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<td>OBIZOBA, Ikemefuna Christopher</td>
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<td>Author 2</td>
<td>AMAECHI, N. A.</td>
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THE EFFECT OF PROCESSING METHODS ON THE CHEMICAL COMPOSITION OF BAOBAB (Adansonia digitata. L) PULP AND SEED

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Sundrying, roasting and fermentation were the traditional processing techniques selected to improve the chemical composition of the baobab pulp and seed. The fruits were purchased from a retailer in Maiduguri. The pulp was scraped and kneaded in cold water to form an emulsion. The emulsion was passed through a fine sieve and frozen until used. The seeds were thoroughly cleaned, peeled, dehulled and divided into five portions. The first two portions were sun dried and roasted. The remaining three portions were fermented for 2, 4 and 6 days at 28°C. After this, they were dried to 96% dry matter, ground into fine powder and stored frozen as the pulp. Standard techniques were adopted for the analysis of the samples. Fermentation of the seeds for 6 days offers much advantages over roasting as judged by crude protein, moisture and minerals. A 6-day fermentation appears to be the promising method for producing nutritious food from baobab seed.

KEY WORDS: Processing methods, baobab pulp and seed, chemical composition

INTRODUCTION

The baobab tree (Adansonia digitata. L.) is a tree legume common in many parts of Africa and other tropical countries (Pelly, 1913). The Hausa-speaking and Fulani cattle farmers who live in the savanna regions of northern Nigeria make free use of every part of the baobab tree (Nicol, 1957). The leaves, either fresh or dried and pulverized, are used for preparing soup which is poured over the dish of porridge made from sorghum (guineesia) or millet (Pennisetum elusine) flour. The stem is used for ropes and the pulp is perhaps the richest source of ascorbate in the savanna belt of Nigeria (Owen, 1970).

When the fruit of the tree is ripe, the pulp is removed from the fibres and seeds by kneading in cold water. The emulsion is passed through a sieve. The resulting fluid (white or whitish-yellow) called in Hausa (gubdi) is used by the farmers to dilute the thick millet dough (fura) to a thin gruel ("kunu"). Kunu is the traditional breakfast or mid-day meal in northern Nigeria. The cattle-owning Fulani use the emulsion to mix with milk. Milk and baobab fruit juice mixtures are popular drinks with Hausa farmers. This drink is always available if there is money to purchase it, particularly during the hot time of the year (October-April) when new farms are being cleared or hoeing of old farms is taking place, preparatory to sowing (Nicol, 1957).
Fermented and ground baobab seed is one of the food condiments used to flavour soups in northern Nigeria. Roasted seeds could replace groundnuts (peanut) to some extent as side dishes (Uphof, 1968), but, unlike the pulp and leaves, it is not a popular item of food in Nigeria because it is regarded as one of the minor legumes. Little work has been done on the effect of processing methods (sundrying, roasting and fermentation) on chemical composition of baobab pulp and seed in Nigeria. The flours of both the pulp and the seed could be incorporated into various traditional dishes for both children and adults. In view of the widespread use of baobab pulp and seed products in northern Nigeria, the study was aimed at investigating modification of traditional processing methods (and/or methods) to improve the chemical composition of baobab pulp and seed.

MATERIALS AND METHODS

Baobab fruits were purchased from the local market. The woody pericarp of the baobab fruit was broken. The dried pulp was scraped from the seeds, hammer-milled into a fine flour (70 mesh screen) and kept frozen until analyzed for various nutrients.

The seeds were washed clean, boiled at 100°C for 25 min, drained and dehulled manually (traditional method). The dehulled seeds were divided into five portions. A portion was sundried for 24h. Another portion was roasted. The remaining three portions, placed separately into containers were covered with fresh banana leaves and put in dark room to ferment by the natural microflora present in the dehulled seeds at 25-30°C for 2, 4 and 6d, respectively. The fermented seeds were dried in an air oven at 85°C for 24h to 96% dry matter. The sundried, roasted and fermented seeds were milled into fine flours using mortar and pestle. The flours were stored safely until used for various analyses.

Laboratory Analysis

Non-protein nitrogen (NPN) was determined by weighing 200mg of each sample into flat bottom flasks. 5ml of 10% trichloroacetate (TCA) and 5ml of water were added to the flasks. The flasks and contents were shaken for about 5-7 min in an Eberbatch Shaker and the samples were filtered. The filtrates were analyzed for NPN using the micro-Kjeldahl method as described by Pearson (1976).

The micro-Kjeldahl method as modified by Pearson (1976) was used for the estimation of crude protein. About 200 mg of each of the samples were weighed into clean micro-Kjeldahl digestion flasks. After digestion, distillation and filtration the crude protein was calculated by multiplying the total nitrogen (N) by the protein conversion factor of 6.25 (N x 6.25).

Lipid was determined by exhaustively extracting a known weight with petroleum ether (BP 40-60°) using the Tecator Soxtec apparatus according to the manufacturer’s instructions.

Carbohydrate was estimated using the procedures outlined in the AOAC (1980). Tannin was estimated by the modified vanillin-HCl method (Price and Butler, 1980).

The flour samples were wet-digested with concentrated nitric acid and perchlorate according to the procedure described by Ranjiham and Gopal (1980).
Calcium, zinc, copper, phosphorus and iron were subsequently determined by polarized Zeeman atomic absorption spectrophotometry.

Ash was estimated by weighing 2g of each of the flours into pre-weighed clean silica dishes. The flours were charred at 500°C in a muffle furnace until light grey ash was obtained. Both the dishes and their contents were removed from the furnace and allowed to cool at room temperature in desiccators before final weight was recorded to obtain ash weight.

The moisture content of the flours was determined by the hot air oven method (Pearson, 1976). 2g of each flour was weighed into dried and cooled aluminium dishes, labelled and placed inside the oven at 100°C at normal atmospheric pressure. The weights of the flours were re-recorded after 48h to ensure that all moisture is completely removed to calculate the moisture content.

The moisture values for the pulp and seed of baobab differed. The pulp, as one would expect, had highest moisture and the seed fermented for 6d the least. The moisture levels of the seeds were a function of the fermentation period.

The seeds that were fermented for 6d had lower value that for both the pulp and other fermented seeds (P < 0.05). The moisture levels for the fermented seeds differed (P < 0.05) except for those fermented for 2 and 4d (P > 0.05). The roasted seeds had lower value than the sundried seeds.

The ash levels in both the pulp and the seed varied. The variations depended on the treatment. Roasting increased ash while sundrying decreased it (P < 0.05). Fermentation for 4d showed a slight increase over that for 2d. The 6-day fermentation produced lower ash than for 2 and 4d. The increased microbial population used the nutrients for their metabolism. The increases in the percentage ash due to roasting was because of loss of dry matter which led to reduced fibre and increased ash. Roasting and Deosthale (1983) observed increased vegetative part of plants due to hydrolysis of dry matter. Roasting appears to be much more beneficial than fermentation.

The pulp had lower lipid content than the seed. Roasting had a more adverse effect than sundrying on the lipid content of the seed. Fermentation had varied effects on lipid levels of the seed. The 4d fermentative period produced values that were higher than for other periods probably due to the hydrolytic actions of some of the fermentation microbes. The 2 and 6d fermentation periods, however,
<table>
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<tr>
<th>Samples</th>
<th>% Moisture</th>
<th>% Ash</th>
<th>% Fat</th>
<th>% Protein</th>
<th>% Carbohydrate</th>
<th>% NPN</th>
<th>mg Tannins</th>
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<tr>
<td>Pulp</td>
<td>19.9 ± 0.1</td>
<td>1.9 ± 0.1</td>
<td>4.1 ± 0.2</td>
<td>15.3 ± 0.3</td>
<td>58.8 ± 0.1</td>
<td>0.13 ± 0.02</td>
<td>77.0 ± 0.1</td>
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<td>SDS</td>
<td>4.5 ± 0.5</td>
<td>5.2 ± 0.4</td>
<td>34.1 ± 0.2</td>
<td>32.7 ± 0.4</td>
<td>58.4 ± 0.4</td>
<td>0.08 ± 0.01</td>
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<td>RS</td>
<td>3.0 ± 0.1</td>
<td>10.2 ± 0.2</td>
<td>31.0 ± 0.1</td>
<td>21.5 ± 0.3</td>
<td>34.1 ± 0.1</td>
<td>0.17 ± 0.02</td>
<td>43.4 ± 0.1</td>
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<td>F2</td>
<td>3.7 ± 0.1</td>
<td>6.9 ± 0.2</td>
<td>32.1 ± 0.1</td>
<td>32.1 ± 0.1</td>
<td>23.4 ± 0.3</td>
<td>0.06 ± 0.01</td>
<td>69.0 ± 0.4</td>
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<td>F4</td>
<td>4.6 ± 0.4</td>
<td>7.0 ± 0.04</td>
<td>42.0 ± 0.2</td>
<td>22.7 ± 0.2</td>
<td>20.3 ± 0.3</td>
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<td>F6</td>
<td>1.8 ± 0.01</td>
<td>6.0 ± 0.1</td>
<td>32.0 ± 0.2</td>
<td>36.4 ± 0.2</td>
<td>23.5 ± 0.3</td>
<td>0.27 ± 0.01</td>
<td>43.0 ± 0.1</td>
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*Mean ± SEM (three determinations)  
SOS = Sun-dried seed; RS = Roasted seed; F2 = 4-day fermentation; F4 = 0-4-day fermentation; and F6 = 6-day fermentation.
were preferable to the 4d period; the lower the lipid level of the flour, the higher the shelf life and better the flavour and aroma.

The pulp had the lowest protein. Roasting had the most adverse effect on protein content of the seed. The decreases in protein level of the roasted seed might be due to denaturation of protein inherent in higher temperature during roasting. Cooking and fermentation had varied effects on protein values. Cooking or sundrying and cooking or fermentation did not affect the protein values except for the seeds fermented for 6d. The 6-day fermentation period produced the highest protein.

The higher protein level during the 6d fermentation appears to suggest this as the optimum period to ferment baobab seeds. The protein values found in this study were higher than described by other workers (Addy and Eteshela, 1984; Fedya, 1973). The higher protein level was due to hydrolysis of complex compounds that chelate protein. Zamora and Fields (1979) attributed increases in protein during fermentation to hydrolysis of tannin-protein and protein-enzyme complexes by microflora enzymes to release more free amino acids. The lower values for the 2 and 4d flours might be due to high levels of minerals and carbohydrate in baobab seed. These components require longer period to hydrolyze protein complexes to release more protein. Baobab seed stores energy in the form of oil while the pulp stores energy as starch. This starch is hydrolyzed by natural microflora in the pulp during fermentation to produce ascorbate and energy for their metabolism.

As one would expect the pulp had more carbohydrate (CHO) than the seed. Sundrying produced the least CHO. This might be because sundrying did not prevent losses in CHO during processing. Fermentation decreased CHO more than roasting. The lower value for the roasted seeds was comparable to that found by Addy and Etshola (1984). The differences in CHO values could be attributed to variation in laboratory analysis or soil or seed type or both. While the NPN values for the seed were all influenced by these treatments, sundrying produced the lowest NPN. The increase in NPN was due to decrease in protein when the SDS and the RS flours are compared.

Roasting produced more NPN than sundrying. Fermentation produced the highest increase in NPN than for the other processing methods. The higher NPN for fermented seeds might be due to increased proteolytic hydrolysis by the fermenting organisms. The pulp had the highest tannin value while the seeds had varied values depending on the treatment. Roasting reduced tanning level to a greater degree than sundrying. In addition, the longer the fermentation period, the lower the tannin value. Roasting and a 6d fermentation period are better methods of lowering tannin in baobab seed than any other methods studied.

The similarity in tannin content following roasting and 6d fermentation period indicates that either treatment could be used to produce low-tannin baobab flours in both home and in industry. The high levels of tannin in baobab pulp is of great concern in Nigeria. This is because in the northern states of Nigeria where baobab grows, the pulp is sucked as a snack or its emulsion is blended with ‘kanu’ (a breakfast or midday drink) made from millet dough. Tannin is known to affect the availability of both protein and minerals. The lower tannin for the 6d flour than the 2 and 4d flour is revealing and suggests that tannin is reduced to a safer level by a longer period of fermentation. The lower tannin in turn caused increases in protein of flours fermented for 6d. The hydrolysis of protein-tannin and protein-enzyme bonds was probably the explanation.
Table II shows the mineral content of pulp and seed of baobab subjected to various processing methods. The pulp had higher calcium (Ca) than for the seed regardless of the treatment. The Ca contents of the seeds ranged from 1.47 to 2.2 mg/100g and were dependent on treatment. The 4-day fermented seed had the lowest Ca content. The increases in Ca for the 2 and 6d flours were because of hydrolysis of complexes between tannin-protein and protein-enzyme by the fermenting microflora.

The phosphorus (P) value ranged from 0.03 to 0.21 mg for the pulp and the seed. Sundrying produced higher levels of P than did roasting. The lower value for the roasted seed might be because of loss of organic matter inherent in uncontrolled temperature during traditional roasting. Fermentation caused slight increases in P compared to the other treatments. However, a 2-day fermentation period caused the highest increase, but did not change significantly for the other fermentation periods.

Ferrando (1983) showed that some 40-99% of the total phosphorus in dry legume seeds is phytin phosphorus. The hydrolytic breakdown of the phytin phosphorus lowered its level in the fermented flours to free more P. The slight increases in P of the 2 and 6d flours could be due to the same phenomenon cited by Ferrando (1983).

The iron (Fe) concentrations in both the pulp and the seed followed the same trend as for P. The pulp had the least while the F2 sample had the highest value. Sundrying was not beneficial as compared to other treatments. The 2-d fermentation period caused the highest Fe concentration and appears to be the optimum time. The lower Fe beyond two days of fermentation was probably because of increased use of the nutrient by the fermenting organisms or its leaching into fermenting media; these are commonly observed phenomena.

The copper (Cu) levels of the pulp and the seeds differed. The pulp had the least value. Roasting and the 4-day fermented seeds had the same value. Sun-drying and 2-d fermented samples had the same value. The 6-d fermented sample had higher value than for other treatments. The higher value for the F6 group indicates that it is the optimum condition for Cu level in baobab seed.

The levels of zinc (Zn) in the pulp and the seed is of interest. The pulp had equal value as the sundried seed. Zinc concentration was dependent on treatment and roasting more than doubled Zn content. Fermentation caused the highest
increase during the fourth day after which it dropped below the 2-d (3.9 vs 3.5 mg). The 4-day period appears to be the optimum for Zn level in baobab seed.

As judged by the parameters selected for use, the advantages of fermentation, especially the 6-d, appear greater than those of the other processing methods studied. It reduced the bulk and antinutrient contents of baobab seeds. The nutrient density, shelf life, flavour and aroma of baobab flours were enhanced by fermentation. The process is simple and does not require expensive equipment. It is cost-effective for both the rural and urban homemakers. The product (flour) could be incorporated into many traditional dishes to improve the nutritional quality of diets of infants and children.

Further detailed work is needed on the effects of fermentation on ascorbate levels of the baobab pulp, vitamin B-complex, minerals, antinutrients and microflora levels of both the pulp and the seed as they are utilized in various traditional dishes.

REFERENCES