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Research Article

Management of Post-Prandial Blood Glucose Level Using Some Common Nigerian Thickeners

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Abstract

This study investigated the effect of the consumption of soups made from some Nigerian soup thickeners such as *Brachystegia eurycoma* (achi), *Detarium microcarpum* (ofor), *Irvingia gabonensis* (ogbono), *Colocasia esculenta* (taro) and *Citrullus vulgaries* (egusi) on the post-prandial blood glucose level of healthy subjects. The soup thickeners were processed into flour and paste using usual traditional processing method. The soups were consumed on separate days by five subjects after an overnight fast. Three days interval was allowed between the consumption of each test soup. Fasting venous blood glucose were taken at fasting (0 min), and post-prandial blood glucose levels were taken at 30 min intervals for 3 hours; and the blood was analyzed for glucose using *FineTest*™ strips and glucometer. Compared with the control, *Irvingia gabonensis* soup elicited significant reduction ($p \leq 0.05$) in plasma glucose levels at 90 and 180 min; while the *Brachystegia eurycoma* had significant reduction only at 180 min. Proximate analysis was also carried out on the six different soup samples used in this study. The percentage crude fiber of the soups compared to the control soup (6.53) was highest *in Irvingia gabonensi* soup (6.59), while in *Brachystegia eurycoma* soup it was (2.0), *Detarium eurycoma* soup (1.30), *colocasia esculenta* soup (4.0) and *Citrullus vulgaries* soup (2.80).

Keywords: *Irvingia gabonensis; Citrullus vulgaries; Colocasia esculenta; Brachystegia eurycoma and Detarium microcarpum*

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Introduction

Diabetes mellitus is defined as a chronic metabolic disorder characterized by high blood glucose (hyperglycaemia) and associated with impaired carbohydrate, fat and protein metabolism, resulting from either insufficient or no release of insulin by pancreas in the body [1] . Type II diabetes is predominant, accounting for over ninety per cent (90%) of cases in sub-Saharan Africa. Among the low and middle income countries such as Nigeria, diabetes has been on the increase contributing to eighty per cent (80%) of deaths [2]. A shift in the eating habit, decreased physical activities and emulation of westernized life style has been reported by the World Health Organization (WHO) and Food and Agricultural Organization (FAO) as the major factor leading to the rapid change in diabetes pattern.

Glycaemic index is a system that characterizes how fast carbohydrate is metabolized in a diet, and how fast it can raise postprandial blood glucose in the body. Dietary studies carried out have shown that the carbohydrate contents of lower glycaemic index foods are slowly broken down in the body, and moves into the blood stream at a slower rate. Foods rich in dietary fibre have been accepted to be suitable for diabetics, this is as a result of its low glycaemic index content and minimal rapidly digestible starch content, consumption of such foods have been said to be important in the treatment and prevention of diet related chronic diseases such as diabetes and also shown to cause an improvement in the intestinal mobility [3,4] . Experiments involving both humans and animals encouraged the view that soluble dietary fibre such as guar gum is an important component of our diet, and this importance has been attributed to its ability to modulate the postprandial blood glucose and insulin response in diabetic and non-diabetic individuals [5] .

Thickeners are hydrocolloids or guar gums used to thicken beverages, gravies, sauces and soups. Hydrocolloids are diverse group of long chain polymers with the characteristic of forming viscous dispersion or gel when dispersed in water; they have neutral taste and aroma [6]. In Nigeria, a wide range of thickening agents are available for use by the millions of Nigerians, they include; *Brachystegia eurycoma* (achi), *Detarium microcarpum* (ofor), *Irvingia gabonensis* (*Ogbono*), *Colocasia esculenta* (taro) and *Citrullus vulgaries* (egusi) [7-9]. Most rural dwellers who diet majorly on these seeds have been observed to have clean records of all the nutritional associated diseases and conditions such as obesity, diabetes and so on[10] . Therefore, there is need for more research work to be carried out on these thickeners. The main purpose of this work was to determine the effect of these thickeners on the postprandial blood glucose level of healthy subjects.

Materials and Methods

Subjects

Five healthy subjects were selected to take part in this study. All were in good physical condition and had a family history without diabetes or metabolic disorders. They were not currently under any medication.

Procurement of soup ingredients

The thickeners and other soup condiments where purchased from the popular Oil Mill market in Port Harcourt, Rivers State.

Obtaining ethical approval for the study

The experimental protocol was approved by the ethical committee of University of Port Harcourt, Rivers State.

Obtaining informed consent from the participants

Every participant provided an informed, written consent.

Preparation of soup samples

The procedures used in the preparation of the soups were as close as possible to the traditional method used by people in the rural areas of Nigeria.

Soup condiments used (none thickening agents) include:

i. Two cooking spoons red oil

ii. Half kilogram beef

iii. Two stock cubes

iv. One medium size stock fish

v. Three table spoons ground crayfish

vi. One table spoon ground pepper

vii. Pumpkin leaf

viii. Water

ix. Salt to taste

The procedure for the preparation of the soups is summarized in the flow chart given in figure 1.

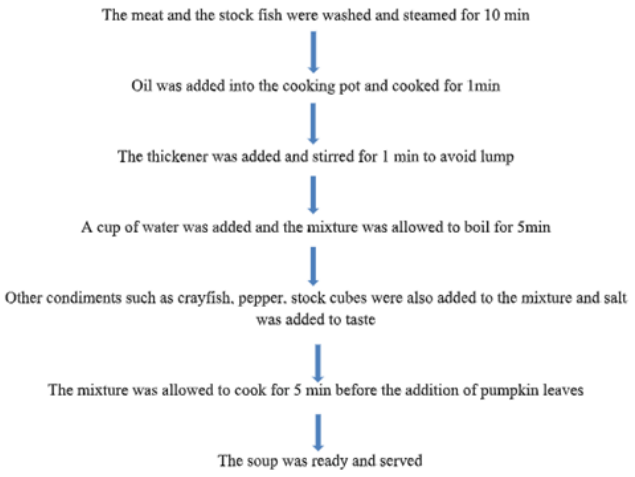

Figure 1: Flow chart for the preparation of the soups.

Grouping of test meals

The study consisted of six groups of five individuals, with each group representing one of the six soup samples, all prepared as they are locally prepared in Igbo land. These are:

i. Group one (control soup) contained no thickener.

ii. Group two (egusi soup) contained the seed flour of Citrullus vulgaries 'egusi'.

iii. Group three (ofo soup) contained the seed flour of Detarium microcarpum 'ofor'.

iv. Group four (cocoyam soup) contained the cormel paste of Colocasia esculenta 'taro'.

v. Group five (achi soup) contained the seed flour of Brachystegia eurycoma 'achi'.

vi. Group six (ogbono soup) contained the seed flour of Irvingia gabonensis 'ogbono'.

Feeding of the subjects with the experimental meals

Groups of five volunteers were drawn from a pool of 5 (4 men, one woman). They each took part in two or more experiments, one of which was a control, which were performed in randomized order at least three days apart. The meals were taken over a 10-minute period in the morning after an overnight fast.

Determination of the post-prandial blood glucose level

On arrival on the test days, subjects rested for 10min before the experiment began to enable the blood volume to stabilize. It was ascertained that the subjects had nothing to eat for 12hrs. Cotton wool was used to apply methylated spirit on the finger tips, usually the thumb. Blood lancet was used to prick the fingers; a drop of blood was applied on the circular portion on the test trip. This was displayed on the screen and the result given after 45 seconds from the glucometer.

Fasting blood glucose was taken and subsequently postprandial blood glucose were measured every 30 min for 3 h. Blood glucose was measured using one FineTest glucometer and test strips, with a measuring range of 0 to 600mg/dL (0 to 33.3mmol/L).

Analysis

The proximate analysis of the samples, that is the ash content, crude fiber, protein, moisture, fat and carbohydrate contents were determined using the standard method as described by the Association of Official Analytical Chemist 1984.

Statical analysis

Data obtained were statistically analyzed using one way ANOVA at 95% confidence interval ($p \leq 0.05$).

Results and Discussion

Results

Table 1 shows the results of the proximate analysis of the six soup samples. The percentage crude protein of the samples ranged from 5.25% (control soup) to 19.25% (*Brachystegia eurycoma* soup). Compared to the control soup, *Brachystegia eurycoma* soup contained the highest percentage crude protein followed by *Citrullus vulgaries* soup (13.13%), *Colocasia esculenta* soup (11.81%), *Irvingia gabonensis* soup (9.63%) and *Detarium microcarpum* soup (8.75%). The lipid content of the various soups differed from the control sample (2.2%) with the Brachystegia eurycoma soup containing the highest percentage of lipid (8.89%); while *Citrullus vulgaries* soup was the

S/N	Sample Identity	Moisture (g/100g)	Ash (g/100g)	Carbohydrate (g/100g)	Crude Protein (g/100g)	Lipid (g/100g)	Crude Fiber (g/100g)	Energy Value (kcal/100g)
1	Control soup	75.92	6.89	3.21	5.25	2.20	6.53	53.64
2	Egusi soup	48.93	2.87	25.64	13.13	6.63	2.80	214.75
3	Ofo soup	78.94	1.30	3.21	8.75	6.50	1.3	106.34
4	Cocoyam soup	67.59	3.63	11.54	11.81	1.43	4.00	106.27
5	Achi soup	53.57	2.19	14.10	19.25	8.89	2.00	173.41
6	Ogbono soup	64.66	9.48	4.49	9.63	5.15	6.59	102.83

Table 1: Proximate analysis of the soup samples.

second highest with 6.63%, followed by *Detarium microcarpum* soup (6.50%), *Irvingia gabonensis* soup (5.15%) and *Colocasia esculenta* soup (1.43%). The *Irvingia gabonensis* soup had the highest percentage of ash content with 9.48% as compared to the control sample which had 6.89%. The dietary fibre contents of the soups were compared and *Irvingia gabonensis* soup had the highest dietary fibre of 6.59% while *Detarium microcarpum* soup had the lowest percentage dietary fibre of 1.30%. The total carbohydrate content of was highest in egusi soup with 25.64% and least in *Detarium microcarpum* soup and the control soup with 3.21% each. *Detarium microcarpum* soup had the highest moisture content of 78.94% whereas *Brachystegia eurycoma* soup had a total of 53.57%, *Colocasia esculenta* soup 67.59%, control soup 75.97% and *Irvingia gabonensis* soup 64.66%.

Figure 2 showed the effect of the test soups on the post-prandial blood glucose level of healthy subjects fed after 30 min. There was an upsurge in the post-prandial blood glucose level of the subjects after 30 min of consumption of the test soups. *Citrullus vulgaries* soup having a great increase by 29.6mg/dL and *Irvingia gabonensis* soup had the least upsurge with 15.2mg/dL. Statistically, there was no significant difference ($p \leq 0.05$) between the various soups and the control soup.

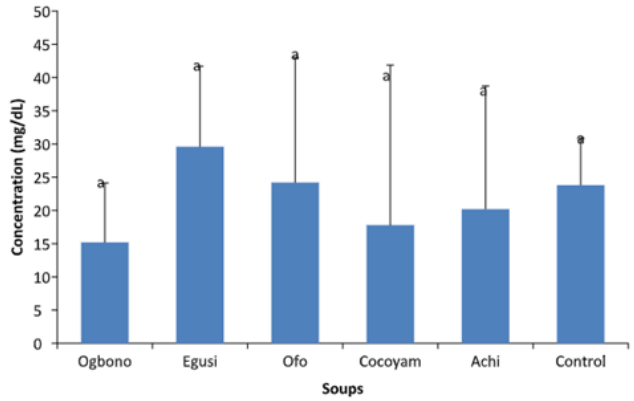

Figure 2: Effect of the soups on the post-prandial blood glucose level of the subjects after 30 min. Values are means ±standard deviation, n=5 per group. Bars with different letters (a,…) are significantly different at $p \leq 0.05$.

Figure 3 represents the effect of the soups on the post-prandial glucose level of the subjects after 60 min. All the thickeners produced substantial reduction effect in the post-prandial blood glucose level of the subjects after 60 min of consumption of test soups compared to the control. *Detarium microcarpum* soup produced the highest reduction effect with 6mg/dL. The statistical analysis showed that there was no significant difference between the soups with thickeners and the control soup.

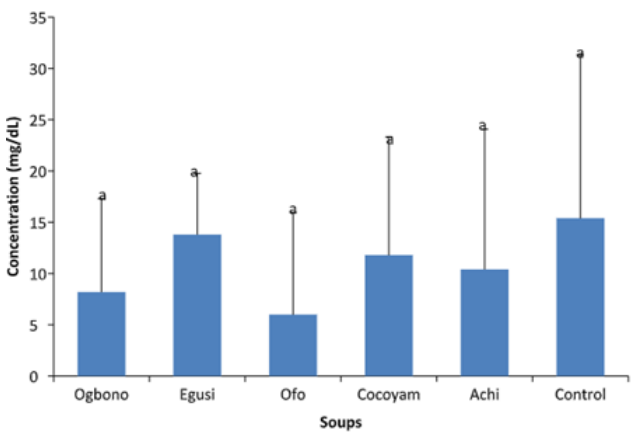

Figure 3: Effect of the soups on the post-prandial blood glucose level of the subjects after 60 min. Values are means ±standard deviation, n=5 per group. Bars with different letters (a,…) are significantly different at $p \leq 0.05$.

Figure 4 is showing the effect of the thickeners on the post-prandial blood glucose level of the subjects after 90 min. After 90 min of consumption of the test soups, *Irvingia gabonensis* soup was able to effect a reduction in the post-prandial blood glucose level of the subjects while the soups of Detarium microcarpum, Brachystegia eurycoma and the control soup greatly increased the post-prandial blood glucose level of the subjects. Statistically, the soups of *Irvingia gabonensis* and *Detarium microcarpum* were significantly different at $p \leq 0.05$. All the soups were not significantly different from the control soup.

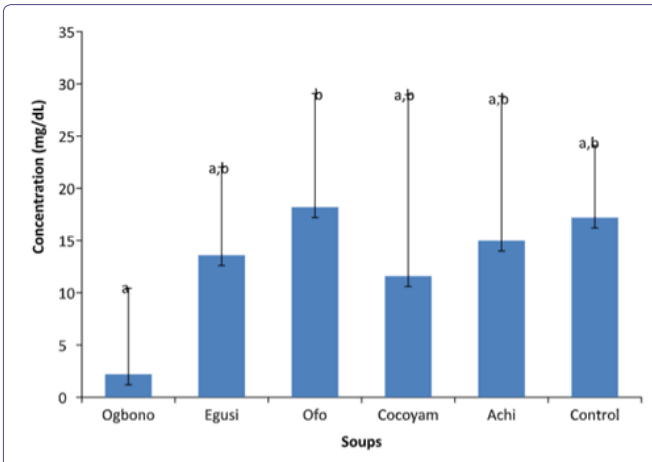

Figure 4: Effect of the soups on the post-prandial blood glucose level of the subjects after 90 min. Values are means±standard deviation, n=5 per group. Bars with different letters (a,b…) are significantly different at $p \leq 0.05$.

The effect of the soups on the post-prandial blood glucose level of the subjects after 120 min is shown in figure 5. The soups of *Irvingia gabonensis, Citrullus vulgaries, Detarium microcarpum and Colocasis esculenta* produced great reductions in the post-prandial blood glucose level of the subjects with the exception of *Brachystegia eurycoma* and the control soups which showed a effected a rise in the post-prandial blood glucose levels of the subjects. The soup thickeners are significantly not different at $p \leq 0.05$ when compared with the control sample.

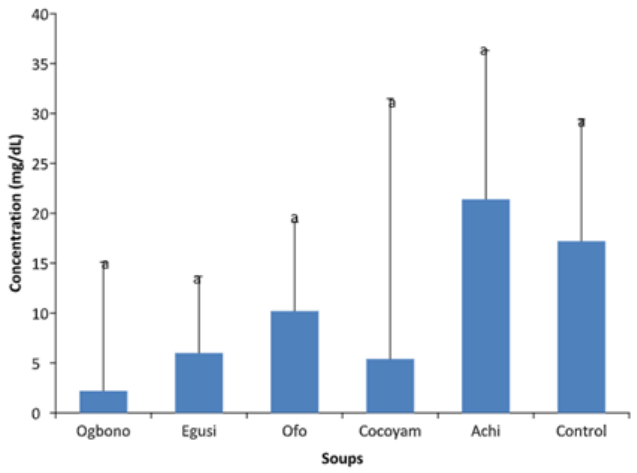

Figure 5: Effect of the soups on the post-prandial blood glucose level of the subjects after 120 min. Values are means ±standard deviation, n=5 per group. Bars with different letters (a,…) are significantly different at $p \leq 0.05$.

Figure 6 is showing the effect of the soup thickeners on the post-prandial blood glucose level of the subjects after 180 min of consumption of the test soups. All the soups are not significantly different when compared with the control sample. *Irvingia gabonensis* soup and *Brachystegia eurycoma* soup are significantly different at $p \leq 0.05$. With the exception of *Irvingia gabonensis* soup and *Citrullus vulgaries* soup which showed modest reduction, all of the soups produced substantial increase in the post-prandial blood glucose level of the subjects.

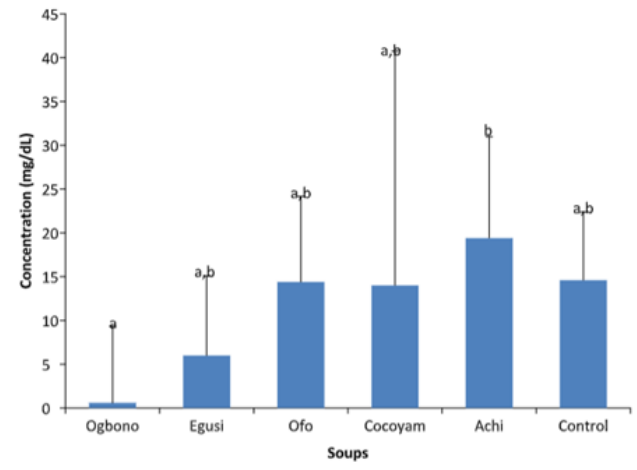

Figure 6: Effect of the soups on the post-prandial blood glucose level of the subjects after 180 min. Values are means±standard deviation, n=5 per group. Bars with different letters (a,b…) are significantly different at $p \leq 0.05$.

Discussion

In this study, the *Irvingia gabonensis*, *Colocasia esculenta* and *Citrullus vulgaries* soups consistently produced lower post prandial glucose levels in the participants, compared to the control soup. This could be attributable to their high crude fibre contents. Studies have shown that soluble viscous fibres have a positive effect of reducing postprandial glycaemia and thus may have a role in managing and preventing type 2 diabetes [11-13]. Amongst the crude fibres are the hydrocolloids or gum, which are a diverse group of long chain polymers characterized by their property of forming viscous dispersions and gels when dispersed in water [6]. According to [14], the digestive and viscosity characteristics of dietary fibres appear to nbe the likely modes of action, through which they decrease nutrient absorption, and thereby, decreasing metabolizable energy. The finding of this study, in respect of the *Irvingia gabonensis* soup (ogbono soup) is in conformity with the findings of [15], who reported that hydrocholloids physically function as soluble fibre when ingested and as such are effective in reducing blood cholesterol levels and moderating glucose response in diabetics.

Conclusion and Recommendations

Conclusion

In conclusion, the results obtained in this study indicated that the above uncharacterized plant foods indigenous to Nigeria have potential as dietary supplements for improving glycaemic control. As these foods are cheap, easily available and commonly used as food thickeners in rural Nigeria, they could be exploited for the treatment of diabetes in the more urban areas of Nigeria and other part of Africa where the prevalence of diabetes is currently a serious health problem. The *Irvingia gabonensis* in particular showed considerable promise. *Irvingia gabonensis* is likely to have other interesting nutritional properties that need investigating in human subjects.

Recommendations

The following are hereby recommended.

- That the effect of the soup thickeners on postprandial glucose levels be studied using others sources of starch.
- That the impact of gender on the effects of the soup thickeners be investigated.

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