Ecological Soil Screening Levels for Nickel

Interim Final

OSWER Directive 9285.7-76

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

March 2007

This page intentionally left blank

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SUMMARY OF ECO-SSLs FOR NICKEL 1

3.0 ECO-SSL FOR TERRESTRIAL PLANTS 3

4.0 ECO-SSL FOR SOIL INVERTEBRATES 6

5.0 ECO-SSL FOR AVIAN WILDLIFE 6
5.1 Avian TRV 6
5.2 Estimation of Dose and Calculation of the Eco-SSL 10

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE 10
6.1 Mammalian TRV 10
6.2 Estimation of Dose and Calculation of the Eco-SSL 14

7.0 REFERENCES 16
7.1 General Nickel References 16
7.2 References for Plants and Soil Invertebrates 16
7.3 References Rejected for Use in Deriving Plant and Soil Invertebrate Eco-SSLs 18
7.4 References Used in Deriving Wildlife TRVs 34
7.5 References Rejected for Use in Derivation of Wildlife TRV 38

LIST OF TABLES

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

Table 3.1 Plant Toxicity Data - Nickel 4

Table 4.1 Invertebrate Toxicity Data - Nickel 7

Table 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Nickel 8

Table 5.2 Calculation of the Avian Eco-SSLs for Nickel 10

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value - Nickel 11

Table 6.2 Calculation of the Mammalian Eco-SSLs for Nickel 14

LIST OF FIGURES

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

Figure 5.1 Avian TRV Derivation for Nickel 9

Figure 6.1 Mammalian TRV Derivation for Nickel 15

LIST OF APPENDICES

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

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

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 nickel and the documentation for their derivation. This document provides guidance and is designed to communicate national policy on identifying nickel 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 NICKEL

Nickel is a naturally occurring element which can be found in all environmental media: air, soil, sediment, and water. In the metal state, nickel is silvery white, hard, malleable, and ductile. It is somewhat ferromagnetic, and a fair conductor of heat and electricity. Nickel occurs in numerous minerals as sulfides, arsenides, antimonides and oxides or silicates. Primary sources include chalcopyrite, pyrrhotite, pentlandite, and garnierite (Budavari, 1996; HSDB).

Nickel is released to the environment through the extraction, processing and use of nickel compounds (HSDB). The single largest use of nickel is in the manufacture of stainless steels (Alloway, 1990). Nickel is also used in the production of alloys with other metals such as iron, copper, chromium, and zinc (ATSDR, 1988; HSDB). Other major uses are in electroplating alloys, nickel-cadmium batteries, electronic components, fuel cells, specialty ceramics, magnets, specialty chemicals, filters for gases, hydrogenation of fats, petroleum products, preparation of colored pigments and for color stabilization of color copy paper (ATSDR, 1988; Alloway, 1990). Nickel may also be released from natural sources, such as volcanoes, windblown dusts, the weathering of rocks, forest fires, and decaying vegetation (Davies, 1974; HSDB).

In the atmosphere, nickel is expected to exist in the particulate phase and is released to soils through wet and dry deposition. The species of nickel present in deposition include soil minerals, oxides and sulphates (Alloway, 1990). The largest anthropogenic sources of nickel to the atmosphere result from the burning of fuel and residual oils followed by diesel exhaust, the combustion of coal and nickel mining and smelting (Alloway, 1990).

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). Figure 2.1 provides a plot of the typical background concentrations of nickel in U.S. soils in the eastern and western portions of the country.

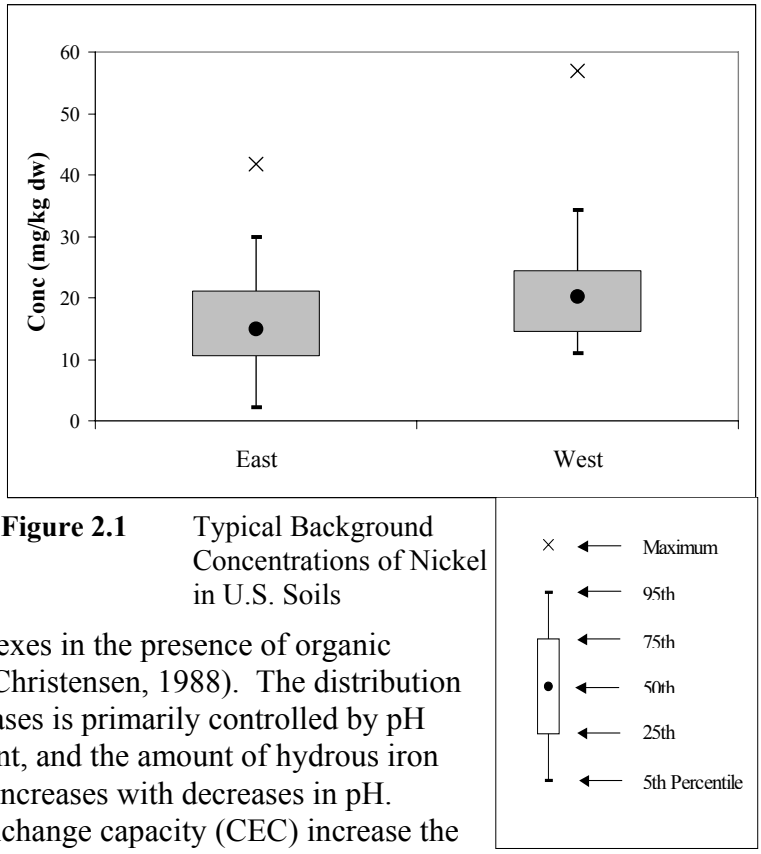


Figure 2.1 Typical Background Concentrations of Nickel in U.S. Soils

In soils, nickel may be present as soluble compounds including chlorides and nitrates, and insoluble compounds such as oxides and sulfides. Soluble nickel compounds tend to exhibit greater mobility than insoluble nickel compounds (Dean, 1985; HSDB). The degree of mobility is influenced by the formation of complexes in the presence of organic substances and sulfates (Anderson and Christensen, 1988). The distribution of nickel between solid and solution phases is primarily controlled by pH with secondary factors being clay content, and the amount of hydrous iron and manganese oxides. Soluble nickel increases with decreases in pH. Increases in metal loading and cation exchange capacity (CEC) increase the amount of metal adsorbed by soil (Alloway, 1990). Due to low vapor pressures, most nickel compounds are not expected to volatilize from moist or dry soil surfaces, with one notable exception being nickel carbonyl (Ohe, 1976; HSDB). The concentration of nickel in plants generally reflects the concentration in soil although the relationship is more related to soluble and exchanged forms of nickel. Factors that increase solubility and

exchangeability of nickel in soils also result in an increase of the element in plant tissue (Alloway, 1990).

In plants nickel is necessary for healthy growth and is essential for metabolic processes (Alloway, 1990; NRC, 2005). Nickel is generally not accepted an essential trace element for mammals and birds as there is no clearly defined biochemical function. Under laboratory experimental conditions nickel deprivation can result in adverse effects including growth depression, impaired reproduction, and other biochemical changes (NRC, 2005).

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

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

Plants	Soil Invertebrates	Wildlife	
		Avian	Mammalian
38	280	210	130

Eco-SSL values were derived for plants, soil invertebrates, avian and mammalian wildlife. The Eco-SSL values for nickel range from 38 mg/kg dry weight (dw) for plants to 280 mg/kg dw for soil invertebrates. All values are higher than the 95th percentile of reported background soil concentrations in eastern and western U.S. soils (Figure 2.1).

3.0 ECO-SSL FOR TERRESTRIAL PLANTS

Of the papers identified from the literature search process, 252 papers were selected for acquisition for further review. Of those papers acquired, 26 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). Thirty-nine 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 11 studies eligible for Eco-SSL derivation with a bioavailability score of two. These results are used to derive the plant Eco-SSL for nickel (U.S. EPA, 2003; Attachment 3-2). The Eco-SSL is the geometric mean of the maximum acceptable toxicant concentration (MATC) and 20% effective concentration (EC_{20}) values for 6 species under different test conditions (pH and % organic matter (OM)) and is equal to 38 mg/kg dw.

Table 3.1 Plant Toxicity Data - Nickel

Reference	IP Number	Study ID	Test Organism		Soil pH	OM %	Bio-availability Score	ERE	Tox Parameter	Tox Value-Soil Conc. (mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
TN&Associates Inc., 2000	56444	G	Alfalfa	*Medicago sative*	5.0	5.0	2	GRO	EC_{20}	17	18	Y	Y
TN&Associates Inc., 2000	56444	H	Barley	*Hordeum vilgare*	5.0	5.0	2	GRO	EC_{20}	7	18	Y	Y
TN&Associates Inc., 2000	56444	I	Brassica	*Brassica rapa*	5.0	5.0	2	GRO	EC_{20}	10	18	Y	Y
TN&Associates Inc., 2000	56444	J	Alfalfa	*Medicago sative*	6.3	0.1	2	GRO	EC_{20}	25	18	Y	Y
TN&Associates Inc., 2000	56444	K	Barley	*Hordeum vilgare*	6.3	0.1	2	GRO	EC_{20}	65	18	Y	Y
TN&Associates Inc., 2000	56444	L	Brassica	*Brassica rapa*	6.3	0.1	2	GRO	EC_{20}	32	18	Y	Y
Dixon, 1988	7450	--	Red Oak	*Quercus rubra*	6.0	1.5	2	GRO	MATC	32	16	Y	Y
Taylor and Allinson, 1981	2790	B	Alfalfa	*Medicago sativa*	6.9	1.7	2	GRO	MATC	177	15	Y	Y
Khalid and Tinsley, 1980	7481	--	Ryegrass	*Lelium perenne*	4.7	4.5	2	GRO	MATC	52	15	Y	Y
Taylor, 1974	9645	--	Alfalfa	*Medicago sativa*	6.4	1.0	2	GRO	MATC	177	11	Y	Y
Halstead et al, 1969	7465	B	Oat	*Avena sativa*	6.1	1.4	2	REP	MATC	71	13	Y	Y
									Geometric Mean	38			
Data Not Used to Derive Plant Eco-SSL													
Narwal et al, 1996	11707	A	Corn	*Zea mays*	8.0	0.3	1	GRO	MATC	141	15	Y	N
Narwal et al, 1996	11707	B	Corn	*Zea mays*	7.8	0.2	1	GRO	MATC	71	15	Y	N
Narwal et al, 1996	11707	C	Corn	*Zea mays*	7.7	1.2	1	GRO	MATC	71	15	Y	N
Taylor and Allinson, 1981	2790	A	Alfalfa	*Medicago sativa*	6.9	4.8	1	GRO	MATC	177	14	Y	N
Halstead et al, 1969	7465	C	Oat	*Avena sativa*	5.7	4.1	1	REP	MATC	224	12	Y	N
Halstead et al, 1969	7465	F	Alfalfa	*Medicago sativa*	5.7	4.1	1	GRO	MATC	32	12	Y	N
Halstead et al, 1969	7465	D	Alfalfa	*Medicago sativa*	7.8	4.0	0	GRO	MATC	224	11	Y	N
Tikhomirov et al, 1988	4757	B	Oat	*Avena sativa*	4.6	2.5	2	GRO	LOAEC	100	14	N	N
Singh and Jeng, 1993	12400	--	Ryegrass	*Lelium perenne*	6.0	0.7	2	GRO	NOAEC	50	14	N	N
Halstead et al, 1969	7465	E	Alfalfa	*Medicago sativa*	6.1	1.4	2	GRO	LOAEC	20	13	N	N
Wallace et al, 1977	57304	A	Bush Beans	*Phaseolus vulgaris*	4.0	2.8	2	GRO	NOAEC	250	12	N	N
Rehab and Wallace, 1978	7523	A	Cotton	*Gossypium barbadense*	6.8	2.2	1	GRO	LOAEC	100	12	N	N
Metwally and Rabie, 1989	1536	D	Corn	*Zea mays*	8.2	1.2	1	GRO	MATC	57	11	N	N
Wallace et al, 1977	57304	B	Bush Beans	*Phaseolus vulgaris*	5.8	2.8	1	GRO	LOAEC	100	11	N	N
Elmosly and Abdel-Sabour, 1997	4094	A	Red Clover	*Trifolium pratense L.*	8.2	1.0	1	GRO	NOAEC	100	14	N	N
Elmosly and Abdel-Sabour, 1997	4094	B	Red Clover	*Trifolium pratense L.*	7.9	0.6	1	GRO	NOAEC	100	14	N	N
Elmosly and Abdel-Sabour, 1997	4094	C	Red Clover	*Trifolium pratense L.*	7.6	0.1	1	GRO	NOAEC	100	14	N	N
Tikhomirov et al, 1988	4757	A	Oat	*Avena sativa*	5.9	2.9	1	GRO	LOAEC	400	13	N	N

Table 3.1 Plant Toxicity Data - Nickel

Reference	IP Number	Study ID	Test Organism		Soil pH	OM %	Bio-availability Score	ERE	Tox Parameter	Tox Value-Soil Conc. (mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Dang et al, 1990	12906	A	Onion	*Allium cepa*	8.3	0.5	1	GRO	LOAEC	50	11	N	N
Dang et al, 1990	12906	B	Fenugreek	*Trigonella poenum*	8.3	0.5	1	GRO	LOAEC	50	11	N	N
Metwally and Rabie, 1989	1536	C	Fava Bean	*Vicia faba*	8.2	1.2	1	GRO	NOAEC	50	11	N	N
Wallace et al, 1977	57304	C	Barley	*Hordeum vilgare*	5.8	2.8	1	GRO	MATC	50	11	N	N
Genovese, 1978	58147	B	Jack Pine	*Pinus banksiana*	7.7	0.1	1	GRO	NOAEC	150	11	N	N
Genovese, 1978	58147	D	Black Spruce	*Picea mariana*	7.7	0.1	1	GRO	NOAEC	150	11	N	N
Halstead et al, 1969	7465	A	Oat	*Avena sativa*	7.8	4.0	0	REP	NOAEC	500	11	N	N
Gupta et al, 1996	13146	A	Chickpea	*Cicer arietinum*	8.0	2.0	0	GRO	MATC	6	11	N	N
Gupta et al, 1996	13146	B	Lentil	*Lens esculentum*	8.0	2.0	0	GRO	MATC	4	11	N	N
Gupta et al, 1996	13146	C	Mustard	*Brassica juncia*	8.0	2.0	0	GRO	MATC	14	11	N	N

EC_{20} = Effect concentration for 20% 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
-- Study ID number not assigned
OM = Organic matter content
PHY = Physiology
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)

4.0 ECO-SSL FOR SOIL INVERTEBRATES

Of the papers identified from the literature search process, 46 papers were selected for acquisition for further review. Of those papers acquired, 9 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). Twelve 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 five studies eligible for Eco-SSL derivation. The Eco-SSL is the geometric mean of the maximum acceptable toxicant concentrations (MATCs) for five species under different test conditions (pH and % organic matter (OM)) and is equal to 280 mg/kg dw.

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 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 1,169 papers with possible toxicity data for either avian or mammalian species. Of these studies, 1,101 were rejected for use as described in Section 7.5. Of the remaining studies, 11 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 28 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 6.71 mg nickel/kg bw/day. This value is lower than the lowest bounded LOAEL for reproduction, growth, or survival. Therefore, the TRV is equal to the geometric mean of the NOAEL values for reproduction and growth and is equal to 6.71 mg nickel/kg bw/day.

Table 4.1 Invertebrate Toxicity Data - Nickel

Reference	IP Number	Study ID	Test Organism		Soil pH	OM %	Bio-availability Score	ERE	Tox Parameter	Tox Value-Soil Conc. (mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Scott-Fordsmand et al, 1999	15163	--	Springtail	*Folsomia fimetaria L.*	5.8	4.0	1	REP	MATC	387	16	Y	Y
Scott-Fordsmand et al, 1998	18892	a	Earthworm	*Eisenia veneta*	5.8	4.0	1	REP	MATC	173	13	Y	Y
Lock and Janssen, 2002	66195	a	Earthworm	*Eisenia fetida*	6.0	10.0	1	REP	MATC	240	14	Y	Y
Lock and Janssen, 2002	66195	b	Earthworm	*Enchytraeus albidus*	6.0	10.0	1	REP	MATC	240	14	Y	Y
Lock and Janssen, 2002	66195	c	Springtail	*Folsomia candida*	6.0	10.0	1	REP	MATC	423	14	Y	Y
									Geometric Mean	280			
Data Not Used to Derive Invertebrate Eco-SSL													
Peredney and Williams, 2000b	56449	m	Roundworm	*Caenorhabditis elegans*	4	1.14	2	MOR	LC_{50}	144	13	N	N
Peredney and Williams, 2000b	56449	n	Roundworm	*Caenorhabditis elegans*	4	1.14	2	MOR	LC_{50}	44	13	N	N
Peredney and Williams, 2000b	56449	o	Roundworm	*Caenorhabditis elegans*	4	4.2	2	MOR	LC_{50}	387	13	N	N
Peredney and Williams, 2000b	56449	p	Roundworm	*Caenorhabditis elegans*	4	4.2	2	MOR	LC_{50}	165	13	N	N
Neuhauser et al, 1985	6812	--	Earthworm	*E. fetida*	6.0	10.0	1	MOR	LC_{50}	242	11	N	N
Korthals et al, 1996	4402	--	Nematodes	nematoda (various sp.)	4.1	1.9	1	POP	LOAEC	100	14	N	N
Peredney and Williams, 2000a	53082	--	Roundworm	*Caenorhabditis elegans*	4	10	1	MOR	LC_{50}	797	12	N	N
Peredney and Williams, 2000b	56449	q	Roundworm	*Caenorhabditis elegans*	4	10	1	MOR	LC_{50}	800	12	N	N
Peredney and Williams, 2000b	56449	r	Roundworm	*Caenorhabditis elegans*	4	10	1	MOR	LC_{50}	348	12	N	N
Neuhauser et al, 1986	17707	--	Earthworm	*E. fetida*	6.0	10.0	0	MOR	LC_{50}	242	14	N	N

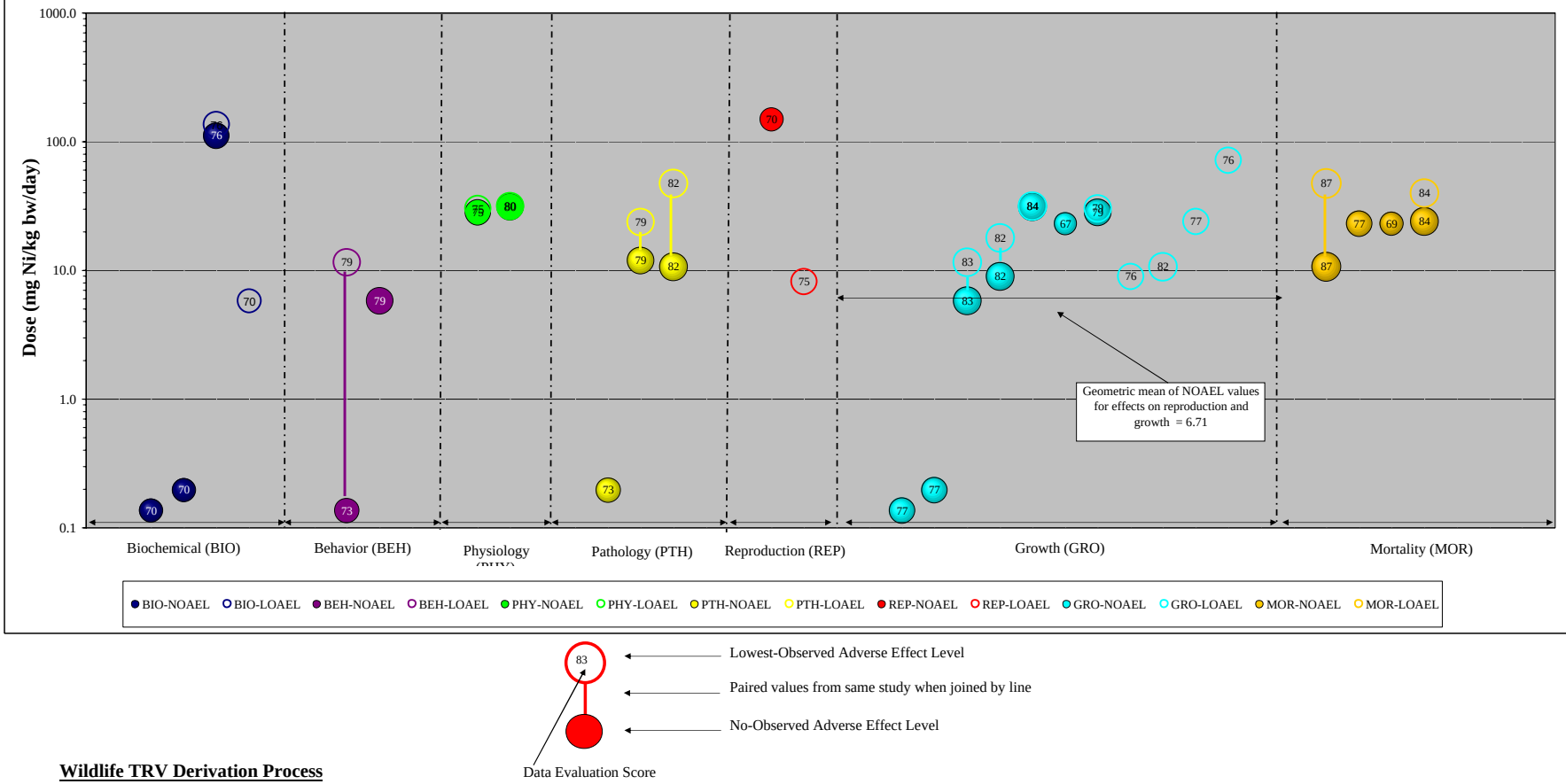
ERE = Ecologically relevant endpoint
LC_{50} = Concentration lethal to 50% of test populatior
LOAEC = Lowest observed adverse effect concentration
MATC = Maximum acceptable toxicant concentration
MOR = Mortality
N = No
-- Study ID not assigned
NOAEC = No observed adverse effect concentration
OM = Organic 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)

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

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	Oscar and Mitchell, 1995	5407	Chicken (*Gallus domesticus*)	3	U	FD	28	d	21	d	JV	F	CHM	LIPD	WO	0.136		70
2	Nielsen et al, 1975	6885	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	CHM	HMCT	BL	0.195		70
3	Ling and Leach, 1979	6666	Chicken (*Gallus domesticus*)	6	U	FD	3	w	1	d	JV	M	CHM	HMGL	BL	110	135	76
4	Martinez and Diaz, 1996	5345	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	CHM	HMGL	BL		5.76	70
Behavior (BEH)																		
5	Oscar and Mitchell, 1995	5407	Chicken (*Gallus domesticus*)	3	U	FD	28	d	21	d	JV	F	FDB	FCNS	WO	0.136		73
6	Martinez and Diaz, 1996	5345	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	FDB	FCNS	WO	5.76	11.5	79
Physiology (PHY)																		
7	Weber and Reid, 1968	60	Chicken (*Gallus domesticus*)	8	U	FD	4	w	1	d	JV	B	PHY	FDCV	WO	28.3	30.2	75
8	Weber and Reid, 1968	60	Chicken (*Gallus domesticus*)	8	U	FD	4	w	1	d	JV	B	PHY	META	WO	31.0	31.5	80
Pathology (PTH)																		
9	Nielsen et al, 1975	6885	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	ORW	SMIX	SK	0.195		73
10	Cain and Pafford, 1981	6461	Duck (*Anas platyrhynchos*)	4	M	FD	28	d	1	d	JV	B	ITX	ATAX	WO	10.7	47.0	82
11	Martinez and Diaz, 1996	5345	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	HIS	GHIS	HE	11.9	23.8	79
Reproduction (REP)																		
12	Eastin and O'Shea, 1981	6492	Duck (*Anas platyrhynchos*)	5	U	FD	90	d	20	mo	LB	F	REP	HTCH	EG	149		70
13	Meluzzi et al, 1996	2771	Chicken (*Gallus domesticus*)	4	U	FD	60	d	22	w	LB	F	EGG	ESWT	EG		8.16	75
Growth (GRO)																		
14	Oscar et al, 1995	5407	Chicken (*Gallus domesticus*)	3	U	FD	28	d	21	d	JV	F	GRO	BDWT	WO	0.136		77
15	Nielsen et al, 1975	6885	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	0.195		77
16	Martinez and Diaz, 1996	5345	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	5.76	11.5	83
17	Hill, 1979	397	Chicken (*Gallus domesticus*)	3	U	FD	5	w	1	d	JV	F	GRO	BDWT	WO	8.95	17.9	82
18	Blalock and Hill, 1985	36697	Chicken (*Gallus domesticus*)	2	U	FD	25	d	1	d	JV	B	GRO	BDWT	WO	22.9		67
19	Weber and Reid, 1968	60	Chicken (*Gallus domesticus*)	8	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO	28.3	30.2	79
20	Weber and Reid, 1968	60	Chicken (*Gallus domesticus*)	8	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO	31.0	31.5	84
21	Hill, 1979	397	Chicken (*Gallus domesticus*)	3	U	FD	5	w	1	d	JV	F	GRO	BDWT	WO		8.95	76
22	Cain and Pafford, 1981	6461	Duck (*Anas platyrhynchos*)	4	M	FD	60	d	1	d	JV	F	MPH	HULT	HM		10.7	82
23	Ling and Leach, 1979	6666	Chicken (*Gallus domesticus*)	6	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO		23.9	77
24	Hill, 1985	36708	Chicken (*Gallus domesticus*)	2	U	FD	19	d	NR	NR	JV	B	GRO	BDWT	WO		71.8	76
Survival (MOR)																		
25	Cain and Pafford, 1981	6461	Duck (*Anas platyrhynchos*)	4	M	FD	30	d	1	d	JV	B	MOR	SURV	WO	10.7	47.0	87
26	Blalock and Hill, 1985	36697	Chicken (*Gallus domesticus*)	2	U	FD	25	d	1	d	JV	B	MOR	MORT	WO	22.9		77
27	Martinez and Diaz, 1996	5345	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	MOR	MORT	WO	23.0		69
28	Ling and Leach, 1979	6666	Chicken (*Gallus domesticus*)	6	U	FD	3	w	1	d	JV	M	MOR	SURV	WO	23.9	39.9	84

AD = adult; ATAX = ataxia; B = both; BDWT = body weight changes; BEH = behavior; BIO = biochemical effects; BL = blood; bw = body weight; CHM = chemical changes; d day; EGG = effects on eggs; EG = egg; ESWT = eggshell weight; F = female; FCNS = food consumption; FD = food; FDB = feeding behavior; FDCV = food conversion efficiency; GHIS = general histology; GRO = growth; HE = heart; HIS = histological changes; HM = humerus; HMCT = hematocrit; HMGL = hemoglobin; HTCH = hatch; HULT = humerus length; ITX = intoxication; JV = juvenile; kg = kilograms; LB = egg laying bird; LIPD = lipid; LOAEL = lowest observed adverse effect level; M = male; M = measured; META = metabolic rate; mo = months; MOR = effects on mortality and survival; MORT = mortality; MPH = morphology effects; NOAEL = No Observed Advese Effect Level; NR = Not reported; ORW = organ weight changes; ORWT = organ weight changes; PHY = physiology; PTH = pathology; REP = reproduction; SK = skin, epidermis; SMIX = weight relative to body weight; SURV = survival;U = unmeasured; w = weeks; WO = whole organism.

Figure 5.1 Avian TRV Derivation for Nickel



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 6.71 mg nickel/kg bw/d and is lower than the lowest bounded LOAEL for results within the reproduction, growth, and survival (MOR) effect groups.

3) The avian wildlife TRV for nickel is equal to 6.71 mg nickel/kg bw/day which is the geometric mean of NOAEL values for effects on reproduction and growth.

5.2 Estimation of Dose and Calculation of the Eco-SSL

Two separate Eco-SSL values were calculated for avian wildlife, one for each of two 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. An Eco-SSL value could not be calculated for the avian ground insectivore (woodcock) as a reliable method to estimate uptake of nickel from soil into soil invertebrates could not be identified (see Attachment 4-1 of the Eco-SSL guidance; U.S. EPA, 2003).

Table 5.2 Calculation of the Avian Eco-SSLs for Nickel

Surrogate Receptor Group	TRV for Nickel (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 Nickel in Biota Type (i)[2,3] (B_i) (mg/kg dw)	Eco-SSL (mg/kg dw)[4]
Avian herbivore (dove)	6.71	0.190	0.139	$\ln(B_i) = 0.748 * \ln(Soil_j) - 2.223$ where i = plants	210
Avian ground insectivore (woodcock)	6.71	0.214	0.164	NA	NA
Avian carnivore (hawk)	6.71	0.0353	0.057	$\ln(B_i) = 0.4658 * \ln(Soil_j) - 0.2462$ where i = mammals	2800

[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).
NA = Not Available.

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 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 1,169 papers with possible toxicity data for nickel for either avian or mammalian species. Of these studies, 1,101 were rejected for use as described in Section 7.5. Of the remaining papers, 52 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)
Nickel

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	Spears et al, 1984	19671	Rat (*Rattus norvegicus*)	3	U	FD	21	d	1	d	JV	NR	ENZ	ALPH	SR	0.265	1.32	74
2	Chatterjee et al, 1979	19098	Rat (*Rattus norvegicus*)	2	U	FD	21	d	NR	NR	JV	M	CHM	ASCA	LI	0.335		74
3	Nielsen, 1980	19478	Rat (*Rattus norvegicus*)	3	U	FD	10	w	NR	NR	JV	F	CHM	HMCT	PL	0.456	4.56	73
4	Pandey et al, 1999	19521	Mouse (*Mus musculus*)	3	U	GV	35	d	NR	NR	JV	M	ENZ	LADH	TE	1.35	2.71	83
5	Spears and Hatfield, 1985	19666	Rat (*Rattus norvegicus*)	3	U	FD	21	d	NR	NR	JV	M	CHM	LEUK	BL	1.47	22.0	72
6	O'Dell et al, 1970	14477	Cattle (*Bos taurus*)	4	U	FD	8	w	14	w	JV	M	CHM	CALC	NR	1.63	6.53	75
7	Kadiiska et al, 1985	19290	Rat (*Rattus norvegicus*)	2	U	DR	30	d	NR	NR	JV	M	ENZ	P450	LI	4.47		67
8	Obone et al, 1999	19507	Rat (*Rattus norvegicus*)	4	U	DR	13	w	NR	NR	JV	M	CHM	PRTL	PL	4.70	11.7	71
9	ODell et al, 1970	14476	Cattle (*Bos taurus*)	3	U	FD	6	w	NR	NR	LC	F	CHM	PRTL	MK	6.75		70
10	Smith et al, 1993	62	Rat (*Rattus norvegicus*)	4	M	DR	26	w	62	d	LC	F	CHM	GBCM	PL	6.80	31.6	78
11	Oosting et al, 1991	19514	Rat (*Rattus norvegicus*)	3	M	FD	28	d	31	d	JV	M	CHM	HMGL	BL	7.78		75
12	Oosting et al, 1991	19514	Rat (*Rattus norvegicus*)	2	M	FD	28	d	31	d	JV	M	CHM	HMGL	BL	8.20		75
13	Whanger, 1973	63	Rat (*Rattus norvegicus*)	4	U	FD	6	w	35	d	JV	NR	CHM	HMGL	BL	9.49	47.4	69
14	Nation et al, 1985	19460	Rat (*Rattus norvegicus*)	3	U	FD	14	d	80	d	JV	M	CHM	GBCM	LI	20.0		74
15	Uthus and Poellot, 1997	19764	Rat (*Rattus norvegicus*)	2	U	FD	57	d	NR	NR	JV	M	ENZ	GENZ	LI		0.0844	70
16	Spears et al, 1986	19664	Cattle (*Bos taurus*)	2	U	FD	28	d	50	d	JV	M	CHM	AMMO	GT		0.101	71
17	Milne et al, 1990	19437	Sheep (*Ovis aries*)	2	U	GV	4	w	5	mo	JV	F	ENZ	GENZ	SH		0.147	73
18	Nielsen et al, 1979	19461	Rat (*Rattus norvegicus*)	3	U	FD	9	w	21	d	JV	F	CHM	HMCT	BL		0.456	69
19	Pandey and Singh, 1999	19522	Mouse (*Mus musculus*)	3	U	GV	35	d	NR	NR	JV	M	ENZ	LADH	TE		0.797	72
20	Spears and Hatfield, 1985	19666	Rat (*Rattus norvegicus*)	2	U	FD	42	d	NR	NR	JV	M	CHM	HMGL	BL		2.63	70
21	Tandon and Mathur, 1986	19746	Rat (*Rattus norvegicus*)	2	U	GV	4	w	NR	NR	JV	M	ENZ	MADH	KI		3.00	77
22	Vyskocil et al, 1994	19787	Rat (*Rattus norvegicus*)	2	U	DR	6	mo	10	w	JV	M	CHM	ALBM	UR		6.25	66
23	Novelli et al, 1998	19496	Rat (*Rattus norvegicus*)	2	U	DR	2	mo	15	w	JV	M	ENZ	AATT	SR		12.5	66
24	Waltschewa et al, 1972	19792	Rat (*Rattus norvegicus*)	2	U	GV	120	d	5	mo	JV	M	ENZ	GENZ	TE		25.0	77
25	Dieter,et al, 1988	61	Mouse (*Mus musculus*)	4	UX	DR	180	d	6-8	w	JV	F	ENZ	G6PD	BM		43.3	71
26	Mathur, 1987	19416	Rat (*Rattus norvegicus*)	2	U	FD	3	w	3	w	JV	M	ENZ	GOTR	LI		44.5	69
27	Weber and Reid, 1969	14485	Mouse (*Mus musculus*)	3	U	FD	4	w	NR	NR	JV	B	ENZ	CCOX	LI		179	66
Behavior (BEH)																		
28	Spears et al, 1986	19664	Cattle (*Bos taurus*)	2	U	FD	140	d	50	d	JV	M	FDB	FCNS	WO	0.101		72
29	O'Dell et al, 1970	14477	Cattle (*Bos taurus*)	4	U	FD	8	w	14	w	JV	M	FDB	FCNS	WO	1.63	6.53	78
30	Gershbein et al 1983	136	Rat (*Rattus norvegicus*)	2	U	FD	80	d	44	d	JV	M	BEH	NMVM	WO	5.89		66
31	Vyskocil et al, 1994	19787	Rat (*Rattus norvegicus*)	2	U	DR	6	mo	10	w	JV	M	FDB	WCON	WO	6.25		69
32	Smith et al, 1993	62	Rat (*Rattus norvegicus*)	4	M	DR	11	w	62	d	LC	F	FDB	WCON	WO	6.80	31.63	81
33	O'Dell et al, 1971	14479	Cattle (*Bos taurus*)	4	UX	FD	8	w	13-21	w	JV	M	FDB	FCNS	WO	7.00	14.6	88
34	Oosting et al, 1991	19514	Rat (*Rattus norvegicus*)	3	M	FD	28	d	31	d	JV	M	FDB	FCNS	WO	7.78		78
35	Oosting et al, 1991	19514	Rat (*Rattus norvegicus*)	2	M	FD	28	d	31	d	JV	M	FDB	FCNS	WO	8.20		78
36	Nation et al, 1985	19460	Rat (*Rattus norvegicus*)	3	U	FD	14	d	80	d	JV	M	BEH	ACTP	WO	10.0	20.0	83
37	Alexander et al, 1978	36694	Meadow vole (*Microtus pennsylvanicus*)	4	M	FD	49	d	14	d	JV	NR	FDB	FCNS	WO	29.4	309	81
38	Dieter,et al, 1988	61	Mouse (*Mus musculus*)	4	UX	DR	180	d	6-8	w	JV	F	FDB	WCON	WO	43.3	107	80
39	Weber and Reid, 1969	14485	Mouse (*Mus musculus*)	3	U	FD	4	w	NR	NR	JV	M	FDB	FCNS	WO	179	265	75
40	Cempel and Janicka, 2002	36331	Rat (Rattus norvegicus)	3	U	DR	90	d	NR	NR	JV	M	FDB	WCON	WO		37.6	69
Physiology (PHY)																		
41	Szakmary et al, 1995	19729	Rat (*Rattus norvegicus*)	2	U	GV	8	d	NR	NR	GE	F	PHY	BLPR	HE	1.36		80
42	O'Dell et al, 1971	14479	Cattle (*Bos taurus*)	4	UX	FD	8	w	13	w	JV	M	PHY	EXCR	UR	1.80	7.00	86
43	Obone et al, 1999	19507	Rat (*Rattus norvegicus*)	4	U	DR	13	w	NR	NR	JV	M	PHY	EXCR	UR	4.70	11.7	74
44	O'Dell et al, 1970	14477	Cattle (*Bos taurus*)	4	U	FD	8	w	14	w	JV	M	PHY	DIFD	WO	6.55		74
45	ODell et al, 1970	14476	Cattle (*Bos taurus*)	3	U	FD	6	w	NR	NR	LC	F	PHY	GPHY	MK	6.75		73
Pathology (PTH)																		
46	Chatterjee et al, 1979	19098	Rat (*Rattus norvegicus*)	2	U	FD	21	d	NR	NR	JV	M	ORW	SMIX	LI	0.335		77
47	Nielsen, 1980	19478	Rat (*Rattus norvegicus*)	3	U	FD	10	w	NR	NR	JV	F	ORW	SMIX	LI	0.456	4.56	76
48	O'Dell et al, 1970	14477	Cattle (*Bos taurus*)	4	U	FD	8	w	14	w	JV	M	ORW	ORWT	LU	1.64	6.55	78
49	Ambrose et al, 1976	14474	Rat (*Rattus norvegicus*)	4	U	FD	24	mo	28	d	JV	B	ORW	SMIX	HE	8.06	80.6	77
50	Ambrose et al, 1976	14474	Dog (*Canis familiaris*)	4	U	FD	24	mo	6	mo	JV	B	ORW	SMIX	KI	45.0	112	78
51	Schroeder and Mitchener, 1975	1858	Mouse (*Mus musculus*)	2	U	DR	520	d	19-20	d	JV	M	HIS	EDMA	WO		0.705	68
52	Pandey et al, 1999	19521	Mouse (*Mus musculus*)	3	U	GV	35	d	NR	NR	JV	M	ORW	ORWT	PG		1.35	80
53	Kakela et al, 1999	19293	Rat (*Rattus norvegicus*)	3	U	DR	62	d	3.5-9	mo	GE	F	ORW	SMIX	LI		3.40	68
54	Obone et al, 1999	19507	Rat (*Rattus norvegicus*)	4	U	DR	13	w	NR	NR	JV	M	ORW	ORWT	HE		4.70	68
55	Schroeder et al, 1974	14484	Rat (*Rattus norvegicus*)	2	M	DR	1217	d	30	d	JV	B	HIS	GHIS	HE		5.44	71
56	Vyskocil et al, 1994	19787	Rat (*Rattus norvegicus*)	2	U	DR	6	mo	10	w	JV	M	ORW	SMIX	KI		6.25	69
57	Dieter,et al, 1988	61	Mouse (*Mus musculus*)	4	UX	DR	180	d	6-8	w	JV	F	ORW	ORWT	LI		43.3	74
58	Seidenberg et al 1986	113	Mouse (*Mus musculus*)	2	U	GV	4	d	NR	NR	GE	F	GRS	BDWT	WO		90.6	80

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

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
Reproduction (REP)																		
59	Kakela et al, 1999	19293	Rat (*Rattus norvegicus*)	4	U	DR	28	d	3.5-9	mo	SM	M	REP	GIDX	WO	1.10	3.31	80
60	Pandey and Srivastava, 2000	36722	Mouse (*Mus musculus*)	4	U	OR	35	d	NR	mo	JV	M	REP	SPCL	SM	1.35	2.71	92
61	Pandey and Srivastava, 2000	36722	Mouse (*Mus musculus*)	4	U	OR	35	d	NR	NR	JV	M	REP	SPCL	SM	1.70	3.40	92
62	Phatak and Patwardhan, 1950	14480	Rat (*Rattus norvegicus*)	4	U	FD	4	mo	4	w	GE	F	REP	PRWT	WO	9.30		71
63	Chernoff and Kavlock, 1982	1260	Mouse (*Mus musculus*)	2	U	GV	5	d	60	d	GE	F	REP	PROG	WO	45.3		86
64	Berman and Rehnberg, 1983	19064	Mouse (*Mus musculus*)	3	U	DR	15	d	NR	NR	GE	F	REP	PRFM	WO	85.3	171	81
65	Seidenberg et al 1986	113	Mouse (*Mus musculus*)	2	U	GV	4	d	NR	NR	GE	F	REP	PRWT	WO	90.6		82
66	Ambrose et al, 1976	14474	Dog (*Canis familiaris*)	4	U	FD	24	mo	6	mo	JV	B	REP	TEWT	TE	112		74
67	Ambrose et al, 1976	14474	Rat (*Rattus norvegicus*)	4	U	FD	118	d	28	d	GE	F	REP	PRWT	WO	164	327	84
68	Ambrose et al, 1976	14474	Rat (*Rattus norvegicus*)	4	U	FD	2	yr	28	d	JV	M	REP	TEWT	TE	205		70
69	Schroeder and Mitchener, 1971	66	Rat (*Rattus norvegicus*)	2	U	DR	9	mo	21	d	GE	F	REP	DEYO	WO		0.551	67
70	Pandey and Singh, 1999	19522	Mouse (*Mus musculus*)	3	U	GV	35	d	NR	NR	JV	M	REP	SPCV	SM		0.797	81
71	Smith et al, 1993	62	Rat (*Rattus norvegicus*)	4	M	DR	23	w	62	d	LC	F	REP	DEYO	WO		1.33	83
72	Pandey et al, 1999	19521	Mouse (*Mus musculus*)	3	U	GV	35	d	NR	NR	JV	M	REP	TEWT	TE		1.35	86
73	Pandey et al, 1999	19520	Mouse (*Mus musculus*)	2	U	GV	35	d	NR	NR	AD	M	REP	RSUC	WO		1.59	86
74	Obone et al, 1999	19507	Rat (*Rattus norvegicus*)	4	U	DR	13	w	NR	NR	JV	M	REP	TEWT	TE		4.70	74
75	Waltschewa et al, 1972	19792	Rat (*Rattus norvegicus*)	2	U	GV	120	d	5	mo	JV	M	REP	SPCL	SM		25.0	86
Growth (GRO)																		
76	Uthus and Poellot, 1997	19764	Rat (*Rattus norvegicus*)	2	U	FD	57	d	NR	NR	JV	M	GRO	BDWT	WO	0.0844		77
77	Spears et al, 1986	19664	Cattle (*Bos taurus*)	2	U	FD	140	d	50	d	JV	M	GRO	BDWT	WO	0.101		78
78	Chatterjee et al, 1979	19098	Rat (*Rattus norvegicus*)	2	U	FD	21	d	NR	NR	JV	M	GRO	BDWT	WO	0.335		81
79	Spears et al, 1984	19671	Rat (*Rattus norvegicus*)	3	U	FD	49	d	1	d	JV	NR	GRO	BDWT	WO	1.17		77
80	Smith et al, 1993	62	Rat (*Rattus norvegicus*)	4	M	DR	15	w	62	d	LC	F	GRO	BDWT	WO	1.33	6.80	85
81	Szakmary et al, 1995	19729	Rat (*Rattus norvegicus*)	2	U	GV	8	d	NR	NR	GE	F	GRO	BDWT	WO	1.36		84
82	Spears and Hatfield, 1985	19666	Rat (*Rattus norvegicus*)	3	U	FD	21	d	NR	NR	JV	M	GRO	BDWT	WO	1.47	22.0	79
83	O'Dell et al, 1970	14477	Cattle (*Bos taurus*)	4	U	FD	8	w	14	w	JV	M	GRO	BDWT	WO	1.64	6.55	82
84	Cikrt et al, 1992	19109	Rat (*Rattus norvegicus*)	2	U	DR	90	d	NR	NR	JV	F	GRO	BDWT	WO	2.97		73
85	Nielsen et al, 1979	19461	Rat (*Rattus norvegicus*)	3	U	FD	9	w	21	d	JV	F	GRO	BDWT	WO	4.56		67
86	Nielsen, 1980	19479	Rat (*Rattus norvegicus*)	3	U	FD	10	w	NR	NR	JV	F	GRO	BDWT	WO	4.56		67
87	Schroeder et al, 1974	14484	Rat (*Rattus norvegicus*)	2	M	DR	1217	d	30	d	JV	B	GRO	BDWT	WO	5.44		75
88	Gershbein et al 1983	136	Rat (*Rattus norvegicus*)	2	U	FD	80	d	44	d	JV	M	GRO	BDWT	WO	5.89		68
89	ODell et al, 1970	14476	Cattle (*Bos taurus*)	3	U	FD	6	w	NR	NR	LC	F	GRO	BDWT	WO	6.75		68
90	O'Dell et al, 1971	14479	Cattle (*Bos taurus*)	4	UX	FD	8	w	13-21	w	JV	M	GRO	BDWT	WO	7.00	14.6	92
91	Oosting et al, 1991	19514	Rat (*Rattus norvegicus*)	3	M	FD	28	d	31	d	JV	M	GRO	BDWT	WO	7.78		82
92	Ambrose et al, 1976	14474	Rat (*Rattus norvegicus*)	4	U	FD	6	w	28	d	JV	B	GRO	BDWT	WO	9.11	91.1	81
93	Phatak and Patwardhan, 1950	14480	Rat (*Rattus norvegicus*)	4	U	FD	8	w	4	w	JV	B	GRO	BDWT	WO	9.30		69
94	Whanger, 1973	63	Rat (*Rattus norvegicus*)	4	U	FD	6	w	35	d	JV	NR	GRO	BDWT	WO	9.49	47.4	76
95	Kakela et al, 1999	19293	Rat (*Rattus norvegicus*)	3	U	DR	62	d	3.5-9	mo	GE	F	GRO	BDWT	WO	11.4		70
96	Obone et al, 1999	19507	Rat (*Rattus norvegicus*)	4	U	DR	13	w	NR	NR	JV	M	GRO	BDWT	WO	11.7	23.4	78
97	Alexander et al, 1978	36694	Meadow vole (*Microtus pennsylvanicus*)	3	U	FD	45	d	14	d	JV	NR	GRO	BDWT	WO	12.5		68
98	Nation et al, 1985	19460	Rat (*Rattus norvegicus*)	3	U	FD	14	d	80	d	JV	M	GRO	BDWT	WO	20.0		72
99	Alexander et al, 1978	36694	Meadow vole (*Microtus pennsylvanicus*)	4	M	FD	49	d	14	d	JV	NR	GRO	BDWT	WO	29.4	309	85
101	Ambrose et al, 1976	14474	Dog (*Canis familiaris*)	4	U	FD	65	w	6	mo	JV	B	GRO	BDWT	WO	45.0	112	82
100	Chernoff and Kavlock, 1982	1260	Mouse (*Mus musculus*)	2	U	GV	5	d	60	d	GE	F	GRO	BDWT	WO	45.3		82
102	Berman and Rehnberg, 1983	19064	Mouse (*Mus musculus*)	3	U	DR	15	d	NR	NR	GE	F	GRO	BDWT	WO	85.3	171	79
103	Dieter,et al, 1988	61	Mouse (*Mus musculus*)	4	UX	DR	180	d	6-8	w	JV	F	GRO	BDWT	WO	107	148	84
104	Spears and Hatfield, 1985	19666	Rat (*Rattus norvegicus*)	2	U	FD	21	d	NR	NR	JV	M	GRO	BDWT	WO		2.81	77
105	Oosting et al, 1991	19514	Rat (*Rattus norvegicus*)	2	M	FD	28	d	31	d	JV	M	GRO	BDWT	WO		8.20	82
106	Clary, 1975	19111	Rat (*Rattus norvegicus*)	2	U	DR	4	mo	NR	NR	JV	M	GRO	BDWT	WO		24.7	72
107	Weber and Reid, 1969	14485	Mouse (*Mus musculus*)	3	U	FD	4	w	NR	NR	JV	F	GRO	BDWT	WO		208	73

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Nickel
Page 3 of 3

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
Survival (MOR)																		
108	Pandey et al, 1999	19521	Mouse (*Mus musculus*)	3	U	GV	35	d	NR	NR	JV	M	MOR	MORT	WO	2.71		85
109	Nielsen et al 1982	19483	Rat (*Rattus norvegicus*)	3	U	FD	11	w	NR	NR	JV	F	MOR	MORT	WO	4.56		77
110	Pandey and Srivastava, 2000	36722	Mouse (*Mus musculus*)	4	U	OR	35	d	NR	NR	JV	M	MOR	MORT	WO	5.42		85
111	Pandey and Srivastava, 2000	36722	Mouse (*Mus musculus*)	4	U	OR	35	d	NR	NR	JV	M	MOR	MORT	WO	6.47		85
112	Alexander et al, 1978	36694	Meadow vole (*Microtus pennsylvanicus*)	4	M	FD	14	d	14	d	JV	NR	MOR	MORT	WO	29.4	309	86
113	Chernoff and Kavlock, 1982	1260	Mouse (*Mus musculus*)	2	U	GV	5	d	60	d	GE	F	MOR	MORT	WO	45.3		76
114	Seidenberg et al 1986	113	Mouse (*Mus musculus*)	2	U	GV	4	d	NR	NR	GE	F	MOR	MORT	WO	90.6		85
115	Ambrose et al, 1976	14474	Dog (*Canis familiaris*)	4	U	FD	24	mo	6	mo	JV	B	MOR	MORT	WO	112		77
116	Cempel and Janicka, 2002	36331	Rat (Rattus norvegicus)	3	U	DR	90	d	NR	NR	JV	M	MOR	MORT	WO	138		74
117	Ambrose et al, 1976	14474	Rat (*Rattus norvegicus*)	4	U	FD	24	mo	28	d	JV	B	MOR	MORT	WO	205		78
118	Schroeder et al, 1964	14447	Mouse (*Mus musculus*)	2	U	DR	16	mo	21	d	JV	B	MOR	SURV	WO		0.620	73
119	Schroeder and Mitchener, 1975	1858	Mouse (*Mus musculus*)	2	U	DR	520	d	19-20	d	AD	F	MOR	LFSP	WO		0.716	68

AATT = alanine aminotransferase; ACTP = accuracy of learned behavior; AD = adult; ALBM = albumins; ALPH = alkaline phosphatase; AMMO = ammonia; ASCA = ascorbic acid; B = both; BDWT = body weight changes; BEH = behavior; BL = blood; BLPR = blood pressure; BM = bone marrow; bw = body weight; CALC = calcium; CCOX = cytochrome C-oxidase; CHM = chemical changes; d - day; DEYO = development of young; DIFD = digestibility of food; DR = Drinking water; EDMA = edema; ENZ = enyzme level changes; EXCR = excretion; F = female; FCNS = food consumption; FD = food; FDB = feeding behavior; G6PD = glucose-6-phosphate dehydrogenase; GBCM = general biochemical changes; GE = gestation; GENZ = general enzyme changes; GHIS = general histology; GIDX = gestation index; GOTR = glutamic-oxaloacetic transaminase; GPHY = general pysiology changes; GRO = growth; GRS = gross body weight changes; GT = gastrointestinal tract; GV = gavage; HE = heart; HIS = histological changes; HMCT = hematocrit; HMGL = hemoglobin; JV = juvenile; kg = kilograms; KI = kidney; L = liter; LADH = lactate dehydrogenase; LEUK = leukocytes; LFSP = lifespan; LI = liver; LOAEL = lowest observed adverse effect level; LU = lungs; M = male; M = measured; MADH = malic dehydrogenase; MK = milk; mo = months; MOR = effects on mortality and survival; M(NMVM = number of movements; NOAEL = No Observed Advese Effect Level; NR = Not reported; OR = other oral; ORW = organ weight changes; ORWT = organ weight changes; P450 = cytochrome P450 proteins; PG = prostrate gland; PHY = physiology; PL = plasma; PRFM = pregnant females in a population; PROG = progeny numbers/counts; PRTL = protein, total; PRWT = progeny weight; PTH = pathology; REP = reproduction; RSUC = reproductive success (general); SH = stomach; SM = sperm; SM = sexually mature SMIX = weight relative to body weight; SPCL = sperm cell counts; SPCV = sperm cell volume; SR = serum; SURV = survival; TE = testes; TEWT = testes weight; U = unmeasured; UR = urine; UX = measured but values not reported; 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.

Within the reviewed papers there are 119 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 7.70 mg nickel/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 1.70 mg nickel/kg bw/day.

6.2 Estimation of Dose and Calculation of the Eco-SSL

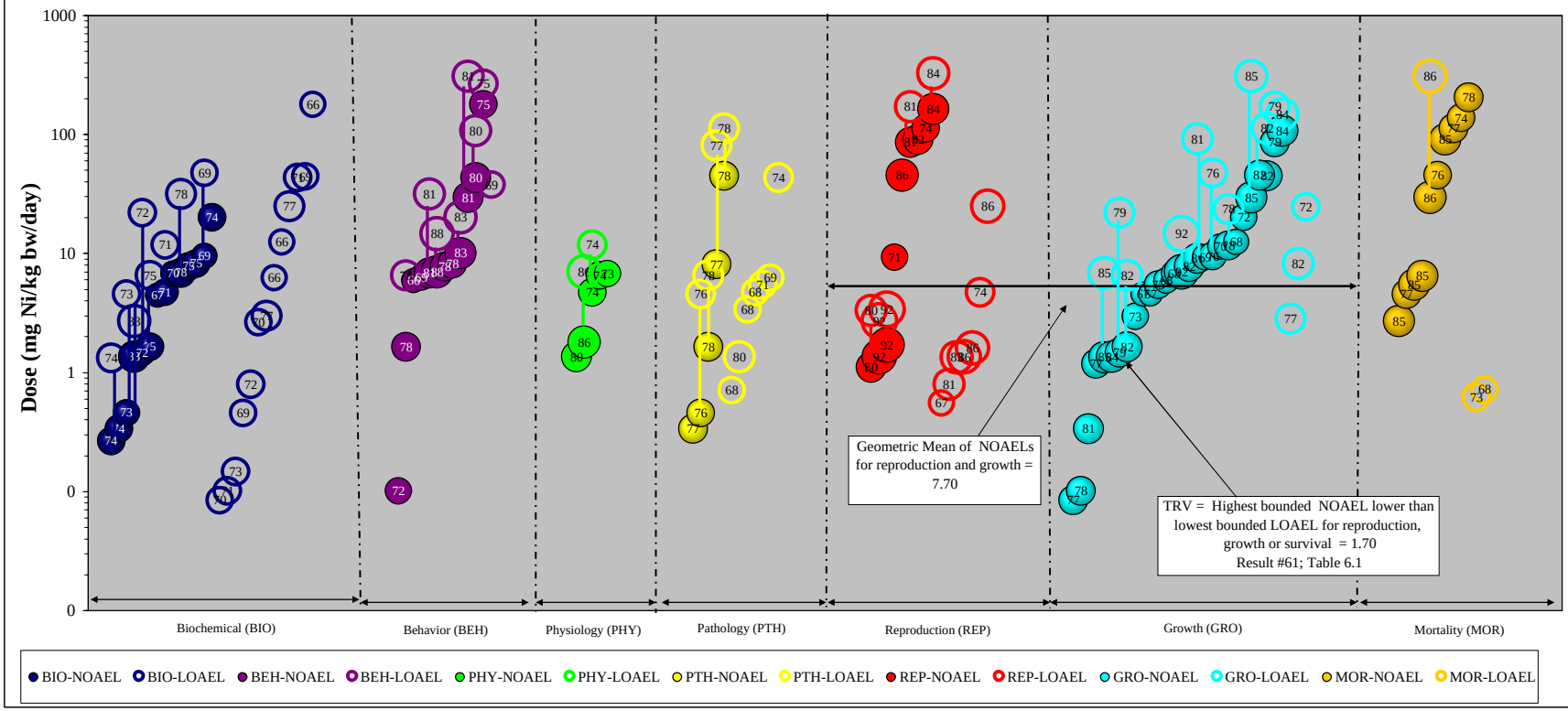
Two separate Eco-SSL values were calculated for mammalian wildlife, one for each of two surrogate receptor groups representing different trophic levels. The mammalian Eco-SSLs derived for nickel were calculated according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5) and are summarized in Table 6.2. An Eco-SSL value could not be calculated for the mammalian ground insectivore (shrew) as a reliable method to estimate uptake of nickel from soil into soil invertebrates could not be identified (see Attachment 4-1 of the Eco-SSL guidance (U.S. EPA, 2003).

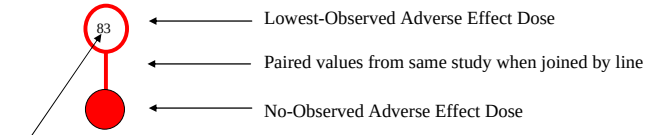
Table 6.2 Calculation of the Mammalian Eco-SSLs for Nickel

Surrogate Receptor Group	TRV for Nickel (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 Nickel in Biota Type (i)[2,3] (B_i) (mg/kg dw)	Eco-SSL (mg/kg dw)[4]
Mammalian herbivore (vole)	1.70	0.0875	0.032	$\ln(B_i) = 0.748 * \ln(Soil_j) - 2.223$ where i = plants	340
Mammalian ground insectivore (shrew)	1.70	0.209	0.030	NA	NA
Mammalian carnivore (weasel)	1.70	0.130	0.043	$\ln(B_i) = 0.4658 * \ln(Soil_j) - 0.2462$ where i = mammals	130

[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).
NA = Not Available

Figure 6.1 Mammalian TRV Derivation for Nickel





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 7.70 mg nickel/kg bw/d. However this value is higher than the lowest bounded LOAEL for results within the reproduction, growth, and survival (MOR) effect groups.

4) The mammalian wildlife TRV for nickel is equal to 1.70 mg nickel/kg bw/day which is the highest bounded NOAEL lower than the lowest bounded LOAEL within the reproduction, growth or survival effect groups.

7.0 REFERENCES

7.1 General Nickel References

Alloway, B.J. 1990. *Heavy Metals in Soils*. Blackie Academic and Professional. New Delhi, India. 339 pp.

Anderson, P.R. and Christensen, T.H. 1988. Distribution coefficients of Cd, Co, Ni, and Zn in soils. *Journal of Soil Science.* 39: 15-22.

Agency for Toxic Substances and Disease Registry (ATSDR). 1988. *Toxicological Profile for Nickel*. ATSDR/TP-88/19.

Budavari , S. (ed.). 1996. *The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals.* Whitehouse Station, New Jersey: Merck and Co., Inc.

Davies, C.N. 1974. Atmos Envir 8: 1069-1079 as cited in National Research Council Canada; *Effects of Nickel in the Canadian Environment*, p. 60 (1981) NRCC No. 18568.

Dean, J.A. (ed.). 1985. *Lange's Handbook of Chemistry*. 13th ed

Spears, J. W., Hatfield, E. E., Forbes, R. M., and Koenig, S. E. 1978. studies on the role of nickel in the ruminant. *Journal of Nutrition*. 108(2): 313-320.

Ohe, S. 1976. Computer Aided Data Book of Vapor Pressure.

National Research Council (NRC). 2005. *Mineral Tolerance of Animals*. Second Edition. The National Academies Press. Washington, D.C. 496 pp.

National Research Council (NRC). 1977. *Drinking Water and Health Volume 1*. Washington, DC: National Academy 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.

7.2 References for Plants and Soil Invertebrates

Dang, Y. P., Chhabra, R., and Verma, K. S. 1990. Effect of Cd, Ni, Pb and Zn on Growth and Chemical Composition

of Onion and Fenugreek. *Commun.Soil Sci.Plant Anal*. 21[9/10], 717-735

Dixon, R. K. 1988. Response of Ectomycorrhizal Quercus rubra to Soil Cadmium, Nickel and Lead. Soil Biol Biochem 20[4], 555-559

Elmosly, W. A. and Abdel-Sabour, M. F. 1997. Transfer Characteristics and Uptake of Nickel by Red Clover Grown on Nickel Amended Alluvial Soils of an Arid Zone. *Agric.Ecosyst.Environ.* 65[1], 49-57

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

Gupta, V. K., Kala, Ram, and Gupta, S. P. 1996. Effect of nickel on yield and its concentration in some Rabi crops grown on Typic Ustipsamment. *J.Indian Soc.Soil Sci* 44[2], 348-349

Halstead, R. I., Finn, B. J., and MacLean, A. J. 1969. Extractability of Nickel Added to Soils and Its Concentration in Plants. *Can.J.Soil Sci*. 49, 335-342

Khalid, B. Y. and Tinsley, J. 1980. Some Effects of Nickel Toxicity on Rye Grass. *Plant Soil* 55, 139-144

Korthals, G. W., Ende, A. van de, Megen, H. van, Lexmond, T. M., Kammenga, J. E., and Bonger, T. 1996. 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

Lock, K. and Janssen, C. R. 2002. Ecotoxicity of Nickel to Eisenia fetida, Enchytraeus albidus and Folsomia candida. Chemosphere 46[2], 197-200.

Metwally, A. I. and Rabie, M. H. 1989. Effect of Ni Addition on Plant Growth and Nutrient Uptake in Two Soils. Egypt. J. Soil Sci. 29[3], 261-274

Narwal, R. P. M. Singh V. Kumar and D. K. Bhandari. 1996. Effect of Nickel Enriched Sewage Water on Dry Matter Yield and Biochemical Characteristics of Corn (Zea mays L.). Indian J.Plant Physiol. 1[3], 185-188

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

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

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

Rehab, F. I. and A. Wallace. 1978. Excess Trace Metal Effects on Cotton: 6. Nickel and Cadmium in Yolo Loam Soil. Commun.Soil Sci.Plant Anal. 9[8], 779-784

Scott-Fordsmand, J. J., Weeks, J. M., and Hopkin, S. P. 1998. Toxicity of Nickel to the Earthworm and the Applicability of the Neutral Red Retention Assay. Ecotoxicology 7[5], 291-295

Scott-Fordsmand, J. J., Krogh, P. H., and Hopkin, S. P. 1999. Toxicity of Nickel to a Soil-Dwelling Springtail, Folsomia fimetaria (Collembola: Isotomidae). Ecotoxicol.Environ.Saf. 43[1], 57-61

Singh, B. R. and Jeng, A. S. 1993. Uptake of Zinc, Cadmium, Mercury, Lead, Chromium and Nickel by Ryegrass Grown in a Sandy Soil. Norw.J.Agric.Sci. 7[2], 147-157

Taylor, R. W. 1974. Presence and Influence of Certain Heavy Metals on the Yield and Utilitzation of Medicago sativa L. M.S.Thesis, Univ.of Connecticut, Storrs, CN , -113 p.

Taylor, R. W. and D. W. Allinson. 1981. Influence of Lead, Cadmium and Nickel on the Growth of Medicago sativa (L.). Plant Soil 60, 223-236

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

TN&Associates Inc. 2000. Plant Toxicity Testing to Support Development of Ecological Soil Screening Levels. Subcontract Agreement No.SC-IDIQ-1999142-29, National Center for Environ.Assess., Washington, D.C. 53 p.

Wallace, A., Romney, E. M., Cha, J. W., .Soufi, S. M., and Chaudhry, F. M. 1977. Nickel Phytotoxicity in Relationship to Soil pH Manipulation and Chelating Agents. Commun.Soil Sci.Plant Anal. 8[9], 757-764

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.

OM Adams, T. M., McGrath, S. P., and Sanders, J. R. 1985. 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

Media Aggangan, N. S., Dell, B., and Malajczuk, N. 1998. Effects of Chromium and Nickel on Growth of the Ectomycorrhizal Fungus Pisolithus and Formation of Ectomycorrhizas on Eucalyptus urophylla S.T. Blake. *Geoderma* 84[1-3], 15-27

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

No Tox Alikhan, M. A. 1993. Differentiation in Copper and Nickel Accumulation in Adult Female and Juvenile Porcellio spinicornus from Contaminated and Uncontaminated Sites in Northeastern Ontario. *Bull.Environ.Contam.Toxicol*. 50, 922-928

No Dose Allinson, D. W. and Dzialo, C. 1981. The Influence of Lead, Cadmium and Nickel on the Growth of Ryegrass and Oats. *Plant Soil* 62, 81-89

OM Allison, R. V., Bryan, O. C., and Hunter, J. H. 1927. 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

OM Almas, A., Singh, B. R., and Sveistrup, T. E. 1995. The Impact of the Nickel Industry in Russia on Concentrations of Heavy Metals in Agricultural Soils and Grass in Sor-Varanger, Norway 49450. *Norw.J.Agric.Sci*. 9[1/2], 61-74

Media Amir, Hamid and Pineau, Rene. 1998. Effects of metals on the germination and growth of fungal isolates from new caledonian ultramafic soils. Soil Biology & Biochemistry 30[14], 2043-2054

OM Anderson, A. J., Meyer, D. R., and Mayer, F. K. 1979. Effects of the Environment on the Symptom Pattern of Nickel Toxicity in the Oat Plant. *Ann.Bot.* 43, 271-283

Mix Anderson, A. J., Meyer, D. R., and Mayer, F. K. 1973. Heavy Metal Toxicities: Levels of Nickel, Cobalt, and Chromium in the Soil and Plants Associated with Visual Symptoms and Variation in Growth of an Oat Crop 49492. *Aust.J.Agric.Res*. 24, 557-571

No Dur Anke, M., Groppel, B., Riedel, E., and Schneider, H. J. 1980. Plant and Animal Tissues as Indicators of Exposure to Nickel. 49530. In: S.S.Brown and F.W.Sunderman,Jr.(Eds.), *Nickel Toxicology*, Academic Press, New York, NY , 65-68

Media Aschmann, S. G. and Zasoski, R. J. 1987. Nickel and Rubidium Uptake by Whole Oat Plants in Solution Culture. *Physiol.Plant*. 71, 191-196

No Dur Ashton, W. M. 1972. Nickel Pollution 49625. Nature 237, 46-47

No Dur Aucejo, A., Ferrer, J., Gabaldon, C., Marzal, P., and Seco, A. 1997. Diagnosis of Boron, Fluorine, Lead, Nickel and Zinc Toxicity in Citrus Plantations in Villarreal, Spain. Water Air Soil Pollut. 94[3/4], 349-360

FL Austenfeld, F. A. 1979. Effects of Nickel, Cobalt and Chromium on Net Photosynthesis of Primary and Secondary Leaves of Phaseolus vulgaris L. (Nettophotosynthese der Primarund Folgeblatter von Phaseolus vulgaris L. unter dem Einfluss von Nickel, Kobalt und Chrom). Photosynthetica 13[4], 434-438

Media Austenfeld, F. A. 1979. Phytotoxicity of Nickel and Cobalt on Phaseolus vulgaris L. Grown in Solution Culture (Zur Phytotoxizitat von Nickel-und Kobaltsalzen in Hydrokultur bei *Phaseolus vulgaris L.*). *Z.Pflanzenernaehr.Dueng.Bodenkd.* 142, 786-791 (GER) (ENG ABS)

Media Babich, H. 1986. Cadmium-Nickel Toxicity Interactions Towards a Bacterium, Filamentous Fungi, and a Cultured Mammalian Cell Line. *Bull.Environ.Contam.Toxicol.* 37[4], 550

Rev Babich, H. and Stotzky, G. 1985. Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies. Environ.Res. 36, 111-137

Media Babich, H. and Stotzky, G. 1982. Nickel Toxicity to Fungi: Influence of Environmental Factors. *Ecotoxicol.Environ.Saf.* 6[6], 577-589

Media Baccouch, S., Chaoui, A., and El Ferjani, E. 1998. Nickel-Induced Oxidative Damage and Antioxidant Responses in Zea mays Shoots. *Plant Physiol.Biochem*. 36[9], 689-694

Media Baccouch, S., Chaoui, A., and El Ferjani, E. 1998. Nickel toxicity: effects on growth and metabolism of maize. *J.Plant Nutr.* 21[3], 577-588

Media Bazzaz, F. A., Carlson, R. W., and Rolfe, G. L. 1974. The Effect of Heavy Metals on Plants: Part 1. Inhibition of Gas Exchange in Sunflower by Pb, Cd, Ni, and Ti. *Environ.Pollut.* 7, 241-246

OM Beasley, T. M. and Held, E. E. Nickel-63 in Marine and Terrestrial Biota, Soil and Sediment 38139. *Science* 164, 169, 1161-1163

Media Berry, W. L. 1978. 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

Mix Berry, W. L. and Wallace, A. 1989. Interaction of the Yield Response Surface of Lettuce with High and Toxic Concentrations of Zinc and Nickel. *Soil Sci*. 147[6], 398-400

No Dose Bhuiya, M. R. H. and Cornfield, A. H. 1972. 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 50069. *Environ.Pollut*. 3, 173-177

Mix Bingham, F. T., Page, A. L., and Strong, J. E. 1980. Yield and Cadmium Content of Rice Grain in Relation to Addition Rates of Cadmium, Copper, Nickel, and Zinc with Sewage Sludge and Liming. *Soil Sci*. 130[1], 32-38

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

Mix Bisessar, S., Rinne, R. J., and Potter, J. W. 1983. Effects of Heavy Metals and Meloidogyne hapla on Celery Grown on Organic Soil near a Nickel Refinery 50106. *Plant Dis*. 67[1], 11-14

Mix Bisessar, S. 1989. Effects of Lime on Nickel Uptake and Toxicity in Celery Grown on Muck Soil Contaminated by a Nickel Refinery 50107. *Sci.Total Environ*. 84, 83-90

Mix Bisessar, S., Rinne, R. J., and Potter, J. W. 1982. Response of Celery to Heavy Metals and Meloidogyne hapla in Soils Near a Nickel Refinery 50105. Annual Meeting of the Northeastern Division of the American Phytopathological Society, Nov.4-6, 1981.*Phytopathology*. 72[2], 257-258

Media Bittell, J., Koeppe, D. E., and Miller, R. J. 1974. Sorption of Heavy Metals Cations by Corn Mitochondria and the Effects on Electron and Energy Transfer Reactions. *Physiol Plant* 30, 226-230

Mix Blair, C. W., Scanlon, P. F., and Hiller, A. L. 1978. Lead, Cadmium, Nickel, and Zinc Levels in Earthworms and Mammals Recovered near Highways of Different Traffic Volumes 58937. *Va.J.Sci.* 29[2], 57 (ABS)

Species Boyd, R. S. and Martens, S. N. 1994. Nickel Hyperaccumulated by Thlaspi montanum var. montanum is Acutely Toxic to an Insect Herbivore. *Oikos* 70[1], 21-25

OM Boyd, R. S., Shaw, J. J., and Martens, S. N. 1994. Nickel Hyperaccumulation Defends *Streptanthus polygaloides* (Brassicaceae) Against Pathogens. Am.J.Bot. 81[3], 294-300

OM Boyd, R. S. and Martens, S. N. 1998. Nickel Hyperaccumulation by *Thlaspi montanum var*. Montanum (Brassicaceae): A Constitutive Trait. *Am.J.Bot.* 85[2], 259-265

OM Boyd, R. S. and Moar, W. J. 1999. The Defensive Function of Ni in Plants: Response of the Polyphagous Herbivore Spodoptera exigua (Lepidoptera: Noctuidae) to Hyperaccumulator and Accumulator Species of Streptanthus (Brassicaceae). Oecologia 118[2], 218-224

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

Rev Brooks, R. R. 1980. Accumulation of Nickel by Terrestrial Plants. In: Nriagu, J.O.(Ed.), *Nickel in the Environment*, Wiley & Sons, New York , 407-430

Mix Brooks, R. R. and Radford, C. C. 1978. Nickel Accumulation by European Species of the Genus Alyssum. *Proc.R.Soc.Lond.Ser.B Biol.Sci*. 200[1139], 217-224

Media Brown, P. H., Welch, R. M., Cary, E. E., and Checkai, R. T. 1987. Beneficial Effects of Nickel on Plant Growth. *J.Plant Nutr.* 10[9-16], 2125-2135

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

Media Burd, G. I., Dixon, D. G., and Glick, B. R. 1998. A Plant Growth-Promoting Bacterium that Decreases Nickel Toxicity in Seedlings. Appl.Environ.Microbiol. 3663-3668

Media Burton, M. A. S., LeSueur, P., and Puckett, K. J. 1981. Copper, Nickel and Thallium Uptake by the Lichen Cladina rangiferina. Can.J.Bot. 59, 91-100

Rev Carboneau, M. L. and Adams, J. P. 1995. National Low-Level Waste Management Program Radionuclide Report Series. Volume 10, Nickel-63. Lockhead Idaho Technologies Co.,Idaho Falls, ID , 27 p. (U.S. NTIS DE95-008568)

Media Carlson, C. L., Adriano, D. C., Sajwan, K. S., Abels, S. L., and Thoma, D. P. 1991. Effects of Selected Trace Metals on Germinating Seeds of Six Plant Species. Water Air Soil Pollut. 59[3/4], 231-240

Media Carlson, R. W., Bazzaz, F. A., and Rolfe, G. L. 1975. The Effect of Heavy Metals on Plants: Part II. Net Photosynthesis and Transpiration of Whole Corn and Sunflower Plants Treated with Pb, Cd, Ni, and Ti. Environ.Res. 10, 113-120

Media Cataldo, D. A., Garland, T. R., and Wildung, R. E. 1978. Nickel in Plants I. Uptake Kinetics Using Intact Soybean Seedlings. Plant Physiol. 62, 563-565

No Dose Cataldo, D. A. and Wildung, R. E. 1978. Soil and Plant Factors Influencing the Accumulation of Heavy Metals by Plants. Environ.Health Perspect. 27, 149-159

FL Celardin, F. and Landry, J. C. 1988. Bioindicators of Pollution Earthworms and Heavy Metals in Soil. Arch.Sci.(Geneva) 41[2], 225-228

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

OM Chaney, R. L., White, M. C., and Simon, P. W. 1975. Plant Uptake of Heavy Metals from Sewage Sludge Applied to Land 50610. In: Proc.2nd Natl.Conf.Munic.Sludge Manage., Information Transfer, Rockville, MD , 169-178

Rev Chang, A. C., Granato, T. C., and Page, A. L. 1992. A Methodology for Establishing Phytotoxicity Criteria for Chromium, Copper, Nickel, and Zinc in Agricultural Land Application of Municipal Sewage Sludges. J.Environ.Qual. 21[4], 521-536

OM Chaudri, A. M., McGrath, S. P., and Giller, K. E. 1992. 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

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

FL Cho, J. Y. and Han, K. W. 1996. Comparison of Growth and Physiological Responses in Radish for Assay of Nickel Toxicity. I. Growth of Radish and Absorption and Translocation of Nickel. Agric.Chem.Biotechnol. 39[4], 287-292 (KOR) (ENG ABS)

FL Cho, J. Y. and Han, K. W. 1996. Comparison of Growth and Physiological Responses in Radish for Assay of Nickel Toxicity. II. Effect of Ni on Physiological Responses in Radish. Agric.Chem.Biotechnol. 39[4], 293-296 (KOR) (ENG ABS)

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

Media Cotton, M. 1930. Toxic Effects of Iodine and Nickel on Buckwheat Grown in Solution Cultures. Bull.Torrey Bot.Club 57[2], 127-141

FL Croessmann, G. 1988. Cycle in the System Soil-Plant-Animal on Locations with Extremely High Soil Contaminations by Cadmium and Nickel Caused by Sewage Sludge. Final Report. Report, UBA-FB-86-106 (German) , 101 p. (GER)(ENG ABS)

Media Crooke, W. M. 1954. Effect of Nickel Versenate on Oat Plants. Nature 173, 403-404

Media Crooke, W. M. and Inkson, R. H. E. 1955. The Relationship Between Nickel Toxicity and Major Nutrient Supply. Plant Soil 6[1], 1-15

Mix Cunningham, J. D., Keeney, D. R., and Ryan, J. A. 1975. Phytotoxicity and Uptake of Metals Added to Soils as Inorganic Salts or in Sewage Sludge50963. J.Environ.Qual. 4[4], 460-462

Mix Cunningham, J. D., Ryan, J. A., and Keeney, D. R. 1975. Phytotoxicity in and Metal Uptake from Soil Treated with Metal-Amended Sewage Sludge 50962. J.Environ.Qual. 4[4], 455-459

ERE Dahiya, D. J., Singh, J. P., and Kumar, V. 1994. Nitrogen Uptake in Wheat as Influenced by the Presence of Nickel. Arid Soil Res.Rehab. 8, 51-58

Rev Davies, E. B. 1954. Note on Pasture Responses to Nickel, Vanadium, and Tungsten. New Zealand Soils News 3, 69-71

OM Davis, R. D. and Carlton-Smith, C. H. 1984. 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

OM Davis, R. D. and Beckett, P. H. T. 1978. 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

Score 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)

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

Rev Donghua, L. and Wusheng, J. 2000. Effects of Nickel Sulfate on Root Growth. In: P.N.Cheremisinioff (Ed.), Ecological Issues and Environmental Impact Assessment , 315-318

Mix Dowdy, R. H. and Ham, G. E. 1977. Soybean Growth and Elemental Content as Influenced by Soil Amendments of Sewage Sludge and Heavy Metals: Seedling Studies 51300. Agron.J. 69, 300-303

OM Echevarria, G., Morel, J. L., Fardeau, J. C., and Leclerc-Cessac, E. 1998. Assessment of Phytoavailability of Nickel in Soils. J.Environ.Qual. 27[5], 1064-1070

Rev Eisler, R. 1998. Nickel Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. Biol.Sci.Rep.No.USGS/BRD/BSR-1998-0001, Contaminant Hazards Review Rep.No.34, U.S.Geological Survey, U.S.Dep.of the Interior, Patuxent Wildl.Res.Ctr., Laurel, MD , 76 p.

No Tox Elkhatib, E. A. 1994. Evaluation of Six Soil Extractants for Assessing Nickel Availability to Wheat 51457. Arid Soil Res.Rehabil. 8[2], 137-145

Media Fargasova, A. 1988. 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

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

Media Gabbrielli, R., Mattioni, C., and Vergnano, O. 1991. Accumulation Mechanisms and Heavy Metal Tolerance of a Nickel Hyperaccumulator. J.Plant Nutr. 14[10], 1067-1080

Media Gabbrielli, R., Gremigni, P., and Intrieri, T. 1990. Cadmium and Nickel Tolerance Mechanisms in Two Alyssum Species. In: 30th Congress of the Italian Soc.of Plant Physiol., Oct.15-18, 1990, Stresa, Italy, G.Biol.Ital. 124[4], 159-160

Media Gabbrielli, Roberto, Pandolfini, T., Vergnano, O., and Palandri, M. R. 1990. Comparison of two serpentine species with different nickel tolerance strategies. Plant Soil 122[2], 271-277

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

Media Gerendas, J., Polacco, J. C., Freyermuth, S. K., and Sattelmacher, B. 1998. Co does not replace Ni with respect to urease activity in zucchini (Cucurbita pepo convar. giromontiina) and Soybean (Glycine max). Plant Soil 203[1], 127-135

No Control Gerzabek, M. H., Mohamad, S. A., Mueck, K., and Horak, O. 1994. 60Co, 63Ni and 94Nb Soil-to-Plant Transfer in Pot Experiments. J.Environ.Radioact. 25, 205-212

FL Gerzabek, M. H. and Schaffer, K. 1989. Nickel and zinc uptake by Lolium perenne in pot experiment. Bodenkultur 40[3], 195-205

Media Gerzabek, Martin H. and Ullah, Shan M. 1990. Influence of Fulvic and Humic Acids on Cadmium- and Nickel-toxicity to Zea mays (L.). Bodenkultur 41[2], 115-124

Species Gimeno-Garcia, E., Andreu, V., and Boluda, R. 1995. Distribution of Heavy Metals in Rice Farming Soils. Arch.Environ.Contam.Toxicol. 29[2], 476-483

No Dur Gish, C. D. and Christensen, R. E. 1973. Cadmium, Nickel, Lead and Zinc in Earthworms from Roadside Soil. Environ.Sci.Technol. 7[11], 1060-1062

Media Gorsuch, J. W., Kringle, R. O., and Robillard, K. A. 1990. 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

Mix Gray, N. F. 1988. 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

Media Gregory, R. P. G. and Bradshaw, A. D. 1965. Heavy Metal Tolerance in Populations of Agrostis

tenuis Sibth. and Other Grasses. New Phytol. 64, 131-143

OM Guo, Y., George, E., and Marschner, H. 1996. Contribution of an arbuscular mycorrhizal fungus to the uptake of cadmium and nickel in bean and maize plants. Plant Soil 184[2], 195-205

ERE Guo, Yanliang, Schulz, Rudolf, and Marschner, Horst. 1995. Genotypic Differences in Uptake and Distribution of Cadmium and Nickel in Plants. Angew.Bot. 69, 42-48

Score Gupta, S. K., Hani, H., Santschi, E., and Stadelmann, F. X. 1987. The Effect of Graded Doses of Nickel on the Yield, the Nickel content of Lettuce and the Soil Respiration. *Toxicol Environ Chem* 14, 1-10.

FL Gushchin, A. V. and Kukushkin, A. K. 1997. Effect of nickel and cadmium ions on bean leaf delayed luminescence. Biofizika 42[2], 466-471

No Control Gworek, Barbara. 1992. Effect of zeolites on the nickel uptake by plants. Pol.J.Soil Sci. 25[2], 127-133

Media Hara, T., Sonoda, Y., and Iwai, I. 1976. Growth Response of Cabbage Plants to Transition Elements Under Water Culture Conditions. II. Cobalt, Nickel, Copper, Zinc, and Molybdenum. Soil Sci.Plant Nutr. 22[3], 317-325

OM Hardison, J. R. 1963. Commercial Control of Puccinia striiformis and Other Rusts in Seed Crops of Poa pratensis by Nickel Fungicides. Phytopathology 53, 209-216

ERE Hartenstein, R., Neuhauser, E. F., and Collier, J. 1980. Accumulation of Heavy Metals in the Earthworm, Eisenia foetida. J.Environ.Qual. 9[1], 23-26

Score 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. 1982. Effects of Nickel and Copper on Acer rubrum, Cornus stolonifera, Lonicera tatarica, and Pinus resinosa. Can.J.Bot. 60, 2674-2681

Media Heikal, M. M. D., Berry, W. L., Wallace, A., and Herman, D. 1989. Alleviation of nickel toxicity by calcium salinity. Soil Sci. 147[6], 413-415

FL Hein, A., Sauerbeck, D., Horst, H., and Bruene, H. 1996. The Nickel Uptake by Plants from Different Soils and Bondings and its Prediction by Chemical Extraction Procedures. (Die Nickelaufnahme Von Pflanzen aus Verschiedenen Boeden und Bindungsformen und Ihre Prognose Durch Chemische Extraktionsverfahren. Abschlussbericht.). Umweltbundesamt, Berlin, Germany FR , 197 (GER)

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

Mix Hewitt, E. J. and Bolle-Jones, E. W. 1951. Investigations on Possible Micronutrient Elements for Higher Plants. I. Experiments with Cobalt, Nickel and Gallium in Sand Culture58611. Ann.Rep.Agric.Hortic.Res.Sta., Long Ashton, Bristol, England , 62-66

Mix Hlusek, J., Juzl, M., and Zrust, J. 1997. Potato yields and cadmium, nickel, and zinc contents in tubers 52693. Rostl.Vyroba 43[6], 263-267

FL Horst, H. and Brune, H. 1987. Influence of Soil, Origin and Plant Species on the Uptake and

Extractability of Nickel. II. Nickel of Geogenic Origin. VDLUFA-Schriftenreihe, Kongressband 23, 343-354

OM Hunter, J. G. 1954. Nickel Toxicity in a Southern Rhodesian Soil. S.Afr.J.Sci. 51, 133-135

OM Hunter, J. G. and Vergnano, O. 1952. Nickel Toxicity in Plants. Ann.Appl.Biol. 39, 279-284

No Dur Hutchinson, T. C. and Whitby, L. M. 1974. Heavy-Metal Pollution in the Sudbury Mining and Smelting Region of Canada, I. Soil and Vegetation Contamination by Nickel, Copper, and other Metals. Environ.Conserv. 1[2], 123-132

Mix Ibekwe, A. M., Angle, J. S., Chaney, R. L., and Van, Berkum P. 1997. Enumeration and N-2 fixation potential of rhizobium Leguminosarum biovar trifolii grown in soil with varying pH values and heavy metal concentrations 52918. Agric.Ecosyst.Environ. 61, 103-111

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

OM Ishihara, M., Hase, Y., Yolomizo II, Konno, S., and Sato, K. 1968. Nutritional Disease of Satsuma mandarin Trees in Serpentine Soil. II. Influence of Excessive Nickel or Cadmium Applications on the Growth and Fruiting of Sarsuma mandarin Trees. Engei Shikenjo Hokoku Ser.A 7, 39-54

Media Jacobs, E. E., Jacob, M., Sanandi, D. R., and Bradley, L. B. 1956. Uncoupling of Oxidative Phosphorylation by Cadmium Ion. J.Biol.Chem. 223, 147-156

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

Media Jones, M. D. and Hutchinson, T. C. 1988. Nickel Toxicity in Mycorrhizal Birch Seedlings Infected with Lactarius rufus or Scleroderma flavidum. II. Uptake of Nickel, Calcium, Magnesium Phosphorus and Iron. New Phytol. 108[4], 461-470

Media Jones, M. D. and Hutchinson, T. C. 1988. Nickel Toxicity in Mycorrhizal Birch Seedlings Infected with Lactarius rufus of Scleroderma flavidum I. Effects on Growth, Photosynthesis, Respiration & Transpiration. New Phytol. 108, 451-459

OM Jones, M. D., Browning, M. H. R., and Hutchinson, T. C. 1986. 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

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

Media Khan, A. A. and Malhotra, S. S. 1987. Effects of Vanadium, Nickel and Sulfur Dioxide on Polar Lipid Biosynthesis in Jack Pine. Phytochemistry 26[6], 1627-1630

Media Khan, A. A. and Malhotra, S. S. 1980. Stress Effects of Nickel and Vanadium Uptake on Enzymes of Jack Pine Seedlings 53398. Annu.Meet.of the Am.Soc.of Plant Physiol.and the Phytochem.Soc.of North Am., Aug.3-7, 1980, Pullman, WA, Plant Physiol. 65[6 Suppl.], 84 (ABS)

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

Media Khan, M. R., Khan, M. Wajid, and Singh, K. 1996. Growth Performance of Chickpea Under the Influence of Nickel and Cobalt as Soil Pollutants. J.Indian Bot.Soc. 75[3/4], 193-196

ERE Khan, M. W. and Salam, M. A. 1990. Interactions of Meloidogyne javanica, Fusarium udum and Rhizobium on Pigeon Pea in the Presence of Nickel and Cobalt as Pollutants. Ann.Appl.Biol. 116[3], 549-556

Media Komczynski, L., Nowak, H., and Rejniak, L. 1963. Effect of Cobalt, Nickel and Iron on Mitosis in the Roots of the Broad Bean (Vicia faba). Nature 198[4884], 1016-1017

Media Kramer, U., Smith, R. D., Wenzel, W. W., Raskin, I., and Salt, D. E. 1997. The Role of Metal Transport and Tolerance in Nickel Hyperaccumulation by Thlaspi goesingense Halacsy. Plant Physiol. 115[4], 1641-1650

Media Kramer, Ute, Cotter-Howells, Janet D., Charnock, John M., Baker, Alan J. M., and Smith, J. A. 1996. Free histidine as a metal chelator in plants that accumulate nickel. Nature (London) 379[6566], 635-638

Media Krogmeier, M. J., McCarty, G. W., Shogren, D. R., and Bremner, J. M. 1991. Effect of nickel deficiency in soybeans on the phytotoxicity of foliar-applied urea. Plant Soil 135[2], 283-286

OM Lagerwerff, J. V. and Specht, A. W. 1970. Contamination of Roadside Soil and Vegetation with Cadmium, Copper, Lead, and Zinc in Soil and Vegetation in the Proximity of a Smelter. Environ.Sci.Technol. 4[7], 583-586

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

Media Lee, C. R., Sturgis, T. C., and Landin, M. C. 1976. A Hydroponic Study of Heavy Metal Uptake by Selected Marsh Plant Species. U.S.Army Eng Waterways Exp Stn Tech Rep.No.D-76-5 , 63

OM Lee, J. 1977. Phytochemical and Biogeochemical Studies on Nickel Accumulation by Some New Caledonian Plants. Ph.D.Thesis, Massey University, Palmerston North, New Zealand , 183 p.

OM Lee, J. and Scott, M. 1991. Response of Pea, Faba Bean and Maize to Nickel as Soil Pollutant. Tests Agrochem.Cultiv. 12[118 SUPPL], 76-77

OM Liu, C. L. and Wang, Y. P. 1993. Effects of nickel contamination in different soils on the growth of crops. Zhongguo Nongye Huaxue Huizhi 31[2], 172-182

Media Liu, D. and , Wusheng L. Guo Y. Hao C. Lu and F. Zhao. 1994. Effects of Nickel Sulfate on Root Growth and Nucleoli in Root Tip Cells of Allium cepa. Isreal J.Plant Sci. 42[2], 143-148

FL Liu, Gaoqiong, Rui, Sanya, Tao, Gongjun, and Li, Shijun. 1992. Effect of Nickel on Urea Assimilation of Leaf Vegetables in Liquid Culture. Zhiwu Shenglixue Tongxun 28[4], 525-254

Media Lou, C., Homma, S., and Kuno, K. 1991. Effects of Nickel Concentration on Growth, Photosynthetic Rate in Mulberry Cuttings. Nippon Sanshigaku Zasshi /J.Sericult.Sci. 60[3], 192-199

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

Media Malan, H. L. and Farrant, J. M. 1998. Effects of the Metal Pollutants Cadmium and Nickel on Soybean Seed Development. Seed Sci.Res. 8[4], 445-453

pH Malecki, M. R., Neuhauser, E. F., and Loehr, R. C. 1982. The Effect of Metals on the Growth and Reproduction of Eisenia foetida (Oligochaeta, Lumbricidae). Pedobiologia 24[3], 129-137

No Dur Marino, F., Ligero, A., and Diaz, C. 1996. Heavy Metals in Earthworms and Soils Around to a Thermic Power Station at as Pontes (La Coruna, NW Spain) 54354. Boletin De La Real Sociedad Espanola De Historia Natural Seccion Biologica 92[1-4], 65-73

No Dur Marino, F., Ligero, A., and Diaz Cosin, D. J. 1994. Heavy Metals in Several Earthworm Species Living in Serpentine Soils 54353. Nova-Acta-Cient.-Compostel.-(Biol.) 5, 245-250

Media McCreight, J. D. and Schroeder, D. B. 1982. Inhibition of Growth of Nine Ectomycorrhizal Fungi by Cadmium, Lead, and Nickel In Vitro. Environ.Exp.Bot. 22[1], 1-7

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

OM McKenzie, R. M. 1978. The Effect of Two Manganese Dioxides on the Uptake of Lead, Cobalt, Nickel, Copper and Zinc by Subterranean Clover. Aust.J.Soil Res. 16[2], 209-214

No Dur McLaughlin, D. L. 1995. Phytotoxicology Survey Report: International Nickel Company Limited, Port Colborne, 1991 54554. Gov.Rep.Announce.Index [8]

Mix Memon, A. R., Ito, S., and Yatazawa, M. 1980. Taxonomic Characteristics in Accumulating Cobalt and Nickel in the Temperate Forest Vegetation of Central Japan 58436. Soil Sci.Plant Nutr. 26[2], 271-280

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 Millikan, C. R. 1948. Effect of Molybdenum on the Severity of Toxicity Symptoms in Flax Induced by an Excess of Either Manganese, Zinc, Copper, Nickel or Cobalt in the Nutrient Solution. J.Aust.Inst.Agric.Sci. 5, 180-186

Nutrient Millikan, C. R. 1949. Effects of Flax of a Toxic Concentration of Boron, Iron, Molybenum, Aluminum, Copper, Zinc, Cobalt, or Nickel in the Nutrient Solution 54720. R Soc Victoria Proc 61, 25-42

Rev Mishra, D. and Kar, M. 1974. Nickel in Plant Growth and Metabolism. Bot.Rev. 40[4], 395-452

Media Mishra, K. and Singh, R. R. 1999. Nickel Genotoxicity Assessment in Hordeum vulgare. J.Environ.Biol. 20[1], 71-72

Mix 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

Mix Mitchell, G. A., Bingham, F. T., and Page, A. L. 1978. 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

OM Mitchell, R. L. 1945. Cobalt and Nickel in Soils and Plants. Soil Sci. 60, 63-70

Media Moral, R., Palacios, G., Gomez, I., Navarro-Pedreno, J., and Mataix, J. 1994. Distribution and Accumulation of Heavy Metals (Cd, Ni and Cr) in Tomato Plant. Fresenius Environ.Bull. 3, 395-399

No Dur Muskett, C. J. and Jones, M. P. 1980. The Dispersal of Lead, Cadmium and Nickel from Motor Vehicles and Effects on Roadside Invertebrate Macro Fauna 54963. Environ.Pollut.Ser.A Ecol.Biol. 23[3], 231-242

Mix Narwal, R. P. and Singh, B. R. 1998. Effect or organic materials on partitioning, extractability and plant uptake of metals in an alum shale soil 55019. Water Air Soil Pollut. 103[1/4], 405-421

Rev National Research Council of Canada. 1981. Effects of Nickel in the Canadian Environment. Publ.No.NRCC 18568, Natl.Res.Council of Canada, NRCC Assoc.Committee on Sci.Crit.for Environ.Qual., Publications, NRC, Ottawa, Ontario, Canada , 277-347

Abstract NERAC Inc. 1996. Toxicity Of Nickel. (Latest Citations From The Energy Science And Technology Database). NTIS Order Number: PB96-867536GAR Withdrawn. [15]

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

Media Neuhauser, E. F., Malecki, M. R., and Loehr, R. C. 1983. 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

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

OM Nicholas, D. J. D. and Thomas, W. D. E. 1954. Some Effects of Heavy Metals on Plants Grown in Soil Culture. II. The Effect of Nickel on Fertilizer and Soil Phosphate. Uptakes and Iron and Nickel Status of Tomato. Plant Soil 5[2], 182-193

Media Nieboer, E., Puckett, K. J., Richardson, D. H. S., Tomassini, F. D., and Grace, B. 1975. 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

Mix Nieboer, E., Ahmed, H. M., Puckett, K. J., and Richardson, D. H. S. 1972. Heavy Metal content of Lichens in Relation to Distant from a Nickel Smelter in Sudbury, Ontario 55122. Lichenologist 5, 292-304

Media Nieboer, E., Puckett, K. J., and Grace, B. 1976. The Uptake of Nickel by Umilicaria muhlenbergii (Ach.) Tuck.: A Physicochemical Process. Can J Bot 54, 724-733

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

Species Nozoe, T. and Yoshida, K. 1992. Effect of Nickel Edta on Production of Methane and Decomposition of Volatile Fatty Acids in Paddy Soil 55186. Soil Sci.Plant Nutr. 38[4], 763-766

pH Nyarai-Horvath, F., Szalai, T., Kadar, I., and Csatho, P. 1997. Germination Characteristics of Pea Seeds Originating from a Field Trial Treated with Different Levels of Harmful Elements. Acta Agron.Hung. 45[2], 147-154

Media Okamoto, K., Suzuki, M., Fukanim, M., Toda, S., and Fuwa, K. 1977. 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

Media Ormrod, D. P. 1977. Cadmium and Nickel Effects on Growth and Ozone Sensitivity of Pea. Water Air Soil Pollut. 8, 263-270

Mix Ozores-Hampton, M., Hanlon, E., Bryan, H., and Schaffer, B. 1997. Cadmium, Copper, Lead, Nickel and Zinc Concentrations in Tomato and Squash Grown in MSW Compost-Amended Calcareous Soil. Compost Sci.Util. 5[4], 40-45

Media Paliouris, G. and Hutchinson, T. 1991. Arsenic, Cobalt and Nickel Tolerances in Two Populations of Silene vulgaris (Moench) Garcke from Ontario, Canada. New Phytol. 117, 449-459

Media Patel, P. M., Wallace, A., and Mueller, R. T. 1976. 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

OM Patterson, W. A. III and Olson, J. J. 1983. 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

FL Piccini, D. F. and Malavolta, E. 1992. Nickel toxicity to rice and beans in three acid soils. Rev.Bras.Cienc.Solo 16[2], 229-233

ERE Piha, M. I., Vallack, H. W., Reeler, B. M., and Michael, N. 1995. 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

OM Poulik, Z. 1999. Influence of Nickel Contaminated Soils on Lettuce and Tomatoes. Sci.Hortic. 81[3], 243-250

OM Poulik, Z. 1997. The Danger of Cumulation of Nickel in Cereals on Contaminated Soil. Agric.Ecosyst.Environ. 63[1], 25-29

Species Pouyat, Richard V., Mcdonnell, Mark J., and Pickett, S. T. A. 1995. Soil characteristics of oak stands along an urban-rural land-use gradient 55699. J.Environ.Qual. 24[3], 516-526

No COC Proctor, J. and McGowan, I. D. 1976. Influence of Magnesium on Nickel Toxicity. Nature 260, 134

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

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

Media Ranta, H., Neuvonen, S., Kaariainen, S., and Vesanto, S. 1994. Copper and Nickel Pollution: Frequency of Endophytic Fungi in Scots Pine Shoots and Endophyte Growth In Vitro. Can.J.Bot. 72[1], 93-99

Media Rauser, W. E. 1978. Early Effects of Phytotoxic Burdens of Cadmium, Cobalt, Nickel and Zinc in

White Beans. Can.J.Bot. 56, 1744-1749

Media Rauser, W. E. and Dumbroff, E. B. 1981. Effects of Excess Cobalt, Nickel and Zinc on the Water Relations of Phaseolus vulgaris. Environ.Exp.Bot. 21[2], 249-255

Media Rehab, F. I. and Wallace, A. 1978. Excess Trace Metal Effects on Cotton: 5. Nickel and Cadmium in Solution Culture. Commun.Soil Sci.Plant Anal. 9[8], 771-778

Mix Rida, A. and Bouche, M. B. 1997. Heavy Metal Linkages With Mineral, Organic And Living Soil Compartments 56035. Soil Biol Biochem 29[3-4], 649-655

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

Mix Sadiq, M. 1985. Uptake of Cadmium, Lead, and Nickel by Corn Grown in Contaminated Soils. Water Air Soil Pollut. 26, 185-190

Abstract Sadusky, M. C. and Simini, M. 1993. Phytotoxicity of Nickel-Coated Graphite Obscurant Fibers. Phytopathology 83[12], 1426 (ABS)

ERE Sajwan, K. S., Ornes, W. H., Youngblood, T. V., and Alva, A. K. 1996. Uptake of Soil Applied Cadmium, Nickel and Selenium by Bush Beans. Water Air Soil Pollut. 91[3/4], 209-217

FL Saly, A. 1983. The Effect of Nickeliferous Ore Wastes from the Nickel Works National Enterprise at Sered Czechoslovakia Upon Free Living Nematodes in Culture Soils. Biologia 38[6], 535-542

Media Samantaray, S., Rout, G. R., and Das, P. 1998. Differential Nickel Tolerance of Mung Bean (Vigna radiata L.) Genotypes in Nutrient Culture. Agronomie 18[8/9], 537-544

Media Samantaray, S., Rout, G. R., and Das, P. 1998. Tolerance of Rice to Nickel in Nutrient Solution. Biol.Plant. 40[2], 295-298

Mix Sanders, J. R., McGrath, S. P., and Adams, T. M. 1986. Zinc, Copper and Nickel Concentrations in Ryegrass Grown on Sewage Sludge-Contaminated Soils of Different pH. J.Sci.Food Agric. 37, 961-968

Mix Sanglimsuwan, Sarunya, Yoshida, Naoto, Morinaga, Tsutomu, and Murooka, Yoshikatsu. 1993. Resistance to and uptake of heavy metals in mushrooms 56278. Journal of Fermentation and Bioengineering 75[2], 112-114

Mix Sarkunan, V., Misra, A. K., and Nayar, P. K. 1989. Interaction of Zinc, Copper and Nickel in Soil on Yield and Metal Content in Rice. J.Environ.Sci.Health 24A[5], 459-466

ERE Sauerbeck, D. R. and Hein, A. 1991. The Nickel Uptake from Different Soils and its Prediction by Chemical Extractions. International Conference on Metals in Soils, Waters, Plants and Animals, Orlando, Florida, Usa, April 30-may 3, 1990.water Air Soil Pollut. 57-58, 861-872

Media Schickler, H. and Caspi, H. 1999. Response of Antioxidative Enzymes to Nickel and Cadmium Stress in Hyperaccumulator Plants of the Genus Alyssum. Physiol.Plant. 105[1], 39-44

Rev Scott-Fordsmand, Janeck J. 1997. Toxicity of Nickel to Soil Organisms in Denmark. Rev.Environ.Contam.Toxicol 148, 1-34

OM Severne, B. C. 1974. Nickel Accumulation by Hybanthus floribundus. Nature 248, 807-808

Media Shaukat-Ahmed. and Evans, H. J. 1961. The Essentiality of Cobalt for Soybean Plants Grown Under Symbiotic Conditions. Proc.Natl.Acad.Sci. 47, 24-36

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

pH Simon, T., Mikanova, O., and Kubat, J. 1998. The Effect of Addition of Inorganic Ni and As Compounds on the Growth of Radish and Activities of Soil Microorganisms. Rostl.Vyroba 44[4], 187-192

ERE Singh, R. K., Shukla, R. P., and Dwivedi, R. S. 1992. Effect of Cadmium, Cobalt and Nickel Salts on the Survivability of Sclerotia and Plant Infection by Sclerotium rolfsii Causing Root-Rot Disease of Barley. Trop.Sci. 32[3], 269-274

Media Slade, S. J. 1993. 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

Rev Slooff, W., Bont, P. F. H., Janus, J. A., and Loos, B. 1992. Exploratory Report Nickel and Nickel Compounds. RIVM Rep.No.710401017, Natl.Inst.of Public Health and the Environ., Bilthoven, Netherlands , 46 p.

Species Smith, C. J., Hopmans, P., and Cook, F. J. 1996. 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

Media Soane, B. D. and Saunder, D. H. 1959. Nickel and Chromium Toxicity of Serpentine Soils in Southern Rhodesia. Soil Sci. 8, 322-330

Media Specht, W. L., Klaine, S. J., and Hook, D. D. 1996. Rapid Bioassessment Methods For Assessing Vegetation Toxicity At The Savannah River Site - Germination Tests And Root Elongation Trials. Westinghouse Savannah River Co., Aiken, SC:37 p., Appendices (NTIS#DE97060221)

OM Stewart, D. K. R. and Ross, R. G. 1969. Nickel Residues in Apple Fruit and Foliage Following a Foliar Spray of Nickel Chloride. Can.J.Plant Sci. 49, 375-377

Mix Sustek, Z., Kaluz, S., Saly, A., Ananeva, N. D., Tyuryukanova, G. K., and Oreshkin, V. N. 1987. The Effect of the Fall of Nickel Leaching Rest on Selected Groups of Edaphic Organisms in the Surroundings of Nickel Smelting Works in Sered South Slovakia, Czechoslovakia 57019. Biologia 42[6], 529-536

FL Tanaka, A., Tadano, T., and Ebine, Y. 1978. Comparison of Adaptability to Heavy Metals Among Crop Plants. III. Adaptability to Nickel and Cobalt. Nippon Dojo Hiryogaku Zasshi 49[4], 314-320 (JPN)

ERE Tang, T. and Miller, D. M. 1991. Growth and Tissue Composition of Rice Grown in Soil Treated with Inorganic Copper, Nickel and Arsenic. Commun.Soil Sci.Plant Anal. 22[19/20], 2037-2046

No Tox Data Telewiak, R. G. 1985. Nickel 57168. In: Canadian Minerals Yeaerbook 1983-1984, Review and Outlook, Mineral Resources Branch, Energy, Mines and Resources Canada, Ottawa , 44-1

Media Tiffin, L. O. 1971. Translocation of Nickel in Xylem Exudate of Plants. Plant Physiol. 48, 273-277

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., N1, P30-3 17[1], 30-33

No Dur Tkeshelashvili, L. K., Reid, T. M., McBride, T. J., and Loeb, L. A. 1993. Nickel Induces a Signature Mutation for Oxygen Free Radical Damage 57267. Cancer Res. 53, 4172-4174

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

No Data Traynor, M. F. and Knezek, B. D. 1973. Effects of Nickel and Cadmium Contaminated Soils on Nutrient Composition of Corn Plants. Proc Annual Conf.on Trace Substances in the Environment 7, 82-87

OM Tripathi, A. K. and Tripathi, S. 1999. Changes in Some Physiological and Biochemical Characters in Albizia lebbek as Bio-Indicators of Heavy Metal Toxicity. J.Environ.Biol. 20[2], 93-98

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

FL Tu, C. 1996. Characteristics of Nickel Toxicity to Lettuce Grown in Different Soils. Zhongguo Huanjing Kexue 16[6], 456-460

FL Uccelli, Raffaella, Angelone, Massimo, Cima, Maria Grazia, Ferrandi, Luigi, Pompei, Franco, Stronati, Laura, and Triolo, Lucio. 1992. Air pollution on the territory of the Tarquinia Agricultural University. Concentrations of nickel, chromium, lead, and cadmium in soil and in some plant and animal species. Inquinamento 34[10], 64-74

Mix Vago, I., Gyori, Z., and Loch, J. 1996. Comparison of Chromium and Nickel Uptake of Plants Grown in Different Soils. Fresenius' J.Anal.Chem. 354[5/6], 714-717

Mix Valdares, J. M. A. S., Gal, M., Mingelgrin, U., and Page, A. L. 1983. Some Heavy Metals in Soils Treated with Sewage Sludge, Their Effects on Yield, and Their Uptake by Plants 57441. J.Environ.Qual. 12[1], 49-57

Rev Vanselow, A. P. 1966. Nickel. In: H.D.Chapman (Ed.), Diagnostic Criteria for Plants and Soils, University of California, Berkeley, CA , 302,307-309

OM Veavington, F. 1975. Heavy Metal Contamination of Vegetables and Soil in Domestic Gardens Around a Smelting Complex. Environ.Pollut. 9[3], 211-217

Media Veer, Bharat. 1989. Effects of nickel and zinc on seedling growth and hydrolytic enzymes in Phaseolus aureus cv. R-851. Geobios (Jodhpur) 16[6], 245-248

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

Media Veltrup, W. 1979. The Effect of Ni2+, Cd2+, and Co2+ on the Uptake of Copper by Intact Barley Roots. Z.Pflanzenphysiol. 93, 1-9

pH Venkata Ram, C. S. 1964. Resistance of Tea Plants to Blister Blight in Soils Augmented with Nickel. Nature 204, 1227

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

Media Vergnano, O. and Hunter, J. G. 1952. Nickel and Cobalt Toxicities in Oat Plants. Ann.Bot.(N.S.)

17[66], 317-328

Mix Versluijs, C. W., Aalbers, T. G., Adema, D. Mm, Assink, J. W., Van, Gestel C. A., and Anthonissen, I. H. 1988. Comparison of Leaching Behavior and Bioavailability of Heavy Metals in Contaminated Soils and Soils Cleaned Up with Several Extractive and Thermal Methods. Wolf, K., W.J.Van Den Brink And F.J.Colon (Ed.).Contaminated Soil '88 Second International Netherlands Organization For Applied Scientific Research/Federal Ministry Of Research And Technology Conference, Hamburg, West Germany, April 11-15, 1988. Xxxvi+1009p.(Vol. 1); Xxv+683p.(Vol. 2). Kluwer Academic Publishers: Dordrecht, 11-22

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

FL Von Scharrer, K. and Schropp, W. 1933. Sand and Water Culture Experiments with Nickel and Cobalt (Sand- und Wasserkulturversuche mit Nickel und Kobalt). Z.Pflanzenernaehr.Dung.Bodenkd. 31A, 94-113 (GER)

Score Voros, I., Biro, B., Takacs, T., Koves-Pechy, K., and Bujtas, K. 1998. Effect of Arbuscular Mycorrhizal Fungi on Heavy Metal Toxicity to Trifolium pratense in Soils Contaminated with Cd, Zn and Ni Salts. Agrokem.Talajtan 47[1-4], 277-288

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

Media Wallace, A. and Berry, W. L. 1989. Dose-Response Curves for Zinc, Cadmium, and Nickel in Combinations of One, Two, or Three. Soil Sci. 147[6], 401-410

No Control Wallace, A., Romney, E. M., and Patel, P. M. 1978. Role of Synthetic Chelating Agents in Trace Metal Uptake by Plants. 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) , 645-657

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

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

FL Wang, Y. P. and Chao, C. C. 1992. 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)

No Dur Watmough, S. A. and Dickinson, N. M. 1995. Dispersal and Mobility of Heavy Metals in Relation to Tree Survival in an Aerially Contaminated Woodland Soil. Environ.Pollut. 90[2], 135-142

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

Media Welch, R. M. and Cary, E. E. 1975. Concentration of Chromium, Nickel, and Vanadium in Plant Materials. J.Agric.Food Chem. 23, 479

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

Mix Wilke, B. M. 1991. Effects of Single and Successive Additions of Cadmium, Nickel and Zinc on Carbon Dioxide Evolution and Dehydrogenase Activity in a Sandy Luvisol 57987. Biol.Fertil.Soils

11[1], 34-37

Rev Williams, J. H. 1977. Effect of Soil pH on the Toxicity of Zinc and Nickel to Vegetable Crops. In: Ref.Book No.326, Inorganic Pollution and Agriculture, Ministry of Agriculture, Fisheries and Food (MAFF), Lowestoft, Suffolk, UK , 211-221

OM Williams, P. C. 1967. Nickel, Iron and Manganese in the Metabolism of the Oat Plant. Nature 214, 628

Mix Wither, E. D. and Brooks, R. R. 1977. Hyperaccumulation of Nickel by Some Plants of South-East Asia. J.Geochem.Explor. 8, 579-583

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

Rev Yagodin, B. A., Govorina, V. V., and Vinogradova, S. B. 1991. Nickel In The Environment - Soil, Fertilizers, Plants, Animals And Humans. Agrokhimiya 1, 128-138

FL Yagodin, B. A., Govorina, V. V., Vinogradova, S. B., and Andreeva, I. V. 1998. Specific features in accumulation and distribution of nickel in oat plants. Izv.Timiryazevsk.S-kh.Akad. [1], 133-140

Media Yang, X., Baligar, V. C., Martens, D. C., and Clark, R. B. 1996. Plant Tolerance to Nickel Toxicity: II Nickel Effects on Influx and Transport of Mineral Nutrients in Four Plant Species. J.Plant Nutr. 19[2], 265-279

Media Yang, X., Baligar, V. C., Martens, D. C., and Clark, R. B. 1996. Plant Tolerance to Nickel Toxicity. I. Influx, Transport and Accumulation of Nickel in Four Species. J.Plant Nutr. 19[1], 73-85

Media Yang, X. E., Baligar, V. C., Foster, J. C., and Martens, D. C. 1997. Accumulation and Transport of Nickel in Relation to Organic Acids in Ryegrass and Maize Grown with Different Nickel Levels. Plant Soil 196[2], 271-276

No Dose Youssef, R. A. 1997. Studies on Nickel and Manganese Dynamics in the Rhizosphere of WheatSoil Sci.Plant Nutr.(Tokyo), NSpec.Issue 43, 1021-1024

OM Youssef, R. A., El Fattah, A. A., and Hilal, M. H. 1997. Studies on the Movement on Ni in Wheat Rhizosphere using Rhizobox Technique. Egypt.J.Soil Sci. 37[2], 175-187

7.4 References Used in Deriving Wildlife TRVs

Alexander, J. Koshut R. Keefer R. Singh R. Horvath D. J. and Chandey R. 1978. Trace Substances in Environmental Health-12. Proceedings of Univ. of Mo 12Th Annual Conference. 377-388. Ref No: 36694

Ambrose, P, Larson, PS, Borzelleca, JF, and Hennigar, GR Jr. 1976. longterm toxicological assesment of nickel in rats and dogs. *J. Food Sci. Technol.* 13: 181. Ref ID: 14474

Berman, E. and Rehnberg, B. 1983. Fetotoxic Effects of Nickel in Drinking Water in Mice. EPA-600/1-83-007. Ref ID: 19064

Blalock, T. L. and Hill C. H. 1985. studies on the effects of iron deficiency on the toxicities of cadmium, cobalt, nickel and vanadium. *Nutr.Res. Suppl.I, 648-654.* Ref ID: 36697

Cain, B. W. and E. A. Pafford. 1981. effects of dietary nickel on survival and growh of mallard ducklings.

Arch. Environ. Contam. Toxicol. 10(6): 737-45 . Ref ID: 6461

Cempel, M. and Janicka, K. 2002. distribution of nickel, zinc, and copper in rat organs after oral administration of nickel(ii) chloride. *Biological Trace Element Research [Biol. Trace Elem. Res.]. Vol. 90, No. 1-3, Pp. 215-226. 2002.* Ref ID: 36331

Chatterjee, K., Chakarborty, D., Majumdar, K., Bhattacharyya, A., and Chatterjee, G. C. 1979. biochemical studies on nickel toxicity in weanling rats - influence of vitamin c supplementation . *Int. J. Vitam. Nutr. Res.* 49(3): 264-75 . Ref ID: 19098

Chernoff, N. and Kavlock, R. J. 1983. a teratology test system which utilizes postnatal growth and viability in the Mouse. *Environ Sci Res* . 27: 417-427. Ref ID: 1260

Cikrt, M., K. Blaha, J. Nerudova, D. Bittnerova, and H. Jehlickova. 1992. distribution and excretion of cadmium and nickel after simultaneous exposure and the effect of n-benzyl-d-glucamine dithiocarbamate on their biliary and urinary excretion. *J. Toxicol. Environ. Health* 35(4): 211-20 . Ref ID: 19109

Clary, J. J. 1975. nickel chloride-induced metabolic changes in the rat and guinea pig. *Toxicology and Applied Pharmacology* 31(1): 55-65. Ref ID: 19111

Dieter, M. P., Jameson, C. W., Tucker, A. N., Luster, M. I., French, J. E., Hong, H. L., and Boorman, G. A. 1988. evaluation of tissue disposition, myelopoietic, and immunologic responses in mice after long-term exposure to nickel sulfate in the drinking water. *J Toxicol Environm Health.* 24: 357-372. Ref ID: 61

Eakin, D. J., Schroeder, L. A., Whanger, P. D., and Weswig, P. H. 1980. cadmium and nickel influence on blood pressure, plasma renin, and tissue mineral concentrations. *Am J Physiol.* 238(1): E53-61. Ref ID: 659

Eastin, William C. Jr. and O'Shea, Thomas J. 1981. effects of dietary nickel on mallards. *J. Toxicol. Environ. Health* 7(6): 883-92 . Ref ID: 6492

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

Hill, C. H. 1979. the effect of dietary protein levels on mineral toxicity in chicks. *J Nutr.* 109(3): 501-7. Ref ID: 397

Hill, C. H. 1985. interaction of vanadate with chloride in the chick. *Nutr. Res. Suppl.I, 555-559.* Ref ID: 36708

Kadiiska, M., Stoytchev, T., and Serbinova, E. 1985. on the mechanism of the enzyme-inducing action of some heavy metal salts. *Archives of Toxicology.* 56(3): 167-9. Ref ID: 19290

Kakela, R., A. Kakela, and H. Hyvarinen. 1999. effects of nickel chloride on reproduction of the rat and possible antagonistic role of selenium. *Comp. Biochem. Physiol. Part C: Pharmacol., Toxicol. Endocrinol.* 123C(1): 27-37 . Ref ID: 19293

Ling, J. R. and Leach, R. M. Jr. 1979. studies on nickel metabolism: interaction with other mineral elements. *Poult. Sci.* 58(3): 591-6. Ref ID: 6666

Martinez, D. A. and Diaz, G. J. effect of graded levels of dietary nickel and manganese on blood hemoglobin content and pulmonary hypertension in broiler chickens. *Avian Pathol. (1996)* 25(3): 537-549 . Ref ID: 5345

Mathur, A. K. 1987. effects of dietary nickel in rats. *National Academy Science Letters-India* 10(1): 37-38. Ref ID: 19416

Meluzzi, A., Simoncini, F., Sirri, F., Vandi, L., and Giordani, G. 1996. feeding hens diets supplemented with heavy

metals (chromium, nickel and lead). *Archiv Fuer Gefluegelkunde* . 60(3): 119-125. Ref ID: 2771

Milne, J. S., Whitelaw, F. G., Price, J., and Shand, W. J. Rowett Research Institute Bucksburn Aberdeen AB2 9SB United Kingdom. 1990. the effect of supplementary nickel on urea metabolism in sheep given a low protein diet. *Animal Production. V. 50(3) P. 507-512* Ref ID: 19437

Nation, J. R. M. F. Hare, D. M. Baker, D. E. Clark, and A. E. Bourgeois. 1985. Dietary administration of nickel: effects on behavior and metallothionein levels. *Physiol. Behav.* 34(3): 349-53. Ref ID: 19460

Neilsen, F. H., T. R. Shuler, T. J. Zimmerman, M. E. Collings, and E. O. Uthus. 1979. interaction between nickel and iron in the rat. *Biol. Trace Elem. Res.* 1(4): 325-35 . Ref ID: 19461

Nielsen, F. H., Hunt, C. D., and Uthus, E. O. 1980. interactions between essential trace and ultratrace elements. *Annals of the New York Academy of Sciences* 355: 152-64. Ref ID: 15690

Nielsen, F. H. 1980. effect of form of iron on nickel deprivation in the rat : plasma and liver lipids. *Biol. Trace Elem. Res. (1980)* 2(3): 199-210 . Ref ID: 19478

Nielsen, F. H. 1980. effect of form of iron on the interaction between nickel and iron in rats : growth and blood parameters. *J. Nutr.* 110(5): 965-73 Ref ID: 19479

Nielsen, F. H., D. R. Myron, S. H. Givand, and D. A. Ollerich. 1975. nickel deficiency and nickel-rhodium interaction in chicks. *J. Nutr.* 105(12): 1607-19 . Ref ID: 6885

Nielsen, F. H., T. J. Zimmerman, and T. R. Shuler. 1982. interactions among nickel, copper, and iron in rats . liver and plasma content of lipids and trace elements. *Biol. Trace Elem. Res.* 4(2-3): 125-43 Ref ID: 19483

Novelli, E. L. B., Hernandes R.T., Novelli Filho, J. L. V. B., and Barbosa, L. L. 1998. differential/combined effect of water contamination with cadmium and nickel on tissues of rats. *Environmental Pollution.* 103(2/3): 295-300. Ref ID: 19496

Novelli, E. L. B., Valente, J. P. S., and Rodrigues, N. L. 1994. toxic effects of water eutrophication on pancreatic, hepatic and osteogenic tissues of rats. *Toxicon (1994)* 32(10): 1270-4 . Ref ID: 19500

O'Dell, GD, Miller, Wj, King, WA, Ellers, JC, and Jurecek, H. 1970. effect of nickel supplementation on prodution and composition of milk. *J. Dairy Sci.* 53: 1545. Ref ID: 14476

O'Dell, GD, Miller, WJ, King, WA, Moore, SL, and Blackmon, DM. 1970. nickel toxicity in the young bovine. *J. Nutr.* 100: 1447. Ref ID: 14477

O'Dell, GD, Miller, WJ, Moore, SL, King, WA, Ellers, JC, and Jurecek, H. 1971. effect of dietary nickel level on excretion and nickel content of tissues in male calves. *J. Anim. Sci.* 32: 769. Ref ID: 14479

Obone, E., S. K. Chakrabarti, C. Bai, M. A. Malick, L. Lamontagne, K. S. Subramanian. 1999. Toxicity and bioaccumulation of nickel sulfate in Sprague-Dawley rats following 13 weeks of subchronic exposure. *Journal of toxicology and environmental health.* 57 (6): 379-401. Ref ID: 19507

Oosting, J. S., A. G. Lemmens, G. J. Van den Berg, and A. Beynen. 1991. Iron, copper, and zinc status in rats fed supplemental nickel. *Biol. Trace Elem. Res.* 31(1): 63-70. Ref ID: 19514

Oscar, T. P., Mitchell, D. M., Engster, H. M., Malone, B. R., and Watson, W. M. 1995. growth performance, carcass composition, and pigmentation of broilers fed supplemental nickel. *Poult. Sci. (1995)* 74(6): 976-82 . Ref ID: 5407

Pandey, R., R. Kumar, S. P. Singh, and S. P. Srivastava. 1999. Toxic effects of nickel sulphate on embryonic mice

(exposed male : normal Female). *Journal of Advanced Zoology*. 20 (1): 10-11 Ref ID: 19520

Pandey, R. and Srivastava S. P. 2000. spermatotoxic effects of nickel in mice. *Bull. Environ. Contam. Toxicol. 64[2]: 161-167.* Ref ID: 36722

Pandey Ratna, Kumar Rakesh, Singh, S. P., Saxena, D. K., and Srivastava, S. P(A). 1999-2000. male reproductive effect of nickel sulphate in mice. *Biometals* 12(4): 339-346. Ref ID: 19521

Pandey Ratna and Singh, S. P(A). 1999. studies on testicular enzymes with abnormal sperm in nickel exposed mice. *Biological Memoirs* 25(1): 9-11. Ref ID: 19522

Phatak, SS and Patwardhan, VN. 1950. toxicity of nickel. *J. Sci. Ind. Res.* 9B(3): 70. Ref ID: 14480

Phatak, SS and Patwardhan, VN. 1952. toxicity of nickel-accumulation of nickel in rats fed on nickel-containing diets and its elimination. *J. Sci. Ind. Res.* 11B(5): 173. Ref ID: 14481

Schroeder, H. A. and Mitchener, M. 1975. life-term effects of mercury, methyl mercury, and nine other tracemetals on mice. *Journal of Nutrition.* 105(4): 452-458. Ref ID: 1858

Schroeder, H. A. and Mitchener, M. 1971. toxic effects of trace elements on the reproduction of mice and rats. *Arch.Environ.Health.* 23: 102-106. Ref ID: 66

Schroeder, HA, Balassa, JJ, and Vinton, WH Jr. 1964. chromium, lead, cadmium, nickel and titanium in mice: effect on mortality, tumors and tissue levels. *J. Nutr.* 83: 239. Ref ID: 14447

Schroeder, HA, Mitchener, M, and Nason, AP. 1974. life-term effects of nickel in rats: survival, tumors, interactions with trace elements and tissue levels. *J. Nutr.* 104: 239. Ref ID: 14484

Schroeder, Henry A. 1968. serum cholesterol levels in rats fed thirteen trace elements. *J. Nutr.* 94(4): 475-80 . Ref ID: 15506

Seidenberg, J. M., Anderson, D. G., and Becker, R. A. 1986. validation of an in vivo developmental toxicity screen in the mouse. *Teratog Carcinog Mutagen.* 6: 361-374. Ref ID: 113

Smith, M. K., George, E. L., Stober, J. A., Feng, H. A., and Kimmel, G. L. 1993. perinatal toxicity associated with nickel chloride exposure. *Environm Res.* 61: 200-211. Ref ID: 62

Spears, J. W., Harvey, R. W., and Samsell, L. J. 1986. effects of dietary nickel and protein on growth, nitrogen-metabolism and tissue concentrations of nickel, iron, zinc, manganese and copper in calves. *Journal Of Nutrition* 116(10): 1873-1882. Ref ID: 19664

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

Spears, J. W., E. E. Jones, L. J. Samsell, and W. D. Armstrong. 1984. Effect of dietary nickel on growth urease activity blood parameters and tissue mineral concentrations in the neo natal pig. *Journal of Nutrition*. 114 (5). 845-853. Ref ID: 19671 :

Szakmary, E., V. Morvai, M. Naray, and G. Ungvary. 1995. Haemodynamic effect of nickel chloride in pregnant rats. *Acta Physiologica Hungarica*. 83 (1). 3-12. Ref ID: 19729

Szakmary, E., V. Morvai, M. Naray, and G. Ungvary. 1995. hemodynamic effect of nickel chloride in pregnant rats . *Acta Physiol. Hung.* 83(1): 3-12 . Ref ID: 19731

Tandon, S. K., and A. K. Mathur. 1986. Role of iron deficiency in susceptibility to nickel toxicity 7 *J. Environ.*

Biol. (4) : 201-7. Ref ID: 19746

Tomokuni, K. and Ichiba M. 1990. interaction between nickel and lead in relation to porphyrin metabolism in mice. *Ind. Health 28: 145-149.* Ref ID: 36732

Uthus, E. O., and R. A. Poellot. 1997. Dietary nickel and folic acid interact to affect folate and methionine metabolism in the rat. *Biol. Trace Elem. Res.* 58 (1 and 2) : 25-41. Ref ID: 19764

Vyskocil, A., Viau, C., and Cizkova, M. 1994. chronic nephrotoxicity of soluble nickel in rats. *Hum. Exp. Toxicol. (1994)* 13(10): 689-93 . Ref ID: 19787

Waltschewa, W., Slatewa, M., and Michailow, I. 1972. testicular changes due to long-term administration of nickel sulfate in rats. *Exp Pathol* 6: 116-120. Ref ID: 19792

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

Weber, C. W. and Reid, B. L. 1968. nickel toxicity in growing chicks. *J Nutr.* 95: 612-616. Ref ID: 60

Weber, CW and Reid, BL. 1969. nickel toxicity in young growing mice. *J. Anim. Sci.* 28: 620. Ref ID: 14485

Whanger, P. D. 1973. effects of dietary nickel on enzyme activities and mineral contents in rats. *Toxicol.Appl.Pharmacol.* 25: 323-331. Ref ID: 63

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 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 aspects of crack growth in structural materials in light water reactors (stainless steel, nickel alloys). *01642159 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss attempts to isolate with gas liquid chromatography chemical differences between reward and frustrative nonreward odor emissions in the rat. *699745 ORDER NO: AAD80-25899*

CP 1971.*Bulletin of the Chemical Society - Belgrade. Volume 34, Number 8-9-10, 1969. SFCSI-COMM(TT-69-51006/8-9-10)*

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

Diss	effects of ethanol on muscarinic receptor-induced responses in astroglia (carbachol, calcium). *01698206 ORDER NO: AAD99-24077*
CP	1971-1977. fifty-sixth annual conference of the north central entomologists.| au-yuill, t. m.; scholl, p. j.; meyer, j. a.; knapp, f. w.; christensen,c. m.; peterson, r. d.; williams, r. e.; hair, j. a.; johnson, o. a.;nickel, c. a.; mcneal, c. d., jr.; campbell, j. b.; moneyham, g. e.;shugart, j. i.; boxler, d.; coffey, m. d.; boxler, d. j.; berry, r.l.; parsons, m. a.; lalonde-weigert, b. j.; restifo, r. a.; keiper,d.; lebio, j.; sipos, c.; bear, f. t.; halpin, t. j.; jennings, m. r.;zaim, m.; newson, h. d. *Proceedings, North Central Branch, Entomological Society of America*
Diss	heavy metal toxicity and nutrient depletion in upper bear creek reservoir. *01229302 ORDER NO: AAD13-46169*
Diss	immune response to orthopaedic biomaterials. *01440048 ORDER NO: AADAA-I9534554*
Diss	the murine dna methyltransferase: purification, heterologous expression, steady-state kinetics and post-translational processing. *01572339 ORDER NO: AAD97-27712*
No COC	news about chemicals. *IRPTC Bull. V8, N1, P17(16)*
No Oral	nickel permeation pathways in the small intestine and the olfactory system (iron deficiency). *01626234 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*
Diss	nickelous nitrate hexahydrate and its effect on reproduction in the mouse. *702149 ORDER NO: AAD13-01167*
Mix	1993. ntp technical report on toxicity studies of a chemical mixture of 25 groundwater contaminants administered in ***drinking*** ***water*** to f344/n ***rats*** and b6c3f1 ***mice***. *Natl. Toxicol. Program Toxic. Rep. Ser.* 35: 184 pp.
FL	1978. (on the use of radioisotopic methods in an hygienic experiment).| au- moscow, ussr. *GIGIENA I SANITARIYA* No. 9: 72-75.
Unrel	1999.*Report on the Proposed Voisey's Bay Mine and Mill Project. SSC-EN106-45/1999E; ISBN-0-662-27511-X*
Diss	the role of the nmda receptor and cyclic guanosine 3',5'-monophosphate (cgmp) in the pathophysiological mechanisms of experimental brain injury: a time-course study (trauma, intracellular signaling, memory). *01603489 ORDER NO: AAD98-04188*
No Oral	soft actuators and artificial muscles. *PCT Int. Appl.* 53 pp..
Diss	studies on the muscarinic receptors in neuroblastoma cells. *750140 ORDER NO: AAD81-14988*
Diss	a study of the chemistry and mutagenicity of welding fume. *910380 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*
Diss	the susceptibility of pulmonary immunologic phenomena to the toxic effects of nickel subsulfide. *933904 ORDER NO: AAD86-25095*
Diss	the synthesis and characterization of some polymer-supported macrocylic complexes and their interaction with oxygen. *01134166 ORDER NO: AADDX-90556*
Diss	theoretical studies of the electronic structure and bonding in some transition metal complexes of

vanadium, chromium, iron, nickel and palladium. *765403 ORDER NO: AAD81-24610*

Drug treatment of septic shock with transition metal complexes. *PCT Int. Appl.* 13 pp.

Diss ultraviolet radiation and allergic contact dermatitis: an experimental and clinical study. *0997098 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

No Oral 1979. whole-body autoradiography of 63ni in mice throughout gestation.| au- blindern, oslo 3, Norway. *Toxicology* 12(2): 165-172.

Diss zinc and calcium effects on nickel dermatitis in the guinea pig. *0961875 ORDER NO: AAD87-17748*

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.

Unrel Adam, J., Pinta, M., and Goyon, M. 1986. hyena disease of cattle. *Bulletin Mensuel De La Societe Veterinaire Pratique De France* 70(7): 405...416.

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 .

CP <Additional> Rapp. W. F., Amin, O. M., Amrine, J. A., Lewis, R. E., McGivern, J. J., Rai, K. S., Treece, R. E., Wagoner, D. E., Johnson, O. A., Childress, D., Nickel, C. A., Birkenmeyer, D. R., Dame, D. A., Pinger, R. R. Jr., Degrugillier, M. E., Leopold, R. A., and Heller, P. R. 1974. medical and veterinary insects. *Proceedings, North Central Branch, Entomological Society of America* 29: 184-188.

Abstract Adkins, B. Jr and Gardner, D. E. the effect of nickel on the enhancement of induced streptococcal infections. *Abstracts of the Annual Meeting of the American Society for Microbiology. 76. 1976 B45*

Acu Adler, M. W. and Adler, C. H. 1977. toxicity to heavy metals and relationship to seizure thresholds. *Clin Pharmacol Ther.* 22(5 Pt 2): 774-9.

FL Ado, V. A. and Horyachkina, L. A. modeling of chemical allergoses and their selective and nonspecific inhibition. *Fiziol Zh (Kiev); 21 (4). 1975 481-485*

Phys Ahmed, Abu, Kobayashi, Sei, Shikasho, Tomomi, Nishimura, Junji, and Kanaide, Hideo. differential effects of ca2+ channel blockers on ca2+ transients and cell cycle progression in vascular smooth muscle cells. *Eur. J. Pharmacol. (1998)* 344(2/3): 323-331

Diss Ahpasri Chaigool. 1985. genotoxicity of some heavy metals on chick embryos. <original> phit khong loha nak bangchanit to san phanthukam nai embryo kai. *83 Leaves*

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 .

Unrel Albracht, S. P. J., Ankelfuchs, D., Vanderzwaan, J. W., Fontijn, R. D., and Thauer, R. K. 1986 . a new electron-paramagnetic-res signal of nickel in methanobacterium-thermoautotrophicum. *Biochimica Et Biophysica Acta* 870(1): 50-57.

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

Not Avail Ali, Usama A., El-Tohamy, Magda M., and Ali., Gamal A. adverse effects of nickel on testicular efficiency of male ***rabbits***. *Zagazig J. Pharm. Sci. (1996)* 5(2): 105-112.

HHE Altmannsberger, M., Weber, K., Droste, R., and Osborn, M. desmin is a specific marker for rhabdomyosarcomas of human and rat origin. *American Journal of Pathology. 118 (1). 1985. 85-95.*

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.

No Oral Andersen, H. R. and Andersen, O. 1989. effect of nickel chloride on hepatic lipid peroxidation and glutathione concentration in mice. *Biological Trace Element Research* 21: 255-61.

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).

FL Anke, M., Glei, M., Arnhold, W., Holzinger, S., Jaritz, M., Seifert, M., Loesch, E., Scholz, E., Hartmann, E., Truepschuch, A., Anke, S., Seeber, O., and Rieke-Hostein, T. 1997. macro element, trace element and ultra trace element supply of pet bird. <original> die mengen-, spuren- und ultraspurenelement-versorgung der ziervoegel. *Uebersichten Zur Tierernaehrung. V. 25(2) P. 207-208*

Rev Anke, M., Groppel, B., Kronemann, H., and Grun, M. 1984. nickel--an essential element. *IARC Scientific Publications* (53): 339-65.

CP Anke, M., Grun, M., Dittrich, G., Groppel, B., and Hennig, A. low nickel rations for growth and reproduction in pigs. *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 715-718*

FL Anke, M., Hennig, A., Grun, M., Partschefeld, M., Groppel, B., and Ludke, H. 1977. nickel, an essential trace element. 1. effect of nickel intake onliveweight gain, feed intake and body composition of growing miniaturepigs and goats. *Archiv Fur Tierernahrung* 27(1): 25-38.

CP Anke, M., Kronemann, H., Groppel, B., Hennig, A., Meissner, D., and Schneider, H. J. 1980. the influence of nickel-deficiency on ***growth*** , ***reproduction*** , longevity and different biochemical parameters of goats. *Spurenelem.-Symp.: Nickel 3rd* : 3-10. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep.

FL Anke, M., Partschefeld, M., Grun, M., and Groppel, B. CS Sekt. Tierprod. 24 DDR-69 Jena German Democratic Republic. 1978. nickel, an essential trace element. iii. influence of nickelon

the reproductive performance of female animals. *Archiv Fur Tierernahrung* 28(2): 83-90.

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*

Phys Antal, M., Freund, T. F., Somogyi, P., and McIlhinney, R. A. 1990. simultaneous anterograde labelling of two afferent pathways to the same target area with phaseolus vulgaris leucoagglutinin and phaseolus vulgaris leucoagglutinin conjugated to biotin or dinitrophenol. *Journal of Chemical Neuroanatomy* 3(1): 1-9.

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 .

No Oral Anwer, J. and Mehrotra, N. K. effect of simultaneous exposure to nickel chloride and benzo-a-pyrene on developing chick Embryos. *Drug Chem Toxicol; 9 (2). 1986. 171-184.*

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.

Unrel Arbab, M. and Shatynski, S. R. 1985. hot corrosion of nickel in na2so4-caso4 mixtures. *Journal Of The Electrochemical Society* 132(9): 2264-2268.

Bio Acc Archibald, JG. 1949. nickel in cow's milk. *J. Dairy Sci.* 32: 877.

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.

In Vit Arsalane, K., Hildebrand, H. F., Martinez, R., Wallaert, B., and Voisin, C. ultrastructural and biochemical changes in alveolar macrophages exposed to nickel hydroxy carbonate. *Science of the Total Environment; 148 (2-3). 1994. 175-183.*

No Oral Athar, M., Misra, M., and Srivastava, R. C. 1987. evaluation of chelating drugs on the toxicity, excretion, and distribution of nickel in poisoned rats. *Fundamental and Applied Toxicology* 9(1): 26-33.

Rev ATSDR. 1995.

CP AU-Freising-Weihenstephan, German Federal Republic. 1978. ni deficiency and its effects on metabolism. *<Document Title>Trace Element Metabolism in Man and Animals - 3.*| : 236-243.

In Vit Audesirk, G., Audesirk, T., Ferguson, C., Lomme, M., Shugarts, D., Rosack, J., Caracciolo, P., Gisi, T., and Nichols, P. l-type calcium channels may regulate neurite initiation in cultured chick embryo brain neurons and n1e-115 neuroblastoma cells. *DEV BRAIN RES. Developmental Brain Research. 55 (1). 1990. 109-120.*

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.

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 .

Bio Acc Ayas, Z. Hacettepe University Ankara Turkey and Kolankaya, D. accumulation of some heavy metals in various environments and organisms. *Bull Environ Contam Toxicol. V56, N1, P65(8)*

Unrel Ayers, R. A(A), Simske, S. J., Bateman, T. A., Petkus, A., Sachdeva, R. L. C., and Gyunter, V. E. 1999. effect of nitinol implant porosity on cranial bone ingrowth and apposition after 6 weeks. *Journal of Biomedical Materials Research* 45(1): 42-47.

FL Babai, F., Skalli, O., Schurch, W., Seemayer, T. A., and Gabbiani, G. 1988. chemically induced rhabdomyosarcomas in rats. ultrastructural, immunohistochemical, biochemical features and expression of alpha-actin isoforms. *Virchows Archiv* 55(5): 263-77.

Alt Babedzhanov, S. N. balance of iron, vanadium, manganese, nickel and copper in experimental cholesterol atherosclerosis. *Med. Zh. Uzb. (1973)* (10): 18-21

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.

CP Bacskai, B. J(A), Xia, M. Q(A), Strickland, D. K., Rebeck, G. W(A), and Hyman, B. T(A). 1999. alpha-2-macroglobulin (a2m*) activation of low density lipoprotein receptor related protein (lrp) increases intracellular calcium in cortical neurons. *Society for Neuroscience Abstracts.* 25(1-2): 1347.

CP Bae I-H. 1994. the effect of ni-2+ in overcoming the 2-cell block in the mouse embryo. *Molecular Biology of the Cell* 5(SUPPL.): 354A.

CP Bae In-Ha and Choi Sung-Mi. 1996. effect of ca-2+ channel blockers of germinal vesicle breakdown of the mouse oocyte. *Molecular Biology of the Cell* 7(SUPPL.): 643A.

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 .

Nut def Baier, S., Drescher, B., Schindler, R., and Classen, H. G. aggravation by magnesium deficiency of pulmonary lymphosarcomatosis occurring spontaneously in a strain of sprague-dawley ***rats***. *Magnesium-Bull. (1997)* 19(2): 37-41.

FL Baier, Silke and Classen, Hans Georg. toxicokinetic studies on the interaction of magnesium, nickel and zinc. *Dermatosen Beruf Umwelt (1998)* 46(1): 12-17

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.

Mix Baker, D. H. and Molitoris, B. A. 1975. lack of response to supplemental tin, vanadium, chromium and nickel when added to a purified crystalline amino acid diet for chicks. *Poultry Science.* 54(3): 925-7.

Unrel Baker, E. N., Baker, H. M., Anderson, B. F., and Reeves, R. D. 1983. chelation of nickel(ii) by citrate - the crystal-structure of a nickel citrate complex, k2[ni(c6h5o7)(h2o)2]2.4h2o. *Inorganica Chimica Acta-Bioinorganic Chemistry Articles And Letters* 78(6): 281-285.

No Oral Ballarini, G., Guizzardi, F., Maletto, S., and Mussa, P. P. 1984. 'hyena disease' of cattle in relation to mineral deficiency. *Obiettivi e Documenti Veterinari* 5(1): 55-58.

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.

Imm Barratt, M. D. and Langowski, J. J. validation and subsequent ***development*** of the derek skin sensitization rulebase by analysis of the bgvv list of contact allergens. *J. Chem. Inf. Comput. Sci. (1999)* 39(2): 294-298

No Oral Baselt, R. C. Sunderman F. W. Jr. Mitchell J. and Horak E. 1977. comparisons of antidotal efficacy of sodium diethyldithiocarbamate, d-penicillamine and triethylenetetramine upon acute toxicity of nickel carbonyl in rats. *Res.Commun.Chem.Pathol.Pharmacol.* 18[4]: 677-688.

No Oral Basinger, M. A., Jones, M. M., and Tarka, M. P. 1980. relative efficacy of chelating agents as antidotes for acute nickel(ii) acetate intoxication. *Research Communications in Chemical Pathology and Pharmacology* 30(1)

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 .

In Vit Bauman, J. W., Liu, J., and Klaassen, C. D. 1993. production of metallothionein and heat-shock proteins in response to metals. *Fundamental and Applied Toxicology* 21(1): 15-22.

Unrel Beal, R. E., Toscano-Cantaffa, D., Young, P., Rechsteiner, M., and Pickart, C. M. 1998. the hydrophobic effect contributes to polyubiquitin chain recognition. *Biochemistry* 37(9): 2925-34.

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.

Unrel Becker, M., Bendoraitis, J. G., Bloch, M. G., Cabal, A. V., and Callen, R. B. 1982.*Analytical Studies for the H-Coal Process. Final Report. DOE/ET/10112-T1; FE-2676-8*

Nutrition 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.

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.

No Oral Bencko, V., Arbetova, D., and Skupenova, V. 1981. use of domesticated rabbit tissues for monitoring of environmental pollution by toxic metals (mn, pb, cr, cd, ni). *Journal of Hygiene, Epidemiology, Microbiology, and Immunology* 25(2)

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.

HHE Bensimon, J. and Rosenfeld, C. influence of nickel sulfate on the growth of 2 human lympho blastoid lines of normal and leukemic origin. *Comptes Rendus Hebdomadaires Des Seances De L'Academie Des Sciences Serie D Sciences Naturelles. 278 (2). 1974 (Recd 1975) 345-348*

Acu Benson, J. M., Henderson, R. F., Mcclellan, R. O., Hanson, R. L., and Rebar, a. H. comparative acute toxicity of four nickel compounds to f-344 rat Lung. *Fundam Appl Toxicol; 7 (2). 1986. 340-347.*

No Oral Benson, J. M. Cheng Y. S. Eidson A. F. Hahn F. H. Henderson R. H. and Pickrell J. A. 1995. pulmonary toxicity of nickel subsulfide in f344/n rats exposed for 1-22 days. *Toxicology 103, 9-22.*

No COC Benson, K. A. and McBride, S. A. uranium levels in the fetus and placenta of female rats implanted with depleted uranium pellets prior to breeding. *Toxicologist 1997 Mar;36(1 Pt 2):258*

In Vit Bentham J(A), Ohlsson, C., Lindahl, A., Isaksson, O., and Nilsson, A. 1993. a double-staining technique for detection of growth hormone and insulin-like growth factor-i binding to rat tibial epiphyseal chondrocytes. *Journal of Endocrinology* 137(3): 361-367.

No Oral Bergman, B., Bergman, M., Magnusson, B., Soremark, R., and Toda, Y. 1980. the distribution of nickel in mice. an autoradiographic study. *Journal of Oral Rehabilitation* 7(4): 319-24.

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.

Rev Beyer, W. N. J. Spann and D. Day. 1999. metal and sediment ingestion by dabbling ducks. *The Science of the Total Environment.* 231: 235-239.

Surv Bierei, G. R. 1974.*Population Response and Heavy Metal Concentrations in Cottontail Rabbits and Small Mammals in Wastewater Irrigated Habitat*

Phys Bixby, J. L., Grunwald, G. B., and Bookman, R. J. 1994. ca2+ influx and neurite growth in response to purified n-cadherin and laminin. *Journal of Cell Biology* 127(5): 1461-75.

Phys Blackburn, K. and Highsmith, R. F. nickel inhibits endothelin-induced contractions of vascular smooth muscle. *American Journal of Physiology. 258 (6 Part 1). 1990. C1025-C1030.*

Mix Blakley, Barry R. 1987. alterations in urethan-induced adenoma formation in ***mice*** exposed to selenium and nickel. *J. Appl. Toxicol.* 7(6): 387-90

Diss Blalock, T. L. 1986. studies on the role of iron in the reversal of zinc, cadmium, vanadium, nickel and cobalt toxicities in broiler pullets. *Diss. Abstr. Int. B 1986, 47(2), 577-8.*: 188 pp.

CP Blalock, T. L. and Hill, C. h. 1986. mechanisms of alleviation of zinc cadmium vanadium nickel and cobalt toxicities by dietary iron. *70th Annual Meeting of the Federation of American Societies*

for Experimental Biology

Unrel Boekenoogen, D. I., Sinha, P. K., Nanda, R. S., Ghosh, J., Currier, G. F., and Howes, R. I. 1996. the effects of exogenous prostaglandin e2 on root resorption in rats. *American Journal of Orthodontics and Dentofacial Orthopedics* 109(3)

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.

FL Bokori, J., Fekete, S., Kadar, I., Vetesi, F., and Albert, M. complex study of the physiological role of aluminum. ii. aluminum tolerance tests in broiler ***chickens***. *Acta Vet. Hung. (1993)* 41(3-4): 235-64 .

FL Bolotnikov, I. A., Malazhaev, E. D., Nikol'skii, V. M., and Smirnova, T. I. 1988. use of complex of trace elements and iminodisuccinic acid in poultryhusbandry. *<Document Title>3 Vsesoyuznoe Soveshchenie Po Khimii i Primeneniyukompleksonov i Kompleksonatov Metodov. Tezisy Dokladov.* 258-259.

Org met Bomhard, E., Loser, E., Dornemann, A., and Schilde, B. 1982. subchronic oral toxicity and analytical studies on nickel rutile yellow and chrome rutile yellow with rats. *Toxicol Lett.* 14(3-4): 189-94.

CP Bonish Brian K, Jones Michael L, and Ward Peter A. 1994. expression and nickel affinity purification of a recombinant 1439bp fragment of rat vascular cell adhesion molecule-1 (vcam-1). *FASEB Journal* 8(4-5): A133.

In Vit Bonner, J. C., Hoffman, M., and Brody, A. R. 1989. alpha-macroglobulin secreted by alveolar macrophages serves as a binding protein for a macrophage-derived homologue of platelet-derived growth factor [see comments]. *American Journal of Respiratory Cell and Molecular Biology* 1(3)

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 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

Unrel Borthomieu, Y. and Duquesne, D. 1994.*Saft Nickel Hydrogen Cell Cycling Status*

In Vit Boussiquet-Leroux, C., Durand-Cavagna, G., Herlin, K., and Holder, D. 1995. evaluation of lymphocyte proliferation by immunohistochemistry in the local lymph node assay. *Journal of Applied Toxicology* 15(6): 465-75.

Unrel Bow, Craig S. and Geist, Dennis J. geology and petrology of floreana island, galapagos archipelago, ecuador. *J. Volcanol. Geotherm. Res. (1992)* 52(1-3): 83-105

In Vit Boyd, Juanell N. Cornell Univ, Stoewsand, Gilbert S., Babish, John G., Telford, John N., and Lisk, Donald J. safety evaluation of vegetables cultured on municipal sewage. *Arch Environ Contam Toxicol. V11, N4, P399(7)*

No COC Bradberry, S. M. and Vale, J. A. 1999. therapeutic review: do diethyldithiocarbamate and

disulfiram have a role in acute nickel carbonyl poisoning? *Journal of Toxicology. Clinical Toxicology* 37(2): 259-64.

Fate Brandt, H. M. and Apkarian, A. V. 1992. biotin-dextran: a sensitive anterograde tracer for neuroanatomic studies in rat and monkey. *Journal of Neuroscience Methods* 45(1-2): 35-40.

Unrel Brown, S. A., Devine, S. D., and Merritt, K. 1983. metal allergy, metal implants and fracture healing. *Biomaterials, Medical Devices, and Artificial Organs* 11(1): 73-81.

Unrel Browner, M. F., Hackos, D., and Fletterick, R. 1994. identification of the molecular trigger for allosteric activation in glycogen phosphorylase. *Nature Structural Biology* 1(5): 327-33.

In Vit Bruni, C. and Rust, J. n. fine structure of dividing cells and of nondividing, differentiating cells of nickel sulfide-induced rhabdomyosarcomas. *J Natl Cancer Inst; 54 (3). 1975 687-696*

In Vit Buckley, N. E., Su, Y., Milstien, S., and Spiegel, S. 1995. the role of calcium influx in cellular proliferation induced by interaction of endogenous ganglioside gm1 with the b subunit of cholera toxin. *Biochimica Et Biophysica Acta* 1256 (3): 275-83.

In Vit Budde, T. and White, J. A. 1998. the voltage-dependent conductances of rat neocortical layer i neurons. *European Journal of Neuroscience* 10(7): 2309-21.

No COC Bueltmann, R., Wittenburg, H., Pause, B., Kurz, G., Nickel, P., and Starke, K. p sub(2)-purinoceptor antagonists. iii. blockade of p sub(2)-purinoceptor subtypes and ecto-nucleotidases by compounds related to suramin. *Arch.-pharmacol. 1996 Vol. 354, No. 4, Pp. 498-504.*

No Oral Buguet, A., Burlet, S., Auzelle, F., Montmayeur, A., Jouvet, M., and Cespuglio, R. 1996. [action duality of nitrogen oxide (no) in experimental african trypanosomiasis]. <original> dualite d'action du monoxyde d'azote (no) dans la trypanosomose africaine experimentale. *Comptes Rendus De L'Academie Des Sciences* 319(3): 201-7.

No Oral Buguet Alain(A), Burlet Sophie, Auzelle Fabrice, Montmayeur Alain, Jouvet Michel, and Cespuglio Raymond. 1996. dual intervention of no in experimental african trypanosomiasis. *Comptes Rendus De L'Academie Des Sciences Serie III Sciences De La Vie* 319(3): 201-207.

HHE Bulger, W. H. and Kupfer, D. characteristics of monooxygenase-mediated covalent binding of methoxychlor in human and rat liver microsomes. *Drug Metabolism and Disposition. 17 (5). 1989. 487-494.*

Surv Burger, J. and Gochfeld, M. 1988-1989. metals in tern eggs in a new jersey estuary usa a decade of Change. *Environ Monit Assess.* 11(2): 127-136.

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 .

Bio Acc Cahill, T. M., Anderson, D. W., Elbert, R. A., Perley, B. P., and Johnson, D. R. 1998. elemental profiles in feather samples from a mercury-contaminated lake in central california. *Arch. Environ. Contam. Toxicol.* 35(1): 75-81 .

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.

No Oral Camner, P. Johansson A. and Lundborg M. 1978. alveolar macrophages in rabbits exposed to

nickel dust. ultrastructural changes and effect on phagocytosis. *Environ. Res. 16[1-3], 226-235.*

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 .

Acute Cartana, Jordi and Arola, Lluis. nickel-induced hyperglycemia: the role of insulin and glucagon. *Toxicology (1992)* 71(1-2): 181-92

Surv Casati, R. M., Vazhapilly, P., Cappa, V. , and Tonna, M. 1988. effect of supplementing the diet with heavy metals on the mineral content of rabbits. *Annali Della Facolta Di Agraria, Universita Cattolica Del Sacro Cuore Milano.* 28(2): 241-269.

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.

Unrel Castaneyra-Perdomo, A., Perez-Delgado, M. M., Montagnese, C., and Coen, C. W. 1992. brainstem projections to the medial preoptic region containing the luteinizing hormone-releasing hormone perikarya in the rat. an immunohistochemical and retrograde transport study. *Neuroscience Letters* 139(1): 135-9.

Unrel Castleman, L. S., Motzkin, S. M., Alicandri, F. P., and Bonawit, V. L. 1976. biocompatibility of nitinol alloy as an implant material. *Journal of Biomedical Materials Research* 10(5): 695-731.

Aquatic Cataldo, D. A. and Wildung, R. E. 1983. the role of soil and plant metabolic processes in controlling trace element behavior and bioavailability to animals. *Science of the Total Environment* 28: 159-68.

Rev Cataldo, D. A., Wildung, R. E., and Garland, T. R. 1987. speciation of trace inorganic contaminants in plants andbioavailability to animals: an overview. *Journal of Environmental Quality.* 16(4): 289-295.

Fate Cavicchia, Juan C., Sacerdote, Fabio L., and Gutierrez, Luis A. nickel nitrate: a new junction permeability tracer for the study of the blood-testis barrier . *Microsc. Res. Tech. (1992)* 20(1): 34-42.

In Vit Champigneulle, A., Siga, E., Vassent, G., and Imbert-Teboul, M. relationship between extra- and intracellular calcium in distal segments of the renal tubule. role of the ca2+ receptor rakcar. *J. Membr. Biol. (1997)* 156(2): 117-129

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. *Photochemistry and Photobiology. 45 (6). 1987. 757-762.*

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*

Mix Chapin, Robert E., Phelps, Jerry L., Schwetz, Bernard A., and Yang, Raymond S. H. toxicology studies of a chemical mixture of 25 groundwater contaminants. iii. male reproduction study in

b6c3f1 mice. *Fundam. Appl. Toxicol. (1989)* 13(3): 388-98 .

Unrel Chapin, Robert E a, Morrissey, Richard E, Gulati, Dushyant K, Hope, Esther, Barnes, Leta H, Russell, Susan a, and Kennedy, Sarah R. 1993. are mouse strains differentially susceptible to the reproductive toxicity of ethylene glycol monomethyl ether? a study of three strains. *Fundamental and Applied Toxicology.* 21(1): 8-14.

Rev Chau, Y. K. and Kulikovsky-Cordeiro, O. T. R. 1995. occurrence of nickel in the canadian environment. *(Ottawa) Environ. Rev.* Volume Date 1995, 3(1): 95-120

Alt Chausmer, A. B., Rogers, C. H., and Colucci, A. V. transmembrane transport of nickel in the rat liver slice model. *Nutrition Reports International.* Sept 1978. v. 18 (3) p. 249-258. ill., charts.

In Vit Chen, C., Israel, J. M., and Vincent, J. D. 1989. electrophysiological responses to somatostatin of rat hypophysial cells in somatotroph-enriched primary cultures. *Journal of Physiology* 408: 493-510.

Phys Chen, C., Zhang, J., Vincent, J. D., and Israel, J. M. 1990. two types of voltage-dependent calcium current in rat somatotrophs are reduced by somatostatin. *Journal of Physiology* 425: 29-42.

No Oral CHEN, C. Y., HUANG, Y. L., and LIN, T. H. 1998. association between oxidative stress and cytokine production in nickel-treated Rats. *Archives of Biochemistry and Biophysics.* 356(2): 127-132.

No Oral Chen, J. K. M. Haro R. T. and Furst A. 1971. excretion of nickel compounds by the rat: blood and urine levels. *Wasmann J. .Biol. 29[1]: 1-15.*

Unrel Chiy, P. C., Avezinius, J. A., and Phillips, C. J. C. 1999. sodium fertilizer application to pasture. 9. the effects of combined orseparate applications of sodium and sulphur fertilizers on herbagecomposition and dairy cow production. *Grass and Forage Science* 54(4): 312-321.

FL Chorvatovicova, D. nickel chloride and potassium dichromate induced sperm abnormalities in swiss mice. *Biologia (Bratisl); 40 (11). 1985. 1151-1156.*

In Vit Christie, N. T. 1989. the synergistic interaction of nickel(ii) with dna damaging agents. *Toxicol.-environ.-chem.* 22(1-4): 51-59.

Unrel Chu, Z. M. and Beilin, L. J(A). 1993. mechanisms of vasodilatation in pregnancy: studies of the role of prostaglandins and nitric oxide in changes of vascular reactivity in the in situ blood perfused mesentery of pregnant rats. *British Journal of Pharmacology* 109(2): 322-329.

Unrel Clerc, C. O., Jedwab, M. R., Mayer, D. W., Thompson, P. J., and Stinson, J. S. 1997. assessment of wrought astm f1058 cobalt alloy properties for permanent surgical implants. *Journal of Biomedical Materials Research* 38(3): 229-34.

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.

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.

BioX Connolly, B. M., Jenson, A. B., Peters, C. J., Geyer, S. J., Barth, J. F., and McPherson, R. A. 1993. pathogenesis of pichinde virus infection in strain 13 guinea pigs: an immunocytochemical, virologic, and clinical chemistry study. *American Journal of Tropical Medicine and Hygiene* 49(1): 10-24.

In Vit Costa, M. alteration of morphology of chinese hamster ovary cells by ni3s2 and dibutyryl camp. *Toxicology and Applied Pharmacology| VO- 44(3)| PG- 555-566|*

In Vit Costa, M., Abbracchio, M. P., and Simmons-Hansen, J. 1981. factors influencing the phagocytosis, neoplastic transformation, and cytotoxicity of particulate nickel compounds in tissue culture systems. *Toxicology and Applied Pharmacology* 60(2): 313-23.

In Vit Costa, M., Cantoni, O., de Mars, M. , and Swartzendruber, D. E. 1982. toxic metals produce an s-phase-specific cell cycle block. *Research Communications in Chemical Pathology and Pharmacology* 38(3)

In Vit Costantini, M. G. and Pearlmutter, A. F. 1984. properties of the specific binding site for arginine vasopressin in rat hippocampal synaptic membranes. *Journal of Biological Chemistry* 259(19): 11739-45.

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.

In Vit Coulombe, A., Lefevre, I. A., Baro, I., and Coraboeuf, E. barium and calcium-permeable channels open at negative membrane potentials in rat ventricular myocytes. *Journal of Membrane Biology. 111 (1). 1989. 57-68.*

Unrel Crampon, M. A., Sawan, M., Brailovski, V., and Trochu, F. 1999. new easy to install nerve cuff electrode using shape memory alloy armature. *Artificial Organs* 23(5): 392-5.

Unrel Cremer, Michel, Weber, Olivier, and Jouanneau, Jean-Marie. 1999. sedimentology of box cores from the cap- ferret*** canyon area (bay of biscay). *Deep-Sea Res. Part II* 46(10): 2221-2247

Phys Cruz, F., Lima, D., and Coimbra, A. 1987. several morphological types of terminal arborizations of primary afferents in laminae i-ii of the rat spinal cord, as shown after hrp labeling and golgi impregnation. *Journal of Comparative Neurology* 261(2): 221-36.

Phys Cullinan, W. E. and Zaborszky, L. 1991. organization of ascending hypothalamic projections to the rostral forebrain with special reference to the innervation of cholinergic projection neurons. *Journal of Comparative Neurology* 306(4): 631-67.

Unrel Cunnane, T. C. and Stjarne, L. frequency dependent intermittency and ionic basis of impulse conduction in postganglionic sympathetic fibers of guinea-pig vas deferens. *Neuroscience. 11 (1). 1984. 211-230.*

Surv Custer, T. W. and Mitchell, C. A. 1993. trace elements and organochlorines in the shoalgrass community of the lower laguna madre, texas. *Environ Monit Assess* 25(3): 235-246.

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 .

Unrel Dai, K. and Chu, Y. 1996. studies and applications of niti shape memory alloys in the medical field in china. *Bio-Medical Materials and Engineering* 6(4): 233-40.

CP Danis, J., Dauksa, K., Kusleikaite, M., Naktinis, I., Juseviciute, B., and Vizas, V. 1973. effect of nickel(ii) chloride on the rat***. *Mater. Nauchn. Konf. Kaunas. Med. Inst. 22nd* : Meeting Date 1972, 69-70. Editor(s): Vaichyuvenas, V. A. Publisher: Kaunas. Med. Inst., Kaunas, USSR.

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 .

FL Darolova, A., Reichrtova, E., and Pavelka, J. 1989. bioaccumulation of metals from nickel works waste in the gull (*Larus ridibundus l.*, 1766). *Biologia (Bratisl).* 44(6): p567-574.

No Oral Das, K. K. and Dasgupta S. 2002. effect of nickel sulfate on testicular steroidogenesis in rats during protein restriction. *Environ. Health Perspect. 110[9]: 923-926.*

No Oral Das, Kusal K. and Dasgupta, Shakuntala. alteration of testicular biochemistry during protein restriction in nickel treated rats. *Biol. Trace Elem. Res. (1997)* 60(3): 243-249

No Oral Das, Kusal K. and Dasgupta, Shakuntala. effect of nickel on testicular nucleic acid concentrations of rats on protein restriction. *Biol. Trace Elem. Res. (2000)* 73(2): 175-180

No Oral Dasgupta, S., Biswas, S. K., and Das, K. K. 1989. effect of nickel on acid and alkaline phosphatase activities in thereproductive system of male rats during protein restriction. *Medical Science Research* 17(2): 95-96.

Phys Dasgupta, S., Ghosh, S., and Das, K. K. transaminase activities in some metabolically active tissues of nickel treated rats under protein restricted condition. *Indian Journal of Physiology and Allied Sciences; 50 (1). 1996. 27-32.*

No Oral Dasgupta, S., Mukherjee, C., Biswas, S. K., Ghosh, S., and Das, K. K. acid and alkaline phosphatase activities in some metabolically active tissues of nickel-treated rats under protein restricted condition. *Indian J. Physiol. Allied Sci. (1989)* 43(3): 119-23

CP Davies, N. T. 1981. an appraisal of the newer trace elements. *Philosophical Transactions of the Royal Society of London. Series B:*

Unrel Davies, R. J., Genghini, M., Walters, D. V., and Morley, C. J. the behavior of lung surfactant in electrolyte solutions. *Biochimica Et Biophysica Acta. 878 (2). 1986. 135-145.*

FL Davydova, V. I., Neizvestnova, E. M., Blokhin, V. A., and Sigova, N. V. 1981. [toxicological evaluation of the combined action of manganese, chromium and nickel]. <original> toksikologicheskaia otsenka kombinirovannogo deistviia margantsa, khroma i nikelia. *Gigiena i Sanitariia* (7): 20-2.

Mineral 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.

No Oral De Broin, Emmanuelle, Urata, Koichi, Giroux, Lise, Lepage, Raymond, and Huet, Pierre-Michel. effect of calcium antagonists on rat liver during extended cold preservation-reperfusion. *Transplantation (1997)* 63(11): 1547-1554

In Vit de Desarmenien, M. G., Dayanithi, G., Tapia-Arancibia, L., and Widmer, H. 1994. developmental autoregulation of calcium currents in mammalian central neurones. *Neuroreport* 5(15): 1953-6.

Abstract De Ruiter N, Mailaender, V., and Kappus, H. 1984. effect of heavy metals on cellular growth metabolism and integrity of cultured chinese hamster kidney cells. *3RD International Workshop on Tissue Culture Application in Toxicology*

FL Decker, W. J. 1968. the influence of lethal x-irradiation on trace metal uptake by the mitochondrion. *Experientia* 24(5): 448-9.

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.

In Vit Dehaye, J. P. regulation by purinergic agonists of zinc uptake by rat submandibular glands. *J. Trace Elem. Med. Biol. (1995)* 9(2): 94-101.

Abstract Deknudt, G. in vivo study of the mutagenicity of heavy metals in mammals. *Mutat Res 97:180,1982*

No Oral Deknudt, G. and Leonard, A. 1982. mutagenicity tests with nickel salts in the male mouse. *Toxicology* 25(4): 289-92.

HHE Denison, M. S., Hamilton, J. W., Young, C. M., and Wilkinson, C. F. 1989. nickel and nickel-conjugate metabolism and acute toxicity. *Veterinary and Human Toxicology* 31(5): 498-9.

Imm Descotes, J., Tedone, R., and Evreux, J. C. 1985. immunotoxicity screening of drugs and chemicals: value of contact hypersensitivity to picryl chloride in the mouse. *Methods and Findings in Experimental and Clinical Pharmacology* 7(6)

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 Devereux, Theodora R. and Fouts, James R. n-oxidation and demethylation of n,n-dimethylaniline by rabbit liver and lung microsomes. effects of age and metals. *Chem.-Biol. Interactions (1974)* 8(2): 91-105

Drug Dhir, H., Agarwal, K., Sharma, A., and Talukder, G. 1991. modifying role of phyllanthus emblica and ascorbic acid against nickel clastogenicity in mice. *Cancer Letters* 59(1): 9-18.

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.

No Oral Dieter, M. P. NIH NC, Jameson, C. W., Tucker, A. N., Luster, M. I., French, J. E., Hong, H. L., and Boorman, G. A. evaluation of tissue deposition, myelopoietic, and immunologic. *J Toxicol Environ Health. V24, N3, P357(16)*

Unrel Difrancesco, D., Noble, D., Denyer, J. C., and Difrancesco, D. the contribution of the pacemaker current i-f to generation of spontaneous activity in rabbit sino-atrial node Myocytes. *J Physiol (Camb). 434 (0). 1991. 23-40.*

Plant Dillon, C. R., Maurice, D. V., and Jones, J. E. 1988. composition of egeria densa. *J. Aquat. Plant Manage.* 26, 44-5 .

Metab Dills, W. L. Jr and Meyer, W. L. studies on 1 deoxy-d fructose 1 deoxy-d glucitol and 1 deoxy-d mannitol as anti metabolites. *BIOCHEMISTRY. Biochemistry. 15 (20). 1976 4506-4512.*

No Oral Diwan, B. A. Kasprzak K. S. and Rice J. M. 1992. transplacental carcinogenic effects of nickel(ii) acetate in the renal cortex, renal pelvis and adenohypophysis in f344/ncr rats. *Carcinogenesis 13[8]: 1351-1357.*

Unrel Dobado-Berrios Pablo M, Ruiz-Navarro Antonio, Torronteras Rafael, and Garcia-Navarro Francisco. 1992. application of an optimized immunostaining technique to evaluate the heterogeneous secretory response from porcine somatotropes by cell blotting. *Journal of Histochemistry and Cytochemistry* 40(11): 1715-1724.

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 .

No Oral Dogra, S., Khanna, A. K., and Kaw, J. L. antibody-forming cell response to nickel and nickel-coated fly ash inrats. *Hum. Exp. Toxicol. (1999)* 18(5): 333-337

In Vit Dolzhanskaya, Natalia, Goncharova, Ekaterina, and Rossman, Toby G. isolation and properties of lead-resistant variants of rat glioma cells. *Biol. Trace Elem. Res. (1998)* 65(1): 31-43 .

Phys DonCarlos, L. L., Monroy, E., and Morrell, J. I. 1991. distribution of estrogen receptor-immunoreactive cells in the forebrain of the female guinea pig. *Journal of Comparative Neurology* 305(4): 591-612.

No Oral Donskoy, E., Donskoy, M., Forouhar, F., Gillies, C. G., Marzouk, A., Reid, M. C., Zaharia, O., and Sunderman, F. W. Jr. 1986. hepatic toxicity of nickel chloride in rats. *Annals of Clinical and Laboratory Science* 16(2): 108-17.

In Vit Dormer, R. L., Kerbey, A. L., Mcpherson, M., Manley, S., Ashcroft, S. Jh, Schofield, J. G., and Randle, P. j. the effect of nickel on secretory systems: studies on the release of amylase, insulin and growth Hormone. *Biochem J; 140 (2). 1974 135-142*

In Vit Dormer, Robert L., Kerbey, Alan L., McPherson, Margaret, Manley, Susan, Ashcroft, Stephen J. H., Schofield, J. George, and Randle, Philip J. effect of nickel on secretory systems. release of amylase, insulin, andgrowth hormone. *Biochem. J. (1974)* 140(2): 135-42.

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 Oral Dostal, Lori A., Hopfer, Sidney M., Lin, Shan Meei, and Sunderman, F. William Jr. effects of nickel chloride on lactating rats and their suckling pups, and the transfer of nickel through rat milk. *Toxicol. Appl. Pharmacol. (1989)* 101(2): 220-31.

FL Dotsenko, V. A. 1979. a special hyposensitizing diet for workers in contact with chemicalallergens. *Gigiena i Sanitariya* (10): 21-25 .

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

CP Drebickas, V. 1980. physiological significance of nickel and iodine. *Spurenelem.-Symp.: Nickel 3rd* : 107-10. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep..

FL Drebickas, V., Miskiniene, M., Dorofejevaite, V., and Zalynaite, M. 1982. effect of salts of iodine, nickel, cadmium, lithium and their mixtures on rabbits and rats. *Liet. TSR Aukst. Mokyklu Mokslo Darb., Biol.* 20: 43-55.

CP Drebickas, V., Vaitekuniene, D., and Aidukoniene, B. 1986. effect of iodine on the laboratory animal. *Spurenelem.-Symp. 5th* : Issue JOD, 127-8. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ. Jena, Jena, Ger. Dem. Rep.

Unrel Dreher, Kevin L., Jaskot, Richard H., Lehmann, James R., Richards, Judy H., McGee, John K., Ghio, Andrew J., and Costa, Daniel L. soluble transition metals mediate residual oil fly ash induced acute lung injury. *J. Toxicol. Environ. Health (1997)* 50(3): 285-305

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

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 .

Abstract Dubiel, A., Stanczyk, J. F., Krolinski, J., and Michalewska, M. concentration of ions of selected trace elements in ejaculates of boars after interruption of the flow of secretion from the testicles epididymides and accessory sex glands. *Polskie Archiwum Weterynaryjne. 21 (4). 1980. 485.*

Unrel Dubrovol'skii, V. V. biogeochemistry of atolls. *Tr. Biogeokhim. Lab.* Akad. Nauk SSSR (1990): 21, 5-34 .

Alt Dwivedi, P. P., Behari, J. R., Misra, M. , and Srivastava, R. C. kinetics and dose dependence of glutathione glutathione-s-transferase and phosphoglucomutase in liver and kidney of nickel treated partially hepatectomized Rats. *Ind Health; 23 (4). 1985 (RECD. 1986). 269-278.*

Unrel Eales, H. V. the birds river intrusion - a quantitative model for karoo central province basalt fractionation. *S. Afr. J. Geol. (1990)* 93(5-6): 717-28 .

Rev Eastin, W. C. and D. J. Hoffman. 1978.: 561-582.

CP Eckert, C., Liegibel, U. M., and Schmezer, P. 1996. mutagenicity of insoluble and soluble nickel compounds in transgenic rat embryonic fibroblasts. *Mutation Research* 360(3): 276.

Mix <Editors> Hemphill, D. D. 1978. movement of nickel from sewage sludge into soil, soybeans and voles. *Document Title>Trace Substances in Environmental Health. XII| AU-Chaney, R.* 377-388.

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.

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.

Unrel Ehlert, F. J., Roeske, W. R., Itoga, E., and Yamamura, H. I. the binding of tritium labeled nitrendipine to receptors for calcium channel antagonists in the heart cerebral cortex and ileum of rats. *Life Sciences. 30 (25). 1982. 2191-2202.*

Nut def Eidelsburger, U., Stangl, G. I., and Kirchgessner, M. iron and cobalt affect intestinal nickel absorption in nickel-deficient and nickel-adequate rats. *Trace Elem. Electrolytes (1996)* 13(4): 182-185

Unrel Eigler, N. L., Khorsandi, M. J., Forrester, J. S., Fishbein, M. C., and Litvack, F. 1993. implantation and recovery of temporary metallic stents in canine coronary arteries. *Journal of the American College of Cardiology* 22(4): 1207-13.

Rev Eisler, R. 1998.*Nickel Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. <NOTE> Technical Rept. USGS/BRD/BSR--1998-0001*

FL Elakhovskaya, N. P. metabolism of nickel entering the body with drinking water. *Gig. Sanit. (1972)* 37(6): 20-2.

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.

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.*

Unrel ENATSU, K. utilization of nickel titanium shape memory alloy for ossicular prosthesis and its biocompatibility with the incus of cats. *Otol Fukuoka; 32 (2). 1986. 256-269.*

No Oral English, J. C. Parker R. D. R. Sharma R. P. and Oberg S. G. 1981. toxicokinetics of nickel in rats after intratracheal administration of a soluble and insoluble form. *Am. Ind. Hyg. Assoc. J. 42: 486-492.*

No Oral Epstein, S., Koehler, W. R., Masurat, T., Singer, E. J., and Solan, J. L. 1964.*Basic Studies in Percutaneous Absorption. <NOTE> Semi-Annual Rept. No. 7, Jan-Jun 64*

In Vit Ershov, Yu. A., Kublik, L. N., Pleteneva, T. V., and Eidus, L. Kh. toxicity of some heavy metal salts for intact and irradiated cultivated animal cells. *Byull. Eksp. Biol. Med. (1992)* 113(3): 280-3

CP Evans, J. and Hastings, L. 1991. effects of nickel sulfate hexahydrate on tests of olfactory function in rats. *Thirteenth Annual Meeting of the Association for Chemoreception Sciences*

No Oral Evans, J. E. Miller M. L. Andringa A. and Hastings L. 1995. behavioral, histological, and neurochemical effects of nickel(ii) on the rat olfactory system. *Toxicol. Appl. Pharmacol. 130[2]: 209-220.*

Bact Ewart, G. D. and Smith, G. D. 1989. immunochemical analysis of the soluble hydrogenase from thecyanobacterium anabaena cylindrica. *Biochimica Et Biophysica Acta, P (Protein Structure and Molecular Enzymology)* 997(1/2): 83-89.

Phy Faivre J-F, Deroubaix, E., Coulombe, A., Legrand A-M, and Coraboeuf, E. effect of maitotoxin on calcium current and background inward current in isolated ventricular rat myocytes. *TOXICON. Toxicon. 28 (8). 1990. 925-938.*

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.

FL Falandysz, J. and Jakuczun, B. 1986. polychlorinated compounds and trace elements in tissues and organs of white-tailed eagle haliaeetus-albicilla. *Bromatol Chem Toksykol.* 19(2): 131-133.

CP Farago, M., Szabo, K., Balogh, I., Gergely, A., and Kovach, A. G. B. 1986. pathophysiological importance of nickel accumulation and release in burns. *Spurenelem.-Symp. 5th* : Issue New Trace Elements, 1183-95. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ. Jena, Jena, Ger. Dem. Rep.

CP Farago, M., Szabo, K., Gergely, A., Balogh, I., and Rubanyi, G. 1983. the role of endogeneous nickel in the development of coronary spasm after burn and bleeding. *Spurenelem.-Symp. 4th* : 73-80. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ., Jena, Ger. Dem. Rep.

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 .

In Vit Fern, R. 1998. intracellular calcium and cell death during ischemia in neonatal rat white matter astrocytes in situ. *Journal of Neuroscience* 18(18): 7232-43.

No COC Fiedler, H. and Hoffmann, H. D. (the action of nickel(ii)-l-glutamate and of different cobalt complexes on the behavior of several lipid components in rabbits.). *Acta Biol Med Ger; 25 (3). 1970 389-398*

FL Fiedler, H. and Hoffmann, H. D. 1970. [the effect of nickel(ii)-l-glutamate and of various cobalt complexes on the behavior of several lipid components in rabbits]: <original> uber die wirkung von nickel(ii)-l-glutamat und verschiedenen kobaltkomplexen auf das verhalten einiger lipidkomponenten bei kaninchen. *Acta Biol Med Ger.* 25(3): 389-98.

Phys Filvaroff Ellen, Calautti Enzo, Reiss Michael, and Dotto, G. Paolo(A). 1994. functional evidence for an extracellular calcium receptor mechanism triggering tyrosine kinase activation associated with mouse keratinocyte differentiation. *Journal of Biological Chemistry* 269(34): 21735-21740.

Unrel Fior, G. O. 1984.*Effects of High Magnetic Fields on the Martensitic Transformation and on the Mechanical Behavior of Cryogenic Fe-9Ni Steel. LBL-18358*

In Vit Firek, L. and Weingart, R. 1995. modification of gap junction conductance by divalent cations and protons in neonatal rat heart cells. *Journal of Molecular and Cellular Cardiology* 27(8): 1633-43.

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 Oral Fisher, G. L., Chrisp, C. E., and McNeill, D. A. 1986. lifetime effects of intratracheally instilled nickel subsulfide on b6c3f1 mice. *Environmental Research* 40(2): 313-20.

Bio Acc Fisher, Nicholas S., Fowler, Scott W., Boisson, Florence, Carroll, JoLynn, Rissanen, Kristina, Salbu, Britt, Sazykina, Tatiana G., and Sjoeblom, Kirsti-Liisa. radionuclide bioconcentration factors and sediment partition coefficients in arctic seas subject to contamination from dumped nuclear wastes. *Environ. Sci. Technol. (1999)* 33(12): 1979-1982 .

No Oral Fleet, J. C. Golemboski K. A. Dietert R. R. Andrews G. K. and McCormick C. C. 1990. induction of hepatic metallothionein by intraperitoneal metal injection: an associated inflammatory response. *Am.J.Physiol.* 258(6 Pt. 1): G926-G933.

Chem Meth Fontani, G. and Tozzi, S. 1980. a method for marking the position of nichrome microelectrode tips in nervous tissue. *Stain Technology* 55(3): 183-4.

CP Forston, J. S., Roberts, L. K., and Krueger, G. G. 1986. development of animal model for contact allergic dermatitis using a weak antigen. *Forty-seventh Annual Meeting of the Society for Investigative Dermatology*

Phys Fox, C. A., Jeyapalan, M., Ross, L. R., and Jacobson, C. D. 1991. ontogeny of cholecystokinin-like immunoreactivity in the brazilian opossum brain. *Brain Research. Developmental Brain Research* 64(1-2): 1-18.

In Vit Fujiwara, Y., Kaji, T., Sakurai, S., Sakamoto, M., and Kozuka, H. inhibitory effect of lead on the repair of wounded monolayers of cultured vascular endothelial cells. *Toxicology; 117 (2-3). 1997. 193-198.*

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.

CP Fukuhara M^Nakahama T^Takabatake E^Fujita M^Urakubo G. effects of heavy metals on the activity of drug-metabolizing enzymes of rabbit lungs. *21st Annual Meeting of the Japanese Society of Toxicological Sciences, Tokyo, Japan, July 1-2, 1985. J Toxicol Sci. 10 (3). 1985. 250.*

In Vit Funakoshi, T., Inoue, T., Shimada, H., and Kojima, S. 1997. the mechanisms of nickel uptake by rat primary hepatocyte cultures: role of calcium channels. *Toxicology* 124(1): 21-6.

Invert Furst, Arthur, Chien, Yvonne, and Chien, Paul K. worms as a substitute for rodents in toxicology: acute toxicity of three nickel compounds. *Toxicol. Methods (1993)* 3(1): 19-23

Carcin Furst, Arthur, Haro, R. T., and Schlauder, M. experimental chemotherapy of nickel-induced fibrosarcomas. *Oncology (1972)* 26(4): 422-6.

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 .

Phys Gainer, J. H. activation of the rauscher leukemia virus by metals. *J. Nat. Cancer Inst. (1973)* 51(2): 609-13.

Drug Gainer, J. H. 1977. effects of heavy metals and of deficiency of zinc on mortality rates in mice infected encephalomyo-carditis Virus. *Amer. J. Veter. Res.* 38(6): 869-872.

Acu Gainer, J. H. 1977. effects of interferon of heavy metal excess and zinc deficiency. *AM J VET RES.* 38(6): 863-867.

In Vit Gainer, J. H. 1977. effects on interferon of heavy metal excess and zinc deficiency. *American Journal of Veterinary Research* 38(6): 863-7.

In Vit Gandia, Luis, Lopez, Manuela G., Fonteriz, Rosalba I., Artalejo, Cristina R., and Garcia, Antonio G. relative sensitivities of chromaffin cell calcium channels to organic and inorganic calcium

antagonists. *Neurosci. Lett. (1987)* 77(3): 333-8.

Unrel Gardner, D. E. 1988. the use of experimental airborne infections to monitor impairments in pulmonary defenses. *J Appl Toxicol.* 8(6): 385-8.

In Vit Garrett, N. E., Campbell, J. A., Stack, H. F., Waters, M. D., and Lewtas, J. 1983. utilization of the rabbit alveolar macrophage and chinese hamster ovary cell for evaluation of the toxicity of particulate materials. 1. model compounds and metal-coated fly ash. *Govt Reports Announcements & Index (GRA&I)*

Unrel Gavett, Stephen H., Madison, Sharon L., Dreher, Kevin L., Winsett, Darrell W., Mcgee, John K., and Costa, Daniel L. metal and sulfate composition of residual oil fly ash determines airway hyperreactivity and lung injury in rats. *Environ. Res. (1997)* 72(2): 162-172.

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.

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

Abstract George, E. L., Stober, J. A., Kimmel, G. L., and Smith, M. K. the developmental effects of nickel chloride in drinking water. *Toxicologist 1989 Feb/Mar;9(1):272*

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.*

Mix Germolec, Dori R., Yang, Raymond S. H., Ackermann, Michael F., Rosenthal, Gary J., Boorman, Gary A., Blair, Patricia, and Luster, Michael I. 1989. toxicology studies of a chemical mixture of 25 groundwater contaminants. ii. immunosuppression in b6c3f1 mice. *Fundam. Appl. Toxicol. (1989)* 13(3): 377-87.

Gene Giaid, A., Hamid, Q., Adams, C., Springall, D. R., Terenghi, G., and Polak, J. M. 1989. non-isotopic rna probes. comparison between different labels and detection systems. *Histochemistry* 93(2): 191-6.

CP Gibbs, P. J. 1992-31820. heavy metal and organochlorine concentrations in tissues of the little penguin eudyptula minor. *DANN*

Abstract Gilani, S. H. and Marano, M. abnormal embryogenesis induced by nickel. *ANAT REC 193:548,1979*

No Oral Gilani, S. H. and Marano, M. congenital abnormalities in nickel poisoning in chick Embryos. *Arch Environ Contam Toxicol 9:17-22,1980*

Meth Glickman, J. Fraser, Flynn James, and Reich Norbert O(A). 1997. purification and characterization of recombinant baculovirus-expressed mouse dna methyltransferase. *Biochemical and Biophysical Research Communications* 230(2): 280-284.

Surv Glooschenko, V., Weller, W. F., Smith, P. GR, Alvo, R., and Archbold, J. HG. 1992. amphibian distribution with respect to pond water chemistry near sudbury, ontario. *Can J Fish Aquat Sci.* 49(Suppl. 1): p114-121.

Phys Godaux, E. and Cheron, G. 1993. testing the common neural integrator hypothesis at the level of the individual abducens motoneurons in the alert cat. *Journal of Physiology (Cambridge)* 469(0): 549-570.

Phys Goetschy Jean-Francois, Letourneur Odile, Cerletti Nico, and Horisberger Michel A(A). 1996. the unglycosylated extracellular domain of type-ii receptor for transforming growth factor-beta. a novel assay for characterizing ligand affinity and specificity. *European Journal of Biochemistry* 241(2): 355-362.

Aquatic Goldberg, E. D. 1972.*Baseline Studies of Pollutants in the Marine Environment and Research Recommendations. NSF/IDOE-74-26*

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.

No Oral Gordon, C. J. 1989. effect of nickel chloride on body temperature and behavioral thermoregulation in the rat. *Neurotoxicology and Teratology* 11(3): 317-20.

Acu Gordon, C. J., Mohler, F. S., Watkinson, W. P., and Rezvani, A. H. 1988. temperature regulation in laboratory mammals following acute toxic insult. *Toxicology* 53(2-3): 161-78.

No Oral Gordon, Christopher J. and Stead, Andrew G. effect of nickel and cadmium chloride on autonomic and behavioral thermoregulation in mice. *Neurotoxicology (1986)* 7(3): 97-106

Alt Gould, E., Woolf, N. J., and Butcher, L. L. 1989. cholinergic projections to the substantia nigra from the pedunculopontine and laterodorsal tegmental nuclei. *Neuroscience* 28(3): 611-23.

No Oral Goutet, M. Ban M. and Binet S. 2000. effects of nickel sulfate on pulmonary natural immunicity in wistar rats. *Toxicology 145: 15-26.*

FL Govorunova, N. N. and Grin, N. V. embryotoxicity of nickel-zinc ferrite inhalations. *GIG SANIT (5):79-80,1984*

Alt Grabitz Ralph G(A), Freudenthal Franz, Sigler Matthias, Le Trong-Phi, Boosfeld Christoph, Handt Stefan, and Von Bernuth Goetz. 1998. double-helix coil for occlusion of large patent ductus arteriosus: evaluation in a chronic lamb model. *Journal of the American College of Cardiology* 31(3): 677-683 .

Unrel Grabitz Ralph G(A), Handt Stefan, Neuss Malte B, Coe James Y, and Von Bernuth Goetz. 1996. enhanced occlusion of vessels combining retrievable, detachable coils as differential electrodes with percutaneous, intravascular radiofrequency electrocoagulation: an experimental study. *Investigative Radiology* 31(12): 789-794.

Unrel Grabitz Ralph G(A), Neuss Malte B, Coe James Y, Handt Stefan, Redel Dierk A, and Von Bernuth Goetz. 1996. a small interventional device to occlude persistently patent ductus arteriosus in neonates: evaluation in piglets. *Journal of the American College of Cardiology* 28(4): 1024-1030.

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.

CP Gracia-Navarro, F., Dobado-Berrios, P. M., and Torronteras, R. optimization of immunostaining

methods on immobilon transfer membranes a model system for quantitative studies. *43rd Annual Meeting of the Histochemical Society, Bethesda, Maryland, Usa, May 15-16, 1992. J Histochem Cytochem. 40 (4). 1992. 600.*

No Oral Graham, J. A. Miller F. J. Daniels M. J. Payne E. A. and Gardner D. E. 1978. influence of cadmium, nickel and chromium on primary immunity in mice. *Environ. Res. 16[1-3]: 77-87.*

In Vit Grant, M. H., Nugent, C., and Bertrand, R. studies on nickel-induced inhibition of fibroblast growth. *Toxicol. in Vitro (1994)* 8(2): 191-5

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 .

Phys Gukovskaya, A. S., Trepakova, E. S., Zinchenko, V. P., Korystov, Y. N., and Bezuglov, V. V. 1992. effect of the sulfhydryl reagent thimerosal on cytosolic free ca2+ and membrane potential of thymocytes. *Biochimica Et Biophysica Acta* 1111(1): 65-74.

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 Oral Gunshin, H., Ohchi, H., and Kato, N. 1988. effects of dietary lactose and calcium level on tissue levels of traceelements, molybdenum, nickel, cobalt and chromium in rats. *Nutrition Reports International* 37(5): 1021-1026.

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

Phys Gupta, A. and Shukla, G. S. 1997. enzymatic antioxidants in erythrocytes following heavy metal exposure possible role in early diagnosis of poisoning. *Bull Environ Contam Toxicol.* 58(2): 198-205.

Meth Gupta, P., Batra, S., Chopra, A. P., Singh, Y., and Bhatnagar, R. 1998. expression and purification of the recombinant lethal factor of bacillus anthracis. *Infection and Immunity* 66(2): 862-5.

BioX Gupta Satish K(A), Sharma Manju, Behera Aruna K, Bisht Rachna, and Kaul Renuka. 1997. sequence of complementary deoxyribonucleic acid encoding bonnet monkey (macaca radiata) zona pellucida glycoprotein-zp1 and its high-level expression in escherichia coli. *Biology of Reproduction* 57(3): 532-538.

In Vit Haddock, P. S., Artman, M., and Coetzee, W. A. 1998. influence of postnatal changes in action potential duration on na-ca exchange in rabbit ventricular myocytes. *Pflugers Archiv* 435(6): 789-95.

CP Haddock Peter S, Coetzee William A, and Artman Michael. 1996. ontogeny of forward and reversed-mode na-ca exchange in the developing rabbit heart. *Circulation* 94(8 SUPPL.): I118.

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 .

Method Halbhuber, K. J., Hulstaert, C. E., Gerrits, P., Moller, U., Kalicharan, D., and Feuerstein, H. 1991.

cerium as amplifying agent--an improved cerium-perhydroxide-dab-nickel (ce/ce-h2o2-dab-ni) method for the visualization of cerium phosphate in resin sections. *Cellular and Molecular Biology* 37(3): 295-307.

Surv Haldar, A., Prakash, V., and Duttagupta, R. 1998. zinc, manganese, chromium and nickel status in blood and hair of goatreared on grazing regimen. *Indian Veterinary Journal* 75(6): 514-516.

Prim Haley, P. J., Bice, D. E., Muggenburg, B. A., Hahn, F. F., and Benjamin, S. A. 1987. immunopathologic effects of nickel subsulfide on the primate pulmonary immune system. *Toxicology and Applied Pharmacology* 88(1): 1-12.

Prim Haley, P. J., Bice, D. E., Muggenburg, B. A., HAHN, F. F., and BENJAMIN, S. A. 1986. immunotoxic effects of nickel subsulfide on the subhuman primate pulmonary immune system. *Joint Annual Meeting of the American Lung Association and the American Thoracic Society*

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 .

Drug Hambright, P. 1989.*Anti-Cyanide Drugs. <NOTE> Annual Rept. 1 Apr 88-31 Mar 89*

HHE Hamilton-Koch, W., Snyder, R. D., and Lavelle, J. M. 1986. metal-induced dna damage and repair in human diploid fibroblasts and chinese hamster ovary cells. *Chemico-Biological Interactions* 59(1): 17-28.

Alt Hancock, M. B. 1982. a serotonin-immunoreactive fiber system in the dorsal columns of the spinal cord. *Neuroscience Letters* 31(3): 247-52.

Rev Hansard, S. L. 1983. microminerals for ruminant animals. *Nutrition Abstracts and Reviews, B.* 53(1): 1-24.

Plant Harada, I. and Murata, H. the absorption characteristics of nickel chloride applied to alfalfa and smooth brome grass. *Journal of Rakuno Gakuen University Natural Science. 15 (1-2). 1990. 139-146.*

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.*

In Vit Harnett, Peter B., Robison, Steven H., Swartzendruber, Douglas E., and Costa, Max. comparison of protein, rna, and dna binding and cell-cycle-specificgrowth inhibitory effects of nickel compounds in cultured cells. *Toxicol. Appl. Pharmacol. (1982)* 64(1): 20-30.

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*

Phys Hartfiel, W. and Sagredos, A. 1989. testing of residues from industrial fatty acid production on broilers. *Fett* 91(4): 154-158.

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.

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.

In Vitro Hass, B. S., McDaniel, L. P., and Littlefield, N. A. 1996. actions and interactions of nickel and magnesium on the transformation response of transformed cells in culture. *Annals of Clinical and Laboratory Science* 26(1): 18-30.

Alt Hattori, Y. and Kanno, M. effect of nickel on the multiphasic positive inotropic responses to histamine mediated by h-1-receptors in left atria of guinea-pigs. *Naunyn-Schmiedeberg'S Archives of Pharmacology. 329 (2). 1985. 188-194.*

Herp Hauptman, O., Albert, D. M., Hopfer, S. M., and Sunderman, F. W. Jr. ocular teratogenesis in xenopus embryos exposed to nickel chloride. *Invest Ophthalmol Vis Sci 1991;32(4):1175*

Unrel He, S. H., Teixeira, M., Legall, J. , Patil, D. S., Moura, I., Moura, J. J. G., Dervartanian, D. V., Huynh, B. H., and Peck, H. D. 1989. epr studies with se-77-enriched (nifese) hydrogenase of desulfovibrio-baculatus - evidence for a selenium ligand to the active-site nickel. *Journal Of Biological Chemistry* 264(5): 2678-2682.

In Vitro Hein, W., Roth, W., Schmidt, W., and Hellthaler, G. 1985. in-vitro studies for objectivation of acute cytotoxicity of orthopedic Implants. *Beitr Orthop Traumatol* 32(10): 485-492.

Mix Heindel, J. J., George, J. D., and Fail, P. A. 1990. final report on the reproductive toxicity of a chemical mixture in cd-1-swiss mice: volume 2, laboratory supplement. *NTIS Technical Report (NTIS/PB91-158451) 1990 Nov;:189 Pp.*

Mix Heindel, Jerold J., Chapin, Robert E., George, Julia, Gulati, Dushyant K., Fail, Patricia A., Barnes, Leta H., and Yang, Raymond S. H. 1995. assessment of the reproductive toxicity of a complex mixture of 25 groundwater contaminants in mice and rats. *Fundam. Appl. Toxicol.* 25(1): 9-19

FL Hennig, A., Jahreis, G., Anke, M., Partschefeld, M., and Grun, M. 1978. nickel, an essential trace element. 2. urease activity of rumen fluidas a possible indicator of the essentiality of the element nickel. *Archiv Fur Tierernahrung* 28(4): 267-268.

No Oral Hicks, R., Hewitt, P. J., and Lam, H. F. an investigation of the experimental induction of hypersensitivity in the guinea pig by material containing chromium, nickel and cobalt from arc welding fumes. *Int Arch Allergy Appl Immunol; 59 (3). 1979. 265-272.*

In Vit Hilaire, C., Diochot, S., Desmadryl, G., Richard, S., and Valmier, J. toxin-resistant calcium currents in embryonic mouse sensory neurons. *Neuroscience; 80 (1). 1997. 267-276.*

CP Hildebrandt, B., Lee, D. K., Hultman, P., Kono, D. H., and Pollard, K. M. 1997. xenobiotic-induced acceleration of systemic autoimmune Disease. *61st National Scientific Meeting of the American College of Rheumatology and the 32nd National Scientific Meeting of the Association of Rheumatology Health Professionals*

Abstract Hill, C. H. 1978. effect of dietary protein levels on metal toxicity. *Federation Proceedings. 37 (3). 405*

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.

Unrel Hino, M., Fukui, T., Kikuchi, H., Matsuda, K., and Itagaki, K. 1999. separation of nickel and cobalt from iron-base alloy scrap by metal solvent. *REWAS '99--Global Symp. Recycl. Waste Treat. Clean Technol., Proc.* Volume 2: 1225-1234. Editor(s): Gaballah, I.; Hager, J.; Solozabal, R. Publisher: Minerals, Metals & Materials Society, Warrendale, Pa..

Unrel Hirano, S. a and Suzuki, K. T. 1996. exposure, metabolism, and toxicity of rare earths and related compounds. *Environmental Health Perspectives.* 104(SUPPL. 1): 85-95.

In Vit Hiroishi, G., Kobayashi, S., Nishimura, J., Inomata, H., and Kanaide, H. 1995. high d-glucose stimulates the cell cycle from the g1 to the s and m phases, but has no competent effect on the g0 phase, in vascular smooth muscle cells. *Biochemical and Biophysical Research Communications* 211(2): 619-26.

Acu Ho, W. and Furst A. 1973. nickel excretion by rats following a single treatment. *Proc.West Pharmacol.Soc.* 16: 245-248.

Diss Hodel, M. 1994.*Untersuchungen Zur Festlegung Und Mobilisierung Der Elemente As, Cd, Ni Und Pb an Ausgewaehlten Festphasen Unter Besonderer Beruecksichtiguung Des Einflusses Von Huminstoffen. (Investigation into the Immobilization and Mobilization of the Elements As, Cd, Ni and Pb at Selected Solid Phases With Special Regard to the Influence of Humic Matter). <NOTE> Diss. (Dr.Rer.Nat.)*

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.

Mix Hoffman, D. J. embryo toxic effects of crude oil containing nickel and vanadium in mallards anas-platyrhynchos. *Bull Environ Contam Toxicol; 23 (1-2). 1979. 203-206.*

No Oral Hoffman, David J. embryotoxic effects of crude oil containing nickel and vanadium inmallards. *Bull. Environ. Contam. Toxicol. (1979)* 23(1-2): 203-6

No Oral Hogan, G. Richard. nickel acetate-induced mortality in mice of different ages. *Bull. Environ. Contam. Toxicol. (1985)* 34(3): 446-50

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.

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. 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 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)

Mix Hong, H. L., Yang, R. S. H., and Boorman, G. A. 1992. alterations in hematopoietic responses in b6c3f1 mice caused by drinking a mixture of 25 groundwater contaminants. *J. Environ. Pathol. Toxicol. Oncol.* 11(2): 65-74 .

Mix Hong, H. L., Yang, R. S. H., and Boorman, G. A. 1993. enhancement of myelotoxicity induced by repeated irradiation inmice exposed to a mixture of groundwater contaminants. *Arch. Toxicol.* 67(5): 358-64.

Mix Hong, H. L., Yang, R. S. H., and Boorman, G. A. residual damage to hematopoietic system in mice exposed to a mixture of groundwater contaminants. *Toxicol. Lett. (1991)* 57(1): 101-11 .

Herp Hopfer, S. M., Plowman, M. C., Bantle, J. A., and Sunderman, F. W. Jr. teratogenicity of nicl2 in xenopus laevis, assayed by the "fetax" procedure. *Ann Clin Lab Sci 1990;20(4):295*

No Oral Hopfer, S. M. and Sunderman F. W. Jr. 1978. manganese inhibition of nickel subsulfide induction of erythrocytosis in rats. *Res.Commun.Chem.Pathol.Pharmacol.* 19(2): 337-345.

No Oral Hopfer, S. M. Sunderman F. W. Jr. Fredrickson T. N. and Morse E. E. 1979. increased serum erythropoietin activity in rats following intrarenal injection of nickel subsulfide. *Res.Commun.Chem.Pathol.Pharmacol.* 23(1): 155-170.

No Oral Hopfer, S. M. Sunderman F. W. Jr. Fredrickson T. N. and Morse E. E. 1978. nickel-induced erythrocytosis: efficacies of nickel compounds and susceptibilities of rat strains. *Ann. Clin. Lab. Sci. 8[5]: 396-402.*

No Oral Hopfer, S. M. Sunderman F. W. Jr. Morse E. E. and Fredrickson T. N. 1980. effects of intrarenal injection of nickel subsulfide in rodents. *Ann.Clin.Lab.Sci.* 10(1): 54-64.

No Oral Hopfer, Sidney M. and Sunderman, F. William Jr. hypothermia and deranged circadian rhythm of core body temperature in nickel chloride-treated rats. *Res. Commun. Chem. Pathol. Pharmacol. (1988)* 62(3): 495-505

No Oral Horak, E. Zygowicz E. R. Tarabishy R. Mitchell J. M. and Sunderman F. W. Jr. 1978. effects of nickel chloride and nickel carbonyl upon glucose metabolism in rats. *Ann. Clin. Lab. Sci. 8[6]: 476-482.*

No Oral Horak, Eva, Sunderman, F. William Jr., and Sarkar, Bibudhendra. comparisons of antidotal efficacy of chelating drugs upon acute toxicity of nickel(ii) in rats. *Res. Commun. Chem. Pathol. Pharmacol. (1976)* 14(1): 153-65

HHE Horstmann, R. D. and Muller-Eberhard, H. J. 1985. isolation of rabbit c3, factor b, and factor h and comparison of their properties with those of the human analog. *Journal of Immunology* 134(2): 1094-100.

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 .

Alt Horvath, T. L., Kalra, S. P., Naftolin, F., and Leranth, C. 1995. morphological evidence for a galanin-opiate interaction in the rat mediobasal hypothalamus. *Journal of Neuroendocrinology* 7(8): 579-88.

Meth Horvath, T. L., Naftolin, F., and Leranth, C. 1992. beta-endorphin innervation of dopamine neurons in the rat hypothalamus: a light and electron microscopic double immunostaining study. *Endocrinology* 131(3): 1547-55.

Prim Horvath Tamas L, Shanabrough Marya, Naftolin Frederick, and Leranth Csaba= (A). 1993. neuropeptide-y innervation of estrogen-induced progesterone receptor-containing dopamine cells in the monkey hypothalamus: a triple labeling light and electron microscopic study. *Endocrinology* 133(1): 405-414.

No Oral Hoshishima, K., Shimai, S., and Kano, K. 1983. the combined administration of certain metals in trace dose upon the postnatal development of behavior in mice. *Dev. Sci. Pract. Toxicol.* 11: 529-32 .

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.

No Oral Hoshishima, K. Ito M. and Hyodo S. 1985. the trace dose of metal(s) and the immunological reaction in mice. *Nutr.Res.* Suppl.I: 740-744.

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.*

Plant Hsieh ChingFang and Hsu KuoNan. 1994. effect of organic manures on the growth and yield of sweet pepper. *Bulletin of Taichung District Agricultural Improvement Station* (42): 1-10.

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.

No Oral Hueper, W. C. 1958. experimental studies in metal cancerigenesis. ix. pulmonary lesions in guinea pigs and rats exposed to prolonged inhalation of powdered metallic nickel. *A.M.A.Arch.Pathol.* 65: 600-607.

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

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*

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.

Nutrition 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 lueckediet. *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 SCI. Life Sciences. 24 (16). 1979. 1453-1466.*

Drug Husain, Mirza M., Ahmad, Nihal, Gupta, Sanjay, Behari, Jai R., Hasan, Syed K., Srivastava, Sanjay

K., and Srivastava, Ramesh C. exacerbation of nickel induced oxidative response by vitamin e. *Ind. Health (1995)* Volume Date 1995, 33(3): 143-52

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.

Unrel Hyodo, H., Fukui, M., and Tamanawa, Y. 1990. [pilot study of a stent made of a shape memorizing alloy used for obstructive jaundice]. *Rinsho Hoshasen* 35(5): 571-6.

No Oral Ikarashi, Y. Momma J. Tsuchiya T. and Nakamura A. 1996. evaluation of skin sensitization potential of nickel, chromium, titanium and zirconium salts using guinea-pigs and mice. *Biomaterials* . 17(21): 2103-2108.

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.

BioX Ilback, N. G., Fohlman, J., and Friman, G. 1993. altered distribution of heavy metals and lipids in coxsackievirus b3 infected mice. *Scandinavian Journal of Infectious Diseases. Supplementum* 88: 93-8.

CP ILBACK, N. G., FOHLMAN, J., and FRIMAN, G. 1990. immune suppressive effects of nickel potentiate the development of inflammatory lesions in viral Myocarditis. *National Meeting of the American Federation for Clinical Research*

Drug Ilbaeck, Nils-Gunnar, Fohlman, Jan, and Friman, Goeran. changed distribution and immune effects of nickel augment viral-induced inflammatory heart lesions in mice. *Toxicology (1994)* 91(2): 203-19.

FL Inouye, M. 1989. teratology of heavy metals: mercury and other contaminants. *Senten Ijo 1989;29:333-44* 29: 333-344.

In Vit Iscan, M. 1984. a comparative-study of the effects of cadmium and nickel on liver microsomal drug-metabolizing enzymes of guinea-pig invitro. *Comparative Biochemistry And Physiology C-Comparative Pharmacology And Toxicology* 79(2): 429-433.

Drug Iscan, M., Coban, T., and Eke, B. C. 1994. differential combined effect of cadmium and nickel on hepatic and renal glutathione s-transferases of the guinea pig. quality management in pharmaceutical development: from molecular design to drug approval. *Pp. 69-72. Vol. 28, No. 4* Drug. Inf. J.

No Oral Iscan, M. Coban T. and Eke B. C. 1992. responses of hepatic xenobiotic metabolizing enzymes of mouse , rat and guinea-pig to nickel. *Pharmacol Toxicol 71: 434-442.*

Imm Ishii, N., Sugita, Y., Nakajima, H., Tanaka, S. I., and Askenase, P. W. elicitation of nickel sulfate (niso4)-specific delayed-type hypersensitivity requires early-occurring and early-acting, niso4-specific dth-initiating cells with an unusual mixed phenotype for an antigen-specific cells. *Cellular Immunology; 161 (2). 1995. 244-255.*

Imm Ishii, Norihisa, Moriguchi, Nobuko, Nakajima, Hiroshi, Tanaka, Shunichi, and Amemiya, Fumiaki. nickel sulfate-specific suppressor t cells induced by nickel sulfate indrinking water. *J. Dermatol. Sci. (1993)* 6(2): 159-64

Acu Ishimatsu, S., Kawamoto, T., Matsuno, K., and Kodama, Y. 1995. distribution of various nickel

compounds in rat organs after oral administration. *Biological Trace Element Research* 49(1): 43-52.

In Vit Ivins, J. K., Raper, J. A., and Pittman, R. N. intracellular calcium levels do not change during contact-mediated collapse of chick drg growth cone structure. *Journal of Neuroscience. 11 (6). 1991. 1597-1608.*

Unrel Iyer, V. R. and Devereux, O. F. 1985. liquid-line corrosion of nickel in molten sodium-carbonate. *Journal Of The Electrochemical Society* 132(5): 1098-1105.

Phys Janas, J., Sitkiewicz, D., Warnawin, K., and Janas, R. M. 1994. characterization of a novel, high-molecular weight, acidic, endothelin-1 inactivating metalloendopeptidase from the rat kidney. *Journal of Hypertension* 12(10): 1155-62.

FL Janicka, Katarzyna and Cempel, Maria. activity of some liver microsomal enzymes in rats exposed per os to nickel chloride. *Bromatol. Chem. Toksykol. (1999)* 32(4): 363-367

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.

Phys Jaramillo, A. and Sonnenfeld, G. 1993. effect of nickel sulfide on induction of interleukin-1 and phagocytic activity. *Environmental Research* 63(1): 16-25.

No Oral Jarstrand, C. Lundborg M. Wiernik A. and Camner P. 1978. alveolar macrophage function in nickel dust exposed rabbits. *Toxicology V11, 353-359.*

No Control JASIM, S. and TJALVE, H. 1986. effect of sodium pyridinethione on the uptake and distribution of nickel cadmium and zinc in pregnant and non-pregnant mice. *Toxicology* 38(3): 327-350.

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.*

FL Jaskowski, J. M. role of nickel in the diet of ruminants. *Medycyna Weterynaryjna. 41 (11). 1985 (Recd. 1986). 666-668.*

FL Jaskowski, J. M., Lachowski, A., Wojciechowski, M., and Lewandowski, H. 1991. calves with hyaena disease - first cases in poland. i. clinical,radiological, haematological and biochemical examinations. *Medycyna Weterynaryjna* 47(7): 296-299.

No Oral Jasmin, G. 1974. 1974. anaphylactoid edema induced in rats by nickel and cobalt salts (38328). *Proc. Soc. Exp. Biol. Med. 147[1]: 289-292.*

No Oral Jasmin, G. and Solymoss, B. polycythemia induced in rats by intrarenal injection of nickel sulfide. *Proc. Soc. Exp. Biol. Med. (1975)* 148(3): 774-6.

No Oral Jasmin, G. and Riopelle J. L. 1976. renal carcinomas and erythrocytosis in rats following intrarenal injection of nickel subsulfide. *Lab.Investig.* 35(1): 71-78.

HHE Jelovsek, Frederick R., Mattison, Donald R., and Chen, James J. prediction of risk for human developmental toxicity: how important are animal studies for hazard identification? *Obstet. Gynecol. (N. Y.) (1989)* 74(4): 624-36 .

Food Jensen, L. S., Maurice, D. V., and Chang, C. H. relation of mineral content of drinking water to liver lipid accumulation in laying hens. *Poult. Sci. (1977)* 56(1): 260-6.

No Oral JIANG, F., LU, D., LI, Y., LUO, Z., and HAN, Y. enzyme histochemistry of testes in healthy and in nickel chloride treated Mice. *Hunan Yike Daxue Xuebao; 14 (4). 1989. 343-346.*

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.

No Oral Johansson, A., Lundborg, M., Hellstroem, P., Camner, P., Keyser, T. R., Kirton, S. E., and Natusch, D. F. S. 1980. effect of iron, cobalt, and chromium dust on rabbit alveolar macrophages: a comparison with the effects of nickel dust. *Environmental Research* 21(1): 165-176.

Meth Joosten, E. A. 1991. light and electron microscopical visualization of anterogradely labelled corticospinal growth cones using a new combination of hrp staining techniques. *Journal of Neuroscience Methods* 37(3): 199-207.

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

No Oral Kadiiska, M. B., Mason, R. P., Dreher, K. L., Costa, D. L., and Ghio, A. J. 1997. in vivo evidence of free radical formation in the rat lung after exposure to an emission source air pollution particle. *Chemical Research in Toxicology* 10(10): 1104-8.

No Oral Kadota, I. and Kurita M. 1955. Hyperglycemia and Islet Cell Damage Caused by Nickelous Chloride. Metab. Clin. Exp. 4 337-342. 1955. hyperglycemia and islet cell damage caused by nickelous chloride.

FL Kaga, M., Onoki, M., and Oikawa, K. 1985. [experimental studies on the biocompatibility of deciduous crowns, the distal-shoe and rat subcutaneous tissues]. *Shoni Shikagaku Zasshi* 23(2): 378-87.

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.

Surv Kalas, JA, Ringsby, TH, and Lierhagen, S. 1995. metals and slenium in wild animals from norwegian areas close to nickel smelters. *Environ. Monitoring Assess.* 36: 251-270.

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.

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.

In Vit Kanous, K. S., Casey, C., and Lindemann, C. B. 1993. inhibition of microtubule sliding by nickel and cadmium: evidence for a differential response of certain microtubule pairs within the bovine sperm axoneme. *Cell Motil Cytoskeleton.* 26(1): 66-76.

Diss Kasahara, T., Iwasaki, K., and Sato, M. 1984-1985. preference-aversion for heavy metals in mice.

18th Japanese Symposium on Taste and Smell

FL Kasamaki, Yuji, Guo, An Chi, Shuba, Lesya M., Ogura, Toshitsugu, and McDonald, Terence F. sodium-pump potentials and currents in guinea - pig ventricular muscles and myocytes. *Can. J. Physiol. Pharmacol. (1999)* 77(5): 339-349

Unrel Kasano, F. and Morimitsu, T. 1997. utilization of nickel-titanium shape memory alloy for stapes prosthesis. *Auris, Nasus, Larynx* 24(2): 137-42.

Carcin Kasprzak, K. S. and Poirier, L. A. 1985. effects of calcium(ii) and magnesium(ii) on nickel(ii) uptake and stimulation of thymidine incorporation into dna in the lungs of strain-a mice. *Carcinogenesis* 6(12): 1819-1821.

No Oral Kasprzak, Kazimierz, Diwan, Bhalchandra A., Konishi, Noboru, Misra, Manoj, and Rice, Jerry M. initiation by nickel acetate and promotion by sodium barbital of renal cortical epithelial tumors in male f344 rats. *Carcinogenesis (London) (1990)* 11(4): 647-52

No Oral Kasprzak, Kazimierz S., Kovatch, Robert M., and Poirier, Lionel A. inhibitory effect of zinc on nickel subsulfide carcinogenesis in fischerrats. *Toxicology (1988)* 52(3): 253-62

No Oral Kasprzak, Kazimierz S., Waalkes, Michael P., and Poirier, Lionel A. effects of magnesium acetate on the toxicity of nickelous acetate inrats. *Toxicology (1986)* 42(1): 57-68

HHE Kato, M., Ozawa, S., Iino, M., Tsuzuki, M., and Suzuki, M. inhibitory effect of nickel ions on human growth hormone releasing factor-induced growth hormone secretion in perfused rat pituitary cells. *65th Annual Meeting of the Physiological Society of Japan, Wakayama, Japan, April 4-6, 1988. J Physiol Soc Jpn. 50 (8-9). 1988. 408.*

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

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 .

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 .

CP Kenney, M. A., Dicker, A., Mccoy, H., and Williams, L. synergism of magnesium deficiency and nickel toxicity in growth and bone development. *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. A1308.*

No COC Kenney, Mary Alice, McCoy, Harriett, and Williams, Louise. effects of dietary magnesium and nickel on growth and bone characteristics in rats. *J. Am. Coll. Nutr. (1992)* 11(6): 687-93

Bact Kerby, R. L., Ludden, P. W., and Roberts, G. P. in vivo nickel insertion into the carbon monoxide dehydrogenase of rhodospirillum rubrum: molecular and physiological characterization of cooctj. *J. Bacteriol. (1997)* 179(7): 2259-2266

FL Kessler, J. 1983. sewage sludge and trace element metabolism in ruminants and swine. *Schweizer Archiv Fur Tierheilkunde* 125(10): 673-683.

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 Kichina, M. M. effectiveness of the administration of cobalt on the accumulation of cobalt, nickel, and iron in animals. *Tezisy Dokl. - Konf. Beloruss. Biokhim. O-Va.* 2nd (1974): 134-5. Editor(s): Vecher, A. S. Publisher: "Nauka i Tekhnika", Minsk, USSR..

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.*

Phys Kihara, T., Baba, A., Koyama, Y., Ishihara, T., and Iwata, H. 1990. inhibition of [3h]glutamate release by zn2+ in rat hippocampal slices. *Journal of Pharmacobio-Dynamics* 13(5): 321-6.

Unrel Kimber, I. Zeneca Central Toxicology Laboratory Cheshire UK, Dearman, R. J., Scholes, E. W., and Basketter, D. A. the local lymph node assay: developments and applications. *Toxicol. V93, N1, P13(19)*

Abstract Kimmel, G. L., Price, C. J., Sonawane, B. R., Rubenstein, R., and Bellin, J. S. the effect of nickel chloride in drinking water on reproductive and developmental parameters. *Teratology 33(3):90C,1986*

FL King, D. W. and Chen, D. C. teratogenic effects of nickel acetate on chick embryogenesis. *Sheng Su K'o Hsueh(biol Sci) 23:44-51,1984*

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. *Journal of Environmental Quality. 10 (4). 1981. 465-472.*

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 Pallauf, J. 1973. the effect of fe, co and ni supplements in zinc deficiency. *Zeitschrift Fur Tierphysiologie Tierernahrung Und Futtermittelkunde.* 31(5): 268-274.

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., Perth, J., and Schnegg, A. 1980. deficient nickel supply and the contents of calcium, magnesium andphosphorus in the bone of growing rats. *Archiv Fur Tierernahrung* 30(10/12): 805-810.

CP Kirchgessner, M., Reichlmayr-Lais, A., and Maier, R. ni retention and concentrations of fe and mn in tissues resulting from different ni supply. *Trace Elements In Man And Animals : Tema 5 : Proceedings Of The Fifth International Symposium On Trace Elements In Man And Animals / Editors C.f. Mills, I. Bremner, & J.k. Chesters.* p. 147-151.

CP Kirchgessner, M., Reichlmayr-Lais, A., and Maier, R. 1985. nickel retention and concentrations of iron and manganese in tissues resulting from different nickel supply. *Trace Elem. Man Anim. -- TEMA 5 Proc. Int. Symp., 5th* : Meeting Date 1984, 147-51. Editor(s): Mills, C. F.; Bremner, I.; Chesters, J. K. Publisher: CAB, Farnham Royals, Slough, UK..

FL Kirchgessner, M., Reichlmayr-Lais, A. M., and Maier, R. 1984. nickel retention and nickel contents of different organs and tissues resulting from different nickel supply in rats. *Z. Tierphysiol. Tierernaehr. Futtermittelkd.* 52(1): 27-34

FL Kirchgessner, M., Reichlmayr-Lais, A. M., and Mathur, A. J. the influence of different nickel and zinc supplies on the activity of some enzymes 5. interactions between zinc and nickel. *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 54 (1). 1985. 6-14.*

FL Kirchgessner, M., Reichlmayr-Lais, A. M., and Mathur, A. K. 1985. activity of selected enzymes in rats given different amounts of zn andni. 5. interactions between nickel and zinc. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 54(1): 6-14.

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. effect of different nickel and zinc supply on the activity of selected enzymes. 5. interactions between zinc and nickel. *Z. Tierphysiol. Tierernaehr. Futtermittelkd.* 54(1): 6-14

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. and Roth, F. X. on the influence of dietary nickel supplements on the growth of piglets. *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 39 (5-6). 1977 (Recd 1978) 277-281.*

FL Kirchgessner, M. and Roth, F. X. CS Inst. Ernahrungsphysiologie der TU Freising-Weihenstephan German Federal Republic. 277. effect of ni supplements on growth of piglets. *Zeitschrift Fur Tierphysiologie Tierernahrung Und Futtermittelkunde*

FL Kirchgessner, M., Roth-Maier, D. A., Reithmayer, F., and Spoerl, R. nickel status of newborn piglets after different nickel supply of sows during gravidity. *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 54 (3). 1985. 131-135.*

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

CP Kirchgessner, M., Roth-Maier, Dora A., and Schnegg, A. 1982. progress of nickel metabolism and nutrition research. *Trace Elem. Metab. Man Anim. Proc. Int. Symp., 4th* : Meeting Date 1981, 621-4. Editor(s): Gawthorne, J. M.; Howell, J. McC.; White, C. L. Publisher: Springer, Berlin, Fed. Rep. Ger..

Nut def Kirchgessner, M. and Schnegg, A. 1979. activity of proteases, leucine arylamidase and alpha -amylase inpancreas tissue during nickel deficiency. *Nutrition and Metabolism* 23(1): 62-64.

FL Kirchgessner, M. and Schnegg, A. .alpha.-amylase and dehydrogenase activities under suboptimal nickel supply. *Ann. Nutr. Metab. (1981)* 25(5): 307-10.

CP Kirchgessner, M. and Schnegg, A. 1980. iron metabolism in nickel deficiency. *Spurenelem.-Symp.: Nickel 3rd* : 27-31. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep...

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.

FL Kirchgessner, M. and Schnegg, A. 1976. ni content of the milk of lactating rats at different levels of niintake. *Archiv Fur Tierernahrung* 26(11): 773-776.

FL Kirchgessner, M. and Schnegg, A. 1976. [nickel content in the milk of lactating rats under intake of various amounts of nickel]. <original> ni-gehalt in der milck laktierender rattern bei unterschiedlicher ni-versorgung. *Archiv Fur Tierernahrung* 26(11): 773-6.

FL Kirchgessner, M. and Schnegg, A. nickel content of milk from lactating rats fed varying nickel levels. *Arch. Tierernaehr. (1976)* 26(11): 773-6

FL Kirchgessner, M. and Schnegg, A. 1976. nickel in the milk of lactating rats given different amounts of nickelin the diet. *Archiv Fur Tierernahrung* 26(11): 773-776.

CP Kirchgessner, M., Schnegg, A., and Roth, F. X. 1980. effect of a higher alimentary nickel increase.

Spurenelem.-Symp.: Nickel 3rd : 309-13. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep.

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 Kirkeby, S. esterase activity in the guinea-pig thyroid under normal and pathological conditions vitamin a deficiency with special regard to cyst-like structures. *Virchows Archiv B Cell Pathology. 23 (2). 1977 129-136.*

In Vit Kirkpatrick, C. J., Mohr, W., and Haferkamp, O. 1982. the effects of nickel ions on articular chondrocyte growth in monolayer culture. *Research in Experimental Medicine* 181(3): 259-64.

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.

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.

Surv Klimowicz Zbigniew, Melke Jerzy, and Uziak Stanislaw. 1997. peat soils in the bellsund region, spitsbergen. *Polish Polar Research* 18(1): 25-39.

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

No Oral Klyachina, K. N. and Podgornaya, I. V. effect of a polycomplexon on the removal of radioactive isotopes of cadmium, nickel, and manganese from the organism. *Fiz. Faktory Proizvod. Sredy Nekot. Vop. Fiziol. Tr. (1969)* : 150-8. Editor(s): Tartakovskaya, L. Ya. Publisher: Sverdlovsk. Nauchn.-Issled. Inst. Gig. Tr. Profzabol., Sverdlovsk, USSR..

No Oral Knight, J. A., Rezuke, W. N., Wong, S. H., Hopfer, S. M., Zaharia, O., and Sunderman, F. W. Jr. 1987. acute thymic involution and increased lipoperoxides in thymus of nickel chloride-treated rats. *Research Communications in Chemical Pathology and Pharmacology* 55(3)

No Oral Knight, Joseph A., Plowman, Marilyn R., Hopfer, Sidney M., and Sunderman, F. William Jr. pathological reactions in lung, liver, thymus, and spleen of rats after subacute parenteral administration of nickel sulfate. *Ann. Clin. Lab. Sci. (1991)* 21(4): 275-83

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

CP Koerten, H. K., Van Blitterswijk Ca, Grote, J. J., and Daems, W. T. 1987-1988. accumulation of trace elements by macrophages during degradation of biomaterials. *De Putter*

FL Kohiyama, Masatake, Chimi, Kenji, Kanematsu, Hiromu, Miki, Katsuyoshi, Takahashi, Yoshikazu, Shimizu, Mitsuru, Niiya, Isao, and Sugano, Michihiro. tissue incorporation and excretion of dietary nickel inrats. *Yukagaku (1994)* 43(4): 357-63.

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.

In Vit Kohlhardt, M., Minich, Z., and Haap, K. analysis of the inhibitory effect of nickel ions on slow inward current in mammalian ventricular myo cardium. *Journal of Molecular and Cellular Cardiology. 11 (12). 1979 (Recd. 1980). 1227-1244.*

Diss Kondakov, M. P. toxic effect of nickel nitrate on rabbits. *(1965)* 10: 60-5.

Phys Kononovich, O. F. 1973. teneur en certains oligo-elements dans les ebauches des dents chez le chien| . *FIZIOL. ZH., U.R.S.R.* 19(4): 554-556.

FL Korchyns'kyi, O. H., Korchyns'ka, O. S., Pentsak, R. H., Stoika, R. S., and Vorobets, Z. D. 1998. regulation of the dna synthesis intensity in normal fibroblasts of the nih-3t3 line by polypeptide growth factors: the effect of calcium blockers. *Dopovidi Natsional'Noyi Akademiyi Nauk Ukrayiny* 0(2): 179-183.

In Vit Koul, Omanand, Prada-Maluf, Maria, and McCluer, Robert H. udp-galactose:globoside galactosyltransferase in murine kidney. *J. Lipid Res. (1990)* 31(12): 2227-34.

Bact Kozloff, L. M. properties of t-4d bacterio phage grown in synthetic media containing zinc ii ion cobalt ii ion or nickel ii ion. *Journal of Biological Chemistry. 253 (4). 1978 1059-1064.*

Gene Kraft, G., Kraft-Weyrather, W., Blakely, E. A., and Roots, R. heavy-ion effects on cellular and subcellular systems: inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions. *Adv. Space Res. (1986)* 6(11, Life Sci. Space Res. 22(1)): 127-36.

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 Oral Krasovskii, G. N., Yurasova, O. I., Charyev, O. G., and et, a. l. 1977. (prediction of gonadotoxic action of heavy metals from the primary effect of material accumulations). *Gigiena I Sanitariya.* 7: 11-16.

Unrel Krogmann, O. N., Tjon-A-Meeuw, L., Hess, O. M(A), Jacob, M., Grimm, J., Leskoske, B., Pasic, M., and Segesser, L. V. 1993. regional diastolic dysfunction in postischaemic myocardium in calf: effect of nisoldipine. *Cardiovascular Research* 27(3): 531-536.

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 VET (BELGR). Acta Veterinaria (Belgrade). 40 (2-3). 1990. 65-76.*

FL Kucherova, F. N., Besschetnov, I. I., and Golubev, S. N. 1980. age-related changes in manganese, nickel and molybdenum content of somehaemopoetic organs of the chick embryo. *Izvestiya Severo-Kavkazskogo Nauchnogo Tsentra Vysshei Shkoly, Estestvennaya Nauka* (4): 96-99.

FL Kucherova, F. N., Besschetnov, I. I., and Golubev, S. N. 1980. age-related dynamics of manganese, nickel, and molybdenum content in certain hemopoietic organs of chick embryos. *Izv. Sev.-Kavk. Nauchn. Tsentra Vyssh. Shk. Estestv. Nauki* (4): 96-9

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 .

No Oral Kurita, Shinya. the influence of metals on bone induction. *Aichi Gakuin Daigaku Shigakkaishi (1992)* 30(1): 171-94 .

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 .

Phys Labadia A(A), Costa, G., Jimenez, E., Triguero, D., and Garcia-Pascual, A. 1997. endothelin receptor-mediated ca-2+ mobilization and contraction in bovine oviductal arteries: comparison with noradrenaline and potassium. *General Pharmacology* 29(4): 611-619.

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*

In Vit Ladoux Annie and Frelin Christian. 1994. cobalt stimulates the expression of vascular endothelial growth factor mrna in rat cardiac cells. *Biochemical and Biophysical Research Communications* 204(2): 794-798.

Plant Lagerwerff, JV and Specht, AW. 1970. contamination of roadside soil and vegetation with cadmium, nickel, lead and zinc. *Environ. Sci. Technol.* 4: 583.

In Vit Lalevee Nathalie, Pluciennik Frederique, and Joffre Michel(A). 1997. voltage-dependent calcium current with properties of t-type current in sertoli cells from immature rat testis in primary cultures. *Biology of Reproduction* 56(3): 680-687.

No Oral Lammintausta, K., Jansen, C. T., and Kalimo, K. 1986. langerhans' cell population in topical patch-test and systemic flare-up sites of nickel-sensitive guinea pigs. *Clinical and Experimental Dermatology* 11(3): 246-52.

Alt Lammintausta, K., Kalimo, K., and Jansen, C. T. 1985. experimental nickel sensitization in the guinea pig: comparison of different protocols. *Contact Dermatitis* 12(5): 258-62.

Alt Lammintausta, K., Pitkanen, O. P., Kalimo, K., and Jansen, C. T. 1985. interrelationship of nickel and cobalt contact sensitization. *Contact Dermatitis* 13(3): 148-52.

No Oral Lammintausta, Kaija, Korhonen, Kimmo, and Jansen, Christer T. method of sensitization determines if uvb irradiation inhibits thedevelopment of delayed type hypersensitivity to nickel inguinea pigs. *Photodermatology (1986)* 3(2): 102-3.

In Vit Lamperth, L., Manuelidis, L., and Webster, H. D. 1989. non myelin-forming perineuronal schwann cells in rat trigeminal ganglia express p0 myelin glycoprotein mrna during postnatal development. *Brain Research. Molecular Brain Research* 5(2): 177-81.

Phys Lamperth, L., Manuelidis, L., and Webster, H. D. 1990. p0 glycoprotein mrna distribution in myelin-forming schwann cells of the developing rat trigeminal ganglion. *Journal of Neurocytology* 19(5): 756-64.

Unrel Lanciego, J. L., Goede, P. H., Witter, M. P., and Wouterlood, F. G. 1997 . use of peroxidase substrate vector vip for multiple staining in light microscopy. *Journal of Neuroscience Methods* 74(1): 1-7.

CP Landolph J R. chemical transformation in c3h-10t1-2-cl-8 mouse embryo cells and diploid human Fibroblasts. *198th Acs (American Chemical Society) National Meeting, Miami Beach, Florida, Usa, September 10-15, 1989. Abstr Pap Am Chem Soc. 198 (0). 1989. Chas 8.*

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

No Oral Larsen, James B., Williams, Brian K., and Nelson, Gordon L. pulmonary effects of combustion products from nickel-coated polycarbonate. *Fire Mater. (1997)* 21(5): 213-217

Unrel Latal, D., Mraz, J., Zerhau, P., Susani, M., and Marberger, M. 1994. nitinol urethral stents: long-term results in dogs. *Urological Research* 22(5): 295-300.

FL Lebedeva, N. V. 1996. population ecotoxicology of birds. *Doklady Akademii Nauk.* 351(3): 425-429.

In Vit Lee-Chen, S. F., Wang, M. C., Yu, C. T., Wu, D. R., and Jan, K. Y. 1993. nickel chloride inhibits the dna repair of uv-treated but not methyl methanesulfonate-treated chinese hamster ovary cells. *Biological Trace Element Research.* 37(1): 39-50.

Rev Leonard, A. and Jacquet, P. 1984. embryotoxicity and genotoxicity of nickel. *Iarc Scientific Publications* (53): 277-291.

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.

Unrel Lepple-wienhues, A., Stahl, F., Willner, U., Schaefer, R., and Wiederholt, M. endothelin-evoked contractions in bovine ciliary muscle and trabecular meshwork: interaction with calcium, nifedipine and Nickel. *Curr Eye Res; 10 (10). 1991. 983-989.*

Unrel Levi Allan J(A), Brooksby Paul, and Hancox Jules C. 1993. a role for depolarisation induced calcium entry on the sodium-calcium exchange in triggering intracellular calcium release and contraction in rat ventricular myocytes. *Cardiovascular Research* 27(9): 1677-1690.

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*

Drug Lewin, J., Lindgren, J. U., and Wahlberg, J. E. 1987. apparent absence of local response to bone screws in guinea pigs with contact sensitivity. *Journal of Orthopaedic Research* 5(4): 604-8.

Unrel Lewin, J., Lindgren, U., and Wahlberg, J. E. 1982. screw fixation in bone of guinea pigs sensitized to nickel and cobalt. *Acta Orthopaedica Scandinavica* 53(4): 675-80.

No Dose Li, W., Chien, P. K., and Furst, A. 1994. evaluation of three antidotes on arsenic toxicity in the common earthworm (lumbricus terrestris). *Journal of Applied Toxicology* 14(3): 181-3.

Sed Liber K(A) and Sobey S(A). 1999. toxicity of uranium, nickel and arsenic to hyalella azteca in spiked-sediment toxicity tests. *Canadian Technical Report of Fisheries and Aquatic Sciences* (2293): 107.

FL Lielais, J. effect of nickel chloride on the weight of chicks. *Latv. Lauksaimn. Akad. Raksti (1974)* : 67, 24-5

No Oral Lin, M., Zhang, X., Wade, M., Harris, M., and Nickel, M. 1998. isolation of proteins from subacrosomal region of spermatozoa from a marsupial, the tammar wallaby (macropus eugenii). *Journal of Reproduction and Fertility* 113(2): 257-67.

No COC Lin, M. H., Takahashi, M. P., Takahashi, Y., and Tsumoto, T. 1994. intracellular calcium increase induced by gaba in visual cortex of fetal and neonatal rats and its disappearance with development. *Neuroscience Research* 20(1): 85-94.

No Oral Lindberg, M., Sagstrom, S., Roomans, G. M., and Forslind, B. 1989. sodium lauryl sulfate enhances nickel penetration through guinea-pig skin studies with energy dispersive x-ray microanalysis. *Scanning Microsc.* 3(1): 221-224.

Phys Lindemann Charles B(A), Walker Jay M, and Kanous Kathleen S. 1995. ni-2+ inhibition induces asymmetry in axonemal functioning and bend initiation of bull sperm. *Cell Motility and the Cytoskeleton* 30(1): 8-16.

Prim Linder-Aronson, A., Forsberg, C. M., Rygh, P., and Lindskog, S. 1996. tissue response to space closure in monkeys: a comparison of orthodontic magnets and superelastic coil springs. *European Journal of Orthodontics* 18(6): 581-8.

Alt Linder, G. and Foulkes, E. C. kinetics of renal aspartate reabsorption and its inhibition by metals in the intact rat kidney. *Environmental Research. 36 (1). 1985. 241-247.*

Species Lineres, M., Fayolle, L., Tauzin, J., and Juste, C. accumulation of heavy metals in eisenia-foetida-andrei oligochaeta lumbricidae grown in garbage. *Agronomie (Paris). 5 (9). 1985. 779-784.*

Mix Lisk, D. J., Boyd, R. D., Telford, J. N. , Babish, J. G., Stoewsand, G. S., Bache, C. A., and Gutenmann, W. H. 1982. toxicologic studies with swine fed corn grown on municipal sewagesludge-amended soil. *Journal of Animal Science* 55(3): 613-619.

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

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

Carcin Lu, C., Matsumoto, N., Iijima, S., and Katsunuma, H. teratogenic potential of nicl2(nickel chloride)in fetal mice. *J Toxicol Sci 1:75-76,1976*

Abstract Lu, C. C., Matsumoto, N., and Iijima, S. placental transfer of nicl2 to fetuses in mice. *Teratology 14:245,1976*

No Oral Lu, C. C. Matsumoto N. and Iijima S. 1981. placental transfer and body distribution of nickel chloride in pregnant mice. *Toxicol. Appl. Pharmacol. 59[3]: 409-413.*

No Oral Lu, C. C. Matsumoto N. and Iijima S. 1979. teratogenic effects of nickel chloride on embryonic mice and its transfer to embryonic mice. *Teratology 19, 137-142.*

In Vit Lucaj Zef and Fujii Joanne T. 1994. multiple subtypes of voltage-gated calcium currents in the edinger-westphal nucleus. *Brain Research* 660(1): 1-7.

Drug Lukac, Maja and Aegerter, Rita. influence of trace metals on growth and toxin production of microcystis aeruginosa. *Toxicon (1993)* 31(3): 293-305

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.

FL Luo, Yang, Zhou, Shusun, and Zhao, Shufeng. 1998. effect of cadmium and nickel on the proliferation and differentiation of mice embryo limb bud cells. *Zhonghua Laodong Weisheng Zhiyebing Zazhi.* 16(1): 15-18.

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 biosphereresevation. *Archiv Fur Lebensmittelhygiene.* 43(6): 131-136.

No Oral Ma, Mingyue, Su, Ya, and Cui, Jinshan. protective effect of sodium selenite on nickel sulfate-induced embryotoxicity in rats. *Gongye Weisheng Yu Zhiyebing (1996)* 22(5): 165-267 .

No Oral Ma, Minyue, Su, Ya, Li, Hongge, and Zhang, Yumin. exptl. study on the effect of nickel on reproductive function in female rats. *Zhongguo Gonggong Weisheng Xuebao (1998)* 17(2): 104-105

Carcin Maenza, R. M., Pradhan, A. M., and Sunderman, F. W. Jr. rapid induction of sarcomas in rats by combination of nickel sulfide and 3,4-benzpyrene. *Cancer-Res; VOL 31, ISS 12, 1971, P2067-71.*

Phys Magee, J. C. and Johnston, D. 1995. characterization of single voltage-gated na+ and ca2+ channels in apical dendrites of rat ca1 pyramidal neurons. *Journal of Physiology* 487(Pt 1): 67-90.

Drug Mahmoud, Alaaeldin and Parrish, John . 1996. effects of ni-2+, co-2+ and la-3+ on bovine sperm capacitation by heparin. *South African Journal of Science.* 92(11-12): 564.

Unrel Mahoney, P. D., Koh, E. T., Irvin, R. W., and Ferris, C. F. computer-aided mapping of vasopressin neurons in the hypothalamus of the male golden hamster evidence of magnocellular neurons that do not project to the Neurohypophysis. *J Neuroendocrinol. 2 (2). 1990. 113-122.*

Chem Meth Makowski, Gregory S and Sunderman, F. William Jr a. 1992. the interactions of zinc, nickel, and cadmium with xenopus transcription factor iiia, assessed by equilibrium dialysis. *Journal of Inorganic Biochemistry.* 48(2): 107-119.

Fungus Malini, R., Mukerji, K. G., and Venkitasubramanian, T. A. 1984. effect of aluminum and nickel on aflatoxin production by aspergillus-flavus. *Folia Microbiologica* 29(2): 104-107.

Rev Malins, D. C. 1979.*Environmental Assessment of the Alaskan Continental Shelf. Volume 5. Biological Studies: Assessment of Available Literature on Effects of Oil Pollution on Biota in Arctic and Subarctic Waters. <NOTE> Final Rept. 1 Jul 75-30 Sep 76*

In Vit Mamelak Daniel and Lingwood Clifford(A). 1997. expression and sulfogalactolipid binding specificity of the recombinant testis-specific cognate heat shock protein 70. *Glycoconjugate Journal* 14(6): 715-722.

Unrel Mantovani, A. 1993. reproductive risks from contaminants in drinking water. *Ann Ist Super Sanita* . 29(2): 317-26.

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.

Unrel Markovits, Andres, Conejeros, Raul, Lopez, Luis, and Lutz, Mariane. evaluation of marine microalga nannochloropsis sp. as a potentialdietary supplement. chemical, nutritional and short term toxicological evaluation in rats. *Nutr. Res. (N. Y.) (1992)* 12(10): 1273-84

In Vit Marks Jeremy D(A), Friedman Jonathan E, and Haddad Gabriel G. 1996. vulnerability of ca1 neurons to glutamate is developmentally regulated. *Developmental Brain Research* 97(2): 194-206.

CP Martens, S. N. and Boyd, R. S. 1990. defensive role of nickel hyperaccumulation by plants a field experiment. *75th Annual Meeting of the Ecological Society of America on Perspectives in Ecology: past*

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.

No Oral Mas, A., Alemany, M., and Arola, L. effects of a nickel load upon the concentration of plasma metabolites in pregnant rats. *Gynecologic and Obstetric Investigation. 21 (4). 1986. 193-197.*

FL Mas, A., Alemany, M., and Arola, L. initial permeability of the 19-day fetus to nickel. *REV ESP FISIOL; 45 (3). 1989. 287-290.*

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.

CP MAS, A., AROLA, L., and ALEMANY, M. 1984. nickel-glucagon interrelationships in pregnant rats uptake and effects of nickel on the Fetuses. *Symposium on Endocrinology Held at the Meeting of the Association Des Physiologistes (Association of Physiologists)*

No Oral Mas, A., Holt, D., and Webb, M. the acute toxicity and teratogenicity of nickel in pregnant Rats. *Toxicology; 35 (1). 1985. 47-58.*

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.

FL Mathur, A. K., Reichlmayr-Lais, and Kirchgessner, M. 1982. growth , food efficiency and protein concentration of some organs through varying supply of nickel and zinc. i. interactions between nickel and zinc. *Z. Tierphysiol. Tierernaehr. Futtermittelkd.* 47(2): 101-9

FL Mathur, A. K., Reichlmayr-Lais, A. M., and Kirchgessner, M. 1982. growth, utilization of feed and protein content of some organs withdifferent supplies of zinc and nickel. 1. interactions of nickel andzinc. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 47(2): 101-109.

No Oral Mathur, A. K. and Tandon, S. K. 1979. some biochemical alterations in early nickel toxicity. *Chemosphere; Chemistry, Physics, and Biology As Focused on Environmental Problems* 8(11-12): 893-901.

No Oral Mathur, A. K. Chandra S. V. Behari J. and Tandon S. K. 1977. biochemical and morphological changes in some organs of rats in nickel intoxication. *Arch. Toxicol. 37: 159-164.*

No Oral Mathur, A. K. Dikshith T. S. S. Lal M. M. and Tandon S. K. 1978. distribution of nickel and cytogenetic changes in poisoned rats. *Toxicology 10: 105-113.*

FL Mathur, A. K. ZTTFA. 1983. effect of toxic amounts of dietary nickel in rats. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde = ; Journal Of Animal Physiology And Animal Nutrition.* 50 (3): 153-156.

FL Mathur, K. A., Reichlmayr-Lais, A. M., and Kirchgessner, M. 1982. [growth, food utilization and protein content of some organs with varying zinc and nickel supplies. 1. interactions between nickel and zinc]. <original> wachstum, futterverwertung und proteingehalt einzelner organe bei unterschiedlicher zink- und nickelversorgung. 1. mitteilung. zu interaktionen zwischen nickel und zink. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde;*

No COC Matsuda, Y., Matsusaka, N., Kobayashi, H., Yuyama, A., Watari, K., and Imai, K. effects of ferro cyanides on the uptake of cesium-137 in the mouse fetus. *Journal of the Faculty of Agriculture Iwate University. 14 (2). 1978 (Recd. 1979). 111-118.*

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

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.*

Nut def Maurice, D. V., Jensen, L. S., and Tojo, H. 1979. comparison of fish meal and soybean meal in the prevention of fattyliver-hemorrhagic syndrome in caged layers. *Poultry Science* 58(4): 864-870.

In Vit Mayence, A. and Jacquet, P. 1982. studies, invitro, on the pre-implantation lethality induced by treatment of male-mice with nickel nitrate. *Mutation Research* 97: 242-243.

No Dose Mayor, P., Cabrera, R., Ribas, B., and Calle, C. 1989. effect of long-term nickel ingestion on insulin binding and antilipolytic response in rat adipocytes. *Biological Trace Element Research* 22(1): 63-70.

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

Unrel Mcnamara, A. and Williams, D. F. enzyme histochemistry of the tissue response to pure metal implants. *J BIOMED MATER RES. 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.

Unrel Merchenthaler, I., Stankovics, J., and Gallyas, F. 1989. a highly sensitive one-step method for silver intensification of the nickel-diaminobenzidine endproduct of peroxidase reaction. *Journal of Histochemistry and Cytochemistry* 37(10): 1563-5.

FL Michel, R., Hofmann, J., Holm, R., and Zilkens, J. penetration of corrosion products of stainless steel implants into surrounding tissue. *Zeitschrift Fuer Orthopaedie Und Ihre Grenzgebiete. 118 (5). 1980 (Recd. 1981). 793-803.*

Phys Mikalsen, S. O., Holen, I., and Sanner, T. morphological transformation and catalase activity of syrian hamster embryo cells treated with hepatic peroxisome proliferators, tpa and nickel sulfate. *Cell Biol Toxicol; 6 (1). 1990. 1-14.*

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.

Acute Milicevic, N. M. and Milicevic, Z. 1989. histochemistry of the acutely involved thymus in nickel chloride-treated rats. *Journal of Comparative Pathology* 101(2): 143-50.

Abstract Miller, W. J. 1973. dynamics of absorption rates, endogenous excretion, tissue turnover,and homeostatic control mechanisms of zinc, cadmium, manganese, andnickel in ruminants. *Federation Proceedings* 32(8): 1915-1920.

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*

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.

Acute Misra, M., Athar, M., Chandra, S., Hasan S.K., and Srivastava R.C. 1987. pharmacokinetics and metabolic disposition of nickel in poisoned rats - effect of chelating Drugs. *Chemosphere* VOL. 16, NO. 1: pp. 259-267.

CP Mitrofanis, J. and Stone, J. the development of tyrosine hydroxylase containing neurons in the retina of the albino rat morphology and topography. *Seventh Meeting of the Australian Neuroscience Society, Newcastle, North South Wales, Australia, February 3-5, 1987. Neurosci Lett Suppl. 0 (27). 1987. S107.*

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.*

Unrel Mogami, H. and Kojima, I. 1993. stimulation of calcium entry is prerequisite for dna synthesis induced by platelet-derived growth factor in vascular smooth muscle cells. *Biochemical and Biophysical Research Communications* 196(2): 650-8.

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

Carcin Mohanty, P. K. cytotoxic effect of nickel chloride on the somatic chromosomes of swiss albino mice mus-musculus. *Current Science (Bangalore). 56 (22). 1987. 1154-1157.*

FL Moiseev, S. Z. effect of long-term supplementary nickel feeding on some aspects of carbohydrate metabolism in rabbit muscles and liver. *Sb. Nauch. Tr. Leningr. Vet. In-t (1979)* (57): 93-9 From: Ref. Zh., Zhivotnovod. Vet. 1980, Abstr. No. 558117.

Abstract Moiseev, S. Z. metabolic effects of the addition of nickel to rabbit rations. *Biol. Akt. Veshchestva Zhizni Rast. Zhivotn. (1973) 179-82 From: Ref. Zh.* Biol. Khim. 1974, Abstr. No. 12F2096.

FL Moiseev, S. Z. 1974. nickel levels in the organs and tissues of rabbits and their role in some carbohydrate metabolism processes in the liver and muscles. *Tezisy Dokl. - Konf. Beloruss. Biokhim. O-Va. 2nd* : 154-5. Editor(s): Vecher, A. S. Publisher: "Nauka i Tekhnika", Minsk, USSR.

Phys Momose-Sato, Y., Sato, K., and Kamino, K. optical identification of calcium-dependent action potentials transiently expressed in the embryonic rat brainstem. *Neuroscience (Oxford) (1999)* 90(4): 1293-1310

Unrel Monro, P. P., Knight, D. P., Pringle, W. S., Fyfe, D. M., and Shearer, J. R. 1986. the use of the chorioallantoic membrane (cam) of the embryonic chick for the direct assessment of implant toxicity. *ATLA Altern. Lab. Anim.* 13(4): 261-6

CP Monro, P. P., Pringle, W. S., Knight, D., and Shearer, J. R. 1986. the use of the chorioallantoic membrane to assess implant toxicity directly. *Eighteenth Triennial Conference of the Institute of Medical Laboratory Sciences*

In Vit Monsees, T. K., Winterstein, U., Hayatpour, J., Schill, W. B., and Miska, W. effect of heavy metals on the secretory function of testicular cells in culture. *Journal of Trace and Microprobe Techniques; 16 (4). 1998. 427-435.*

No Oral Morimoto, Y. Nambu Z. Tanaka I. Higashi T. Yamato H. Hori H. Cho S. and Kido M. 1995. effects of nickel oxide on the production of tumor necrosis factor by alveolar macrophages of rats. *Biol. Trace Elem. Res. 48: 287-296.*

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

Drug Morvai, Veronika, Szakmary, E., Ungvary, Gy., and Szenasi, G. the effects of simultaneous alcohol and nickel sulfate poisoning on the cardiovascular system of rats. *Acta Physiol. Hung. (1993)* 81(3): 239-51.

Drug Morvai, Veronika, Ungvary, Gyorgy, and Zsenasi, Gabor. effect of joint alcohol and nickel sulfate poisoning on the cardiovascular system of the rat. *Kiserl. Orvostud. (1989)* 41(5): 336-43

No Oral Mukubo, Kiyomi. experimental lung tumor from chemical carcinogens and inorganic substances. iii. histopathological studies on lung tumor in rats induced by pertracheal vinyl tube infusion of 20-methylcholanthrene combined with chromium and nickel powder. *Nara Igaku Zasshi (1978)* 29(1): 321-40

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.

No Oral Murthy, R. C. and Chandra S. V. 1979. effect of interaction of manganese and nickel on their content in various tissues of guinea pigs. *Chemosphere.* 8(1-6): 35-38.

Alt Mutafova-Yambolieva, V., Staneva-Stoytcheva, D., Lasova, L., and Radomirov, R. effects of cobalt or nickel on the sympathetically mediated contractile responses in rat -isolated vas deferens. *Pharmacology (1994)* 48(2): 100-10

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

FL Nadeenko, V. G., Lenchenko, V. G., Arkhipenko, T. A., Saichenko, S. P., and Petrova, N. N. embryo toxic effect of nickel ingested in drinking water. *Gigiena i Sanitariya. 0 (6). 1979. 86-88.*

FL Nadeenko, V. G., Lenchenko, V. G., Arkhipenko, T. A., and Saichenko, S. Petrova N. N. 1979. embryotoxic action of nickel ingested with drinking water. *Gigiena i Sanitariya* (6): 86-88.

Unrel Nakanishi Toshio(A), Gu Hong, Hagiwara Nobuhisa, and Momma Kazuo. 1993. mechanisms of oxygen-induced contraction of ductus arteriosus isolated from the fetal rabbit. *Circulation Research* 72(6): 1218-1228.

Rev NAS, Subcommittee on Mineral Toxicity Committee on Animal Nutrition. 1980.: 588.

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.

In Vit Nicoll Roger A(A), Oliet Stephane H R, and Malenka Robert C. 1998. nmda receptor-dependent and metabotropic glutamate receptor-dependent forms of long-term depression coexist in ca1 hippocampal pyramidal cells. *Neurobiology of Learning and Memory* 70(1-2): 62-72.

Rev Nieboer, E., Rossetto, F. E., and Menon, C. R. 1988. toxicology of nickel compounds. *Metal Ions In Biological Systems* 23: 359-402.

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.

Abstract Nielsen, F. H. effect of the dietary level of nickel on the responsiveness of chicks to changes in hormonal status. *Federation Proceedings. 31 (2). 1972 700*

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.

CP Nielsen, F. H. 1980. nickel deprivation in the rat : effect on the absorption of ferric ions. *Spurenelem.-Symp.: Nickel 3rd* : 33-8. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep.

CP Nielsen, F. H. possible functions and medical significance of the abstruce trace metals. *Martell, A.*

E. (Ed.). Acs (American Chemical Society) Symposium Series, Vol. 140. Inorganic Chemistry in Biology and Medicine; Symposium at the 178th Meeting, Washington, D.c., Usa, Sept. 10-11, 1979. Viii+436p. American Chemical Society: Washington, D.c., Usa. Illus. Isbn 0-8412-0588-4. 0 (0). 1980 (Recd. 1981). P23-42.

CP Nielsen, F. H. 1983. studies on the interaction between nickel and iron during intestinal absorption. *Spurenelem.-Symp. 4th* : 11-18. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ., Jena, Ger. Dem. Rep.

Nut def Nielsen, F. H. and Higgs, D. J. 1971. further studies involving a nickel deficiency in chicks. *<Document Title>Trace Substances in Environmental Health. IV.* 241-246.

Nut def Nielsen, F. H. and Myron, D. R. effect of form of iron on the interaction between nickel and iron inrats : iron absorption. *Proc. N. D. Acad. Sci. (1980)* : 34, 31.

Nut def Nielsen, F. H., Myron, D. R., Givand, S. H., Zimmerman, T. J., and Ollerich, D. A. 1975. nickel deficiency in rats. *Journal of Nutrition* 105(12): 1620-30.

Rev Nielsen, F. H. and Ollerich, D. A. 1974. nickel. new essential trace element. *Fed. Proc. Fed. Amer. Soc. Exp. Biol.* 33(6): 1767-72.

Nut def Nielsen, F. H., Ollerich, D. A., Fosmire, G. J., and Sandstead, H. H. 1974. nickel deficiency in chicks and rats: effects on liver morphology, function and polysomal integrity. *Advances in Experimental Medicine and Biology* 48(0): 389-403.

Nut def Nielsen, F. H. and Shuler, T. R. effect of dietary nickel and iron on the trace element content of rat liver. *Biol. Trace Elem. Res. (1979)* 1(4): 337-46

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.

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.*

CP Nielsen, Forrest H. and Sauberlich, Howerde E. evidence of a possible requirement for nickel by the chick. *Proc. Soc. Exp. Biol. Med. (1970)* 134(3): 845-9.

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

Nut def Nielsen, Forrest H., Zimmerman, Thomas J., Collings, Michael E., and Myron, Duane R. nickel

deprivation in rats : nickel-iron interactions. *J. Nutr. (1979)* 109(9): 1623-32

Nut def Nielsen, Forrest H., Zimmerman, Thomas J., Shuler, Terrence R., Brossart, Beth, and Uthus, Eric O. 1989. evidence for a cooperative metabolic relationship between nickel and vitamin b12 in rats. *J. Trace Elem. Exp. Med.* 2(1): 21-9 .

No Oral Nielsen, Gitte D., Andersen, Ole, and Jensen, Mikael. toxicokinetics of nickel in mice studied with the .gamma.-emitting isotope nickel-57. *Fundam. Appl. Toxicol. (1993)* 21(2): 236-43

Alt Niiro Naohisa, Nishimura Junji, Hirano Katsuya, Nakano Hitoo, and Kanaide Hideo(A). 1998. mechanisms of galanin-induced contraction in the rat myometrium. *British Journal of Pharmacology* 124(8): 1623-1632.

In Vit Nikodijevic, B., Aschkenasy, M., Dickens, G., Lachance, C., and Guroff, G. 1995. characteristics of the k-252a-induced increase in calcium uptake in pc12 cells. *Journal of Neuroscience Research* 40(4): 494-8.

Unrel Nikodijevic, B. and Guroff, G. nerve growth factor-stimulated calcium uptake into pc12 cells uniqueness of the channel and evidence for phosphorylation. *Journal of Neuroscience Research. 31 (4). 1992. 591-599.*

CP Nikodijevic, B., Nikodijevic-Kedeva, D., Kozak, A., Yavin, E., and Guroff, G. 1992. the regulation of nerve growth factor-stimulated calcium uptake by intracellular calcium levels in pc12 cells. *Society for Neuroscience Abstracts* 18(1-2): 613.

In Vit Nishimura, J., Kobayashi, S., Shikasho, T., and Kanaide, H. 1992. platelet derived growth factor induces c-fos and c-myc mrna in rat aortic smooth muscle cells in primary culture without elevation of intracellular ca2+ concentration. *Biochemical and Biophysical Research Communications* 188(3): 1198-204.

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

Prim Nomiyama, Kazuo, Nomiyama, Hiroko, Nomura, Yasuo, and Tsukiji, Haruhisa. 1985 . health effects of potassium dichromate in drinking water in monkeys. *Heavy Met. Environ. Int. Conf., 5th* : Volume 2, 125-7. Editor(s): Lekkas, Themistokles D. Publisher: CEP Consult., Edinburgh, UK.

Alt Novak, Jacqueline and Banks, Robert O. lead and nickel alter the cardiorenal actions of endothelin in therat. *Proc. Soc. Exp. Biol. Med. (1995)* 208(2): 191-8

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 Novelli, E. L. B., Rodrigues, N. L., and Ozonas, B. R. 1987. nickel chloride and alloxan .1. glucose, insulin and superoxide-dismutase determinations in blood and pancreas of rats. *Acta Physiologica Et Pharmacologica Latinoamericana* 37(3): 377-393.

Alt Novelli, E. L. B., Rodrigues, N. L., and Ribas, B. O. 1988. effect of nickel chloride on streptozotocin-induced diabetes in rats. *Canadian Journal Of Physiology And Pharmacology* 66(5): 663-665.

No Oral Novelli, E. L. B., Rodrigues, N. L., Sforcin, J. M., and Ribas, B. O. toxic effects of nickel exposure on heart and liver of rats. *Toxic Subst. Mech. (1997)* 16(3): 251-258

No Oral Novelli, E. Lb, Novelli Filho J L Vb, Rodrigues, N. L., Ribas, B. O., and Barbosa, L. L. long-term toxicity following acute administration of nickel. *Toxic Substance Mechanisms; 17 (3). 1998. 175-185.*

Nut def Novelli, Ethel L. B., Rodrigues, Ney L., and Ribas, Bartolome O. influence of nickel chloride on bone marrow of iron-deficient rats. *Bol. Estud. Med. Biol. (1988)* 36(1-4): 35-42

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.

Abstract O Dell G D, Miller, W. J., and Moore, S. L. nickel toxicity and tolerance in the bovine. *FED PROC. Federation Proceedings. 29 (2). 1970 696*

No Dose O'Dell, GD, Miller, WJ, Moore, SL, and King, WA. 1970. effect of nickel as the chloride and the carbonate on palatability of cattle feed. *J. Dairy Sci.* 53: 1266.

Unrel Odekerken, Jules M. a comparative study of some modern bright nickel-chromium systems. *Electroplat. Met. Finish. (1967)* 20(5): 142-50

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

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 Ollerich, D. A. and Nielsen, F. H. effect of a diet low in nickel on the fine structure of chick and rat liver. *Anatomical Record. 181 (2). 1975 439-440*

BioAcc Ono, Hiroko, Wada, Osamu, and Ono, Tetsu. distribution of trace metals in nuclei and nucleoli of normal and regenerating rat liver with special reference to the differentbehavior of nickel and chromium. *J. Toxicol. Environ. Health (1981)* 8(5-6): 947-57

Abstract Oscar, T. P. and Spears, J. W. performance and ruminal fermentation changes associated with dietary nickel supplementation to growing beef steers. *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). 1987. 27-28.*

Rev Oskarsson, A. and Fowler, B. A. 1987. alterations in renal heme biosynthesis during metal nephrotoxicity. *Ann.N.Y.Acad.Sci.* 514: 268-277.

BioAcc Oskarsson, A. and Tjalve, H. an auto radiographic study on the distribution of nickel-63 nickel chloride in mice. *Annals of Clinical and Laboratory Science. 9 (1). 1979. 47-59.*

No Oral Oskarsson, A. Reid M. C. and Sunderman F. W. Jr. 1981. effects of cobalt chloride, nickel chloride, and nickel subsulfide upon erythropoiesis in rats. *Ann. Clin. Lab. Sci. 11: 165-172.*

BioAcc Oskarsson, Agneta and Tjalve, Hans. an autoradiographic study on the distribution of nickel-63 dichloride inmice. *Ann. Clin. Lab. Sci. (1979)* 9(1): 47-59

No Oral Ottolenghi, A. D. Haseman J. K. Payne W. W. Falk H. L. and Macfarland H. N. 1974. inhalation studies of nickel sulfide in pulmonary carcinogenesis of rats. *J Natl Cancer Inst.* 54(5): 1165-1172.

FL Ozols, A. Ya., Sheshukova, T. A., Gutmane, L. A., Basova, N. A., Apsite, M. R., and Antonyuk, Z. F. 1991. functional state of the digestive system of chickens fed with a diettreated with the fungicide tilt. *Sel'Skokhozyaistvennaya Biologiya* (No.4): 53-56.

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 Panikarovskii, V. V., Polenichkin, V. K., Grigor'ian, A. S., Fastykovskaia, E. D., and Antipova, Z. P. 1986. [biomedical characteristics of designs made from an alloy with thermomechanical memory based on x-ray and histological research data]. <original> mediko-biologicheskaia kharakteristika konstruktsii iz splava s termomekhanicheskoi pamiat'iu po dannym rentgenologicheskogo i gistologicheskogo issledovanii. *Stomatologiia* 65(1): 4-6.

In Vit Papini, E., Satin, B., Norais, N., de Bernard, M., Telford, J. L., Rappuoli, R., and Montecucco, C. 1998. selective increase of the permeability of polarized epithelial cell monolayers by helicobacter pylori vacuolating toxin. *Journal of Clinical Investigation* 102(4): 813-20.

In Vit Parenti, M., Rusconi, L., Cappabianca, V., Parati, E. A., and Groppetti, A. 1988. role of dopamine in manganese neurotoxicity. *Brain Research* 473(2): 236-40.

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*

No Oral Parker, D. and Turk, J. L. delay in the development of the allergic response to metals following intratracheal instillation. *Int Arch Allergy Appl Immunol; 57 (4). 1978 289-293*

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.

FL Pastuszko, J. 1991. attempts to induce immunity in chicks by use of ultrasound-attenuatedoocysts of eimeria tenella. *Zeszyty Naukowe Akademii Rolniczej We Wroclawiu, Weterynaria* (49): 161-166.

No Oral Patai, K. and Balogh, I. 1988. nickel and cadmium-induced fetal myocardial changes in the mouse the hazards of cigarette smoke in pregnancy. *Acta Chir Hung.* 29(4): 315-322.

CP Patay, K., Balogh, I., and Szarvas, Z. 1987. ultrastructural and cytochemical alterations in nickel and cadmium fed mouse heart muscle. *Viiith Congress of the International Society for Heart Research (European Section)*

In Vit Patierno, S. R. and Costa, M. 1985. dna-protein cross-links induced by nickel compounds in intact cultured mammalian cells. *Chemico-Biological Interactions* 55(1-2): 75-91.

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.

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*

FL Paulov, S. effects of nickel on growth and liver proteins of ducks. *Vet. Med. (Prague) (1975)* 20(5): 283-8

FL Paulov, S. ucinky niklu na rast a pecenove bielkoviny kacic; the effects of nickel on the growth and on the liver proteins of ducks. *Vet Med (Prague)* May 1975 20 (5): 283-288. Ref. Eng. sum.

FL Paulov, S. Komenskeho Universita Bratislava Czechoslovakia Prirodovedecka Fakulta. 1975. the effect of nickel on the growth and on the liver proteins of ducks. <original> ucinky niklu na rast a pecenove bielkoviny u kacic. *Veterinarni Medicina - UVTI. V. 20(5) P. 283-288*

No COC Pawar, S. S. and Fawade, M. M. alterations in the toxicity of thiodemeton due to the pre treatment of inducers substrates and inhibitors of mixed function oxidase system. *Bulletin of Environmental Contamination and Toxicology. 20 (6). 1978 (Recd. 1979). 805-810.*

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).

No Oral Peligero, M. J., Mas, A., Arola, L., and Alemany, M. 1985. effects of an acute administration of nickel upon blood-glucose compartmentation in pregnant rats. *Archives Internationales De Physiologie Et De Biochimie* 93(1): 1-5.

No Oral Peng, Z. C., Chen, S., and Bentivoglio, M. 1995. a sensitive double immunostaining protocol for fos-immunoreactive neurons. 36(1): 101-5.

No Oral Pereira, M. C., Pereira, M. L., and Sousa, J. P. 1998. evaluation of nickel toxicity on liver, spleen, and kidney of mice after administration of high-dose metal ion. *Journal of Biomedical Materials Research* 40(1): 40-7.

Unrel Pereira, M. L., Pereira, M. C., and Sousa, J. P. evaluation of nickel effects on mouse liver: tissue response and metal ion accumulation. *Biomedical Letters; 52 (208). 1995. 235-244.*

Unrel Pernfuss, B., Ebner, C., Pumpel, T., Diels, L., Macaskie, L., Tsezos, M., Keszthelyi, Z., and Glombitza, F. the " behavior " of five metal biosorbing and bioprecipitating bacterial strains, inoculated in a moving-bed sand filter. *Process Metall. (1999)* 9B(Biohydrometallurgy and the Environment Toward the Mining of the 21st Century, Pt. B): 373-382

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..

No Oral Piezzi, Ramon S., Gutierrez, L., and Fogal, T. neonatal and adult adrenal cortex: intercellular permeability to nickel nitrate. *Tissue Cell (1990)* 22(5): 697-704

CP Poddubnyi, S. K. and Patyukov, A. G. 1994. electrophysiological and contractile properties of the smooth muscle cells in neonatal guinea pigs. *Uspekhi Fiziologicheskikh Nauk* 25(4): 18.

CP Poellot, R. A., Shuler, T. R., Uthus, E. O., and Nielsen, F. H. dietary margaric acid affects the response to nickel deprivation and the interaction between nickel and vitamin b12 in the rat. *Proceedings Of The North Dakota Academy Of Science.* Apr 1990. v. 44 p. 80.

CP Poellot, R. A. and Uthus, E. O. 1996. dietary histidine loading has no marked effect on the interaction between nickel and folic acid in rats. *FASEB Journal* 10(3): A783.

CP Poellot, R. A., Uthus, E. O., and Nielsen, F. H. 1995. exercise and high dietary sucrose modifies the response of rats to nickel (ni) deprivation. *FASEB Journal* 9(3): A448.

CP PORT C.D. 1975. interaction of nickel oxide and influenza infection in the hamster. *Conference On Heavy Metals in the Environment, II.In Environmental Health Perspectives, 10: 268, Apr. 1975*

Carcin Poupon, M. F., Pauwels, C., Jasmin, C., Antoine, E., Lascaux, V., and Rosa, B. 1984. amplified pulmonary metastases of a rat rhabdomyosarcoma in response to nitrosourea treatment. *Cancer Treatment Reports* 68(5): 749-58.

Soil Proctor, J., Johnston, W. R., Cottam, D. A., and Wilson, A. B. 1981. field-capacity water extracts from serpentine soils. *Vol. 294, No. 5838, Pp. 245-246* Nature.

In Vit Puil Ernest(A), Meiri Hanoch, and Yarom Yosef. 1994. resonant behavior and frequency preferences of thalamic neurons. *Journal of Neurophysiology (Bethesda)* 71(2): 575-582.

No Dose Pyatt, F. B., Lacy, D., and Pyatt, A. J. some effects of acid rain on the mobilization of elements frombird eggs. *Fresenius Environ. Bull. (1998)* 7(5/6): 334-337.

In Vit Quarles, L. D., Hartle, J. E. II, Siddhanti, S. R., Guo, Rong, and Hinson, T. K. 1997. a distinct cation-sensing mechanism in mc3t3-e1 osteoblasts functionally related to the calcium receptor. *Vol. 12, No. 3, Pp. 393-402* J. Bone Miner. Res.

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.*

FL Raben, A. S. and Anton'ev, A. A. mechanism of skin-sensitizing effect of chromium and nickel compounds. *Vestn. Dermatol. Venerol. (1966)* 40(12): 19-23.

Nut def Ragan, H. A. effects of iron deficiency on absorption of nickel. *Pac. Northwest Lab. Annu. Rep. DOE Assist. Secr. Environ. (1978) PNL-2500-Pt. 1, Pac. Northwest Lab. Annu. Rep. 1977 Doe*

Assist. Secr. Environ., Pt. 1: Biomed. Sci., 1.9-1.10

Meth Rajanayagam, V., Fabry, M. E., and Gore, J. C. 1991. in vivo quantitation of water content in muscle tissues by nmr imaging. *Magnetic Resonance Imaging* 9(4): 621-5.

Bio Acc Rana, S. V. 1975. on the distribution of heavy metals in the ovary of common ground squirrel, funambulus pennanti: a histochemical study. *Acta Histochem.* 54(2): 290-294.

Gene Randerath, K., Randerath, E., Smith, C. V., and Chang, J. 1996. structural origins of bulky oxidative dna adducts (type ii i-compounds) as deduced by oxidation of oligonucleotides of known sequence. *Chemical Research in Toxicology* 9(1): 247-54.

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.

No Oral Raun Andersen, H. and Andersen, O. 1989. cadmium and nickel induced hepatic lipid peroxidation. 1502-1508.

Nutrition Reeves, P. G. and <Editors> Beck, M. A. et al. 1997. components of the ain-93 diets as improvements in the ain-76a diet. *Journal of Nutrition* 127(5SUPPL): 838S-841S.

Nutrition Reeves, Philip G., Nielsen, Forrest H., and Fahey, George C. Jr. ain-93 purified diets for laboratory rodents: final report of the american institute of nutrition ad hoc writing committee on the reformulation of the ain-76a rodent diet. *J. Nutr. (1993)* 123(11, Pt. 1): 1939-51 .

Unrel Regius-Mocsenyi, A. 1991. zinc, manganese, molybdenum, nickel and cadmium supply in cattle, sheepand horses. 6. cadmium supply. *Allattenyesztes Es Takarmanyozas* 40(5): 465-477.

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*

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., Kirchgessner, M., and Mathur, A. K. 1985. concentration of zn and ni in organs and tissues of rats givendifferent amounts of zn and ni. 2. interactions between nickel andzinc. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 53(3-4): 207-213.

FL Reichlmayr-Lais, A. M., Kirchgessner, M., and Mathur, A. K. 1985. haematological changes in rats given different amounts of ni and zn. 4.interactions between nickel and zinc. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 53(5): 279-284.

FL Reichlmayr-Lais, Anna M., Kirchgessner, M., and Mathur, A. K. 1985. hematological values in rats after different nickel and zinc supply. 4. interactions between zinc and nickel. *Z. Tierphysiol. Tierernaehr. Futtermittelkd.* 53(5): 279-84

FL Reichlmayr-Lais, Anna M., Kirchgessner, M., and Mathur, A. K. 1985. zinc and nickel concentrations in selected organs and tissues after different zinc and nickel supply in rats . 2. interactions between zinc and nickel. *Z. Tierphysiol. Tierernaehr. Futtermittelkd.* 53(3-4): 207-13

Surv Reichrtova, E., Takac, E., Kranerova, J. , Vencko, B., Sulicova, L., and Holusa, R. biomonitoring of environmental pollution hazards from a nickel smelter waste dump. *Journal of Hygiene Epidemiology Microbiology and Immunology (Prague). 30 (4). 1986 (Recd. 1987). 359-364.*

FL Reichrtova, E., Takac, L., Kahanec, J., Sulicova, L., and Kovacikova, Z. bioindication of magnesite emissions on the f1 generation ofrabbits . iii. bioaccumulation of contaminating metals. *Cesk. Hyg. (1987)* 32(6): 350-4

In Vit Reitstetter Raven and Yool Andrea J(A). 1998. morphological consequences of altered calcium-dependent transmembrane signaling on the development of cultured cerebellar purkinje neurons. *Developmental Brain Research* 107(1): 165-167.

Unrel Reppich, B. and Schumann, G. 1988. electron-microscopy of gamma-'-particles in nickel-based superalloys. *Materials Science And Engineering A-Structural Materials Properties Microstructure And Processing 1988, V101, May, P171-182*

FL Reuling, N., Fuhrmann, R., and Keil, M. 1992. [experimental studies on the systemic toxicity of dental alloys free of precious metals]. <original> experimentelle untersuchungen zur systemischen toxizitat edelmetallfreier dentallegierungen. *Schweizer Monatsschrift Fur Zahnmedizin* 102(7): 818-27.

Unrel Reuling, Norbert, Wisser, W., Jung, A., and Denschlag, H. O. release and detection of dental corrosion products in vivo:development of an experimental model in rabbits. *J. Biomed. Mater. Res. (1990)* 24(8): 979-91

FL Reus, M. I. S., Rodrigues, N. L., Ribas, B., and Ruiz, A. S. some cations in plasma and pancreas of rats after ingestion of nickel. *Anales De La Real Academia De Farmacia. 50 (1). 1984. 125-132.*

Abstract Reynolds, R. P. and Fail, P. A. nickel chloride (ni++)-induced perinatal toxicity in cd-1 mice may be due to decreased prolactin secretion. *Toxicologist 1990 Feb;10(1):224*

FL Ribas, B., Lobato-Rodrigues, N., Sanchez-Reus, M. I., Sainz-Vadillo, M. C., Garcia-Martin, M. C., De la Torre, A. M., Bondia, S., Tamarit, J., and Cadorniga, R. 1982. [data on the biochemical significance of nickel]. <original> algunos datos sobre la significacion bioquimica del niquel. *Revista Espanola De Fisiologia* 38 Suppl: 321-6.

FL Ribas, B., Lobato-Rodrigues, N., Sanchez-Reus, M. I., Sainz-Vadillo, M. C., Garcia-Martin, M. C., De la Torre, A. M., Bondia, S., Tamarit, J., and Cadorniga, R. data on biochemical significance of nickel. *Rev. Esp. Fisiol. (1982)* 38(Suppl.): 321-6

Unrel Richter, F., Haschke, W., Leichsenring, A., Wicher, C., and Schmidt, D. 1993. medial septal area modulation of sustained negative shifts in awake rabbits. *International Journal of Neuroscience* 68(3-4): 179-84.

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.

Carcin Rigaut, J. P., Reith, A., and el Kebir, F. Z. 1984. karyometry by automated image analysis. application to precancerous lesions. *Pathology, Research and Practice* 179(2): 216-9.

In Vit Rivedal, E. and Sanner, T. 1980. synergistic effect on morphological transformation of hamster embryo cells by nickel sulphate and benz[a]pyrene. *Cancer Letters* 8(3): 203-8.

In Vit Rivedal E^Hemstad J^Sanner, T. synergistic effects of cigarette smoke extracts, benz (a) pyrene and nickel sulphate on morphological transformation of hamster embryo cells. *<JN> Dev Toxicol Environ Sci. <VO> 8 P259-63. <PY> 1980.*

Plant Robinson, B. H., Brooks, R. R., and Hedley, M. J. cobalt and nickel accumulation in nyssa (tupelo) species and its significance for new zealand agriculture. *New Zealand Journal of Agricultural Research; 42 (3). 1999. 235-240.*

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. 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

Unrel Rosenthal, D., Herring, M. B., McCready, R. A., and Levy, A. M. 1993. angioscope-assisted endovascular occlusion of venous tributaries: preclinical studies. *Cardiovascular Surgery* 1(3): 225-7.

Bact Rosner, J. L. 1985. nonheritable resistance to chloramphenicol and other antibiotics induced by salicylates and other chemotactic repellents in escherichia coli k-12. *Proceedings of the National Academy of Sciences of the United States of*

CP Rozsalyi, K. and Balogh, I. 1987. calcium and nickel cytochemistry in calcium-free calcium-paradox and oxygen-paradox heart damages. *VIIIth Congress of the International Society for Heart Research (European Section)*

Phys Ruan Benfang, Watanabe Shinya, Eppig John J, Kwoh Christopher, Dzidic Natasha, Pang Jihai, Wilson William K, and Schroepfer George J Jr(A). 1998. sterols affecting meiosis: novel chemical syntheses and the biological activity and spectral properties of the synthetic sterols. *Journal of Lipid Research* 39(10): 2005-2020.

Alt Rubanyi, G. and Inovay, J. 1982. effect of nickel ions on spontaneous, electrically and norepinephrine stimulated isometric contractions in the isolated portal vein of the rat. *Acta Physiologica Academiae Scientiarum Hungaricae* 59(2): 181-6.

Alt Rubanyi, G., Kalabay, L., Pataki, T., and Hajdu, K. 1982. nickel induces vasoconstriction in the isolated canine coronary artery by a tonic ca2+-activation mechanism. *Acta Physiologica Academiae Scientiarum Hungaricae* 59(2): 155-9.

CP Rubanyi, G., Toth, A., and Kovach, A. G. A. 1981. effect of calcium and nickel ions on glycolytic and oxidative metabolism and contractility of the rat uterus. *Adv. Physiol. Sci. Proc. Int. Congr., 28th* : Meeting Date 1980, Volume 25, Issue Oxygen Transp. Tissue, 259-60. Editor(s): Kovach, A. G. B.; Dora, E.; Kessler, M. Publisher: Akad. Kiado, Budapest, Hung..

Unrel Ryhanen, J., Kallioinen, M., Tuukkanen, J., Junila, J., Niemela, E., Sandvik, P., and Serlo, W. 1998. in vivo biocompatibility evaluation of nickel-titanium shape memory metal alloy: muscle and perineural tissue responses and encapsule membrane thickness. *Journal of Biomedical Materials Research* 41(3): 481-8.

Unrel Ryhanen, J., Kallioinen, M., Tuukkanen, J., Lehenkari, P., Junila, J., Niemela, E., Sandvik, P., and Serlo, W. 1999. bone modeling and cell-material interface responses induced by nickel-titanium shape memory alloy after periosteal implantation. *Biomaterials* 20(14): 1309-17.

FL Ryzhkovskii, V. L., Elfimova, E. V., and Gusev, M. I. resorptive action of small concentrations of metal nickel aerosol on the body. *Gig. Sanit. (1974)* (11): 8-13.

Gene Ryzhova, N. I. and Savluchinskaya, L. A. 1996. experimental assessment of the possible blastomogenic effects of some substances and materials used in medicine. *Gigiena I Sanitariya.*(1): 39-41.

Unrel Sadiq, M. and Zaidi, T. H. vanadium and nickel content of nowruz spill tar flakes on the saudi-arabian coastline and their probable environmental impact. . *Bulletin of Environmental Contamination and Toxicology. 32 (6). 1984. 635-639.*

Phys Sahmali, S. M., Kural, O., and Kilic, Z. 1991. systemic effects of nickel-containing dental alloys: analysis of nickel levels in serum, liver, kidney, and oral mucosa of guinea pigs. *Quintessence International* 22(12): 961-6.

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.

Meth Saito Takashi. 1994. light and electron microscopic studies on experimental oral epithelial dysplasia produced by wounding and nickel and heterocyclic amines (trp-p-2,iq) applications. *Aichi-Gakuin Journal of Dental Science* 32(1): 55-90.

In Vit Sakaki Yoko, Sugioka Miho, Fukuda Yutaka, and Yamashita Masayuki(A). 1997. capacitative ca-2+ influx in the neural retina of chick embryo. *Journal of Neurobiology* 32(1): 62-68.

In Vit Sanchez Reus, M. I., Garcia Martin, M. C., Lobato Rodrigues, N., and Ribas Ozonas, B. nickel ingestion increases calcium, zinc and insulin uptake in rat pancreas. *Cienc. Biol. (Coimbra) (1981)* 6(4): 275-8.

FL Sanchez Reus, M. I., Lobato Rodrigues, N., Ribas, B., and Santos Ruiz, A. pancreatic and plasma cations of rats ingesting nickel. *An. R. Acad. Farm. (1984)* 50(1): 125-32

Unrel Sandrik, J. L., Kaminski, E. J., and Greener, E. H. biocompatibility of nickel-base dental alloys. *Biomater Med Devices Artif Organs; 2 (1). 1974 31-39*

Unrel Santella, M. L. and McDonald, R. 1996.*Development of Ni(Sub 3)Al Alloys for Use As Transfer*

Rolls in Hot Processing of Steels. CRADA Final Report. <NOTE> PROGRESS REPT. ORNL/M-5113

Meth Santhanam Ramasamy, Panda Amulya K, Kumar, V. Senthil, and Gupta Satish K(A). 1998. dog zona pellucida glycoprotein-3 (zp3): expression in escherichia coli and immunological characterization. *Protein Expression and Purification* 12(3): 331-339.

Mix Sapozhkov, S. V. 1982. effect of cobalt and nickel on histological changes in the nervous system. *Sbornik Nauchnykh Trudov Leningradskogo Veterinarnogo Instituta.*(71): 102-108.

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*

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.

Abstract Sayato, Y., Nakamuro, K., Matsui, S., and Tanimura, A. 1980. behavior and chemical form of nickel in rats administered with nickel-63 chloride. *7th Meeting on Environmental Pollutants and Toxicology*

CP Sayato, Y., Nakamuro, K., Matsui, S., and Tanimura, A. 1981. studies on behavior and chemical form of nickel in rat administered with 63nicl2. *Journal Of Pharmacobio-Dynamics* 4: S73.

Bio Acc Scheiner, D. M., Katz, S. A., and Samitz, M. H. 1976. nickel levels in hair and nickel ingestion in guinea pigs. *Environmental Research* 12(3): 355-357.

Alt Schiffer, R. B., Baggs, R. B., and McDermott, M. P. 1996. effects of exposure to dietary nickel and zinc upon experimentalallergic encephalomyelitis in swxj mice. *Journal of Trace Elements in Experimental Medicine* 9(1): 1-9.

Imm Schiffer, R. B., Herndon, R. M., and Eskin, Thomas. 1990. effects of altered dietary trace metals upon experimental allergic encephalomyelitis. *Neurotoxicology (1990)* 11(3): 443-50.

CP SCHIFFER, R. B. and MOYNIHAN, J. 1990. effects of dietary trace metals upon immune responses to antigen challenge in sjl mice. *42nd Annual Meeting of the American Academy of Neurology*

Imm Schiffer, R. B., Sunderman, F. W. Jr, Baggs, R. B., and Moynihan, J. A. 1991. the effects of exposure to dietary nickel and zinc upon humoral and cellular immunity in sjl mice. *J Neuroimmunol.* 34(2-3): 229-39.

Nut def Schnegg, A. and Kirchgessner, M. absorption and availability of iron in the presence of nickel deficiency. *International Journal for Vitamin and Nutrition Research. 46 (1). 1976 96-99.*

Nut def Schnegg, A. and Kirchgessner, M. [absorption and metabolic efficiency of iron in nickel deficiency]. <original> zur absorption und verfugbarkeit von eisen bei. *International Journal for Vitamin and Nutrition Research; 46 (1)*

FL Schnegg, A. and Kirchgessner, M. 200. changes in activity of enzymes of the liver and kidneys in nickel oriron deficiency. *Zeitschrift Fur Tierphysiologie Tierernahrung Und Futtermittelkunde*

FL Schnegg, A. and Kirchgessner, M. 247. changes in concentration of some substrates in serum and liver in nife deficiency. *Zeitschrift Fur Tierphysiologie Tierernahrung Und Futtermittelkunde*

FL Schnegg, A. and Kirchgessner, M. 1975. [changes in hemoglobin content, erythrocyte count and hematocrit in nickel deficiency]. <original> veranderungen des hamoglobingehaltes, der erythrozytenzahl und des hamatokrits bei nickelmangel. *Nutrition and Metabolism* 19(5-6): 268-78.

Nut def Schnegg, A. and Kirchgessner, M. changes in the hemoglobin content, erythrocyte count, and hematocrit in nickel deficiency. *Nutr. Metab. (1975)* 19(5-6): 268-78.

FL Schnegg, A. and Kirchgessner, M. changes of several substrate concentrations in serum and liver in response to nickel vs iron deficiency. . *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 39 (5-6). 1977 (Recd 1978) 247-251.*

FL Schnegg, A. and Kirchgessner, M. 1977. concentration changes of several substrates in serum and liver in response to nickel versus iron deficiency. *Z. Tierphysiol. Tierernaehr. Futtermittelkd.* 39(5-6): 247-51

FL Schnegg, A. and Kirchgessner, M. 1977. contents of nickel in the organs of rats in nickel deficiency. *Zentralblatt Fur Veterinarmedizin, A* 24(5): 394-401.

FL Schnegg, A. and Kirchgessner, M. 1977. differential diagnosis of iron and nickel deficiency by estimating theactivities of some enzymes. *Zentralblatt Fur Veterinarmedizin, A* 24(3): 242-247.

CP Schnegg, A. and Kirchgessner, M. 1980. essential use of nickel for animal growth. *Spurenelem.-Symp.: Nickel 3rd* : 11-16. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep..

FL Schnegg, A. and Kirchgessner, M. 1975. [the essentiality of nickel for animal growth]. <original> zur essentialitat von nickel fur das tierische wachstum. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde;*

FL Schnegg, A. and Kirchgessner, M. 1975. essentiality of nickel for growth of animals. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 36(2): 63-74.

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. 1977. nickel content of rat organs in nickel deficiency. *Zentralbl. Veterinaermed. Reihe A* 24(5): 394-401.

CP Schnegg, A. and Kirchgessner, M. 1978. nickel deficiency and its effects on metabolism. *Trace Elem. Metab. Man Anim. Proc. Int. Symp., 3rd* : Meeting Date 1977, 236-43. Editor(s): Kirchgessner, M. Publisher: Arbeitskreis Tierernaehrungsforschung Weihenstephan Inst. Ernaehrungsphysiol., Freising-Weihenstephan, Ger..

Nut def Schnegg, A. and Kirchgessner, M. on the absorption and metabolism of iron in nickel deficiency. *Int. J. Vitam. Nutr. Res. (1976)* 46(1): 96-9.

FL Schnegg, A. and Kirchgessner, M. 1976. the toxicity of dietary nickel. *Landwirtschaftliche Forschung* 29(3/4): 177-185.

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.

FL Schnegg, A and Kirchgessner, M. zur toxizitat von alimentar verabreichtem nickel; on the toxicity of dietary nickel [rats]. *Landwirtsch Forsch* 1976 29 (3/4): 177-185. Ref. Eng. sum.

FL Schnegg, S and Kirchgessner, M. 1976. [toxicity of dietary nickel.]. *Landwirtsch. Forsch.* 29(3-4): 177.

Unrel Schofield, J. G. and Orci, L. release of growth hormone from ox pituitary slices after pronase treatment. *J CELL BIOL. Journal of Cell Biology. 65 (1). 1975 223-227.*

Drug Schreiber, V., Pribyl, T., Svobodova, V. , and Jahodova, J. 1984. modulation of the effect of oestradiol on adenohypophyseal weight: ineffectiveness of nickel chloride, potentiation by cimetidine. *Physiologia Bohemoslovaca* 33(1): 11-6.

Dup Schroeder, H. A. 1970.*Metallic Micronutrients and Intermediary Metabolism: Progress Rept. No. 3 (Final).*: 22 p.

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.

Unrel Schwager, I. 1980.*Development of New Catalysts for Coal Liquids Refining. Seventh Quarterly Report, 1 July 1980 - 30 September 1980. DOE/ET/12103-T5; FE-2595-7*

Nutrition Schwarz, K. recent dietary trace element research exemplified by tin fluorine and silicon. . *Federation Proceedings. 33 (6). 1974 1748-1757*

No Oral Seffner, W. and Geppert, H. 1987. histological studies on the effect of surface modification of nickel particles on the cancer induction in the muscle tissue ofrats. *Mengen- Spurenelem. Arbeitstag.* 2: 275-8. Editor(s): Anke, Manfred. Publisher: Karl-Marx-Univ. Leipzig, Leipzig, Ger. Dem. Rep...

Dup Seidenberg, J. M. and Becker, R. A. 1987. a summary of the results of 55 chemicals screened for developmental toxicity in mice. *Teratog Carcinog Mutagen.* 7(1): 17-28.

Imm Selgrade, M. K, Daniels, M. J., and Dean, J. H. 1992. correlation between chemical suppression of natural killer cell activity in mice and susceptibility to cytomegalovirus: rationale for applying murine cytomegalovirus as a host resistance model and for interpreting immunotoxicity testing in terms of risk of disease. *Journal of Toxicology and Environmental Health.* 37(1): 123-137.

In Vit Sen, Pramila and Costa, Max. induction of chromosomal damage in chinese hamster ovary cells by soluble and particulate nickel compounds: preferential fragmentation of the heterochromatic long arm of the x-chromosome by carcinogenic crystalline nickel sulfide particles. *Cancer Res. (1985)* 45(5): 2320-5

Unrel Serafini, M. T. and Romeu, A. nickel interactions with glutathione and related enzyme in 11-day embryo and yolk sac in rat. *Bull Environ Contam Toxicol; 47 (6). 1991. 840-844.*

Bio Acc Severa, J, Vyskocil, A, Fiala, Z, and Cizkova, M. distribution of nickel in body fluids and organs of rats chronically exposed to nickel sulfate. *Hum. Exp. Toxicol. (1995)* Volume Date 1995, 14(12): 955-8 .

Unrel Seymour, Raymond B. and Montgomery, Stewart R. murray raney - pioneer catalyst producer.

ACS Symp. Ser. (1983) 222(Heterog. Catal.): 491-503

Oil Seys, J. and Meire, P. Institute of Nature Conservation Brussels Belgium. 1997. oil pollution and seabirds. *Bulletin De La Societe Royale Des Sciences De Liege. V. 66(1-3) P. 61-66*

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 .

Unrel Sharata, H. H. and Burnette, R. R. effect of dipolar aprotic permeability enhancers on the basal stratum corneum. *Journal of Pharmaceutical Sciences. 77 (1). 1988. 27-32.*

Abstract Shimai, S. effects of combined administration of trace amount of metals on the behavioral development of mouse offspring. *Teratology 24(1):31A,1981*

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.

FL Shkol'nik, M. I. effect of nickel chloride on some indexes of protein-lipid metabolism in experimental animals. *Biol. Rol Mikroelem. Ikh Primen. Sel'Sk. Khoz. Med. (1974)* : 401-5. Editor(s): Peive, Ya. V.; Khailova, G. F. Publisher: "Nauka" , Moscow, USSR..

In Vit Short, B. G., Zimmerman, D. M., and Schwartz, L. W. 1997. automated double labeling of proliferation and apoptosis in glutathione s-transferase-positive hepatocytes in rats. *Journal of Histochemistry and Cytochemistry* 45(9): 1299-305.

FL Sigwart, U. 1990. [coronary endoprostheses (stents)]. <original> koronare endoprothesen (stents). *Herz* 15(5): 319-28.

Mix Simmons, Jane Ellen, Yang, Raymond S. H., Svendsgaard, David J., Thompson, Morrow B., Seely, John C., and McDonald, Anthony. 1994. toxicology studies of a chemical mixture of 25 groundwater contaminants: hepatic and renal assessment, response to carbon tetrachloride challenge, and influence of treatment-induced water restriction. *J. Toxicol. Environ. Health* 43(3): 305-25.

Unrel Simske, S. J. and Sachdeva, R. 1995. cranial bone apposition and ingrowth in a porous nickel-titanium implant. *Journal of Biomedical Materials Research* 29(4): 527-33 .

In Vit Singh, A. and Gilman, J. PW. use of the double diffusion chamber for an analysis of muscle-nickel sulphide interaction. *Indian J Med Res; 61 (5). 1973 704-707*

Bio Acc 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.

Acu 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.

FL Skal'nyi, A. V., Slavin, F. I., Myasoedov, S. P., Shvarts, I. A., and Drozdov, E. S. hair content of lead, antimony, chromium, cadmium, titanium, nickel and strontium under chronic alcohol intoxication. *Gig. Sanit. (1990)* (5): 80-2

Unrel Skov, K. A., Adomat, H., and Farrell, N. P. 1993. radiosensitization by nickel lapachol. *International Journal of Radiation Biology* 64(6): 707-13.

In Vit Skreb, Yvette and Simeon, Vladimir. metal antagonism in cadmium(ii)/zinc(ii) and manganese(ii)/nickel(ii) treatments of cultured chinese hamster fibroblasts. *Period. Biol. (1987)* 89(3): 149-54

No Oral Smialowicz, R. J., Rogers, R. R., Rowe, D. G., Riddle, M. M., and Luebke, R. W. 1987. the effects of nickel on immune function in the rat. *Toxicology* 44(3): 271-81.

Imm Smialowicz, Ralph J., Rogers, Ronald R., Riddle, Marie M., Rowe, Denise G., and Luebke, Robert W. 1986. immunological studies in mice following in utero exposure to nickel(ii) chloride . *Toxicology.* 38(3): 293-303.

CP Smith, James Cecil. 1969. controlled environment system for trace element deficiency studies. *Trace Subst. Environ. Health - 2 Proc. Univ. Mo. Annu. Conf., 2nd* : Meeting Date 1968, 223-42. Editor(s): Hemphill, Delbert D. Publisher: Univ. of Missouri, Columbia, Mo.

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.

Unrel SNYDER, C. A. core--exposure and analytical facility. *Crisp Data Base National Institutes Of Health*

In Vit Sobti, R. C. and Gill, R. K. incidence of micronuclei and abnormalities in the head of spermatozoa caused by the salts of a heavy metal nickel. *Cytologia (TOKYO); 54 (2). 1989. 249-254.*

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 Oral Sokolov, V. E., Albone, E. S., Flood, P. F., Heap, P. F., Kagan, M. Z., Vasilieva, V. S., Roznov, V. V., and Zinkevich, E. P. secretion and secretory tissues of the anal sac of the mink mustela-vison chemical and histological studies. *J CHEM ECOL. Journal of Chemical Ecology. 6 (4). 1980. 805-82.*

No Oral Sole, J. Huguet J. Arola L. and Romeu A. 1990. in vivo effects of nickel and cadmium in rats on lipid peroxidation and ceruloplasmin activity. *Bull. Environ. Contam. Toxicol. 44[5]: 686-691.*

HHE Solomons, N. W., Viteri, F., Shuler, T. R., and Nielsen, F. H. bio availability of nickel in man effects of foods and chemically defined dietary constituents on the absorption of inorganic nickel. *Journal of Nutrition. 112 (1). 1982. 39-50.*

No Oral Song Bai-Zheng, Donoff, R. Bruce, Tsuji Takanori, Todd Randy, Gallagher George T, and Wong David T W(A). 1993. identification of rabbit eosinophils and heterophils in cutaneous healing wounds. *Histochemical Journal* 25(10): 762-771.

Unrel Soong Tuck Wah, Stea Anthony, Hodson Connie D, Dubel Stefan J, Vincent Steven R, and Snutch Terry P(A). 1993. structure and functional expression of a member of the low voltage-activated calcium channel family. *Science (Washington D C)* 260(5111): 1133-1136.

Carcin Soubrane, C., Jacobs, C., Jacquillat, C., Dubois, M., Poupon, M. F., Judde, J. G., Maral, J., Beaufils, H., and Jaudon, M. C. 1986. influence of the uremic state on the development of malignancy. an experimental study in the rat. *American Journal of Nephrology* 6(5): 363-8.

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.

Abstract Spears, J. W., Harvey, R. W., and Samsell, L. J. influence of nickel on nitrogen metabolism and tissue retention of trace minerals in calves. *69th Annual Meeting of the Federation of American Societies for Experimental Biology, Anaheim, Calif., USA, APR. 21-26, 1985. FED PROC. 44 (6). 1985. 1848.*

In Vit Spears, J. W. and Hatfield, E. E. 1978. nickel for ruminants. 1. influence of dietary nickel on ruminal urease activity. *Journal of Animal Science* 47(6): 1345-1350.

Nut def Spears, J. W., Hatfield, E. E., and Fahey, G. C. Jr. 1978. nickel depletion in the growing ovine. *Nutrition Reports International* 18(6): 621-629.

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.

Plant Spears, J. W., Hatfield, E. E., and Forbes, R. M. 1979. nickel for ruminants part 2 influence of dietary nickel on performance and metabolic parameters. *Journal of Animal Science. 48 (3). 1979. 649-657.*

Nut def Spears, J. W., Hatfield, E. E., Forbes, R. M., and Koenig, S. E. 1978. studies on the role of nickel in the ruminant. *Journal of Nutrition* 108(2): 313-320.

Unrel Spears, J. W., Smith, C. J., and Hatfield, E. E. 1977. rumen bacterial urease requirement for nickel. *J Journal of Dairy Science. 60 (7). 1977 1073-1076.*

Nut def Spears, J. W. Hatfield E. E. and Forbes R. M. 1979. nickel for ruminants ii. influence of dietary nickel on performance and metabolic parameters. *J. Anim. Sci. 48[3]: 649-657.*

FL Spoerl, R. and Kirchgessner, M. 205. increased storage of iron, zinc, manganese and nickel in pregnancy. *Zeitschrift Fur Tierphysiologie Tierernahrung Und Futtermittelkunde*

FL Spoerl, R. and Kirchgessner, M. studies on increased deposition of iron zinc manganese and nickel by the pregnant organism. *Zeitschrift Fuer Tierphysiologie Tierernaehrung Und Futtermittelkunde. 38 (4). 1977 205-210.*

No Oral Srivastava, Amita, Katiyar, S. S., Behari, Jai Raj, Srivastava, Sanjay K., Hasan, S. K., and Srivastava, R. C. 1989. comparative evaluation of macrocyclic drugs and their linear counterparts in preventing nickel toxicity in mice. *J. Environ. Sci. Health Part A* Z24(1): 77-86

Alt Srivastava, R. C., Ahmad, I., Kaur, G. , and Hasan, S. K. alterations in the metabolism of endogenous trace metals due to cadmium manganese and nickel effect of partial hepatectomy. *J Environ Sci Health Part a Environ Sci Eng; 23 (2). 1988. 95-102.*

Alt Srivastava, R. C., Athar, M., Hasan, S. K., and Misra, L. R. influence of partial hepatectomy on the metabolic disposition of nickel in Rats. *Bull Environ Contam Toxicol; 40 (3). 1988. 439-443.*

No Oral Srivastava, R. C., Hasan, S. K., Jyotsana, and Gupta, Sanjay. protective role of metallothionein in nickel induced oxidative damage. *Biochem. Mol. Biol. Int. (1993)* 30(2): 261-70.

No Oral Srivastava, R. C., Husain, M. M., Srivastava, S. K., Hasan, S. K., and Lal, A. 1995. effect of pre-exposure to cadmium and silver on nickel induced toxic manifestations in mice : possible role of ceruloplasmin and metallothionein. *Bull. Environ. Contam. Toxicol. (1995)* 54(5): 751-9

Unrel Standlee, D. 1991.*Hubble Space Telescope Battery Background*

FL Stangl, G. I. and Kirchgessner, M. comparative effects of nickel and iron depletion on circulating thyroid hormone concentrations in rats. *J. Anim. Physiol. Anim. Nutr. (1998)* 79(1): 18-26

Nut def Stangl, G. I. and Kirchgessner, M. effect of nickel deficiency on fatty acid composition of total lipids and individual phospholipids in brain and erythrocytes of rats. *Nutr. Res. (N. Y.) (1996)* Volume Date 1997, 17(1): 137-147.

Nut def Stangl, G. I. and Kirchgessner, M. effect of nickel deficiency on various metabolic parameters ofrats. *J. Anim. Physiol. Anim. Nutr. (1996)* 75(3): 164-74

Nut def Stangl, G. I. and Kirchgessner, M. 1996. nickel deficiency and liver metabolism. *Mengen-Spurenelem. Arbeitstag., 16th* : 159-169. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

Nut def Stangl, G. I., Kirchgessner, M., and Giesecke, D. ed. 1996. effect of nickel deficiency on energy metabolism and clinical-chemical parameters on serum of rats. <original> einfluss von nickelmangel auf parameter des energiestoffwechsels sowie klinisch-chemische serumparameter von ratten. [proceedings of the society of nutrition physiology]. <original> berichte der gesellschaft fuer ernaehrungsphysiologieund tier. *P. 62. No. 5*

Nut def Stangl, G. I. and Kirschgessner, M. effect of nickel deficiency on fatty acid composition of milk and adipose tissue of rats. *Trace Elem. Electrolytes (1996)* 13(3): 117-122

Nut def Stangl, G. I., Schwarz, F. J., and Kirchgessner, M. 1999. cobalt deficiency effects on trace elements, hormones and enzymesinvolved in energy metabolism of cattle. *International Journal for Vitamin and Nutrition Research* 69(2): 120-126.

FL Stangl, G. I., Wild, S., and Kirchgessner, M. 1996. effect of nickel deficiency on the activity of cytochrome-c-oxidase inrats. *Journal of Animal Physiology and Animal Nutrition* 75(4/5): 226-230.

Nut def Stangl, Gabriele I., Eidelsburger, Ulrich, and Kirchgessner, Manfred. nickel deficiency alters nickel flux in rat everted intestinal sacs. *Biol. Trace Elem. Res. (1998)* 61(3): 253-262

Nut def Stangl, Gabriele I. and Kirchgessner, Manfred. 1997. effect of nickel deficiency on the activities of enzymes from energy metabolism. *Trace Elem. Man Anim.--9 Proc. Int. Symp., 9th* : Meeting Date 1996, 645-646. Editor(s): Fischer, Peter W. F. Publisher: National Research Council of Canada, Ottawa, Ont.

Nut def Stangl, Gabriele I. and Kirchgessner, Manfred. nickel deficiency alters liver lipid metabolism in rats. *J. Nutr. (1996)* 126(10): 2466-2473

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.

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.

Surv Stevens, J. B. 1991. disposition of toxic metals in the agricultural food chain: 1. steady-state bovine milk biotransfer Factors. *Environ Sci Technol.* 25(7): 1289-1294.

Mix Stoewsand, Gilbert S., Telford, John N., Anderson, Judy L., Bache, Carl A., Gutenmann, Walter H., and Lisk, Donald J. toxicologic studies with japanese quail fed winter wheat grown on municipal sludge-amended soil. *Arch. Environ. Contam. Toxicol. (1984)* 13(3): 297-301 .

BioX Stokes, A., Cameron, R. S., Marshall, R. N., and Killington, R. A. 1997. high level expression of equine herpesvirus 1 glycoproteins d and h andtheir role in protection against virus challenge in the c3h (h-2kk)murine model. *Virus Research* 50(2): 159-173.

Unrel Stoll, U., Barth, B., Scheerer, N., Schneider, E., and Kiefer, J. 1996. hprt mutations in v79 chinese hamster cells induced by accelerated ni, au and pb ions. *International Journal of Radiation Biology* 70(1): 15-22.

In Vit Stoll, U., Schneider, E., and Kiefer, J. mutation induction to 6tg-resistance in chinese hamster v79 cells after heavy ion exposure. *GSI-Rep. (1991) GSI 91-1, 223*

Unrel Stoll, U., Schneider, E., Kranert, T., and Kiefer, J. 1995. induction of hprt- mutants in chinese hamster v79 cells after heavy ion exposure. *Radiation and Environmental Biophysics* 34(2): 91-4.

In Vit Storeng, R. and Jonsen, J. 1980. effect of nickel chloride and cadmium acetate on the development of pre-implantation mouse embryos invitro. *Toxicology* 17(2): 183-187.

No Oral Storeng, R. and Jonsen, J. 1981. nickel toxicity in early embryogenesis in mice. *Toxicology* 20(1): 45-51.

Abstract Storeng, R. and Jonsen, J. 1980. nickel toxicity in early mammalian embryogenesis. *Toxicol Lett.* 1000: 110.

In Vit Storeng, R. and Jonsen, J. 1984. recovery of mouse embryos after short-term invitro exposure to toxic nickel chloride. *Toxicology Letters* 20(1): 85-91.

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.

Phys Strube Caroline(A), Monteil Arnaud, Nargeot Joel, and Lory Philippe. 2000. evidence for functional expression of alpha1h in mouse fetal skeletal muscle cells. *Biophysical Journal* 78(1 Part 2): 460A.

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.

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 .

In Vitro Su, Z., Bridge, J. H., Philipson, K. D., Spitzer, K. W., and Barry, W. H. 1999. quantitation of na/ca exchanger function in single ventricular myocytes. *Journal of Molecular and Cellular Cardiology* 31(5): 1125-35.

Abstract Sugita, Y., Miyazawa, S., Suzuki, S., Arai, T., Simomitsu, T., Oku, T., Murabayashi, S., Harasaki, H., Kambic, H., and Et Al. development of angioplasty ring stent using thermal shape memory

titanium-nickel alloy nitinol to prevent restenosis following Ptca. *52nd Annual Scientific Meeting of the Japanese Circulation Society, Akita, Japan, May 1988. JPN CIRC J. 52 (8). 1988. 768.*

No Oral Sunderman, F. W., Marzouk, A., Hopfer, S. M., Zaharia, O., and Reid, M. C. 1985. increased lipid-peroxidation in tissues of nickel chloride-treated rats. *Annals Of Clinical And Laboratory Science* 15(3): 229-236.

No Oral Sunderman, F. W. Donnelly A. J. West B. and Kincaid J. F. 1959. nickel poisoning. ix. carcinogenesis in rats exposed to nickel carbonyl. *A.M.A. Arch. Ind. Health 20: 36-41.*

No Oral Sunderman, F. W. J. and Donnelly A. J. 1965. studies of nickel carcinogenesis metastasizing pulmonary tumors in rats induced by the inhalation of nickel carbonyl. *Am. J. Pathol. 46: 1027-1041.*

No Oral Sunderman, F. W. J. Reid M. C. Bibeau L. M. and Linden J. V. 1983. nickel induction of microsomal heme oxygenase activity in rodents. *Toxicol. Appl. Pharmacol. 68[1]: 87-95.*

In Vitro Sunderman, F. W. Jr. 1971. effect of nickel carbonyl upon hepatic concentrations of adenosine triphosphate. *Research Communications in Chemical Pathology and Pharmacology* 2(4)

Rev Sunderman, F. W. JR. review of the metabolism and toxicology of nickel. *Ann Clin Lab Sci 7:377-398,1977*

Not Avail Sunderman, F. W. JR. the toxicology and metabolism of nickel compounds. *REPORT DOE/EV/03140-5:15 PP,1980*

No Oral Sunderman, F. W. Jr, Allpass, P. R., Mitchell, J. M., Baselt, R. C., and Albert, D. M. eye malformations in rats:induction by prenatal exposure to nickel carbonyl. *Science 203:550-553,1979*

No Oral Sunderman, F. W. Jr, Mangold, B. L., Wong, S. H., Shen, S. K., Reid, M. C., and Jansson, I. 1983. high-performance size-exclusion chromatography of 63ni-constituents in renal cytosol and microsomes from 63nicl2-treated rats. *Research Communications in Chemical Pathology and Pharmacology* 39(3)

Chem Meth Sunderman, F. W Jr, Marzouk, A., Crisostomo, M. C., and Weatherby, D. R. electrothermal atomic absorption spectrophotometry of nickel in tissue homogenates. *Ann Clin Lab Sci; 15 (4). 1985. 299-307.*

Abstract Sunderman, F. W. Jr, Mitchell, J., Allpass, P., and Baselt, R. embryotoxicity and teratogenicity of nickel carbonyl in rats. *Toxicol Appl Pharmacol 45:345,1978*

No Oral Sunderman, F. W. Jr, Reid, M. C., Shen, S. K., and Kevorkian, C. B. embryotoxicity and teratogenicity of nickel compounds, in: reproductive and developmental toxicity of metals. *Reprod Dev Toxic Met(proc Jt Meet 1982) :399-416,1983*

Abstract Sunderman, F. W. Jr, Shen, S., Mitchell, J., Allpass, P., and Damjanov, I. fetal toxicity and transplacental transport of nickel in rats. *Toxicol Appl Pharmacol 41:205,1977*

Abstract Sunderman, F. W. Jr, Shen, S. K., Reid, M. C., and Allpass, P. R. teratogenicity and embryotoxicity of nickel carbonyl in syrian Hamsters. *Ann Clin Lab Sci 11:84,1981*

No Oral Sunderman, F. W. Jr. Maenza R. M. Hopfer S. M. Mitchell J. M. Allpass P. R. and Damjanov I. 1979. induction of renal cancers in rats by intrarenal injection of nickel subsulfide. *J. Environ. Pathol. Toxicol. 2: 1511-1527.*

Carcin Sunderman, F. William, Schneider, Henry P., and Lumb, George. sodium diethyldithiocarbamate administration in nickel-induced malignant tumors. *Ann. Clin. Lab. Sci. (1984)* 14(1): 1-9

No Oral Sunderman, F. William Jr. and McCully, Kilmer S. effects of manganese compounds on carcinogenicity of nickel subsulfide inrats. *Carcinogenesis (London) (1983)* 4(4): 461-5

Nut def Sunderman, F. William Jr., Nomoto, Shozo, Morang, Richard, Nechay, Maria W., Burke, Carol N., and Nielsen, Svend W. nickel deprivation in chicks. *J. Nutr. (1972)* 102(2): 259-67.

No Oral Sunderman, F. William Jr., Shen, Samuel K., Mitchell, John M., Allpass, Patricia R., and Damjanov, Ivan. embryotoxicity and fetal toxicity of nickel in rats. *Toxicol. Appl. Pharmacol. (1978)* 43(2): 381-90

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 Vit Suzuki, Y., Morita, I., Yamane, Y., and Murota, S. preventive effects of zinc on cadmium-induced inhibition of alkaline phosphatase activity and mineralization activity in osteoblast-like cells mc-3t3-e1. *J Pharmacobio-dyn; 12 (2). 1989. 94-99.*

Unrel Swanson, S. M. and Roest, N. 1997. biophysical effects of uranium mining in canada and some suggestions for biomarkers of effects. *Canadian Technical Report of Fisheries and Aquatic Sciences* 0(2144): 33.

In Vit Swierenga, S. H. H., Marceau, N., Katsuma, Y., French, S. W., Mueller, R., and Lee, F. altered cytokeratin expression and differentiation induction during neoplastic transformation of cultured rat liver cells by nickel subsulfide. *Cell Biol. Toxicol. (1989)* 5(3): 271-86

In Vit Sykes, A. K. and Basrur, P. K. 1971. a melinex coverslip method for ultrastructural studies of monolayer cultures. *In Vitro* 7(2): 68-73.

Unrel Szabo, K., Balogh, I., Kovach, A. G., and Novak, J. 1985. cardiopathogenetic importance of detectable nickel in heart muscle after thermal injury. *Acta Medicinae Legalis Et Socialis* 35(2): 225-48.

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.

CP Szakmary, E., Ungvary, G., Naray, M., Mede, A., Tatrai, E., and Morvai, V. 1989. harmful effects of heavy metals chromium nickel cobalt on offspring. *17th Conference of the European Teratology Society*

FL Szakmary, Eva, Ungvary, Gyorgy, Naray, Miklos, Szeberenyi, Szabolcs, Tatrai, Erzsebet, and Morvai, Veronika. the offspring damaging effect of nickel on rats , mice and rabbits. *Egeszsegtudomany (1993)* 37(1): 83-91

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.

Nut def Szilagyi, M., Anke, M., and Balogh, I. 1991. effect of nickel deficiency on biochemical variables in serum, liver,heart and kidneys of goats. *Acta Veterinaria Hungarica* 39(3-4): 231-238.

FL Szilagyi, M., Regiusne Mocsenyi, A. Allattenyesztesi es Takarmanyozasi Kutatokozpont

Herceghalom Hungary, Balogh, I. Semmelweis Orvostudomanyi Egyetem Budapest Hungary Igazsagugyi Orvostani Intezet, and Anke, M. Karl-Marx-Univ. Jena German D. R. Wissenschaftsbereich Tierernahrungschemie. 1989. biochemical and histological consequences of nickel deficiency (goats). <original> a nikkelhiany biokemiai es korszovettani vonatkozasai. *Magyar Allatorvosok Lapja. V. 44(8) P. 495-500*

Abstract Szilagyi, M., Szentmihalyi, S., and Anke, M. activity of some enzymes in nickel deficiency. *22nd Meeting of the Hungarian Biochemical Society, Debrecen, Hungary, Aug. 25-28, L982. Acta Biochim Biophys. 17 (1-2). 1982. 171.*

Unrel Tabarowski, Z., Gibson-Berry, K., and Felten, S. Y. 1996. noradrenergic and peptidergic innervation of the mouse femur bone marrow. *Acta Histochemica* 98(4): 453-7.

No Oral Takahashi, K., Tateishi, N., Kaneda, M., and Akaike, N. 1989. comparison of low-threshold ca2+ currents in the hippocampal ca1 neurons among the newborn, adult and aged rats. *Neuroscience Letters* 103(1): 29-33.

No Org Takahashi, S., Oishi, M., Takeda, E., Kubota, Y., Kikuchi, T., and Furuya, K. 1999. physicochemical characteristics and toxicity of nickel oxide particles calcined at different temperatures. *Biological Trace Element Research* 69(2): 161-74.

No Oral Takahashi, S. National Institute of Radiological Sciences Chiba Japan, Esaka, F., Sato, H., Kubota, Y., Kikuchi, T., and Furuya, K. concentrations of metal elements in mouse lung after intratracheal. *Inhal Toxicol. V6, N1, P67(11)*

Phys Takakura, H., Sugita, Y., Matsui, M., Miyazawa, S., Harasaki, H., Nose, Y., and Arai, T. development of coronary stent using thermal shape memory titanium nickel alloy to prevent restenosis following percutaneous transluminal coronary angioplasty. *Japanese Journal of Artificial Organs. 19 (3). 1990. 1275-1277.*

No Oral Takenaka, S., Muhle, H., Bellmann, B., Creutzenberg, O., and Mohr, U. morphological effects of nickel powders on the lung of syrian golden hamsters. *J. Aerosol Sci. (1988)* 19(7): 1149-52

Unrel Takeshita, F., Takata, H., Ayukawa, Y., and Suetsugu, T. 1997. histomorphometric analysis of the response of rat tibiae to shape memory alloy (nitinol). *Biomaterials* 18(1): 21-5.

No Oral Tallkvist, J. and Tjalve, H. effect of dietary iron deficiency on the disposition of nickel in rats. *Toxicol. Lett. (1997)* 92(2): 131-138

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.

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

Nut def Tandon, S. K., Khandelwal, S., Jain, V. K., and Mathur, N. influence of dietary iron deficiency on nickel, lead and cadmium intoxication. *Sci. Total Environ. (1994)* 148(2-3): 167-73

CP Taylor, T. G. 1975. perspectives in mineral nutrition. *Proceedings of the Nutrition Society* 34(1): 35-41.

Alt Templeton, D. M. metal-binding properties of the isolated glomerular basement membrane. *Biochimica Et Biophysica Acta. 926 (1). 1987. 94-105.*

HHE Templeton, D. M. and Sarkar, B. 1985. peptide and carbohydrate complexes of nickel in human-kidney. *Biochemical Journal* 230(1): 35-42.

Alt Templeton, Douglas M. and Chaitu, Nita. effects of divalent metals on the isolated rat glomerulus. *Toxicology (1990)* 61(2): 119-33.

Unrel Terlesky, K. C., Nelson, M. J. K., and Ferry, J. G. 1986. isolation of an enzyme complex with carbon-monoxide dehydrogenase-activity containing corrinoid and nickel from acetate-grown methanosarcina-thermophila. *Journal Of Bacteriology* 168(3): 1053-1058.

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 .

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

Bio Acc Tjalve, H. and Stahl K. 1984. effect of 5-chloro-7-iodo-8-hydroxy-quinoline (clioquinol) on the uptake and distribution of nickel, zinc and mercury in mice. *Acta Pharmacol. Toxicol. 55: 65-72.*

Unrel Tominaga, R., Harasaki, H., Sutton, C., Emoto, H., Kambic, H., and Hollman, J. 1993. effects of stent design and serum cholesterol level on the restenosis rate in atherosclerotic rabbits. *American Heart Journal* 126(5): 1049-58.

CP Torres, J. T., Ribas, B., Garcia, M. C., and Lobato, N. effect of the nickel ion on the endocrine pancreas secretion of rat. *Spurenelem.-Symp.: Nickel* 3rd (1980): 101-6. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep..

In Vitro Towianska, Anna, Potajallo, Urszula, and Kubica, Barbara. a study of antiviral action of histamine and its complex derivatives; determination of cytotoxicity of those compounds in cell cultures in vitro on the model of vaccinia. *Bull. Inst. Marit. Trop. Med. Gdynia (1986)* 37(1-2): 87-101

No Oral Toya, T., Serita, F., Sawatari, K., and Fukuda, K. 1997. lung lesions induced by intratracheal instillation of nickel fumes and nickeloxide powder in rats. *Industrial Health* 35(1): 69-77.

Unrel Trabandt Andreas, Gay Renate E, Sukhatme Vikas P, and Gay Steffen(A). 1995. enzymatic detection systems for non-isotopic in situ hybridization using biotinylated cdna probes. *Histochemical Journal* 27(4): 280-290.

No Oral Travis, W. C. and Johnson, A. A. the behavior of a wrought equiatomic gold nickel alloy as an implant material in living rats. *Stark, Lawrence and Gyan Agarwal (Edited By). Biomaterials. XVIII + 284P. Illus. Plenum Press: New York, N.Y., U.S.A. 1969 41-53*

Unrel Tripod, Jean. 1965. general pharmacodynamic aspects of mobilizing iron with chelators. *Atti Accad. Med. Lombarda Suppl.* 20: 2025-7

FL Truepschuch, A., Anke, M., Mueller, M., Illing-Guenther, H., Anke, S., and Hartmann, E. 1997. reproductive toxicology of nickel. ii. effect of excessive nickel load on the manganese content of organs and tissues. *Mengen- Spurenelem. Arbeitstag., 17th* : 706-712. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany..

FL Truepschuch, A., Anke, M., Mueller, M., Illing-Guenther, H., and Hartmann, E. 1997. reproductive toxicology of nickel. i. effect of excessive nickel load on magnesium content of organs and tissues.

Mengen- Spurenelem. Arbeitstag., 17th : 699-705. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

CP Trupschuch, A., Anke, M., Muller, M., Illing-Gunther, H., and Hartmann, E. 1996. the effects of nickel supplementation on the nickel and zinc content in different organs and tissues of poultry. *Mengen- Spurenelem. Arbeitstag., 16th* : 170-179. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

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.

FL Tsyrkunov, L. P. experimental investigation of the allergic effects of penicillin, streptomycin, and nickel. *Vrach. Delo (1967)* (2): 101-3

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.*

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*

Phys Tyczkowski, J. K., Schaeffer, J. L., Parkhurst, C., and Hamilton, P. B. 1986. 3'-oxolutein, a metabolite of lutein in chickens. *Poultry Science* 65(11): 2135-41.

Unrel Ulff-Moeller, Finn. formation of native iron in sediment-contaminated magma: i. a case study of the hanekammen complex on disko island, west greenland. *Geochim. Cosmochim. Acta (1990)* 54(1): 57-70

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.

Unrel Uo, M., Watari, F., Yokoyama, A., Matsuno, H., and Kawasaki, T. 1999. dissolution of nickel and tissue response observed by x-ray scanning analytical microscopy. *Biomaterials* 20(8): 747-55.

CP Uthus, E. O. and Poellot, R. A. 1995. dietary nickel (ni) and folic acid (fa) interact to affect folate and methionine metabolism. *FASEB Journal* 9(3): A448.

CP Uthus, E. O(A). 1999. compartmental model of orally administered nickel (ni) in rats. *FASEB Journal* 13(4 PART 1): A577.

No Oral Uthus, Eric O. and Poellot, Rhonda A. dietary folate affects the response of rats to nickel deprivation. *Biol. Trace Elem. Res. (1996)* 52(1): 23-35

No Oral Uthus, Eric O. and Poellot, Rhonda A. effect of nitrous oxide on nickel deprivation in rats. *Biol. Trace Elem. Res. (1993)* 38(1): 35-46

CP Uziel M^Butler A. additive toxic responses on exposure of hamster embryo cell to nickel ii and benzo a pyrene. *74th Annual Meeting of the American Society of Biological Chemists, San Francisco, Calif., USA, JUNE 5-9, 1983. FED PROC. 42 (7). 1983. Abstract 2057.*

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.

Imm Van Hoogstraten, Ingrid M. W., Boden, Dagmar, Von Blomberg, B. Mary E., Kraal, Georg, and Scheper, Rik J. persistent immune tolerance to nickel and chromium by oral administration prior to cutaneous sensitization. *J. Invest. Dermatol. (1992)* 99(5): 608-16

No Oral Van Hoogstraten, Ingrid M. W., Boos, Colin, Boden, Dagmar, Von Blomberg, Mary E., Scheper, Rik J., and Kraal, Georg. oral induction of tolerance to nickel sensitization in mice. *J. Invest. Dermatol. (1993)* 101(1): 26-31.

No Oral Van Hoogstraten, Intrid M. W., De Groot, Jan, Boden, Dagmar, Von Blomberg, B. Mary E., Kraal, Georg, and Scheper, Rik J. development of a concomitant nickel and chromium sensitization model in the guinea pig. *Int. Arch. Allergy Immunol. (1992)* 97(4): 258-66

In Vit van Rhee, A. M., van der Heijden, M. P., Beukers, M. W., IJzerman, A. P., Soudijn, W., and Nickel, P. 1994. novel competitive antagonists for p2 purinoceptors. *Eur J Pharmacol.* 268(1): 1-7.

In Vit Varnai, P., Osipenko, O. N., Vizi, E. S., and Spat, A. 1995. activation of calcium current in voltage-clamped rat glomerulosa cells by potassium ions. *Journal of Physiology* 483(Pt 1): 67-78.

Phys Vassilev, Peter P., Venkova, Kalina, Pencheva, Nevena, and Staneva-Stoytcheva, Dushka. changes in the contractile responses to carbachol and in the inhibitory effects of verapamil and nitrendipine on isolated smooth muscle preparations from rats subchronically exposed to cobalt(2+) and nickel(2+). *Arch. Toxicol. (1993)* 67(5): 330-7

Rev Venugopal, B. and Luckey, T. D. 1978.*Metal Toxicity in Mammals* 2

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.

FL Vodichenska, T. s. 1992. [the effect of chronic combined exposure to nickel and lead on the enzymatic indices in body uptake with the drinking water]. <original> vliianie na khronichnoto kombinirano vuzdeistvie s nikel i olovo vurkhu niakoi enzimni pokazateli pri postupvaneto im v organizm s piteinite vodi. *Problemi Na Khigienata* 17: 48-56.

FL Vodichenska, T. s. 1991. [experimental data on the biological effect of nickel and lead contained in the drinking water acting in combination]. <original> eksperimentalni danni za biologichniia efekt na nikela i olovoto, sudurzhashti se v piteinite vodi, pri kombinirano deistvie. *Problemi Na Khigienata* 16: 24-33.

FL Vodichenska, T. s. 1986. [toxic action of nickel when taken up by the body from the drinking water]. <original> vurkhu niakoi strani ot toksichnoto deistvie na nikela pri postupvaneto mu v organizma s piteinite vody. *Problemi Na Khigienata* 11: 14-24.

FL Vodichenska, T. s. and Budeva, B. 1993. [an experimental study of the atherogenic effect of the vanadium and nickel contained in drinking water when combined]. <original> eksperimentalno prouchvane vurkhu aterogenniia efekt na vanadiia i nikela, sudurzhashti se v piteinite vodi, pri kombinirano deistvie. *Problemi Na Khigienata* 18: 50-62.

FL Vodichenska, T. s. S. and Dinoeva, S. K. 1987. [experimental study of the atherogenic effect of nickel entering the body in drinking water]. <original> eksperimental'noe izuchenie aterogennogo effekta nikelia pri ego postuplenii v organizm s pit'evoi vodoi. *Gigiena i Sanitariia* (4): 69-71.

FL Vodichenska, Ts. toxic effect of nickel after its ingestion in drinking water. *Probl. Khig. (1986)* : 11, 14-24

FL Vodichenska, Ts. and Dinoeva, S. experimental study of atherogenic effects of nickel ingestion with drinking water. *Gig. Sanit. (1987)* (4): 69-71

FL Vodichenska, Ts. S. and Dinoeva, S. K. 1987. atherogenic effect of nickel ingested in drinking water. *Gigiena i Sanitariya* (4): 69-71.

FL Vodichenska, Z. and Razboinikov, F. content of some trace elements in blood and organs of rats with chronic nickel intoxication. *Khig. Zdraveopaz. (1985)* 28(4): 76-83

Phys Vogel Volker, Kramer Herbert J(A), Baecker Angela, Meyer-Lehnert Harald, Jelkmann Wolfgang, and Fandrey Joachim. 1997. effects of erythropoietin on endothelin-1 synthesis and the cellular calcium messenger system in vascular endothelial cells. *American Journal of Hypertension* 10(3): 289-296.

No Oral Vohr, H-W., Blumel, J., Blotz, A., Homey, B., and Ahr, H. J. an intra-laboratory validation of the integrated model for the differentiation of skin reactions (imds): discrimination between (photo)allergic and (photo)irritant skin reactions in mice. *Arch. Toxicol. (2000)* 73(10-11): 501-509

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.*

Imm Vreeburg, K. J., de Groot, K., van Hoogstraten, I. M., von Blomberg, B. M., and Scheper, R. J. 1991. successful induction of allergic contact dermatitis to mercury and chromium in mice. *International Archives of Allergy and Applied Immunology* 96(2)

Imm Vreeburg, K. J., Van Hoogstraten, I. M., Von Blomberg, B. M., de Groot, K., and Scheper, R. J. 1990 . oral induction of immunological tolerance to chromium in the guinea pig. *Journal of Dental Research* 69(10): 1634-9.

Mix Vyaizenen, G. and Budyanu, I. 1995. sapropel during finishing (of pigs). *Svinovodstvo (Moskva)* (5): 5-7.

Mix Vyaizenen, G., Savin, V., Tokar', A., Gulyaev, V., Zinkevich, V., Kuznetsova, I., Chugunova, Yu., Nikitina, Yu., Fedotov, A., and Marinets, R. 1997. reduction of the concentration of heavy metals in pork. *Svinovodstvo (Moskva)* (1): 18-22.

Unrel Vyaizenen, G. N., Tokar', A. I., Gulyaev, V. A, Marinets, R. M., and Struchkov, A. A. 1998. conifer extract for obtaining ecologically clean product. *Kormoproizvodstvo* (1): 28-29.

No Oral Waalkes, M. P., Kasprzak, K. S., Ohshima, M., and Poirier, L. A. 1985. protective effects of zinc acetate toward the toxicity of nickelous acetate in rats. *Toxicology* 34(1): 29-41.

No Oral WAALKES, M. P. and KLAASSEN, C. D. 1985. concentration of metallothionein in major organs of rats after administration of various metals. *Fundam Appl Toxicol; 5 (3). 473-477.*

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.

No Oral Waalkes, M. P. Liu J. Kasprzak K. S. and Diwan B. A. 2004. minimal influence of metallothionein over-expression on nickel carcinogenesis in mice. *Toxicol.Lett.* 153: 357-364.

Alt Wahlberg, J. E. and Maibach, H. I. 1981. sterile cutaneous pustules: a manifestation of primary irritancy? identification of contact pustulogens. *Journal of Investigative Dermatology* 76(5): 381-3.

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*

Mix Warner, R. D., Dorn, C. R., Blakeslee, J. R., Gerken, D. F., Gordon, J. C., and Angrick, E. J. zinc effects on nickel dermatitis in the guinea-pig. *Contact Dermatitis. 19 (2). 1988. 98-108.*

Herp Wasser, J. S. 1985.*Hibernation in the Northern Water Snake, Nerodia Sipedon: Seasonal Variations in Plasma and Tissue Chemistry (Plasma Spectrometry, Ectotherm)*

No Oral Watanabe, Chiho, Weiss, Bernard, Cox, Christopher, and Ziriax, John. modification by nickel of instrumental thermoregulatory behavior in rats. *Fundam. Appl. Toxicol. (1990)* 14(3): 578-88

Unrel Watkinson, W. P. and Gordon, C. J. 1993. caveats regarding the use of the laboratory rat as a model for acute toxicological studies: modulation of the toxic response via physiological and behavioral mechanisms. *Toxicology* 81(1): 15-31.

Surv Watras, C. J., Macfarlane, J., and Morel, F. M. M. 1985. nickel accumulation by scenedesmus and daphnia - food-chain transport and geochemical implications. *Canadian Journal Of Fisheries And Aquatic Sciences* 42(4): 724-730.

Unrel Watson, R. E. Jr, Hutchinson, R. K., Langub, M. C. Jr, Landis, J. W., Seksaria, S., Rainey, D. M., and Keil, L. C. 1994. colocalization of natriuretic peptide and estrogen receptor immunoreactivities in preoptic nuclei in the female rat. *Journal of Neuroendocrinology* 6(1): 79-87.

Bact Waugh, R. and Boxer, D. H. 1986. pleiotropic hydrogenase mutants of escherichia-coli-k12 - growth in the presence of nickel can restore hydrogenase activity. *Biochimie* 68(1): 157-166.

No Oral Webb, M. Heath J. C. and Hopkins T. 1972. intranuclear distribution of the inducing metal in primary rhabdomyosarcomata induced in the rat by nickel, cobalt and cadmium. *Br. J. Cancer 26: 274-278.*

No Oral Weber, A. J. and Kalil, R. E. 1983. the percentage of interneurons in the dorsal lateral geniculate nucleus of the cat and observations on several variables that affect the sensitivity of horseradish peroxidase as a retrograde marker. *Journal of Comparative Neurology* 220(3): 336-46.

No Oral Wehner, A. P., Dagle, G. E., and Busch, R. H. 1984. pathogenicity of inhaled nickel compounds in hamsters. *IARC Scientific Publications* (53): 143-51.

No Oral Wehner, A. P. Busch R. H. Olson R. J. and Craig D. K. 1975. chronic inhalation of nickel oxide and cigarette smoke by hamsters. *Am.Ind.Hyg.Assoc.J.* 36: 801-810.

CP Wellenreiter, R. H., Ullrey, D. E., and Miller, Elwyn Ritter. 1970. nutritional studies with nickel. *Trace Elem. Metab. Anim. Proc. WAAP World Ass. Anim. Prod.)/IBP (Int. Biol. Progr.) Int. Symp.* Meeting Date 1969, 52-8. Editor(s): Mills, Colin F. Publisher: Livingstone, London, Engl..

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.

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

Unrel Wever, D. J., Veldhuizen, A. G., Sanders, M. M., Schakenraad, J. M., and Van Horn JR. cytotoxic, allergic and genotoxic activity of a nickel-titanium alloy. *Biomaterials; 18 (16). 1997. 1115-1120.*

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.

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.

Unrel Williams Peter J, Pittman Quentin J, and Macvicar Brian A(A). 1993. blockade by funnel web toxin of a calcium current in the intermediate pituitary of the rat. *Neuroscience Letters* 157(2): 171-174.

Rev Williams, S. N. and McDowell, L. R. 1985. newly discovered and toxic elements. *Animal Feeding and Nutrition: Nutrition of Grazing Ruminants in Warm Climates.* 317-338.

Drug Wilson, C. L. 1970. experimental attempts to stimulate bone growth. *Journal of Bone and Joint Surgery* 52(5): 1033-40.

Unrel Wilson, M. J. and Berrow, M. L. 1978. the mineralogy and heavy metal content of some serpentinite soils in north-east scotland. *Chemie Der Erde.* 37: 181-205.

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 .

Mix Woggon, H., Klein, S., Plass, R., and Nickel, B. 1984. transformation reactions of special metals in organisms and in the environment .3. invivo reaction between mercury(ii)-chloride and monomethyl tin trichloride in rats. *Nahrung-Food* 28(9): 995-1002.

Rev Worth, J. hazardous waste: a health hazard for our wildlife. *The-Conservationist-39(4):43-47; 1985. 1985.*

In Vitro Wouterlood, F. G., Goede, P. H., Arts, M. P., and Groenewegen, H. J. 1992. simultaneous characterization of efferent and afferent connectivity, neuroactive substances, and morphology of neurons. *Journal of Histochemistry and Cytochemistry* 40(4): 457-65.

Unrel Wouterlood, F. G., Steinbusch, H. W., Luiten, P. G., and Bol, J. G. 1987. projection from the prefrontal cortex to histaminergic cell groups in the posterior hypothalamic region of the rat. anterograde tracing with phaseolus vulgaris leucoagglutinin combined with immunocytochemistry of histidine decarboxylase. *Brain Research* 406(1-2): 330-6.

Gene Wronska-nofer, T., Wisniewska-knypl, J. M., and Dziubaltowska, E. genotoxicity of cadmium and nickel as dependent on ethanol-induced cytochrome p-450: role of free radical mechanism. *Trace Elements and Electrolytes; 14 (2). 1997. 96-101.*

Drug Wu Changgui, Sun Bin, and Mao Baoling. 1998. the distribution of substance p in the lungs of asthmatic guinea pigs and the influence of dexamethasone on the distribution. *Zhonghua Jiehe He Huxi Zazhi* 21(1): 16-18.

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 Xian, Yuezhong, Xue, Jian, Zhang, Song, Ying, Xiangyang, and Jin, Litong. an ni(chitin)2 modified nitric oxide microsensor. *Fresenius' J. Anal. Chem. (1999)* 365(7): 587-591

No Oral Xie, J., Funakoshi, T., Shimada, H., and Kojima, S. 1995. effects of chelating agents on testicular toxicity in mice caused by acute exposure to nickel. *Toxicology* 103(3): 147-55.

No Oral Xie, Jimin, Funakoshi, Takayuki, and Kojima, Shoji. effects of chelating agents in protection against the toxicity of nickel. *Sagawa Sentan Kagaku Gijutsu Shinko Zaidan Josei Kenkyu Hokokusho (1996)* : Volume Date 1995, 8th, 58-65

No Oral Xie, Jimin, Funakoshi, Takayuki, Shimada, Hideaki, and Kojima, Shoji. comparative effects of chelating agents on pulmonary toxicity of systemic nickel in mice. *J. Appl. Toxicol. (1996)* 16(4): 317-324.

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 Yamaguchi, Masayoshi and Uematsu, T. effects of various metals on hepatic bile calcium excretion in rats : the stimulatory effect of zinc is mediated through acetylcholine action. *Res. Exp. Med. (1990)* 190(2): 145-51

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.

Carcin Yamashiro, S., Gilman, J. P. W., Basrur, P. K., and Abandowitz, H. M. 1978. growth and cytogenetic characteristics of nickel sulfide-induced rhabdomyosarcomas in rats. *Acta Pathologica Japonica* 28(3): 435-444.

No Oral Yan, Xue-Ming, Tao, Zheng-Qin, Liang, You-Yi, Chen, Xhen-Jia, Zhang, Jian-Shi, and Xu, Xin-Hua. effect of catecholamic acid on detoxication and distribution of nicl2 in mice and rats. *Zhongguo Yaoli Xuebao (1998)* 19(1): 80-84

Unrel Yang, C., Sun, Y., Dong, P., and Wang, H. 1994. experimental study of a new sutureless intraluminal graft with a shape-memory alloy ring. *Journal of Thoracic and Cardiovascular Surgery* 107(1): 191-5.

Acute Yawets, A., Alter, A., and Oron, U. 1984. biochemical and histological anomalies in the rat hepatic tissue following administration of bichromate and nickel in ionized form. *Toxicology.* 33(2): 145-55.

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.*

In Vit Yonemoto, J. 1991. teratogen prescreening using micromass culture of rat limb bud mesenchymal Cells. *31st Annual Meeting of the Japanese Teratology Society*

Phys Yongqia Zhou(A), Xuying Hu, Di Quyang, Jiesheng Huang, and Yuwen Wang. 1994. the novel behaviour of interactions between ni-2+ ion and human or bovine serum albumin. *Biochemical Journal* 304(1): 23-26.

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.

Unrel Yoshimura, M., Tsugawa, C., and Tsubota, N. 1994. [experimental study of an intratracheal stent made of shape memory alloy]. *[Zasshi]* 42(11): 2054-9.

Mix Young, R. W., Furr, A. K., Stoewsand, G. S., Bache, C. A., and Lisk, D. J. 1978. lead and other elements in tissues of guinea pigs fed crown vetch grown adjacent to a highway. *Cornell Veterinarian* 68(4): 521-9.

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

Meth Zaret Kenneth S(A) and Stevens Kimberly. 1995. expression of a highly unstable and insoluble transcription factor in escherichia coli: purification and characterization of the fork head homolog hnf3-alpha. *Protein Expression and Purification* 6(6): 821-825.

Gene Zeiger, Errol, Anderson, Beth, Haworth, Steve, Lawlor, Timothy, and Mortelmans, Kristien. salmonella mutagenicity tests: v. results from the testing of 311 chemicals. *Environ. Mol. Mutagen. (1992).* 19(Suppl. 21): 2-141 .

No Oral Zhang, Q., Kusaka, Y., Sato, K., Mo, Y., Fukuda, M., and Donaldson, K. toxicity of ultrafine nickel particles in lungs after intratracheal instillation. *Journal of Occupational Health; 40 (3). 1998. 171-176.*

Rev Zhang, Qifeng, Yang, Saili, Zhang, Xizhe, and Sha, Yin. relation of cytotoxicity and metal elements of coal dusts in various coal mines. *Gongye Weisheng Yu Zhiyebing (1987)* 13(5): 284-7

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

FL Zhigunova, A. T. some trace elements in organs and tissues of animals after their addition to the rations. *Sb. Nauchn. Rab. - Leningr. Vet. Inst. (1982)* : 71, 38-42.

FL Zhigunova, A. T. and Moiseev, S. Z. effect of chromium and nickel on some indexes of carbohydrate metabolism in rabbit blood. *Fiziol. Biokhim. Osn. Povysh. Prod. S-Kh. Zhivotn. (1983)* 33-6. Editor: 33-6. Editor(s): Bashkirov, B. A. Publisher: Leningr. Vet. Inst., Leningrad, USSR.

Fate Zhigunova, A. T. and Moiseev, S. Z. 1980. some indexes of carbohydrate metabolism in the liver and muscles of rabbits fed chromium and nickel in the diet. *Sb. Nauch. Tr. Leningr. Vet. In-t.*(64): 24-8.

Gene Zhuang, Zhixiong and Costa, Max. development of an 125i-postlabeling assay as a simple, rapid, and sensitive index of dna-protein cross-links. *Environ. Health Perspect. Suppl. (1994)* 102(SUPPL. 3): 301-4

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.

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.

Unrel Zurbruegg Heinz Robert(A), Wied Markus, Angelini Gianni D, and Hetzer Roland. 1999. reduction of intimal and medial thickening in sheathed vein grafts. *Annals of Thoracic Surgery* 68(1): 79-83.

This Page Intentionally Left Blank

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) - Nickel

---

March 2007

This page intentionally left blank

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Nickel

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/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
Biochemical																																																
1	5407	Oscar et al, 1995	Nickel chloride hexahydrate	24.69	Chicken (*Gallus domesticus*)	1	3	0/6/12	mg/kg diet	N	na	DLY	U	FD	28	d	21	d	JV	F	C	Lab	BIO	CHM	LIPD	WO	12.0		Y	1.98	N	0.09079	0.136		10	10	5	10	6	1	4	10	10	4	70
2	6885	Nielsen et al, 1975	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/50/250/2500	ng/g diet	N	na	NR	U	FD	3	w	1	d	JV	M	C	Lab	BIO	CHM	HMCT	BL	2500		Y	0.433	N	0.03375	0.195		10	10	5	10	6	1	4	10	10	4	70
3	6666	Ling and Leach, 1979	Nickel chloride	100	Chicken (*Gallus domesticus*)	1	6	0/300/500/700/900/1100	mg/kg diet	N	na	ADL	U	FD	3	w	1	d	JV	M	C	Lab	BIO	CHM	HMGL	BL	900	1100	Y	0.1179	N	0.01447	110	135	10	10	5	10	6	1	10	10	10	4	76
4	5345	Martinez and Diaz, 1996	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/123.5/247/494	mg/kg diet	N	na	ADL	U	FD	42	d	1	d	JV	M	C	Lab	BIO	CHM	HMGL	BL		124	Y	1.8901	N	0.08809		5.76	10	10	5	10	6	1	4	10	10	4	70
Behavior																																																
5	5407	Oscar et al, 1995	Nickel chloride hexahydrate	24.69	Chicken (*Gallus domesticus*)	1	3	0/6/12	mg/kg diet	N	na	DLY	U	FD	28	d	21	d	JV	F	C	Lab	BEH	FDB	FCNS	WO	12.0		Y	1.98	N	0.09079	0.136		10	10	5	10	6	4	4	10	10	4	73
6	5345	Martinez and Diaz, 1996	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/123.5/247/494	mg/kg diet	N	na	ADL	U	FD	42	d	1	d	JV	M	C	Lab	BEH	FDB	FCNS	WO	123.5	247	Y	1.8901	N	0.08809	5.76	11.5	10	10	5	10	6	4	10	10	10	4	79
Physiology																																																
7	60	Weber and Reid, 1968	Nickel acetate	100	Chicken (*Gallus domesticus*)	2	8	0/3.04/9.25/13.68/14.61/15.86/16.21/17.25	mg/org/d	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	PHY	PHY	FDCV	WO	13.7	14.6	Y	0.484	Y	0.001	28.3	30.2	10	10	5	5	7	4	10	10	10	4	75
8	60	Weber and Reid, 1968	Nickel sulfate	100	Chicken (*Gallus domesticus*)	1	8	0/3.11/9.61/13.32/14.14/14.50/14.71/17.07	mg/org/d	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	PHY	PHY	META	WO	14.5	14.71	Y	0.467	Y	0.001	31.0	31.5	10	10	5	10	7	4	10	10	10	4	80
Pathology																																																
9	6885	Nielsen et al, 1975	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/50/250/2500	ng/g diet	N	na	NR	U	FD	3	w	1	d	JV	M	C	Lab	PTH	ORW	SMIX	SK	2500		Y	0.433	N	0.03375	0.195		10	10	5	10	6	4	4	10	10	4	73
10	6461	Cain and Pafford, 1981	Nickel sulfate	100	Duck (*Anas platyrhynchos*)	1	4	0/176/774/1069	mg/kg diet	N	na	ADL	M	FD	28	d	1	d	JV	B	C	Lab	PTH	ITX	ATAX	WO	176	774	Y	1.023	N	0.05907	10.7	47.0	10	10	10	10	6	4	8	10	10	4	82
11	5345	Martinez and Diaz, 1996	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/123.5/247/494	mg/kg diet	N	na	ADL	U	FD	42	d	1	d	JV	M	C	Lab	PTH	HIS	GHIS	HE	247	494	Y	1.7285	N	0.08311	11.9	23.8	10	10	5	10	6	4	10	10	10	4	79
Reproduction																																																
12	6492	Eastin and O'Shea, 1981	Nickel sulfate	100	Duck (*Anas platyrhynchos*)	1	5	0/12.5/50/200/800	mg/kg diet	N	na	ADL	U	FD	90	d	20	mo	LB	F	V	Lab	REP	REP	HTCH	EG	800		N	1.1	Y	0.20470	149		10	10	5	10	6	10	4	1	10	4	70
13	2771	Meluzzi et al, 1996	Nickel sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/100/300/500	mg/kg diet	N	na	NR	U	FD	60	d	22	w	LB	F	C	Lab	REP	EGG	ESWT	EG		100	N	1.6	Y	0.1306		8.16	10	10	5	10	6	10	4	10	6	4	75
Growth																																																
14	5407	Oscar et al, 1995	Nickel chloride hexahydrate	24.69	Chicken (*Gallus domesticus*)	1	3	0/6/12	mg/kg diet	N	na	DLY	U	FD	28	d	21	d	JV	F	C	Lab	GRO	GRO	BDWT	WO	12.0		Y	1.98	N	0.09079	0.136		10	10	5	10	6	8	4	10	10	4	77
15	6885	Nielsen et al, 1975	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/50/250/2500	ng/g diet	N	na	NR	U	FD	3	w	1	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	2500		Y	0.433	N	0.03375	0.195		10	10	5	10	6	8	4	10	10	4	77
16	5345	Martinez and Diaz, 1996	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/123.5/247/494	mg/kg diet	N	na	ADL	U	FD	42	d	1	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	123.5	247	Y	1.8901	N	0.08809	5.76	11.5	10	10	5	10	6	8	10	10	10	4	83
17	397	Hill, 1979	Nickelous chloride	45.29	Chicken (*Gallus domesticus*)	1	3	0/400/800	mg/kg diet	N	na	ADL	U	FD	5	w	1	d	JV	F	C	NR	GRO	GRO	BDWT	WO	400	800	N	1.042	N	0.05978	8.95	17.9	10	10	5	10	5	8	10	10	10	4	82
18	36697	Blalock and Hill, 1985	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/400	mg/kg diet	N	na	ADL	U	FD	25	d	1	d	JV	B	C	Lab	GRO	GRO	BDWT	WO	400		N	1.042	N	0.05978	22.9		10	10	5	10	5	8	4	1	10	4	67
19	60	Weber and Reid, 1968	Nickel acetate	100	Chicken (*Gallus domesticus*)	2	8	0/3.04/9.25/13.68/14.61/15.86/16.21/17.25	mg/org/d	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	GRO	GRO	BDWT	WO	13.7	14.6	Y	0.484	Y	0.001	28.3	30.2	10	10	5	5	7	8	10	10	10	4	79
20	60	Weber and Reid, 1968	Nickel sulfate	100	Chicken (*Gallus domesticus*)	1	8	0/3.11/9.61/13.32/14.14/14.50/14.71/17.07	mg/org/d	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	GRO	GRO	BDWT	WO	14.5	14.71	Y	0.467	Y	0.001	31.0	31.5	10	10	5	10	7	8	10	10	10	4	84
21	397	Hill, 1979	Nickelous chloride	45.29	Chicken (*Gallus domesticus*)	1	3	0/400/800	mg/kg diet	N	na	ADL	U	FD	5	w	1	d	JV	F	C	NR	GRO	GRO	BDWT	WO		400	N	1.042	N	0.05978		8.95	10	10	5	10	5	8	4	10	10	4	76
22	6461	Cain and Pafford, 1981	Nickel sulfate	100	Duck (*Anas platyrhynchos*)	1	4	0/176/774/1069	mg/kg diet	N	na	ADL	M	FD	60	d	1	d	JV	F	C	Lab	GRO	MPH	HULT	HM		176	Y	1.023	N	0.05907		10.7	10	10	10	10	6	8	4	10	10	4	82
23	6666	Ling and Leach, 1979	Nickel chloride	100	Chicken (*Gallus domesticus*)	1	6	0/300/500/700/900/1100	mg/kg diet	N	na	ADL	U	FD	3	w	1	d	JV	M	C	Lab	GRO	GRO	BDWT	WO		300	Y	0.4046	N	0.03229		23.9	10	10	5	10	6	8	4	10	10	4	77
24	36708	Hill, 1985	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/400	mg/kg diet	N	na	ADL	U	FD	19	d	NR	NR	JV	B	C	Lab	GRO	GRO	BDWT	WO		400	N	0.0397	N	0.00712		71.8	10	10	5	10	5	8	4	10	10	4	76
Survival																																																
25	6461	Cain and Pafford, 1981	Nickel sulfate	100	Duck (*Anas platyrhynchos*)	1	4	0/176/774/1069	mg/kg diet	N	na	ADL	M	FD	30	d	1	d	JV	B	C	Lab	MOR	MOR	SURV	WO	176	774	Y	1.023	N	0.05907	10.7	47.0	10	10	10	10	6	9	8	10	10	4	87
26	36697	Blalock and Hill, 1985	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	2	0/400	mg/kg diet	N	na	ADL	U	FD	25	d	1	d	JV	B	C	Lab	MOR	MOR	MORT	WO	400		N	1.042	N	0.05978	22.9		10	10	5	10	5	9	4	10	10	4	77
27	5345	Martinez and Diaz, 1996	Nickel chloride hexahydrate	100	Chicken (*Gallus domesticus*)	1	4	0/123.5/247/494	mg/kg diet	N	na	ADL	U	FD	42	d	1	d	JV	M	C	Lab	MOR	MOR	MORT	WO	494		Y	1.8901	N	0.08809	23.0		10	10	5	10	6	9	4	1	10	4	69
28	6666	Ling and Leach, 1979	Nickel chloride	100	Chicken (*Gallus domesticus*)	1	6	0/300/500/700/900/1100	mg/kg diet	N	na	ADL	U	FD	3	w	1	d	JV	M	C	Lab	MOR	MOR	SURV	WO	300	500	Y	0.4046	N	0.03229	23.9	39.9	10	10	5	10	6	9	10	10	10	4	84
Data Not Used to Derive TRV																																																
29	2771	Meluzzi et al, 1996	Nickel sulfate	100	Chicken (*Gallus domesticus*)	1	4	0/100/300/500	mg/kg diet	N	na	NR	U	FD	75	d	22	w	AD	F	C	Lab	BEH	FDB	FCNS	WO	500		N	1.6	Y	0.1306	40.8		10	10	5	10	6	4	4	1	6	4	60
30	6492	Eastin and O'Shea, 1981	Nickel sulfate	100	Duck (*Anas platyrhynchos*)	1	5	0/12.5/50/200/800	mg/kg diet	N	na	ADL	U	FD	90	d	20	mo	LB	F	V	Lab	BEH	FDB	FCNS	WO	800		N	1.1	Y	0.20470	149		10	10	5	10	6	4	4	1	6	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.

Appendix 6-1

Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Nickel

---

March 2007

This page intentionally left blank

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Nickel

Ref			Exposure																						Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	# 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	19671	Spears et al, 1984	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	3	0/5/25	mg/kg diet	N	na	ADL	U	FD	21	d	1	d	JV	NR	C	Lab	BIO	ENZ	ALPH	SR	5	25	Y	4.329	N	0.22912	0.265	1.32	10	10	5	10	6	1	8	10	10	4	74
2	19098	Chatterjee et al, 1979	Nickel sulfate hexahydrate	22.33	Rat (*Rattus norvegicus*)	2	0/1.5	mg/kg bw/d	N	na	NR	U	FD	21	d	NR	NR	JV	M	C	Lab	BIO	CHM	ASCA	LI	1.50		Y	0.0755	N	0.008215	0.335		10	10	5	10	10	1	4	10	10	4	74
3	19478	Nielsen, 1980	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	DLY	U	FD	10	w	NR	NR	JV	F	C	Lab	BIO	CHM	HMCT	PL	5.00	50.0	N	0.204	N	0.0186	0.456	4.56	10	10	5	10	5	1	8	10	10	4	73
4	19521	Pandey et al, 1999	Nickel sulfate	37.94	Mouse (*Mus musculus*)	3	0/3.57/7.14	mg/kg bw/d	N	na	5 per w	U	GV	35	d	NR	NR	JV	M	C	Lab	BIO	ENZ	LADH	TE	3.57	7.14	Y	0.025	N	0.00331	1.35	2.71	10	8	10	10	10	1	10	10	10	4	83
5	19666	Spears and Hatfield, 1985	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	3	0/15/225	mg/kg diet	N	na	ADL	U	FD	21	d	NR	NR	JV	M	C	Lab	BIO	CHM	LEUK	BL	15	225	Y	0.137	N	0.01341	1.47	22.0	10	10	5	10	6	1	6	10	10	4	72
6	14477	O'Dell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	4	0/62.5/250/1000	mg/kg diet	N	na	DLY	U	FD	8	w	14	w	JV	M	C	Lab	BIO	CHM	CALC	NR	250	1000	Y	180.8	Y	1.180	1.63	6.53	10	10	5	10	7	1	8	10	10	4	75
7	19290	Kadiiska et al, 1985	Nickel sulfate hexahydrate	22.33	Rat (*Rattus norvegicus*)	2	0/20	mg/kg bw/d	N	na	DLY	U	DR	30	d	NR	NR	JV	M	C	Lab	BIO	ENZ	P450	LI	20.0		Y	0.175	N	0.02062	4.47		10	5	5	10	10	1	4	8	10	4	67
8	19507	Obone et al, 1999	Nickel sulfate	100	Rat (*Rattus norvegicus*)	4	0/44.7/111.75/223.5	mg/L	N	na	ADL	U	DR	13	w	NR	NR	JV	M	C	Lab	BIO	CHM	PRTL	PL	44.7	112	Y	0.55	N	0.0578	4.70	11.7	10	5	5	10	6	1	10	10	10	4	71
9	14476	ODell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	3	0/365/1835	mg/org/d	N	na	1 per d	U	FD	6	w	NR	NR	LC	F	C	NR	BIO	CHM	PRTL	MK	1835		N	272	Y	7.350	6.75		10	10	5	10	6	1	4	10	10	4	70
10	62	Smith et al, 1993	Nickel chloride	100	Rat (*Rattus norvegicus*)	4	0/1.33/6.8/31.63	mg/kg bw/d	N	na	ADL	M	DR	26	w	62	d	LC	F	C	Lab	BIO	CHM	GBCM	PL	6.80	31.6	Y	0.3325	Y	0.06389	6.80	31.6	10	5	10	10	10	1	8	10	10	4	78
11	19514	Oosting et al, 1991	Nickel chloride	100	Rat (*Rattus norvegicus*)	3	0/49.5/104.9	mg/kg diet	N	na	ADL	M	FD	28	d	31	d	JV	M	C	Lab	BIO	CHM	HMGL	BL	105		N	0.217	Y	0.01610	7.78		10	10	10	10	6	1	4	10	10	4	75
12	19514	Oosting et al, 1991	Nickel chloride	100	Rat (*Rattus norvegicus*)	2	0/100	mg/kg diet	N	na	ADL	M	FD	28	d	31	d	JV	M	C	Lab	BIO	CHM	HMGL	BL	100		N	0.217	Y	0.0178	8.20		10	10	10	10	6	1	4	10	10	4	75
13	63	Whanger, 1973	Nickel acetate	100	Rat (*Rattus norvegicus*)	4	0/100/500/1000	mg/kg diet	N	na	DLY	U	FD	6	w	35	d	JV	NR	C	Lab	BIO	CHM	HMGL	BL	100	500	Y	0.163	N	0.01547	9.49	47.4	10	10	5	5	6	1	8	10	10	4	69
14	19460	Nation et al, 1985	Nickel Chloride	100	Rat (*Rattus norvegicus*)	3	0/10/20	mg/kg bw/d	N	na	DLY	U	FD	14	d	80	d	JV	M	C	Lab	BIO	CHM	GBCM	LI	20.0		Y	0.1867	N	0.0173	20.0		10	10	5	10	10	1	4	10	10	4	74
15	19764	Uthus and Poellot, 1997	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	2	0/1	ug/g diet	N	na	DLY	U	FD	57	d	NR	NR	JV	M	C	Lab	BIO	ENZ	GENZ	LI		1	Y	0.315	N	0.0265808		0.0844	10	10	5	10	6	1	4	10	10	4	70
16	19664	Spears et al, 1986	Nickel chloride	100	Cattle (*Bos taurus*)	2	0/5	mg/org/d	N	na	DLY	U	GV	4	w	5	mo	JV	F	C	FieldA	BIO	CHM	AMMO	GT		5	Y	247.6	Y	5.00		0.101	10	10	5	10	7	1	4	10	10	4	71
17	19437	Milne et al, 1990	Nickel Chloride hexahydrate	100	Sheep (*Ovis aries*)	2	0/5	mg/org/d	N	na	DLY	U	GV	4	w	5	mo	JV	F	C	Lab	BIO	ENZ	GENZ	SH		5.00	Y	34	N	1.247		0.147	10	8	10	10	6	1	4	10	10	4	73
18	19461	Nielsen et al, 1979	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	DLY	U	FD	9	w	21	d	JV	F	C	Lab	BIO	CHM	HMCT	BL		5.00	N	0.204	N	0.0186		0.456	10	10	5	10	5	1	4	10	10	4	69
19	19522	Pandey and Singh, 1999	Nickel sulfate hexahydrate	22.33	Mouse (*Mus musculus*)	3	0/3.57/7.14	mg/kg bw/d	N	na	5 per w	U	GV	35	d	NR	NR	JV	M	C	Lab	BIO	ENZ	LADH	TE		3.57	Y	0.02	N	0.00276		0.797	10	8	5	10	10	1	4	10	10	4	72
20	19666	Spears and Hatfield, 1985	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	2	0/30	mg/kg diet	N	na	ADL	U	FD	42	d	NR	NR	JV	M	C	Lab	BIO	CHM	HMGL	BL		30	Y	0.253	N	0.02220		2.63	10	10	5	10	6	1	4	10	10	4	70
21	19746	Tandon and Mathur, 1986	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/3	mg/kg bw/d	N	na	DLY	U	GV	4	w	NR	NR	JV	M	C	Lab	BIO	ENZ	MADH	KI		3	Y	0.15	N	0.01444		3.00	10	8	10	10	10	1	4	10	10	4	77
22	19787	Vyskocil et al, 1994	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/6.25	mg/kg bw/d	N	na	ADL	U	DR	6	mo	10	w	JV	M	C	Lab	BIO	CHM	ALBM	UR		6.25	Y	0.5	Y	0.03120		6.25	10	5	5	10	7	1	4	10	10	4	66
23	19496	Novelli et al, 1998	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/2.97	mg/org/d	N	na	ADL	U	DR	2	mo	15	w	JV	M	C	Lab	BIO	ENZ	AATT	SR		2.97	Y	0.2	Y	0.0238		12.5	10	5	5	10	7	1	4	10	10	4	66
24	19792	Waltschewa et al, 1972	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/25	mg/kg bw/d	N	na	DLY	U	GV	120	d	5	mo	JV	M	C	Lab	BIO	ENZ	GENZ	TE		25	Y	0.12	N	0.012024		25.0	10	8	10	10	10	1	4	10	10	4	77
25	61	Dieter et al, 1988	Nickel sulfate	37.4	Mouse (*Mus musculus*)	4	0/115.7/285.7/395.7	mg/kg bw/d	N	na	ADL	UX	DR	180	d	6-8	w	JV	F	C	Lab	BIO	ENZ	G6PD	BM		116	Y	0.03	Y	0.00347		43.3	10	5	10	10	7	1	4	10	10	4	71
26	19416	Mathur, 1987	Nickel sulphate hexahydrate	100	Rat (*Rattus norvegicus*)	2	0/500	mg/kg diet	N	na	ADL	U	FD	3	w	3	w	JV	M	C	Lab	BIO	ENZ	GOTR	LI		500	N	0.235	N	0.02089		44.5	10	10	5	10	5	1	4	10	10	4	69
27	14485	Weber and Reid, 1969	Nickel acetate	100	Mouse (*Mus musculus*)	3	0/4.143/6.143	mg/org/d	N	na	ADL	U	FD	4	w	NR	NR	JV	B	C	Lab	BIO	ENZ	CCOX	LI		4.143	Y	0.0232	Y	0.004590		179	10	10	5	5	7	1	4	10	10	4	66
Behavior																																														
28	19664	Spears et al, 1986	Nickel chloride	100	Cattle (*Bos taurus*)	2	0/5	mg/kg diet	N	na	2 per d	U	FD	140	d	50	d	JV	M	C	FieldA	BEH	FDB	FCNS	WO	5		Y	247.6	Y	5.00	0.101		10	10	5	10	7	4	4	8	10	4	72
29	14477	O'Dell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	4	0/62.5/250/1000	mg/kg diet	N	na	DLY	U	FD	8	w	14	w	JV	M	C	Lab	BEH	FDB	FCNS	WO	250	1000	Y	180.8	Y	1.180	1.63	6.53	10	10	5	10	7	4	8	10	10	4	78
30	136	Gershbein et al, 1983	Nickelous chloride	100	Rat (*Rattus norvegicus*)	2	0/75	mg/kg diet	N	na	ADL	U	FD	80	d	44	d	JV	M	C	Lab	BEH	BEH	NMVM	WO	75		Y	0.4700	N	0.03693	5.89		10	10	5	10	6	4	4	3	10	4	66
31	19787	Vyskocil et al, 1994	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/6.25	mg/kg bw/d	N	na	ADL	U	DR	6	mo	10	w	JV	M	C	Lab	BEH	FDB	WCON	WO	6.25		Y	0.5	Y	0.03120	6.25		10	5	5	10	7	4	4	10	10	4	69
32	62	Smith et al, 1993	Nickel chloride	100	Rat (*Rattus norvegicus*)	4	0/1.33/6.8/31.63	mg/kg bw/d	N	na	ADL	M	DR	11	w	62	d	LC	F	C	Lab	BEH	FDB	WCON	WO	6.80	31.6	Y	0.2732	Y	0.03079	6.80	31.63	10	5	10	10	10	4	8	10	10	4	81
33	14479	O'Dell et al, 1971	Nickelous carbonate	100	Cattle (*Bos taurus*)	4	0/1.8/7.0/14.6	mg/kg bw/d	N	na	DLY	UX	FD	8	w	13-21	w	JV	M	C	NR	BEH	FDB	FCNS	WO	7.00	14.6	Y	183.8	Y	5.100	7.00	14.6	10	10	10	10	10	4	10	10	10	4	88
34	19514	Oosting et al, 1991	Nickel chloride	100	Rat (*Rattus norvegicus*)	3	0/49.5/104.9	mg/kg diet	N	na	ADL	M	FD	28	d	31	d	JV	M	C	Lab	BEH	FDB	FCNS	WO	105		N	0.217	Y	0.0161	7.78		10	10	10	10	6	4	4	10	10	4	78
35	19514	Oosting et al, 1991	Nickel chloride	100	Rat (*Rattus norvegicus*)	2	0/100	mg/kg diet	N	na	ADL	M	FD	28	d	31	d	JV	M	C	Lab	BEH	FDB	FCNS	WO	100		N	0.217	Y	0.0178	8.20		10	10	10	10	6	4	4	10	10	4	78
36	19460	Nation et al, 1985	Nickel Chloride	100	Rat (*Rattus norvegicus*)	3	0/10/20	mg/kg bw/d	N	na	DLY	U	FD	14	d	80	d	JV	M	C	Lab	BEH	BEH	ACTP	WO	10.0	20.0	Y	0.1833	N	0.0170	10.0	20.0	10	10	5	10	10	4	10	10	10	4	83
37	36694	Alexander et al, 1978	Nickel chloride hexahydrate	100	Meadow vole (*Microtus pennsylvanicus*)	4	0/21/187/1968	mg/kg diet	N	na	ADL	M	FD	49	d	14	d	JV	NR	C	Lab	BEH	FDB	FCNS	WO	187	1968	Y	0.035	Y	0.0055	29.4	309	10	10	10	10	7	4	6	10	10	4	81
38	61	Dieter et al, 1988	Nickel sulfate	37.4	Mouse (*Mus musculus*)	4	0/115.7/285.7/395.7	mg/kg bw/d	N	na	ADL	UX	DR	180	d	6-8	w	JV	F	C	Lab	BEH	FDB	WCON	WO	116	286	Y	0.03	Y	0.00347	43.3	107	10	5	10	10	7	4	10	10	10	4	80
39	14485	Weber and Reid, 1969	Nickel acetate	100	Mouse (*Mus musculus*)	3	0/4.143/6.143	mg/org/d	N	na	ADL	U	FD	4	w	NR	NR	JV	M	C	Lab	BEH	FDB	FCNS	WO	4.143	6.143	Y	0.0232	Y	0.004590	179	265	10	10	5	5	7	4	4	10	10	4	75
40	36331	Cempel and Janicka, 2002	Nickel chloride hexahydrate	100	Rat (Rattus norvegicus)	3	0/7.9/29.0	mg/org/d	N	na	ADL	U	DR	90	d	NR	NR	JV	M	C	Lab	BEH	FDB	WCON	WO		7.9	Y	0.21	Y	0.0000263		37.6	10	5	5	10	7	4	4	10	10	4	69
Physiology																																														
41	19729	Szakmary et al, 1995	Nickelous chloride	45.29	Rat (*Rattus norvegicus*)	2	0/3	mg/kg bw/d	N	na	DLY	U	GV	8	d	NR	NR	GE	F	C	Lab	PHY	PHY	BLPR	HE	3		Y	0.263	N	0.02292	1.36		10	8	10	10	10	4	4	10	10	4	80
42	14479	O'Dell et al, 1971	Nickelous carbonate	100	Cattle (*Bos taurus*)	4	0/1.8/7.0/14.6	mg/kg bw/d	N	na	DLY	UX	FD	8	w	13	w	JV	M	C	NR	PHY	PHY	EXCR	UR	1.80	7.00	Y	198	Y	5.800	1.80	7.00	10	10	10	10	10	4	8	10	10	4	86
43	19507	Obone et al, 1999	Nickel sulfate	100	Rat (*Rattus norvegicus*)	4	0/44.7/111.75/223.5	mg/L	N	na	ADL	U	DR	13	w	NR	NR	JV	M	C	Lab	PHY	PHY	EXCR	UR	44.7	112	Y	0.55	N	0.0578	4.70	11.7	10	5	5	10	6	4	10	10	10	4	74
44	14477	O'Dell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	4	0/62.5/250/1000	mg/kg diet	N	na	DLY	U	FD	8	w	14	w	JV	M	C	Lab	PHY	PHY	DIFD	WO	1000		Y	180.08	Y	1.180	6.55		10	10	5	10	7	4	4	10	10	4	74
45	14476	ODell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	3	0/365/1835	mg/org/d	N	na	1 per d	U	FD	6	w	NR	NR	LC	F	C	NR	PHY	PHY	GPHY	MK	1835		N	272	Y	7.350	6.75		10	10	5	10	6	4	4	10	10	4	73
Pathology																																														
46	19098	Chatterjee et al, 1979	Nickel sulfate hexahydrate	22.33	Rat (*Rattus norvegicus*)	2	0/1.5	mg/kg bw/d	N	na	NR	U	FD	21	d	NR	NR	JV	M	C	Lab	PTH	ORW	SMIX	LI	1.50		Y	0.0755	N	0.008215	0.335		10	10	5	10	10	4	4	10	10	4	77
47	19478	Nielsen, 1980	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	DLY	U	FD	10	w	NR	NR	JV	F	C	Lab	PTH	ORW	SMIX	LI	5.00	50.0	N	0.204	N	0.0186	0.456	4.56	10	10	5	10	5	4	8	10	10	4	76
48	14477	O'Dell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	4	0/62.5/250/1000	mg/kg diet	N	na	DLY	U	FD	8	w	14	w	JV	M	C	Lab	PTH	ORW	ORWT	LU	250	1000	Y	180.08	Y	1.180	1.64	6.55	10	10	5	10	7	4	8	10	10	4	78
49	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Rat (*Rattus norvegicus*)	4	0/100/1000/2500	mg/kg diet	N	na	ADL	U	FD	24	mo	28	d	JV	B	C	Lab	PTH	ORW	SMIX	HE	100	1000	Y	0.409	N	0.0329	8.06	80.6	10	10	5	10	6	4	8	10	10	4	77
50	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Dog (*Canis familiaris*)	4	0/100/1000/2500	mg/kg diet	N	na	1 per d	U	FD	24	mo	6	mo	JV	B	C	Lab	PTH	ORW	SMIX	KI	1000	2500	N	10.8	N	0.4858	45.0	112	10	10	5	10	5	4	10	10	10	4	78
51	1858	Schroeder and Mitchener, 1975	Nickelous acetate	100	Mouse (*Mus musculus*)	2	0/5	mg/L	N	na	NR	U	DR	520	d	19-20	d	JV	M	C	Lab	PTH	HIS	EDMA	WO		5.00	Y	0.029	N	0.004091		0.705	10	5	5	10	6	4	4	10	10	4	68
52	19521	Pandey et al, 1999	Nickel sulfate	37.94	Mouse (*Mus musculus*)	3	0/3.57/7.14	mg/kg bw/d	N	na	5 per w	U	GV	35	d	NR	NR	JV	M	C	Lab	PTH	ORW	ORWT	PG		3.57	Y	0.025	N	0.00331		1.35	10	8	10	10	10	4	4	10	10	4	80
53	19293	Kakela et al, 1999	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	3	0/30/100	mg/L	N	na	ADL	U	DR	62	d	3.5-9	mo	GE	F	C	Lab	PTH	ORW	SMIX	LI		30.0	Y	0.257	N	0.02915		3.40	10	5	5	10	6	4	4	10	10	4	68
54	19507	Obone et al, 1999	Nickel sulfate	100	Rat (*Rattus norvegicus*)	4	0/44.7/111.75/223.5	mg/L	N	na	ADL	U	DR	13	w	NR	NR	JV	M	C	Lab	PTH	ORW	ORWT	HE		44.7	Y	0.55	N	0.0578		4.70	10	5	5	10	6	4	4	10	10	4	68

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Nickel

Ref			Exposure																						Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	# 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
55	14484	Schroeder et al, 1974	Nickel	100	Rat (*Rattus norvegicus*)	2	0/5.44	mg/kg bw/d	N	na	DLY	M	DR	1217	d	30	d	JV	B	C	Lab	PTH	HIS	GHIS	HE		5.44	Y	0.397	Y	0.027290		5.44	10	5	10	4	10	4	4	10	10	4	71
56	19787	Vyskocil et al, 1994	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/6.25	mg/kg bw/d	N	na	ADL	U	DR	6	mo	10	w	JV	M	C	Lab	PTH	ORW	SMIX	KI		6.25	Y	0.5	Y	0.03120		6.25	10	5	5	10	7	4	4	10	10	4	69
57	61	Dieter et al, 1988	Nickel sulfate	37.4	Mouse (*Mus musculus*)	4	0/115.7/285.7/395.7	mg/kg bw/d	N	na	ADL	UX	DR	180	d	6-8	w	JV	F	C	Lab	PTH	ORW	ORWT	LI		116	Y	0.03	Y	0.00347		43.3	10	5	10	10	7	4	4	10	10	4	74
58	113	Seidenberg et al, 1986	Nickelous chloride	45.29	Mouse (*Mus musculus*)	2	0/200	mg/kg bw/d	N	na	DLY	U	GV	4	d	NR	NR	GE	F	C	Lab	PTH	GRS	BDWT	WO		200	Y	0.0392	N	0.00479		90.6	10	8	10	10	10	4	4	10	10	4	80
Reproduction																																															
59	19293	Kakela et al, 1999	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	4	0/10/30/100	mg/L	N	na	ADL	U	DR	28	d	3.5-9	mo	SM	M	C	Lab	REP	REP	GIDX	WO	10.0	30.0	Y	0.3379	N	0.03729	1.10	3.31	10	5	5	10	6	10	10	10	10	4	80
60	36722	Pandey and Srivastava, 2000	Nickel sulfate	37.93	Mouse (*Mus musculus*)	4	0/3.57/7.14/14.29	mg/kg bw/d	N	na	5 per w	U	OR	35	d	NR	mo	JV	M	C	Lab	REP	REP	SPCL	SM	7.14	14.29	Y	0.025	N	0.00331	1.35	2.71	10	8	10	10	10	10	10	10	10	4	92
61	36722	Pandey and Srivastava, 2000	Nickelous chloride	45.29	Mouse (*Mus musculus*)	4	0/3.57/7.14/14.29	mg/kg bw/d	N	na	5 per w	U	OR	35	d	NR	NR	JV	M	C	Lab	REP	REP	SPCL	SM	3.57	7.14	Y	0.025	N	0.00331	1.70	3.40	10	8	10	10	10	10	10	10	10	4	92
62	14480	Phatak and Patwardhan, 1950	Nickel carbonate	100	Rat (*Rattus norvegicus*)	4	0/.25/.5/1	mg/g diet	N	na	ADL	U	FD	4	mo	4	w	GE	F	C	Lab	REP	REP	PRWT	WO	1.00		Y	0.115	Y	0.001070	9.30		10	10	5	10	7	10	4	1	10	4	71
63	1260	Chernoff and Kavlock, 1982	Nickel chloride	45.29	Mouse (*Mus musculus*)	2	0/100	mg/kg bw/d	N	na	DLY	U	GV	5	d	60	d	GE	F	C	Lab	REP	REP	PROG	WO	100		N	0.0225	N	0.00304	45.3		10	8	10	10	10	10	4	10	10	4	86
64	19064	Berman and Rehnberg, 1983	Nickel chloride	100	Mouse (*Mus musculus*)	3	0/85.3/170.7	mg/kg bw/d	N	na	ADL	U	DR	15	d	NR	NR	GE	F	C	Lab	REP	REP	PRFM	WO	85.3	170.7	Y	0.0297	Y	5.387	85.3	171	10	5	5	10	7	10	10	10	10	4	81
65	113	Seidenberg et al, 1986	Nickelous chloride	45.29	Mouse (*Mus musculus*)	2	0/200	mg/kg bw/d	N	na	DLY	U	GV	4	d	NR	NR	GE	F	C	Lab	REP	REP	PRWT	WO	200		Y	0.0392	N	0.00479	90.6		10	8	10	10	10	10	4	6	10	4	82
66	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Dog (*Canis familiaris*)	4	0/100/1000/2500	mg/kg diet	N	na	1 per d	U	FD	24	mo	6	mo	JV	B	C	Lab	REP	REP	TEWT	TE	2500		N	10.8	N	0.4858	112		10	10	5	10	5	10	4	6	10	4	74
67	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Rat (*Rattus norvegicus*)	4	0/250/500/1000	mg/kg diet	N	na	DLY	U	FD	118	d	28	d	GE	F	C	Lab	REP	REP	PRWT	WO	500	1000	N	0.000156	N	0.0001	164	327	10	10	5	10	5	10	10	10	10	4	84
68	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Rat (*Rattus norvegicus*)	4	0/100/1000/2500	mg/kg diet	N	na	ADL	U	FD	2	yr	28	d	JV	M	C	Lab	REP	REP	TEWT	TE	2500		Y	0.367	N	0.0301	205		10	10	5	10	6	10	4	1	10	4	70
69	66	Schroeder and Mitchener, 1971	Nickel	100	Rat (*Rattus norvegicus*)	2	0/5	mg/L	N	na	ADL	U	DR	9	mo	21	d	GE	F	C	Lab	REP	REP	DEYO	WO		5.00	N	0.344	N	0.03789		0.551	10	5	5	4	5	10	4	10	10	4	67
70	19522	Pandey and Singh, 1999	Nickel sulfate hexahydrate	22.33	Mouse (*Mus musculus*)	3	0/3.57/7.14	mg/kg bw/d	N	na	5 per w	U	GV	35	d	NR	NR	JV	M	C	Lab	REP	REP	SPCV	SM		3.57	Y	0.02	N	0.00276		0.797	10	8	5	10	10	10	4	10	10	4	81
71	62	Smith et al, 1993	Nickel chloride	100	Rat (*Rattus norvegicus*)	4	0/1.33/6.8/31.63	mg/kg bw/d	N	na	ADL	M	DR	23	w	62	d	LC	F	C	Lab	REP	REP	DEYO	WO		1.33	Y	0.2689	Y	0.02479		1.33	10	5	10	10	10	10	4	10	10	4	83
72	19521	Pandey et al, 1999	Nickel sulfate	37.94	Mouse (*Mus musculus*)	3	0/3.57/7.14	mg/kg bw/d	N	na	5 per w	U	GV	35	d	NR	NR	JV	M	C	Lab	REP	REP	TEWT	TE		3.57	Y	0.025	N	0.00331		1.35	10	8	10	10	10	10	4	10	10	4	86
73	19520	Pandey et al, 1999	Nickel sulfate hexahydrate	22.33	Mouse (*Mus musculus*)	2	0/7.14	mg/kg bw/d	N	na	5 per w	U	GV	35	d	NR	NR	AD	M	V	Lab	REP	REP	RSUC	WO		7.14	Y	0.02	N	0.00276		1.59	10	8	10	10	10	10	4	10	10	4	86
74	19507	Obone et al, 1999	Nickel sulfate	100	Rat (*Rattus norvegicus*)	4	0/44.7/111.75/223.5	mg/L	N	na	ADL	U	DR	13	w	NR	NR	JV	M	C	Lab	REP	REP	TEWT	TE		44.7	Y	0.55	N	0.0578		4.70	10	5	5	10	6	10	4	10	10	4	74
75	19792	Waltschewa et al, 1972	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/25	mg/kg bw/d	N	na	DLY	U	GV	120	d	5	mo	JV	M	C	Lab	REP	REP	SPCL	SM		25	Y	0.12	N	0.012024		25.0	10	8	10	10	10	10	4	10	10	4	86
Growth																																														
76	19764	Uthus and Poellot, 1997	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	2	0/1	ug/g diet	N	na	DLY	U	FD	57	d	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	1		Y	0.315	N	0.0265808	0.0844		10	10	5	10	6	8	4	10	10	4	77
77	19664	Spears et al, 1986	Nickel chloride	100	Cattle (*Bos taurus*)	2	0/5	mg/kg diet	N	na	2 per d	U	FD	140	d	50	d	JV	M	C	FieldA	GRO	GRO	BDWT	WO	5		Y	247.6	Y	5.00	0.101		10	10	5	10	7	8	4	10	10	4	78
78	19098	Chatterjee et al, 1979	Nickel sulfate hexahydrate	22.33	Rat (*Rattus norvegicus*)	2	0/1.5	mg/kg bw/d	N	na	NR	U	FD	21	d	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	1.50		Y	0.0755	N	0.008215	0.335		10	10	5	10	10	8	4	10	10	4	81
79	19671	Spears et al, 1984	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	3	0/5/25	mg/kg diet	N	na	ADL	U	FD	49	d	1	d	JV	NR	C	Lab	GRO	GRO	BDWT	WO	25		Y	8.501	N	0.39901	1.17		10	10	5	10	6	8	4	10	10	4	77
80	62	Smith et al, 1993	Nickel chloride	100	Rat (*Rattus norvegicus*)	4	0/1.33/6.8/31.63	mg/kg bw/d	N	na	ADL	M	DR	15	w	62	d	LC	F	C	Lab	GRO	GRO	BDWT	WO	1.33	6.80	Y	0.3707	Y	0.02921	1.33	6.80	10	5	10	10	10	8	8	10	10	4	85
81	19729	Szakmary et al, 1995	Nickelous chloride	45.29	Rat (*Rattus norvegicus*)	2	0/3	mg/kg bw/d	N	na	DLY	U	GV	8	d	NR	NR	GE	F	C	Lab	GRO	GRO	BDWT	WO	3		Y	0.263	N	0.02292	1.36		10	8	10	10	10	8	4	10	10	4	84
82	19666	Spears and Hatfield, 1985	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	3	0/15/225	mg/kg diet	N	na	ADL	U	FD	21	d	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	15	225	Y	0.137	N	0.01341	1.47	22.0	10	10	5	10	6	8	6	10	10	4	79
83	14477	O'Dell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	4	0/62.5/250/1000	mg/kg diet	N	na	DLY	U	FD	8	w	14	w	JV	M	C	Lab	GRO	GRO	BDWT	WO	250	1000	Y	180.08	Y	1.180	1.64	6.55	10	10	5	10	7	8	8	10	10	4	82
84	19109	Cikrt et al, 1992	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	2	0/1.18	mg/org/d	N	na	ADL	U	DR	90	d	NR	NR	JV	F	C	Lab	GRO	GRO	BDWT	WO	1.18		Y	0.3978	N	0.04319	2.97		10	5	5	10	7	8	4	10	10	4	73
85	19479	Nielsen, 1980	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	DLY	U	FD	10	w	NR	NR	JV	F	C	Lab	GRO	GRO	BDWT	WO	50		N	0.204	N	0.0186	4.56		10	10	5	10	5	8	4	1	10	4	67
86	19461	Nielsen et al, 1979	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	DLY	U	FD	9	w	21	d	JV	F	C	Lab	GRO	GRO	BDWT	WO	50.00		N	0.204	N	0.0186	4.56		10	10	5	10	5	8	4	1	10	4	67
87	14484	Schroeder et al, 1974	Nickel	100	Rat (*Rattus norvegicus*)	2	0/5.44	mg/kg bw/d	N	na	DLY	M	DR	1217	d	30	d	JV	B	C	Lab	GRO	GRO	BDWT	WO	5.44		Y	0.397	Y	0.02779	5.44		10	5	10	4	10	8	4	10	10	4	75
88	136	Gershbein et al 1983	Nickelous chloride	100	Rat (*Rattus norvegicus*)	2	0/75	mg/kg diet	N	na	ADL	U	FD	80	d	44	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	75		Y	0.4700	N	0.03693	5.89		10	10	5	10	6	8	4	1	10	4	68
89	14476	ODell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	3	0/365/1835	mg/org/d	N	na	1 per d	U	FD	6	w	NR	NR	LC	F	C	NR	GRO	GRO	BDWT	WO	1835		N	272	Y	7.350	6.75		10	10	5	10	6	8	4	1	10	4	68
90	14479	O'Dell et al, 1971	Nickelous carbonate	100	Cattle (*Bos taurus*)	4	0/1.8/7.0/14.6	mg/kg bw/d	N	na	DLY	UX	FD	8	w	13-21	w	JV	M	C	NR	GRO	GRO	BDWT	WO	7.00	14.6	Y	183.8	Y	5.100	7.00	14.6	10	10	10	10	10	8	10	10	10	4	92
91	19514	Oosting et al, 1991	Nickel chloride	100	Rat (*Rattus norvegicus*)	3	0/49.5/104.9	mg/kg diet	N	na	ADL	M	FD	28	d	31	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	105		N	0.217	Y	0.0161	7.78		10	10	10	10	6	8	4	10	10	4	82
92	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Rat (*Rattus norvegicus*)	4	0/100/1000/2500	mg/kg diet	N	na	ADL	U	FD	6	w	28	d	JV	B	C	Lab	GRO	GRO	BDWT	WO	100	1000	Y	0.205	N	0.0187	9.11	91.1	10	10	5	10	6	8	8	10	10	4	81
93	14480	Phatak and Patwardhan, 1950	Nickel carbonate	100	Rat (*Rattus norvegicus*)	4	0/.25/.5/1	mg/g diet	N	na	ADL	U	FD	8	w	4	w	JV	B	C	Lab	GRO	GRO	BDWT	WO	1.00		Y	0.115	Y	0.001070	9.30		10	10	5	10	7	8	4	1	10	4	69
94	63	Whanger, 1973	Nickel acetate	100	Rat (*Rattus norvegicus*)	4	0/100/500/1000	mg/kg diet	N	na	DLY	U	FD	6	w	35	d	JV	NR	C	Lab	GRO	GRO	BDWT	WO	100	500	Y	0.163	N	0.01547	9.49	47.4	10	10	5	5	6	8	8	10	10	4	76
95	19293	Kakela et al, 1999	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	3	0/30/100	mg/L	N	na	ADL	U	DR	62	d	3.5-9	mo	GE	F	C	Lab	GRO	GRO	BDWT	WO	100		Y	0.2357	N	0.02696	11.4		10	5	5	10	6	8	4	8	10	4	70
96	19507	Obone et al, 1999	Nickel sulfate	100	Rat (*Rattus norvegicus*)	4	0/44.7/111.75/223.5	mg/L	N	na	ADL	U	DR	13	w	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	112	224	Y	0.575	N	0.0602	11.7	23.4	10	5	5	10	6	8	10	10	10	4	78
97	36694	Alexander et al, 1978	Nickel chloride hexahydrate	100	Meadow vole (*Microtus pennsylvanicus*)	3	0/18/100	mg/kg diet	N	na	ADL	U	FD	45	d	14	d	JV	NR	C	Lab	GRO	GRO	BDWT	WO	100		Y	0.0349	N	0.0043567	12.5		10	10	5	10	6	8	4	1	10	4	68
98	19460	Nation et al, 1985	Nickel Chloride	100	Rat (*Rattus norvegicus*)	3	0/10/20	mg/kg bw/d	N	na	DLY	U	FD	14	d	80	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	20.0		Y	0.1867	N	0.0173	20.0		10	10	5	10	10	8	4	1	10	4	72
99	36694	Alexander et al, 1978	Nickel chloride hexahydrate	100	Meadow vole (*Microtus pennsylvanicus*)	4	0/21/187/1968	mg/kg diet	N	na	ADL	M	FD	49	d	14	d	JV	NR	C	Lab	GRO	GRO	BDWT	WO	187	1968	Y	0.035	Y	0.0055	29.4	309	10	10	10	10	7	8	6	10	10	4	85
100	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Dog (*Canis familiaris*)	4	0/100/1000/2500	mg/kg diet	N	na	1 per d	U	FD	65	w	6	mo	JV	B	C	Lab	GRO	GRO	BDWT	WO	1000	2500	N	10.8	N	0.4858	45.0	112	10	10	5	10	5	8	10	10	10	4	82
101	1260	Chernoff and Kavlock, 1982	Nickel chloride	45.29	Mouse (*Mus musculus*)	2	0/100	mg/kg bw/d	N	na	DLY	U	GV	5	d	60	d	GE	F	C	Lab	GRO	GRO	BDWT	WO	100		N	0.0225	N	0.00001	45.3		10	8	10	10	10	8	4	1	10	4	82
102	19064	Berman and Rehnberg, 1983	Nickel chloride	100	Mouse (*Mus musculus*)	3	0/85.3/170.7	mg/kg bw/d	N	na	ADL	U	DR	15	d	NR	NR	GE	F	C	Lab	GRO	GRO	BDWT	WO	85.3	170.7	Y	0.0297	Y	5.387	85.3	171	10	5	5	10	7	8	10	10	10	4	79
103	61	Dieter et al, 1988	Nickel sulfate	37.4	Mouse (*Mus musculus*)	4	0/115.7/285.7/395.7	mg/kg bw/d	N	na	ADL	UX	DR	180	d	6-8	w	JV	F	C	Lab	GRO	GRO	BDWT	WO	286	396	Y	0.028	Y	0.0016	107	148	10	5	10	10	7	8	10	10	10	4	84
104	19666	Spears and Hatfield, 1985	Nickel chloride hexahydrate	100	Rat (*Rattus norvegicus*)	2	0/30	mg/kg diet	N	na	ADL	U	FD	21	d	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO		30	Y	0.175	N	0.01640		2.81	10	10	5	10	6	8	4	10	10	4	77
105	19514	Oosting et al, 1991	Nickel chloride	100	Rat (*Rattus norvegicus*)	2	0/100	mg/kg diet	N	na	ADL	M	FD	28	d	31	d	JV	M	C	Lab	GRO	GRO	BDWT	WO		100	N	0.217	Y	0.0178		8.20	10	10	10	10	6	8	4	10	10	4	82
106	19111	Clary, 1975	Nickel chloride	100	Rat (*Rattus norvegicus*)	2	0/225	mg/L	N	na	ADL	U	DR	4	mo	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO		225	Y	0.356	N	0.03908		24.7	10	5	5	10	6	8	4	10	10	4	72
107	14485	Weber and Reid, 1969	Nickel acetate	100	Mouse (*Mus musculus*)	3	0/4.143/6.143	mg/org/d	N	na	ADL	U	FD	4	w	NR	NR	JV	F	C	Lab	GRO	GRO	BDWT	WO		4.143	Y	0.0199	Y	0.003780		208	10	10	5	5	7	8	4	10	10	4	73
Survival																																														
108	19521	Pandey et al, 1999	Nickel sulfate	37.94	Mouse (*Mus musculus*)	3	0/3.57/7.14	mg/kg bw/d	N	na	5 per w	U	GV	35	d	NR	NR	JV	M	C	Lab	MOR	MOR	MORT	WO	7.14		Y	0.025	N	0.00331	2.71		10	8	10	10	10	9	4	10	10	4	85
109	19483	Nielsen et al 1982	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	ADL	U	FD	11	w	NR	NR	JV	F	C	Lab	MOR	MOR	MORT	WO	50.0		N	0.204	N	0.0186	4.56		10	10	5	10	5	9	4	10	10	4	77

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Nickel
Page 3 of 3

Ref			Exposure																						Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	# 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
110	36722	Pandey and Srivastava, 2000	Nickel sulfate	37.93	Mouse (*Mus musculus*)	4	0/3.57/7.14/14.29	mg/kg bw/d	N	na	5 per w	U	OR	35	d	NR	NR	JV	M	C	Lab	MOR	MOR	MORT	WO	14.29		Y	0.025	N	0.00331	5.42		10	8	10	10	10	9	4	10	10	4	85
111	36722	Pandey and Srivastava, 2000	Nickelous chloride	45.29	Mouse (*Mus musculus*)	4	0/3.57/7.14/14.29	mg/kg bw/d	N	na	5 per w	U	OR	35	d	NR	NR	JV	M	C	Lab	MOR	MOR	MORT	WO	14.29		Y	0.025	N	0.00331	6.47		10	8	10	10	10	9	4	10	10	4	85
112	36694	Alexander et al, 1978	Nickel chloride hexahydrate	100	Meadow vole (*Microtus pennsylvanicus*)	4	0/21/187/1968	mg/kg diet	N	na	ADL	M	FD	14	d	14	d	JV	NR	C	Lab	MOR	MOR	MORT	WO	187	1968	Y	0.035	Y	0.0055	29.4	309	10	10	10	10	7	9	6	10	10	4	86
113	1260	Chernoff and Kavlock, 1982	Nickel chloride	45.29	Mouse (*Mus musculus*)	2	0/100	mg/kg bw/d	N	na	DLY	U	GV	5	d	60	d	GE	F	C	Lab	MOR	MOR	MORT	WO	100		N	0.0225	N	0.00304	45.3		10	8	10	10	10	9	4	1	10	4	76
114	113	Seidenberg et al, 1986	Nickelous chloride	45.29	Mouse (*Mus musculus*)	2	0/200	mg/kg/bw/d	N	na	DLY	U	GV	4	d	NR	NR	GE	F	C	Lab	MOR	MOR	MORT	WO	200		Y	0.0392	N	0.00479	90.6		10	8	10	10	10	9	4	10	10	4	85
115	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Dog (*Canis familiaris*)	4	0/100/1000/2500	mg/kg diet	N	na	1 per d	U	FD	24	mo	6	mo	JV	B	C	Lab	MOR	MOR	MORT	WO	2500		N	10.8	N	0.4858	112		10	10	5	10	5	9	4	10	10	4	77
116	36331	Cempel and Janicka, 2002	Nickel chloride hexahydrate	100	Rat (Rattus norvegicus)	3	0/7.9/29.0	mg/org/d	N	na	ADL	U	DR	90	d	NR	NR	JV	M	C	Lab	MOR	MOR	MORT	WO	29		Y	0.21	Y	0.0000242	138		10	5	5	10	7	9	4	10	10	4	74
117	14474	Ambrose et al, 1976	Nickel sulfate hexahydrate	100	Rat (*Rattus norvegicus*)	4	0/100/1000/2500	mg/kg diet	N	na	ADL	U	FD	24	mo	28	d	JV	B	C	Lab	MOR	MOR	MORT	WO	2500		Y	0.367	N	0.0301	205		10	10	5	10	6	9	4	10	10	4	78
118	14447	Schroeder et al, 1964	Divalent Nickel	100	Mouse (*Mus musculus*)	2	0/5	mg/L	N	na	DLY	U	DR	16	mo	21	d	JV	B	C	Lab	MOR	MOR	SURV	WO		5.00	N	0.0375	Y	0.0047		0.62	10	5	5	10	6	9	4	10	10	4	73
119	1858	Schroeder and Mitchener, 1975	Nickelous acetate	100	Mouse (*Mus musculus*)	2	0/5	mg/L	N	na	NR	U	DR	520	d	19-20	d	AD	F	C	Lab	MOR	MOR	LFSP	WO		5.00	Y	0.025	N	0.003579		0.716	10	5	5	5	6	9	4	10	10	4	68
Data Not Used to Derive TRV																																														
120	19787	Vyskocil et al, 1994	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/6.25	mg/kg bw/d	N	na	ADL	U	DR	6	mo	10	w	JV	M	C	Lab	GRO	GRO	BDWT	WO	6.25		Y	0.5	Y	0.03120	6.25		10	5	5	10	7	8	4	1	10	4	64
121	1858	Schroeder and Mitchener, 1975	Nickelous acetate	100	Mouse (*Mus musculus*)	2	0/5	mg/L	N	na	NR	U	DR	520	d	19-20	d	JV	F	C	Lab	GRO	GRO	BDWT	WO	5.00		Y	0.0428	N	0.005807	0.678		10	5	5	5	6	8	4	6	10	4	63
122	19461	Nielsen et al, 1979	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	DLY	U	FD	9	w	21	d	JV	F	C	Lab	PTH	ORW	SMIX	LI	50.0		N	0.204	N	0.0186	4.56		10	10	5	10	5	4	4	1	10	4	63
123	19483	Nielsen et al 1982	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	ADL	U	FD	11	w	NR	NR	JV	F	C	Lab	BIO	CHM	LIPD	PL	50.0		N	0.204	N	0.0186	4.56		10	10	5	10	5	1	4	1	10	4	60
124	19479	Nielsen, 1980	Nickel chloride trihydrate	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	DLY	U	FD	10	w	NR	NR	JV	F	C	Lab	BIO	CHM	HMCT	BL	50		N	0.204	N	0.0186	4.56		10	10	5	10	5	1	4	1	10	4	60
125	15690	Nielsen et al, 1980	Nickel chloride	100	Rat (*Rattus norvegicus*)	3	0/5/50	ug/g diet	N	na	DLY	U	FD	10	w	NR	NR	JV	F	C	Lab	BIO	CHM	HMGL	BL	50.00		N	0.2024	N	0.018478	4.56		10	10	5	10	5	1	4	1	10	4	60
126	136	Gershbein et al, 1983	Nickelous chloride	100	Rat (*Rattus norvegicus*)	2	0/75	mg/kg diet	N	na	ADL	U	FD	80	d	44	d	JV	M	C	Lab	PTH	HIS	GHIS	MT	75		Y	0.4700	N	0.03693	5.89		10	10	5	10	6	4	4	1	10	4	64
127	14476	ODell et al, 1970	Nickelous carbonate	100	Cattle (*Bos taurus*)	3	0/365/1835	mg/org/d	N	na	1 per d	U	FD	6	w	NR	NR	LC	F	C	NR	BEH	FDB	FCNS	WO	1835		N	272	Y	7.300	6.75		10	10	5	10	6	4	4	1	10	4	64
128	36732	Tomokuni and Ichiba, 1990	Nickel nitrate hexahydrate	100	Mouse (*Mus musculus*)	2	0/57	mg/L	N	na	ADL	U	DR	12	d	NR	NR	JV	M	C	Lab	BIO	ENZ	ALAD	BL	57		Y	0.045	N	0.00607	7.69		10	5	5	10	6	1	4	1	10	4	56
129	19496	Novelli et al, 1998	Nickel sulfate	100	Rat (*Rattus norvegicus*)	2	0/2.97	mg/org/d	N	na	ADL	U	DR	2	mo	15	w	JV	M	C	Lab	BEH	FDB	WCON	WO	2.97		Y	0.2	Y	0.0238	12.5		10	5	5	10	7	4	4	3	10	4	62
130	14481	Phatak and Patwardhan, 1952	Nickel	100	Rat (*Rattus norvegicus*)	2	0/250	mg/kg diet	N	na	DLY	U	FD	60	w	5	w	JV	B	C	Lab	GRO	GRO	BDWT	WO	250		Y	0.25	N	0.021982	22.0		10	10	5	4	6	8	4	1	10	4	62
131	659	Eakin et al, 1980	Nickel acetate	100	Rat (*Rattus norvegicus*)	2	0/500	mg/kg diet	N	na	ADL	U	FD	16	w	NR	NR	JV	F	C	Lab	GRO	GRO	BDWT	WO	500		Y	0.325	N	0.02727	42.0		10	10	5	5	6	8	4	1	10	4	63
132	659	Eakin et al, 1980	Nickel acetate	100	Rat (*Rattus norvegicus*)	2	0/500	mg/kg diet	N	na	ADL	U	FD	16	w	NR	NR	JV	M	C	Lab	PHY	PHY	BLPR	WO	500		Y	0.325	N	0.02727	42.0		10	10	5	5	6	4	4	1	10	4	59
133	659	Eakin et al, 1980	Nickel acetate	100	Rat (*Rattus norvegicus*)	2	0/500	mg/kg diet	N	na	ADL	U	FD	16	w	NR	NR	JV	M	C	Lab	BIO	CHM	GBCM	PL	500		Y	0.325	N	0.02727	42.0		10	10	5	5	6	1	4	1	10	4	56
134	14485	Weber and Reid, 1969	Nickel acetate	100	Mouse (*Mus musculus*)	3	0/4.143/6.143	mg/org/d	N	na	ADL	U	FD	4	w	NR	NR	JV	B	C	Lab	PHY	PHY	DIFD	FC	6.143		Y	0.0184	Y	0.003730	334		10	10	5	5	7	4	4	1	10	4	60
135	15506	Schroeder, 1968	Nickelous acetate	100	Rat (*Rattus norvegicus*)	2	0/3.764	mg/kg bw/d	N	na	ADL	U	DR	306	d	21-23	d	JV	F	C	Lab	BIO	CHM	CHOL	SR		3.76	N	0.51	N	0.054007		3.76	10	5	5	5	10	1	4	10	10	4	64
136	19500	Novelli et al, 1994	Nickel monosulfide	100	Rat (*Rattus norvegicus*)	2	0/21.2	mg/kg bw/d	N	na	ADL	U	DR	7	d	15	mo	AD	M	C	Lab	BIO	ENZ	ALPH	SR		200	N	0.5	N	0.0531		21.2	10	5	5	10	5	1	4	10	3	4	57
137	19111	Clary, 1975	Nickel chloride	100	Rat (*Rattus norvegicus*)	2	0/225	mg/L	N	na	ADL	U	DR	4	mo	NR	NR	JV	M	C	Lab	BIO	CHM	CHOL	SR		225	Y	0.356	N	0.03908		24.7	10	5	5	10	6	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.