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Full Length Research Paper

Nutrient composition and contribution of noodles (*abacha*) and local salad from cassava *(Manihot spp)* to nutrient intake of Nigerian consumers

Adepoju, Oladejo Thomas[1]* and Nwangwu, Justina Oriaku[2]

[1]Department of Human Nutrition, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria.
[2]Department of Chemistry, Faculty of Science, The Polytechnic, Ibadan, Oyo State, Nigeria.

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Dietary diversification through indigenous diets as means of ensuring household nutrition security is being promoted. Cassava diets constitute staple food to most Nigerian populace, but their contribution to nutrient intake is not well documented. Nutrient composition, effect of processing, and contribution of noodles (*Abacha*) and local salad from cassava to nutrient intake of consumers were studied. Proximate and mineral composition of raw cassava, *Abacha* snack and salad menu were carried out using standard methods of analysis of AOAC. The crude protein, lipid, fibre and ash content of cassava were very low (0.9, 0.3, 0.5 and 0.4/100 g, respectively). Processing cassava to *Abacha* led to significant reduction in proximate and significant improvement in mineral composition of product ($p < 0.05$). Preparing *Abacha* into local salad brought significant improvement ($p < 0.05$) in its nutrient content. 100 g portion of *Abacha* and local salad contained 0.8 and 14.3 g crude protein, 0.5 and 13.6 g lipids, 0.7 and 3.2 g fibre, 0.7 and 6.7 g ash, yielded 358.3 and 430.4 kilocalories and can contribute 15.6 and 18.7% energy, 1.3 and 22.7% protein, 4.7 and 21.3% crude fibre, 13.3 and 51.3% iron, 13.9 and 30.3% phosphorus, 24 and 36.0% zinc to percentage recommended dietary allowances (%RDAs) of consumers, respectively.

Key words: *Abacha* snack, nutrient composition, cassava, local salad, nutrient contribution.

INTRODUCTION

Cassava (*Manihot utilisima*) also known as manioc, tapioca or yucca, is a widely grown crop in most countries in the tropical regions of Africa, Latin America and Asia and ranks as one of the main crops in the tropical countries (Calpe, 1992). It is extremely reliable to grow, especially on sloping rain-fed soils of low fertility, survives drought periods (Burrell, 2003) and grows well with limited supplies of water. In addition, it is tolerant of acid (pH 5 to 5.5) or alkaline (pH 8 to 9) soils and yields well on sandy or sandy loam and all types of soils except water-logged ones, without excessive use of costly inputs. With a hardpan, soils about 30 – 40 cm deep are desirable because they prevent deep penetration of roots (Polthanee et al., 1998), which aids in harvesting. The plant is propagated mostly from stem cuttings and the major harvested organ is the tuber. Among the starchy staples, cassava gives a carbohydrate production which is about 40% higher than rice and 25% more than maize, with the result that cassava is the cheapest source of calories for both human nutrition and animal feeding (Nyerhovwo, 2004). More than two-third of the total production of cassava is used as food for humans, with lesser amounts being used for animal feed and industrial purposes (Nwokoro et al., 2002). Nigeria alone currently produces over 14 million tones annually, representing

*Corresponding author. E-mail: tholadejo@yahoo.com. Tel: (+234) 808 4565 826.

about 25% of Sub-Saharan Africa's output (Ayodeji, 2005).

Although, cassava is the third most important food source in the tropical world after rice and maize and provides calories for over 160 million people of Africa (Polsen and Spencer, 1991), its food value is greatly compromised by the endogenous presence of cyanogenic glucosides. However, drying and ensiling have been found to be effective ways of reducing the toxicity of cassava products (Twe, 1991; Phuc et al., 2000 (http://www.forum.org.kh/~mekam/proc-cass/phuc.html, Cited May, 2007)).

Abacha and its local salad are cassava products that are popular and relished by the Eastern and Southern Nigerians. Dried *Abacha* is usually soaked in water and eaten with or without coconut or peanuts as snack (Ihekoronye and Ngoddi, 1985), while the local salad is softened *Abacha* cooked with vegetable, palm oil, fish and other additives.

Various studies had been carried out on the use of cassava starch for human consumption, animal feed and industrial uses (Nwokoro et al., 2002; Nyerhovwo, 2004; Ayodeji, 2005) but literature information on nutrient composition of various cassava diets and snacks are limited. Dietary diversification is being promoted as a means of combating food and nutrition insecurity, especially among the people living the traditional lifestyle. This study therefore determined the nutrient composition of *Abacha* (cassava noodles) and its local salad and their contribution to nutrient intake of Nigerian consumers.

MATERIALS AND METHODS

Preparation of *Abacha* (cassava noodles)

Fresh bitter cassava tubers were purchased from a farm in Alegongo, Akobo area in Ibadan; Oyo State, Nigeria. The tubers were peeled the same day and cut into small pieces. From the small pieces, two composite samples were prepared by mixing thoroughly and dividing randomly into two portions. One portion was analyzed as fresh sample (sample 1) while the other portion was processed into dry *Abacha* of about 1,500 g by further cuttings into smaller pieces of about 10 cm long, followed by washing with distilled water. The washed sample was boiled for ten (10) min at 100°C and cooled. After cooling, product was shredded into thread-like strands using a locally made shredder. The shredded product was then washed gently four times with distilled water, followed by soaking in distilled water for 24 h. It was then rinsed thoroughly, drained and thinly spread on a tray and sun-dried at about 60°C for five days. Market sample of prepared *Abacha* was bought and analyzed as standard for comparison of our preparation (Figure 1).

Preparation of local salad dish

Only our laboratory-prepared *Abacha* sample (sample 2) was used in preparation of the local salad, as there was no raw data for the market sample with which to compare. 500 g of laboratory-prepared dry *Abacha* was soaked in distilled water for ten minutes to rehydrate, removed and drained through a sieve. Palm oil was fried for two minutes, followed by addition of dehulled smoked fish, stock-fish, fresh pepper, *ugwa* (local pea), salt and maggi. Drained *Abacha* was added to the mixture of oil and other ingredients and stirred. Garden egg leaf was added and stirred very well to form the local salad. The whole mixture was left to steam for ten minutes.

Analyses

Composite samples of fresh cassava, *Abacha* and local salad were analyzed in triplicate for moisture, crude protein, lipid, fibre and ash using standard methods of AOAC (1995) as follows: Moisture content of the samples was determined by air oven (Gallenkamp) method. The crude protein was determined using micro- Kjeldhal method by digesting 5 g of the sample with concentrated H_2SO_4 and Kjeldhal catalyst in Kjeldhal flask for 4 h. The resulting digest was made up to the mark of 100 ml volumetric flask with distilled water. 5 ml portion of the resulting solution was pipetted to Kjeldhal apparatus and 5 ml of 40% (w/v) NaOH solution added. The mixture was steam distilled and the liberated ammonia collected in 10 ml of 2% Boric acid and titrated against 0.01 M HCl solution. The amount of crude protein was then calculated by multiplying percentage nitrogen in the digest by 6.25.

Crude lipid was determined by weighing 5 g of dried, powdered sample into fat free extraction thimble and plug lightly with cotton wool. The thimble was placed in the soxhlet extractor fitted up with reflux condenser. The dried sample was then extracted with petroleum ether and the crude lipid estimated as g/100 g dry weight of sample and then converted to g/100 g fresh sample weight.

The ash content was determined by weighing 5 g of sample in triplicate and heated in a muffle furnace at 550°C for 4 h, cooled to about 100°C in the furnace and then transferred into a dessicator to cool to room temperature, weighed and ash calculated as g/100 g original sample. Crude fibre was determined by refluxing 2 g of the sample with 100 ml of 0.30 N H_2SO_4 for 1 h. The hot mixture was filtered through a fibre sieve cloth. The residue obtained was returned to the flask and refluxed for another 1 h with 100 ml of 0.3N NaOH solution. The mixture was filtered through a sieve cloth and the residue washed with 10 ml of acetone. The residue was then washed with 50 ml hot distilled water twice on the sieve cloth before it was finally transferred into the crucible. The crucible and the residue was oven dried at 105°C overnight, and weighed. The crucible and its content was then transferred into a muffle furnace set at 550°C and heated for 4 h, cooled and re-weighed. The weight of crude fibre was then calculated as g/100 g of original sample (Saura-Calixto et al., 1983). The carbohydrate content was obtained by difference and the gross energy determined using Gallenkamp ballistic bomb calorimeter.

Mineral analysis

Potassium and sodium were determined by digesting the ash of the sample with perchloric acid, nitric acid and then taking the readings on Jenway digital flame photometer/spectronic20 (Bonire et al., 1990). Calcium, magnesium, iron and zinc were determined spectrophotometrically using Buck 200 atomic absorption spectro-photometer (Buck Scientific, Norwalk) (Essien et al., 1992) and compared with absorption of standards of these minerals. Phosphorus was determined by vanado-molybdate colorimetric method.

RESULTS AND DISCUSSION

The proximate composition of the fresh cassava, *Abacha* and local salad are as shown in Table 1. The values

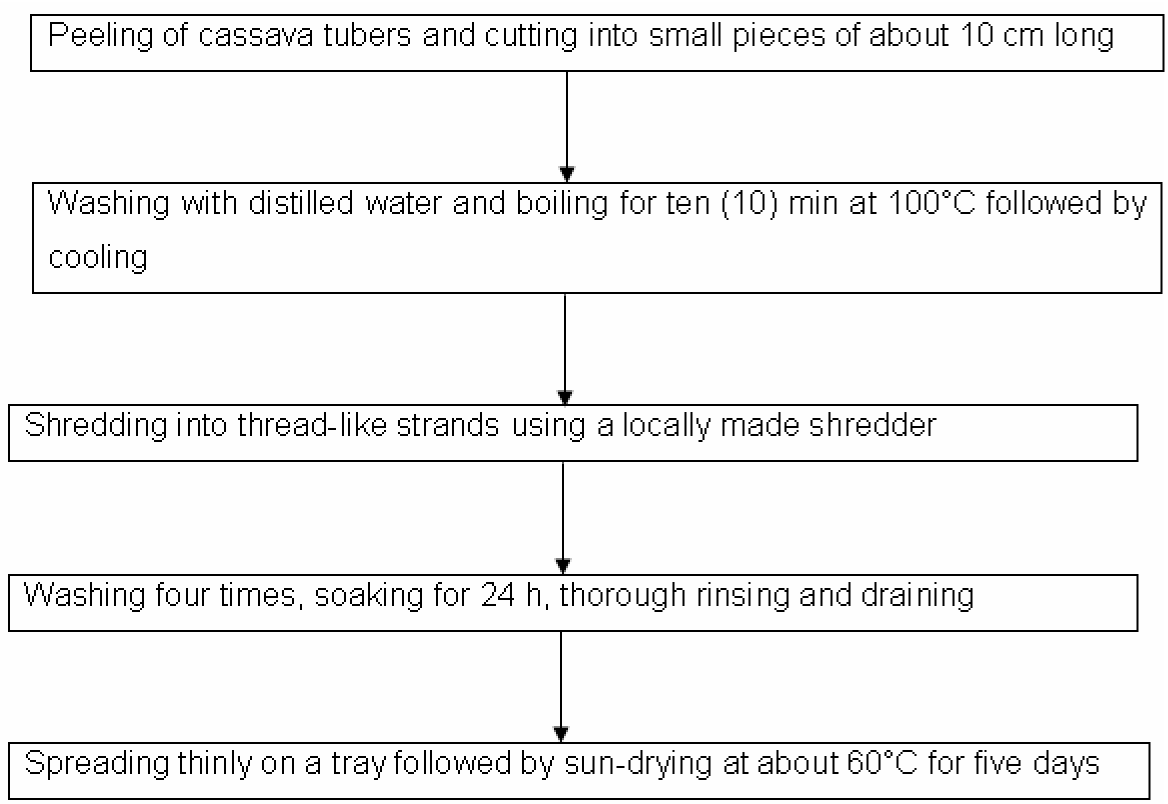

Figure 1. Flow chat of *Abacha* preparation.

Table 1. Proximate composition of fresh cassava, *abacha* and local salad (g/100 g).

Sample	1	2	3	4	5	6
Moisture	65.3 ± 0.86	9.0 ± 0.82	7.8 ± 0.10	11.1 ± 0.81	9.3 ± 0.46	3.7 ± 0.09
Dry matter	34.7 ± 0.34	90.0 ± 0.82	92.2 ± 0.10	89.0 ± 0.81	90.7 ± 0.46	96.3 ± 0.09
Crude protein	0.9 ± 0.07	1.6 ± 0.00	1.8 ± 0.02	0.8 ± 0.00	0.8 ± 0.03	14.3 ± 0.09
Crude lipid	0.3 ± 0.02	0.5 ± 0.02	0.7 ± 0.03	0.5 ± 0.01	0.7 ± 0.02	13.6 ± 0.19
Crude fibre	0.5 ± 0.02	1.0 ± 0.02	0.8 ± 0.03	0.8 ± 0.03	0.7 ± 0.02	3.2 ± 0.40
Ash	0.4 ± 0.02	0.9 ± 0.03	0.5 ± 0.02	0.7 ± 0.04	0.3 ± 0.01	6.7 ± 0.10
Carbohydrates	32.6 ± 0.05	87.0 ± 0.00	88.4 ± 0.00	86.2 ± 0.06	91.2 ± 0.01	58.5 ± 0.81
Gross energy (Kcal /100g)	140.5 ± 0.51	362.5 ± 1.45	371.9 ± 1.42	358.3 ± 1.60	380.3 ± 0.40	430.4 ± 1.20

Sample 1 = fresh cassava tuber, sample 2 = laboratory *abacha,* sample 3 = market *abacha*, sample 4 = rehydrated laboratory *abacha*, sample 5 = Rehydrated market *abacha*, sample 6 = local salad from laboratory *abacha*.

obtained for proximate composition of raw cassava were within the range stated in the literature (Gomez, 1979; Ihekoronye and Ngoddy, 1985). Fresh cassava was very high in moisture content. This presupposes its easy spoilage and susceptibility to microbial attack. In fact, fresh cassava tuber easily turns from white to blue-black colouration on storage for a period of two to three days, even without any physical wound on it. The crude protein, lipid, fibre and ash content of fresh cassava were very low and cannot possibly be a good source of these nutrients. The observed low protein content of cassava was in line with the finding of Jalaludin (1977). Roots and tubers are generally poor sources of plant protein and lipids. The low ash value was indicative of low mineral content in fresh cassava. The low crude fibre content of cassava was suggestive of the fact that greater percentage of its carbohydrate is present as available carbohydrates in the form of starch and sugars. Fresh

Table 2. Mineral composition of fresh cassava, abacha and local salad (mg / 100 g).

Sample	1	2	3	4	5	6
Potassium	166.6 ± 5.20	369.0 ± 14.14	359.6 ± 14.14	249.2 ± 15.50	187.4 ± 12.10	29.7 ± 21.21
Sodium	222.1 ± 7.55	486.0 ± 21.21	496.1 ± 12.21	347.1 ± 14.14	281.1 ± 15.10	462.2 ± 15.5
Calcium	25.0 ± 0.40	59.4 ± 0.80	55.3 ± 0.40	44.5 ± 2.50	34.7 ± 2.40	16.4 ± 0.50
Magnesium	12.5 ± 0.20	18.9 ± 0.40	17.9 ± 0.25	8.9 ± 0.50	11.2 ± 0.55	89.6 ± 5.30
Iron	1.7 ± 0.04	3.6 ± 0.02	2.8 ± 0.03	2.0 ± 0.02	1.5 ± 0.01	7.7 ± 0.05
Phosphorus	57.3 ± 0.30	129.6 ± 8.15	139.9 ± 12.12	97.0 ± 6.50	103.1 ± 8.15	211.9 ± 8.50
Zinc	2.1 ± 0.02	4.9 ± 0.04	3.7 ± 0.04	3.6 ± 0.02	1.9 ± 0.02	5.4 ± 0.04

cassava was very high in carbohydrates compared with other nutrients. Vogt (1966) reported that the nitrogen free extract (carbohydrates) of cassava tuber contained 80% starch and 20% sugars and amides. This probably explains the reason why cassava is used as source of energy for humans and animals and as industrial starch. Fresh cassava was slightly low in gross energy. This might be due to the fact that only carbohydrates contributed significantly to the gross energy.

There was significant reduction ($p < 0.05$) in the moisture content of various products prepared from cassava. This significant reduction in moisture content brought about significant increase ($p < 0.05$) in the nutrient content of the products and hence, a highly significant increase in their gross energy (Samples 2 and 6). This observed significant increase in nutrient content was an indication that processing influenced nutrient availability in cassava products. However, re-soaking the *Abacha* in water to rehydrate led to significant reduction ($p < 0.05$) in crude protein, fibre and ash of rehydrated samples (Samples 4 and 5). The significant reduction in protein and fibre content of rehydrated *Abacha* was suggestive of the fact that they contained water-soluble components.

The proximate nutrient composition of laboratory-prepared *Abacha* (sample 2) compared favorably with that of market sample (sample 3). The laboratory sample was significantly higher in moisture content ($p < 0.05$) compared with that of the market sample. This observed difference in moisture content might be due to the length and method of storage of the market sample which could not be determined as well as varietals differences. The observed difference in moisture content resulted in the values of crude protein, lipid, carbohydrate and gross energy of the market sample to be slightly higher. However, our preparation was significantly higher in ash and crude fibre values. This was suggestive that our preparation was superior to the market sample, as this implied higher retention of the minerals and dietary fibre in our preparation.

The same pattern was observed in rehydrated laboratory-prepared and market *Abacha* samples. However, processing *Abacha* to local salad greatly improved its nutrient composition. There was highly significant increase ($p < 0.05$) in crude protein, lipid, fibre, ash and gross energy content of the local salad (sample 6) while its carbohydrate content significantly reduced, compared with rehydrated *Abacha* (sample 4). The observed significant increase in nutrient content of local salad was believed to have resulted from the added fish and other ingredients, which greatly influenced its nutrient content and nutritional quality.

The mineral composition of fresh and processed cassava is as shown in Table 2. Fresh cassava tuber (sample 1) was rich in sodium, moderate in potassium, iron and zinc, but very low in calcium, magnesium and phosphorus when compared with their Recommended Dietary Allowance (RDA) values. Processing of fresh cassava into *Abacha* (sample 2) brought significant increase ($p < 0.05$) in its mineral content compared with the raw, unprocessed one. Laboratory processed *Abacha* can serve as a good source of potassium, sodium, iron, phosphorus and zinc. Except for sodium and phosphorus content of market sample of *Abacha* (sample 3) which were significantly higher than that of laboratory (sample 2), all the other minerals were significantly higher than that of market sample ($p < 0.05$). This observation was in line with the ash content of the two samples. Soaking and rehydration of the two *Abacha* samples (samples 4 and 5) resulted in significant reduction in their mineral content. This was an indication that the minerals leached into the soaking water.

Processing the laboratory-based *Abacha* to local salad resulted in highly significant improvement ($p < 0.05$) in potassium, sodium, magnesium, iron, phosphorus and zinc content of the salad compared with fresh cassava and laboratory-based *Abacha* and a significant reduction in its calcium content. The level of iron content in the prepared local salad was an indication that the diet can serve as good source of both haem and non-haem iron. The nutrient contribution by *Abacha* snack and local salad (Table 3) showed that major nutrient contribution from *Abacha* was in the area of gross energy, iron, phosphorus and zinc. This was an indication that taking

Table 3. %RDA Contribution of *abacha* and salad to nutrient intake of consumers.

Sample	RDA*	Laboratory *abacha* (4)	%RDA contribution	Local salad (Sample 6)	%RDA contribution
Energy	2300	358.3	15.6	430.4	18.7
Protein	63	0.8	1.3	14.3	22.7
Crude fibre	15	0.7	4.7	3.2	21.3
Iron	15	2.0	13.3	7.7	51.3
Phosphorus	700	97.0	13.9	211.9	30.3
Zinc	15	3.6	24.0	5.4	36.0

*Source : Wardlaw (1999) perspectives in nutrition.

rehydrated *Abacha* alone without any supplement(s) contributes minimally to nutrient intake of consumers. Large amount of it will have to be taken for it to contribute meaningfully. However, *Abacha* is normally consumed as a snack, hence, other menu or diets can make up for the nutrient requirements of consumers. On the other hand, local salad menu was rich and nutrient-dense and 100 g portion of it can contribute 18.7% energy, 22.7% protein, 21.3% crude fibre, 51.3% iron, 30.3% phosphorus and 36.0% zinc to percentage recommended dietary allowances (%RDAs) of consumers.

Conclusion

Abacha consumption can only serve as a refreshing snack and should not be taken as main course as some consumers use it. To improve its nutritional quality and contribution to nutrient intake of consumers, it is advisable to consume it alongside other supplements such as coconut and peanuts. Local salad on the other hand is nutrient dense and of higher nutritional quality than *Abacha*. The consumption of local salad should therefore be promoted among the people of Nigeria as a means of combating nutrition insecurity, especially among those living the traditional lifestyle.

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