

Thosai mixed with side dishes altered the Glycaemic Index

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(Keywords: Glycaemic index, glycaemic response, Thosai, fruits)

Abstract

Objective To determine the GI values of 'Thosai' mixed with different side dishes

Methods Healthy volunteers (20) with mean age, weight, and height and body mass index of the 20.05 (± 0.92) years, 54.70 (± 5.74) kg, 1.63 (± 0.08) m and 20.73 (± 2.63) kgm⁻² respectively were selected with their informed written consent. After overnight fasting 75g glucose and each test food containing 75g digestible carbohydrate were administered at different instances and blood glucose levels were measured half hourly for two hours. The GI values were calculated and analyzed by Randomized Complete Block Design using SAS analytical package.

Results The mean GI values of 'Thosai' either with 'sambol' or 'sambol' & plantain ('itharai' variety) or 'sampar' or 'sampar' & plantain or 'sambol' & 'sampar' or 'sambol', 'sampar' & 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.

Conclusions Thus, when consuming the basic foods with different side 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, but also the side dishes have to be considered.

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Introduction

The glycaemic index (GI) is an important parameter which compares the hyperglycaemic effect of a tested meal with pure glucose (1). The blood glucose response to a food is reflected by its glycaemic index of a particular food. Glycaemic index is defined as the incremental area under the blood glucose response curve elicited over a two-hour period by a 75g carbohydrate portion of a food, expressed as a percentage of the response to the same amount of carbohydrate from a standard food taken by the same subject (2). Foods with GI values of 70 or more are considered to be high GI diet, with an index value

between 55 to 69 as medium GI diet and less than 55 as low GI diets (3).

The aim of the study was to determine the GI values of commonly consumed thosai mixed with meals to recommend to the diabetic, obese and coronary vascular disease patients. The evaluation of GI will help the local public to decide on the foods which have to be consumed.

Hence, in this study the GI values of 'Thosai' either with 'sambol' or 'sambol' & plantain ('itharai') or 'sampar' or 'sampar' & plantain or 'sambol' & 'sampar' or 'sambol', 'sampar' & plantain were determined.

Methods

Materials

The pure glucose (Royal Pure Glucose, Smithkline Beecham Pvt Ltd, Moratuwa), 'Thosai', 'sambol', sambar and plantain ('itharai') were used for this study.

Preparations of foods

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 overnight. 'Thosai' was prepared from the mix by roasting in the pan for 5 min.

The 'sampar' was prepared by taking following ingredients. Pumpkin (dubai), yellow dhal, carrot, brinjol and tomatoes were washed well in water and were cooked in water with onions and chilly for 20min. Then coconut milk powder and chili powder were added and cooked well.

The sampol was prepared as follows; The onions, Chilly, salt were added and ground in a domestic grinder. Then scraped coconut was added and grand for 10min. The ripped "itharai" variety of plantain was purchased in local market.

Analysis of foods

All foods were analyzed for their total sugar (4), total protein (Pearson, 14976), moisture (4), and soluble

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dietary fiber (5), insoluble dietary fiber (5), & total dietary fiber (5) contents .

Selection of subjects

A group of 20 healthy volunteers between 20 to 22 years old was selected and the weight & 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 study.

Ethical clearance

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

Estimation of blood glucose level of volunteers

The blood samples were collected and measured using semiautomated biochemical analyzer (TC 3300).

Calculation of glycaemic response and glycaemic index values

Glycaemic index and glycaemic response were calculated (6).

Statistical analysis

Glycaemic response and glycaemic index values of different types of bakery products were analyzed by Randomized Complete Block Design (RCBD) using SAS analytical package.

Results

Mean age, weight, and height and body mass index of the group I volunteers were 20.05 (± 0.92) years, 54.70 (± 5.74) kg, 1.63 (± 0.08) m and 20.73 (± 2.63) kgm^{-2} respectively. When 75g of glucose was orally administered to the volunteers, blood glucose level reached the peak value at 30min. The mean glycaemic response to the reference food (glucose) at 30, 60, 90 and 120 min were 56.70 (± 7.51), 35.30 (± 7.02), 19.60 (± 10.54) and 0.90 (± 2.77) mgdL^{-1} respectively. The proximate compositions of different foods are given in Table 1. After overnight fasting (12 h), 75g digestible carbohydrate containing different combinations of selected black gram based combined food items were administered to the volunteers on separate days. Peak glycaemic response to all the foods was obtained at 30min.

When 75.0g digestible carbohydrate containing 'Thosai' with 'sambol' was administered to the ten volunteers, the mean fasting blood glucose level was 91.70 (± 4.37) mgdL^{-1} and the mean blood glucose levels at 30, 60, 90

and 120 min were 127.0 (± 5.72), 115.10 (± 11.77), 106.30 (± 12.07) and 94.00 (± 4.40) mgdL^{-1} respectively (Table 2). The mean change in glycaemic response at 30, 60, 90 and 120 min were 36.20 (± 6.16), 23.40 (± 10.41), 14.60 (± 12.11), 2.30 (± 7.36) mgdL^{-1} respectively.

When 75.0g digestible carbohydrate containing 'Thosai' with 'sambol' and 'itharai' plantain was administered to the ten volunteers, the mean fasting blood glucose level was 94.20 (± 3.61) mgdL^{-1} and the mean blood glucose levels at 30, 60, 90 and 120 min were 128.40 (± 5.19), 115.80 (± 4.76), 106.80 (± 6.80) and 94.80 (± 3.65) mgdL^{-1} respectively (Table 2). The mean change in glycaemic response at 30, 60, 90 and 120 min were 34.20 (± 5.49), 21.60 (± 4.90), 12.60 (± 6.79) and 0.60 (± 3.78) mgdL^{-1} respectively (Table 3).

When 75.0g digestible carbohydrate containing 'Thosai' with 'sampar' was administered to the ten volunteers, the mean fasting blood glucose level was 87.40 (± 6.00) mgdL^{-1} and the mean blood glucose levels at 30, 60, 90 and 120 min were 128.00 (± 8.33), 117.00 (± 12.83), 103.60 (± 12.28) and 92.50 (± 5.38) mgdL^{-1} respectively (Table 2). The mean change in glycaemic response at 30, 60, 90 and 120 min were 40.60 (± 4.72), 29.60 (± 11.56), 16.20 (± 13.16) and 5.10 (± 7.67) mgdL^{-1} respectively (Table 3).

When 75.0g digestible carbohydrate containing 'Thosai' with 'sampar' and 'itharai' plantain was administered to the ten volunteers, the mean fasting blood glucose level was 93.30 (± 3.95) mgdL^{-1} and the mean blood glucose levels at 30, 60, 90 and 120 min were 132.30 (± 7.50), 120.40 (± 6.67), 109.00 (± 5.01) and 94.50 (± 4.55) mgdL^{-1} respectively (Table 2). The mean change in glycaemic response at 30, 60, 90 and 120 min were 39.00 (± 6.24), 27.10 (± 6.61), 15.70 (± 6.80) and 1.20 (± 3.74) mgdL^{-1} respectively (Table 3).

When 75.0g digestible carbohydrate containing 'Thosai' with 'sambol' and 'sampar' was administered to the ten volunteers, the mean fasting blood glucose level was 92.90 (± 2.51) mgdL^{-1} and the mean blood glucose levels at 30, 60, 90 and 120 min were 130.10 (± 7.16), 110.00 (± 6.41), 103.10 (± 7.36) and 97.40 (± 2.84) mgdL^{-1} respectively (Table 2). The mean change in glycaemic response at 30, 60, 90 and 120 min were 37.20 (± 5.33), 17.10 (± 6.40), 10.20 (± 7.60) and 4.50 (± 3.69) mgdL^{-1} respectively (Table 3).

When 75.0g digestible carbohydrate containing 'Thosai' with 'sambol', 'sampar' and 'itharai' plantain was administered to the ten volunteers, the mean fasting blood glucose level was 92.70 (± 2.71) mgdL^{-1} and the mean blood glucose levels at 30, 60, 90 and 120 min were 128.30 (± 4.42), 120.30 (± 4.55), 104.10 (± 8.29) and 95.50 (± 4.77) mgdL^{-1} respectively (Table 2). The mean change

in glycaemic response at 30, 60, 90 and 120 min were 35.60 (±4.67), 27.60 (±3.96), 11.40 (±8.10) and 2.80 (±4.21) mgdL⁻¹ respectively (Table 3).

The mean GI values of ‘Thosai’ either with ‘sambol’ or ‘sambol’ & plantain (‘itharai’) or ‘sampar’ or ‘sampar’ & plantain (‘itharai’) or ‘sambol’ & ‘sampar’ or ‘sambol’, ‘sampar’ & plantain (‘itharai’) 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 4).

The glycaemic response of glucose differed significantly (p<0.05) from ‘Thosai’ with ‘sambol’ or ‘sambol’ & ‘itharai’ plantain or ‘sampar’ & ‘itharai’ plantain or ‘sambol’ & ‘sampar’ or ‘sambol’, ‘sampar’ & ‘itharai’ plantain. The glycaemic response and glycaemic index values of ‘Thosai’ with ‘sambol’ differed significantly (p<0.05) from that of ‘Thosai’ with ‘sambol’ and ‘itharai’ plantain. The glycaemic response of ‘Thosai’ with ‘sampar’ did not differ significantly (p>0.05) from that of ‘Thosai’ with ‘sampar’ and ‘itharai’ plantain, while the glycaemic index value of ‘Thosai’ with ‘sampar’ differed significantly (p<0.05) from ‘Thosai’ with ‘sampar’ and ‘itharai’ plantain. The glycaemic response and glycaemic index values of ‘Thosai’ with ‘sambol’ and ‘sampar’ did not differ significantly (p>0.05) from ‘Thosai’ with ‘sambol’, ‘sampar’ and ‘itharai’ plantain.

Discussion

The GI of same amount of digestible carbohydrate containing cooked ‘Thosai’ either with ‘sambol’ or ‘sambol’ & plantain (‘itharai’) or ‘sampar’ or ‘sampar’ &

plantain or ‘sambol’ & ‘sampar’ or ‘sambol’, ‘sampar’ & 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. Based on these GI values, it can be suggested that ‘Thosai’ either with ‘sambol’ or ‘sambol’ & plantain or ‘sampar’ & plantain or ‘sambol’ & ‘sampar’ or ‘sambol’, ‘sampar’ & plantain are medium GI foods. The ‘Thosai’ either with ‘sampar’ is high GI food.

According to previous studies, the mean glycaemic index value of ‘Thosai’ with ‘sambol’ [63.93 (±7.62) %] was higher than that of “Thosai” [55.0 (±2.0) %] (Parboiled and raw rice, soaked, ground, fermented and toasted) with ‘chutney’ from a study in India (7, 8). The mean glycaemic index value of ‘Thosai’ with ‘sambol’ [63.93 (±7.62) %] was lower than that of “Thosai” [73.0 (±3.0) %] (Parboiled and raw rice, soaked, ground, fermented and toasted) with ‘chutney’ from another study in India (8). The mean glycaemic index value of ‘Thosai’ with ‘sampar’ and ‘sampar’ & ‘itharai’ plantain [71.90 (±4.73) and 68.59 (±4.18) % respectively] was closer to that of ‘Thosai’ [73.0 (±3.0) %] (Parboiled and raw rice, soaked, ground, fermented and toasted) with ‘chutney’ from India (8).

Among the different combinations of ‘Thosai’ studied with six different side dishes, ‘Thosai’ with ‘sambol’ & plantain is the best choice. Consumption of ‘Thosai’ either with ‘sambol’ or ‘sambol’ and plantain for those who need a low GI diet is advisable. Even though the above diets are selected for the diabetic and coronary heart disease patients, recommendation of the diets should be made the after analyzing their GI, glycaemic load and energy contents.

Table 1: Proximate compositions (%) of ‘Thosai’, ‘sambol’, ‘sampar’ and ‘itharai’ plantain

Food items	‘Thosai’	‘Sambol’	‘Sampar’	‘Itharai’ variety of plantain
Total CHO	39.2 (±0.17)	3.5 (±0.05)	4.5 (±0.08)	30.7 (±1.42)
Total Protein	8.2 (±0.18)	2.6 (±0.25)	2.7 (±0.12)	1.0 (±0.02)
Total Digestible CHO	38.1 (±0.18)	2.2 (±0.25)	3.8 (±0.12)	27.7 (±1.42)
Total fiber	1.1 (±0.0)	1.2 (±0.01)	0.7 (±0.0)	3.7 (±0.05)
Soluble fiber	0.7 (±0.0)	0.8 (±0.0)	0.4 (±0.0)	0.7 (±0.04)
Insoluble fiber	0.4 (±0.0)	0.4 (±0.0)	0.3 (±0.0)	2.9 (±0.03)
Moisture	50.5 (±0.14)	66.1 (±0.61)	85.6 (±0.20)	63.7 (±1.41)

Table 2: The changes in blood glucose (mg/dL) values of ‘Thosai’ with different side dishes

‘Thosai’ with	Blood glucose level (mg/dL)			
	30 min	60 min	90 min	120 min
‘Sambol’	127.0 (±5.72)	115.1 (±11.77)	106.3 (±12.07)	94.0 (±4.40)
‘Sambol’ & Plantain	128.4 (±5.19)	115.8 (±4.76)	106.8 (±6.80)	94.8 (±3.65)
‘Sampar’	128.0 (±8.33)	117.0 (±12.83)	103.6 (±12.28)	92.5 (±5.38)
‘Sampar’ & Plantain	132.3 (±7.50)	120.4 (±6.67)	109.0 (±5.01)	94.5 (±4.55)
‘Sambol’ & ‘Sampar’	130.1 (±7.16)	110.0 (±6.41)	103.1 (±7.36)	97.4 (±2.84)
‘Sambol’, ‘Sampar’ & Plantain	128.3 (±4.42)	120.3 (±4.55)	104.1 (±8.29)	95.5 (±4.77)

Table 3: The glycaemic responses (mg/dl) values of 'Thosai' with different side dishes

'Thosai' with	30 min	Glycaemic Response		(mg/dL)
		60 min	90 min	
'Sambol'	36.2 (±6.16)	23.4 (±10.41)	14.6 (±12.11)	2.3 (±7.36)
'Sambol' & Plantain	34.2 (±5.49)	21.6 (±4.90)	12.6 (±6.79)	0.6 (±3.78)
'Sampar'	40.6 (±4.72)	29.6 (±11.56)	16.2 (±13.16)	5.1 (±7.67)
'Sampar' & Plantain	39.0 (±6.24)	27.1 (±6.61)	15.7 (±6.80)	1.2 (±3.74)
'Sambol' & 'Sampar'	37.2 (±5.33)	17.1 (±6.40)	10.2 (±7.60)	4.5 (±3.69)
'Sambol', 'Sampar' & Plantain	35.6 (±4.67)	27.6 (±3.96)	11.4 (±8.10)	2.8 (±4.21)

Table 4: Glycaemic Index (%) of 'Thosai' with different side dishes

Different combinations of side dishes with 'Thosai'	Glycaemic Index (%)
'Sambol'	63.93 (±7.62)
'Sambol' & 'Plantain'	60.17 (±3.58)
'Sampar'	71.90 (±4.73)
'Sampar' & 'Plantain'	68.59 (±4.18)
'Sambol' & 'Sampar'	65.63 (±3.46)
'Sambol', 'Sampar' & 'Plantain'	63.04 (±5.05)

The composition of the food or meal will influence the blood glucose response. Further foods within the same classification can have different glycaemic indices. For example, the different varieties of potatoes, cereals showed variations in glycaemic indices (9,10). 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 (11). Therefore structural integrity of cell wall and starch granules also determine the glycaemic index. However, the methods of preparations of 'sambol' & 'sampar' were different. The moisture contents of the both preparations varied significantly. Thus the GI of 'Thosai' 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 (9).

When the total dietary fibre, soluble dietary fibre and insoluble dietary fibre contents are considered in the different basic diet in combination with different side dishes, no direct correlations with the changes in the GI were observed (Tables 2 and 3). An increase in the total fibre content of food can delay the glycaemic response (12). Fibre 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 monosaccharides through the microvillai of the epithelial cells of the jejunum and the upper part of the ileum (13). Total dietary fibre content has a significant negative correlation with GI (14) Based on the results, the 'Thosai' with 'itharai plantain' was 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 (Tables 3). 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. From the results it can be concluded that glycaemic index of a mixed diet is influenced by the ingredients included in the curries. Digestibility of sorgum, winged bean and horse gram was not influenced when it was supplemented with the red chilli, cumin, black pepper, coriander, garlic, asafoetide, dry ginger and ajowan (15). The digestibility of proteins of different legumes was decreased by chili and coriander (16). Therefore it is not possible to support the increase in glycaemic index of the food combinations with gravy, due to added spices. Inclusion of gravy to the different basic foods increased the GI. This may be due to the increased digestibility with high moisture content of the foods. However, further research on this observation is necessary.

Conclusions

Based on these GI values, it can be suggested that 'Thosai' either with 'sambol' or 'sambol' & plantain or 'sampar' & plantain or 'sambol' & 'sampar' or 'sambol', 'sampar' & 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 side 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 side 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 glycaemic index, glycemic load and energy contents of the foods.

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