

**Zinc and chromium in commonly used food items, intake by
Sri Lankan adults and their levels in serum**

By

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M.Phil.

2006

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Thesis submitted to the University of Sri Jayewardenepura for the award of the Degree of Master of Philosophy in Biochemistry on 'Zinc and chromium in commonly used food items, intake by Sri Lankan adults and their levels in serum' on October 2006.

DECLARATION BY CANDIDATE

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...10.07.2008.....

Date

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DECLARATION BY SUPERVISORS

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ABBREVIATIONS

24 HR	- 24 hour recall
AAS	- Atomic absorption spectrometry
AOAC	- Association of Official Analytical Chemists
APDC	- Ammonium pyrrolidine dithiocarbamate
ASV	- Anodic stripping voltammetry
BMI	- Body mass index
BMR	- Basal metabolic rate
BW	- Body weight
CAD	- Coronary artery disease
CMP	- Capacitively coupled microwave plasma
CRM	- Certified reference materials
CSV	- Cathodic stripping voltammetry
DCS	- Department of Census and Statistics of Sri Lanka
DH	- Diet history
DP-ASV	- Differential-pulse Anodic stripping voltammetry
EDTA	- Ethylene di-amine tetra acetic acid
EHC	- Environmental health criteria
ESADDI	- Estimated safe and adequate daily dietary intake
ETAAS	- Electrothermal atomic absorption spectrometry
FAAS	- Flame atomic absorption spectrometry
FAO	- Food and Agricultural Organization
FFQ	- Food frequency questionnaires
FI	- Flow injection
GTF	- Glucose tolerance factor
HDL	- High density lipids
IAEA	- International Atomic Energy Agency
ICDA	- International Chromium Development Association
ICP-AES	- Inductively coupled plasma atomic emission spectrometry
ICP-MS	- Inductively coupled plasma mass spectrometry
INCLEN	- International Clinical Epidemiological Network
IOS	- International Organization for Standardization

LOD	- Limit of detection
LOL	- Level of linearity
MRI	- Medical Research Institute
NAA	- Neutron activation analysis
NHANES III	- The third national health and nutrition examination survey
NRC	- National Research Council
RDA	- Recommended dietary allowances
SD	- Standard deviation
SEM	- Standard error of mean
SF-ICP-MS	- Sector-field inductively coupled plasma mass spectrometry
US-EPA	- Environmental Protection Agency, United States
VAD	- Vitamin A deficiency
WHO	- World Health Organization
XRF	- X-ray fluorescence

ACKNOWLEDGEMENT

I express my deepest gratitude to my supervisors Dr. (Mrs.) M.I.F.P. Jayawardene and Dr. K.A.S. Pathiratne for their guidance, help and encouragement given me throughout this study. And I address special thanks to Dr. K.A.S. Pathiratne for giving me the opportunity to learn and to be confident on atomic absorption spectrometric analysis and his endless patience in correcting my thesis and improving my writing.

I extend my warmest gratitude to Professor E.R. Jansz who was an endless source of help and advice during this period. I am grateful to Professor Nalini Wickramasinghe, Professor Hemantha Peiris, Dr. Sagarika Ekanayake and other academic staff of the Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura for their advice and numerous supports in the achievement of this work. Also my sincere gratitude goes to the non academic staff members of the department for their numerous supports.

I extended my warmest gratitude to Professor W.D.W. Jayatilake, Department of Chemistry, Dr. Upul Subasinghe, Mr. Wijesinghe and other academic and non academic members of the Department of Forestry and Environmental Science, University of Sri Jayewardenepura for providing me with numerous support and very useful materials.

I would like to thank Professor Rohan Weerasooriya, Institute of Fundamental Studies, Kandy, for his valuable guidance at the initial stage of this study and directing me to the Dr. K.A.S. Pathiratne's lab.

My sincere gratitude goes to my research colleagues, Indika, Channa, Chandika, Lakshmee, Inoka and non academic staff of the Department of Chemistry, University of Kelaniya, for their numerous supports.

I am happy to acknowledge my research colleagues Sumuduni, Keerthi, Chamani, Sampath, Shiromi, Chaminda, Samantha, Inoka, Sugandika, Darshika, Ishira and Nadee for their endless support and motivation. I am also thankful to my friends, Sisira Ediriweera, Pradeep Rajathewa, Ruwanthi Gunawardene and her family for the help given me during the preparation of this thesis.

Special thanks are due to my mother, brothers & sisters and their families for their boundless faith and love extended to me in achieving my goals. Finally I would like to express my indebtedness to my wife for her sacrifice and understanding. Without her encouragement and understanding it would have been impossible for me to finish this work.

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ABSTRACT

Zinc and chromium are two essential trace elements required in modest amounts to maintain health and optimal physical function of humans. Trace elements either toxic or essential, reach the human body through foods, drinks, ambient air and other occupational and accidental exposures. There are no reported data on levels of these metals in foods, environmental samples, and dietary intake levels of the population with their serum levels in Sri Lanka. The aim of the present study is to determine Zn and Cr in commonly used food items and to determine the intake and the levels of Zn and Cr in serum of Sri Lankan adults and compare their intake levels with respect to serum levels of Zn and Cr.

Individual food items (categorized into groups) were analysed for Zn and Cr using flame atomic absorption spectrometry (FAAS) and electrothermal atomic absorption spectrometry (ETAAS) respectively. Accuracy and validity of the results were examined by analyzing certified reference materials [IAEA-155, Whey powder and IAEA-140/TM, Sea weeds (*Fucus sp.*)], which gave expected values.

Dietary energy, protein, Zn and Cr intake were measured by using twenty-four-hour recall method (24 HR) in a selected group of Sri Lankan adult men and women age 20 to 59 years. In order to compare the reported dietary intakes of Zn and Cr, market baskets containing more than a hundred food items included in the average Sri Lankan diet were purchased from 4 locations: Colombo, Kandy, Dambulla and Balangoda.

Freeze dried homogenates representative of each basket of food from each location were then dry ashed and analysed for Zn and Cr elements using FAAS and ETAAS respectively.

The 24 HR reported mean dietary Zn intakes of Sri Lankan adult men and women were 8.6 ± 1.7 mg/day and 7.2 ± 1.3 mg/day respectively. Market basket results reported the average Zn level to be 9.4 ± 0.2 mg/day. Based on the 24 HR, the mean dietary Cr intakes of Sri Lankan adult men and women were 65.3 ± 32.3 μ g/day and 62.6 ± 34.6 μ g/day respectively. Market basket results reported the average Cr level to be 70.0 ± 1.0 μ g/day. These reported Zn and Cr intakes were comparable with several research studies conducted worldwide. The results of the dietary intake survey indicate that the dietary intake of Zn is lower than the recommended dietary allowance (RDA) of Sri Lanka and intake level is nearly 60 % for men and 72 % for women. In all the cases, the reported Cr intake levels were above the lower limit of the safe and adequate daily dietary intake levels of 50 – 200 μ g/day suggested by the National Research Council, USA (1989).

In estimation of the serum levels of Zn and Cr, serum samples were diluted with a mixture of 1% HNO₃ and 2% Triton X-100 and analysed for Zn and Cr using FAAS and ETAAS respectively. For the whole population mean serum Zn for men and women were 93.8 ± 3.0 μ g/dl and 91.4 ± 3.2 μ g/dl respectively. Reported mean serum Cr for men and women were 4.4 ± 0.3 μ g/dm³ and 3.9 ± 0.2 μ g/dm³ respectively. In this limited number of samples, serum Zn and Cr levels decreased with age. In order to decide the correlation between Zn and Cr intake of individuals with their respective values in serum, further extensive research including bioavailability studies are needed.