet	N	N	ADL	U	FD	50	d	21	d	JV	M	C	NR	BIO	CHM	HMGL	BL	500		Y	0.280	N	0.024128	43.1		10	10	6	10	5	1	4	1	10	4	61
336	12718	Moffitt and Murphy, 1973	Copper sulfate pentahydrate	100	Rat (*Rattus norvegicus*)	1	4	0/50/150/450	mg/L	N	N	ADL	U	DR	30	d	NR	NR	JV	B	C	LAB	GRO	GRO	BDWT	WO	450		Y	0.25	N	0.02843	51.2		10	5	5	10	6	8	4	1	10	4	63
337	12079	Komulainen, 1983	Copper chloride	100	Rat (*Rattus norvegicus*)	1	4	0/28/50/64	mg/kg bw/d	N	N	ADL	U	DR	3	w	4	w	JV	M	C	COM	BIO	HRM	DOPA	BR	64		Y	0.158	Y	0.00016	64.0		10	5	5	10	10	1	4	6	10	4	65

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Copper
Page 7 of 7

Ref			Exposure																						Effects						Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
338	36389	Tatum et al, 2000	Copper chloride	100	Rat (*Rattus norvegicus*)	1	2	0/800	mg/kg diet	N	N	ADL	U	FD	6	w	NR	NR	JV	F	C	LAB	PTH	ORW	SMIX	LI	800		Y	0.165	N	0.015622	75.7		10	10	5	10	6	4	4	1	10	4	64
339	2216	McNatt et al, 1971	Copper (I) acetate	51.84	Rat (*Rattus norvegicus*)	1	2	0/0.2	% in diet	N	N	ADL	U	DR	4	w	4-11	mo	JV	M	C	COM	PTH	ORW	SMIX	LI	0.2		Y	0.356	N	0.039079	114		10	5	5	5	6	4	4	8	10	4	61
340	2216	McNatt et al, 1971	Copper (I) acetate	51.84	Rat (*Rattus norvegicus*)	1	2	0/0.2	% in diet	N	N	ADL	U	DR	4	w	4-11	mo	JV	M	C	COM	GRO	GRO	BDWT	WO	0.2		Y	0.356	N	0.039079	114		10	5	5	5	6	8	4	8	10	4	65
341	2126	Hebert, 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	5	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	15	d	6	w	JV	B	C	LAB	BEH	FDB	FCNS	WO	16000		Y	0.0236	Y	0.0040	690		10	10	5	10	7	4	4	1	10	4	65
342	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Rat (*Rattus norvegicus*)	5	6	0/32/64/129/259/551	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	B	C	COM	BEH	FDB	FCNS	WO	551		Y	0.275	N	0.023773	798		10	10	5	10	6	4	4	1	10	4	64
343	2126	Hebert, 1993	Copper (II) sulfate pentahydrate	25.45	Mouse (*Mus musculus*)	6	6	0/1000/2000/4000/8000/16000	mg/kg diet	N	N	ADL	U	FD	13	w	6	w	JV	B	C	LAB	BEH	FDB	FCNS	WO	16000		Y	0.0268	Y	0.0050	1188		10	10	5	10	7	4	4	1	10	4	65
344	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	4	6	0/168/362/773/1154/2817	mg/org/d	N	N	ADL	U	FD	15	d	6	w	JV	B	C	COM	PTH	ORW	ORWT	MT	2817		Y	0.0236	N	0.003159	47519		10	10	5	10	6	4	4	1	10	4	64
345	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	6	6	0/173/382/736/1563/3201	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	B	C	COM	BIO	CHM	FECO	SP	3201		Y	0.0264	N	0.003464	48270		10	10	5	10	6	1	4	1	10	4	61
346	2127	Hebert et al, 1993	Copper (II) sulfate	39.81	Mouse (*Mus musculus*)	6	6	0/173/382/736/1563/3201	mg/org/d	N	N	ADL	U	FD	92	d	6	w	JV	B	C	COM	BEH	FDB	FCNS	WO	3201		Y	0.0264	N	0.003464	48270		10	10	5	10	6	4	4	1	10	4	64
347	36201	Gopinath and McC. Howell, 1975	Copper sulfate pentahydrate	25.45	Sheep (*Ovis aries*)	1	2	0/30	mg/kg bw/d	N	N	DLY	U	DR	55	d	NR	NR	AD	F	C	COM	PTH	HIS	GHIS	KI		30	N	73	N	4.705717		7.64	10	5	5	10	10	4	4	10	3	4	65
348	2307	Thompson and Todd, 1976	Copper acetate	100	Sheep (*Ovis aries*)	1	2	0/250	mg/kg diet	N	N	NR	U	FD	1	mo	NR	NR	MA	NR	C	DOM	BIO	ENZ	GLRE	ER		250	N	65.1	N	2.126769		8.17	10	10	5	5	5	1	4	10	3	4	57
349	3755	Olson et al, 1984	Copper	100	Sheep (*Ovis aries*)	1	2	0/257	mg/kg diet	N	N	DLY	M	FD	140	d	4-13	yr	AD	F	C	DOM	BIO	ENZ	GENZ	BL		257	N	65.1	N	2.126769		8.40	10	10	10	4	5	1	4	10	3	4	61
350	36321	Ozcelik et al, 2003	Copper	100	Rat (*Rattus norvegicus*)	1	2	0/100	mg/L	N	N	ADL	U	DR	4	w	NR	NR	JV	M	C	LAB	BIO	CHM	GBCM	PL		100	Y	0.21	N	0.024301		11.6	10	5	5	4	6	1	4	10	10	4	59
351	1717	Bataineh et al, 1998	Copper chloride dihydrate	37.28	Rat (*Rattus norvegicus*)	1	2	0/1000	mg/L	N	N	ADL	U	DR	12	w	NR	NR	AD	M	V	LAB	PTH	GRS	BDWT	WO		1000	Y	0.33067	N	0.036567		41.2	10	5	5	10	6	4	4	10	3	4	61
352	1717	Bataineh et al, 1998	Copper chloride dihydrate	37.28	Rat (*Rattus norvegicus*)	1	2	0/1000	mg/L	N	N	ADL	U	DR	12	w	NR	NR	AD	M	V	LAB	BEH	BEH	AGGT	WO		1000	Y	0.33067	N	0.036567		41.2	10	5	5	10	6	4	4	10	3	4	61
353	2225	Myers et al, 1993	Copper (I) acetate	51.84	Rat (*Rattus norvegicus*)	1	2	0/0.125	% in diet	N	N	DLY	U	DR	6	w	NR	mo	JV	M	C	LAB	PTH	HIS	GHIS	LI		0.125	Y	0.261	N	0.029554		73.4	10	5	5	5	6	4	4	10	10	4	63
354	2225	Myers et al, 1993	Copper (I) acetate	51.84	Rat (*Rattus norvegicus*)	1	2	0/0.125	% in diet	N	N	DLY	U	DR	6	w	NR	mo	JV	M	C	LAB	BIO	CHM	PHPH	LI		0.125	Y	0.261	N	0.029554		73.4	10	5	5	5	6	1	4	10	10	4	60
355	2047	Chesta et al, 1989	Copper (II) sulfate	39.81	Guinea pig (*Cavia porcellus*)	1	2	0/0.185	% in diet	N	N	NR	U	DR	45	d	NR	NR	GE	F	C	LAB	BIO	CHM	GBCM	PL		0.185	N	0.9	N	0.090044		73.7	10	5	5	10	5	1	4	10	10	4	64
356	2216	McNatt et al, 1971	Copper (I) acetate	51.84	Rat (*Rattus norvegicus*)	1	2	0/0.2	% in diet	N	N	ADL	U	DR	4	w	4-11	mo	JV	M	C	COM	BIO	ENZ	ACPH	LI		0.2	Y	0.356	N	0.039079		114	10	5	5	5	6	1	4	10	10	4	60

All abbreviations and definitions are used in coding stuides are available from Attachment 4-3 of the Eco-SSL guidance (U.S. EPA 2003).

Duplicate values for NOAELs and LOAELs for the same reference represent results from different experimental designs and are identified by different Phase numbers.