Journal of Food Technology 10 (3): 83-86, 2012
ISSN: 1684-8462

Effect of Fermentation on Some Functional Properties of *Mucuna sloanei* and *Detarium microcarpum*

B.D. Igbabul, H.O. Idikwu and C.U. Inyang
Department of Food Science and Technology, University of Agriculture, Makurdi, Nigeria

Abstract: Effect of fermentation on the proximate composition and functional properties of brown hamburger bean (*Mucuna sloanei*) and sweet detar seeds (*Detarium microcarpum*) was studied. Results showed that fermentation for a period of 72 h significantly ($p \leq 0.05$) increased the protein, moisture and crude fibre of the *Mucuna sloanei* flour while there was no difference of crude fat but significant decrease in ash and carbohydrate contents. Protein and crude fibre also increased significantly ($p \leq 0.05$) with fermentation of *Detarium microcarpum* whereas there was no significant difference in the moisture content and crude fat. Ash and carbohydrate also decreased significantly. It was observed that functional properties studies showed significant decrease as fermentation period increased in the two legumes. However, water absorption capacity, increased significantly ($p \leq 0.05$) over the period of fermentation for the two legumes investigated.

Key words: Fermentation, functional properties, *Mucuna sloanei*, *Detarium microcarpum*, Nigeria

INTRODUCTION

Legumes are functional foods that promote good health and have therapeutic properties. Legumes rank second to the grasses as food for man but perhaps also serve man in a greater variety of other ways than do the grasses. Legumes are important ingredients of a balanced human diet in many parts of the world due to their high protein and starch contents. They are consumed traditionally as whole seeds or as ground flour after dehulling and these include cowpea, peas, broad beans chickpeas, garbanzo beans, common beans, kidney beans, lima beans, soybeans, pigeon peas, bambara groundnut and African yambeans among others (Enwere, 1998).

Lesser known legumes on the other hand are legumes which have remained either unexplored or are underutilised or only localised in a particular region (Arinathan *et al*., 2003). In Nigeria, they include those which are prepared and eaten as other legumes, e.g., pigeon peas (*Cajanus cajan*), bambara groundnut (*Voandzeia subterranea*) and African yambeans (*Sphenostylis sternocarpa*). Others which are not eaten by themselves but which may be used as thickeners, stabilizers or processed into condiments or fermented food products include *Afzelia africana* (akparata), *Brachystegia eurycoma* or *B. nigerica* (achi), *Detarium microcarpum* (ofor) and different varieties of Mucuna, e.g., *M. sloanei* (ukpo). Those processed into fermented condiments include African locust bean (*Parkia* sp.) and castor oil seeds as well as African oil bean seeds (*Pentaclethra macrophyla*).

Exploring lesser known/underutilised legumes could be of high significance for food security and combating protein-energy malnutrition among low income groups. This is because many of the lesser known legumes such as *Mucuna sloanei* and *Detarium microcarpum* possess adequate amounts of protein, carbohydrate, fat and ash comparable to other common legumes. Matured seeds of *Mucuna sloanei* are prepared into flour and used as thickeners in soup while its young fruit can be cooked and eaten as vegetable.

A black dye from the kernel has been used to dye fibres in Nigeria while oil extracted from its seed can be used in the preparation of resin, paint, polish, wood varnish, skin cream and liquid soap. Sweet detar seed (*Detarium microcarpum*) is also prepared into flour and used as thickeners in soups. Its kernel can also be used to extract oil for culinary use while the solid residue from the process is used as animal feed. Its seeds are also fashioned into ornaments.

Fermentation is known to have added value to foods and has been reported to increase the soluble phenolic content of legumes thereby enhancing its antioxidants activities (Oyarekua, 2011). There is a report of remarkable improvement in the nutritive value and quality of legume seeds through fermentation (Torres *et al*., 2006), however not much has been done on the fermentation of *Mucuna sloanei* and *Detarium microcarpum* flour. The present study was aimed at observing the effect of fermentation on the proximate composition and some functional properties of the flour from these two underutilised legumes.

Corresponding Author: B.D. Igbabul, Department of Food Science and Technology, University of Agriculture, Makurdi, Nigeria

MATERIALS AND METHODS

Sample collection: Brown hamburger bean (*Mucuna sloanei*) and sweet detar seeds (*Detarium microcarpum*) were purchased from Railway market, Makurdi, Benue State of Nigeria. Samples were prepared in the Food Processing Laboratory of Department of Food Science and Technology, University of Agriculture, Makurdi, Benue State, Nigeria for further analysis.

Preparation of brown hamburger and sweet datar flour: The method outlined by Onyemelukwe and Enwere (1992) was adopted with modification for the purpose of the fermentation. The seeds of brown hamburger and sweet detar were respectively sorted to remove extraneous materials. Sorted seeds were cracked using a hammer mill, washed and dried in the oven (60°C) and grinded into flour in the laboratory using attrition mill to reduce the size of particle and then hammer mill to grind into fire flour, for the unfermented flour sample. While for the fermented flour, the cracked seeds were washed and soaked in tepid water to ferment for 24, 48 and 72 h, respectively before drying in the hot air oven (60°C) then milled to obtain the fermented flour (Fig. 1 and 2).

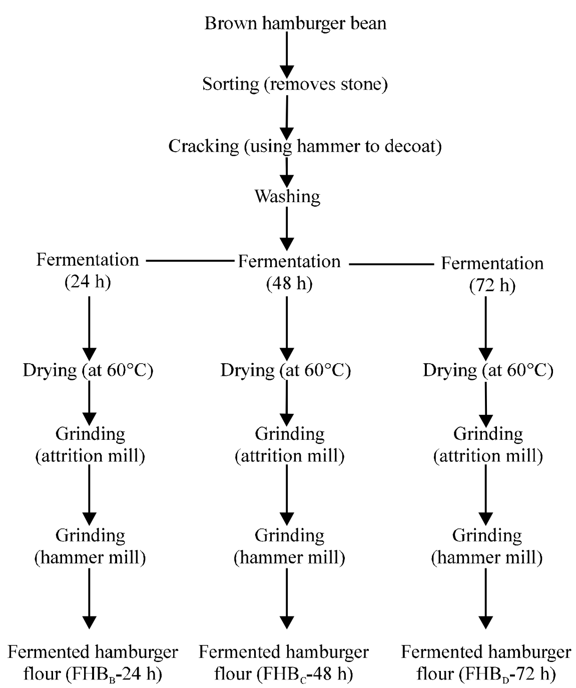

Fig. 1: Flow chart for the production of fermented brown hamburger bean flour with modification (Onyemelukwe and Enwere, 1992)

Determination of chemical properties: Proximate analysis was carried out to determine protein, crude fat, fibre, ash and moisture content using the methods described by AOAC (1995). Crude protein determination was by the and moisture content using the methods described by Kjeldhal nitrogen assay (N×6.25). Crude fat was determined for each flour sample using Soxhlet apparatus with anhydrous diethyl ether as the solvent.

Crude fibre estimates were carried out by calculating the loss in weight on ignition of dried residue following the digestion of the fat free samples with 1.25% each of H_2SO_4 and NaOH solutions. The carbohydrate was determined by difference. Functional properties of the fermented flours were analysed to determine bulk density, water/oil absorption capacity, foaming capacity, emulsification capacity and viscosity following procedure described by Abebowale and Maliki (2011).

Statistical analysis: Results obtained were subjected to statistical analysis of variance and the mean compared to determine if there was significant difference between samples using SPSS 19.0 Software.

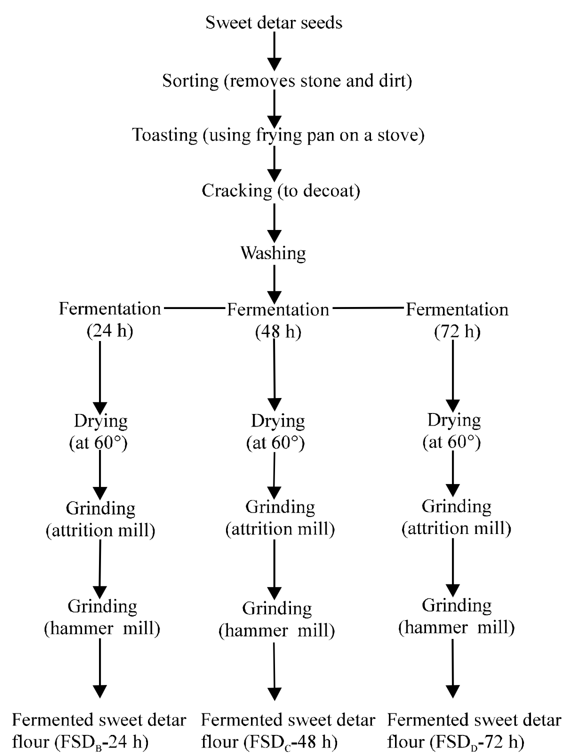

Fig. 2: Flow chart for the production of fermented sweet etar flour with modification (Onyemelukwe and Enwere,1992)

RESULTS AND DISCUSSION

Results of proximate composition of unfermented and fermented brown hamburger bean showed significant increase ($p \leq 0.05$) in protein, moisture and crude fibre after fermentation but decrease in ash and carbohydrate. There was no difference in crude fat content (Table 1). Protein and crude fibre also increased significantly ($p \leq 0.05$) with fermentation of sweet detar seeds whereas there was no difference in moisture and crude fat (Table 2). These results agree with various other reports in which fermentation has been seen to affect some of the chemical components of other legumes such as pigeon pea (*Cajanus cajan*) (Torres *et al*., 2006; Abebowale and Maliki, 2011; Oyarekua, 2011), *Mucuna cochichinensis* (Udensi and Okoronkwo, 2006). The significant increase in protein content of the fermented *Mucuna sloanei* and *Detarium microcarpum* in this study indicates that they can serve as rich protein sources for consumers who cannot afford the animal-protein foods especially in developing countries.

This study also revealed changes in functional properties of fermented seeds. There was significant decrease in bulk density, oil absorption capacity, foaming capacity and emulsification capacity with fermentation of the two legumes (Table 3 and 4). The water absorption capacity increased significantly ($p \leq 0.05$) over the period of fermentation for the two legumes investigated. This improved functional property of the fermented *Mucuna sloanei* and *Detarium microcarpum* suggests their potential applications in various food processes such as baking. Similarly, fermented pigeon pea (*Cajanus cajan*) has been earlier reported to be utilized as ingredients in paste products (Torres *et al*., 2006) and desirable functional properties of gums of *Mucuna flagellipes* and *Detarium microcarpum* seeds have made them potential stabilizers in raw beef burger (Onweluzo *et al*., 2004). The result of study by Abebowale and Maliki (2011) on the functional properties of fermented pigeon pea showed some variations in certain of the functional properties. They observed a significant decrease in fat content of their fermented

Table 1: Proximate composition of fermented/unfermented brown hamburger bean flour

Samples	Protein (%)	Moisture (%)	Crude fat (%)	Crude fibre (%)	Ash (%)	Carbohydrate (%)
UHB_A	15.31 ± 0.89^a	6.0 ± 0.17^a	6.0 ± 2.00^a	0.5 ± 0.1^a	1.8 ± 0.20^a	69.89 ± 2.69^a
FHB_B	13.12 ± 0.92^a	6.5 ± 0.20^a	7.8 ± 1.82^a	0.5 ± 0.0^a	1.6 ± 0.35^a	70.48 ± 0.90^a
FHB_C	15.31 ± 0.11^a	4.0 ± 0.87^b	6.6 ± 1.91^a	1.0 ± 0.2^b	0.8 ± 0.17^b	72.29 ± 1.17^a
FHB_D	32.82 ± 1.00^b	5.0 ± 1.00^b	8.6 ± 1.10^a	1.0 ± 0.0^b	1.0 ± 0.10^b	51.59 ± 1.15^b

Values are Mean±Standard Deviation from triplicate determinations; values not followedby the same superscript in the same columnare significantly different ($p \leq 0.05$); UHB_A = Unfermented Brown Hamburger bean flour (0 h); FHB_B = Fermented Brown Hamburger bean flour (24 h); FHB_C = Fermented Brown Hamburger bean flour (48 h); FHB_D = Fermented Brown Hamburger bean flour (72 h)

Table 2: Proximate compostion of fermented/unfermented sweet detar flour

Samples	Protein (%)	Moisture (%)	Crude fat (%)	Crude fibre (%)	Ash (%)	Carbohydrate (%)
USD_A	13.12 ± 0.92^a	5.0 ± 1.0^a	10.0 ± 1.090^a	0.5 ± 0.0^a	1.4 ± 0.26^a	69.98 ± 2.69^a
FSD_B	10.93 ± 0.93^a	4.5 ± 0.5^a	10.20 ± 2.05^a	0.5 ± 0.1^a	0.6 ± 0.10^b	73.09 ± 2.90^a
FSD_C	13.12 ± 3.53^a	5.0 ± 0.0^a	9.60 ± 0.89^a	0.5 ± 0.0^a	0.5 ± 0.10^b	71.20 ± 3.30^a
FSD_D	28.43 ± 2.56^b	5.0 ± 0.0^a	11.2 ± 1.050^a	1.5 ± 0.1^b	0.4 ± 0.10^b	53.47 ± 3.01^b

Valuesare Mean±Standard Deviation from triplicate determinations; values not followed by the same superscript in the same column are significantly different ($p \leq 0.05$); USD_A = Unfermented Sweet Detar flour (0 h); FSD_B = Fermented Sweet Detar flour (24 h); FSD_C = Fermented Sweet Detar flour (48 h); FSD_D = Fermented Sweet Detar flour (72 h)

Table 3: Functional properties of fermented/unfermentedbrown hamburgerbean flour

Samples	Bulk density ($g\ mL^{-1}$)	WAC ($g\ mL^{-1}$)	OAC ($g\ mL^{-1}$)	Viscosity ($N\ m^{-2}$)	Foaming capacity (%)	Emulsification capacity (%)
UHB_A	0.65 ± 0.01^a	4.7 ± 0.06^a	1.19 ± 0.02^a	1440 ± 0.0	13.34 ± 0.29^a	36.09 ± 0.59^a
FHB_B	0.63 ± 0.01^b	5.2 ± 0.10^b	1.01 ± 0.01^b	1440 ± 0.0	9.71 ± 0.23^b	21.18 ± 1.13^b
FHB^C	0.62 ± 0.01^b	5.4 ± 0.87^b	1.01 ± 0.10^b	1440 ± 0.0	8.38 ± 0.44^c	26.27 ± 0.65^c
FHB_D	0.58 ± 0.01^c	5.8 ± 0.10^c	0.90 ± 0.20^b	1440 ± 0.0	6.28 ± 0.26^d	33.21 ± 0.81^d

Values are Mean± Standard Deviation from triplicate determinations; values not followedby the same superscript in the same columnare significantly different ($p \leq 0.05$); UHB_A = Unfermented Brown Hamburger bean flour (0 h); FHB_B = Fermented Brown Hamburger bean flour (24 h); FHB_C = Fermented Brown Hamburger bean flour (48 h); FHB_D = Fermented Brown Hamburger bean flour (72 h); WAC = Water Absorption Capacity; OAC = Oil Absorption Capacity

Table 4: Functional properties of fermented/unfermented sweet detar flour

Samples	Bulk density ($g\ mL^{-1}$)	WAC ($g\ mL^{-1}$)	OAC ($g\ mL^{-1}$)	Viscosity ($N\ m^{-2}$)	Foaming capacity (%)	Emulsification capacity (%)
USD_A	0.82 ± 0.02^a	4.5 ± 0.100^a	2.02 ± 0.02^a	1440 ± 0.0	12.16 ± 0.17^a	34.53 ± 0.45^a
FSD_B	0.78 ± 0.02^b	4.6 ± 0.060^b	1.75 ± 0.03^b	1440 ± 0.0	7.71 ± 0.19^b	27.22 ± 0.23^b
FSD^c	0.73 ± 0.01^c	5.03 ± 0.15^b	1.16 ± 0.04^c	1440 ± 0.0	6.15 ± 0.22^c	30.08 ± 0.17^c
FSD_D	0.67 ± 0.02^d	5.40 ± 0.10^c	0.92 ± 0.02^a	1440 ± 0.0	4.33 ± 0.21^d	30.76 ± 0.20^d

Values are Mean±Standard Deviation from triplicate determinations; values not followedby the same superscript in the same columnare significantly different ($p \leq 0.05$); USD_A = Unfermented Sweet Detar flour (0 h); FSD_B = Fermented Sweet Detar flour (24 h); FSD_C = Fermented Sweet Detar flour (48 h); FSD_D = Fermented Sweet Detar flour (72 h); WAC = Water Absorption Capacity; OAC = Oil Absorption Capacity pigeon pea. This difference may be as a result of lower activity of lipolytic enzymes during the fermentation of *Mucuna sloanei* and *Detarium microcarpum*.

Other reports of functionality of these lesser known legumes include those on protein isolate of *Mucuna cochichinensis* (Udensi and Okoronkwo, 2006) and the study of the starch-hydrocolloids system of *Mucuna sloanei*, *Detarium microcarpum* and *Brachystegia eurycoma* seeds (Uzomah and Odusanya, 2011). Besides fermentation, functional properties of legumes have been reported to be influenced by other processes such as electron bean-irradiation (Bhat *et al*., 2008), germination (Marero *et al*., 1988) and partial proteolysis (Narayana and Narasinga-Rao, 1984).

CONCLUSION

Fermentation of brown hamburger bean (*Mucuna sloanei*) and sweet detar seed (*Detarium microcarpum*) for a period of 72 h showed increase in the protein values of the flours. This indicates that the fermented flours of these underutilized legumes can be used to improve the nutritional qualities of local staples like cereal, roots and tuber flours. The increased water absorption capacity obtained on fermentation suggests that these fermented legumes can be used as ingredients in paste products and also in production of some baked products.

REFERENCES

AOAC, 1995. Official Methods of Analysis. 16th Edn., Association of Official Analytical Chemists, Washington, DC., USA.

Abebowale, O.J. and K. Maliki, 2011. Effect of fermentation period on the chemical composition and functional properties of pigeon pea (*Cajanus cajan*) seed flour. Int. Food Res. J., 18: 1329-1333.

Arinathan, V., V.R. Mohan and A.J. De Britto, 2003. Chemical composition of certain tribal pulses in South India. Int. J. Food Sci. Nutr., 54: 209-217.

Bhat, R., R.R. Sridha, C.C. Young, A.A. Bhagwath and S. Ganesh, 2008. Composition and functional properties of raw and electron bean-irradiated *Mucuna puriens* seeds. Int. J. Food Sci. Tech., 43: 1338-1351.

Enwere, N.J., 1998. Foods of Plant Origin: Processing and Utilization With Recipes and Technology Profiles. Afro-Orbis Publications Ltd., Nsukka, pp: 301.

Marero, L.M., E.M. Payumo, E.C. Librando, W.N. Lainez, M.D. Gopez and D. Homma, 1988. Technology of weaning food formulations prepared from germinated cereals and legumes. J. Food Sci., 53: 1391-1395.

Narayana, K. and M.S. Narasinga-Rao, 1984. Effect of partial proteolysis on the functional properties of winged bean flour. J. Food Sci, 49: 944-947.

Onweluzo, J.C., Z.A. Obanu and M.C. Okwandu, 2004. Potentials of gum from *Detarium microcarpum* (DM) and *Mucuna flagellipes* (MF) seeds as raw beef burger stabilizers. Plant Foods Human Nutr., 59: 137-141.

Onyemelukwe, N.N. and N.J. Enwere, 1992. Characteristics of porridge type Breakfast cereal formulated from soybean and maize. Proceedings of the 16th Annual Conference of Nigerian Institute of Food Science and Technology, October 26-30, 1992, Enugu, Nigeria, pp: 26-30.

Oyarekua, M.A., 2011. Biochemical and micobiological changes during the production of fermented pigeon pea (*Cajanus cajan*) flour. Afr. J. Biotech., 2: 223-231.

Torres, A., J. Frias, M. Granito and C. Vidal-Valverde, 2006. Fermented pigeon pea (*Cajanus cajan*) ingredients in paste products. J. Agric. Food Chem., 54: 6685-6691.

Udensi, E.A. and K.A. Okoronkwo, 2006. Effect of fermentation and germination on the physico-chemical properties of *Mucuna cochichinensis* protein isolate. Afr. J. Biotech., 5: 896-900.

Uzomah, A. and O.S. Odusanya, 2011. *Mucuna sloanei*, *Detarium microcarpum* and *Brachystegia eurycoma* seeds: A preliminary study of their starch-hydrocolloids system. African J. Food Sci., 5: 733-740.