PJN
ISSN 1680-5194

# PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 10 (11): 1058-1060, 2011
ISSN 1680-5194


# Glycemic Index of Some Commonly Consumed Staples in Nigeria

Okafor, E.N.[1], I. Onyechi[2], A.U. Ozumba[1], G.N. Elemo[1], O.F. Kayode[1] and G.O. Asieba[1]
[1]Department of Food and Analytical Services, Federal Institute of Industrial Research, Oshodi, Nigeria
[2]Alpha Pharmacy, Lagos, Nigeria

**Abstract:** Blood glucose response and glycemic index of some common staples consumed in Nigeria were investigated. Eleven healthy volunteers (2 females and 9 males), mean aged 32.63 years and a mean BMI value of 21.38kg/m$^2$ were eventually selected. Subjects were studied on separate occasions in the morning after a 10-12h overnight fast. After fasting blood glucose was taken, subjects ate a test meal at a comfortable pace within 15 mins and further blood glucose response were taken at intervals of 15mins then 30 mins, over a period of 2hrs. The blood glucose response to the staples increased with time, reaching their peak after 45 min. except for sweet potato which peaked after 30 min., after which a fall in the responses with increasing time was observed. Glycemic index values ranged from 56 to 62. Boiled rice was observed to have the lowest value of 56, this was followed by boiled yam and plantain with values of 58 respectively. The highest GI was observed in boiled sweet potato and beans with a value of 62 respectively. These values were observed not to be significantly different. Results from this study indicates medium GI values of staples commonly consumed in Nigeria.

**Key words**: Glycemic index, blood glucose response, staples, Nigeria

## INTRODUCTION

The glycemic index, is a measure of the effects of carbohydrates on blood sugar levels (Jenkins *et al*., 1981). Glycemic index was conceived as a tool for the dietary management of type II diabetes (Brand-Miller, 2003). The American Dietetic Association (ADA) reviewed the evidence of glycemic index as a nutrition therapy intervention for diabetics and acknowledged that low glycemic index foods may reduce postprandial blood glucose levels, and asserted that there is sufficient evidence of long term benefit to recommend using low glycemic index diets as a primary strategy in meal planning (Asp, 1996).

The causes of type II diabetes is not well established but is usually associated with a diet rich in sweets and refined products and poor in whole grains and vegetables (Kranse and Hunsher, 1972; Pamplona-Roger, 2008). Until recently diabetics were prescribed diets that are low in all types of carbohydrate and rich in proteins and fats. This type of diet exposes the diabetic to high incidence of arteriosclerosis and cardiovascular diseases (Pamplona-Roger, 2008). The new approach therefore is to eat diets that are rich in complex carbohydrate, rich in fibre, low in fat particularly saturated animal fats and low in sugar.

Nigeria is blessed with varieties of dishes which provide adequate nutrition for the body, integrating information about the glycemic index of these foods into the Nigerian diet is however, limited by lack of data.

This study therefore, aims at investigating the blood glucose response and to determine the glycemic index of some common staples consumed in Nigeria. The information will be relevant to medical personnel's, researchers, food manufacturer/processors for product development and effective dietary management.

## MATERIALS AND METHODS

The raw material used for this study were high carbohydrate Nigerian staples (Table 1) and white bread (which served as the control). The staples were purchased from a local market in Lagos, Nigeria. The bread was purchased at Mr. Biggs restaurant, Ikeja, Lagos, Nigeria.

Table 1: Test Meals

| Meals* | Serving portion (g) |
|---|---|
| Boiled rice | 169 |
| Boiled yam | 163 |
| Boiled sweet potato | 205 |
| Boiled plantain | 161 |
| Boiled beans | 226 |
| Control | 77 |

*All meals contained 50g carbohydrate

**Processing of raw materials:** The raw staples were cleaned, cooked by boiling with water and some salt to taste, and served plain.

**Experimental procedure:** Forty volunteers were screened for the study. A self assessment questionnaire was used to collect the subjects' personal characteristics including general knowledge of their health conditions. Eleven healthy volunteers (2 females

**Corresponding Author:** E.N. Okafor, Department of Food and Analytical Services, Federal Institute of Industrial Research, Oshodi, Nigeria

Table 2: Blood Glucose Concentration (Mg/Dl) of Subjects

| Group | 0 mins | 15 mins | 30 mins | 45 mins | 60 mins | 90mins | 120 mins |
|---|---|---|---|---|---|---|---|
| Boiled rice | 81.71±11.43 | 97.00±10.5 | 112.86±20.4 | 105.86±16.9 | 98.71±13.9 | 89.14±9.9 | 87.14±10.14 |
| Boiled yam | 89.00±2.52 | 98.86±11.52 | 115.00±11.83 | 118.86±15.8 | 107±14.63 | 92.00±17.5 | 89.14±9.55 |
| Boiled plantain | 86.00±8.76 | 98.86±8.80 | 125.71±20.21 | 125.71±16.2 | 116.3±16.73 | 97.43±17.8 | 86.57±6.10 |
| Boiled sweet potato | 90.14±6.67 | 103.00±8.52 | 119.86±18.44 | 108.50±11.2 | 102.00±8.60 | 89.71±15.92 | 93.83±8.42 |
| Boiled beans | 93.33±8.21 | 103.33±14.61 | 113.00±10.86 | 125.17±9.39 | 115.17±20.1 | 107.17±10.7 | 87.67±5.79 |

Data = mean±SD, n = 11

and 9 males), mean aged 32.63 years and a mean BMI value of 21.38kg/m$^2$ were eventually selected. Subjects were studied on separate occasions in the morning after a 10-12h overnight fast. After fasting blood glucose was taken, subjects ate a test meal at a comfortable pace within 15 min and further blood glucose response were taken at 15, 30, 45, 60, 90 and 120 min. Test meals were served with a drink of water in all occasions.

**Blood analysis:** The blood samples were analyzed using One Touch Ultra 2 Glucometer to determine the fasting blood glucose (FBG) levels.

**Determination of glycemic index:** The glycemic index was calculated geometrically using the method described by FAO (1998) as the incremental area under the blood glucose response curve of a 50g carbohydrate portion of the test food expressed as a percent of the same amount of carbohydrate from a standard food taken by the same subject. White bread was used as a reference food. GI values obtained were adjusted relative to glucose.

**Data analysis:** The data obtained were analyzed using means, standard deviations and Analysis of Variance (ANOVA) and significance judged at $p<0.05$

## RESULTS

**Blood glucose response:** The blood glucose response of the studied meals are depicted in Table 2. The blood glucose response of subjects after eating the test meals was observed to be significantly lower ($p \leq 0.05$) than that of bread. The blood glucose response to the meals fell within close range with sweet potato having the highest and rice, the lowest. The blood glucose response to the meals increased with time, reaching their peak at 45 minutes except for sweet potato which peaked at 30 minutes, after which a fall in the responses with increasing time was observed.

**Glycemic index:** The glycemic index (GI) of the test meals is presented in figure 1. It ranged from 56 to 62. Boiled rice was observed to have the lowest value of 56, this was followed by boiled yam and plantain with values of 58 respectively. The highest GI was observed in boiled sweet potato and beans with a value of 62 respectively. These values were observed not to be significantly different.

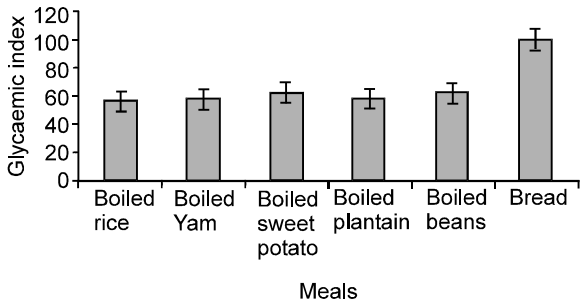


Fig. 1: Glycemic index of test meals

## DISCUSSION

The glycemic index (GI) of foods have been reported to be a marker of some beneficial effects of grains, legumes, and some vegetables (Trout *et al*., 1993). Low glycemic index diets are important in the management of hyperglycemia and hyperinsulinemia because they are more effective, per unit of energy, than most other foods in inducing satiety, thereby suggesting these foods have a potential role in dietary strategies to avoid and treat diabetes and obesity (Anderson *et al*., 1991; Oboh *et al*., 2010). This paper reports the glycemic index of some common staples consumed in Nigeria.

The studied staples had a relatively medium GI. The observed variations could be attributed to fibre, amylose content and amount per serving. Carbohydrate foods have been reported to produce different glycemic values depending on their chemical structure, particle size, amount and type of dietary fibre, fats, proteins, anti nutrients, and food processing which may explain the variation among the carbohydrate staples (Jenkins *et al*., 2000). Processing have been reported to have effect on GI (Omoregie and Osagie, 2008). Boiling, cooking and heating results in alteration of the physical properties of carbohydrate through gelatinization and retrogradation, thereby increasing the starch availability to amylase (Jimoh *et al*., 2008). The heat utilized, the amount of water, and the time of cooking, all have a significant effect on the GI (Pi-Sunyer, 2002), this could also be attributed to the observed variation in the GI of the test meals. However, potatoes, irrespective of variety, cooking method or maturity, have been reported to have exceptionally high GI values (Soh and Brand-Miller, 1999). This can be attributed to its high GI in this present study.

The test meals were chewed. Chewing have been shown to reduce the particle size of foods and facilitates

mixture with salivary amylase, thereby reducing digestion time of carbohydrates (Omoregie and Osagie, 2008). This is in conformity with reports that different meals with similar quality and type of carbohydrate form show different glycemic response (Thorsdottir *et al.*, 2005).

Legumes have been reported to produce relatively low glycemic response in both healthy individuals and in diabetics due to their components particularly the soluble dietary fiber and the nature of the starch (Oboh *et al*., 2010). However, we observed a rather higher GI which contradicts earlier report of Oboh *et al*. (2010) on GI values of boiled beans. The higher GI value of beans in this present study may be explained by the amount of beans served, molecular weight and length of amylose present in the beans as well as degree of retrogradation.

**Conclusion:** Results from this study indicate medium GI value of staples commonly consumed in Nigeria. It will be recommended that these foods be served with equal amounts of fibre to further reduce their GI values. However, no particular food has a definitive GI, because the GI is dependent on the history of the processing, storing, ripening, cutting, and cooking of the food.

## REFERENCES


Anderson, J.W., J.A. Zeigler, D.A. Deakins, T.L. Floore, D.W. Dillon, C.L. Wood and P.R. Oeltgen, 1991. Metabolic effects of high-carbohydrate, high-fiber diets for insulin-dependent diabetic individuals. Am. J. Clin. Nutr., 54: 936-943.

Asp, N.G., 1996. Dietary carbohydrates: Classification by chemistry and physiology. Food Chem., 57: 9-14.

Brand-Miller, J.C., M. Thomas, V. Swan, Z.I. Ahmed, P. Petocz and S. Colagiuri, 2003. Physiological validation of the concept of glycemic load in lean young adults. J. Nutr., 133: 2728-2732.

FAO, 1998. Carbohydrates in Human Nutrition, FAO/WHO Joint Expert Consultation, 14 - 18 April 1997. FAO Food and Nutrition, paper 66. Rome: FAO.

Jenkins, D.J.A., T.M.S. Wolever, R.H. Taylor, H. Barker, F. Hasemein, J.M. Baldwin, A.C. Bowling, H.C. Newman, A.L. Henkins and D.V. Goff, 1981. Glycemic index of foods: a physiological basis for carbohydrate exchange. Am. J. Clin. Nutr., 34: 184-190.

Jenkins, D.J., C.W. Kendall and M. Axelsen, 2000. Viscous and nonviscous fibres, nonabsorbable and low glycaemic index carbohydrates, blood lipids and coronary heart disease. Curr. Opin. Lipidol., 11: 49-56.

Jimoh, A.K., O.S. Adediran, S.A. Adebisi, S.A. Biliaminu and A.B. Okesina, 2008. Effect of food processing on glycemic response to white yam (*Dioscorea rotunda*) meals. Diabetol Croat., 37: 67-72.

Kranse, M.V. and M.A. Hunsher, 1972. Food, Nutrition and Diet Therapy (5th Edn.), pp: 410-414.

Oboh, H., A. Osagie and A. Omotosho, 2010. Glycemic response of some boiled legumes commonly eaten in Nigeria. Diabet Croat., 39: 125-131.

Omoregie, E.S. and A.U. Osagie, 2008. Glycemic indices and glycemic load of some Nigerian foods. Pak. J. Nutr., 7: 710-716.

Pamplona-Roger, G.D., 2008. Healthy Foods (1st Edn.), pp: 276-277.

Pi-Sunyer, F.X., 2002. Glycemic index and disease. Am. J. Clin. Nutr., 76 (suppl): 290S-298S.

Soh, N.L. and J. Brand-Miller, 1999. The glycaemic index of potatoes: the effect of variety, cooking method and maturity. Eur. J. Clin. Nutr., 53: 249-254.

Thorsdottir, I., B. Birgisdottir, L. Steingrimdottir, B. Karistrom, I. Bjorck and A. Flint, 2005. Glycemic index: From research to nutritional recommendations. Ekpresson and Kopiceter, Denmark, pp: 1-84.

Trout, D.L., K.M. Behall and O. Osilesi, 1993. Prediction of glycemic index for starchy food. Am. J. Clin. Nutr., 58: 873-878.