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EFFECTS OF TREATMENT METHODS ON SOME PROPERTIES OF BAMBARA NUT (*VOANDZEIA SUBTERRANEAN L.* THOUARS) FLOURS

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ABSTRACT

The effects of some treatments of Bambara nut (*Voandzeia subterranean L. Thouars*) seeds on the functional and pasting properties and proximate composition of flours milled from the treated seeds were investigated. The first portion of the brown variety of the legume was soaked in cold portable water for 24 hrs, the second and third portions were soaked separately in cold portable water at room temperature for 3 hrs, followed by draining, and controlled germination on cleaned, moistened sawdust in opaque plastic trays for 48 and 72 hrs respectively. The soaked and sprouted samples were then drained and harvested seperately, followed by drying at 60^{o}C for 8 hrs in a locally fabricated air-dryer. The fourth portion was taken as un-treated sample. Each portion was then manually de-hulled and milled into flour of particle size < 300microns. The flours were analyzed for proximate composition and physical and rheological properties. Each flour sample was used to prepare steam bean paste gel "Moinmoin" which was then evaluated for sensory parameters. Water-soaking produced no appreciable effect on proximate composition, while sprouting produced marginal increase in protein (22.24$\pm$0.88 for sample sprouted for 48 hrs compared to 20.73$\pm$1.24 for untreated sample) and crude fibre contents but reduction in fat and carbohydrate contents compared to untreated sample. Sprouting and water-soaking resulted in reductions in most functional and pasting properties of the samples compared to untreated sample except solubility (9.58 and 13.05 for untreated and 48-hr sprouted samples respectively) and peak viscosity (9.67 and 29-72 for untreated and 24-hr sprouted samples respectively), for which untreated sample had lower values . Most "Moinmoin" sensory parameters were adversely affected by sprouting compared to water-soaked and untreated samples. There were significant differences for most sensory parameters ($p < 0.01$ and $p < 0.05$), except for taste. "Moin-moin" prepared from water-soaked sample received highest acceptability scores for the sensory parameters ($p < 0.05$) compared to other treated sample.

Keywords: Bambara nut**,** Flours, Functional Properties, "Moinmoin", Pasting Characteristics, Sprouting.

INTRODUCTION

Legumes are the edible seeds of leguminous plants belonging to the *Leguminosae* or bean family, which constitute an important source of dietary protein in many West African countries including Nigeria (Roberts, 1970; Sieged and Farwell, 1976.). Widespread prevalence of protein malnutrition in many developing countries had refocused the importance of legumes

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as excellent but cheap source of protein, especially when consumed with cereals to which they act as protein extenders. Legumes are also good sources of common minerals including phosphorus and iron (Enwere, 1998; Ihekoronye and Ngoddy, 1989).

One of the most important and commonly consumed legume in Nigeria is the Bambara nut (*Voandzeia subterranean L. Thouars*), which is widely cultivated in Nigeria and is considered to contain higher nutrients than cowpea (*Vigna unguiculata*), the most widely consumed legume in Nigeria (Onayemi and Potter, 1976; Francis, 2006). Despite its high nutritional potentials, Bambara nut has not been fully exploited in local diets due partly to its hard-to-cook phenomenon, pronounced beany and often offensive flavour and high degree of anti-nutritional factors (Enwere, 1998). Some treatments such as cold water soaking, boiling and sprouting had been successfully applied to reduce these problems in order to enhance the use of this legume in local dishes.

It is however expected that these treatments will produce certain effects on the flours produced from such treated seeds and also on dishes prepared from the flours, especially steamed bean paste gel ("Moinmoin"), which is one common form in which legumes are consumed. The objective of this study was to examine the influence of certain treatment methods on some properties of flours from Bambara nut and on "Moinmoin" prepared from the flours.

MATERIALS AND METHODS

Materials

The material used for the study was the cream-coloured variety of the Bambara nut (V. subterranean L Thouars), which was purchased at the Oyingbo *Retail Market in Lagos Mainland. Ingredients for "Moinmoin" recipe were obtained from a local market in Mushin on the outskirt of Lagos.*

Sample Preparation

The seeds were cleaned and divided into four portions and treated as follows. The first portion was soaked in portable water at room temperature for 24 hrs, the second and third portions were soaked separately in three times their volume of portable water at room teperature for 3 hrs, followed by draining, and controlled germination on cleaned, moistened sawdust in opaque plastic trays for 24 and 48 hrs, respectively. The soaked and sprouted samples were then drained and harvested, respectively, followed by drying at 60^{o}C for 8 hrs in a locally fabricated air-dryer. The fourth portion was taken as un-treated sample.

Each sample was then soaked in portable water for 12 hrs and manually de-hulled by vigorous hand-rubbing, while the freed seed coat was removed by floatation. The de-hulled seed were then dried in a locally fabricated air-dryer at 60^{o}C for 12 hrs, followed by milling in a Premier Grinding Mill (Christy Ltd., Earls Colne, England) and the flour fraction that passed through sieve of mesh size 425µ was collected and used for the study.

Proximate Analyses

Proximate compositions of the flour samples were determined by standard AOAC (1990) methods. Carbohydrate was obtained by difference. Mean of triplicate determinations were reported on dry weight basis except for moisture.

Functional Characteristics Measurement

Physical characteristics of the flour samples including bulk densities, water absorption, swelling, solubility and reconstitution index were obtained by the methods of D'Appolonia (1976).

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Pasting Characteristics Determination

Pasting properties of the flour samples were determined using the Rapid Visco Analyzer (RVA); Newport Scientific, Sydney). Parameters obtained include pasting temperature and time, peak, trough and final viscosities, as well as consistency, setback and breakdown.

Preparation of 'Moinmoin' for Sensory Evaluation

Each flour sample was used to prepare steamed bean paste gel, 'Moinmoin', using the recipes of Dovlo et al. (1983), and the 'moinmoin' samples were evaluated for some sensory parameters including colour, taste, texture, aroma and overall acceptability in the department's sensory evaluation laboratory. A twelve-member untrained panel chosen from among students and staff were used to conduct a scoring test on a grading scale ranging between 1 for 'extremely poor' and 9 for 'extremely good', 'neither good nor poor' was in-between. The responses of panelists were converted into quantitative data and subjected to Analysis of Variance as in Akinjayeju (2002).

RESULTS AND DISCUSSION

Proximate Composition

The proximate compositions of the flour samples are presented in Table 1. The values obtained for raw untreated sample are in agreement with values reported in literature (Enwere,1998). The marginal increases in protein, ash and crude fibre, and reductions in fat and carbohydrate contents for sprouted samples compared to untreated sample are consistent with previous study for sprouted cowpea (Akinjayeju and Soniregun, 1998), and the observations of Ishiwu (2004) that available lysine increased in flours that were milled from sprouted cowpea. Tsai *et al.* (1975) and Adeyemo *et al.* (1992) also reported increased protein values in sprouted maize, which was attributed to mobilization of storage protein to produce protein.

The result obtained in this and previous studies are however contrasted by the result of Nwabugwu and Onweluzo (2005) who reported reduction in the protein contents of sprouted Pigeon pea compared to unsprouted sample, which was attributed to protein hydrolysis. The increased ash content in sprouted samples is most likely as a result of losses during sprouting (germination losses), leading to reduction in dry matter and increase in ash content. Reduction in carbohydrate in sprouted samples has been attributed to increase in alpha-amylase activities, which breaks down complex carbohydrates to simpler and more soluble sugars needed by the growing seedling.

The proximate composition of water-soaked sample was almost the same as for untreated samples (no significant difference in these parameters ($p>0.01$ and

p>0.05), except for minor reductions in fat, crude fibre and ash contents in water-soaked sample, which indicates that soaking produced no appreciable effect on proximate composition. Reduction in fat content in sprouted samples is in agreement with the results of Adeyemo *et al*. (1992) for sprouted maize, which they argued was most probably due to hydrolysis of fat to fatty acid and glycerol by lypolytic enzymes during sprouting.

Results indicate that sprouted samples had reduced water absorption, swelling and packed bulk density, while loose bulk density and solubility values increased when compared with untreated sample. Most physical characteristics of water-soaked sample reduced when compared with untreated sample except solubility and reconstitution index for which water-soaked sample recorded higher value. Reconstitution index values for most samples were almost the same except for water-soaked sample, which had higher value. This is most probably due to effects in water-soaked sample, which was absent in other samples.

Reduced water absorption capacity in sprouted cowpea flours was previously reported by Akinjayeju and Adekanye (2006), which they attributed to modification of starch granules during sprouting. These results are however in contrast to the observation of Akinjayeju and Soniregun (1998) who reported reduced solubility and bulk density for sprouted cowpea flour, while Nwoji (2005) reported that flour milled from sprouted cowpea seeds produced lower bulk density compared to untreated seeds. The generally low swelling of the samples is consistent with the observations of Lineback and Ke (1975), Akinjayeju and Enude (2002) and Akinjayeju and Bisiriyu (2004) that legume flours are characterized by restricted swelling. Reduced water absorption and swelling values obtained for sprouted samples, and also as sprouting period was increased, was most probably due to reduction in starch (Table 1), which was been used up during sprouting. These results will produce some effects when the flours are reconstituted and made into paste during "moinmoin" preparation, especially in the amount of water to achieve a given paste consistency and on the texture of the "moinmoin" products.

Pasting Characteristics

The pasting characteristics of the samples are shown in Table 3. Pasting temperature which is an indication of the quantity of heat required to cook a given food sample are almost the same for all the samples except for water-soaked sample, which had a slightly lower pasting time than others. This is most likely due to the water already absorbed as a result of the pre-sprouting soaking treatment given the sample, which also affected the reconstitution indices of the samples (Table 2).

The hard-to-cook phenomenon in Bambara nut, is demonstrated by its high pasting temperature and time, compared to Cowpea (a staple, common food legume), which recorded a lower pasting temperature and time (Lineback and Ke, 1975; Akinjayeju and Enude, 2002; Akinjayeju and Adekanye, 2006). Peak viscosity increased for both water-soaked and sprouted samples compared to untreated sample, due most probably to the modification of the

starch granules brought about by moisture absorption and sprouting respectively.

The stability of the samples, a measure of their ability to withstand high temperature and shearing was generally low, ranging from 0.67RVU for untreated sample to 1.75 for sample sprouted for 48 hrs. This is as a result of the similarity between the peak and trough viscosities of the samples, and this also demonstrated by the high consistency values of the samples, especially sprouted ones. Consistency of legume starch pastes had been observed to increase with decreasing stability and with increase in susceptibility to breakdown Henshaw and Adebowale (2004). Consistency values were higher for sprouted samples, and to a lesser extent in soaked sample compared with untreated sample. These results are in agreement with those obtained for sprouted cowpea flours (Akinjayeju and Adekanye, 2006).

Sensory Evaluation

The mean scores for the sensory parameters of 'Moinmoin" prepared from the flour samples are shown in Table 4. Samples from untreated and water soaked samples recorded high acceptability scores for most parameters evaluated, with water soaked sample having higher acceptability scores for most parameters especially colour, taste and texture (9 for extremely good and 1 for extremely poor). Sprouting adversely affected most 'Moinmoin" sensory parameters with the texture recording the least acceptability, which becomes more pronounced as sprouting period increased (4.75 ± 0.94 and 4.42 ± 0.69 for samples sprouted for 24 and 48 hrs, respectively). These results are in agreement with the observations of Lasekan et al., (1987), Ishiwu (2004) and Akinjayeju and Adekanye (2006) who studied sprouting properties of cowpea.

The relatively high acceptability scores for aroma and taste of "Moinmoin" prepared from sprouted samples, compared with untreated and soaked samples, may have been due to the removal of the characteristic beany flavour by spouting which has been observed to reduce the incidence of this characteristic in legumes. The presence of such beany flavour in legumes had been shown to be offensive to most consumers (Enwere, 1998). Analysis of variance indicates significant differences ($p<0.01$ and $p< 0.05$) for most parameters except for taste where there was no significant difference at both levels, while aroma recorded significant difference ($p<0.01$). The relatively low mean score for texture obtained for samples prepared from sprouted flours was most probably as a result of the modification and reduction in starch component brought about by sprouting. The starch component is mostly responsible to the firm texture in flour gels.

CONCLUSION

Results of this study show that spouting of Bambara nut affects appreciably most of the physico-chemical and rheological properties and proximate compositions of the flours milled from such sprouted seeds. Most of the sensory parameters of the steamed bean paste "Moinmoin" prepared from the flours were also significantly affected. This means that when sprouting is used to reduce the beany flavour and certain anti-nutritional factors in Bambara nut, the extent of sprouting that should be used to achieve a given level reduction of beany flavour should be such that will not result in too much adverse effect on other impor-

tant characteristics of the sprouted seeds and the products prepared from them.

This study, therefore, shows that even though sprouting resulted in marginal increases in some nutrients including protein, and may result in reduction of offensive beany flavour, it adversely affected most physical properties of the flours. These effects become even more noticeable if the flours are to be used for the preparation of steamed bean paste ('moin-moin'). Water-soaked sample recorded the highest acceptable scores for most sensory parameters evaluated, except for untreated sample.

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Table 1: Proximate composition of sprouted, water-soaked and untreated Bambara nut flours (%)

	Samples [1]			
Parameters[2]	UTD	WSD	SP1	SP2
Moisture	12.24±0.95a	11.60±1.05a	12.64±0.85a	12.71±0.79a
Protein	20.73±1.24c	20.73±0.97c	21.85±1.02d	22.24± 0.88d
Fat	7.41±0.99b	6.83±0.76d	7.00±1.05d	6.73±0.45d
Crude Fibre	4.10± 0.59a	3.33±0.95b	4.40±0.85c	4.83±0.78c
Ash	3.67±0.92a	2.96±0.68a	4.39±1.02b	4.59±0.75b
Carbohydrate	64.09±1.35b	66.15±1.58b	62.36±0.85c	61.61±1.05c

1. UTD = Untreated; WSD = Water-soaked; SP1 = Sprouted for 24 hrs; SP2 = Sprouted for 48 hrs.
2. Expressed as dry-weight basis except moisture
   Means with the same letters along the same row are not significantly different ($p < 0.05$)

Functional Properties

The physical parameters of the flour samples are shown in Table 2.

Table 2:Physical composition of sprouted, water-soaked and untreated Bambara nut flours (%)

	Samples[1]			
Parameters	UTD	WSD	SP1	SP2
Bulk density (kg/m^3)				
Packed flour	357a	345a	333b	263c
Loose flour	526b	500bc	556d	625e
Water absorption (%)	162a	145b	156b	138c
Solubility (%)	9.58a	10.48ab	11.10b	13.05c
Swelling (%)	206b	204b	200bc	180c
Reconstitution index (cm)	12.00a	16.00b	12.00a	11.50a

[1] UTD = Untreated; WSD = Water-soaked; SP1 = Sprouted for 24 hrs;
SP2 = Sprouted for 48 hrs
Means with the same letters along the same row are not significantly different (p>0.05)

Table 3:Pasting characteristics of sprouted, water-soaked and untreated Bambara nut flours

	Samples[1]			
Parameters	UTD	WSD	SP1	SP2
Pasting temp. (^{o}C)	80.00a	79.90a	80.10a	79.43a
Pasting time (mins)	7.00a	5.87b	6.47b	6.60b
Peak viscosity (VP) (RVU)[2]	9.67a	24.25b	29.72c	24.17b
Final viscosity (VF)(RVU)	15.58b	32.83c	41.83d	35.50c
Trough viscosity (VT)(RVU)	9.00a	23.43b	28.83c	22.42b
Breakdown (VP–VT)(RVU)	0.67a	0..83a	1.08b	1.75b
Setback from Peak (VF–VP) (RVU)	5.91a	8.58a	12.11b	11.33b
Consistency (VF–VT) (RVU)	6.58a	9.40b	13.00c	13.08c

[1] UTD = Untreated; WSD = Water-soaked; SP1 = Sprouted for 24 hrs; SP2 = Sprouted for 48 hrs
[2] RVU = Rapid Visco Units
Means with the same letters along a row are not significantly different (p>0.05)

Table 4: Mean scores* and calculated variance ratios for sensory parameters of 'Moinmoin' prepared from sprouted, water-soaked and untreated Bambara nut flours

	Samples/Variance ratios (F)[2]				
Parameters	UTD	WSD	SP1	SP2	F
Colour	6.58±0.97a	7.17±1.05	5.08±0.87b	5.00±0.95b	5.46
Taste	5.83±1.07a	6.58±0.78b	6.75±1.00b	7.18±1.25c	1.56
Aroma	6.00±0.95a	6.52±1.32b	6.88±0.68bc	7.02±0.96c	3.97
Texture	6.08±0.79a	7.83±1.06b	4.75±0.94c	4.42±0.69c	9.88
Overall Acceptability	7.00±1.15a	6.75±1.23a	5.25±1.23b	5.87±0.85b	8.97

*1 for extremely poor; 9 for extremely good.

[1] UTD = Untreated; WSD = Water-soaked; SP1 = Sprouted for 24 hrs; SP2 = Sprouted for 48 hrs

[2] Tabulated Variance Ratios F(0.05 = 2.90 F(0.01) = 4.45

Means with the same letters along a row are not significantly different (p>0.05)