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## Effect of Blanching Prior to Oven-drying on Some Functional Compositions of Bitter Yam (*Dioscorea dumetorum*)

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### ABSTRACT

The study investigated the effect of blanching prior to the traditional method of drying and milling on some functional properties of bitter yam flour. Seven equal parts of cleaned, peeled and sliced bitter yam tubers were respectively blanched in clean water (at 100°C) for 0, 3, 6, 9, 12, 15 and 18 min, dewatered, oven-dried at 50°C and milled, using standard protocols. The peak effect was recorded in the sample blanched for 18 min. The real value range and the peak value relative to the control showed a time independent and non-significant ( $p>0.05$ ) decrease in the bulk density ( $0.55\pm0.00\%$  to  $0.54\pm0.03\%$ ; 1.82%). However, the decrease in the swelling index ( $3.24\pm0.00\%$  to  $2.94\pm0.10\%$ ; 9.26%), water absorption capacity ( $3.14\pm0.00\%$  to  $2.64\pm0.02\%$ ; 15.92%), oil absorption capacity ( $2.17\pm0.01\%$  to  $1.93\pm0.01\%$ ; 11.06%) and foam capacity ( $17.55\pm0.08\%$  to  $16.20\pm0.01\%$ ; 7.69%) and the increase in the pH ( $5.96\pm0.01\%$  to  $6.20\pm0.01\%$ ; 4.02%) were time dependent and significant ( $p<0.05$ ). Thus, blanching as in this study, irrespective of time, significantly reduced most of the functionalities of the resultant bitter yam flour. As discussed, the results may imply that the resultant bitter yam flour could be less acidic, less toxic and less bitter but may neither bulk up nor interact, especially with protein. These warrant further studies, especially on the sensory evaluation and toxic potential of the resultant bitter yam flour.

**Key words:** Blanching, foam capacity, swelling index, pH value, *Dioscorea dumetorum*

### INTRODUCTION

Inadequate food supply in sub-saharan African and the attendant malnutrition problem necessitated researches aimed at finding alternative food supply from available but less utilized food sources (Musieba *et al.*, 2013; Enujiugha and Ayodele-Oni, 2003). Yam (*Dioscorea* spp.) is a food with economic and socio-cultural importance in many tropical countries (Medoua *et al.*, 2005). Yam is of nutritional and economic importance to the people in Nigeria and other West African countries. It is rich in starch and allows many recipes. It is available all year round making it preferable to other unreliable seasonal crops. Bitter yam (*Dioscorea dumetorum*) belongs to the genus *Dioscorea* and family Dioscoreaceae (Bai and Ekanayake, 1998). Ethno-medicinal importance of bitter yam has been suggested (Dike *et al.*, 2012). Bitter yam is rich in phyto-nutrients (Medoua *et al.*, 2005; Alozie *et al.*, 2009), yet it remains underutilized amid potential industrial application (Owuamanam *et al.*, 2013; Ukpabi, 2010; Onuegbu *et al.*, 2011).

The reasons for the limited use of bitter yam include the unpalatable bitter taste and high post harvest hardening of the tubers (Medoua *et al.*, 2005). To prevent the high post harvest hardening, the tubers were dried and milled into flour. This simple processing measure may affect the compositions of the tubers (Nowak and Haslberger, 2000). Ezeocha *et al.* (2012) reported that increased cooking duration improves the nutritional and phytochemical properties of the bitter yam flour. Egbuonu *et al.* (2014) reported that soaking in clean water prior to oven-drying modified the functional properties of the bitter yam flour. Therefore, there is need to assess the effect of other simple processing methods prior to the traditional method of drying and milling on the resultant bitter yam flour. Blanching is a cooking process but unlike ordinary cooking, the food substance is plunged into boiling water and removed after a brief timed interval and 'shocked' by plunging into iced water or cold running water to halt the cooking process. The purposes of blanching (which literary means "to whiten") include removing a strong taste from the food and softening or cooking the food. Applewhite (1989) reported that blanching could enhance tenderization, palatability and nutritional value by inactivating the endogenous toxic factors of foods.

Thus, this study aimed to investigate the effect of blanching in clean water (100°C) over time prior to oven-drying (50°C) on some functional properties of the resultant bitter yam flour. The result from this study may provide basis for further studies aimed at improving the physicochemical properties of the bitter yam flour.

## **MATERIALS AND METHODS**

**Source and preparation of materials:** Bitter yam tubers were purchased randomly from retail sellers at Owerri relief market in Imo State, south-eastern Nigeria. The equipment used including milling machine, weighing balance thermometer, shaker and centrifuge machine, were obtained from the laboratory of Food Science and Technology Department, Federal Polytechnic Nekede Owerri, Imo State. All the chemicals used were of analytical grade.

**Preparation of the bitter yam flour samples:** Damaged tubers could result in loss of nutrients (Adeyeye and Otokiti, 1999). Therefore, wholesome bitter yam tubers were sorted out, cleaned, peeled, sliced with a chipping machine and weighed. The chips were shared into seven equal parts, based on weight. The other parts were, respectively processed by blanching (at 100°C) for 3, 6, 9, 12, 15 and 18 min and then dewatered. All (the seven parts) were separately dried to a constant weight in a moisture extraction oven (Gallenkamp 1H-100) set at 50°C, cooled for 30 min. and milled (in a laboratory mill, Thomas Wiley mill model ED-5) into flour. The separate samples flour was packaged in a properly labeled airtight container prior to analysis (Fig. 1).

**Functional analysis:** The bulk density, oil absorption capacity and water absorption capacity were determined by the methods of Okaka and Porter (1979). The foam capacity was determined by the method of Narayana and Narasinga Rao (1982). The swelling index was determined by the method of Takashi and Sieb (1988) while the pH value was read from a pH meter.

**Statistical analysis:** Collected data was subjected to statistical analysis of variance (ANOVA) with the Statistical Package for Social Sciences (SPSS) for Windows version 16. The Bonferroni *post hoc* test was used to identify the means that differ significantly at  $p < 0.05$ . Results were expressed as Mean  $\pm$  Standard Deviation (SD).

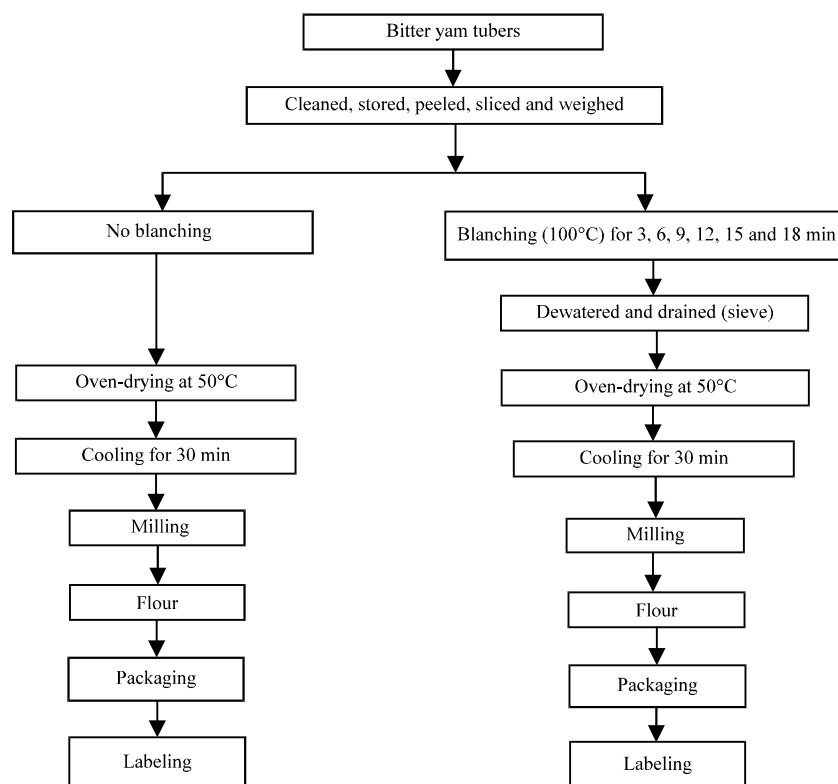


Fig. 1: Schematic diagram for the control and soaked bitter yam flour

## RESULTS

Blanching caused a significant ( $p < 0.05$ ) and time dependent increase in the pH value ( $5.96 \pm 0.01$  to  $6.20 \pm 0.01$ ). This represents a peak increase by 4.02% in the sample blanched for 18 mins relative to control (Fig. 2).

As shown in Fig. 3, the decreased effect of blanching on the bulk density ( $0.55 \pm 0.00$  to  $0.54 \pm 0.03$ ) was neither significant ( $p > 0.05$ ) nor time dependent and the peak effect (18 min) represents a decrease by 1.82% relative to control (0 min).

The decrease in the swelling index ( $3.24 \pm 0.00$  to  $2.94 \pm 0.10$ ) or a peak decrease by 9.26% in the sample blanched for 18 min relative to control, was significant ( $p < 0.05$ ) and time dependent (Fig. 4).

The results show a significant ( $p < 0.05$ ) and time dependent decrease in water absorption capacity ( $3.14 \pm 0.00$  to  $2.64 \pm 0.02$ ), oil absorption capacity ( $2.17 \pm 0.01$  to  $1.93 \pm 0.01$ ) and foam capacity ( $17.55 \pm 0.08$  to  $16.20 \pm 0.01$ ), representing a peak decrease by 15.92, 11.06 and 7.69%, respectively (Table 1).

## DISCUSSION

This study investigated the effect of blanching in water ( $100^\circ\text{C}$ ) over time prior to the traditional method of drying and milling on the pH value, swelling index, bulk density, water, oil and foam capacities of the resultant bitter yam flour. This is because these functional properties may affect food quality, utility and acceptability. In a similar study on the bitter yam flour

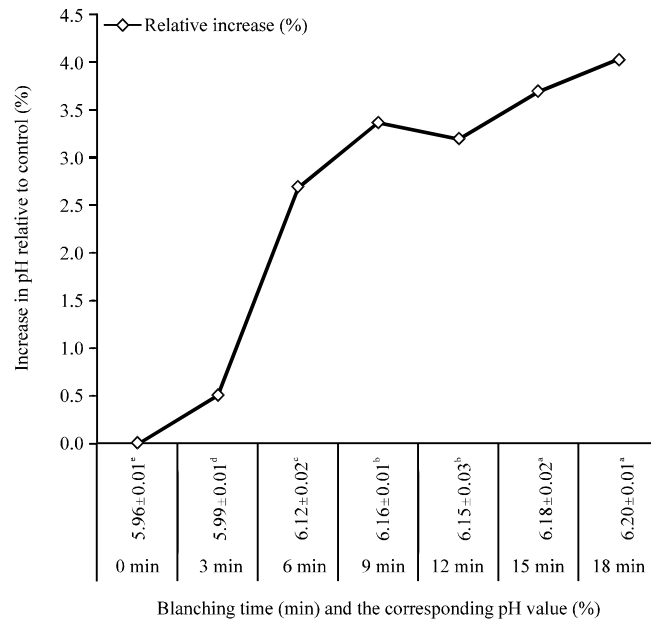


Fig. 2: Effect of blanching on the pH value of the resultant bitter yam flour

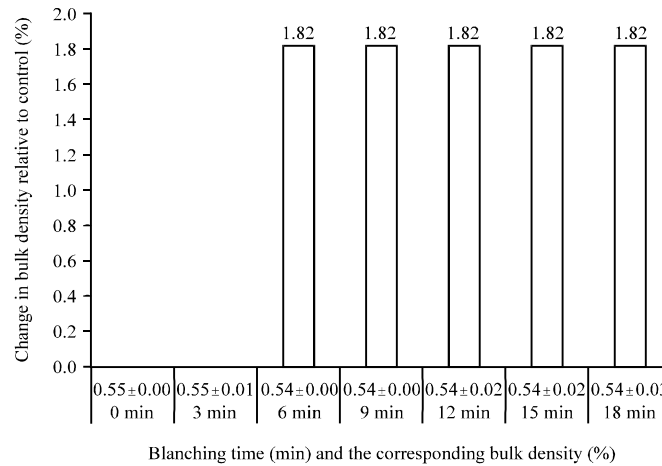


Fig. 3: Effect of blanching on the bulk density of the resultant bitter yam flour

obtained by soaking prior to oven-drying. Egbuonu *et al.* (2014) suggested that some functional properties of the bitter yam flour can be modified by simple processing methods.

The pH value increased ( $p < 0.05$ ) from 5.96-6.20% (from 0-18 min blanching time), implying an increase in the alkalinity or a reduction in the acidity of the bitter yam flour. Blanching temperature (100°C) could result in the vaporization of the volatile fatty acids leading to the present observation. Similar result was reported (Owuamanam *et al.*, 2013). The low acidity implication of the result further suggests reduced toxicity and improved storage capacity of the blanched samples. For these reasons, the bitter yam flour sample blanched for 18 min was the most preferred. Acid value is a measure of the amount of free fatty acids and the extent to decomposition by lipase action (Champe and Harvey, 1994). The decreasing ( $p < 0.05$ ) value in foam capacity with

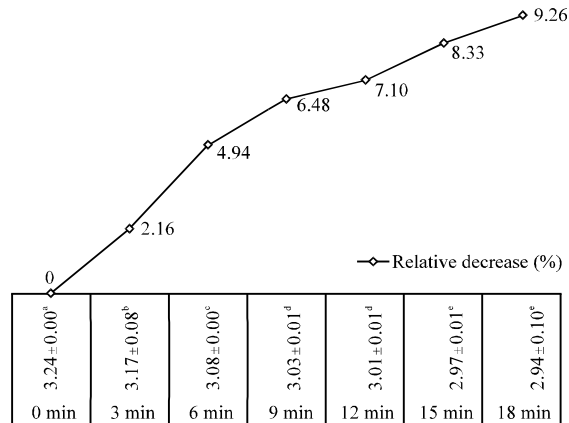


Fig. 4: Effect of blanching on the swelling index of the resultant bitter yam flour

Table 1: Effect of blanching on the water absorption capacity, oil absorption capacity and foam capacity of the resultant bitter yam flour

Blanching time (h)	Water absorption		Oil absorption		Foam capacity (%)	
	capacity (%)	Relative decrease (%)	capacity (%)	Relative decrease (%)	decrease (%)	
0	3.14±0.00 <sup>a</sup>		2.17±0.01 <sup>a</sup>		17.55±0.08 <sup>a</sup>	
3	3.00±0.00 <sup>b</sup>	4.46	2.13±0.00 <sup>b</sup>	1.84	16.80±0.01 <sup>b</sup>	4.27
6	2.98±0.00 <sup>b</sup>	5.10	2.10±0.01 <sup>b</sup>	3.23	16.71±0.01 <sup>b</sup>	4.79
9	2.81±0.00 <sup>c</sup>	10.51	2.08±0.01 <sup>c</sup>	4.15	16.28±0.02 <sup>c</sup>	7.24
12	2.76±0.00 <sup>d</sup>	12.10	1.98±0.01 <sup>d</sup>	8.76	16.25±0.03 <sup>c</sup>	7.41
15	2.69±0.01 <sup>d</sup>	14.33	1.95±0.04 <sup>d</sup>	10.14	16.23±0.01 <sup>d</sup>	7.52
18	2.64±0.02 <sup>e</sup>	15.92	1.93±0.01 <sup>e</sup>	11.06	16.20±0.01 <sup>e</sup>	7.69

Values are Mean±SD of triplicate determinations. Values on the same column with different superscripts means that the difference is statistically significant (p<0.05)

increasing blanching time probably was due to reduction in the acidic content of the blanched samples compared to the control. Adejumo *et al.* (2013) attributed the decrease in foam capacity to a reduction in the acidic content. This does appear to support the present result on pH value that increased (p<0.05) with blanching time, implying reduction in the acidic content.

Bulk density determines packaging requirements and material handling in the food industry (Unuigbo and Ozekhome, 2009) and low bulk density suggests lesser weight and improved handling. The effect of blanching on the bulk density of the bitter yam (Fig. 3) was not-significant (p>0.05) and time independent, hence the observed slight modification could be negligible. The swelling index decreased (p<0.05) from 3.24-2.96% (from the unblanched sample to the sample blanched for 18 min). This implies the reducing exposure of the bitter yam flour to the action of water or its (bitter yam flour) reducing potential to absorb water and bulk up. The observation was contrary to the report that heat treatment over time resulted in increased swelling index of flours (Ikegwu and Ekwu, 2009). Owuamanam *et al.* (2013) reported a significant (p<0.05) increase in the swelling index of bitter yam flour but the processing method involved steeping and boiling in varying concentration of trona solution. Processing time affects swelling (Iwe, 2003) which may explain the difference in the swelling capacity of the bitter yam flour at different blanching times. However, the difference between 9 min (3.03±0.01%) and 12 min (3.01±0.01%) or 15 min

( $2.97 \pm 0.01\%$ ) and 18 min ( $2.94 \pm 0.10\%$ ) was not statistically significant ( $p > 0.05$ ), suggesting that a wider range of blanching time is required to achieve a significant difference in the swelling index of the resultant bitter yam flour.

Usually, heat induces increased water absorption in foods (Onimawo and Akubor, 2005; Etudaiye *et al.*, 2009). Thus, the decrease ( $p < 0.05$ ) in water absorption capacity (from 3.14 to 2.64%) observed in this study was not expected. It could be that the heat generated within the blanching time range in this study did not favor the increase in water absorption capacity. The decrease in the water absorption capacity contradicts the significant ( $p < 0.05$ ) increase reported by Owuamanam *et al.* (2013) but the bitter yam flour was processed by steeping and boiling in varying concentration of trona solution. Nevertheless, the result supports that of this study on swelling index, which implied the reduced potential of the bitter yam flour to absorb water. Furthermore, low water absorption capacity indicated compactness of the molecular structure of food (Sanni *et al.*, 2006) which does seem to support the decreased bulk density result of this study. The significant ( $p < 0.05$ ) and time dependent decrease in water absorption capacity is a major limitation on the potential use of the resultant bitter yam flour for bread making and, in aqueous formulations, may further limit protein incorporation as suggested by Enujiugha (2003).

The oil absorption capacity decreased ( $p < 0.05$ ) from 2.17-1.93% (unblanched to the sample blanched for 18 min). This is contrary to the increase reported by Padmashree *et al.* (1987), although in cowpea but is in agreement with the decrease reported by Owuamanam *et al.* (2013) in bitter yam flour processed by steeping and boiling in varying concentration of trona solution. Oil absorption capacity indicates the food potential to retain flavor and to increase the mouth feel (Kinsella and Melachouris, 1976; Hutton and Campbell, 1981; Udensi and Iwe, 2009). Therefore bitter yam flour obtained by blanching may have a low degree of flavor retention and mouth feel as suggested by Ikegwu and Ekwu (2009). This may as well reduce the characteristic 'bitter taste' of the bitter yam, which is among the reasons for the limited use of bitter yam (Medoua *et al.*, 2005).

Thus, blanching as in this study, irrespective of time, significantly reduced most of the functionalities of the resultant bitter yam flour. As discussed, the results may imply that the resultant bitter yam flour could be less acidic, less toxic and less bitter but may neither bulk up nor interact, especially with protein for possible industrial utilization. These warrant further studies, especially on the sensory evaluation and toxic potential of the resultant bitter yam flour.

## REFERENCES

- Adejumo, B.A., R.O. Okundare, O.I. Afolayan and S.A. Balogun, 2013. Quality attributes of yam flour (Elubo) as affected by blanching water temperature and soaking time. *Int. J. Eng. Sci.*, 2: 216-221.
- Adeyeye, E.I. and M.K.O. Otokiti, 1999. Proximate composition and some nutritionally valuable minerals of two varieties of *Capsicum annum* (Bell and Cherry peppers). *Discovery Innov.*, 11: 75-81.
- Alozie, Y., M.I. Akpanabiatu, E.U. Eyong, I.B. Umoh and G. Alozie, 2009. Amino acid composition of *Dioscorea dumetorum* varieties. *Pak. J. Nutr.*, 8: 103-105.
- Applewhite, T.H., 1989. Proceedings of the World Congress on Vegetable Protein Utilization in Human Foods and Animal Feedstuffs. The American Oil Chemists Society, USA., ISBN-13: 9780935315257, pp: 125-189.

- Bai, K.V. and I.J. Ekanayake, 1998. Taxonomy, Morphology and Floral Biology. In: Food Yams: Advances in Research, Orkwor, G., R. Asiedu and I.J. Ekanayake (Eds.). IITA/NRCRI, Nigeria Co-Publication, Umudike, Nigeria, pp: 13-37.
- Champe, P.C. and R.A. Harvey, 1994. Lippincott's Illustrated Reviews: Biochemistry. 2nd Edn., Lippincott, Philadelphia, USA., pp: 150-360.
- Dike, I.P., O.O. Obembe and E.F. Adebisi, 2012. Ethnobotanical survey for potential anti-malarial plants in South-Western Nigeria. J. Ethnopharmacol., 144: 618-626.
- Egbonu, A.C.C., D.C. Nzewi and O.N.C. Egbonu, 2014. Functional properties of bitter yam (*Dioscorea dumetorum*) as influenced by soaking prior to oven-drying. Am. J. Food Technol., 9: 97-103.
- Enujiugha, V.N. and O. Ayodele-Oni, 2003. Evaluation of nutrients and some anti-nutrients in lesser-known, underutilized oilseeds. Int. J. Food Sci. Technol., 38: 525-528.
- Enujiugha, V.N., 2003. Chemical and functional characteristics of conophor nut. Pak. J. Nutr., 2: 335-338.
- Etudaiye, H.A., T. Nwabueze and L.O. Sanni, 2009. Pasting and functional properties of processed fufu from cassava mosaic disease-resistant varieties cultivated in a high rainfall zone. Niger. Food J., 27: 185-193.
- Ezeocha, V.C., P.C. Ojimelukwe and G.I. Onwuka, 2012. Effect of cooking on the nutritional and phytochemical components of trifoliate yam (*Dioscorea dumetorum*). Global Adv. Res. J. Biochem. Bioinform., 1: 26-30.
- Hutton, C.W. and A.M. Campbell, 1981. Water and Fat Absorption. In: Protein Functionality in Foods, Cherry, J.P. (Ed.). American Chemical Society, Washington, D.C., pp: 177-200.
- Ikegwu, O.J. and F.C. Ekwu, 2009. Effect of processing time on Rheological and functional properties of achi flour as influenced by processing time. Niger. Food J., 27: 88-95.
- Iwe, M.O., 2003. The Science and Technology of Soybean: Chemistry, Nutrition, Processing and Utilization. Rejoint Communication Services Limited, Nigeria, pp: 123-128.
- Kinsella, J.E. and N. Melachouris, 1976. Functional properties of proteins in foods: A survey. Crit. Rev. Food Sci. Nutr., 7: 219-280.
- Medoua, G.N., I.L. Mbome, T. Agbor-Egbe and C.M.F. Mbofung, 2005. Study of the hard-to-cook property of stored yam tubers (*Dioscorea dumetorum*) and some determining biochemical factors. Food Res. Int., 38: 143-149.
- Musieba, F., S. Okoth, R.K. Mibey, S. Wanjiku and K. Moraa, 2013. Proximate composition, amino acids and vitamins profile of *Pleurotus citrinopileatus* singer: An indigenous mushroom in Kenya. Am. J. Food Technol., 8: 200-206.
- Narayana, K. and M.S. Narasinga Rao, 1982. Functional properties of raw and heat processed winged bean (*Psophocarpus tetragonolobus*) flour. J. Food Sci., 47: 1534-1538.
- Nowak, W.K. and A.G. Haslberger, 2000. Food and chemical toxicology. Institute for Nutritional Science, University of Vienna, Athanstrasse, Vienna Austria, pp: 473-483.
- Okaka, J.C. and N.N. Potter, 1979. Physico-chemical and functional properties of cowpea powders processed to reduce beany flavor. J. Food Sci., 44: 1235-1240.
- Onimawo, A.I. and P.I. Akubor, 2005. Food Chemistry: Intergrated Approach with Biochemical Background. 1st Edn., AMDIK Press Ltd., Bennis City, Edo State, pp: 193-224.
- Onuegbu, N.C., C.I. Iwuoha, C.I. Owuamanam and N.C. Ihediohanma, 2011. Effects of boiling solution (trona) concentration and time on the proximate composition and physico-chemical properties of flour from three-leaved yam (*Dioscorea dumetorum* pax) tubers. Afr. J. Food Sci., 5: 1-5.



- Owuamanam, C.I., C.I. Iwuoha, N.C. Onuegbu, C.C. Ogueke and J.N. Nwosu, 2013. Quality characteristics of processed flours from trifoliate yam (*Dioscorea dumetorum*) as influenced by steeping and boiling in varying concentration of trona solution over time. *Am. J. Food Technol.*, 8: 162-172.
- Padmashree, T.S., L. Vijayalakshmi and S. Puttaraj, 1987. Effect of traditional processing on the functional properties of cowpea (*Vigna cajan*) flour. *J. Food Sci. Technol.*, 24: 221-225.
- Sanni, O.L., A.A. Adebewale, T.A. Filani, O.B. Oyewole and A. Westby, 2006. Quality of flash and rotary dried fufu flour. *J. Food Agric. Environ.*, 4: 74-78.
- Takashi, S. and P.A. Sieb, 1988. Paste and gel properties of prime corn and wheat starches with and without native lipids. *J. Cereal Chem.*, 65: 474-483.
- Udensi, E.A. and M.O. Iwe, 2009. Functional properties of pigeon pea (*Cajanus cajan*) predicted using response surface methodology. *Nig. Food J.*, 27: 194-203.
- Ukpabi, U.J., 2010. Farmstead bread making potential of lesser yam (*Dioscorea esculanta*) flour in Nigeria. *Aust. J. Crop Sci.*, 4: 68-73.
- Unuigbo, O.M. and M.C. Ozekhome, 2009. Comparative quality assessment of flour from sun-dried and heated air-dried green banana (*Musa sapientum*) and plantain (*Musa paradisiacal*). *Niger. Food J.*, 27: 114-118.