Indian Journal of
Nutrition

Open Science Publications

Volume 7, Issue 1 - 2020

www.opensciencepublications.com

Determination of Glycemic Index and Glycemic Load of Taste Good Biscuits in Healthy Human Adult Subjects, Under Fasting Conditions

Research Article

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Article Information: **Submission:** 07/02/2020; **Accepted:** 09/03/2020; **Published:** 12/03/2020

Abstract

Study background: Complementary alternative system of medicine is widely used in the management of Diabetes mellitus. *Momordica charantia* is a medicinal plant with significant hypoglycaemic activity and can be used as an adjuvant to allopathic treatment. Taste Good karela biscuits were developed with good palatability and nutritional value. It is essential to have the glycaemic index and glycaemic load of a food product, before any healthcare professional recommends it to patients with hyperglycaemia.

Objective: To determine the glycaemic index and glycaemic load of Taste Good biscuits in healthy human adult subjects under fasting conditions.

Methods: This was a single centre study. Twelve healthy human adult subjects participated, data is available for 10 subjects. The study was conducted as per the recommendations of FAO / WHO.

Results: The mean peak capillary blood glucose was 147.4±29.3mg/dL at 45 minutes with test food (Taste Good biscuits) and 188.1±29.2mg/dL at 30 minutes with reference food (Glucon D). The mean blood glucose incremental area under the curve for test food was 3681.9 min.mg/dL (SEM±736.1) and for reference food 6651.9min.mg/dL (SEM±740.2).

Conclusion: The glycaemic index of Taste Good biscuits was 57.94 which is medium as per GI classification. The glycaemic load is 6.14 per typical serving of two biscuits which is low as per the classification of glycaemic load. Taste Good biscuits can be used as a mid meal snack by patients with diabetes mellitus along with their regular anti diabetic treatment.

Keywords: Taste good biscuits; Karela; Glycaemic index; Glycaemic Load

Introduction

Momordica charantia (*M. charantia*), popularly known as bitter melon, Karela, balsam pear or bitter guard and is used in the treatment of Diabetes Mellitus (DM) [1]. Bitter guard is one of the commonly used vegetable that contains insulin like protein known to reduce the blood sugar levels [1]. The blood glucose lowering properties of *M. charantia* have been consistently demonstrated in clinical trials [2]. A number of bioactive phytochemical compounds have been isolated from it [2].

M. charantia has a good nutritional value containing a variety of phytonutrients like dietary fibre, minerals, vitamins and antioxidants [1,3]. Possible modes of hypoglycaemic actions of *M. charantia* are due to phytonutrient Polypeptide - p or p-insulin. This plant insulin, works similar to human insulin in the body and lowers the blood glucose levels apart from protecting the pancreatic islet cells [1].

The other bioactive phytochemical compound is Charantin. This helps in promoting insulin release and stimulates the peripheral and skeletal muscle glucose utilisation. Inhibition of intestinal glucose uptake and its transportation, suppression of key gluconeogenic enzymes are some of the other actions of charantin [1].

In addition to the glycaemic control, *M. Charantia* is proposed to have protective effects on target organs by delaying nephropathy,

ISSN: 2395-2326

neuropathy, retinopathy, gastroparesis, cataract and atherosclerosis as well [2].

The concept of food as medicine is the central theme in diabetic and nutritional science [1]. Natural food products are acquiring substantial importance for the treatment of diabetes mellitus [4]. *M. charantia* has been used as a dietary supplement and ethno-medicine throughout centuries for relieving symptoms and conditions related to diabetes mellitus [1]. Food quality and diabetes mellitus have close association with each other.

With this concept of food, as medicine Karela Biscuits (TASTE GOOD) were developed by AZISTA INDUSTRIES PRIVATE LIMITED, HYDERABAD as a mid-meal snack (between two meals). These biscuits are high in fibre, with no added sugars, zero trans-fat and no cholesterol [5].

Glycaemic Index (GI) is a scale which helps in ranking the carbohydrate containing foods, depending on how rapidly, the blood glucose levels raise in a span of 2 hours after having the food/food product as compared to pure glucose, which is assigned a glycaemic index value of 100 [5].

Glycaemic load is also a better predictor of glycaemic response [6]. It indicates whether the food eaten in typical servings is healthy or not.

It is important to establish the GI value of the Taste Good biscuits and make it available to the population. Hence, the present study was undertaken to determine the glycaemic index and glycaemic load of Taste Good Biscuits in healthy human adult subjects under fasting conditions.

Materials and Methods

This study was approved by the Institutional Ethics Committee, Ramdev Rao Hospital, Hyderabad. 12 healthy, non-diabetic, adult subjects of either gender, aged between 18 - 45 years were included in the study. Written informed consent was obtained from the participants before initiation of the study related procedures.

On the day of study, subjects reported in the department after an overnight fast of 10-12 hours [7]. A general clinical examination, anthropometric measurements were recorded. Subjects received either Taste Good biscuits or Glucon D as per randomization. After a washout period of 3 days, during the period 2, those subjects who consumed Taste Good biscuits during the period 1 received and consumed Glucon D and vice versa (the subjects were crossed over during the period 2).

Each subject consumed either 95 grams of Taste Good biscuits (equivalent to 50 grams of glucose) with 250 - 500ml of water or 50 grams of Glucon D dissolved in 240ml of water. The study food products were consumed within 12-15 minutes. The subjects were restricted from performing any physical activity during the 2 hour study period.

Baseline fasting capillary blood sample was collected by finger prick method. Blood glucose levels were estimated using glucometer (Accu Chek Roche Diabetic Care, calibrated with the control solution) [8]. Further capillary blood samples were collected at 15, 30, 45, 60, 90 and 120 min after completing the consumption of the study food products [7,9].

Blood glucose curves were constructed from capillary blood glucose values for each subject at time 0, 15, 30, 45, 60, 90 and 120 minutes intervals after consumption of the study food products. The average blood glucose response curve was constructed by the mean blood glucose concentration of the subjects at each time point.

Blood glucose concentration was calculated by subtracting the fasting value. The incremental area under the blood glucose response curves (IAUC) was calculated by applying trapezoidal rule for each subject separately [10].

Glycemic index (GI) for each individual subject was calculated by Test IAUC by the Reference IAUC .

$$\text{The individual subject glycemic index } (GI) = \frac{\text{IAUC for test food}}{\text{IAUC for reference food}} \text{ X } 100 \quad [10]$$

Resulting mean value of the 10 subjects was the GI of the test food product (Taste Good biscuits).

The glycemic load (GL) is the impact of the carbohydrate containing food has on blood sugar. GL = GI (%) x grams of carbohydrate in the typical serving of test food eaten.

$$GL = \frac{\text{Net carbohydrates in a typical serving} \times GI}{100} \quad [11]$$

Results

Out of 12 subjects enrolled, two were lost to follow up and were eliminated from analysis. Demographic data is available for 10 subjects. Out of 10 subjects 3 were males and 7 were females, the mean age was 29.2±4.7 yrs, mean height, weight and BMI was 160.7±7.3 cms, 71.0±17.3Kgs and 27.3±5.3 respectively (Table 1).

Table 2 shows the capillary blood glucose response from 0 min to 120 min with Test food product (Taste Good Biscuits) and reference food product (Glucon-D). The mean fasting capillary blood glucose was 106.9±17.5mg/dL with the test food product and 99.2±9.9mg/dL with the reference food product before consumption of the study food products. The mean peak capillary blood glucose was 147.4±29.3

Table 1: Demographic data (n=10).

Parameters	Value	
Number of subjects (n)	10	
Sex	Male	3
	Female	7
Age (yrs)	Min	23
	Max	36
	Mean ± S.D	29.2 ± 4.7
Height (cm)	Min	149.4
	Max	172
	Mean ± S.D	160.7 ± 7.3
Weight (kg)	Min	48.1
	Max	98.2
	Mean ± S.D	71.0 ± 17.3
BMI	Min	20.2
	Max	34.5
	Mean ± S.D	27.3 ± 5.3

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Table 2: Capillary blood glucose levels (mg/dL) (n=10).

S No	Test food (Taste Good Biscuits) arm							Reference food (Glucon D) arm						
	Time Points (min)							Time Points (min)						
	0	15	30	45	60	90	120	0	15	30	45	60	90	120
1	72	135	139	166	125	123	113	95	145	169	158	157	155	104
2	118	189	199	196	183	183	136	88	152	256	214	217	215	121
3	120	131	145	140	150	118	120	90	154	167	153	163	121	162
4	101	133	150	124	124	123	118	100	136	171	171	173	88	80
5	111	162	167	183	169	145	136	111	150	213	202	192	163	73
6	111	162	163	161	132	146	127	119	164	188	170	170	134	108
7	114	111	121	124	125	137	123	103	168	158	154	209	129	121
8	134	92	103	102	103	113	117	90	126	180	228	137	129	126
9	99	148	131	149	162	124	102	95	165	203	182	170	141	90
10	89	117	134	129	114	120	115	101	146	176	187	179	172	79
Mean	**106.9**	**138.0**	**145.2**	**147.4**	**138.7**	**133.2**	**120.7**	**99.2**	**150.6**	**188.1**	**181.9**	**176.7**	**144.7**	**106.4**
±S.D	**±17.5**	**±28.3**	**±26.8**	**±29.3**	**±26.0**	**±20.8**	**±10.4**	**±9.9**	**±13.2**	**±29.2**	**±25.9**	**±23.9**	**±34.2**	**±27.4**

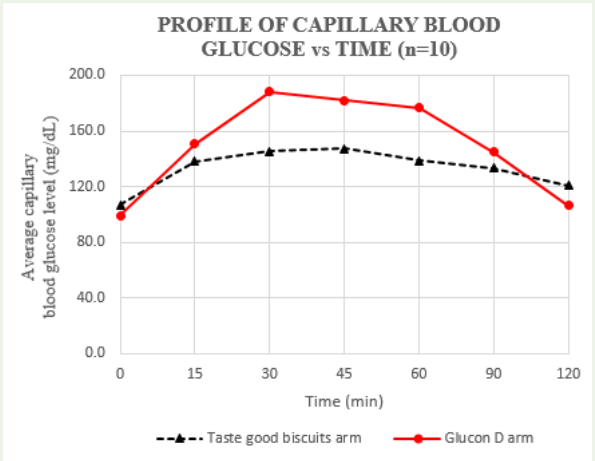

Figure 1: Profile of capillary blood glucose versus time.

mg/dL at 45 min with the test food and 188.1±29.2mg/dL at 30 min with the reference food.

Mean capillary blood glucose response with test and reference food products (mg/dL) are shown in Figure 1.

The mean blood glucose incremental area under the curve for test food was 3681.9min.mg/dL (SEM±736.1) and for reference food was 6651.9 min.mg/dL (SEM±740.2). The Glycaemic index of the test food product was 57.94.

The Glycemic Load was calculated as the GI (%) multiplied by the grams of carbohydrate in typical serving of the test food (2 Taste Good biscuits).

$$\text{Glycaemic Load} = \frac{\text{Net carbohydrates in a typical serving}}{100} \text{ X GI} \quad [11]$$

- Each 10 gram Taste Good Biscuit contains 5.3 grams of carbohydrates.
- Typical serving = 2 Taste Good Biscuits.

$$\text{Glycemic Load}(GL) = \frac{2 \times 5.3}{100} \text{ X } 57.94 = \frac{614.05}{100} = 6.14$$

The study food products were tolerated without any untoward effects.

Discussion

One of the modalities of treating hyperglycaemia naturally and economically is through diet. Quality of food is closely associated with diabetes mellitus and proper diet can reduce its incidence and severity. Eating foods with high GI can be detrimental to health because it raises the blood glucose levels. Switching to eating foods with low or medium GI has many benefits.

It is suggested that along with regular meals a small snack between meals helps patients on anti-diabetic treatment. Improving the acceptance by modifying the bitter taste and formulating palatable foods with optimal nutritional and medicinal values was the objective of developing Taste Good biscuits with bitter gourd [3].

Presence of inhibitors in bitter gourd showed hypoglycaemic action in diabetes. Consumption of 40gm of bitter gourd for 30days lowered post-prandial glucose by 36% in diabetes [5].

The glycemic index of Taste Good biscuits was medium (57.94) as compared to baked recipes like maize dhokla with dal (116.3) and steamed and wheat bati with dhal was 112.6 [5].

Foods with low or medium GI can increase the sensitivity to insulin and improve the diabetes control by reducing the hunger and keeping full for a longer duration of time. Starch not only reduces postprandial glycaemia but also exerts sustained effect on satiety [12].

The success of diets containing low or medium GI and their clinical utility in controlling hyperglycaemia needs to be established. As the International Diabetes Federation guidelines recommends that postprandial hyperglycaemia is harmful and should be lowered by incorporating a variety of non-pharmacological and pharmacological therapies [13].

It was essential to determine the glycaemic index and glycaemic load of Taste Good biscuits, before Health Care Professionals recommend it to patients with diabetes as mid meal snack.

Our future plan is to evaluate whether addition of Taste Good biscuits to existing anti diabetic therapy results in better glycaemic

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control and is able to reduce the glucose variability by using continuous glucose monitoring in patients with diabetes mellitus.

Conclusion

Excellent taste with medium glycaemic index and low glycaemic load of the typical serving of two biscuits was achieved with Taste Good biscuits with added medicinal benefits of karela for patients with diabetes mellitus. The findings of the present study will be of great help to healthcare professionals while treating patients with hyperglycaemia.

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