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The Effects of Processing on the Functional Properties of
'Oze' (*Bosqueia angolensis*) Seeds

J.N. Nwosu

Department of Food Science and Technology, Federal University of Technology, Owerri, Nigeria

Abstract: 'Oze' (*Bosqueia angolensis*) found in the tropical rain forest grows in thick humid forest of undisturbed land and belongs to the family *Moracea*. Wholesome 'oze' (*Bosqueia angolensis*) seeds were given different treatments, which included blanching, cooking, roasting and malting. Malting was carried out by soaking for 24 h, germinated for 3 weeks and then dried and milled. The samples obtained from these treatments were analyzed for their functional properties. The emulsion capacity of raw 'oze' seeds was 6.6 ml while the oil and water absorption capacities were 8.9 ml and 7.8 ml respectively. The 'oze' seed flour samples had reasonable increases in the proximate composition, amino acid profile and most of the functional properties. The high emulsion, oil and water absorption capacities of the malted samples showed that 'oze' seed flour would be good as sausage extenders.

Key words: Oze seed flour, tropical rain forest, thick humid forest, sausage extender

INTRODUCTION

Oze (*Bosqueia angolensis*) referred to, as the "hospitality tree" in the cultural Igbo Community is a member of the botanical family, *Moracea*. It is a tropical rain forest tree and grows in the thick, humid forest of undisturbed land (Keay, 1989). The tree grows up to 30-40 meters high as it competes with other hard wood for sunlight (Irvine, 1961). Its green glossy leaves resemble those of 'Ogbono' (*Irvingia gabonensis*); but it is readily distinguished by the remarkably abundant latex flow observed immediately at a slash of its node. This plant called "Oze" in the Igbo speaking states of South Eastern zone of Nigeria is called "koko eran" in the Yoruba speaking states of South Western states of Nigeria (Okigbo, 1977).

In most developing tropical countries the food situation is worsening owing to increasing population; shortage of fertile land, high prices of available staples and restrictions on the importation of food (Sadik, 1991; Weaver, 1994). This has resulted in a high incidence of hunger and malnutrition, a situation in which children and women, especially pregnant and lactating women, are most vulnerable (Coulter *et al.*, 1988; Pelletier, 1994). Predictions of future rates of population increase and food production emphasize the seriousness of this problem (FAO, 1990). There seems to be no immediate single solution to the problem of food sufficiency, thus interdisciplinary approach is necessary (Avery, 1991). All information on new sources of food will be of value in dealing with the food problem as suggested by Masek (1966).

While every measure is being taken to boost food production by conventional agriculture, a lot of interest is currently being focused on the possibilities of exploiting the vast numbers of less familiar food plant resources existing in the wild (RAO, 1994). Many such plants have been identified, but the lack of data on their chemical composition has limited the prospects for their broad utilization (Vijayakumari *et al.*, 1994; Viano *et al.*, 1995). Most reports on some lesser-known and unconventional crops indicate that they could be good sources of nutrients and many have the potentials of broadening the present narrow food base for human (Van Etten *et al.*, 1967; Okigbo, 1977; Aletor and Aladetimic, 1989; Janick and Simon, 1990).

The aroma of roasted 'Oze' seed is reminiscence (resembles) that of its family member, African breadfruit; but its usual traditional dehulling process is more laborious (drudgery) than that of African breadfruit seeds. This factor has limited the traditional processing of 'Oze' to mere hot-ash roasting and a limited consequent utilization as snacking kernels, just as roasted cashew nuts. Thus 'Oze' though aromatically and morphologically more like African breadfruit is utilized mainly as indigenous snacking nuts just like cashew nuts.

Usually, the consumption of hot ash roasted Oze seed results in high gasing phenomenon, suggesting the presence of some anti-nutritional factors. Also the gas has a smell reminiscence of hydrogen sulphide suggesting the presence of sulfur containing amino acids which are among the essential amino acids needed in our daily diet.

Application of different processing methods to 'Oze' seed will give some information, which may increase the utilization of Oze seeds and enhance its potential in food

formulations. A good result will increase the awareness of the plant and may promote it as a new cash crop. This will certainly encourage its cultivation thereby saving it from being endangered. The objective of this study therefore is to investigate some of the functional properties of 'Oze' seed flour as affected by processing treatments.

MATERIALS AND METHODS

Materials collection and preparation: The 'oze' seeds with intact pulp were obtained from abandoned shrine spots at Ubomiri in Mbaitoli Local Government Area and Umuchima in Ideato South L.G.A both in Imo State. The pulp was washed off with water by rubbing with the hands. The seeds were then dried in the oven at 50-55°C for 24 h. The cleaned dry seeds were then given different treatments, which included blanching, cooking, roasting and malting after which they were dehulled. Blanching was carried out for 4, 6 and 8 min while cooking was carried out at boiling temperatures for 20, 40 and 60 min respectively. Roasting was carried out in the oven (Astell Hearson, England) at a temperature of 150°C for 45 min. Malting was done by steeping the 'oze' seeds for 24 h in water at a ratio of 1:2; (seed to water) then germinating the seeds at room temperature for 3 weeks before drying. All samples were dehulled and then milled using the manual grinder (Corona model), sieved to obtain fine powder, which were packaged in airtight plastic containers until needed for analysis.

Analysis of the functional properties of 'oze' seed flour
Determination of gelation capacity/boiling point: The gelling and boiling points were determined according to the method of Narayana and Rao (1982) with slight modification.
Three grams of each flour sample were weighed into a 50 ml beaker; each sample was dispersed in the distilled water to make 30 ml suspension using distilled water. Next a thermometer was clamped to a retort stand with its bulb submerged in the beaker. The beaker was then supported by a tripod stand, heated on a Bunsen burner and stirred gently with a stirring rod. The temperature at which the suspension began to gel was recorded. The stirring was continued until the suspension began to boil and the boiling point was also recorded.

Determination of water absorption capacity: The method described by Abbey and Ibeh (1988) was adopted with slight modification.
One (1.0 g) of each sample was put into a test tube and mixed with 10mls of distilled water. The mixture was left to stand for 30 min at room temperature being shaken every 10 min. At the end, it was blended using a magnetic stirrer for 5 min. The supernatant was carefully measured in a graduated cylinder and the volume used

to calculate the volume of water absorbed and retained by the sample:

$$\text{Water absorption capacity} = \frac{(V_1 - V_2)P}{\text{Weight of sample}}$$

Where:
V_1 = is the initial volume of water used
V_2 = is the vol. remaining (not absorbed)
P = is the density of water (1.0 g/cm³)

Determination of oil absorption capacity: For the oil absorption capacity, the Gino brand of vegetable oil was used. The method of Beuchat (1977) was followed. One gram of each flour sample was mixed with 10ml of oil for 30 sec in a mixer (Vari-whirl-mixing control set at fast speed). The sample was then allowed to stand at room temperature for 30 min. It was then centrifuged at 5000 rpm for 30 min, using a magnetic stirrer and the volume of the supernatant noted in a 10 ml graduated cylinder. The density of the oil was determined too. The volume of oil absorbed was multiplied by the density of the oil to determine the weight of oil so absorbed.

$$\text{Oil absorption capacity} = \frac{(V_1 - V_2)P}{\text{Weight of sample}}$$

Where:
V_1 = Initial volume of oil used
V_2 = Volume remaining (not absorbed)
P = density of the oil used

Determination of emulsion capacity and stability: The method of Beuchat (1977) was used. 2 g of each flour sample and 100 ml distilled water were blended at room temperature for 30 sec in Philips blender at 1600 rpm. After complete dispersion, vegetable oil (Gino) was added continuously in 5ml portions from a burette. Blending continued until the emulsion breakpoint (where a separation into two layers/phases) was observed. The emulsion capacity was expressed as ml of oil emulsified per gram of sample and was expressed as %:

$$\text{Emulsion capacity (\%)} = \frac{V_E}{V} \times \frac{100}{W}$$

Where:
W = The weight of sample
V_E = Volume of emulsion layer
V = Total volume of mixture

For the emulsion stability, the emulsion so prepared was then allowed to stand in a 250 ml graduated cylinder over time and the volume of the emulsion layer

read. The stability was measured in terms of the amount of oil that was retained in the emulsion layer and given by:

$$\text{Emulsion stability (\%)} = \frac{V_{ET}}{V} \times 100$$

V_{ET} = Emulsion volume at Time (T)
V = total volume of the mixture

Determination of bulk density: The method described by Okezie and Bello (1988) was adopted. A clean dry measuring cylinder was filled with the flour sample and the bottom of the cylinder was tapped on a table until the level could fall no further at the 100 cm³ mark.
The weight of the flour, which occupied the 100 cm was measured and expressed as a ratio of the volume. The bulk density was given by:

$$\text{Bulk density} = \frac{W \text{ g/cm}^3}{V}$$

Determination of the foaming capacity and stability: The method described by Coffman and Gracia (1977) was adopted. Two grams of the sample was whipped with 100 ml-distilled water in a micro blender at high speed for 5 min and quickly transferred carefully into a 250 ml graduated cylinder. The total volume of foam was noted and expressed as a ratio of the volume before blending. It was expressed as a percentage and was given by:

$$\text{Foam capacity (\%)} = \frac{Va - Vb}{Vb} \times \frac{100}{1}$$

Va = Volume of liquid and foam
Vb = Volume of mixture before whipping

The foam stability was measured in terms of how stable the formed foam lasted at room temperature. The cylinder containing the sample was left undisturbed following the foam capacity experiment. At intervals the foam volume was recorded. The foam stability was determined by measuring the foam volume at time (T). (T = life span of foam = 12 h) and expressed as the ratio of the foaming volume at the beginning.

Determination of swelling index: The swelling capacity of the samples were determined using the method of Lin *et al.* (1974), with slight modification. One gram (1 g) of the flour sample was dispersed in 10 ml of cold distilled water in a graduated centrifuge tube. The suspension was left at room temperature for 5 min to absorb water but not to swell. After 5 min the mixture was centrifuged at 2000 rpm for 30 min and the volume of the sediment recorded as initial volume.

Another 1 g of the sample was dispersed in a centrifuge tube of known weight and the suspensions heated in boiling water for 30 min. The suspension was cooled to room temperature under the tap water and then centrifuged at 2000 rpm for 30 min. using a magnetic stirrer. The volume of the heated sediment was recorded as final volume:

$$\text{Swelling index} = \frac{\text{Final Vol. after heating}}{\text{Initial Vol. before heating}}$$

Determination of wettability: The method described by Okezie and Bello (1988) was adopted. One gram (1 g) of each flour sample was measured into a 10 cm³-measuring cylinder. The cylinder was inverted at 10cm above the water contained in 600 ml beaker. The finger was used to close the cylinder disallowing the flour sample from falling. By removing the finger and giving the cylinder a gentle tap, the flour sample was discharged into the water surface. The time taken by the sample to get completely wet was recorded as the time of wettability.

Determination of viscosity: The viscosity of each flour sample was determined by blending 10g of its flour in 90ml-distilled water using a mixer. The viscosity was measured at room temperature (28±1°C) with a Brookfied Viscometer (model LV), at 30 rpm for 5 min using spindle No 2. The viscosity readings were recorded in centipoises (cP).

RESULTS AND DISCUSSION
Functional properties of 'oze' seed flour samples: The results of the functional properties is shown in Table 1. Raw and heat-treated 'oze' seed flour samples had pH values very close to neutral (6.05-6.67) (Table 1). There was no significant difference (p>0.05) between the pH values of all samples irrespective of method and time of heat treatment. This implied that the seeds were neither acidic nor basic in nature. Thus its inclusion in food formulation would not influence the pH of the food product. This range of pH lies very close to the optimum (pH 7) for bacterial growth (Ejimadu, 1991) and explains why 'oze' seeds spoil rapidly when kept at room temperature. Though the raw 'oze' seeds and those cooked for 60 min had the lowest swelling index value (1.4 ml) there was no significant difference (p>0.05) between the swelling index values obtained for all the samples. With respective values of 4 and 5 min, the malted and raw seed flour samples had lowest wettability period as compared to all the heat treated samples. There were significant differences (p<0.05) between the wettability values of the blanched and all the other samples, with the blanched having values in the range of 13-16 min and the cooked having values in the

Table 1: Mean values of the functional properties of oze seed flour samples

Sample	pH	Swelling index (ml)	Wettability (min)	Bulk density	Gelation °C	Emulsion stability
Raw	6.65[a]	1.4[a]	5[a]	48[c]	70[a]	6.6[a]
4 min blanching	6.60[a]	1.55[a]	3[b]	49[c]	70[a]	6.0[ab]
6 min blanching	6.58[a]	1.64[a]	15[bc]	49[c]	70[a]	6.0[ab]
8 min blanching	6.54[a]	1.90[a]	16[c]	50[c]	70[a]	6.0[ab]
20 min cooking	6.52[a]	1.90[a]	21[d]	51[c]	70[a]	5.8[ab]
40 min cooking	6.50[a]	1.73[a]	34[a]	52[c]	70[a]	5.8[ab]
60 min cooking	6.35[a]	1.50[a]	40[f]	57[d]	80[b]	5.8[ab]
Roasted (45 min)	6.05[a]	1.80[a]	34[e]	67[s]	80[b]	3.8[c]
Malted	6.67[a]	1.80[a]	4[a]	41[c]	80[b]	6.8[a]
Hulls	5.80[a]	1.80[a]	3[a]	25[a]	70[a]	1.5[d]
LSD (±)	0.24	0.20	12.81	9.02	6.34	1.33
Sample	Emulsion capacity	Foaming stability	Foaming capacity	Oil abs. capacity	Water abs. capacity	Viscosity
Raw	3.5[a]	5.0[a]	4.0[a]	8.9[a]	7.8[ab]	11.5[bc]
4 min blanching	3.4[a]	3.8[ab]	1.8[ab]	8.8[a]	7.7[ab]	12.5[bcd]
6 min blanching	3.0[ab]	3.5[ab]	1.4[b]	8.8[a]	7.6[ab]	13.0[bcd]
8 min blanching	2.8[ab]	3.0[ab]	2.0[ab]	8.9[a]	7.5[ab]	13.5[abc]
20 min cooking	3.2[ab]	2.4[b]	1.4[b]	8.3[a]	7.4[ab]	13.5[ab]
40 min cooking	3.0[ab]	1.5[bc]	00	8.2[a]	7.3[ab]	14[abc]
60 min cooking	3.0[ab]	1.0[bc]	00	8.4[a]	7.2[ab]	14.5[b]
Roasted (45 min)	2.8[ab]	1.0[bc]	00	8.9[a]	8.6[a]	15.5[a]
Malted	3.4[a]	4.0[ab]	3.0[ab]	9.0[a]	7.8[ab]	11[bc]
Hulls	1.0[b]	0.8[c]	00	4.3[b]	5.4[b]	10[bc]
LSD (±)	0.62	1.34	0.99	1.19	0.72	1.46

Note: Means down the column with the same superscript are not significant at p>0.05

range of 21-40 min. The wettability values decreased with increased period of moist heat treatment. The ready-to-eat samples (cooked up to 40 min and roasted for 45 min) had wettability values of 34-40 min. This result indicated that the raw and malted seed flours would serve better in food formulae which require fast water absorption.

The bulk density increased with increased period of moist-heat treatment, ranging from 48 g/100 ml in the raw sample to 57 g/100 ml in 60 min cooked sample. Roasted seed flours had the highest bulk density value (67 g/100 ml) among all samples. There was significant difference (p<0.05) between the bulk density of the ready to eat (roasted and 40-60 min cooked) and undercooked samples. The malted samples had the lowest value (41 g/100 ml) in bulk density. Thus it would be more convenient for packaging and transportation.

The gelation temperature of samples ranged from 70-80°C with undercooked samples gelling at 70 °C while ready-to-eat samples gelled at 80°C and these values were significantly different (p<0.05). It is suggested therefore that this flour should not be added to formulae where gelling is required under 70°C.

Heating decreased the emulsion capacity and emulsion stability of 'oze' seed flour samples (Table 1). While raw 'oze' seed flour and malted seed flour samples had emulsion capacities of 6.6 and 6.8 ml/g with stability values of 3.5 ml and 3.4 ml respectively, heated samples had emulsion capacities ranging from 2.8 to 3.4 ml respectively. Samples blanched between 4-8 min

had emulsion capacity value of 6.0 ml, while those cooked for 20-60 min had emulsion capacity value of 5.8 ml. Samples treated with dry heat (roasted) had the least value (3.8 ml) in emulsion capacity. There was significant difference (p<0.05) between the emulsion capacity of the roasted and the values for all other samples. The lower value (3.8 ml) for the roasted sample could be attributed to a higher degree of protein denaturation caused by dry heat as opposed to moist heat of cooking since the emulsion capacity is dependent on the nature of protein molecules and its surface properties (Sathe *et al.*, 1982; Watanabe *et al.*, 1984; Shamasunder and Prakash, 1994). The effect of heat processing in decreasing emulsion capacity of soy, peanut, wingbean, cowpea and brown bean flour samples McWatters and Holmes (1979), Abbey and Ibeh (1987); Abbey and Ibeh (1988). The very low emulsion capacity value (1.5 ml/g) for the hull flour samples was expected recognizing that it's protein content was 1.46% as compared to values of 6.41-11.81% in the main seed samples.

The data obtained indicated that either raw, blanched or malted 'oze' flours can be used in food formulation without much difference in emulsification power; and roasting is not desirable for flour samples intended to achieve product emulsification like in sausage; as dry heat caused higher denaturation of proteins (Sathe *et al.*, 1982) desired for emulsification.

As observed for emulsion properties heating in all forms decreased the foaming properties (foam capacity and

stability) of 'oze' seed flours (Table 1). Specifically, the foaming capacity decreased from a value of 5.0 ml/g in the raw sample to a value of 1.0 ml/g in the roasted sample. The malted samples had the highest foam capacity value (4.0 mg/g) among the treated samples while the roasted and the 60 min-cooked samples had the least (1.0 ml/g) value. This low value for the roasted flour sample could also be attributed to higher degree of protein denaturation as compared to the protein nature in the raw, malted and blanched samples while the low value for the cooked samples (1.0-2.4 ml/g) could be attributed to the reduction of soluble protein by leaching (into cook-water) during cooking and the greater the period of cooking the higher the leaching effect as reported by Monteiro and Prakash (1980); Narayana and Rao (1982); Pawar and Ingle (1988); Rahama and Mastafa (1988). Interestingly, foams arising from ready-to-eat (40-60 min cooking and roasted) samples collapsed within 10 min of formation. The foams from the raw and malted samples had greater stability, 4 ml and 3 ml after 30 min. These 'oze' flour samples are not suitable for products requiring foam formations such as ice creams.

Though cooked samples had relatively lower oil absorption capacities (8.2-8.4ml/g) when compared to the values (8.8-9.0 ml/g) of all other seed flour samples. There was no significant difference (p>0.05) between the individual treatment samples. This implied that both raw and treated samples can be used in foods requiring oil absorption such as sausage products, with the same level of effect. The malted sample had a slightly higher level (9.0 ml/g) of oil absorption capacity than all the other samples. Though the increase was slight, but it agreed with the finding of Lund (1982) that malting increased the non-polar hydrophobic proteins resulting in superior binding of lipids. Sathe *et al.* (1982) reported that heat processing increased fat absorption capacity due to the dissociation and denaturation of the proteins but this trend was not evident in this study since the roasted sample which could have had higher oil absorption capacity value had the same value (8.9 ml/g) with the raw (unheated sample). Since oils contribute greatly in flavour perception and products with good oil absorption capacity are good flavour retainers, any of these samples could be substituted for the other in food formulation if flavour was the critical quality property (Kinsella, 1976).

Among the samples, the roasted flour had the highest value (8.6 ml/g) for water absorption capacity than all other samples whose values ranged from 7.2 ml/g (for 60 min cooked samples) to 7.8 ml/g (for raw and malted samples). There was significant difference (p<0.05) between the water absorption capacity value of the roasted and the values (7.2-7.8 m/g) of the other samples. Moist heat application had slight and gradual decrease effect in water absorption capacity of 'oze'

seed flour samples. The hull flour sample had water absorption value of 5.4 ml/g which was lower than the values observed for all main (cotyledon) samples irrespective of treatment. It was expected that the water absorption capacity of samples would increase with increase in starch gelatinization and protein denaturation during the heating operation as in cooking and roasting (Lin *et al.*, 1974). But such increase was only slight and gradually decreased as the cooking time increased from 20-60 min cooking in this study. A high water absorption value is required for flours used in dough products and soup thickening. Thus 'oze' seed flour could be good for light thickening as in sauces but not preferable for gravies where heavy thickening is required.

With regards to the viscosity of flour samples, what was observed were relative differences between samples, with the exception of the roasted seed flour samples whose viscosity value (15.5 Cp) differed significantly (p<0.05) from the values (11.0-14.5 Cp) of the other samples. The viscosity values increased with increase in period of heating. Since viscosity is a measure of flow rate and an indicator of thickening ability, only the heat processed 'oze' seed flour samples should be used for instant food formulae since the viscosity values are too low compared to other seed samples used as thickeners whose viscosity values range from as high as 20-50 Cp like Okro and Ogbono (Amadi, 2004).

Conclusion: The results obtained from the project have shown that *Bosqueia angolensis* popularly known as 'oze' in Igbo speaking community yields flour which contain appreciable quantities of major nutrients like proteins and carbohydrates. The results of the studies on functional properties showed that 'oze' seed flour displayed diverse functional characteristics. From the studies it is believed that the seed has both great nutritional and functional values, which could be harnessed to meet nutritional needs and used in formulation of various foods.

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