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INVESTIGATION OF GLYCAEMIC INDICES OF BREAKFAST MEALS TYPICAL TO SRI LANKA

By

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DECLARATION BY CANDIDATE

The work described in this thesis was carried out by me under the supervision of Dr. S. Ekanayake (Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura) and Prof. J. Welihinda (Department of Biochemistry, Faculty of Medicine, 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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16.10.2008

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Date

DECLARATION BY SUPERVISORS

We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

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16/10/08

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ABBREVIATIONS

AB-S	Absorbance of the standard glucose
AB-T	Absorbance of the test sample
ANOVA	Analysis of Variance
AUC	Area Under Curve
AX	Arabinoxylan
CHD	Coronary Heart Disease
CV	Coefficient of Variance
CVD	Cardio Vascular Disease
FF_M	Moisture of the fresh food
FM	Fresh Weight
F_M	Moisture of the flour
FW	Fresh Weight
GI	Glycaemic Index
GL	Glycaemic Load
HDL	High Density Lipoprotein
HMWC	High Molecular Weight Carbohydrates
IAUC	Incremental Area Under Curve
IDF	Insoluble Dietary Fibre
IGF	Insulin-like Growth Factor
II	Insulinaemic Index
LDL	Low Density Lipoprotein
LMWC	Low Molecular Weight Carbohydrates
MMWC	Medium Molecular Weight Carbohydrates

N_1	Normality of standard HCl
NA	Not Applicable
ND	Not Detected
r.p.m.	Rounds per minute
RAG	Rapidly Available Glucose
RS	Resistant Starch
SAG	Slowly Available Glucose
SD	Standard Deviation
SDF	Soluble Dietary Fibre
SEM	Standard Error of the Mean
SI	Satiety Index
TDF	Total Dietary Fibre
V	Nutrient value calculated from analysis of the flour sample
V_s	Total volume of the sample
W	Sample weight in milligram
W_{105}	Constant weight of the crucible with dried sample at 105 °C
W_{550}	Weight of the crucible with sample after incineration at 550 °C
WAI	Water Absorption Index
W_b	Constant weight of the beaker
W_c	Weight of the empty centrifuge tube
W_d	Dry weight of the sample
W_g	Weight of the centrifuge tube containing the gel
WHO/ FAO	World Health Organization/ Food and Agriculture Organization
W_s	Constant weight of the beaker containing dried supernatant

W_{sample}	Weight of the sample analyzed
WSI	Water Solubility Index
X	Volume of standard HCl used for the sample in mL
Y	Volume of standard HCl used for the blank

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ABSTRACT

The Glycaemic Index (GI), which ranks foods according to their acute glycaemic impact is of immense use to dieticians in planning meals for patients seeking glycaemic control through dietary management. The GI values of typical Sri Lankan meals except for a few foods are not currently available. Hence the objective of this study was to determine the GI of selected breakfast meals typical to Sri Lanka and determine the factors responsible for the differences in GI.

The selected breakfast meals were *roti* made with wheat, rice, kurakkan and atta flour, *pittu* (wheat, rice and kurakkan), hoppers, boiled legumes (chickpea, mungbean and cowpea), *olu*-milk rice and boiled breadfruit. *Roti* and *pittu* preparations contained 50% coconut scrapings (w/w).

The proximate compositions (ash, protein, insoluble and soluble dietary fibre, fat, digestible and total starch) of the above food items were determined by standard methods.

The glycaemic indices were determined according to the WHO criteria with healthy volunteers (n=10, age 20-30 years). The volunteers were subjected to overnight fast and served the test foods and standard food/ Prima-crust top (containing 50g or 25g digestible starch). The GI values were calculated using the IAUC (Incremental Area Under Curve) of test and standard.

The light microscopic studies of isolated starch (×100 and ×400), effect of particle size, water solubility, amylose, amylopectin and water absorption indices of food flour and molecular size distribution of carbohydrates of selected foods (wheat flour *roti*, wheat flour *pittu* and chickpea) were studied in order to investigate the factors responsible for significant changes in GI.

The digestible carbohydrate content per 100 g fresh weight of the foods studied ranged from 9.3-41.8 %. The resistant starch content of kurakkan flour *roti*, chickpea and mungbean were 6.6 %, 2.7 % and 1.2 % respectively. The IDF (insoluble dietary fibre), SDF (soluble dietary fibre), protein and fat content per 100 g fresh weight of cereal based foods, *olu*-milk rice and breadfruit ranged from 1.3 to 11.6 %, 0.7 to 3.1 % and 0.5 to 22.3 % respectively. The IDF, SDF, protein and fat contents per 100 g fresh weight of legumes were 6.6 to 8.2 %, 1.9 to 3.1 %, 8.8 to 10.8 % and 0.9 to 3.0 % respectively.

The boiled legumes (chickpea, mungbean and cowpea) were categorized as low GI foods and the GI (±SEM) were 29±5, 57±6 and 49±8 respectively. Wheat flour *roti*, rice flour *roti*, kurakkan flour *roti*, atta flour *roti*, kurakkan flour *pittu* and breadfruit were categorized as medium GI foods with corresponding GI values of 71±6, 69±7, 70±8, 67±9, 85±6 and 64±7 respectively. Hoppers, wheat flour *pittu*, rice flour *pittu* and *olu*-milk rice were classified as high GI foods and the GI (±SEM) were 120±8, 101±8, 103±7 and 91±8 respectively.

The GI values of the foods studied significantly ($p<0.01$) and negatively correlated with the IDF (ρ -0.780), SDF (ρ -0.712) and protein (ρ -0.738) contents in gram per 100 g digestible starch containing foods.

The GI values of *roti* were significantly lower than that of *pittu* except for kurakkan flour *pittu*. This was irrespective of wheat flour *roti* and wheat flour *pittu* being made using the same composition of wheat flour and coconut scrapings. In order to explain this difference effect of processing on starch structure was studied.

According to light microscopic pictures, in *roti* where a dry cooking method has been employed the starch granules were swollen but intact. A significant ($p<0.05$) increase in length and breadth of wheat starch granules was observed in wheat flour *pittu* compared to wheat flour *roti*. The molecular size distribution patterns of carbohydrates of wheat flour *roti* and wheat flour *pittu* also indicated that wheat flour *pittu* to have a higher percentage of low molecular size carbohydrates compared to wheat flour *roti*. The other wet heat processed foods (hoppers, rice flour *pittu*, kurakkan flour *pittu*, *olu*-milk rice and breadfruit) also had their starch granules disintegrated. According to the above observations the reason for the increase in GI of wet heat processed foods compared to dry heat processed foods could be mainly attributed to higher starch granular gelatinization/ disintegration. As revealed by gel filtration studies and light microscopic pictures gelatinized/ cell enclosed starch granular structure of boiled legumes could be partly responsible for the low GI of those foods.