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METABOLISM OF SELENIUM IN CATS AND DOGS

A thesis presented in partial fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY
in Physiology and Nutrition

at Massey University, Palmerston North
New Zealand

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2006

ACKNOWLEDGEMENTS

I would like to thank my original supervisor Dr Wouter Hendriks for starting me on this journey and for his knowledge, guidance and patience throughout the following years, and Drs David Thomas, Claudia Ugarte and Lucy Tucker for taking over from Dr Hendriks as supervisors when he took up another position overseas. I am sincerely grateful to Dr David Thomas for assuming the role of chief supervisor, Dr Claudia Ugarte for her pivotal involvement in conducting the trials, for making the time to share her valuable knowledge, give practical advice and offer different perspectives, and to Dr Lucy Tucker who, after immigrating to New Zealand at a most opportune time, kept things on track and provided support, guidance and encouragement in an enthusiastic and uncompromising manner. Thank you also to Dr Timothy Wester who has been a part of this supervisory team throughout the duration of this PhD.

I gratefully acknowledge Alltech Inc. (Nicholasville, Kentucky, USA) for the Graduate Student Fellowship which made this PhD possible, and for the opportunities which allowed me to travel and experience the industry at an international level. I would also like to thank the team at Cundy Technical Services (Auckland, NZ), especially Mr Mike Cundy for his support and liaison with Alltech, and Ms Trish Lewis for her friendship and encouragement.

There are many people I wish to thank for their technical assistance in laboratory and trial work. In particular I would like to thank Mr Shane Rutherford for his help, skill and patience in developing the fluorometric assay, the team in the IFNHH Nutrition Laboratory, especially Ms Maggie Zou and Mrs Leiza Turnbull for accommodating me in their respective laboratories, and Mr Donald Thomas and his team at the Poultry Unit for the use of their facilities and their assistance processing samples. I would like to acknowledge the use of The Centre for Feline Nutrition and extend my thanks to the staff there, in particular Ms Karin Weidgraaf and Mrs Heather Nicol, who made it possible for me to carry out my trials. I am indebted to those people who gave so generously of their time to assist with the trial work: Ms Kelly O'Flaherty, Ms Clare Browne, Ms Katherine Bell, Ms Margreet Hekman, Mr Stuart Fafeita, Ms Maggie Honeyfield-Ross, Mr Don Brereton, Ms Heidi Roesch, Ms Yvette Cottam, Ms Karin Weidgraaf and Ms Stacey Kopf. Many of these people went beyond the call of duty in trying conditions and for this I am sincerely grateful. I would also like to acknowledge

Heinz Wattie's (Hastings, New Zealand) for accommodating our requirements and providing the diets that were used in these studies.

My family and friends have provided support and understanding throughout the personal and academic rollercoaster of this degree. I would like to convey my appreciation to Dr David Simcock who endured the early years and whose guidance, encouragement and positivity motivated and inspired me to keep going. I am grateful to Ms Joanne Cheyne for her friendship and support during the hard times, and for her invaluable friendship I thank Ms Katherine Bell who has shared the highs and lows firsthand, and who has always been there when it matters. I am grateful to Mr Stuart Fafeita for his patience, support, generosity, and sense of perspective.

And finally, I wish to express heartfelt gratitude to my family, who in their own very different ways have always been there for me, especially my mother for her dedication and active encouragement, my father for his unassuming manner and unconditional support and Mrs Jan Murphy for her unfailing love and support at all times.

ABSTRACT

The main objective of this PhD was to provide fundamental information regarding some metabolic aspects of selenium metabolism in cats and dogs.

The total selenium content of a range of commercially available petfoods was analysed using a fluorometric method. The petfoods contained a wide range of selenium concentrations, with up to 6 $\mu\text{g Se/g DM}$ found in cat foods. Mean concentrations of selenium in dog and cat foods were 0.40 and 1.14 $\mu\text{g Se/g DM}$ respectively. All petfoods analysed met the recommended current minimum dietary selenium requirements.

The use of blood parameters for the assessment of selenium status was investigated in a study in which cats were fed inorganic and organic selenium supplemented at concentrations of up to 2.0 $\mu\text{g Se/g DM}$ for 32 days. Plasma selenium concentrations reflected dietary selenium intakes, however there were no differences between the different levels of supplementation. Whole blood selenium concentrations showed less distinct patterns and were thought to be a more useful indicator of longer term selenium status. Activities of glutathione peroxidase in plasma and whole blood showed no response and the response of cats to supplementation of the different forms of selenium were similar. In the same study, faecal and urinary excretion ($\mu\text{g/kg BW/d}$) were measured and apparent absorption and retention were estimated during the last seven days of the 32 day trial. Faecal excretion of selenium remained constant whereas urinary excretion of selenium increased with increased dietary intake. The form of selenium had no effect on excretion or apparent absorption however there was a trend in which more selenium was retained in cats fed organic selenium.

A study was conducted with cats and dogs fed high levels (10 $\mu\text{g Se/g DM}$) of inorganic and organic selenium for 21 days to determine whether there were species differences in their metabolic response. Cats and dogs exhibited the same pattern of response, however cats showed higher plasma selenium levels, lower levels in liver and excreted more selenium compared to dogs. It was concluded from this data that cats and dogs differ in their metabolism of selenium.

The effect of heat processing on the addition of inorganic and organic selenium to petfoods was investigated in cats fed 3.0 $\mu\text{g Se/g DM}$ for 11 days. Apparent absorption was higher in cats fed inorganic selenium added after processing, whilst less selenium of organic origin was excreted in the urine when added after processing.

These preliminary results suggest heat processing may decrease the apparent availability and utilisation of selenium in petfoods.

LIST OF ABBREVIATIONS

λ_{em}	emission wavelength
λ_{ex}	excitation wavelength
%	percent
AAFCO	Association of American Feed Control Officials
ANOVA	analysis of variance
AOAC	Association of Official Analytical Chemists
β	beta
BW	body weight
$^{\circ}\text{C}$	degrees Celsius
cGSHPx	classical glutathione peroxidase
cm	centimetre
DAN	2,3-diaminonaphthalene
DM	dry matter
DNA	deoxyribose nucleic acid
EDTA	ethylenedinitrilotetraacetic acid
FAD	flavin adenine dinucleotide
FDA	Food and Drug Administration
g	gram
GSHPx	glutathione peroxidase
gGSHPx	gastrointestinal glutathione peroxidase
HCl	hydrochloric acid
HIV-1	human immunodeficiency virus
ID	iodothyronine deiodinase
IDI	type 1 iodothyronine deiodinase
IDII	type 2 iodothyronine deiodinase
IDIII	type 3 iodothyronine deiodinase
kcal/kg BW/d	kilocalories per kilogram body weight per day
kDa	kilodalton
kg	kilogram
ME	metabolisable energy
m^2	metres squared
mg	milligram
mg Se/kg	milligrams selenium per kilogram

ml	millilitre
ml/min	millilitres per minute
mM	millimolar
mmol/L	millimoles per litre
mRNA	messenger ribonucleic acid
NADPH	nicotinamide adenine dinucleotide phosphate
ng	nanogram
nm	nanomole
NOAEL	no-observed-adverse-effect level
NRC	National Research Council
pGSHPx	plasma glutathione peroxidase
phGSHPx	phospholipid glutathione peroxidase
ppm	parts per million
rpm	revolutions per minute
Se	selenium
SeEMP	selenium exchangeable metabolic pool
SEM	standard error of the mean
SPS	selenophosphate synthetase
T ₂	diiodothyronine
T ₃	triiodothyronine
T ₄	thyroxine
tRNA	transfer ribonucleic acid
TRR	thioredoxin reductase
µg	microgram
µg/L	micrograms per litre
µg/ml	micrograms per millilitre
µg Se/g DM	micrograms selenium per gram dry matter
U/L	units per litre
µmol/L	micromoles per litre
USA	United States of America

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