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Glycaemic Response of Minor Millet-Based Chapathi in Normoglycemic Subjects

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Abstract

Diet is corn stone in the management of non-communicable diseases i.e., diabetes and low glycemic index of foods are gaining more importance as they delay the release of glucose in the blood. It is necessary to develop low glycemic food from regionally available ingredients for use in daily dietaries. Hence, the present study was undertaken to assess the glycemic index of the traditional recipe prepared from developed millet-based food mix and their GI on normal subjects. The glycemic index was found to be 54 moderate glycemic load of < 18.8 for MMBC. However, the developed chapathi showed a relatively lower glycemic index. The glycaemic index study indicating it is a preferable option in the management of diabetes mellitus.

Keywords: Millets; Glucose; Glycaemic Index; Chapathi

Abbreviations: IAUC: Incremental Area Under The Curve; GI: Glycemic Index; RF: Reference Food; TF: Test Food.

Introduction

In recent trends, the consumption of refined foods and high-energy, low-nutrient-dense foods raises blood sugar rapidly and are termed as high glycemic foods. High glycemic foods are leading to increasing non-communicable diabetes i.e obesity, diabetes, and metabolic syndrome [1]. The Glycemic index represents the blood glucose alteration capacity of the food. Foods with a low glycemic index show the slower release of glucose [2]. Low GI diets have been shown to improve glucose levels and prevent weight gain because they help to control appetite, and reduce insulin resistance, resistance to increase lipoproteins it helps in prevent the risk of cardiovascular diseases, diabetes and some cancers.

The management of non-communicable diseases needs diet modification which includes a diet complex carbohydrates, protein, fiber, and low in fat, which does not cause a rapid rise in blood glucose levels. Significant alterations in the glycemic index and dietary fiber content of meals were known to include small but significant glucose profile changes [3]. In recent decades the millets have been gaining importance in nutrition due to rich dietary fiber source that provides a wide range of nutrients and phytochemicals, including Vitamin E, magnesium, and folate that optimize health and millets contain a higher proportion of unavailable carbohydrate and release of sugar from millets.

They contain water-soluble gum and β-glucan which help improve glucose metabolism. Millets contribute to antioxidant activity through phytates, polyphenols, and tannins present in them, having an essential role in aging and metabolic diseases [4]. Therefore, even pulses are known for their low glycemic value due to high protein and dietary fiber content, which leads to the slow release of carbohydrates. Functional food grains such as barley, oats, fenugreek seeds are proven hypoglycemic foods. A meal consisting of the combination of cereals, pulses and functional ingredients are found to be more effective than only the cereal diet. There is an immense need to develop cost-effective food products using nutridense ingredients hich is of practical utility in preventing and management of diabetes and obesity [5]. Hence, the present study was undertaken to assess the glycemic index of the specific traditional recipe of Southern and North Indian prepared from developed millet-based food mix which may be of daily use for the management of diabetes.

Methodology

Study Site

The present study was carried out at department of Foods and nutrition, Post Graduate Research Centre, Professor Jayashankar Telangana State Agricultural University, Telangana, India.

Development of Minor Millet-Based Chapathi

Millet based chapathi was prepared by using the ingredients viz., four minor millets are foxtail millet, proso millet, barnyard millet and kodo millet along with other flours i.e., whole wheat flour, oats, barley, defatted soya (Glycine max) flour, green gram flour (*Vigna radiata*), fenugreek seeds (*Trigonella foenum-graecum*), and gums. Minor millet based chapathi was developed by mixing the flours with different proportions. The chapathi was selected due to be a traditional recipe North and South State of India. Were prepared from the developed mix to assess their glyceamic index.

Selection of Traditional Recipe

The present study purpose is the development of a low glycaemic index product for diabetics. A preliminary survey was conducted on 50 diabetic subjects to select the most commonly consumed breakfast and lunch items in the study area. Based on the survey chapathi as meal item was chosen for the study. Assessment of Glyceamic index

Selection of Subjects for Glycaemic Index Assessment

For the present study purpose 12 sedentary, normoglycemic healthy subjects aged between 18 to 30 years were selected from students and non-teaching staff of professor Jayashankar Telangana State Agricultural University, for testing glycaemic index of each product. Initially, blood glucose levels assessed as pre evaluation assessment. Based on pre evaluation 12 subjects were selected for the study. The information sheet was provided to subjects, after a clear explanation about the protocol and purpose of the study, the written consent was obtained. Selected subjects were requested to maintain their usual daily food intake and activity throughout the study period.

Assessment of Glycaemic Index

Glycemic index of the product prepared from 'minor millet flour mix' was evaluated according to Wolever, et al. [6] method on twelve healthy subjects. Developed mix equivalent to 50 g of available carbohydrate was taken for preparation of roti, used for glycemic index assessment. Capillary blood was drawn through finger prick method and evaluated for glucose content by using the glucometer (One touch).

Initial fasting blood glucose was taken with overnight fasting of 10–12 h, further, 50 g of glucone-D in 200 ml of water was given as reference food, and post-prandial blood glucose response at 30, 60, 90 and 120 min interval were assessed. With the gap of 3 days period, chapathi equivalent to 50 g of available carbohydrate was given separately with the wash out period of 3 days for each product. Fasting and postprandial blood glucose level was assessed for each product. Blood glucose response curves were plotted for both reference food and test food product (chapathi). The incremental area under the curve (IAUC) was calculated to reflect the total rise in glucose concentration after the administration of test foods in comparison with reference glucose powder. The Glycemic index was calculated by using the formula.

$$Glycemic\ index = \frac{\Delta\ Area\ under\ glucose\ curve\ forest\ food}{\Delta\ Area\ under\ glucose\ curve\ for\ reference\ food}$$

Glycaemic Load

Glycemic load was calculated by multiplying the actual amount of carbohydrates present in one serving of test food (chapathi) with the glycemic value of respective test food, divided by 100 [7].

$$Glycemic\ load = \frac{Glycemic\ index \times Available\ carbohydrate\ content\ preserving\ of\ meal\,(g)}{100}$$

Results and Discussion

Glycemic Index of MMBC

The glycemic index consists of a scale ranging from 1 to 100, indicating the rate at which 50 g of carbohydrate in a particular food is absorbed into the bloodstream as blood sugar. Glucose is used as reference food and is rated 100.

Classification of GI i) High glycemic index foods (GI > 70) ii) Medium glycemic index foods (GI in between 56- 69) and iii) Low glycemic index foods (GI ≤ 55) as reported by Gordillo-Bastidas. The study on glycemic index profile of minor millet based chapathi was carried out and the results are presented as IAUC, GI and GL in Figures 1 & 2.

The Glycaemic effect of the food is a measure of speed and level of blood glucose increase, and the time taking by the body to bring it back to normal [8,9]. The glycemic load, which assesses the diet's total glycemic effect and has proved very useful in epidemiologic studies, is the product of the dietary glycemic index and total dietary carbohydrate [7].

In the present study, twelve healthy human subjects had volunteered for participating in the study; they had normal ranges of glucose i, from 90- 100 mg/dl. After administration of 50g of glucose, the blood glucose values were recorded at different point of time0, 30, 60, 90 and 120 minutes with a 3 day washout period, later on,a similar procedure was followed in case of test food, and results are presented in Figure 1.

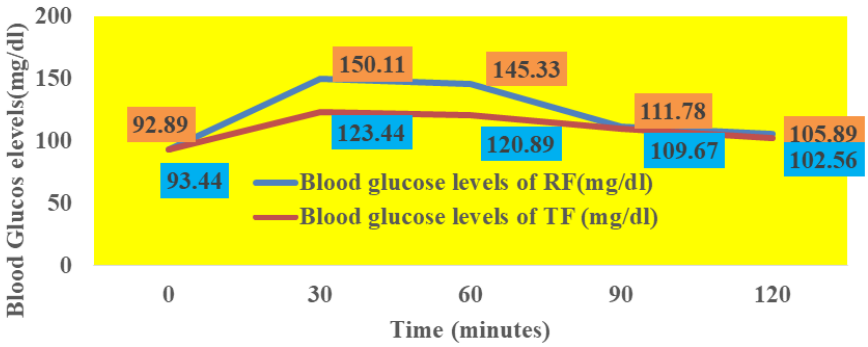

Figure 1: Blood glucose levels of glucose and test food (Minor millet based chapathi) during 2 hours period (RF: Reference food, TF: Test food).

Figure 1.1: Compares the rise of blood glucose at different time intervals in the test food and reference food. A higher increase (92.89 to 105.89 mg/dl) in blood glucose in the case of reference food was observed than in test food (93.44 to 102.6mg/dl).

The Glycaemic index of minor millet-based chapathi 54.29mg/dl (Glycaemic load is18.68) lower than the reference food. The results of the present investigation indicate that reference food exhibited a higher Glycaemic response; minor millet-based chapathi (MMBC) had a lower response. This is due to the millet and other functional ingredient having higher soluble fibre, dietary fibre and resistant starch content, and the soluble fibre content incorporated in chapathi. These components are found to reduce gastric emptying and absorption of glucose after a meal, resulting in improved glucose tolerance. Soluble dietary fibre component has been reported to decrease the activity of digestive enzymes, thus resulting in incomplete hydrolysis of carbohydrates, protein and fats and delaying absorption.

Similar results observed by Meyer, et al. [10] the GI was inversely related to the fibre content of the food. These values are similar to those of composite flour and bread 54.53, 50.69 and 54.76 for, T1V1 (kodo millet), T2V2(little millet) and T3V3(foxtail millet) respectively, which was found to be significantly lower than control T0 (71.33). The Glycaemic index of composite bread was lower than control bread with the values being 44.44, 42.64, 46.48 and 64.01 for T1V1, T2V2 T3V3 and T0 respectively [3]. Similar results were reported by Arora, et al. [11] for finger millet and foxtail millet flour incorporated bread. Shukla, et al. [12] to developed finger millet incorporated noodles for diabetic patients. The 30%finger millet incorporated noodles of the glyceamic index was observed significantly lower (45.13) than control noodles (62.59). It was found that finger millet flour incorporated noodles to be nutritious and showed a hypoglycaemic effect.

Anderson, et al. [13] stated that millets contain water-soluble gum β-glucan, helpful in improving glucose metabolism. In addition, high fibre foods slow down the influx of contents from the gut, finally reducing the rate of digestibility hence called low glycaemic foods [2]. Likewise, the quality of carbohydrates shows a significant close association with the increased disease risk for diabetes and CVD [14]. Therefore, as the chapathi from developed millet-based flour mix as low GI, this can be recommended to the diabetic population in regular high GI products.

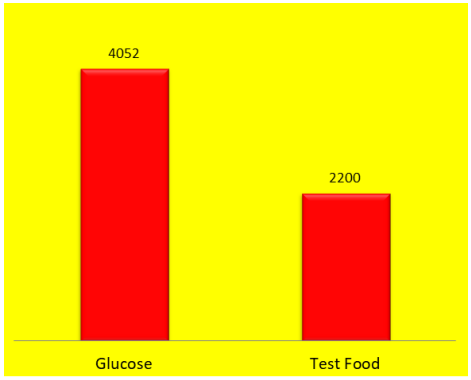

Figure 2: AUIC of Glucose (reference) vs Test Food (Minor millet based *chapathi*).

The data on the AUIC of minor millet based chapathi (test food) and glucose (reference food) in normal subjects is depicted in Figure 2. It is clear from the AUIC of the test food is nearly half of the AUIC of reference food, indicating the lower glycemic response when an equal amount of both the foods are consumed.

Conclusion

The concept of glycemic index and glycemic load in diet therapy is beneficial in reducing the rising incidence of diabetes, obesity, metabolic syndrome. Millets have being playing functional and therapeutic properties due to their high nutritious content. Foods with millets, pulses, and along with other nutriedense grains based chapathi proved low glycaemic index. This chapathi would be a cost-effective dietary option for diabetes and other non-communicable diseases. Further, the mix can be explored for preparation of other traditional recipes for day-to-day use which would be beneficial for the management of diabetes. The results suggested that developed millet based chapathi had low glycaemic index and glycaemic load, it may play a potential role in lowering the FBS and HbA1c indicating the preferable option of such food for diabetics.

- **Ethical Committee Approval**

An institutional ethical committee clearance certificate was obtained before the initiation of the study (Project No. 01/ IEC/PJTSAU/AICRP/-PGRC/HHD/2017-01).

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