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Glycemic Index of Traditional Foods in Northern Sri Lanka

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Abstract

Glycemic Index (GI) is the measure of increase in blood glucose level after intake of food rich in carbohydrate related to glucose. There are many research projects have been carried out in several countries. There were no studies conducted for analyzing GI of Northern traditional food items in Sri Lanka. This study was aimed to determine the GI values of our traditional foods alone and mixed meals. When dietary advices are given to diabetic and coronary heart disease patients, not only the basic foods have to be considered but also the slide dishes to be consumed. Consumption of food containing fiber diet will significantly reduce the rise in blood sugar level. However recommendation of the foods should be made after analyzing the glycemic index, glycemic load and energy contents of the foods. Lower GI diets are better choices for the diabetes and coronary heart disease patients. Further studies have to be carried out on the pre-diabetes and diabetes. This study will be useful to Physicians and public to decide on the consumption of fruits particularly by the diabetic and coronary heart disease patients in Sri Lanka.

Keywords: Glycemic index; Traditional meals; Northern Sri Lanka

Introduction

Glycemic Index (GI) is the measure of increase in blood glucose level after intake of food rich in carbohydrate related to glucose. It measures the rate at which the carbohydrate in certain food is digested and absorbed into blood stream as glucose, i.e. GI of food represents its blood-glucose raising potential [1]. It ranks carbohydrate according to their effects on blood glucose levels. Glycemic index (also glycemic index, GI) is a ranking system for carbohydrates based on their effect on blood glucose levels [2]. It compares available carbohydrates gram for gram in individual foods, providing a numerical, evidence-based index of postprandial (post-meal) glycemia [3]. The concept was invented by Dr. David, J. Jenkins and colleagues in 1981 at the University of Toronto [4].

Glycemic Index is defined as "the incremental area under the blood glucose response curve of 75 g carbohydrate portion of a food Expressed as a percent of response to same amount of carbohydrate from a standard food taken by same subject" [1].

What does glycemic index offer?

It measures the effect of consumption of food on blood glucose level. It

- reflects the physiological effects of food
- helps to keep blood glucose levels even, and
- substitutes the old terms of complex and simple carbohydrates [5].

It ranks foods on a scale from 0-100, according to their actual effect on blood glucose level [5]. On GI scale, glucose is taken as 100, because it causes greatest and most rapid rise in blood glucose. All other foods related in comparison to glucose. It provides an accurate tool for regulating blood glucose levels. If food has glycemic index of 80, it means that it raises blood glucose by 80% compared to glucose. Different studies of the same food have resulted in glycemic variations ranging from 20-40 points [6,7]. Foods with an index number of 70 (or) more are considered to be of high GI, with index number between 55-70 as medium GI, and 55 (or) less as low GI [8].

It has following benefits;

- Low GI diets help people to lose and control body weight [9,10].
- Low GI diets increase body sensitivity to insulin [11,12].
- Low GI carbohydrates improve diabetic control and heart disease [10].
- Low GI carbohydrates reduce blood glucose level [11,12].
- Low GI carbohydrates reduce hunger and keep fuller for longer [12].
- Low GI carbohydrates prolong physical endurance [13].
- High GI carbohydrates help re-fuel carbohydrate stores after exercise.

There are many research projects have been carried out in several countries. There were no studies conducted for analyzing GI of Northern traditional food items in Sri Lanka. This study was aimed to determine the GI values of our traditional foods alone and mixed meals. This study will be useful to Physicians and public to decide on the consumption of fruits particularly by the diabetic and coronary heart disease patients in Sri Lanka.

Materials and Methods

The pure glucose (Royal Pure Glucose, Smithkline Beecham Pvt Ltd, Moratuwa), different varieties of rice (*Oryza sativa*) such as (white rice ('Bg-11-11'), raw brown rice ('At-402') and parboiled rice ('*Mottaikarupan*') and raw mottaiarupan rice, wheat flour, and *Manihot esculenta* (boiled cassava) and legumes like *Vigna radiata* (boiled green gram) and *Cicer arietinum* (boiled chick pea),bakery products (bread, normal bun, butter cake, hard bun and rusk) purchased from a local bakery, fruits like different varieties of plantain *(Musa spp)* Tamil-'Kathali' (*Sinhala-'Embul'*), Tamil-'Kappal' (*Sinhala-'Kolikuttu'*) and Tamil-'Itharai' (*Sinhala-'Poo kesel'*), jack fruit and papaya purchased from local market, *'atta'* flour (whole wheat flour) (Anna International PTE Ltd., Colombo), green leaf *(Amaranthus sp.)*, *'kurakkan' (Eleucine coracana)*, soy meat (Convenience Foods Lanka PLC, Ratmalana)

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),black gram, ravae vegetables such as tomatoes, carrot, drum strict, bringoles and yellow dhal were used for this study.

Preparations of foods

Main meals: The white rice, brown rice and parboiled rice washed well in water. The white rice and brown rice were cooked in excess volume of water for 30 min, while parboiled rice was cooked in excess volume of water for 40 min. The excess water drained off and the water retained was dried off.

The wheat flour was steam boiled for 30 min and whole raw 'mottaikaruppan' rice washed, dried, milled to powder and roasted for 30 min. The boiled wheat flour and roasted rice flour were mixed in 2:1 ratio. Small amount of salt water were added, mixed well after addition of hot water and cut into small pellets. The mixture was steamed in a 'Pittu' maker for 30 min.

The boiled wheat flour and roasted rice flour were mixed in 2:1. By addition of hot water and small amount of salt water, the flour was mixed well to attain suitable consistency that the dough is moist enough and non-sticky. Using wooden string hopper maker, dough was laid on the bamboo frame and steamed for 15 min.

Roasted *'kurakkan'* flour was mixed with salt (added to taste) and hot water, made into small particles and steamed. In similar manner *'atta pittu'* was prepared from roasted '*atta*' flour.

The black gram was soaked into water for 8 hrs and was grand in a domestic grinder. It was mixed with wheat flour and rice flour (1:1:1 ratio) and was fermented for overnight. 'Thosai' was prepared from the mix by roasting with it in the pan for 5 min. The black gram dhal was soaked into water for 8 hrs and was grinded in grinder. It was mixed with ravae (1:1 ratio) and was fermented for overnight. 'Idly' was prepared from mix in an 'Idly' mould by steaming for 15 min.

The top and bottom portion of cassava root were cut. The middle portion was cut into small pieces and was boiled for 40 min in excess boiling water. Excess water was drained off.

The potatoes were boiled for 40 min in excess boiling water. Excess water was drained off. The skin was peeled off and cut into small pieces.

The green gram and chick pea were washed well in water and were boiled in excess water for 25 and 40 min respectively. Excess water was drained off.

Bakery products: The bread (454.0 g) was prepared with appropriate amount of water, wheat flour (333.33 g), Sugar (3.33 g), margarine (4.66 g), bread improver (2.0 g) and yeast (1.33 g) and was baked for 50 min.

The one pair of normal bun was prepared with appropriate amount of water, wheat flour (75.0 g), milk powder (1.0 g), sugar (22.50 g) and margarine (2.50 g) and was baked for 20 min.

Hard bun was prepared with appropriate amount of water, wheat flour (633.33 g), sugar (316.0 g), margarine (50.0 g) and salt (3.33 g) and was baked for 20 min.

Butter cake was prepared with wheat flour (250.0 g), sugar (250.0 g) margarine (250.0 g), baking powder (10.0 g) and eggs (No 06) and was baked for 30 min.

Rusk was prepared with appropriate amount of water, wheat flour (834.20 g), sugar (22.02 g) margarine (14.66 g), salt (12.32 g) and yeast (14.66 g) and was baked for 20 min.

Fruit items: Ripen fruits like different varieties of plantain *(Musa spp)* Tamil-'Kathali' (*Sinhala-'Embul'*), Tamil-'Kappal' (*Sinhala-'Kolikuttu'*) and Tamil-'Itharai' (*Sinhala-'Poo kesel'*), jack fruit and papaya were purchased from local market and were served small pieces

Side dishes: Amaranthus leaves were cleaned, washed well in running tap water and cooked with salt, green chillies, onions and small amount of first extract of coconut milk.

Soya meat gravy was prepared with soya meat, coconut milk (third and first extracts), chilli powder and onions. For the experiment only the gravy was used without the soya meat.

The (dubai) drumstrict, yellow dhal, carrot, brinjol and tomatoes were washed well in water and were cooked in water with onions and chilly for 20 min. Then coconut milk powder and chili powder were added and cooked well.

The onions, Chilly, salt were added and grand in a domestic grinder. Then scraped coconut was added and grand for 10 min.

Analysis of foods: All foods were analyzed for their total sugar [14], total protein [14], moisture [14], and soluble dietary fiber [15], insoluble dietary fiber [15], and total dietary fiber contents [15].

Selection of Participants: A group of 20 healthy volunteers between 20 to 22 years old was selected and the weight and height were determined and body mass index were calculated. The volunteers who had abnormal glucose tolerance, underweight or overweight, dieting or restricting their carbohydrate intake, suffering from any illness or food allergy were excluded from the studies. The blood samples were collected and measured using semi-automated biochemical analyzer (TC 3300).

Calculation of glycemic index: Glycemic index and glycemic response were calculated [16,17].

Statistical analysis: Glycemic response and glycemic index values of different types of bakery products were analyzed by Randomized Complete Block Design (RCBD) using SAS analytical package.

Ethical clearance: The ethical clearance for this study was obtained from the 'Ethical Review Committee', Faculty of Medicine, University of Jaffna, Sri Lanka

Results and Discussion

Glycemic Index of different varieties of rice

The glycemic index (GI) values of cooked white rice, brown rice and parboiled rice were 66.61 (± 9.86), 60.24 (± 8.16) and 55.97 (± 6.01)% respectively (Table 1) [18-20]. When fiber contents of the three cooked rice varieties were considered the cooked parboiled rice contained more soluble dietary fibers (0.42%), insoluble dietary fibers (1.88%) and total dietary fibers (2.3%), than the cooked brown rice (0.21, 1.88 and 2.09%) and cooked white rice (trace, 1.21 and 1.21%). The available carbohydrate in the foods for absorption might be made unavailable due to its Soluble Dietary Fibers (SDF), Insoluble Dietary Fibers (IDF) and Total Dietary Fibers (TDF) contents. The monosaccharaides released by the hydrolysis and available for absorption might be made unavailable. This could be due to the tendency of the fibers to absorb sugars and absorbed sugar released slowly. A soluble fiber slows down

Rice	Glycemic index (%)
Parboiled	56.00
Sampa	66.60
Polished (At-402)	60.20

Table 1: Glycemic index values of different varieties of rice commonly eaten by Jaffna inhabitants.

Foods	Glycemic index (%)
String Hoppers	50.00
Pittu	43.70

Table 2: Glycemic index values of String hopper and 'pittu' prepared from rice flour and wheat flour in 1:2 ratios.

Foods			Glycemic Index (%)
Parboiled rice	Green leafy curry		47.50
	Gravy		56.30
	Green leafy curry and gravy		54.70
Pittu	Rice flour and wheat flour- 1:2 ratio		43.70
	Kurakan flour	Green leafy curry	57.50
		Gravy	63.30
		Green leafy curry and gravy	59.30
	Atta flour	Green leafy curry	44.40
		Gravy	50.80
		Green leafy curry and gravy	46.30

Table 3: Glycemic Index values of rice and 'pittu' prepared from rice flour and wheat flour; 'kurakan flour' and 'atta' flour with different side dishes.

Boiled foods	Glycemic index (%)
Potato	75.20
Cassava	78.70
Chick pea	33.30
Green gram	31.40

Table 4: Glycemic index values of different foods commonly eaten by Jaffna inhabitants.

the digestion of starches and absorption of the glucose in to blood stream. The total dietary fiber content of cooked parboiled rice was higher than that of the other cooked rice. When the insoluble dietary fiber is considered, the cooked parboiled rice contained same amount (1.88%) and the cooked white rice contained lower (1.21%) than other varieties. However the total dietary fiber contents of cooked parboiled rice and brown rice varieties were closer to each other. Thus the parboiled rice variety is a better choice for the diabetics and coronary heart disease patients.

Food items prepared from rice flour

The mean glycemic index values of 'Pittu' and 'string hopper' were 43.74 (± 9.09) and 50.01 (± 7.06)% respectively (Table 2) [19,20]. When the fiber content of 'pittu' and string hopper were considered 'pittu' contained more soluble dietary fibers than (0.45%), insoluble dietary fiber (1.56%) and total dietary fiber (2.01%) and string hopper contained soluble dietary fibers 0.43%, insoluble dietary fiber 1.45% and total dietary fiber 1.88%. The total dietary fiber of 'pittu' was higher than that of string hopper. 'pittu' and string hoppers are made out of roasted rice flour and steamed wheat flour. When the rice flour is roasted heat might have initiated the Mailard reaction and caramelization. With steaming the starch exposed to moist heat may undergo gelatinization and subsequently they may have retrograded causing a lowering effect on glycemic index. This might be the reason for the lower glycemic index values for 'pittu' and string hoppers when compared with cooked rice.

Effect of side dishes on glycemic index

The mean GI values of parboiled rice (*'Mottaikarupan'*), *'kurakkan pittu'* (*Eleucine coracana*) and *'atta pittu'* (whole wheat grain flour) either with green leaf curry (*Amaranthus*) or gravy (soya meat) or green leaf curry and gravy were determined (Table 3). The GI of parboiled rice or *'kurakkan pittu'* or *'atta pittu'* with green leaf curry differed significantly ($p<0.05$) from other combined foods [18]. The GI of parboiled rice or *'kurakkan pittu'* or *'atta pittu'* with gravy or green leaf curry and gravy did not differ significantly ($p > 0.05$) among them. *'Kurakkan pittu'* is inferior to *'atta pittu'* and parboiled rice. Including curries to basic foods altered the GI. Therefore, when dietary advice is given to diabetic patients, not only the basic foods, but also the curries to be consumed have to be considered. From the findings it could be concluded that among the starch sources 'atta flour' pittu was the best followed by parboiled rice. Even though we had believed that 'kurakan' and its flour are good starch based diets for diabetics and CVD patients, and obese and overweight persons, the results indicated that the foods made out of 'kurakan flour should not be recommended for diabetics.

Glycemic index values of some tubers and legumes

The Glycemic Index (GI) values of cassava (*Manihot esculenta*), potato (*Solanum tuberosum, Nuwara Elia*), boiled green gram (Vigna radiata) and chick pea (*Cicer arietinum*) were determined (Table 4) [19,20].

When boiled potato or cassava, which contained 75 g digestible carbohydrate, was administered to the volunteers the peak blood glucose level was obtained at 30 min. The mean glycemic index values of potato and cassava were 65.2 (± 6.56) and 78.7 (± 7.3%). When the fiber contents of boiled potato and cassava are considered, the soluble dietary fiber (0.48%, 0.47%), insoluble dietary fiber (1.21%, 2.18) and total dietary fiber (1.69%, 2.65) respectively. the mean glycemic response to boiled potato and boiled cassava were 40.8 (± 4.11) and 49.3 (± 4.57) mg dl^{-1} respectively. These values could not be due to the effect of soluble dietary fiber or insoluble dietary fiber in these two food items. Because the boiled potato and cassava contained almost same amount of SDF and the boiled cassava contained higher IDF than boiled potato. Hence the fiber content did not affect the glycemic response of boiled potato and boiled cassava. Cooking also has shown to exert a differential effect on GI of a carbohydrate -rich food, particularly one that is high in starch. In the boiled and cooled potato the processing could have formed the resistant starch. Thus, the variation in the glycemic index of boiled potato from boiled cassava could be due to more resistant starch formation in during boiling and cooling of potato and cassava. Thus cassava is a high GI diet.

When boiled green gram or chickpea, which contained 75 g digestible carbohydrate, was administered to the volunteers the peak blood glucose level was obtained at 60 min. The mean glycemic index values of boiled green gram and boiled chickpea were 31.4 (±6.96) and 33.3 (±6.23%). When the fiber content of boiled green gram and chickpea are considered, the soluble dietary fiber is (0.43%, 0.4%) and insoluble dietary fiber is (8.8%, 7.2%). So, the total dietary fiber was found to be (9.2%, 7.6%) respectively. The mean glycemic response to boiled green gram and boiled chickpea were 19.7 (± 4.36) and 20.8 (± 3.9) mg dl^{-1} respectively. Boiled green gram contained more soluble dietary fibers, insoluble dietary fiber and total dietary fiber than chickpea. Due to higher fiber content of boiled green gram and chickpea the glycemic response was delayed ad were less. Boiled green gram and chickpea are low GI diets and are good for diabetic and coronary heart disease patients.

Glycemic Index values of some bakery products

The glycemic index of the bakery products such as bread, normal bun, butter cake, hard bun, and rusk available in Jaffna was determined (Table 5) [21].

When fiber contents of the bread and normal bun were considered, bread contained less soluble dietary fiber (0.5%) and more insoluble dietary (2.73%) and total dietary fibers (3.23%), than the normal bun

Bakery products	Glycemic index (%)
Wheat flour bread	68.59
Normal bun	67.30
Hard bun	52.78
Butter cake	64.72
Rusk	50.30

Table 5: Glycemic index values of different bakery products.

Fruits		Glycemic index (%)
Plantain	'Kappal'	54.5
	'Kathali'	50.4
	'Itharai'	48.5
Papaya fruit		34.8
Jack fruit		64.4

Table 6: Glycemic index values of different fruits.

Different combinations of side dishes with 'Thosai' and 'Idly'	Glycemic index (%)
'Thosai' &'Sambol'	63.93
'Thosai', 'Sambol' & 'Plantain'	60.17
'Thosai' and 'Sampar'	71.90
'Thosai' & 'Sampar' & Plantain'	68.59
'Thosai','Sambol' & 'Sampar'	65.63
'Thosai' &'Sambol','Sampar' & Plantain'	63.04
'Idly'&'Sambol'	56.85
'Idly','Sambol' & 'Plantain'	51.10
'Idly' and 'Sampar'	70.32
'Idly','Sampar' & Plantain'	67.45
'Idly','Sambol' & 'Sampar'	63.09
'Idly','Sambol','Sampar' & Plantain'	61.30

Table 7: Glycemic index (%) of 'Thosai' and 'Idly' with different side dishes.

(0.56, 2.43 and 2.99% respectively). The SDF, IDF and TDF of wheat bread and normal bun did not show much difference. Even though, bread contains higher IDF, the mean glycemic response to bread is higher (43.0 ± 2.32 gL^{-1}) than the normal bun (42.2 ± 3.15 gL^{-1}). It could be due to the less amount of SDF in wheat bread.

When fiber contents of the normal bun and hard bun were considered, hard bun contained more soluble dietary fiber (0.76%), insoluble dietary fiber (2.99%) and total dietary fibers (3.75%), than the normal bun (0.56, 2.43 and 2.99% respectively). The mean glycemic response to normal bun (42.2 ± 3.15 gL^{-1}) is higher than the hard bun (33.1 ± 3.39 gL^{-1}). This could be due to the effects of SDF, IDF and TDF in these buns.

The soluble dietary fiber (0.6%), insoluble dietary fiber (2.57%) and total dietary fibers (3.17%), of butter cake were higher than the bread and normal bun. The mean glycemic response to butter cake was 40.5 (±4.03 gL^{-1}) and this was lower than those of bread and normal bun and this could be due to the higher dietary fiber content while the fat content did not influence.

Rusk contained more soluble dietary fiber (0.87%), insoluble dietary fiber (3.18%) and total dietary fiber (4.05%) than other bakery products. Among all the bakery products, rusk gave the lowest glycemic response (31.1 ± 3.03 $mgdL^{-1}$). Here the soluble dietary fiber highly influenced the glycemic response than insoluble dietary fiber. The hard bun and rusk are lower GI diets (GI values<55%). Bread, normal bun and butter cake are medium GI diets (GI values between 55-70%).

Glycemic Index values of some fruits

This Glycemic Index (GI) values of fruits such as 'Kathali' (Yellow plantain), 'Kappal' (Golden plantain), and 'Itharai' (Green plantain) varieties of plantains, jackfruit and papaya were studied. The mean GI values of the 'Kathali', 'Kappal', 'Itharai' varieties of plantains, jack fruit and papaya were 54.45 (± 9.26), 50.43 (± 5.79), 48.47 (± 10.13), 65.36 (±8.00) and 34.80 (± 12.78)% respectively [22]. The three varieties of plantains and papaya were low GI fruits, and jackfruit was found to be an intermediate GI fruit. The presence of dietary fiber, esp. soluble fiber, reduces the glycemic response and glycemic index of foods. Thus among the different types of plantain varieties, ripped 'ithari' is best followed by kappal. However, among all papya is the best followed by 'Ithari' variety of plantain (Table 6).

Glycemic index values of 'Thosai' and 'Idly' with different side dishes

The GI of same amount of digestible carbohydrate containing cooked 'Thosai' either with 'sambol' or 'sambol' and plantain ('itharai') or 'sampar' or 'sampar' and plantain or 'sambol' and 'sampar' or 'sambol', 'sampar' and plantain were 63.93 (± 7.62), 60.17 (± 3.58), 71.90 (± 4.73), 68.57 (± 4.18), 65.63 (± 3.46) and 63.04 (± 5.05)% respectively (Table 7). The GI value of 'Idly' with 'sambol' or 'sambol' and 'itharai' plantain or 'sampar', 'sampar' and 'itharai' plantain or 'sambol' and 'sampar' or 'sambol', 'sampar' and 'itharai' plantain were 56.85 (± 6.26), 51.10 (± 6.57), 70.32 (± 8.22), 67.45 (± 7.87), 63.99 (± 3.29) and 61.30 (± 3.09)% respectively (Table 7) [23,24].

Among the different combinations of 'Thosai'/'Idly' studied with six different side dishes, 'Thosai' /'Idly' with 'sambol' and plantain is the best choice. Consumption of 'Thosai'/'Idly' either with 'sambol' or 'sambol' and plantain for those who need a low GI diet are advisable.

When the total dietary fiber, soluble dietary fiber and insoluble dietary fiber contents are considered in the different basic diet [('Thosai': TDF-1.1%, SDF-0.7%, IDF-0.4), ('Idly': TDF-2.26%, SDF-0.94%, IDF-1.34%)] in combination with different side dishes, direct correlations with the changes in the GI were observed. An increase in the total fiber content of food can delay the glycemic response. Fiber delays the digestion of starch in the stomach, transition time of the stomach contents to the duodenum, delay the diffusion of different saccharides in the duodenum, delay the hydrolysis of polysaccharides in the duodenum and delay the absorption of mono-saccharides through the micro-villai of the epithelial cells of the jejunum and the upper part of the ileum. Total dietary fiber content has a significant negative correlation with GI.

The composition of the food or meal will influence the blood glucose response. Further foods within the same classification can have different glycemic indices. Furthermore processing of the food influences the GI. During cooking gelatinization of starch takes place, the cell walls are ruptured and the starch molecules are released. Therefore structural integrity of cell wall and starch granules also determine the glycemic index. However, the methods of preparations of 'sambol' and 'sampar' were different. The moisture contents of the both preparations ('sambol' and 'sampar'; 85.6%, 66.1%) varied significantly. Thus the GI of 'Thosai'/'Idly' with sampar was higher than that of 'sambol'. When the moisture content of the food is high the digestion of the food will be easier and hence the glucose release into the blood will be quicker. Addition of 'Itharai' variety of plantain to above basic foods was significantly decreased Glycemic index of each mixed meals. This was due high fiber content of plantain (TDF-3.7%, SDF-0.7%, IDF-2.9%).

Based on the results, the 'Thosai'/'Idly' with 'itharai plantain' were the best basic food having lowest GI with all different combinations of side dishes. With 'itharai plantain', the low GI was obtained with all different combinations of side dishes. When consumed without 'itharai plantain', the GI of all different combinations of side dishes increased (Table 7). The results from this study indicated that the GI of the diet does not depend only on the type of the basic food but also on the side dishes consumed.

Conclusions

'Pittu', 'string hopper', green gram and chick pea, hard bun, rusk, three varieties of plantains and papaya are lower GI diets (GI values<55%). White rice, brown rice, parboiled rice, bread, normal bun, butter cake and jack fruit are medium GI diets (GI values between 55-70%). Cassava is high glycemic index diet (GI value>70%).

Parboiled rice either with green leaf curry or green leaf curry and gravy, *'atta pittu'* either with green leaf curry or gravy, or green leaf curry and gravy are lower GI diets (GI values<55%). Parboiled rice with gravy, *'kurakkan pittu'* either with green leaf curry or gravy or green leaf curry and gravy are medium GI diets (GI values between 55 to 70%). *'Atta pittu'* is the best choice for patients with diabetes and coronary heart disease followed by parboiled rice. Even though *'kurakkan pittu'* was thought to be a good meal for these patients, it is inferior to *'atta pittu'* and parboiled rice. Consumption of green leaf curry significantly reduces the rise in blood sugar level.

Based on these GI values, it can be suggested that 'Thosai' either with 'sambol' or 'sambol' and plantain or 'sampar' and plantain or 'sambol' and 'sampar' or 'sambol', 'sampar' and plantain are medium GI foods (the GI values between 55 to 70%). The 'Thosai' either with 'sampar' is high GI food (the GI values are more than 70%). When plantain ('itharai') was given with 'Thosai', the GI values were decreased. When these foods were eaten with 'sampar', the GI values were increased. The GI values were increased when the foods were consumed with 'sampar' alone or 'sampar' and 'sambol'. Thus, when consuming the basic foods with different slide dishes, the GI values would be altered.

Based on these GI values, it can be suggested that 'Idly' with 'sambol' and plantain ('Itharai') is lower GI food. The 'Idly' either with 'sambol' or 'sampar' and plantain ('Itharai') or 'sambol' and 'sampar' or 'sambol', 'sampar' and plantain ('Itharai') are medium GI foods. The 'Idly' with 'sampar' are high GI foods. When plantain ('Itharai') was given with 'Idly', the GI values were decreased. When these foods were eaten with 'sampar', the GI values were increased. The GI values were increased when the foods were consumed with 'sampar' alone or 'sampar' and 'sambol'. Thus, when consuming the basic foods with different slide dishes, the GI values would be altered.

Therefore, when dietary advices are given to diabetic and coronary heart disease patients, not only the basic foods have to be considered but also the slide dishes to be consumed. Consumption of food containing fiber diet will significantly reduce the rise in blood sugar level. However recommendation of the foods should be made after analyzing the glycemic index, glycemic load and energy contents of the foods.

Lower GI diets are better choices for the diabetes and coronary heart disease patients. Further studies have to be carried out on the pre-diabetes and diabetes.

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References

1. Joint FAO/WHO Expert Consultation, April 14-18, 1997. Carbohydrates in Human Nutrition. FAO Food and Nutrition, Paper 66. Rome: FAO; 1998.
2. Chlup R, Bartek J, Reznickova M, Zapletalova J, Doubravova B, et al. (2004) Determination of glycemic index of selected foods (white bread and cereal bars) in healthy persons. Biomed 148: 17-25.
3. Anderson GH (1997) Sugars and health. Nutrition Research 17: 1485 -1498.
4. Brouns F, Bjorck I, Frayn KN, Gibbs AL, Lang V, et al. (2005). "Glycemic index methodology." Nutrition Research Reviews 18: 145-171.
5. Wolever TMS, Bolognesi C (1996) Source and amount of carbohydrate affect postprandial glucose and insulin on normal subjects. The Journal of Nutrition 126: 2798-2806.
6. Percheron C, Colette C, Avignon A, Monnier L (1997) Metabolic responses to high carbohydrate breakfasts in obese patients with impaired glucose tolerance: comparison of meals containing dairy products and fruits versus bread. Nutrition Research 1997; 17: 797-806.
7. Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Protein and Amino Acids. Institute of Medicine: (2002) Washington, DC.
8. Mendosa D (2007) Glycemic Index.
9. Brand–Miller JC, Holt SHA, Powlak DP, McMillan J (2002) Glycemic index and obesity. American Journal Clinical Nutrition 76: 281S –85S.
10. Srinivasan SR, Bao W, Wattigney WA, Berenson GS (1996) Adolescent overweight is associated with adult overweight and related multiple cardiovascular risk factors: the Bogalusa Heart Study. Metabolism 45: 235- 240.
11. Heacock PM, Hertzler SR, Williams JA, Wolf BW (2005) Effects of a medical food containing an herbal alpha-glucosidase inhibitor on postprandial glycemia and insulinemia in healthy adults. Journal of the American Dietetic Association 105: 65-71.
12. Giacco A, Parillo M, Rivellese AA (2000) Long-term dietary treatment with increased amounts of fiber-rich low-glycemic index natural foods improves blood glucose control and reduces the number of hypoglycemic events in type 1 diabetic patients. Diabetes Care 10: 1461-1466.
13. Galgani J, Agurirre C, Diaz E (2006) Acute effect of meal glycemic and glycemic load on blood glouse &insulin response in humans. Nutr J 5: 5-22.
14. Pearson D, The Chemical analysis of foods.1976; 7th ed. Edinburgh, London, Churchill. Living stone.
15. Megazyme (2007) Total dietary fibre assay procedure.
16. Wolever TMS, Jenkins DJA, Jenkins AL, Josse RG (1997) The Glycemic Index:Methodology and Clinical Implications. American Journal of Clinical Nutrition 54: 846-54.
17. Foster-Powell K, Holt SHA, Brand miller JC (2002) International table of glycemic index and glycemic load values. The American Journal of Clinical Nutrition 76: 5-56.
18. Pirasath S, Thayananthan K, Balakumar S, Arasaratnam V (2010) Effect of dietary fiber on glycemic index. Ceylon Medical Journal 55: 118-122.
19. Pirasath S, Thayananthan K, Balakumar S, Arasaratnam V (2012) Effect of soluble fiber on glycemic index. Galle Medical Journal 17: 23-31.
20. Pirasath S, Balakumar S, Thayaananthan K Arasaratnam V (2011) Glycemic Index values of locally available foods in Jaffna. Ceylon Medical Journal 56: 36.

21. Pirasath S, Thayananthan K, Balakumar S, Arasaratnam V (2011) Bakery products and their glycemic indicies in Jaffna. Jaffna Medical Journal 27: 38-43.

22. Pirasath S, Thayananthan K, Balakumar S and Vasanthy Arasaratnam (2012) Glycemic Index values of some Jaffna fruits. International Journal of Functional Foods in Health and Disease 2: 25-34.

23. Pirasath S, Thayananthan K, Balakumar S, Arasaratnam V (2013) Including side dishes to traditional main meals alter the glycemic index. Journal of Endocrinology, Diabetes and Metabolism 3: 12-18.

24. Pirasath S, Thayananthan, Balakumar S, Arasaratnam V (2014) Thosai mixed side dishes altered the Glycemic Index. Batticaloa Medical Journal 6: 24-28.

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