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EFFECTS OF VARIOUS PROCESSING METHODS OF RIPE AND UNRIPE PLANTAIN DIETS ON BLOOD GLUCOSE LEVEL.

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ABSTRACT: *Ripe and unripe plantain was processed by frying, roasting and boiling. 30 human volunteers consumed individually 161g of different plantain diets prepared equivalent to 50g available carbohydrate or glucose after 10-12 hours over night fast. The venous blood samples were drawn at 30 minutes intervals for 2 hours after fasting blood glucose test. Using the glucose oxidase method, the blood glucose levels after feeding were determined. The areas under curve were calculated by trapezoid method. The glycemic index values for ripe plantain were found to be 56,54 and 55 for fried, boiled and roasted respectively while the glycemic indices for unripe plantain diets where 46, 44 and 46. For fried, boiled and roasted respectively. There were significant differences (P <0.05) in the glycemic indices of ripe and unripe plantain diets although both ripe and unripe plantain diets are within the low glycemic index range. Looking at the different processing methods the results of this study suggest that boiled unripe plantain has more promising control effect on blood glucose level and better glycemic control in carbohydrate related metabolic disorders than other processing methods.*

KEYWORDS: Processing, Plantain Diets, Glycemic Index, Blood Glucose

INTRODUCTION

Carbohydrate in plantain is stored in the form of starch and the rate of digestion of carbohydrate foods differs (Oke *et al., 1998*). Certain carbohydrate foods are digested rapidly releasing glucose into the blood stream where as some carbohydrate foods are digested slowly releasing glucose slowly into the blood stream (Jenkins *et al.,* 1994). Carbohydrate foods which raise the blood glucose level quickly after meal are regarded as high glycemic index foods and are assigned a value of 70 and above where as low glycemic index foods which release glucose slowly into the blood stream have a value of 55 and below (Brand-Miller *et al., 1996*).

Health problems associated with high blood glucose such as metabolic syndrome, diabetes, obesity and impaired glucose tolerance are due to high glycemic index foods. Clinical trials have shown that low glycemic diets improve glycemic control in diabetes, increase insulin sensitivity, reduce food intake and body weight (Juntunen *et al., 2003*). Prospective studies suggest that low glycemic index diets may reduce the risk of diabetes, cardiovascular disease, metabolic

syndrome, chronic inflammation and possibly some type of cancer (Salmeron *et al., 1997*, Liu *et al., 2000*). Postprandial glycemic response to food can be affected by the method of food preparation. Processing in a number of ways can alter the content and nutritional quality of food carbohydrates. Boiling, cooking and heating of carbohydrate result in alteration of physical properties through gelatinization and retrogradation. Altering the physical form of a complex carbohydrate changes the postprandial glucose and insulin response to it (Odea *et al., 1993*).The effect of moist and dry heat on *in vivo* and *in vitro* starch digestibility showed that boiling and pressure cooking resulted in faster rate of digestion than roasting(Thorne,1983). The type and time of cooking may influence the *in-vivo* and *in-vitro* digestibility of carbohydrate foods. According to Booher *et al.*, (1981), the conditions which increase the digestibility of starches include those modifications that produce obvious hydration of the granules distinct from changes in chemical nature, or disruption of the organized structure. In general, it appears that the greater the change in the physical form of a food the higher is the glycemic response it will produce.

Plantain and other food crops contain carbohydrates with different compositions which is the major source of energy to man. Before the discovery of treatment for diabetes mellitus, the management was usually on dietary intake of some local diets of which plantain is one. It is therefore important to understand the glycemic effect of foods based on their compositions and processing methods as this will enhance the understanding of their roles in the management of carbohydrate metabolic disorders and to find out the best preparation method that produces a low glycemic index.

MATERIALS AND METHOD

Sample Collection and Preparation.

Fresh plantain fingers ripe and unripe were obtained from different marketers in Ariaria, Umungasi and Ngwa Road Markets, all in Aba, Abia State. The plantain diets were prepared by roasting, frying and boiling respectively. The different menu was fed to six-groups of volunteers (5-persons in each group). On each menu ripe and unripe plantains were fed to different groups and a group was also fed with anhydrous glucose after drawing their fasting venous blood sample.

Subjects on drugs that could affect carbohydrate metabolism were excluded from the study. The age, height and weight were determined in all subjects. Consent was obtained from the subjects before recruitment into the study.

Determination of Blood Glucose Response

Blood samples were drawn from the volunteers at 30 minutes interval for two hours after feeding. Each of the drawn blood was centrifuged to obtain a serum sample. 0.02ml of blood serum sample were mixed with 3ml glucose-oxidase reagent and incubated at 37^{o}_{C} with water bath for 10 minutes (Ojiako and Akubugwo, 1997, Tietz, 1990). The absorbance of the incubated sample was measured at 520nm spectrophotometer and the blood glucose concentrations were extrapolated from the standard glucose calibration curve. The area under the curve was determined using trapezoid method at different time intervals. A plot of concentration against time was used to determine the curve. The formula below was used for the calculations.

AUC, = C_{onc2} +C_{onc1}/2x(t2-1) (David, 2002).

Determination of Glycemic Index

The sum of area under curve for each plantain menu was divided by the sum of area under curve for standard glucose and multiplied by 100. The value obtained is the glycemic index (Brouns *et al.,* 2005)

Statistical Analysis

The result obtained was analyzed with a replicate of five samples on each treatment, using one way analysis of variance. (ANOVA) at f=0.05 and student/test at p=0.05 to determine the level of significance of the treated samples. (Ogbonna, 2005)

RESULTS AND DISCUSSION

Table 1 show the demographic features and fasting plasma glucose at recruitment were comparable.

There were no significant differences at (P<0.05)

Table 1**: Demographic features of study subjects**

Age (yrs)	36.a	36.7a	36.8a	36.9a	37.8a
Weight (kg)	59.65a	60.5a	59.8a	60.1a	59.9a
Height (m)	1.62a	1.63a	1.64a	1.63a	1.64a
Fasting blood					
Glucose (mMol/L)	4.4a	4.8a	4.6a	4.5a	4.7a

Means on the same row with the same superscripts are not significantly different (P<0.05

Table 3 **Glycemic index for ripe plantain menu** Replicate Glycemic indices

Treatment		1	2	3	4	5	Mean
Roasted plantain		50	54	55	56	56	54.2±2.49
Boiled plantain		52	59	53	53	51	53.6±3.13
Fried plantain	55	52	59	53	61	56.0±3.87	

Table 4 **Glycemic index for unripe plantain menu** Replicate Glycemic indices

Treatment		1	2	3	4	5	Mean
Roasted plantain		50	43	48	44	43	45.6±3.21
Boiled plantain		42	44	45	46	42	43.8±1.79
Fried plantain	44	47	47	44	47	45.8±1.64	

Tables 3 and 4 show the glycemic indices of ripe and unripe plantain. The individual ripe plantain menu shows a mean glycemic index value of 54,54, and 56 for roasted, boiled and fried plantain respectively. The mean glycemic value for unripe plantain menu shows 46 for fried, 44 for boiled and 45 for roasted plantain respectively.

Table 5 shows the blood glucose response for standard glucose, ripe plantain and unripe plantain. Ripe and unripe plantain diet release glucose slowly into the blood stream and blood glucose response for standard glucose is rapid. In addition the peak concentration in blood glucose among ripe plantain is greater than unripe plantain menu, suggesting that there is somewhat significant difference between blood glucose response of ripe and unripe plantain.

Table 5 **Blood glucose response for standard glucose, ripe plantain and unripe plantain**

Time (min)	Standard glucose	Ripe plantain			Unripe plantain			mMol/L
		Fried	Boiled	Roasted	Fried	Boiled	Roasted	
0	4.42	3.60	3.49	3.85	3.21	3.18	3.25	
30	3.80	3.90	3.66	4.66	3.42	3.313.40		
60	9.17	4.06	4.23	4.26	3.66	3.523.65		
90	7.92	5.11	4.63	4.32	3.66	3.523.77		
120	6.80	4.81	4.40	4.22	3.70	3.373.65		

The liberation of sugar was highest in the ripe plantain, due to post harvest changes, storage conditions and processing history. (Roder *et al.,* 2005, Vasloo, 2005). The starch content of plantain is converted to sucrose, glucose and fructose upon ripening. Digestion and release of sugar is faster leading to higher glucose response.

The average peak of blood glucose response for ripe plantain is 4.68mMol/L and 3.65mMol/L for unripe plantain. The average glycemic index for ripe plantain is 54.6 and 45.3 for unripe plantain. Although there is statistical significant difference in glycemic indices of ripe and unripe plantain ($p<0.05$), ripe and unripe plantain are still within the low glycemic index range. However unripe plantain diet will be more recommendable for a person who encounter carbohydrate metabolic disorders, but due to the role of fats and polycyclic aromatic hydrocarbon such as benzapyrene from fried and roasted foods, respectively to human health (Mcmurry and castellion, 1999), people are not encouraged to depend solely on them. Boiled unripe plantain diet remains a heather diet than other menu.

Low glycemic index foods have been associated with certain low risk factors in metabolic and cardiovascular disorders and high glycemic index foods are associated with high risk factors in carbohydrate metabolic and cardiovascular disorders, it is therefore important to understand the glycemic effect of foods as well as their nutritional values for good meal planning. With the increasing incidence of diabetes mellitus, dietary restriction and modification remains a cornerstone in the prevention and management of the disease.

CONCLUSION

The glycemic indices of ripe and unripe plantain using the different processing methods differs . However the results of this study suggest that boiled unripe plantain has more promising control effect on blood glucose level and could be better used in the management of metabolic disorder such as diabetes mellitus.

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