Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension
Volume 2, Number 1, January 2001 pp. 35 - 41

ISBN 1119-7455

EVALUATION OF THE NUTRIENT AND ORGANOLEPTIC PROPERTIES OF PULVERIZED BAOBAB LEAF (*ADANSONIA DIGITATA L.*) SOUP

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ABSTRACT

The study examined the nutrient composition, viscosity and acceptability of pulverized baobab leaf soup among graduate students from University of Nigeria, Nsukka. Pulverized baobab leaves and ogbono seed flour were analyzed chemically and used to prepare separate soups. The ogbono seed flour soup served as the control. The soups were organoleptically and chemically evaluated using standard methods. The pulverized baobab leaves and its soup contained more ($p<0.05$) carbohydrate, fiber, ash, calcium (Ca), phosphorus (P), ascorbate and vitamin A as retinol equivalent than the ogbono seed flour and its soup. The pulverized baobab soup had 4.36% protein, 22.62% carbohydrate, 88.61 mg Ca, 102.27 mg P and 43.80 µg provitamin A. The slurries from the two soup ingredients had similar viscosities. The pulverized baobab leaf soup was accepted by the judges. However they preferred the ogbono seed flour soup probably because, they are familiar with it. The pulverized baobab leaf soup should be popularized because of its rich nutrient potentials.

Key words: Nutrient composition, acceptability, baobab leaf.

INTRODUCTION

Green leafy vegetables are good sources of micronutrients particularly ascorbate and vitamin A (FAO, 1997; Rajyalakshmi, 2001). There are a lot of leafy vegetables in Nigeria ecosystem which could provide adequate quantities of micronutrients in the diet if they are properly processed and utilized. In spite of this, Nigerians still suffer from micronutrient deficiencies (NDHS, 1990, OMNI and USAID, 1993). This is partly because of a lack of knowledge on the processing, nutrient composition and utilization of many and varied leafy vegetables indigenous to Nigeria. Baobab (*Adansonia digitata L.*) leaf is one of such vegetables. Baobab leaves, fruits and seeds are used as articles of food in the northern states of Nigeria where it grows extensively. However they are not consumed in the southern states. Baobab plant is a deciduous tree and a member of the family Bombaceae. Flowers, fruits and leaves develop in the tree during the rainy season. The leaves fall and the fruits mature in the dry season. The tree may live for hundreds of years. The baobab tree grows extensively in semi-arid Africa, from Senegal east to Kenya, and throughout southern Africa and Madagascar. As the baobab has many uses, young trees are kept alive and encouraged to grow in and around village sites (Scheuring et al., 1999).

The leaf of the baobab tree has rich nutrient potentials. FAO (1990) reported its protein value as 12.3%, 3.1% fiber, 9.6% ash, 11.8% moisture, 221mg calcium, 24mg iron, 275 mg phosphorus and traces of ascorbate. The leaf has been identified as a rich source of beta-carotene, the precausor of vitamin A (156.5 µg/g) (Scheuring *et al.*, 1999). The baobab leaf would be useful in providing macro and micronutrients to the diets of people who consume it. The leaf is used as a vegetable in soups either in fresh, dried or powdered form. The powder, known as *akuka* in northern Nigeria is used to thicken soups

called *miyan kuka* (Addy, 1978). This is because the pulverized baobab leaf has a high mucilage content like *Irvingia gobonensis* seed (FAO, 1988). The soup appears promising as a good source of nutrients. Its use could be extended from northern Nigeria to southern states to diversify the diet, change food habit and increase nutrient intake of the populace. This is particularly important in the dietary diversification approach to combating malnutrition. However, there is a need to establish information on the nutrient composition of the soup and its acceptability among consumers from the southern states. This will provide base line data for popularizing the soup in the areas where it is not consumed in Nigeria. The objective of the study was to determine the nutrient composition, viscosity and acceptability of pulverized baobab leaf soup among consumers from the southern states of Nigeria.

ogbono seed flour soup served as the control for evaluating the baobab leaf soup. This is because *ogbono* seed flour and pulverized leaf are used as soup thickeners because they have high mucilage content (FAO, 1988). *Ogbono* soup is also popular in Nigeria (Bennuah, 1994).

Preparation of soups

Pulverized baobab leaf soup and *ogbono* soup were prepared separately. Ninety grammes of onions, 14.5g of maggi cubes and 14.5g of table salt were added to 625g of meat and 125g of stockfish. 1.5L (1500ml) of water was added to each of the mixture, the mixtures were allowed to boil separately in a thermostatically controlled water bath (Thermostirrer 95 Gallenkamp, England) set at 75°C for 15 min. Either 50g of pulverized baobab leaves or 50g of *ogbono* seed flour were stirred into the respective soups. The stirring of the soups continued until the ingredients were completely dissolved and the soups were thickened. About 125g of palm oil were added to each of the soups. They were separately allowed to boil for another 10 min. 25g of crayfish, 150g of dried fish and 7.25g of pepper were added to the respective soups. The soups were allowed to simmer for 10min, removed from the heater and left on the rack to cool to 40°C (serving temperature). Ingredients used in the soups preparation are shown in Table 1.

Table 1: Ingredients used in preparation of the soups.

Ingredients	Quantity (S.I. unit)	Quantity (Household measure)
Pulverised baobab leaf/*Ogbono* seed flour	50g	3 cooking spoons
Meat	625g	25 pieces
Stockfish	125g	1 small size
Dried fish	150g	5 medium size
Crayfish	25g	1 desert spoon
Fresh pepper	7.25g	4 pieces
Maggi cubes	14.50g	2 cubes
Onions	90g	1 medium size
Salt	14.50g	1 table spoon
Palm oil	125g	2 cooking spoons
Water	1.5L (1500ml)	2 big cups

MATERIALS AND METHODS

Materials

Pulverized baobab (*Adansonia digitata L.*) leaves used for the study were purchased from Lafia market in Nassarawa state, Nigeria while *ogbono* seeds *dikanut* (*Irvingia gabonensis*) were purchased from Nsukka market in Enugu state. The *ogbono* seeds were cleaned and milled into fine flour using a Gallenkamp mixer (Model MPR 201). The *ogbono* seed flour and the pulverized baobab leaves were used to prepare two separate soups. The

Sensory evaluation of the soups

Organoleptic evaluation of the soups was carried out using a one-hundred consumer judges drawn from the University of Nigeria Graduate Student's Association. Only the students from the southern states of Nigeria were selected through random sampling. This is because the baobab soup is not commonly consumed in southern states. They evaluated the acceptability of the soups using the indices of flavour, appearance and consistency. A 9-point hedonic scale from 1 "dislike extremely" to 9 "like extremely" was used to evaluate the soups (Watts *et al.*, 1989). The students were divided into four groups of twenty five each. Morning and afternoon evaluation sessions were organized for two days. Each group of students participated in one of the evaluation sessions. The pulverized baobab leaf soup and the *ogbono* seed flour soup (the control) were coded and presented to the judges in small transparent soup bowels. Clean water was provided to the judges to rinse their mouth in-between testing of the soups to avoid carry over effect. The evaluation was conducted in the food research laboratory of the Department of Home Science and Nutrition, University of Nigeria, Nsukka. The laboratory was clean and free from distractions. Fluorescent lights provided uniform illumination and the judges were positioned independent of each other. An evaluation form with codes as in the soup sample was given to each judge to record his or her observations.

Preparation of samples for chemical analysis

Pulverized baobab leaf soup and *ogbono* seed flour soup were prepared separately as described earlier. However, meat fish and stockfish were omitted during the preparation of the soups. This was because the ingredients are very rich in some nutrients and their inclusion might lead to overestimation of the nutrient composition of the soups. A sample of each of the soups was homogenized in a Moulinex blender.

Chemical analysis

The homogenized soups, the pulverized baobab leaves and the *ogbono* seed flour used in the preparation of the soups were analyzed for proximate, mineral and ascorbate composition according to the standard assay methods of AOAC (1995). Provitamin A was determined using the method adopted from IVACG (1982). The vitamin A activity, as retinol equivalents (RE) was calculated based on the in vivo conversion factor given by WHO (1982).

Viscosity determination

Twenty five grams of pulverized baobab leaves and *ogbono* seed flour were separately dissolved in 300ml of cold deionized water to make slurry. The respective slurries were separately heated in a thermostatically controlled water bath set at 75°C for 10min. The slurries were allowed to cool to 40°C. The viscosities of the slurries were determined using the Universal Torsion Viscometer, VHA-200-M, Gallenkamp, England.

Statistical analysis

The results obtained from the chemical and the sensory evaluations were statistically analysed. The means and standard deviations were calculated. A two-tailed student T-test was used to determine differences between the means at 5% ($p<0.05$) level of significance (Obi, 1986).

RESULTS AND DISCUSSION

Nutrient composition of pulverized baobab leaves and *ogbono* seed flour

Table 2 presents the statistical comparison of the nutrient content of pulverized baobab leaves and *ogbono* seed flour on dry weight basis. The pulverized baobab leaves contained higher ($p<0.05$) protein, carbohydrate, fiber, ash, calcium (Ca), phosphorus (P), copper (Cu), ascorbate and Provitamin A than the *ogbono* seed flour. However, the *ogbono* seed flour contained more fat than the pulverized baobab leaves. The high fat level of the *ogbono* seed flour was not surprising because

Table 2: Statistical comparison of the nutrient composition of pulverized baobab leaves and *ogbono* seed flour (100g, dry weight basis).

Proximate composition	Protein (%)	Fat (%)	Carbohydrate (%)	Fiber (%)	Ash (%)
	PBL 12.40±0.02[a]	4.30±0.10[b]	66.50±0.20[a]	9.90±0.12[a]	6.90±0.02[a]
	OSF 9.10±0.07[b]	58.00±0.08[a]	23.10±0.12[b]	8.40±0.07[b]	1.40±0.06[b]
Mineral Composition	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Zinc (mg)	Copper (mg)
	PBL 147.00±0.09[a]	203.00±0.09[a]	0.02±0.01[a]	0.02±0.02[a]	0.14±0.01[a]
	OSF 0.80±0.01[b]	0.08±0.02[b]	0.02±0.01[a]	0.02±0.0[a]	0.06±0.01[b]
Vitamin Composition	Ascorbate (mg)	Provitamin A (µgRE)			
	PBL 3.20±0.02[a]	89.61±0.07[a]			
	OSF 1.50±0.01[b]	0.34±0.01[b]			

Means ± SD

Means with similar letters are statistically ($p>0.05$) similar while those with different letters are statistically ($p<0.05$) different. PBL - Pulverized baobab leaves; OSF - *Ogbono* seed flour

Table 3: Statistical comparison of the nutrient composition of pulverized baobab leaf and *ogbono* seed flour soup (100g, wet weight basis).

Proximate composition	Protein (%)	Fat (%)	Carbohydrate (%)	Fiber (%)	Ash (%)	Moisture (%)
	PBLS 4.3624±0.05[a]	1.47±0.06[b]	22.62±0.09[a]	3.39±0.09[a]	2.36±0.02[a]	65.80±0.09[a]
	OSFS 3.09.0±0.01[a]	19.73±0.02[a]	7.82±0.04[b]	2.86±0.02[b]	0.48±0.03[b]	66.02±0.07[a]
Mineral Composition	Calcium (%)	Phosphorus (mg)	Iron (mg)	Zinc (mg)	Copper (mg)	
	PBLS 88.61±0.12[a]	102.27±0.11[a]	0.14±0.04[a]	0.03±0.04[a]	0.26±0.01[a]	
	OSFS 0.34±0.02[b]	0.41±0.02[b]	0.06±0.08[a]	0.02±0.04[a]	0.09±0.01[a]	
Vitamin Composition	Ascorbate (mg)	Provitamin A (µgRE)				
	PBLS 1.45±0.02[a]	43.80±0.09[a]				
	OSFS 0.52±0.03[b]	0.15±0.01[b]				

Means ± SD

Means with similar letters are statistically ($p > 0.05$) similar while those with different letters are statistically ($p < 0.05$) different.

PBLS - Pulverized baobab leaf soup

OSFS - *Ogbono* seed flour soup

Table 4: Viscosity of pulverized baobab leaf slurry and *ogbono* seed flour slurry at 40°C.

Sample	Viscosity (cps)
PBLS	320
OSFS	310

PBLS - Pulverised baobab leaf slurry
OSFS - *Ogbono* seed flour slurry
cps - Centipose

Table 5: Statistical comparison of the sensory scores of pulverized baobab leaf soup and *ogbono* seed flour soup.

Sample	Flavour[1]	Appearance[1]	Consistency[1]	Acceptability[1]
PBLS	6.95 ± 0.80^{b}	7.01 ± 0.80^{a}	6.12 ± 0.30^{a}	6.63 ± 1.01^{b}
OSFS	7.92 ± 0.92^{a}	6.92 ± 1.30^{a}	6.64 ± 1.60^{a}	7.68 ± 0.90^{a}

Means ± SD
Means with similar letters are statistically ($p > 0.05$) similar while those with different letters are statistically ($p < 0.05$) different.
PBLS - Pulverized baobab leaf soup
OSFS - *Ogbono* seed flour soup
[1]Scores are based on a 9-point hedonic scale where scores of

9 - Like extremely	6 - Like slightly	3 - Dislike moderately
8 - Like very much	5 - Neither like nor dislike	2 - Dislike very much
7 - Like moderately	4 - Dislike slightly	1 - Dislike extremely

ogbono seed is an oil seed and stores its food energy as fat. The higher ascorbate, provitamin A and mineral levels of the pulverized baobab leaves than the *ogbono* seed flour is in line with literature reports on green leafy vegetables (FAO, 1997; Oguntona, 1998; Rajyalakshmi *et al.*, 2001). The reports showed that green leafy vegetables contain appreciable quantities of minerals, ascorbate and provitamin A. The high provitamin A level (89.61 µgRE) of the pulverized baobab leaves is of interest. Use of the leaves should be fully explored in the food based approach as a means to combat vitamin A deficiency in Nigeria. The provitamin A level of the leaves could be pushed up if they are carefully dried under the sun or in a solar drier (Rahman *et al.*, 1997, Scheuring *et al.*, 1999).

Nutrient composition of the soups

The statistical comparison of the nutrient content of pulverized baobab leaf soup and *ogbono* seed flour soup are presented in Table 3. The pulverized baobab leaf soup had higher ($p < 0.05$) carbohydrate, fiber, ash, Ca, P, ascorbate and provitamin A than the *ogbono* seed flour soup. The differences in the nutrient composition of the soups might be attributed to the compositional differences in the parts of the different plants used as base ingredient in the soup preparations. The *ogbono* seed flour soup however, had higher ($p < 0.05$) fat (19.73%) level than the pulverized baobab leaf soup (1.47%). The higher fat content of the *ogbono* seed flour soup than the pulverized baobab leaf soup is of interest. This is because the fat consists mainly of the polyunsaturated fatty acids which are desirable in the diet. The *ogbono* seed flour soup with its high fat content could be of value in providing concentrated source of energy particularly in the diets of infants and young children. This is because it is difficult for a small child to consume enough food to cover his energy requirements. The pulverized baobab leaf soup with higher Ca (80.61mg), P (102.27 mg), ascorbate (1.45 mg) and provitamin A (43.80 µgRE) than the *ogbono* seed flour soup could be useful in improving the micronutrient intake of the populace.

Viscosities of the pulverized baobab leaf and *ogbono* seed flour slurries

The viscosities of pulverized baobab leaf and *ogbono* seed flour slurries are shown in Table 4. The pulverized baobab leaf slurry had slightly higher viscosity than the *ogbono* seed flour slurry. This confirmed the high mucilage content of the pulverized baobab leaf (FAO, 1988) and showed that the leaf could provide thickening property comparable to that of *ogbono* seed flour.

Organoleptic properties of the soups

The statistical comparison of the sensory scores of pulverized baobab leaf soup and *ogbono* seed flour soup are presented in Table 5. There was a significant ($p< 0.05$) difference between the flavour scores of the two soups. The judges liked the flavour of the pulverized baobab leaf soup slightly and liked that of *ogbono* seed flour moderately. The preference for the flavour of the *ogbono* soup over that of pulverized baobab leaf soup might be due to the familiarity of the judges with the *ogbono* soup flavour. The appearance and consistency of the two soups were similar ($p>0.05$). This was probably because the two soup ingredients (pulverized baobab leaf and *ogbono* seed flour) had dull colours with similar high mucilage content (FAO, 1988) which translated to a similar thickening capacity and consistency. The acceptability of the two soups differed ($P<0.05$). The judges liked the pulverized baobab leaf soup slightly. However, they liked the *ogbono* seed flour soup moderately. Again the preference for the *ogbono* soup than for the pulverized baobab leaf soup could be attributed to the familiarity of the judges with the flavour of *ogbono* soup. Flavour has been identified as the major factor that influences acceptability of foods (Nnam, 1999). The consumption of pulverized baobab leaf soup should be encouraged because of its rich nutrient composition.

CONCLUSION

The pulverized baobab leaf soup had promising nutrient potentials. The soup is a potentially good source of Ca, P and provitamin A. The viscosities of the pulverized baobab leaf and *ogbono* seed slurries were similar. The judges liked the pulverized baobab leaf soup slightly. Promotion is required to popularize the pulverized baobab leaf soup in areas where it is not commonly consumed because of its rich nutrient composition. It is suggested that mothers, especially those from southern Nigeria, should be enlightened through nutrition education and home economics extension programmes on the nutrient potentials of the pulverized baobab leaf soup and how to prepare it. This could help to improve the nutritional status of Nigerian populace.

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