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Full Length Research Paper

Evaluation of the Proximate and Functional Properties of African Yam Bean (*Spenostylis stenocarpa*) using Malting Treatmemt

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Abstract
Whole African yam bean (AYB) known as Spenostylis stenocarpa was subjected to malting after soaking for 24h and 48h. Each portion of the soaked samples was germinated for 24h, 48h, 72h and 96h respectively. After germination, they were dried and milled into flour; packaged in air tight containers and used for analyses. The proximate composition and the functional properties were determined for each of the samples. The result of the proximate composition showed that the protein content was highest in samples soaked for 48h and malted for 96h (26.00%) while the least protein was with the raw sample (23.20%). Ash, crude fibre and moisture contents of the samples soaked for 24h and malted for 96h ranged from 3.6%, 4.60% and 19.00% respectively; those soaked for 48h and malted for 96h ranged from 4.21%, 4.22% and 20.32% respectively while the unmalted (control) sample gave 3.22%, 5.12% and 7.52% respectively. Malting increased the foam capacity from 18.09% to 19.36%, water absorption capacity from 2.78% to 4.31%, emulsion capacity from 30.23% to 33.78% and bulk density from 0.80% to 1.47%. The nutritive value and functional properties were slightly improved by malting. As a result of this improvement of the flour, it could be incorporated into various foods to improve their nutritional value especially weaning foods for infants.

Keywords: *Malting, Proximate composition, Functional properties.*

Introduction

African yam bean (AYB) is a legume which belongs to the family leguminosae and sub-family papillionadae (Enwere *et al*., 1990). The plant is cultivated for both its seed and tuberous roots but also worth growing for its beautiful flowers with tuber rich in starch and seed being more resistant to weavils than those of other legumes of cowpea, soybean etc. (Irvine, 1990). AYB is known with different names in different countries which include "Akitereku" in West Africa; "Degiemtenguere" in Mali; "Konkonbas" in West Africa and "Roya" in Sudan. Other local names in Nigeria include "Girigiri" (Hausa); "Sese" (Yoruba) (Amihud, 1992). Nutritionally, AYB contains dry matter basis 15.8 – 34.7% protein; 1.50 – 2.60% fat, 5.20 – 5.70% crude fibre; 2.8 – 3.4% ash and 74.1% total carbohydrate (Edem et al., 1990). The pod contains 20 – 30 seeds with smooth hard testa varying in colour from brown, green and black. African yam bean is produced and eaten in many parts of middle belt. AYB has been reported as a legume with exceptional potential for adaptation to low land. It yields more than most pulses, but is not as popular as most other legumes such as cowpea, groundnut and pigeon pea (Enwere, 1985). AYB can be roasted and eaten with palm kernel or cconut as snacks. Although AYB has not been widely utilized, recent studies have shown that the seed can be processed into flour and paste and are used in many food formulations such as "Akara" and "Moimoi" (Akoma, 1996); biscuit (Nzereogu, 1993) and in ogi supplementation (Okwamba, 1996).

In the Nwanta District, the 'konkoubas' mill the dry seeds into flour which is processed into paste with water and some condiments. This is then wrapped with plantain leaves, boiled and eaten as 'Turbani'. The 'chalas' another ethnic group in Nwanta district boil the dry seeds for about three (3) hours, replacing the water intermittently. The cooked beans are made into a sauce and eaten with 'garri' (a roasted cassava product). Reports also showed that the water drained after boiling the beans may be taken by lactating mothers to increase their milk production (FAO, 1989). Studies have shown that malting increases the protein content of AYB (AOAC, 1990). Also the functional properties of AYB has been studied and was found to cowpea favourably with those cowpea and soybeans (Ezema, 1989; Ehe and Akobundu, 1999). The traditional method of dehulling method AYB involves the manual removal of the hulls from individual soaked beans. Consequently studies from this result revealed that dehulled AYB had higher content of carbohydrate, fat and lower content of protein crude fibre, ash, phytic acid and tannin than that of undehulled counterpart (AOAC, 1990). Dehulling AYB therefore would help to improve the physiochemical properties and sensory quality of the beans. It is therefore the objective of this work to study the effect of malting on the proximate and functional properties of AYB with the hope for improved quality to enhance its utilization in various food formulations. This will also help top revive this seed and prevent it from going into extinction.

Materials and methods

The dry seeds of African yam bean (AYB) were purchased from a local market in Abriba in Bende local government area of Abia State, Nigeria. The chemicals used were of analytical grade. The equipment and chemicals used were obtained from the departments of Food Science and Technology and Crop Science and Technology of the Federal University of Technology, Owerri.

Sample preparation

The purchased dry raw seeds (AYB) were cleaned and sorted to remove the white and black species, extraneous materials and damaged seeds. The brown species were used for this work. It was then divided into 3 portions. A portion was soaked in water for 24h and germinated for 24h, 48h, 72h and 96h. The second portion was soaked in water for 48h and germinated for 24h, 48h, 72h and 96h. The third portion was used as the control sample where no treatment was given. After germination and kilning; the samples were ground/milled using an attrition mill to reduce the particle size of the seed to fine flour. It was then winnowed to remove the mills. The flour was now sieved with a 300µm sieve aperture, packaged in air tight container, labeled and kept ready for analysis.

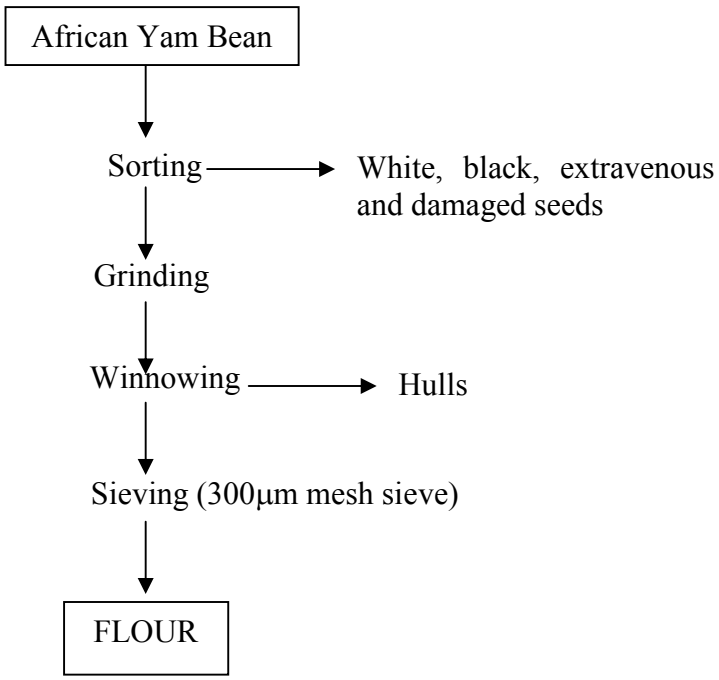

Fig 1: Flow diagram for processed raw AYB used as the control sample

Analysis of the Proximate Compositions

The proximate composition analysis of the samples were carried out according to the method of AOAC (1995)

Determination of Moisture Content

The oven drying method was used as described by AOAC (1995) the aluminum pans were thoroughly washed, dried in the oven at 85°C for 30min and put inside the desiccators to cool. Each of the pans were weighed together with the dish and then placed inside the oven and was heated for more 20min value maintaining the temperature of 105°c, the samples weighed. This was repeated until the weight became constant. The percentage of moisture content (MC) was calculated from the weight loss using the formula below

$$\% \text{ moisture content} = \frac{w_2 - w_3 \times 100}{W_2 - w_1} = \frac{\text{Weight loss after drying} \times 100}{\text{Weight of the sample before drying}}$$

W_1 = initial weight of empty pan
W_2= weight of the pan +sample before drying
W_3= final weight of pan+ sample after drying

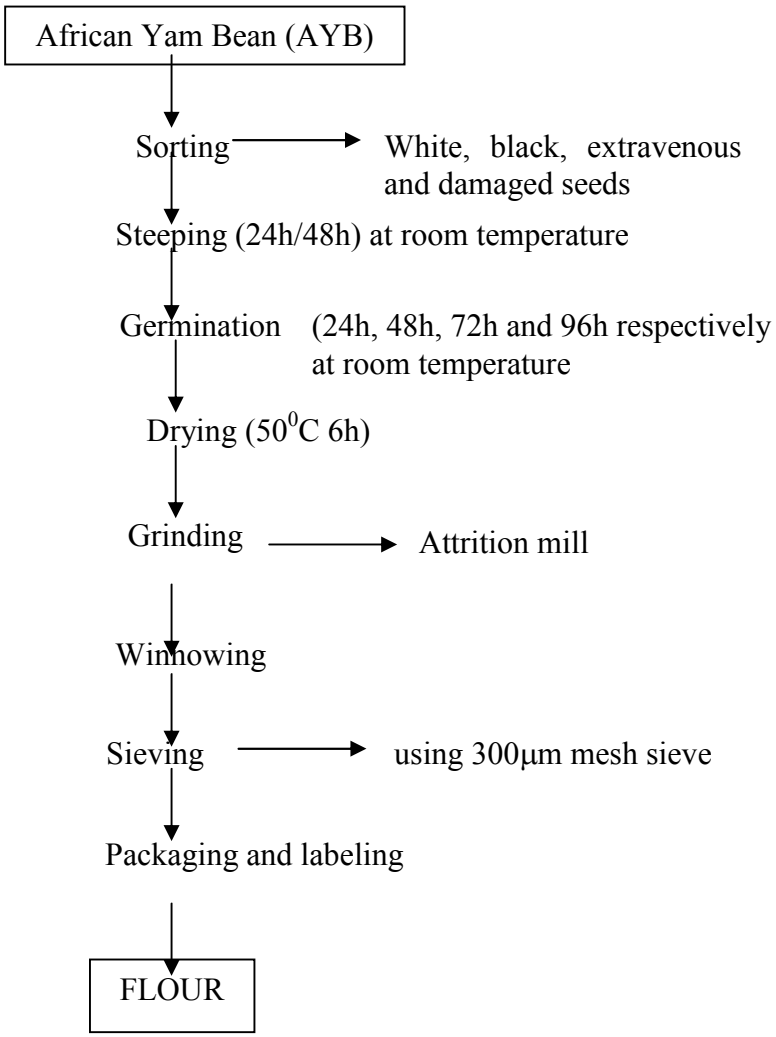

Fig 2: Flow diagram for the production of malted AYB flour

Determination of Ash Content

The AOAC (1995) was used. The crucibles were washed, dried in hot aim oven at 105^{o}C and cooled in a desiccators. 2g of the sample were charred into the crumbles on a heater inside a fume cupboard to drive off the smoke. The sample were transferred into a preheated muffle furnace at 550^{o}c and left at this temperature for two until when gray ash resulted. The residence was then cooled in a desiccators than weighed the percentage of ash (dry matter basis) was calculated as follows

$$\% \text{ ash} = \frac{W_3 - W_1}{W_2} \times 100$$

Weight of original sample

W_1= weight of the empty crucible

W_2= weight of crucible +sample before ashing+w3= weight of crucible + sample after ashing

Determination of Fat Content

The soxhlet fat extraction methods as designed by AOAC (1995) was used the 250ml boiling flask was cleaned dried in the oven at 105^{o}c for 30min. The flask was then transferred into a desicator and allowed to cool. The flask was then labeled, weighed and then filled with 300ml petroleum either. 2g of the sample were weighed into a correspondingly labeled thimble. The extraction thimble

tightly plugged with cotton wool. The soxhlet apparatus was assembled and allowed to reflux for either was collected in the top of the container in the set up and drained into another container for re-use. The flask was removed and dried at 103°c for the transferred from the oven into a desicator and allowed to cool and then weighed the percentage fat was calculated as follows.

$$\% \text{ Fat} = \frac{\text{Weight of defatted sample x100}}{\text{Weight of sample}}$$

Determination of Crude Protein Content

The micro kjeldahl method as described by Pearson (1976) was used. 2 kilogram of the sample was weighed out into a micro kjeldahl flask, 5g of anhydrous sodium sulphate, 1g of copper sulphate and a spark of selenium, 25ml of concentrated sulphuric acid and 5 glass beads were introduced into the micro kjeldahl flask to prevent bump during heating the solution was heated gently in a fume cupboard and then heating increased with occasional shaking till the solution turned to green colour the black particle showing at the mouth and neck of the flask was showing at the mouth and neck of the flask was cooled and washed down with distilled water. The mixture (contents) was reheated gently until the green colour disappeared and then allowed to cool, after cooling the digest was transferred with several washing into a 250ml volumetric flask and made up to the mark with distilled water. The Markham distillation apparatus was steamed for 15min before use under the condenser a 100ml council flask containing 5ml of boric indicator was placed such that the condenser tip is under the liquid 5ml of the digest was pipette into the body of the apparatus through a small funnel aperture, then washed down with distilled water followed by 5ml of 60% NaOH with distilled solution and steamed for 5min. the receiving flask was removed and the top of the condenser was washed down into the flask. The condenser water was then removed. The solution in the receiving flask was titrated using 0.01N hydrochloric acid and the nitrogen was calculated and converted to protein content of the food using a factor (6.25)

Calculation:

% nitrogen = V_S-V_B x N acid x 0.01401 x 100

V_S= vol. (ml) of acid required to titrate sample

V_B= vol. (ml) of acid required to titrate the blank

N_{acid} = normality of acid (0.01N)

W= weight of sample in grams

% crude protein = % N x conversion factor (6.25)

2.2.2 Determination of Crude Fibre

The method of AOAC (1995) was used 2g of the sample was defatted with petroleum either the defatted sample was boiled under refuse for about 30min with 200ml of a solution containing 1.25 grams H_2SO_4 in 100ml and then filter through a linen on a fluted funnel and then washed with boiling water until the washing are no longer acid, the residue was transferred into a beaker and boiled for another 30min with 200ml of solution containing 1.25g of carbonate- free Na0H per 100ml. the final residue was filtered through a thin and washed with boiling water then the residue was then dried in a hot air oven and weighed the dries residue was incinerated cooled and weighed. The crude fibre was incinerated as weight loss after incineration x 100.

Determination of Carbohydrate Content

The carbohydrate content was determined by difference using the formula.

% Available carbohydrate = 100 (% moisture + % ash + % protein + % fat + % crude fibre)

Functional properties of aerial yam flour

Determination of Bulk Density

The bulk density was determined according to the method of Abbey and Ibeh (1988). A calibrated measurement tube was weighed and the samples were filled to 10ml with constant tapping until there were no further change in volume the content was weighed and the volume taken the difference in weight the bulk density of the sample was calculated as calculation

$$\text{Bulk density} = \frac{\text{weight of sample (g)}}{\text{Volume of sample (ml)}}$$

Determination of Water Absorption Capacity

The method of Sosulski (1962) was described by Abbey and Ibeh (1988) and it was adopted. One gram (1g) of each sample was weighed out into a dry, clean centrifugal tube and both weight noted. 10ml of distilled water was poured into the tube and properly

mixed with the sample to make a suspension. It was then centrifuged at speed of 3500rpm for 15mm. After which supernatant was discarded then the tube and its content re-weighed and noted. The gain in weight is the water absorption capacity of the test sample.

Determination of Oil Absorption Capacity
The method of Sosulski (1962) as described by Abbey and Ibeh (1988) was adopted. One gram of each sample was weighed into a dry, clean centrifugal tube and both weight noted. 10ml of refined vegetable oil was poured into the tube and properly mixed with the flour. The suspension was centrifuged at 3500rpm speed for 15minutes then, the supernatant was discarded, the tube with its content re-weighed. The gain in mass is the oil absorption capacity of the sample.

Determination of Swelling Index
A portion (3g) of each flour sample was weighed into a clean, dry, graduated (50ml) cylinder. The sample gently leveled in the cylinder and the volume noted. 30ml of distilled water was added to each sample. The swirled cylinder was allowed to stand for 60min, while the change in volume was recorded every 15minutes. The swelling power index of each sample was calculated as a multiple of the original volume (Sosulski, 1962).

Determination of Wettability
This as described by Onwuka (2005) was adopted. One gram of each sample was placed in a clean, dry, measuring cylinder (10ml). Placing a finger over the open end, the cylinder was inverted and clamped at a height of 10cm from the surface of a 500ml beaker containing 500ml of distilled water. The sample in the cylinder was gradually spread on the surface of the water on moderate speed. The time taken for each sample to be completely wet is noted as wet ability.

Determination of Gelling and Boiling points
The method of Narayana - Rao (1982) was adopted. The sample (10g) was dispersed in distilled water, in a 250ml beaker and made up to 100ml. A thermometer was clamped on a retort stand with its build submerged in the suspension. With a magnetic stirrer the suspension was continuously stirred and heated. This continued until the suspension began to gel and the corresponding temperature recorded. The temperature as soon as boiling commence was also noted and recorded.

Determination of Foam Capacity
The method as described by Onwuka (2005) was adopted in the determination of foam capacity. Test sample in 100ml distilled water and its volume noted. The suspension was blended with a warming blender 1600rpm for 5min. It was then poured into a 250ml measuring cylinder, its volume noted and recorded.
Using Abbey and Ibeh (1988) formula, foam capacity expressed percentage increase in volume is as follows:

$$\text{Foam capacity} = \frac{\text{volume after whipping-volume before whipping}}{\text{Volume before whipping}} \times 100\ \%$$

Determination of Emulsion Capacity
The procedure of Beuchat *et al.,* (1975) as described by Eke (2002) was adopted. The sample (2g) and 75ml of distilled water were blended for 30seconds using a magnetic stirrer. After complete dispersion, refined vegetable oil was added continuously through a burette until emulsion break point, separation into two layers was reached. The emulsion capacity was expressed as ml of oil emulsified per gram of sample

Results and Discussion

The effect of malting on the proximate composition of African Yam Bean (AYB).
From the result of the proximate composition as shown in Table 1, the unmalted seed of AYB which had a protein content of 23.20%, is also the control sample; while the value reported in literature in these seeds ranged from 15.80% to 34.70% (Edem et al., 1990). The relatively high content of protein in AYB seeds as found in this study suggest that a good proportion of an individual daily protein needs may be met if the seeds are consumed in significantly large quantities. After malting the crude protein content of AYB soaked for 24h and germinated up to 96h increased from the initial 23.20% to 25.10% with the sample germinated for 24h having the lowest value of 23.95%. For the 48h soaked samples, the 24h germinated sample had the least value of 25.03% protein while the 96h germination had the highest value of 26.00%. There was a significant difference ($P \leq 0.05$) between the control and all the other samples in terms of protein value. This increase as germination time increased may be due to the degradation of higher molecular weight storage protein to lower fraction as a result of malting. This increase may also be attributed to the increase in lysine content

that accompanies sprouting and to the loss in dry matter since malting is a process of activation of enzymes and proteins are also enzymes (Wu, 1983).

Table 1: Mean Values for Proximate Properties of African Bean

Soaking/ Steeping time (h)	Malting germination time (h)	Ash %	Fat %	Moisture %	Crude fibre %	Crude protein %	CHO %
R.S	R.S	3.22[a]	2.54[a]	7.52[d]	5.12[a]	23.20[c]	62.60[a]
24HS	24h G	3.43[a]	1.77[b]	14.52[c]	4.91[a]	23.95[bc]	54.82[b]
	48h G	3.44[a]	1.62[b]	16.52[bc]	4.83[a]	24.20[b]	54.68[b]
	72h G	3.57[a]	1.49[b]	18.33[ab]	4.75[a]	24.62[ab]	54.44[b]
	96h G	3.69[a]	1.39[b]	19.00[a]	4.60[a]	25.10[a]	54.21[b]
$LSD_{0.05}$		0.6353	0.5743	2.3331	0.5887	0.7569	0.5937
24HS	24h G	3.80[a]	1.32[b]	19.85[a]	4.68[a]	25.03[a]	54.05[b]
	48h G	3.98[a]	1.29[b]	20.02[a]	4.51[a]	25.61[a]	53.96[b]
	72h G	4.08[a]	1.27[b]	20.18[a]	4.39[a]	25.90[a]	53.71[b]
	96h G	4.21[a]	1.22[b]	20.32[a]	4.22[a]	26.00[a]	53.48[b]
		0.9987	0.5752	2.3266	0.6445	0.7322	0.6123

Mean values with the same superscript in the same column are not significantly different at (P≥0.05)

R.S. - Raw sample
24H S - 24 hours soaking
24h G - 24 hours germination
48h G - 48h hours germination
72h G – 72 hours germination
96h G – 96 hours germination
48HS. – 48 hours soaking

The ash content of 3.22% (Table 1) was found in the unmalted sample in this study. This fell within the range of ash contents in legumes of between 10 – 17% (Apata and Ologhobo, 1990). During malting the ash content increased from 3.43% to 3.69% on the 24h soaked samples and from 3.80% to 4.21% on the 48h soaked samples and malted for 24h, 48, 72 and 96h respectively.

This showed that the ash content of the various malted samples increased as malting increased though there was no significant difference (P≥0.05) among the raw and malted samples.

The fat content of the unmalted (control) sample was observed to be 2.54%. Samples soaked for 24h and also malted for 24h had the highest fat content of 1.77% and the ones soaked for 24h and malted for 96h had the lowest value of 1.22%. The fat content decreased as the soaking and malting times increased. This decrease may be due to the utilization of stored lipid reserves in the endosperm portion of the seeds during germination. This report is in agreement with the findings of Prudent and Mabesa (1981); where Mungo beans were sprouted in light and dark areas. The lipids are also a source of carbon for the synthesis of sucrose which is ultimately transported to the growing embryo (Paul and Benedick, 1982). Also there is a significant difference (P≤0.05) between the fat of the control (raw/unmalted) sample and all the malted samples.

The moisture content of the malted AYB increased from the raw (unmalted) sample which had 7.52% to that of the sample soaked for 48h and germinated for 96h which gave 20.32%. All the malted samples had an increase in the moisture content which compared to that of the unmalted (raw) sample as stated earlier. The moisture content of the various malted samples increased with increase in soaking time. This may be attributed to the increase in the uptake of moisture by the bean due to soaking. There was a significant difference (P≤0.05) between the raw (unmalted) and all the various malted samples.

The crude fibre content for the different samples (24h and 48h) soaking were not significantly different (P≥0.05) for the four different days of germination (24h, 48h, 72h and 96h). The crude fibre content of 4.91% was the highest among treated samples and this was

observed in the 24h soaked and germinated samples; and those soaked for 48h and germinated for 96h had the least crude fibre value of 4.22%. The raw sample recorded the highest crude fibre content of 5.12% and this is within the range reported by Enwere (1985).

The Effect of Malting on the Functional Properties of AYB Flavor

From the result in Table 2, there were observed changes in the functional properties of AYB after malting. These changes were either favourable or unfavourable. On the emulsion capacity, there was an increase in malting time; with the 48h soaked sample and germinated for 96h having the highest emulsion capacity of 33.78% as against 30.07% for the control (raw) sample. Though there was an increasing trend from the raw to all the malted samples, there was no significant difference ($P \geq 0.05$) between them. The least value was found on the sample soaked for 48h and malted for 24h which had a value of 29.40%. Sprouting has been found to modify the protein content of legumes e.g. soybean. Also increase in protein during malting increases the emulsion capacity due to the hydrophilic and hydrophobic amino acid of the protein (Abbey and Ibeh, 1988).

For bulk density the 48h soaked and malted for 96h had the highest bulk density of g/m^3 when compared with the control which had $0.78g/m^3$. The bulk density increased with soaking and germination time for the various samples processed. There was a significant difference ($P \leq 0.05$) between the raw (control) and the other samples. Since bulk density shows the rate at which flour made from legumes is expressed to the volume occupied by /g of the flour sample. The mass of the sample is directly proportional to bulk density. Bulk density is seen as weight of the sample per volume of the sample and this helps to know how this product can be packaged and its transportation. Also use of bulk density helps to determine the foods that it can be easily incorporated.

In terms of wettability, the raw (control) sample recorded the highest value of 92.00 secs while the 48h soaked sample and germinated for 96h had the least value of 85.00 secs. The wettability decreased with increase in the soaking time of the different samples. This may be due to the fact that much water had been absorbed during soaking. Also it could be attributed to the disruption of nature of molecules in the malted sample which resulted to low interfacial tension between the particles and the liquid (Elemo and Adu, 2005). According to their report, at high interfacial tension between materials and liquid, wettability is slow on controlling step dissolution of powdery substances. Also wettability is dependent on dispensability, solubility, sinking and wetting. Some other properties that affect wettability include dryness, particle size and surface characteristics of particles (Onwuka, 2005).

The result in Table 2 showed that gelling point ranged from 85 – 108^0C. The gelling point of the 48h soaked and germinated for 72h and 96h recorded a gelling point of 106^0C and 108^0C respectively which were the highest values recorded. The unmalted sample had the lowest gelling point of 85^0C. The 24h soaked samples and germinated for 24h, 48h, 72h and 96h had their gelling points in the range of 89^0C, 90^0C, 94^0C and 97^0C respectively while the 48h soaked and germinated for 48h had 99^0C, 103^0C, 106^0C and 108^0C respectively.

The high gelling point for the malted samples could be as a result of high protein content. Sathe and Salukhe (1981) reported that the associated variation in geling properties to different constituents (proteins, lipids and carbohydrates) that makes up the legume protein was attributed to globulin fraction and gelling point and indeed an aggregation of denatured molecules. This suggests that this property would make the malted samples suitable in food systems such as pudding and moi-moi which requires thickening and gelling properties. Also significant differences ($P \leq 0.05$) existed between the various malted samples with the control.

The boiling point of the various samples ranged from 96.00 – 102.00^0C. The boiling point of the 48h soaked and 96h germinated sample recorded the highest value of 102.0^0C while the raw sample had the least boiling point of 96.00^0C. There was no significant difference ($P \geq 0.05$) among the samples with the control. The higher boiling point of the malted samples could be associated with the relative ratio of the different constituents like protein, carbohydrates and lipids that was left after processing. The swelling index of the samples decrease slightly with malting time though they were not significantly different ($P \geq 0.05$) from each other. The value for the swelling index for the raw (control) sample was recorded as $2.72cm^3$ while that obtained after soaking for 24h and germinating for another 24h had the least value of $2.58cm^3$. This may be because germination brought about a slight decrease in the starch content, amylase and non-reducing sugar. Hence the decrease in the swelling index of the malted samples could be attributed to the lower carbohydrate content which were used up for malting activities by enzymes. Also the oil absorption capacity (OAC) slightly increased with increase in the malting time. The OAC for the unmalted (raw) sample was 1.60ml/g of sample. This value increased slightly as malting progressed. It was highest for samples soaked for 48h and germinated for 96h which had a value of 2.34 ml/g of sample. Though a slight increase existed; there was no significant difference ($P \geq 0.05$) between them. This result suggests that AYB flour contains more superior binding of lipids during malting. Since oils act in flacour retention in foods and increase mouth feel, it is an important property in food formulations. As a result, malted AYB flour could be used in various food formulations where flavor enhancement is a priority especially in baby foods.

Table 2: Mean Values for Functional Properties of African Bean Flour

Soaking time (h)	Germination time (h)	Bulk density (kg/m^3)	Wettability (Sec.)	Gelling point (0C)	Boiling pint (0C)	Swelling index (Cm^3)	Emulsion capacity (Cm^3)	Oil absorption capacity (ml/g)	Water absorption capacity (ml/g)	Foam capacity (ml/g)	Viscosity
R.S	R.S	0.78^{a}	92.00^{a}	85.00^{a}	96.00^{a}	2.72^{a}	30.07^{a}	1.60^{a}	2.14^{a}	18.32^{a}	12.30^{a}
24h	24h G	0.80^{ab}	90.00^{a}	89.00^{ab}	97.00^{a}	2.58^{a}	30.23^{a}	1.67^{a}	2.78^{b}	18.09^{a}	3.54^{c}
	48h G	0.803^{ab}	89.00^{a}	90.00^{b}	97.00^{a}	2.61^{a}	30.28^{a}	1.71^{a}	2.92^{b}	18.18^{a}	3.5^{c}
	72h G	0.89^{ab}	89.00^{a}	94.00^{c}	98.00^{a}	2.64^{a}	30.37^{a}	1.78^{a}	2.48^{b}	18.24^{a}	3.2^{c}
	96h G	0.92^{b}	88.00^{a}	97.00^{c}	99.00^{a}	2.68^{a}	30.49^{a}	1.83^{a}	2.29^{a}	18.12^{a}	2.8^{c}
$LSD_{0.05}$		0.1323	8.0134	4.743	4.372	0.09276	5.3266	0.9623	0.5841	0.4589	0.8818
	24h G	1.12^{b}	88.00^{a}	99.00^{c}	97.00^{a}	2.69^{a}	29.40^{a}	1.85^{a}	3.78^{b}	18.17^{a}	6.51^{b}
48h	48h G	1.21^{b}	87.00^{a}	103.00^{c}	98.00^{a}	2.69^{a}	33.33^{a}	1.92^{a}	3.95^{c}	18.18^{a}	6.00^{b}
	72h G	1.35^{c}	86.00^{a}	106.00^{c}	100.00^{a}	2.70^{a}	33.51^{a}	2.23^{a}	4.18^{c}	19.20^{a}	5.7^{b}
	96h G	1.47^{c}	85.00^{a}	108.00^{c}	102.00^{a}	2.71^{a}	33.78^{a}	2.34^{a}	4.31^{c}	19.36^{a}	5.2^{b}
$LSD_{0.05}$		0.13782	7.8137	5.0806	7.2541	0.07231	4.9571	0.5175	0.5868	0.8688	0.8852

Mean values with the same superscript in the same column are not significantly different at ($P \geq 0.05$)

For the Water Absorption Capacity (WAC) for the various samples, it was observed that there was an increase in the water absorption of the samples. The water absorption of the raw (unmalted) sample was lowest (2.14ml/g) while the sample soaked for 48h and malted for 96h had the highest value of 4.31mg/g. According to Abbey and Ibeh (1988), the higher water uptake by the malted samples compared to the control might be due to the presence of more protein or hydrophilic polysaccharides in the malted samples. There was a significant difference between the control and the other samples. The water absorption capacity could be used to determine the rate of water intake when used in food formulations. The high water absorbed in some samples shows that when used in foods the rate of water uptake will be higher in those samples that had higher values than the control samples.

From the foam capacity, it could also be seen that the increase in malting showed a corresponding increase in the foam capacity of the samples; though there was no significant difference ($P \geq 0.05$) between them. The foam capacity for the control samples was 18.32ml/g while that for 48h soaking and 96h germination was 19.36ml/g. According to Kadam *et al* (1987), proteins are utilized to form a stable foam by unfolding the polypeptide claims and exposing substantial region of hydrophobic residue into air in lipid phase where they form a good foam capacity and stability; hence the malted samples. Since there was no significant variation in foam formation, it shows that any of the samples could be used in the form they are for foods requiring little foam in formulations. Based on the viscousity values obtained; the raw (control) sample had the lowest value (12.30 Cp). There was irregularity in the viscousity though the increase shows that there was increase in the protein and carbohydrate level which is related to viscousity.

Conclusion

This investigative study has been able to generate information on the effect of malting on the proximate and functional properties of Africa Yam Bean (AYB). From the results obtained from this work it could be said that flour could be a good substitute for flour from other legumes such as soy bean, cowpea in some food formulations. The result for the functional properties showed that malting involved and modified the functional properties of AYB. Malting improved the emulsion, water and oil absorption capacities of the flour which are important parameters in food formulation. Thus this will give a guide to the use of the flour for some food products. Also the result of the proximate composition has shown that malting could be used to improve the nutritional value of AYB seed. However malting of AYB for nutritional purposes should not be allowed to go beyond 96h. Generally malting eased the dehulling of AYB seed and also yielded flour with flour comparable to that of the raw sample in terms of functional properties. As a result of these findings, increase in intake of AYB is highly encouraged much more as the nutritional benefits. AYB could serve as a good substitute for products like moimoi in cowpea; flour for bakery confections etc. By so doing, this less utilized properly used in food formulations and above all in improving the security of quality foods.

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