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Glycemic index of home made dark chocolates

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ABSTRACT
The glycemic index is a ranking of foods based on the post prandial blood glucose response compared with a reference food. Ten Healthy volunteers belonged to 35-60 years of age were recruited for the study. The glycemic response was found out before and after supplementation of test food and reference food. The blood sample was collected at zero, half an hour, one hour, one and half an hour and two hour intervals after giving 50g of glucose, 78 grams of Commercial Home Made Chocolate with 50 grams of carbohydrate and 200 grams of Developed Home Made Dark Chocolate (HMDC) samples containing 50 grams of carbohydrate. The blood sugar levels were measured in mmols/L using ascensia entrust diabetes care system. The glycemic index is calculated using the area under the curve (AUC) values. The subjects were healthy consuming sufficient amount of nutrients as recommended by Gopalan et al., 2007. Glycemic index and glycemic load value of the developed sample was. Thus the developed product was a low glycemic food compared to the standard product.

Introduction

The metabolic response to carbohydrate ingestion plays an important role in health and in disease states such as diabetes mellitus and hyperlipidemia.. The glycemic index is defined as the *incremental area* under the *blood glucose* response curve of a *50g carbohydrate portion* of a test food expressed as a percent of the response to the same amount of carbohydrate from a *standard food* taken by the *same subject.* The glycemic index (GI) quantifies the blood glucose change after eating a certain food compared to the change after eating a similar amount of carbohydrate as glucose. Different carbohydrates can have a significantly different GI. The GI has potential value in the management of persons with diabetes mellitus. Although the GI is a specific indicator of blood glucose response, glucose is not the only parameter which may be affected by the GI of a food. Serum triglycerides and cholesterol are modestly decreased by a low GI diet, in nondiabetics as well as those with NIDDM (Thomas et al., 1998).

Materials and methods

The glycemic index ranks carbohydrate containing foods on how quickly the blood sugar levels elevate. It is measured by comparing the increase in blood sugar after eating 50 grams of carbohydrate from a single food with the increase in blood sugar after eating the same quantity of carbohydrate from a reference food, which is either pure glucose or white bread. The average change in blood sugar levels over the next two hours compared to the change in blood sugar levels after consuming the reference food is the glycemic index value of that particular food (Miller Jones, 2002).

Ten healthy volunteers belonged to 35-60 years of age were recruited for the study. On the first day measured the fasting blood glucose level of the subjects and were given 50 grams of glucose(reference food) and raise in the blood sugar level was measured at the interval of 30 minutes for two hours from i.e. 0^{th}, 30^{th}, 60^{th}, 90^{th} and 120^{th} minutes. The same procedure was followed for the next two days with the commercial Home Made Chocolates (CHMC) samples i.e. 78 grams of Commercial Home Made Chocolate with 50 grams of carbohydrate and 200 grams of Developed Home Made Dark Chocolate (HMDC) samples containing 50 grams of carbohydrate. The investigator recorded the three days food intake of the selected subjects as it should not influence the Glycemic index values. The blood sugar levels were measured in mmols/L using ascensia entrust diabetes care system adopting the procedures as follows.

Step 1: Remove a test strip from the test strip bottle and immediately, tightly replace the push top cap. Use the test strip immediately after removal from the bottom.

Step 2: Be sure the meter is off before inserting the strip. Holding the strip at the test strip handle with the contact points up, insert the test strip into the test strip holder.

Step 3: All segments of the display will appear briefly. The meter display will show current test strip code. Verify that the 4-digit code display matches the 4-digit code on the strip bottle.

Step 4: Stick finger with the Ascensia Microlet Adjustable Lancing Device and form a drop of blood.

Step 5: Apply the blood to the absorbent area at the curved edge of the reaction zone or gently touch the blood drop to the top of the reaction zone. Make sure the reaction zone is completely covered.

Step 6: The timing bars will then flash and gradually diminish during countdown (approximately 30 seconds).

Step 7: When the timing bars have completely disappeared the meter will display the test result. After test result is displayed remove and discard the test strip.

The obtained values were compared against the values given by Miller Jones, 2002 given below

The glycemic index was calculated using International Glycemic index methodology of Brouns et al., 2005 administering the following steps. The raise in the blood sugar levels after the ingestion of reference food (glucose), standard

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food (home made chocolate) and the test sample (developed cocoa fudge samples) were noted using Ascensia Entrust Diabetes care system and it's Sensor.

Category of a person	Fasting value mmols/dl		Postprandial value 2 hours after consuming glucose mg/dl
	Minimum value	Maximum value	
Normal	3.9	5.6	Less than 7.8
Early diabetes	5.6	7	7.8 to 11.1
Established diabetes	More than 7	-	More than 11.1

Blood glucose response curve was drawn to assess the Area under the Curve (AUC) thereby the Glycemic Index (GI) was determined.

The glycemic index is calculated using the area under the curve (AUC) values. Many methods can be used to calculate AUC and since the use of different methods can result in different GI values, this should be standardized. Among the different methods like total AUC; Incremental AUC_{cut} ; incremental AUC; incremental AUC_{min} and net incremental AUC, incremental AUC method was recommended by the Food and Agriculture Organization (1988), and the method used for most calculations of GI up to the present time.

$$\text{Glycemic index} = \frac{\text{Test food}}{\text{Reference food}} \times 100$$

Results and discussion

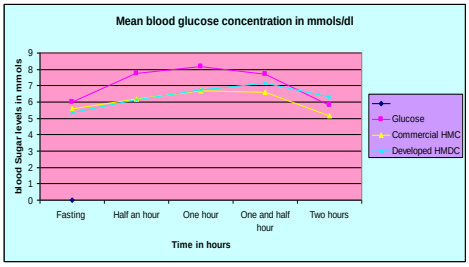
The ability of food item to raise the blood sugar is measured in terms of glycemic index. The area above the fasting glucose concentration is calculated and is expressed as a percentage of the area obtained after the ingestion of 50g glucose. The higher the area under the curve the higher glycemic index

Significant clinical effects or epidemiologic associations have been reported relating glycemic index or glycemic load of diets and indicators of chronic disease risk. There is accumulating evidence that diets containing a higher level of fibre that elicit low glycemic responses (low GI foods or diets) cause important health benefits such as lowering total cholesterol and improving the metabolic control of diabetes (Brouns, et al., 2005). In the present study the investigator assessed the glycemic index of the developed samples by measuring the rise in blood sugar levels in the selected 10 healthy subjects for three consecutive days, with the reference food (glucose) on the first day, standard food (Commercial HMC) on the second day and test food (developed HMDC samples) on the third day. The mean nutrient intakes of the selected subjects were also recorded and the values are given in table I.

In this present study the mean caloric intake of men was 2468.57±252.03 Kcal and 2379±46.50 Kcal for women. The carbohydrate content of men and women were 298.43 ± 48.05 grams and 288.33±19.29 grams respectively. The standard requirement of carbohydrate was 60% of the caloric intake. The average protein intake of men and women were 65.06±4.37 grams and 54.4±5.09 grams respectively, whereas the RDA for protein was 60 grams for men and 50 grams for women. The average fat intake of the selected subjects was 17.17±2.63 grams for men and 18.9±1.23 grams for women, where as the standard RDA for men and women is 20 grams of fat per day. The average fiber intake of men and women in this present study was 7.22±1.28 grams and 7.13±2.02 grams respectively. From the above data it is clear that the subjects were healthy consuming sufficient amount of nutrients as recommended by Gopalan et al., 2007.

The mean blood glucose concentrations of the reference food (glucose), standard food (Commercial HMC) and test food (developed HMDC) are given in table II.

Figure I Blood glucose response curve for glucose, Commercial HMC and Developed HMDC sample



Glycemic index and glycemic load of the Commercial HMC and Developed HMDC sample

Glycemic index or glycemic load may be related to heart disease risk and blood lipid levels. In a large epidemiological study, a diet high in glycemic load was linked to increased heart disease risk. Intervention studies have shown that substituting low glycemic foods for higher glycemic foods lowers blood triglycerides by 15 to 25% (Pelkaman et al., 2001). The glycemic index value and glycemic load value of the Commercial HMC and Developed HMDC are given in table III

Glycemic index value of the developed sample was 43.50 and 10.84 as the glycemic load. Glycemic index value less than 55 are considered low glycemic food whereas 55-60 are intermediate glycemic foods and above 61 are high glycemic foods. Thus the developed product was a low glycemic food compared to the standard product.

Conclusion

The glycemic index or GI describes this difference by ranking carbohydrates according to their effect on our blood glucose levels. The *glycemic load* (GL) is an alternative way of measuring the effect of carbohydrate on blood sugar levels, compared to the traditional *glycemic index* (GI) scale. Both the Glycemic index and Glycemic load of the developed home made dark chocolate was found to be low thus it is safe and healthy food and could be recommended even for diabetic and CVD subjects.

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Table I Nutrient intake of the selected subjects (N=10)

Nutrients	Men (mean ± SD)	Women (mean ± SD)
Carbohydrates (g %)	298.43 ± 48.05	288.33±19.29
Protein (g %)	65.06±4.37	54.4±5.09
Fat (g %)	17.17±2.63	18.9±1.23
Fiber (g %)	7.22±1.28	7.13±2.02
Energy (Kcal)	2468.57±252.03	2379±46.50

Table: II Mean blood glucose concentration in mmols/dl (N=10)

Samples	Fasting (0 hour)	Half an hour	One hour	One and half hour	Two hours
Glucose	5.98 ± 0.736	7.75 ± 0.389	8.17 ± 0.287	7.73 ± 0.569	5.8 ± 0.824
Commercial HMC	5.6 ± 0.61	6.19 ± 0.45	6.68 ± 0.28	6.6 ± 0.24	5.18 ± 0.65
Developed HMDC	5.37 ± 0.49	6.12 ± 0.39	6.76 ± 0.21	7.14 ± 0.16	6.32 ± 0.54

Table: III Incremental AUC values

Samples	Increment AUC values [mean ±SD]
Reference sample	3048.21±2774.92
Standard sample	1450.03±1318.47
Test sample	831.38±175.036