Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 5, Issue, 12, pp.2210-2213, December, 2014

International Journal of Recent Scientific Research

ISSN: 0976-3031

RESEARCH ARTICLE

ESTIMATION OF GLYCEMIC INDEX OF FOXTAIL MILLET

[1]V.Shubhashini and [2]Ushadevi.C

[1,2]Smt VHD Central Institute of Homescience, Bangalore

ARTICLE INFO

Article History:

Received 5th, November, 2014
Received in revised form 12th, November, 2014
Accepted 8th, December, 2014
Published online 28th, December, 2014

Key words:

Type 2 Diabetes, Foxtail Millet and Glycemic Index.

ABSTRACT

The glycemic index (GI) is a measure of the food power to raise blood glucose (B-glucose) concentration after a meal. For healthy eating, foods with low GI are recommended. However, for many foods in the European Union the GI has not been defined yet. The aims of this prospective open-label study were to determine the GI of FOXTAIL MILLET

Methods: To determine the GI, measured portions of food containing 50 g of carbohydrates were given to 10 healthy volunteers. B-glucose curves were constructed from B-glucose values at time 0, 30, 60, 90 and 120 min after the meal. The GI was calculated by dividing the incremental area under the curve (IAUC) for the tested food by that for the standard food (IAUCS). In each volunteer and the GI's was obtained and the average was calculated. The GI for each tested food was calculated as the mean from the respective average GI's of the 10 volunteers. MS Excel and the statistical program SPSS v. 10.1 were used to analyze the data.

Results and Discussion: The intake of test food was associated with high average blood glucose at 0 min P>0.05 then later the measurements at 30, 60, 90, 120 minutes after the ingestion of test food showed a decrease in average blood glucose value which was significantly different (P<0.05) when compared to glucose consumption the GI was found to be low.

INTRODUCTION

Glycemic index, or GI, measures how a carbohydrate-containing food raises blood glucose. Foods are ranked based on how they compare to a reference food– either glucose or white bread. A food with a high GI raises blood glucose more than a food with a medium or low GI.

Hence glycemic index (GI) is an important parameter of food quality which compares the hyperglycemic effect of a tested meal with pure glucose (or of another defined standard food). The GI is a measure of the food power to raise B-glucose concentration after a meal. The GI is defined as relation of the incremental area under the B-glucose response curve (IAUC) of a tested meal containing 50 g of digestible carbohydrates and the incremental area under the B-glucose response curve of the standard food, i.e. 50 g pure glucose (IAUCS). Carbohydrates that breakdown quickly during digestion have a high GI because their B-glucose response is fast and high. Carbohydrates that breakdown slowly have a low GI (11, 23).

For healthy eating, particularly in persons with diabetes, obesity and insulin resistance, foods with low GI are recommended as they may help keep the euglycemia and the normal spectrum of lipoproteins (3,4,8,12,22,23) These effects result in decreased cardiovascular danger and probably also in reduced risk for colon and breast cancer.

METHODOLOGY & STUDY DESIGN

A step by step procedure to estimate the GI of tested samples: as per WHO and FAO protocol (11)

The study was approved by the institutional Bioethics Committee involved (Nutri-Explore ethics committee, Bangalore university project No: NEEC 005) and subjects were also given informed consent

Step 1

Selection of 10 healthy non-smoking, normal BMI, male volunteers aged between 29-32 years were selected (Table 1) to perform a formal experiment. The volunteers showed no family history of diabetes or any food allergies, were not on any medication and also were not on weight loss diet. Since, Estimating glycemic index can only be done in a controlled environment with a control substance and the test food sample.

Step 2

50 gm of glucose in 300ml water was given to the samples (10 volunteers)

Step 3

A single venous blood sample was taken in the fasting state and at 30 min, 1 hr, 1 hr 30 min and 2 hourly after consuming each sample was analyzed using glucometer optium exceed and strips with LOT no: 49867 to produce a graph of glucose

* Corresponding author: **V. Shubhashini**
Smt VHD Central Institute of Homescience, Bangalore

levels over time. The area under the resulting curve is what is measured, and it is called the incremental area under the blood glucose response curve, or IAUC.

Table 1 Characteristics of Male Volunteers participating in the study

Parameter	Participants	Normal Range
N	10	
Age (yrs)	29 ± 3	
Wt (kg)	65 ± 6.2	
Ht (mts)	1.71 ± 0.08	
BMI (kg/mt2)	23.1 ± 1.8	<25
Systolic Blood Pressure (mm Hg)	119 ± 7	<130
Diastolic Blood Pressure (mm Hg)	73 ± 8	<85
Fasting Blood Sugar	87 ± 9	70-126mg/dl

Step 4

The test food was given to the volunteers after they have been in fasting mode for at least 10-12 hours was administered; the test was performed in the morning along with a drink of water which was often given with the test meal.

Step 5

The blood plasma glucose level for the next two hours was charted the same way as charted for 50gm glucose. The IAUC was also calculated the same way, as the area under the resulting curve.

Step 6

By dividing the IAUC of the test food by the IAUC of the control food and multiplying it by 100. The GI of the test food for each test subject was calculated.

Step 7

Add the results for each test subject together and divide the sum by 10 (Mean is then calculated)

Calculations of individual GI values in every volunteer

The incremental area under the curve (IAUC) was calculated for each meal in every volunteer separately (as the sum of the surface of triangles and trapezoids between the B-glucose curve and horizontal baseline going parallel to x-axis from the beginning of B-glucose curve at time 0 to the point at time 120 min) to reflect the total rise in B-glucose concentration after eating the tested food.

The IAUCS for the standard reference food (i.e. 50 g of pure glucose) was obtained, in the IAUC/IAUCS calculations, all B-glucose values in the course of the test lower than the first value (at time 0) were equalized to the respective first value. In each volunteer, the GI (%) was calculated by dividing the IAUC for the tested food by the IAUCS for the standard food and multiplying by 100.

IAUC – Incremental Area Under the blood glucose response Curve for the tested meal
IAUCS – Incremental Area Under the blood glucose response Curve for the standard meal

Final calculation of the GI for each tested food

The GI for each tested food was calculated as the mean from the respective average GI's of the 10 volunteers.

Statistical Analysis

A PC link was used to transfer the data from glucometer optium exceed to PC and statistical analysis were performed with SPSS V.10.1.

Tested foods

Two different foods with a known content of nutrients were tested

1. Pure glucose, one serving 50 g; Glucose was dissolved in 200 ml of water before drinking.
2. Foxtail Millet Rice Nutrient composition: carbohydrates 67.3 gm, protein 13.2gm, fat 4.4gm, energy 362 kcal /100g; one serving 74 gm(equal 50.0 g of carbohydrates); The food was professionally prepared in the expected quality and quantity; the portions were packed and marked with a set sign. Each serving contained 50 g of carbohydrates.

Table 2 Proximate Analysis of Foxtail Millet Rice Bath (Navanakki) /100gm

Moisture	70.1gm
Ash	1.25 gm
Crude Fibre	1.3 gm
Protein (NX6.25)	1.5 gm
Total fat	18.8gm
Energy	117.1 kcal

Chemical and Nutritional Analysis

Physiochemical composition of Foxtail Millet Rice was determined using standard AOAC 18th edition methods (12) for moisture No: 986.21, Ash No: 923.09, Crude fibre No: 962.09, Protein (NX 6.25) No: 984.13, Total Fibre No: 925.06 and by difference method Carbohydrate was estimated and by calculation total energy was estimated (Table 2)

Histograms for glucose and Foxtail Millet Rice bath for different time interval

Fig 1 at 0 min

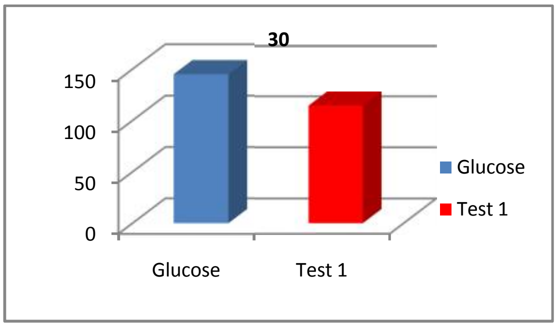

Fig 2 at 30 min

Fig 1 at 0 min

Mean B-glucose curves (glucometer Optium exceed) after consumption of 50 g of glucose for breakfast and test sample

(Foxtail Millet Rice) in every volunteer on fasting overnight for atleast 10-12 hrs

Fig 2 at 30 min

Mean B-glucose curves (glucometer Optium exceed) after consumption of 50 g of glucose for breakfast and test sample (Foxtail Millet Rice) in every volunteer after 30min which is significant (p<0.05)

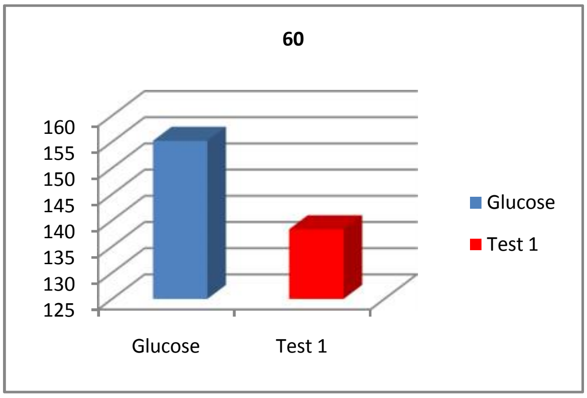

Fig 3 at 60 min

Mean B-glucose curves (glucometer Optium exceed) after consumption of 50 g of glucose for breakfast and test sample (Foxtail Millet Rice) in every volunteer after 60min which is significant (p<0.05)

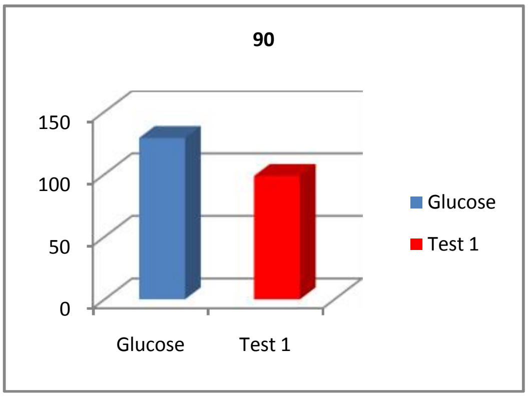

Fig 4 at 90 min

Mean B-glucose curves (glucometer Optium exceed) after consumption of 50 g of glucose for breakfast and test sample (Foxtail Millet Rice) in every volunteer after 90min which is significant (p<0.05)

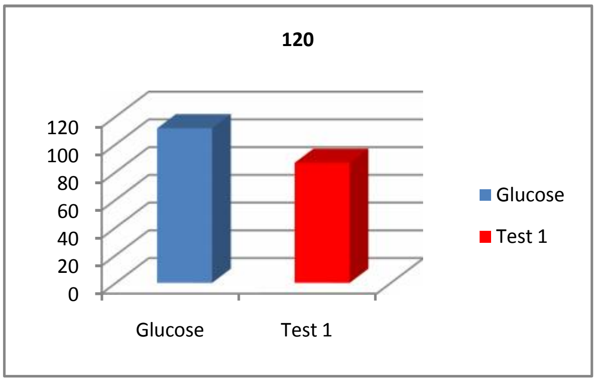

Fig 5 at 120 min

Mean B-glucose curves (glucometer Optium exceed) after consumption of 50 g of glucose for breakfast and test sample (Foxtail Millet Rice) in every volunteer after 120min which is significant (p<0.05)

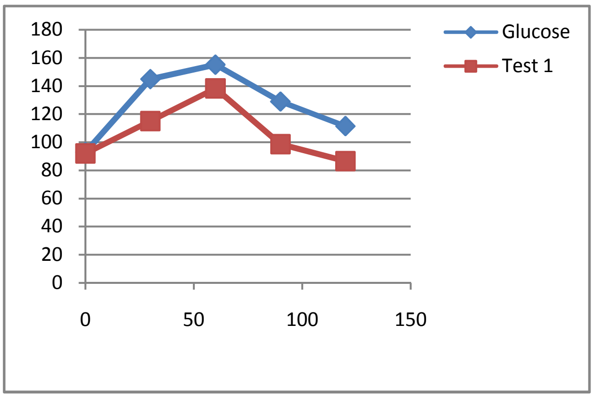

Fig 6 B glucose curve of glucose and test sample (Foxtail Millet Rice)

The intake of test food was associated with high average blood glucose at 0 min P>0.05 then later the measurements at 30, 60, 90, 120 minutes after the ingestion of test food showed a decrease in average blood glucose value which was significantly different (P<0.05) when compared to glucose consumption.

Table 3 Glycemic index GI of Foxtail Millet Rice's and Glucose in 10 volunteers SD [%]

Group	GI of Foxtail Millet Rice	GI of glucose
Male volunteers	45.3 ± 54.4	96.7 ± 11.9

P < 0.05 of tested food vs. glucose

Foxtail Millet Rice presented a favorable glycemic response, ranking as low GI, the mean GI of Foxtail Millet Rice falls under low glycemic index foods, the value being 47.89.

RESULTS AND DISCUSSION

Recent studies from Harvard School of Public Health indicate that the risks of diseases such as type 2 diabetes and coronary heart disease are strongly related to the GI of the overall diet. In 1999, the World Health Organisation (WHO) and Food and Agriculture Organisation (FAO) recommended that people in industrialised countries base their diets on low-GI foods in order to prevent the most common diseases, such as coronary heart disease, diabetes and obesity5, 7, 9, 10, 14, 15, 17, 23.

Hence an attempt was made to estimate the glycemic index of Peral Millet Rice and the nutritional characteristics of sample food is described in table 2 Food composition among food products is very different from the raw ingredients to the cooked form The intake of test food was associated with high average blood glucose at 0 min P>0.05 then later the measurements at 30, 60, 90, 120 minutes after the ingestion of test food showed a decrease in average blood glucose value which was significantly different (P<0.05) when compared to glucose consumption.

Food factor such as food from particle size, processing, preparation and cooking methods, type of starch structure, the presence of other nutrients may affect the GI value (19,21)

An important effect attributable to the results associated with low GI in Foxtail Millet Rice when compared to the raw ingredients quoted in the study, It is important to note that Foxtail Millet are rich in fibre which provides bulk to Gastro-Intestinal tract contents and slows transit time of matter through the tract (11)

Soluble fibre also decreases the rate of starch digestion by pancreatic amylase in vivo, probably by delaying the interaction between enzymes and substrates (19)

With regards to legumes such as peas, beans and lentils. The fibre content has been repeated between 14.65% and 24.08% (24) foods that are known for their low GI with values between 22 & 42 (13) the fibre value for Foxtail Millet corresponds to an average to 5% for cooked Foxtail Millet rice's /100 gm (table 2) a component that has an important effect when estimating the product's GI values.The fat content of Foxtail Millet cooked and raw in one study was approximately 5% /100gm (table 2) and it is another factor to reduce the Glycemic response (16) as it delays gastric emptying (rove et. al (20)

A similar effect could have occurred with Foxtail Millet consumption too.

CONCLUSION

According to the results, the average GI value for Foxtail Millet was found to be 47.89 classified as low GI food.

Hence the intake of Foxtail Millet can be consistent favorable to diabetics who require low GI foods in the daily diet and it is also a good choice for healthy eating habits and also could be good alternative cereal food

References

1. AOAC (Association of Official Analytical Chemists) official methods of analysis of AOAC Internation 18th edition.
2. Aston LM, Gambell JM Lee PM, Bryant SD, Jebb SA. Determination of the glycemic index of various staple carbohydrate rich foods in UK Eur J Clin Nutr. 2008;62:279-85
3. Augustin LS, Gallus S, Bosetti C, Levi F, Negri E, Franceschi S,Dak Maso L, Jenkins DJ, Kendal CW, La Vecchia C. (2003) Glycemic index and glycemic load in endometrial cancer. Int J Can *105*, 404–407.
4. Berger M. (1995) Diabetes mellitus I. Urban & Schwarzenberg, Munchen, Wien, Baltimore, 135–157.
5. Bjorch J, Granfeldt Y. Liljeberg h, Torar J, sp N-G, food properties affecting the digestion and absorption of carbohydrates. Am J clin Nutr 1994; 59 (Suppl): 6965-7055
6. Bornet FRJ, Costagliola D, Rizkalla SW, Blayo A, FontvieilleAM, Haardt MJ, Letanoux M, Tchobroutsky G, Slama G. (1987)Insulinemic and glycemic indexes of six starch-rich foods takenalone and in a mixed meal by type-2 diabetics. Am J Clin Nutr *45*,588–595.
7. Brand-Miller JC, Holt SH, Pawlak DB, McMillan J. (2002) Glycemicindex and obesity. Am J Clin Nutr *76*, 2815–2855.
8. Bruns W, Wagner D, Taubert FP. (1989) Untersuchung zum Verhalten von Glykamie, Insulinamie und Lipiden bei stoff wechselgesunden Nichtdiabetikern und Typ-2 (non-insulindependent) Diabetikern unter 3 bzw. 6 Mahlzeiten. Abstract Akt Endokr Stoff w *10*, 85.
9. Crowe TC, Seligman SS. Copeland L. Inhibition of enzymic digestion of amylase by free fatty acids in vito contributes to resistant starch formation J Nutr. 2000, 130; 2006-8
10. Foster-Powell K, Holt AH, BrandMiller JC, International table of glycemic index and glycemic load values. Am J Clin Nutr. 2002; 76;5-56.
11. Foster-Powell K, Holt SH, Brand-Miller JC. (2002) International table of glycaemic index and glycaemic load values. American Journal of Clinical Nutrition *76*, 5–56.
12. Gannon MC, Nuttall FQ, Krezowski PA, Billington CJ, S. Parker. (1986) the serum insulin and plasma glucose responses to milk and fruit products in type-2 (non-insulin-dependent) diabetic patients. Diabetologia *29*, 784–791.
13. Heilbrann LK, Noakes M, Clifton PM. (2002) The eff ect of highand low-glycemic index energy restricted diets on plasma lipid and glucose profi les in type 2 diabetic subjects with varying glycaemic control. J Am Coll Nutr *21*, 120–127.
14. Jenkins AL, Jenkins DJ, Zdravkovitz U, Wursch P, Vuksan V. (2002) Depression of glycemic index by high levels of beta-glucan fi ber in two functional foods tested in type 2 diabetes. Eur J Clin Nutr *56*, 622–628.
15. Jenkins DJ, Kendall CW, Augustin LS, Franceschi S, Hamidi M, Marchie A, Jenkins AL, Axelsen M. (2002) Glycemic index: overwiew of implications in health and disease. Am J Clin Nutr *76*, 2665–2673.
16. Jenkins DJ, Kendall CW, Augustin LS, Vuksan V. (2002) Highcomplex carbohydrate or lente carbohydrate foods? Am J Med 113, Suppl *98*, 30S–37S.
17. Kabir M, Oppert JM, Vidal H, Bruzzo F, Fiquet C, Wursch P, Slama G, Rizkalla SW. (2002) Four-week low-glycemic index breakfast with a modest amount of soluble fi bers in type 2 diabetic men. Metabolism: Clinical & Experimental *51*, 819–826.
18. Liu S, Willett WC. (2002) Dietary glycemic load and atherotrombotic risk. Curr Atheroscler Rep *4*, 454–61.
19. Ludwig DS. (2002) The glycemic index: physiological mechanisms relating to obesity, diabetes, and cardiovascular disease. JAMA *287*, 2414–2423.
20. R. Chlup, J. Bartek, M. Řezníčková, J. Zapletalová, B. Doubravová, L. Chlupová, P. Sečkař, S. Dvořáčková, V. Šimánek Biomed. Papers 148(1), 17–25 (2004)
21. Raben A. (2002) Should obese patients be counselled to follow a low-glycaemic index diet? No. Obesity Reviews *3*, 245–256.
22. Scharel S; Schauer R, Himes J. Harnach L, Van Heel N. Development of a glycemic index database for dietary assessment.J Food Compost Analysis 2008;21: S50-S55.
23. Spraul M, Chantelau E, Schonbach AM, Berger M. (1988) Glycemic effects of beer in IDDM patients. Diabetes Care *11*, 659–661.

****