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SOME MICRONUTRIENT AND MACRONUTRIENT CONTENTS OF SOME SRI LANKA FOOD VARIETIES

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Abstract

The food tables used today in Sri Lanka contain only little data on Sri Lanka food varieties : besides they do not contain information about some of the nutritionally important minerals present in these food varieties. As a result food composition data users are dependent on a food table that is inadequate. As a remdial measure some nutritionally important minerals (Na,K,Ca,Mg, Fe, Zn, & Cu,) present in some Sri Lanka fruits, leafy vegetables, pulses and cereals; the total available carbohydrate content of cereals, pulses & fruits, the protein content of cereals & pulses and the fibre & moisture content of fruits and leafy vegetables have been determined.

Key Words : Macronutrient, Micronutrient, Nutrition, Carbohydrate Content Protein Content, Fibre Content, Mineral Content, Sri Lanka Food Varieties.

1.0 Introduction

All forms of living matter require many minerals for their life processes. The animal body requires many minerals (among them are Na, K, Ca, Mg.) in relatively large amounts (gram quantities) and some (include Fe, Cu, Zn) in lesser quantities (1, 2). It is important to recognize that, just as proteins, carbohydrates and fats do not play independent roles in human nutrition, the minerals are inter-related and balanced against one another. The importance of these and other elements in maintaining a state of complete physical, mental and social wellbeing is well documented (2-9).

The food tables (10) used today in Sri Lanka contain only little data on Sri Lanka food varieties (11). The rest are from Indian publications. Hence the food table data users (include nutritionist, pediatricians and other medical personnel, dietitians, food and nutrition

policy planners) are dependent on a food table that is inadequate. Further more, this table does not list many of the nutritionally important elements. The need to launch a fresh effort to gather information on Sri Lanka foods has been emphasized (11). Here we report our data on the Na, K, Ca, Mg, Fe, Cu and Zn contents of some fruits, vegetables, cereals and pulses consumed in Sri Lanka. We also report the fibre & moisture content of fruits and leafy vegetables ; the total available carbohydrate (solubilised starches together with soluble sugars) content of cereals, pulses and fruits and the protein content of cereals & pulses. This data will give some idea about the macronutrient vs. micronutrient content of these Sri Lanka food varieties.

2.0 MATERIALS & METHODS

2.1 Sample Collection and Preparation

The data given in Table I, II, & III are the results of analysis of 5 samples of each variety of food. The samples were collected at random from five different locations (markets). In the case of rice they were five different samples of the same variety (B. W. 100 - Samba rice, B. W. 351 - red Kakulu rice, B. G. 94 - 1 - Kora rice) collected from the corresponding agricultural stations. The samples of food were washed with deionized water and dried. The mineral contents are reported in milligrams per 100 grams fresh weight of the edible portion. The carbohydrate, protein, fibre & moisture contents are reported in grams per 100 grams fresh weight of the edible portion.

2.2 The Total Available Carbohydrate Content

The total available carbohydrate content (i.e. solubilised starches together with soluble sugars) was determined colorimetrically by the Manual Clegg Anthrone Method (3) after digestion with perchloric acid and is expressed as grams per 100 grams fresh weight of the edible portion.

2.3 The Crude Protein Content

The crude protein content was calculated by determining the total nitrogen content.

Crude Protein Content = Total Nitrogen Content X 6.38.

The total Nitrogen Content was determined by the Kjeldhal method using a Kjeltec Auto Analyzer (12) and by the classical Kjeldhal methods (3). The results of both determinations were in agreement.

2.4 Fibre and Moisture Content

The samples were dried at 105°C to constant weight (ca. 4 hours) and then extracted for 16 hours with hexane using a Soxhlet extractor. The moisture and fat free samples were then digested with acid and alkali ; washed with water and ethanol ; dried and weighed. This sample was burnt in a muffle furnace at 600°C and the fibre content calculated from the difference in weight before and after burning (13).

2.5 Metal Ions

All glassware were soaked overnight in dilute nitric acid and washed thoroughly with deionized water. Determination of the metal ion contents were carried out after digestion of the food with concentrated nitric and sulphuric acid (3) by atomic absorption spectroscopy (Mg, Ca, Fe, Cu, Zn) and flame photometry (Na, K) (14).

3.0 Results

The total available carbohydrate content (i.e. solubilished starches together with soluble sugars), the protein content, and the Na, K, Mg, Ca, Fe, Cu & Zn contents of red Dhal (*Lens culinaris*, Mysor Parippu), yellow Dhal (*Cajanus cajan*, thora parippu), Gram Dhal, Kadala (*Cicer arietinum*, Winged bean (*Psophocarpus tetragonolobus*), Soya bean, (*Glycince max*), Mung (*Phaseolus aureus*), Cowpea (*Vigna unguiculata*), Ulundu (*Vigna mungo*), Maize (*Zea mays*), Kurakkan (*Eleusine coracana*), Rice (B. W. 100 - Samba rice, B. W. 351 - red Kakulu rice, B. G. 94-1 — Kora rice) are reported in table 1.

The crude fibre & moisture content and the Na, K, Mg, Ca, Fe, Zn & Cu contents of Gotukola (*Centella asiatica*), Kan-kun (*Ipomoea aquatica*), Katuru-murunga (*Sesbania grandiflora*), Mukunu-wenna (*Alternanthera sessilis*) Niviti (*Basella alba*), Sarana (*Boerhavia diffusa*) & Hatawariya (*Asparagus racemosus*) are reported in table II.

The total available carbohydrate content, crude fibre & moisture content, and the Na, K, Mg, Ca, Fe, Zn & Cu contents of Bananas (*Musa*), (Kolikuttu, Anamalu, Embul, Suwadel), Avocadao (*Persia gratissima*), *Guava*, (*Pasidium guajava*), Mango (*Mangifera indica*) (Kohu Amba-ripe), Nelli (*Phyllanthus embilica*), Narun (*Citrus crenatiflora*) and Papaw (*Carica - papaya*) (ripe) are reported in Table III.

The values reported are the mean and standard deviation of the analysis of 5 samples selected at random.

4.0 Discussion

Diseased states arising from the lack of minerals is well documented (2-9). Even very recent research (15) has shown that low Mg diets could be linked to diabetes, high blood pressure, pregnancy problems and cardiovascular diseases. In many cases of individuals suffering from irritability, the blood has shown low values for Mg. In order to maintain a complete state of health the minerals are inter-re'ated and balanced against one another. Ca & P are in a defined relationship in the formation of bones and teeth (2), Na, K, Mg, Phosphate and Chloride ions serve individual and collective purposes in the control of body fluids (2). A deficiency in one mineral may result in a deficiency of another. Cu deficiency may cause a physiological deficiency of Fe. Zn deficiency may cause Cu deficiency (2). A patient with K deficiency will also be depleted in Mg (15). A diet that is high in Ca increases the body's need for Mg and also may increase the excretion of P & Ca (15).

Not only are the minerals inter-related, but they also control the metabolism of proteins, fats and carbohydrates : e.g. Mg helps in the use of fat in the diet. The higher the amount of protein consumed, the more Mg is needed (15).

Many enzymes in the body require metal ions as co-factors for their function (2).

The tables I-III provide data on some nutritionally important minerals present in some Sri Lanka food varieties as well as data on some important macronutrient contents.

As expected the protein content of pulses was found to be 3-4 times greater than that of the cereals with Soya bean and Winged bean appearing at the top of the list. The cereals were rich in available carbohydrate, rice being its best source. The available carbohydrate content of Winged bean and Soya bean were depleted compared to that of other pulses. Of the minerals investigated Potassium was the most abundant mineral in pulses and cereals with Soya bean heading the list. The Sodium content of the same foods were very low. Magnesium was the next most abundant mineral ; Winged bean & Soya bean being comparatively rich sources. The highest Calcium content was found in Winged bean. The same was true for Iron. Soya and Winged bean had the highest amount of Copper. The highest Zinc content was found in Dhal varieties.

Leafy vegetables were rich sources of Potassium while the Sodium content of the same vegetables were comparatively small ; the contrast being greatest with Mukunu-wenna. Leafy vegetables were also rich sources of Calcium and Magnesium ; with Katuru-murunga heading the list for Calcium. Katuru-murunga and Niviti had a relatively significant magnesium content. The standard deviations of the mineral contents are relatively high ; this would be expected as the samples were selected at random from different locations and the mineral content would be influenced by the nature of the soil. The fibre content of Hata-wariya was greater than the other leafy vegetables used in this study.

Potassium was found to be the most abundant mineral in fruits, but the Sodium content of the same fruits were comparatively small ; the contrast being greatest with Anamalu bananas. The Calcium and Magnesium contents were greatest with Narun and Embul bananas respectively. Guava showed a significant Zinc content while Avocado headed the list for Iron.

Table 1. Carbohydrate, Protein, Na, K, Mg. Ca, Fe, Zn & Cu Contents of Some Pulses & Cereals Consumed in Sri Lanka.

Values are given per 100 grams (fresh weight) of edible portion

Pulses & Cereals	Carbohydrate Content (g)	Protein Content (g)	Na (mg)	K (mg)	Mg (mg)	Ca (mg)	Fe (mg)	Za (mg)	Cu (mg)
Dhal (red) (*Lens culinaris*)	49.50±2.55	25.58±0.61	15.80±1.92	535.00±56.50	67.33±2.30	3.50±0.00	6.28±3.50	5.30±0.69	1.79±0.0
Dhal (yellow) (*Cajanus caja*)	39.86±5.10	21.68±1.11	7.67±0.60	650.00±50.00	62.50±10.60	5.07±0.24	10.35±0.45	5.37±0.00	2.21±0.12
Dhal (gram)	55.46±5.46	24.69±0.62	18.00±3.04	812.50±53.00	101.00±7.07	9.66±0.72	12.90±0.20	4.82±0.75	1.16±0.15
Kadala (*Cicer arietinum*)	39.47±2.66	21.76±0.77	12.10±1.06	882.50±29.47	150.00±14.10	21.37±2.60	8.50±0.20	3.75±0.20	0.00±0.00
Winged Bean (*Psophocarpus tetragonolobus*)	7.51±0.70	32.48±1.43	19.40±1.61	1005.00±134.00	261.30±9.01	65.00±1.00	22.75±3.80	2.34±0.24	3.08±0.76
Soya bean (*Glycine max*)	6.76±0.58	41.93±1.62	25.00±4.20	1690.00±127.20	254.00±5.29	23.16±1.75	15.25±0.35	4.87±0.03	2.91±0.38
Mung (*Vigna mungo*)	48.52±2.80	23.24±0.52	5.60±0.80	1001.66±62.5	185.60±34.06	29.30±0.88	14.00±1.10	3.95±0.18	0.00±0.00
Ulundu (*Phaseolus mungo*)	35.67±8.70	22.81±0.65	13.28±1.20	1068.33±110.26	202.30±19.50	12.75±0.00	5.01±0.53	3.84±0.24	0.00±0.00
Cowpea (*Vigna unguiculata*)	37.96±2.76	22.83±0.50	8.23±0.53	758.33±38.18	165.00±7.07	8.12±1.50	6.22±1.15	4.36±1.10	2.05±0.28
Maize (*Zea mays*)	47.40±0.31	9.32±0.26	12.26±1.23	342.00±46.60	115.00±18.73	0.38±0.10	9.05±0.32	3.77±0.09	0.00±0.00
Kurakkan (*Eleusine coracana*)	60.60±1.05	6.14±0.43	13.15±1.80	354.00±42.50	161.66±33.08	34.91±9.88	10.07±0.63	4.85±1.20	0.00±0.00
Rice B. W. 100 (*Samba Rice*)	69.15±6.84	3.31±0.29	5.96±0.10	300.00±40.00	46.66±8.62	14.70±0.26	0.55±0.00	0.31±0.02	0.00±0.00
Rice B. W. 351 (*Red Kakulu rice*)	76.42±3.27	5.30±0.56	5.83±0.30	325.00±49.00	135.00±15.00	13.25±0.35	0.55±0.00	0.35±0.02	0.88±017
Rice B. G. 94-1 (*Kora Rice*)	65.23±5.15	2.70±0.53	5.30±0.28	175.00±21.00	35.50±0.70	12.75±0.35	0.04±0.00	0.24±0.04	0.00±000

Table 2. Fibre, Moisture, Na, K, Mg, Ca, Fe, Zn & Cu Contents of Some leafy Vegetables Consumed in Sri Lanka.

Values are given per 100 grams (fresh weight) of edible portion

Vegetable	Crude Fibre (g)	Na (mg)	K (mg)	Mg (mg)	Ca (mg)	Fe (mg)	Zn (mg)	Cu (mg)	Moisture (g)
Gotukola (*Centella asiatica*)	1.29 ± 0.10	88.08 ± 23.62	1621.59 ± 50.95	101.95 ± 36.42	175.17 ± 19.42	1.32 ± 0.75	1.80 ± 1.42	0.21 ± 0.10	86.98 ± 0.70
Kan-kun (*Ipomoea aquatica*)	0.53 ± 0.04	250.00 ± 50.00	986.65 ± 200.97	37.00 ± 6.24	28.56 ± 1.28	2.41 ± 0.54	0.51 ± 0.02	0.13 ± 0.03	92.38 ± 0.58
Katuru-murunga (*Sesbania grandiflora*)	1.03 ± 0.12	40.30 ± 15.58	941.06 ± 221.89	118.85 ± 9.62	300.00 ± 77.5	4.46 ± 2.93	0.66 ± 0.01	0.18 ± 0.09	79.12 ± 1.02
Mukunu-wenna (*Alternanthera sessilis*)	1.52 ± 0.47	4.95 ± 0.61	1249.66 ± 83.33	75.08 ± 11.93	66.50 ± 20.0	1.41 ± 0.26	1.18 ± 0.16	0.21 ± 0.07	85.29 ± 2.66
Niviti (*Basella alba*)	0.26 ± 0.07	23.54 ± 3.64	688.73 ± 19.05	125.00 ± 8.66	135.0 ± 22.7	1.37 ± 0.16	0.38 ± 0.09	0.11 ± 0.06	93.32 ± 0.05
Sarana (*Boerhavia diffusa*)	0.50 ± 0.07	227.33 ± 38.94	844.16 ± 315.06	58.75 ± .7.5	30.53 ± 1.96	1.08 ± 0.40	0.65 ± 0.12	0.03 ± 0.00	90.71 ± 1.78
Hata-wariya (*Asparagus racemosus*)	5.61 ± 1.03	118.33 ± 65.37	1099.56 ± 50.95	71.41 ± 15.94	102.83 ± 19.42	1.97 ± 0.20	0.76 ± 0.27	0.21 ± 0.08	73.83 ± 1.46

Table 3. Carbohydrate, Fibre, Moisture, Na, K, Mg, Ca, Fe, Zn & Cu Contents of Some Fruit Varieties Consumed in Sri Lanka

Values are given per 100 grams (fresh weight) of edible portion.

Fruit	Carbohydrate Content (g)	Crude Fibre (g)	Na (mg)	K (mg)	Mg (mg)	Ca (mg)	Fe (mg)	Zn (mg)	Cu (mg)	Moisture (mg)
Bananas(musa)										
Kolikuttu	69.80 ± 15.53	±	5.16 ± 0.89	358.65 ± 7.15	35.42 ± 3.23	0.57 ± 0.13	8.03 ± 0.59	0.12 ± 0.02	0.04 ± 0.01	±
Anamalu	73.14 ± 7.32	±	4.54 ± 1.97	429.19 ± 28.70	24.30 ± 4.37	5.55 ± 1.30	7.25 ± 0.34	0.27 ± 0.03	0.29 ± 0.02	±
Embul	24.69 ± 2.87	0.58—0.05	7.11 ± 1.71	391.79 ± 32.96	97.521 ± 1.88	1.62 ± 0.14	8.13 ± 0.62	0.97 ± 0.14	0.50 ± 0.21	75.97 ± 0.42
Suwadel	54.56 ± 8.11	±	11.64 ± 1.38	170.89 ± 16.48	21.35 ± 3.88	1.00 ± 0.21	6.46 ± 0.43	0.41 ± 0.08	0.13 ± 0.01	±
Avocado (*Persia gratissima*)	3.75 ± 0.09	3.28 ± 0.05	13.14 ± 2.01	361.32 ± 41.95	53.48 ± 9.05	0.17 ± 0.02	13.25 ± 0.48	0.14 ± 0.05	0.07 ± 0.01	86.45 ± 1.03
Guava (*Psidium guajava*)	15.88 ± 2.44	9.55 ± 1.04	9.07 ± 1.24	371.33 ± 24.35	8.07 ± 2.27	4.53 ± 0.53	6.27 ± 0.27	1.48 ± 0.43	0.33 ± 0.00	80.74 ± 0.94
Mango (*Mangifera indica*) (Kohu amba ripe)	6.05 ± 2.42	0.81 ± 0.02	15.68 ± 4.33	228.69 ± 8.51	20.28 ± 5.41	3.70 ± 0.33	12.64 ± 0.24	0.28 ± 0.05	0.25 ± 0.06	86.51 ± 1.31
Nelli (*Phyllanthus embilica*)	5.15 ± 0.52	1.24 ± 0.06	10.49 ± 0.83	282.49 ± 25.52	6.25 ± 1.15	7.03 ± 0.24	7.03 ± 0.27	0.23 ± 0.05	0.25 ± 0.07	90.67 ± 1.10
Narun (*Citrus Crenatifolia*)	9.25 ± 1.42	1.71 ± 0.26	7.34 ± 2.85	275.89 ± 7.56	10.75 ± 2.89	18.98 ± 1.36	9.72 ± 0.36	0.48 ± 0.08	0.17 ± 0.07	87.88 ± 0.75
Papaw (*Carica papaya*)	3.31 ± 0.81	1.05 ± 0.15	6.58 ± 2.45	342.81 ± 20.34	18.75 ± 7.56	3.22 ± 0.26	5.88 ± 0.45	0.45 ± 0.06	0.28 ± 0.08	87.47 ± 1.32

± data not available.

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