International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Nutritive Value, Glycemic Index and Glycemic Load of Selected *Dosa* Varieties

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ABSTRACT

Background: Diets with low glycemic index (GI) are recommended for all pre-diabetics, diabetics and generally health conscious consumers. Methods: Five *dosa* items namely onion roast, *ragi* (finger millet) *dosa*, green gram *dosa*, *ravadosa* and *appam* were chosen for the study. These items were organoleptically evaluated, standardized and the nutritive value was estimated by factorial method. The GI and GL (Glycemic Load) of these items were studied using the procedure given by Jennie Brand Miller (2004). Findings: Organoleptic evaluation proved high acceptability of the *dosas*. The carbohydrate content (per portion) of all the *dosas* was 50g as it was planned so for the study of glycemic index. The protein content of green gram *dosa* was the highest (20.3g / portion) because the green gram is rich in proteins. The fat content of *appam* was the highest (11.6g / portion) due to the addition of coconut. The calcium content of *ragidosa* was the highest (240 mg / portion) as *ragi* is a rich source of calcium. Onion roast registered a low GI of 37 due to the inclusion of fibre rich onion. *Appam* recorded a high GI of 73 due to the presence of more amount of rice in it. The other *dosa* items recorded medium GI values ranging from 59 – 68. High GL was recorded by all the *dosa* items which could be attributed to the large nominal serve size and more available carbohydrate. Conclusion: Inclusion of fibre and protein rich foods reduces the GI.

Key Words: GI, GL, diabetes, carbohydrates, blood glucose, *dosa*

INTRODUCTION

The main risk factors for the high prevalence of diabetes among Asian - Indians were high racial susceptibility to diabetes, high familial aggregation, central obesity, insulin resistance and lifestyle changes due to the urbanisation (Ramachandran [1] *et al.*, 2003). To fight type 2 diabetes and its high risk of cardio vascular disease, life style intervention with diet and exercise are of utmost importance. Glycemic index (GI) is ranking of carbohydrates based on their immediate effect of blood glucose level. Carbohydrates that break down quickly, releasing glucose rapidly into the blood stream, have the highest GI. The blood glucose response is fast and high. On the other hand, carbohydrates that break down slowly releasing glucose gradually into the blood stream have the lower GI (Jenkins [2] *et al.*, 2002). Diets with low GI are recommended for all pre-diabetics, diabetics and generally health conscious consumers as they provide health benefits. Selection of foods with lower glycemic indices would contribute in prolonging the absorption of glucose, thereby improving the glycemic profile and reducing insulin requirements and fasting lipids (Roith [3] *et al.*, 2000). *Dosa* is a type of pancake from the Indian subcontinent, made from a fermented batter. The ingredients are rice, black gram and fenugreek seeds. *Dosa* is a typical part of the Southern Indian diet and popular all over the Indian subcontinent. Traditionally, *dosa* is served hot along with *sambar* and *chutney*. Nowadays varieties of *dosas* are

available attracting the consumers of all the sections of society.

MATERIALS AND METHODS

1. Selection of five *dosa* items, organoleptic evaluation

Five standard *dosa* items namely onion roast, *ragidosa*, green gram *dosa*, *ravadosa* and *appam* were chosen for the study. The *dosas* were prepared and organoleptically evaluated by 20 semi trained judges for the criteria viz., colour and appearance, texture, flavour and taste.

2. Estimation of carbohydrate content and portion size of each *Dosa* item for the study of Glycemic Index

Determination of portion size is very important for the study of glycemic index of a food item. Carbohydrate content of each of the selected *dosa* items for the raw ingredients was assessed making use of the food composition table given by ICMR (Gopalan [4] *et al*., 2000). Each *dosa* item was prepared and weighed. Based on the weight and carbohydrate content, the portion size containing 50 g of carbohydrate was determined. On the day of the study of glycemic response (on administration of the test food), the test food was prepared in bulk for 10 volunteers as per the recipe and the above steps were repeated for administering accurate portion sizes.

3. Assessment of nutritive value of one portion of each *dosa* item

The energy, protein, fat, fibre, calcium, iron, carotene, vitamin B_1, B_2, B_3 and vitamin C content of one portion (containing 50 g carbohydrate) of the standardized *dosas* were assessed.

4. Estimation of Glycemic Index (GI) of the *dosas*

The glycemic index of a food is thought to directly reflect the rate of digestion and entry of glucose into the systemic circulation (Schenk [5] *et al.*, 2003). Ethical clearance was obtained from PSG Institute of Medical Sciences and Research, Coimbatore and informed consent was obtained from the volunteers before conduct of the study. By convenient sampling 10 non-diabetic healthy adult volunteers were selected and the importance of the study was explained to them. The fasting blood glucose levels of the volunteers were determined using glucometers and test strips. Fifty grams of glucose was diluted in 150 ml of water and administered to them. The blood glucose levels after 30, 60, 90 and 120 minutes were determined and recorded. With the same volunteers, the study was carried out on the following day. The fasting blood glucose levels were recorded. Instead of glucose, the previously fixed portion of selected *dosa* containing 50 g of carbohydrate was administered and the blood glucose levels were determined as given above and recorded.

Using these values, the glycemic index of the selected *dosas* was determined using the following standard formula given by Brand Miller J (2004):

$$\text{Glycemic Index} = \frac{\text{Incremental area under the 2 hours blood glucose curve after eating 50 g of carbohydrate from test food}}{\text{Incremental area under the 2 hours blood glucose curve after taking 50 g of reference food (glucose in water)}} \times 100$$

5. Estimation of Glycemic Load (GL) of the *dosas*

Ebbeling and Ludwig [6] (2001) defined glycemic load as the weighted mean of the dietary glycemic index multiplied by the available carbohydrate content per serve size divided by 100. The GL was calculated using the following formula:

$$\text{Glycemic Load} = \frac{\text{GI} \times \text{Available carbohydrate content per serve size}}{100}$$

Hence glycemic load depends on the GI of the food items, the available carbohydrate content and its nominal serve size.

RESULTS

Acceptability of the *Dosas*

Organoleptic evaluation of the prepared *dosas* showed that the colour and appearance, texture, flavor and taste were highly acceptable to the selected panel of 20 semi trained judges.

Nutritive value of one portion of each *dosa* item

Table 1 gives the nutritive value per portion of the *dosas* (administered). The carbohydrate content (per portion) of all the *dosas* was 50 g as it was planned so for the study of glycemic index. The protein content of green gram *dosa* was the highest (20.3 g / portion) because the green gram is rich in proteins. The fat content of *appam* was the highest (11.6 g / portion) due to the addition of coconut. The calcium content of *ragidosa* was the highest (240 mg / portion) as *ragi* is a rich dietary source of calcium.

Table 1.Nutritive Value Of The Selected *Dosa*items Per Portion Size Used For The Study Of GI

S. No	Name of the Food Item	Portion size (g)	Energy (k.cal)	Carbohydrate (g)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Fibre (g)	Carotene (µg)	Vitamin B_1 (mg)	Vitamin B_2 (mg)	Vitamin B_3 (mg)	Vitamin C (mg)
1.	Onion *Roast*	136	277	50	6.9	5.4	34	1.16	0.3	5	0.18	0.05	2.26	1.6
2.	*RagiDosa*	136	274	50	5.1	5.9	240	2.73	2.5	29	0.29	0.13	0.77	-
3.	Green Gram *Dosa*	177	333	50	20.3	5.9	62	3.24	0.6	40	0.39	0.17	1.99	-
4.	*RavaDosa*	135	291	50	8	6.2	92	1.74	1.1	745	0.21	0.12	1.37	12.6
5.	*Appam*	114	332	50	6.7	11.6	22	0.73	1.0	3	0.12	0.05	1.33	0.1

Glycemic Responses to glucose and the *dosa* items in the selected volunteers

The fasting blood sugar levels of the selected volunteers ranged between 85 and 98mg/dl. On administration of 50 g of glucose with water, the blood glucose values elevated to the peak in 30 minutes with the values ranging from 137 to 141 mg/dl. On administration of the *dosa* varieties the peak values at 30 minutes were only 117-136 mg/dl. The values followed a reducing trend thereafter in both the cases

Glycemic Index of selected *Dosas*

Glycemic index is a numerical system of measuring how much of a rise in circulating blood sugar that the carbohydrate triggers. The higher the number, the greater the blood sugar response. Brand Miller J [7] *et al.* (2004) gave a special classification of foods based on their respective GI values as follows:

Range of GI	Category
1 - 55	Low GI
56 - 69	Medium GI
70 - 100	High GI

Table2. Glycemic index of selected *dosa* items

S.No	Name of the *Dosa* Item	Quantity Administered (g)	Glycemic Index (GI)	Category
1.	Onion *Roast*	136	37	Low
2.	*RagiDosa*	136	59	Medium
3.	Green Gram *Dosa*	177	63	Medium
4.	*RavaDosa*	135	68	Medium
5.	*Appam*	114	73	High

Of the five *dosa* varieties studied only onion roast was found to register a low GI of 37 which could be attributed to the presence of high fibre content in onion. *Appam* recorded

a high GI of 73 due to the presence of more amount of rice in it. The other *dosa* items recorded medium GI values ranging from 59 – 68 due to the inclusion of fibre rich millets / protein rich pulses (Table 2).

Glycemic Load of the selected *Dosas*

The concept of glycemic load (GL) is defined as the product of the GI and available carbohydrate content divided by 100 and was introduced to derive a global estimate of post prandial glycemia and insulin demand (Higginbotham [8] *et al.*, 2004). David Mendosa [9] (2008) gave a special classification of foods based on their glycemic loads as follows:

Range of GL	Category
1 – 10	Low GL
11 – 19	Medium GL
20 and More	High GL

Source: www.mendosa.com/gilists.htm

Table 3. Glycemic load of the selected *dosa* items

S.No	Name of the Food Item	Glycemic Index (GI)	Nominal Serve Size (g)	Available Carbohydrate (g)	Glycemic Load (GL)
1.	Onion *Roast*	37	181	67	25
2.	*RagiDosa*	59	182	67	40
3.	Green Gram *Dosa*	63	265	75	47
4.	*RavaDosa*	68	216	80	54
5.	*Appam*	73	182	80	58

From table 3, it could be seen that the nominal serve size varied widely between 181 and 265 gram and available carbohydrate from 67-80 g. High GL was recorded by all the five items (25-58)which could be attributed to the large nominal serve size common in India and more available carbohydrate.

DISCUSSION

Dietary management is an indispensable tool for the control of glycemia and prevention of complications of diabetes. Since foods with low GI causes significantly lower post prandial glycaemic responses, they are considered better for people with diabetes. A diet with low-glycemic index (GI) not only lowers postprandial hyperglycemia but also decreases the risk of post absorptive hypoglycemia in people with type 1 diabetes. (Rovner [10] AJ, *et al.*, 2009). Diets with low glycemic index acutely bring about a number of favourable effects, such as rapid weight loss, reduction of fasting blood glucose and insulin levels, reduction of circulating triglyceride level and improvement of blood pressure (Radulian and Rusu [11], 2009). According to Khan [12] *et al.* (2008), both the glycemic index (29) and glycemic load (5.3) of moong dhal were low due to the presence of complex carbohydrates which is beneficial for diabetics. Moong dhal was also reported to have a lot of phytonutrients which are anti-inflammatory and anti-microbial helping to boost immunity. Khan [12] *et al.* (2008) also studied the glycemic index of various pulses like chickpea, *chana* dal, kidney bean, mash bean, mung bean and peas and found that pulses have low glycemic index which may be attributed to their high dietary fiber and protein content. Janani [13] *et al.* (2016) revealed that the GI of foxtail millet *dosa* was 59.25 and rice *dosa* was 77.96. They also proved the superiority of millet - based *dosa* over the rice - based *dosa* through study of post prandial glucose in selected patients. Niveditha [14] *et al.* (2017) stated that the wheat *upma*, corn *puttu*, wheat *dosa* and *ragidosa* recorded lower glycemic responses than white *ravaupma*, rice *puttu*, rice *dosa* and wheat *dosa* respectively. Kathy Kolasa [15] (2017) reported that *ragi* had a lower GI than rice. *Ragi* is considered to be ideal food for diabetics due to its slow release of glucose/sugar in the body (Kang [16] *et al.*, 2008 and Lakshmi and Sumathi [17], 2002). The results of the present study are also in accordance with the above findings.

CONCLUSION

Inclusion of fibre rich onions and millets / protein rich pulses and other such ingredients had reduced the GI of *dosas*

compared to the *appam* which is made only with rice as the major ingredient. Diabetics should be encouraged to include such fibre and protein rich ingredients in all the food items to reduce the glycemic index considerably in order to achieve a better glycemic control.

ACKNOWLEDGEMENT

The authors acknowledge the University Grants Commission, New Delhi, India for sponsoring a major research project and this study is a part of it.

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How to cite this article: Sathiya V, Chithra R. Nutritive value, glycemic index and glycemic load of selected *dosa* varieties. Int J Health Sci Res. 2019; 9(3):215-219.

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