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***RESEARCH ARTICLE***

# GLYCEMIC EFFECT OF FUNCTIONAL FOODS ITEMS.

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## *Abstract*

**Background:** Low-Glycemic Index foods may reduce the insulin demand, improve blood glucose control, reduce blood lipid concentrations and body weight and thus could help prevent diabetes-related cardiovascular events. Low GI foods have been found to increase satiety, reduce hunger and food intake in many short term feeding studies thus useful in weight management. **Objectives:** To determine the glycemic index of the developed ready to eat functional food products. **Materials and Methods:** Normal subjects aged between 20 to 25 yrs (female) 10 students of SHUATS were selected. They were clinically normal and non-diabetic. The subjects were appraised about the experiment and their consent will be taken. **Results:** Study revealed that composite flour based mathri had low glycemic index while control mathri had high glycemic index and composite flour based biscuits had moderate glycemic index while control biscuits had high glycemic index**. Conclusion:** Glycemic index of medicinal herbs will be help to combat deficiency diseases as well as the combination of barley, garlic and black cumin seeds will provide a wide variety of nutrients and maintaining healthy die.



## Introduction:-

The glycaemic index (GI) was introduced by Jenkins and co-workers in the early 1980s, and is a concept for ranking of carbohydrate foods based on their effects on postprandial glycaemia **(Jenkins *et al.* 1981).** The GI is defined as the incremental blood glucose area following the test food, expressed as the percentage of the corresponding area following a carbohydrate equivalent load of a reference product. With white bread as reference, GIs range from less than 20 to approximately 120 %. The main cause for these large differences in GI is differences in the rate of digestion or absorption of the carbohydrates, and low-GI foods thus release glucose to the blood at a slower rate. The concept appears to rank foods similarly in diabetic and non-diabetic individuals **(Crapo *et al.* 1981),** although originally the identification of foods of low-GI character was considered mainly in diabetes.

Many people have raised concerns about the variation in published GI values for apparently similar foods. This variation may reflect both methodologic factors and true differences in the physical and chemical characteristics of the foods. One possibility is that 2 similar foods may have different ingredients or may have been processed with a

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different method, resulting in significant differences in the rate of carbohydrate digestion and hence the GI value. Two different brands of the same type of food, such as a plain cookie, may look and taste almost the same, but differences in the type of flour used, in the moisture content, and in the cooking time can result in differences in the degree of starch gelatinization and consequently the GI values. In one study, using GI values of the included food items from the international table **(Foster-Powell 2002)** and measuring the GI value of the final meal **according to WHO,** no correlation between the measured and calculated values of 14 European breakfast meals was found. **Dutch Zutphen** Study showed no relationship between intake of ‘‘simple’’ or ‘‘complex’’ carbohydrates and risk of diabetes in elderly (64_85-year old) men and women during a four-year follow-up.

**Objectives:** To determine the glycemic index of the developed ready to eat functional food products.

## Materials and Methods:-

The present study “Development and Evaluation of Glycemic Index of Functional Foods using Low Glycemic Ingredients” was concluded in the Department of Foods, Nutrition and Public Health, Ethelind College of Home science, Sam Higginbottom University of Agriculture, Technology and Science (SHUATS), Allahabad**.**

Barley, garlic and black cumin seed were procured from local market of Allahabad district, for the preparation of low glycemic based products. Blends were prepared by mixing barley seed, garlic seed and black cumin seed in different ratios such as T1 ( 60:27:10:3), T2(50:37:10:3), T3 (40:47:10:3) and T4 (30:57:10:3) on a dry to dry basis to develop low glycemic functional foods.

**Computation of Glycaemic Index of the developed ready to eat functional food products:-**

**Selection of subjects:**

Normal subjects aged between 20 to 25 yrs (female) 10 students of SHUATS were selected. They were clinically normal and non-diabetic. The subjects were appraised about the experiment and their consent will be taken.

**Ethical Approval:** Approval of the Ethical Committee was taken prior to the experiment.

**Analysis of blood glucose in the subjects:**

All subjects for investigation fasted overnight (10-12) hr. Their blood sample was collected through finger prick using a hypodermic needle. Each blood sample was inserted into a calibrated glucometer (Accu-check) which gave direct reading after 45 seconds based on glucose oxidase assay method. The determination of blood sugar was taken at intervals i.e. 0 fasting, 15mins, 45mins, 60mins, 90mins, and 120mins after feeding the experimental diets.

**Experimental diets:**

**Reference foods: -**

After fasting for 10-12 hours, subjects were required to arrive at the laboratory at 8 O’ clock in the morning and blood samples were obtained. Fasting blood sugar was estimated and postprandial blood sugar was taken at 15, 30, 45, 60, 90 and 120 minutes after consumption of 50g glucose dissolved in 200 ml drinking water.

**Test food I (control):-**

Mathri and biscuits (control food containing 50g carbohydrate) standardized in the nutrition lab. Fasting blood glucose of the subjects after 10-12 hour’s overnight fasting was obtained and postprandial blood sugar (PPBS) was taken at 15, 30, 45, 60, 90, 120 minutes interval after consumption of test food

**Test food II (treatment):-**

Mathri and biscuits were developed by incorporation of wheat flour, barley flour, garlic powder and black cumin powder functional food products (mathri) at different percent level was taken as a test food II as it scored best in terms of organoleptic characteristics. 50g available carbohydrate for test food sample was calculated from the results of the proximate analysis and the measured portion of the food was served to the subjects. Fasting blood glucose of the subjects after 10-12 hours of overnight fasting was obtained whereas PPBS was taken at 15, 30, 45, 60, 90, and 120 minutes interval after the consumption of test food II.

**Glycemic Index Calculation:-**

Changes in blood glucose concentration were calculated separately for each post meal period by using the blood concentration before meal (time 0) as a baseline. Postprandial responses were compared for maximum increase and incremental area under the glucose curves for each food. The integrated area under the postprandial glucose curve was calculated by the trapezoidal method **(Wolever *et al.*, 1987).**

**Area under curve:-**
The incremental area, under the blood glucose response curve (IAUC) was calculated by the following as given by **(Wolever 2004)** at times t0……..tn (here equaling 0, 15…..120 min, respectively) the blood glucose concentrations are G0, G1….Gn respectively.
IAUC of food taken by each subject was calculated to find GI. The GI of the test food was calculated as the mean GI± M.S.E of the 10 subjects.

**Glycemic index was calculated by the following formula:-**

$$\boldsymbol{GI = \frac{Incremental\ area\ under\ blood\ glucose\ response\ curve\ (IUAC) for\ the\ food}{Corresponding\ area\ after\ equi-carbohydrate\ portion\ of\ a\ reference\ food\ (glucose)} \times 100}$$

**Data analysis:-**
After collecting all data, data entry was performed in Microsoft Excel. Data were organized and presented by applying principles of descriptive statistics. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp was used for analysis. Logistic t test was applied in the presence of considered data.

## Results:-

**Glycemic index of the developed ready to eat functional food products.**
**Mean blood glucose concentration of subjects after consuming reference, control and test foods (mathri).**
Table 1. shows that the mean blood glucose level of experimental subjects after consuming reference food (glucose), control mathri and mathri developed by incorporation of wheat flour, barley flour, garlic powder and black cumin powder (50:37:10:3) ($T_2$) as test food II.

**Table: 1:-** Mean Blood glucose concentration (mg/dl) of the subjects after consuming reference food, control food and food developed by utilizing of composite flour (mathri).

| **Time** / **Foods** | **Fasting** | **15 min** | **30 min** | **45 min** | **60min** | **90 min** | **120 min** |
|---|---|---|---|---|---|---|---|
| **Reference Food (glucose)** | 91.1 | 140 | 133.1 | 126.8 | 119.1 | 127 | 139.2 |
| **Control (mathri)** | 88.3 | 114.3 | 96.4 | 90 | 82.9 | 93.9 | 113 |
| **Composite flour (mathri)** | 86.3 | 103.6 | 90.4 | 84.5 | 79.6 | 82 | 82.5 |

Table 1 shows that postprandial blood glucose values of reference food (glucose) ranged between 119.1 to 140 mg/dl with peak value at 15imnutes. Postprandial blood sugar (PPBS) values were highest for reference food followed by control mathri (test food I) and least value were reported for composite flour based mathri (test food II) ranging between 82 to 103.6 mg/dl with peak value at 15 minutes.

**1. (a) Mean glycemic index of developed products prepared by composite flour.**
Data presented in table 1.(a) shows that the glycemic indices of control (mathri) and developed products prepared by utilizing of composite flour (mathri).

**Table 1.(a)** Glycemic index of control mathri and composite flour based mathri.

| S. No. | GI of Control mathri | GI of Composite flour based mathri | $T_{cal}$ | $T_{tab}$ (5%) |
|---|---|---|---|---|
| **1** | 77.85 | 63.39 | | |
| **2** | 74.82 | 66.63 | | |
| **3** | 83.08 | 58.23 | | |
| **4** | 84.17 | 52.96 | | |
| **5** | 80.29 | 48.46 | | |
| **6** | 83.94 | 49.23 | | |
| **7** | 74.14 | 51.86 | | |
| **8** | 80.57 | 55.43 | | |
| **9** | 86.76 | 48.53 | | |
| **10** | 73.91 | 50.04 | | |
| **Mean± SD** | **79.96±4.61** | **54.48±6.41** | **3.096**$^{S}$ | **2.7764** |

Table 1.(a) shows that the mean value of glycemic index (GI) for test food II (mathri) was found to be 54.476 ± 6.41. Glycemic index of control mathri was found to be 79.95 ±4.61. Composite flour based mathri had low glycemic index while control mathri had high glycemic index. Significant (5%) was found between control and test sample. So substitution of low-GI (GI< 55) carbohydrates for an isoenergetic amount of high-GI (GI >70) carbohydrates or low-GI carbohydrates for medium-GI (55<GI<70) carbohydrates was not associated with diabetes risk.

**Mean blood glucose concentration of subjects after consuming reference, control and test foods (biscuits).**

Table 2 shows that the mean blood glucose level of experimental subjects after consuming reference food (glucose), control biscuits and biscuits developed by incorporation of wheat flour, barley flour, garlic powder and black cumin powder (30:57:10:3) ($T_4$) as test food II.

**Table: 2.** Mean Blood glucose concentration (mg/dl) of the subjects after consuming reference food, control food and food developed by utilizing of composite flour (biscuits).

| Time / Foods | Fasting | 15 min | 30 min | 45 min | 60min | 90 min | 120 min |
|---|---|---|---|---|---|---|---|
| **Reference Food (glucose)** | 92.1 | 139.8 | 134.3 | 127.6 | 120.6 | 126.9 | 139.1 |
| **Control (mathri)** | 92.8 | 119.5 | 98 | 92.6 | 86 | 96.6 | 115.7 |
| **Composite flour (mathri)** | 93.6 | 105 | 92 | 85.6 | 81.4 | 83.2 | 84.3 |

Table 2 reported that postprandial blood glucose values of reference food (glucose) ranged between 120.6 to 139.8 mg/dl with peak value at 15 minutes. Postprandial blood sugar (PPBS) values were highest for reference food followed by control biscuits (test food I) and least value were reported for composite flour based biscuits (test food II) ranging between 821.4 to 105 mg/dl with peak value at 15 minutes.

**2. (a) Mean glycemic index of developed products prepared by composite flour.**

Data presented in table 2. (a) shows that the glycemic indices of control (biscuits) and developed products prepared by utilizing of composite flour (biscuits).

**Table 2. (a) Glycemic index of control mathri and composite flour based biscuits.**

| S. No. | GI of Control biscuits | GI of Composite flour based mathri | $T_{cal}$ | $T_{tab}$ (5%) |
|---|---|---|---|---|
| **1** | 89.13 | 58.31 | | |
| **2** | 78.32 | 62.32 | | |

| | | | | |
|---|---|---|---|---|
| **3** | 83.08 | 59.33 | | |
| **4** | 84.89 | 61.42 | | |
| **5** | 81.75 | 58.23 | | |
| **6** | 83.09 | 54.14 | | |
| **7** | 76.76 | 52.16 | | |
| **8** | 82.87 | 56.19 | | |
| **9** | 84.89 | 51.86 | | |
| **10** | 85.6 | 52.98 | | |
| **Mean ± SD** | **83.05 ± 3.55** | **56.69 ± 3.80** | **3.834$^{S}$** | **2.7764** |

Table 2. (a) Indicates that the mean value of glycemic index (GI) for test food II (biscuits) was found to be 56.69 ± 3.80. Glycemic index of control biscuits was found to be 83.03 ±3.55. There was significant difference between control and test sample. Composite flour based biscuits had moderate glycemic index while control biscuits had high glycemic index**.**

## Discussion:-

**According to FAO/WHO (1998)** the IAUC of the blood glucose response is calculated for two hours after starting to eat the food. The GI is the IAUC of the test food divided by the corresponding IAUC after the control food, multiplied by 100%, first calculated for each subject and then the GI of the food is the mean of the GIs of the subjects. Predicting glycemic responses of meals that also include fat or protein is however, more complicated because fat and protein affect (typically lower) glycemic responses similar study reported by **Hatonen *et al.*, (2011). Marsh *et al.*, (2011)** reported that the epidemiologic GI studies do not typically examine the health effects of lower GI carbohydrates relative to the effects of higher GI carbohydrates within the food groups. The GI concept recommends substitution of low-GI foods for high-GI foods within the same food group. The possibility of examining effects of lower GI within food groups is restricted by the limited consumption of foods with variable GIs within food groups.

Associations between consumption of sugar and metabolic states might depend on the magnitude of sugar consumption. In this study, the median sugar intake was 6.7 E%. Metabolic disadvantages of sugars have been reported with higher consumption of added sugar (mean 15.8 E %) **Welsh *et al.*, (2010).**

**Busetto *et al.*, (2011**) studied that in addition, exploring separately the associations between carbohydrates with different GIs (high-, medium-, and low-GI carbohydrates) and risk of diabetes would clarify the inconsistency between the hypothesis of detrimental effects of high-GI carbohydrates and the finding of many large prospective cohort studies that greater total carbohydrate intake is not associated with increased diabetes risk. Recently, high-protein, low-carbohydrate diets for weight loss has received much attention.

Dietary GI as an average ratio fell within a narrow range, limiting the possibilities to observe associations of dietary GI with normal person. Dietary GI concealed unexpected dimensions of the diet; the main contributors to the interindividual variation in dietary GI differed substantially from the main contributors to carbohydrate intake. Furthermore, the main contributor foods to the interindividual variation in dietary GI, milk and beer, were associated with diabetes risk in a direction opposite that expected based on their GIs.

## Conclusion:-

High dietary GI and GL were not associated with increased diabetes risk. Application of multivariate nutrient density models to epidemiologic studies on GI and diseases allows the GI and the amount of carbohydrates to be considered separately. In this study, substitution of lower-GI carbohydrates for higher-GI carbohydrates was not consistently associated with lower diabetes risk. The product *mathri* and *biscuits* were prepared from barley flour, whole wheat flour, black cumin powder and garlic powder was found to produce a glycemic index of 54.48 and 56.69 which is a low glycemic and moderate glycemic index food. Hence it can be recommended as a snack or breakfast item for diabetics as well the general population in order to overcome the nutritional problems in future.

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