

**ASSESSMENT OF NUTRITIVE VALUE
AND RELATED BIOCHEMICAL
PARAMETERS OF SELECTED
BREAKFAST FOODS**

By

Rathnabahu Mudiyansele Indika Sanjeewa Kumara

Senavirathna

M. Phil



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Senavirathna

Thesis submitted to the University of Sri Jayewardenepura for the
award of the Degree of Master of Philosophy in Biochemistry


2010

DECLARATION BY THE CANDIDATE

The work described in this thesis was carried out by me under the supervision of Prof. Sagarika Ekanayake (Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura), Prof. E.R. Jansz (Emeritus Professor, University of Sri Jayewardenepura) and Prof. J. Welihinda (Department of Biochemistry and Molecular Biology, University of Colombo) and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree/Diploma.

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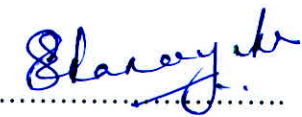
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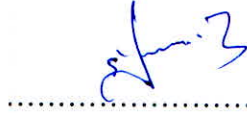
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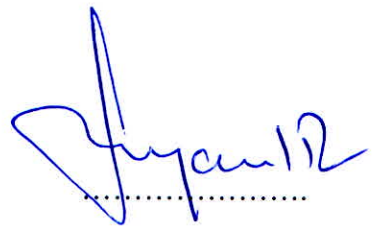
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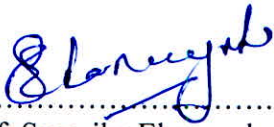


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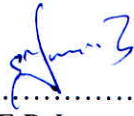


Prof. J. Welihinda

We certify that the candidate has incorporated all corrections, amendments and additions recommended by the examiners.



.....
Prof. Sagarika Ekanayake



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Prof. E.R Jansz



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Prof. J. Welihinda

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ABBREVIATIONS

ABTS	2, 2'- Azino-bis(3-ethylbenzothiazoline -6-sulfonic acid) diammonium salt
AVI	Anthocyanin vacuolar inclusions
BAW	n-butanol: acetic acid: water
BMAA	Beta -N-Methylamino-L-alanine
CV	Coefficient variation
DPPH	2,2-Diphenyl-1-picrylhydrazyl
FW	Fresh weight of sample
GAE	Gallic acid equivalent
GDM	Gestational diabetes mellitus
GI	Glycaemic index
GL	Glycaemic load
GPR	General Purpose reagents
H and E	Haematoxylin and Eosin stains
IAUC	Incremental area under curve
ICR	Institute of cancer research
IDF	Insoluble dietary fibre
ITI	Industry Technology Institute
MAM	Methylazoxymethanol
MRI	Medical Research Institute
RS	Resistant starch

SD	Standard deviation
SDF	Soluble dietary fibre
SEM	Standard error of mean
TEAC	Trolox equivalent antioxidant capacity
TRAP	Total reactive antioxidant potential assay
UV	Ultra violet
WHO	World Health Organization

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ABSTRACT

ASSESSMENT OF NUTRITIVE VALUE AND RELATED BIOCHEMICAL PARAMETERS OF SELECTED BREAKFAST FOODS

R.M.I.S.K SENA VIRATHNA

Studies on the nutritive value of traditional breakfast foods or foods prepared with indigenous raw materials available in Sri Lanka are a neglected area of research. These foods have been consumed by Sri Lankans for centuries but have been slowly replaced with wheat based food products. This thesis attempts to study a few such foods/foods made with indigenous raw materials for their nutritional properties. The foods studied included *Dioscorea alata* tuber (*raja ala*, both violet and white) and *Canna indica* tuber (*buthsarana*), *Maranta arudinacea* L. tuber (*hulankeeriya*) and foods made with *Cycas circinalis* (*madu*) seeds (*roti and pittu*) and *Vateria copallifera* (*hal*) fruit (*pittu*) and *Caryota urens* (*kithul*) pith (*roti, thalapa and muffin*).

The proximate compositions (ash, moisture, digestible carbohydrate, crude protein, soluble and insoluble dietary fibre and total fat contents) of these foods made according to standard recipes were determined by the AOAC methods. Antioxidant capacity was determined as Trolox equivalents (TEAC) and phenolic/polyphenol content as Gallic acid equivalence (GAE/100g fresh weight). The glycaemic indices were determined with healthy volunteers according to WHO criteria. The properties of constituent digestible carbohydrates (amylose content, changes in starch with processing by studying the molecular size distribution, starch grain size, swelling capacity) were studied as these have a bearing on glycaemic index. The effects on absorption of glucose by these foods were

determined by inhibition on Na^+/K^+ ATPase activity. In addition some toxicity studies on *Cycas circinalis* were conducted.

Digestible carbohydrate content in food ranged from 9.4% - 44% fresh weight, with *kithul roti* and *kithul thalapa* having the highest and lowest respectively. The IDF, SDF, protein and fat in the four tuber varieties ranged from 1.3% - 3.1%, 0.6% - 1.6%, 1.2%-2.6% and 0.2% - 0.6% respectively with carbohydrates being the main constituent. *Raja ala* and *hulankeeriya* had highest protein content (8- 9%/100g DW). In *roti* (02) and *pittu* (02) preparations IDF, SDF, protein and fat ranged from 2.5% - 5.7%, 0.8 % - 3%, 1.3% - 7.9% and 6.4 % - 9.7% respectively.

Kithul thalapa and *buthsarana* were categorized as high GI foods with GI (\pm SEM) 128 ± 11 and 110 ± 8 respectively. Muffin prepared from *kithul* flour and *hulankeeriya* had medium GI values of 92 ± 9 and 82 ± 8 respectively. The *madu roti* and *pittu*, *kithul roti*, *hal pittu* and two *raja ala* varieties (*raja ala* violet and white) had low GI (66 ± 6 , 72 ± 4 , 57 ± 4 , 67 ± 7 , and 64 ± 9 and 69 ± 4 respectively). The glycaemic load as expressed for 50g digestible carbohydrates ranged from 20 to 46, with lowest observed in *hal pittu* and highest in *kithul thalapa*.

Light microscopic studies of starch granules revealed that in all the tuber varieties (subjected to wet process) the starch granules were swollen significantly ($P < 0.05$) compared to other food preparations. When compared with the raw flour of the same percentage of swelling ranged from 330% to 544%. However, in the two *raja ala* varieties the granules were observed to be cell enclosed which could be partly responsible for the low GI. In the two *roti* varieties and *madu pittu* starch granules were not swollen

significantly compared to their raw flour. In the case of *kithul thalapa* all the granules had disintegrated. Generally in the starch molecular size distribution patterns, a high percentage of high molecular weight starch fractions were observed.

Phenolic/polyphenolic contents of the raw flour ranged from 79 - 1162 (GAE/100 g FW) with the antioxidant capacity ranging from 3-225 TEAC. Raw *hal* flour had the highest whereas *kithul* raw flour had the lowest phenolics/polyphenolics content. Correspondingly total phenolic/polyphenolic content of food items was lower than raw and ranged from 57 - 347 (GAE/100 g FW) with the antioxidant capacity ranging from 5 - 142 (TEAC) with *hal pittu* having significantly low ($P < 0.05$) antioxidant capacity compared to the raw. The highest percentage reduction of phenolic/polyphenolics was observed in *hal pittu* (70%). *Hal* raw flour had the highest antioxidant capacity whereas raw *kithul* flour had the lowest.

Liver of the ICR mice fed with different foods prepared from *madu* flour were subjected to histopathological studies. Fatty changes and lymphocytes accumulations were observed in histopathological sections of liver, indicating toxicity when fed for 28 days.