

SHORT COMMUNICATION

Determination of the glycemic index of varying proportions of a novel formulation of staple cassava flour - *Gari*

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Abstract

This study was carried out to determine the glycemic index of coconut-enriched *gari* which was fermented at various durations. A total of 18 apparently healthy subjects participated in the study. The determination of total carbohydrate, crude fibre and available carbohydrate, followed by glycemic index was performed on six samples of the coconut *gari* using the standard operating procedure. The coconut *gari* samples (48 hours fermentation) gave mean glycemic index values ranging from 81.96 ± 3.42 - 84.96 ± 4.90 while the 72 hours fermentation gave a mean range of 74.34 ± 2.24 - 82.04 ± 5.40 . The samples were subjected to statistical analysis using ANOVA and found to be non-significantly ($p > 0.05$) different when compared to each other. The low G.I rating observed in coconut *gari* fermented for 72 hours is an indication that the food may be good for consumption as a staple except with under some exceptional conditions. This study suggests that extensive fermentation of *gari* enriched with coconut could be nutritionally appropriate for diabetics.

Key words: Glycemic index, coconut, *gari*, diabetes, fermentation

Introduction

The rationale behind glycemic index (GI) (Feskens and Du, 2006) determination was to assist diabetic patients in the sugar level management after it was proven through research that high GI foods pose serious risk to health implications such as type 2 diabetes mellitus (Thorburn et al., 1987; Willett et al., 2002) which is likely to lead to the manifestation of other diseases such as hypertension, obesity, etc. Through some epidemiological and dietary studies, it is now evident that foods with a low GI content are preferential for blood glucose management while those with high GI is attributed to contribute to the inception of obesity, cardiovascular disease, and others such as few cancers (Brand et al., 1990; Neuhouser et al., 2006; Ma et al., 2006) as well as the

predominant one-diabetes mellitus. With studies showing the high relationship between GI of predominant carbohydrate foods, it is highly imperative to study the GI content of *gari* sold in major markets in Umudike, Abia State, Eastern part of Nigeria.

Gari is obtained from cassava tubers after industrial processing after peeling, washing and grating of the tubers. The *gari* is processed into granular size (CAC, 2013) and is consumed in various food forms (Ogueke et al., 2013). *Gari* enriched with coconut –“coconut *gari*” is a novel food that has not yet gained popularity in the Nigerian market. The food was formulated in a bid to boost the nutritional content, taste and general palatability of the cassava product (*gari*), which is known to be rich in calories but low in protein, fat, and

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some minerals and vitamins. This study was done in order to ascertain the glycemic index (GI) of coconut *gari* in comparison with the normal *gari* as consumed by the general population.

Materials and methods

Source of research materials

Six different samples of processed coconut enriched *gari* - “coconut *gari*” derived from cassava fermented for 48 hrs and 72 hrs, were supplied by Prof P.N Okafor of the Biochemistry Department, Michael Okpara University of Agriculture. Each sample varied from the other by different ratios in mixture of the coconut with *gari* on processing while pure glucose-D (100%) was obtained from a pharmaceutical store in Umudike, Abia State.

Definition of samples

Table 1. Definition of samples for G.I determination.

S/N	Name
A	50 kg Cassava :1.8 kg coconut WHITE 72 HRS (5/419)
B	50 kg Cassava : 1.8 kgcoconut WHITE 48HRS (5/419)
C	48 kg Cassava : 1.5 kg coconut YELLOW 72HRS (5/195)
D	48kg Cassava : 1.5 kg coconut YELLOW 48HRS (5/195)
E	50 kg Cassava : 1 kg coconut YELLOW 48HRS (5/195)
F	50 kg Cassava : 1 kg coconut YELLOW 72 HRS (5/195)

Subjects

Eighteen (18) apparently healthy human subjects aged between 22 and 26 years (9 males and 9 females) with mean age of 23 years and mean BMI 22.79 Kg/m²were randomly selected from the students of 400 level Biochemistry Department, Micheal Okpara University of Agriculture, Umudike after obtaining their informed consent.

Experimental design

A known quantity (50g) of pure glucose was dissolved in 250ml of distilled water and served to the subjects on the first day. This served as the reference food or standard. The amount of each *gari* sample given to a subject

was calculated from the result of the proximate analysis done in the determination of total carbohydrate and crude fibre that yielded 50 g available carbohydrate. On the second day, 50 g available carbohydrate dissolved in distilled water which served as the test foods were served to the subjects. The blood glucose levels of the subjects were noted on consumption of reference and test foods at 0, 30, 60 and 120 mins, on the two occasions and the results obtained were used for the calculation of glycemic index.

Determination of total carbohydrate

Total carbohydrate was determined by the method described by FAO (2003).

Determination of crude fibre

Crude fibre was determined by the Wende method as described by Okonkwo and Ogu (2014).

Determination of the available carbohydrate

The available carbohydrate was calculated by the method of FAO (2003).

Procedure for the determination of the glycemic index

The trapezoid method was used in the determination of glycemic index. Total blood sugar level was determined from each of the blood samples with a portable glucometer (AccuChek). The area under curve for the blood glucose level elicited by the *gari* samples and standard glucose solutions was calculated using the trapezoid method (Wolever et al., 2008) and this was used to determine the G.I of the coconut- *gari* samples.

$$G.I\ of\ Test\ Food = \frac{AUC\ of\ test\ food}{AUC\ of\ control\ food} \times 100$$

where AUC = Area under the curve

Statistical analysis

The means, standard deviations and standard error of the data obtained were analysed using the statistical tools - Microsft Excel and one way analysis of variance – ANOVA. The significance was judged at the 0.05 level.

Results

Table 2. Proximate analysis and serving size of samples.

Samples	Total CHO (g %)	Crude fibre (g %)	Weight of sample containing 50g available CHO. (g)
A	52.17	2.667	96.8
B	36.96	2.676	137.3
C	71.3	2.88	71.0
D	54.35	2.893	93.0
E	52.17	2.674	97.0
F	78.26	2.73	64.3

Table 2 above shows that the total CHO was least in sample B and highest in sample F where:

Sample A = 50 kg cassava : 1.8 kg C/Nut (72 hrs fermentation)

Sample B = 50 kg cassava : 1.8 kg C/Nut (48 hrs fermentation)

Sample C = 48 kg cassava : 1.5 kg C/Nut (72 hrs fermentation)

Sample D = 48 kg cassava : 1.5 kg C/Nut (48 hrs fermentation)

Sample E = 50 kg cassava : 1.0 kg C/Nut (48 hrs fermentation)

Sample F = 50 kg cassava : 1.0 kg C/Nut (72 hrs fermentation)

The serving size for each sample was calculated from the available carbohydrate content and expressed as "The weight of sample containing 50 g available carbohydrate".

*CHO = carbohydrate

Table 3. Glycemic index of the coconut- *gari* samples.

Samples	N	48 hrs fermentation	72 hrs hrs fermentation
50 kg cassava : 1.8 kg C/Nut	3	82.40 ± 3.30*	82.04 ± 5.40*
48 kg cassava : 1.5 kg C/Nut	3	84.99 ± 4.9*	77.39 ± 2.40*
50 kg cassava : 1.0 kg C/Nut	3	81.96 ± 3.42*	74.34 ± 2.24*

Table 3 above shows the result of glycemic index of the 6 different samples. Samples marked * are non-significantly ($p > 0.05$) different when compared against other samples under same fermentation period.

(n = 3)

Discussion

An assessment of the coconut-*gari* samples showed that the samples gave mean glycemic index values ranging from 74.34 ± 2.24 – 84.96 ± 4.9 , which are high G.I values on the glycemic scale (low G.I < 55, moderate G.I = 56-69, high G.I = 70 and above). Mixtures of Cassava and coconut in the ratios of 50kg: 1.8kg, 48kg: 1.5 kg and 50kg: 1 kg were observed to give a mean total G.I of 83.1 ± 2.02 at 48 hrs and 77.92 ± 2.14 at 72 hrs. The 50 kg cassava: 1.0 kg coconut preparation at 72 hrs had the least mean G.I rating of 74.3 ± 2.24 while 48 kg cassava: 1.5 kg coconut resulted in the highest G.I. However, all the samples were not significantly ($p > 0.05$) different when compared to each other. Studies on the glycemic index of *gari* as reported by Ihediohanma (2011) showed that *gari* fermented at 48hrs had an intermediate G.I of 67 and those fermented at 72hrs were observed to give a high glycemic index of 73. These G.I values when compared to the result of the present study shows that the coconut-*gari* samples yielded high G.I values when

fermentation was allowed for lesser time (48 hours compared to 72 hours).

The high glycemic index observed in the samples of coconut enriched *gari* fermented for 48 hours may be due to the addition of coconut which has glucose as one of its macronutrients and the reduced fermentation period during processing of the food (Omorieg and Osagie, 2008; Ishiaq and Odeyemi, 2012). This corresponds with reports suggesting that increased processing of foods through addition of other nutrients, may increase the G.I (Ludwig, 2002; Ishiaq and Odeyemi, 2012).

The mean G.I values of the coconut-*gari* samples were lower when compared to the glycemic index of other local carbohydrate foods like maize (92.3 ± 0.05), Semolina (wheat) 95.8 ± 0.28 , amala (yam) 84.4 ± 2.68 , Rice 95.3 ± 1.25 etc., as reported by Omorieg and Osagie (2008). Glycemic response can be influenced by some factors such as quantity of the carbohydrate food eaten, amount of carbohydrate in the food, nature of the monosaccharide present in the food and other food components (fat, protein and dietary

fibre, anti-nutrient and organic acids) (Ihediohanma, 2011). While selecting food rich in carbohydrate, the glycemic index should be considered. But most of the less GI diet seems to be high fat. Conversely, some high GI foods may be a good choice because of convenience or because of the presence of high nutritional content thus, it is not necessary to avoid all high GI foods (FAO/WHO, 1997).

Conclusion

The low G.I rating observed in 72-hour fermented *gari* enriched with coconut shows that the food may be good for regular consumption as a staple and for diabetics and people with obesity issues.

Conflict of Interest

The authors have declared that no conflict of interest exists.

Authors' contributions

Egba, SI.: Co-designed and supervised the work, Okafor PN.: Co-designed and supervised the work, Adimuko GC.: Carried out field and laboratory work, Akokwu GC.: Carried out field and laboratory work, Omeoga HC.: Supervised the laboratory work, did statistical analysis and interpretation of data.

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