American Journal of Food Science and Technology, 2015, Vol. 3, No. 6, 145-149
Available online at http://pubs.sciepub.com/ajfst/3/6/1

DOI:10.12691/ajfst-3-6-1

Some Quality and Micro-structural Characteristics of Soup Enriched with Debittered *Moringa Oleifera* Seeds Flour

Radha C.[1], Ogunsina B.S.[2,*], Hebina Babu K.T.[1]

[1]Department of Protein Chemistry & Technology, Central Food Technological Research Institute, Mysore, India
[2]Department of Agricultural & Environmental Engineering, Obafemi Awolowo University, Ile Ife, Nigeria
*Corresponding author: babatundeogunsina@gmail.com

Abstract Soup enriched with debittered moringa seeds flour (DBMS) was investigated for its quality and micro-structural characteristics following appropriate standard procedures reported in literatures. The results showed that soup sample enriched with 0.5% of DBMS had the highest overall sensory score for acceptability and its protein content was 4 g/100 g more than that of the control. Scanning electron micrographs showed soup sample enriched with DBMS as a dense, continuous agglomerated protein strands of irregular sizes and shapes. As the addition of DBMS increased, the viscosity and the body of the soup increased; the lightness "L" colour value of the soup reduced and the total colour difference (ΔE) increased. Enrichment of soup with DBMS promotes the use of moringa seeds as a protein ingredient; especially in the tropics where it is fast gaining acceptance as human food.

Keywords: *soup, debittered moringa seeds, microstructure, sensory properties*

Cite This Article: Radha C., Ogunsina B.S., and Hebina Babu K.T., "Some Quality and Micro-structural Characteristics of Soup Enriched with Debittered *Moringa Oleifera* Seeds Flour." *American Journal of Food Science and Technology*, vol. 3, no. 6 (2015): 145-149. doi: 10.12691/ajfst-3-6-1.

1. Introduction

Awareness regarding the consumption of moringa products as food and nutriceutical keeps spreading in the tropics [1,2,3]. India leads the world's moringa seeds production with about 1.3 million metric tonnes produced over 380 km² land area. Major producing areas are in Andhra Pradesh, Karnataka and Tamil Nadu States [4]. Virtually all parts of moringa plant, from the leaves and flowers to the immature pods and kernels have been found useful for different industrial, medicinal and food purposes. In India, Thailand and the Philippines, moringa tree is commonly grown in home gardens and the leaves and immature pods are sold in the local markets as soup ingredient [5]. The oldest known use of moringa seeds flour is as substitute for aluminium sulphate (alum) in domestic water clarification [6]. The leaves have been explored as a feedstock for biogas production, organic manure, bio-pesticide and livestock feeds [5,6,7]. Moringa leaves and seeds are particularly rich in tocopherols, ß-carotene, proteins, vitamins, minerals and essential sulfur amino acids which are rarely found in daily diets [5,8,9]. On the other hand, Ferreira *et al.* [10] associated the long lasting bitter and sugary taste of moringa seeds to the presence of alkaloids, saponins, cyanogenic glucosides and glucosinolates. On this note, Ogunsina and Radha [11] successfully documented a non-chemical heat-assisted process for debittering and detoxifying moringa seeds and compared the functional properties of defatted and debittered moringa seeds flour with that of defatted soybean flour. The study revealed that debittered moringa seeds flour shows higher emulsification, foaming and gelation properties than soybean. Oliveira *et al.* [9] and Vasconcelos *et al.* [12] also found that the lipid content of moringa seed is higher than that of soybean and the oleic acid-rich moringa seed oil compares favourably with olive oil in terms of thermal, frying and oxidative stability [13]. In another baseline study, Ogunsina [14] found that debittered and roasted moringa kernels have a peanut-like aroma and taste. An investigation of the physicochemical and functional properties of full fat and defatted moringa kernels flour showed that it is a good source of vegetable protein for functional food products [8]. Consequently, Ogunsina *et al.* [15] studied the quality characteristics of bread and cookies enriched with debittered *Moringa oliefera* seeds flour (DBMS). It was found that bread with 10% DBMS flour and cookies with 20% DBMS grits had more protein, iron and calcium. It was submitted that incorporating moringa seeds in baked food products is a means of boosting nutrition in Africa and Asia where moringa is largely grown and malnutrition is prevalent [15]. Based on the foregoing, it is expected that future demand for moringa products will continue to increase in many regions of the world [7].

The preparation and consumption of soup as human food accompaniment must have begun around the time cooking of foods was invented [16]. A soup is typically prepared as a concoction of ingredients including pepper, tomatoes, onions, meat/fish, seasonings, spices and vegetables combined with other liquids or slurries; cooked together until an acceptable consistency, blend and desired taste are achieved. Sometimes, grain cereal or oilseed flours, potatoes and other additives are added as thickeners to improve the soup body; depending on the desired end product. Although, soup is a choice delicacy virtually everywhere; the recipe varies from place to place; depending on regional/traditional food habits, taste and local availability of specific ingredients [17]. Generally, the process of preparing a delicious soup is time consuming, laborious and painstaking; hence, semi-processed soup mix/powders have gained worldwide recognition in fast cookery. Being a liquid-food (usually served warm), a good soup powder should be re-hydratable and cookable within minimum time, retaining nutrients and palatability almost similar to the freshly cooked product [18].

New trends in food science now makes soup available in pre-processed form; as canned or dehydrated products permitting the inclusion of medicinal herbs, spices and adjustment of nutrients to meet specific dietary needs [17,19]. Soup mixes have been developed for a number of food products including: dika kernels; fish, moringa leaves; vegetables and mushroom [7,16,18,20,21,22,23]. In addition, groundnut, soybean, cowpea and crayfish soup powder are popularly eaten in Nigeria and other countries in the sub-Sahara region. In Asia and Middle East, cashew, almonds and pitachio are popularly used as food garnish, but hitherto there is no such information regarding moringa seeds. Given the growing awareness about the nutritional benefits of moringa seeds, this work investigates the microstructural and some quality characteristics of soup enriched with debittered *Moringa oleifera* seeds flour.

2. Materials and Methods

2.1. Sample Preparation

Dry *Moringa oleifera* seeds, Onion, carrot, ginger, garlic, green chilly, coriander leaves, pepper powder, seasoning and sodium chloride (Merck Co., Mumbai India) were purchased from Mysore market, Karnataka, India. The soup recipe was in accordance with a traditional method of curry preparation in Mysore, Karnataka, India. *Moringa oleifera* seeds were defatted, debittered, dried and powdered according to the method of Ogunsina and Radha [11] to obtain debittered moringa seed flour (DBMS). The ingredients: carrot, 14 g; onion, 24 g; green chilly, 2 g; coriander leaves, 6 g; powder pepper, 1 g; ginger, 1 g and garlic, 1.6 g were washed and chopped into small pieces and allowed to season for 2-3 mins. Debittered moringa seeds flour varied at 0, 0.5 and 1.0% w/w levels was added as pre-gelatinized solution and boiling continued for 5-7 mins until the desired consistency was reached. The soup samples were garnished with additional chopped coriander leaves and about 5 ml of vinegar was added to the preparation and it was stirred properly. The soup samples were dried at 50-55°C for 2 days in a cabinet drier; and afterwards, powdered by dry-milling in a kitchen blender to obtain instant soup mix [24]. Each soup mix sample was reconstituted in boiling water (1:100 w/v) and allowed to simmer for about 2 mins. The entire procedure may be summarized as shown in Figure 1.

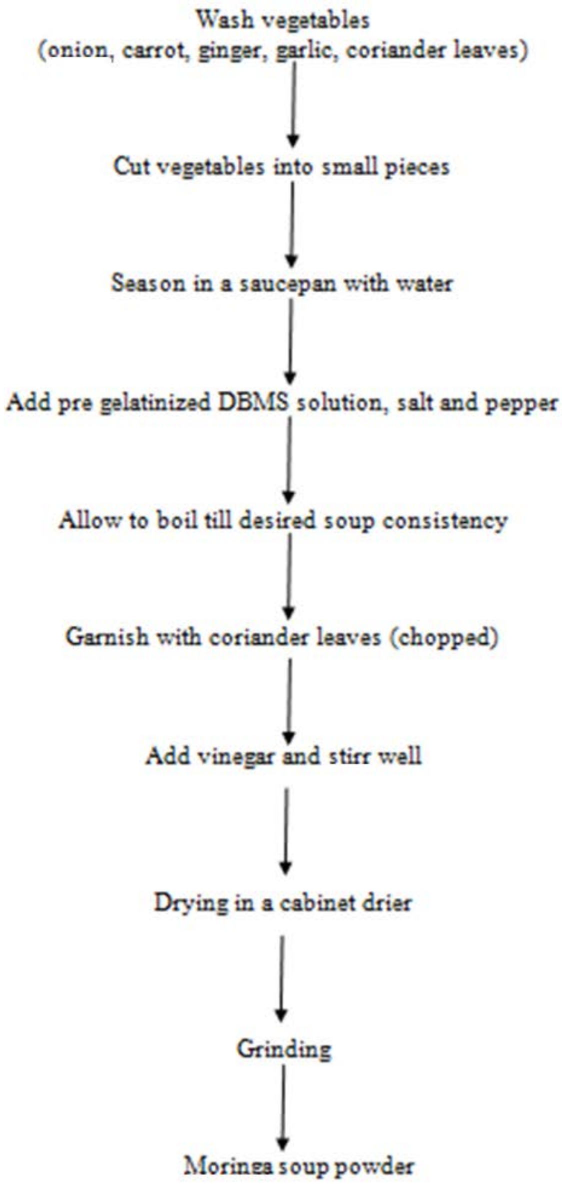

Figure 1. Procedure for preparing soup enriched with debittered moringa seeds flour

2.2. Protein Estimation

Percent nitrogen was estimated by micro-Kjeldhal method using an automated nitrogen distiller and protein content was calculated by multiplying the nitrogen value with 6.25. Determinations were carried out in Triplicates.

2.3. Sensory Evaluation

The soup samples were subjected to sensory evaluation by a taste panel of 20 people. The panelists have no prejudice against any specific food product. At the time of evaluation, soup samples were served in glazed china plates labeled with three-digit random codes and panelists were provided with distilled water to clean their mouth between samples. The order of serving of the soup samples was randomized so that bias due to the sequence of presentation was minimized. Twelve volunteers were screened and chosen as panelists based on their ability to identify the six basic tastes: sour, bitter, salty, pepper, onion, garlic and bitter. The panelists gave remarks about each sample; especially, considering colour, appearance, body and overall acceptability. A balanced 10-point hedonic rating was employed for all the attributes with 9–10 denoting “like very much”, 7-8 “like”, 5-6 “neutral”, 3-4 “dislike”, and 1-2 indicated “dislike very much.” The booth area was under white fluorescent lighting at a temperature and relative humidity of 22±2°C and 50±5% respectively. The typical attributes for the soup samples were earlier identified in a preliminary session to profiling.

2.4. Scanning Electron Microscopy

The microstructural characteristics of the soup mix samples were studied by scanning electron microscopy. Scanning electron micrographs were taken using a scanning electron microscope (LEO 435 VP, Cambridge, UK). Dried and powdered soup samples were coated with gold using poloron coating system E-5000 within 2–3 min. The coating thickness was calculated as 200–300 nm, using the formula: $T = 7.5I\,t$, where I = current (mA), t = time (min), T = thickness (A°). The coated samples were transferred to the microscope where it was viewed at 15 kV and 9.75×10^{-5}torr using secondary electron image. A 35 mm Ricoh Camera (LEO 435 VP, Operator Manual Version V2.04) was used to capture the image.

2.5. Viscosity

Viscosity was determined using a viscometer (Model R1:3:M-3, Rheology International Ltd., Shannon, Ireland). About 80 mL of soup sample was filled into the 100 mL sample adaptor and the ASTM spindle size number 3 attached to the viscometer was immersed into the soup to the marked portion. Viscosity was measured at 100 rpm rotor speed under ambient temperature conditions (26±2 °C) and expressed as m.Pa.S.

2.6. Colour

Colour measurement of flour samples was carried out using a Labscan XE colour meter (Hunter Associates Lab. Inc., Reston, VA). Approximately 100 ml of each soup sample was served in a small glass bowl each with flat glass cover to provide uniform flat surface. The colour parameters measured were lightness (L), redness (+a), greenness (a), yellowness (+b) and blueness (-b). A white tile of known L, a, and b values were used as standard. Total colour difference (ΔE) was estimated using the following equation $\Delta E = (\Delta L^2 + \Delta a^2 + \Delta b^2)^{1/2}$ where ΔL, Δa and Δb were the respective differences between the standard plate.

3. Results and Discussion

The results show that the protein content of DBMS flour was about 45.22 g/100 g and that of the soup increased from 0.3 g/100 g, for the control; to 4 g/100 g, for soup sample S2 which was enriched with 0.5% DBMS. In India, the consumption of vegetable proteins in different food systems is very crucial because the population is largely vegetarian. Hitherto, soups and curries enriched with vegetable proteins are widely accepted as delicacies in different parts of the world and have been a proven way of enriching the diet of a teeming population of malnourished people. Instant soup mixes are popular among busy wives, restaurants and eateries around the world especially because it largely reduces problems associated with bulk handling during processing and the product has longer shelf life than liquid soup preparations. The utilization of a high protein seed such as moringa as a soup ingredient is a way of boosting the nutritional status of the low income group in Asia, Africa, Latin America where moringa has found favourable conditions for growth. The rapidly changing food habits in the tropics and emerging trends in the consumption of underutilized protein seeds complements the global drive towards ensuring that the world’s poorest people are no longer malnourished [25].

The scanning electron micrographs of the flour samples are shown in Figure 2. Soup sample enriched with 0.5% DBMS shows a dense continuous agglomerated protein matrices of irregular sizes and shapes, whereas the control shows particles separated by large air vacuoles. Ogunsina and Radha [11] earlier submitted that the hydrothermal process involved in debittering may be associated with the increase in inter-protein bonding between the particles; because processing of proteins by moist heat can cause aggregation of particles. The relationship between structure and function in foods has long been studied by scanning electron microscopy. It is known that the microstructural characteristics of a particular food material are often linked with its texture, rheology, flavor, appearance and stability.

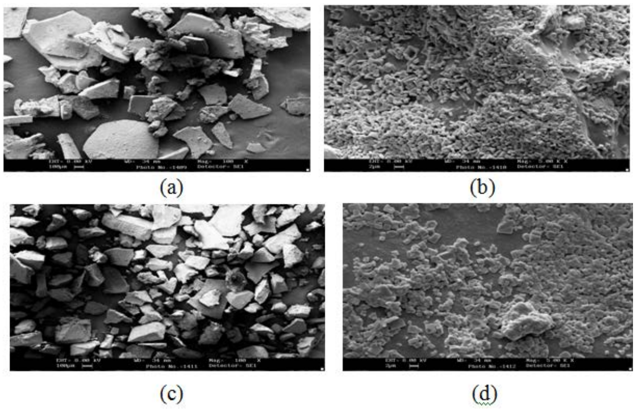

Figure 2. Scanning Electron Micrographs (SEM) of soup samples

LEO 435 VP, Cambridge model scanning electron microscope was used.
(a): SEM Soup (control) at cross section in1000X;
(b): SEM of Soup (control) at cross section in 500X
(c): SEM of Soup incorporated with 0.5% DBMS at cross section in 1000X and
(d): SEM of Soup incorporated with 0.5% DBMS at cross section in 500X

The results of sensory analysis of the soup samples are shown in Figure 3. The soup colours were generally buff, but the shade in S1 was lighter than that of S2 and S3. However, the buff colour increased as the addition of DBMS increased. The body of the soup samples also increased progressively from 6.7 to 8.6 as the incorporation of DBMS increased, making S3 thicker than the other two samples. This behaviour is further substantiated by the viscosity values of 273.5, 311.3 and 407 mPa.S which were obtained for S1, S2 and S3 respectively. It shows a progressive increase in viscosity as the incorporation of DBMS powder increased. Though the viscosity of a soup is often associated with the amount and quality of ingredients (with or without thickener), it measures the internal friction of the soup or its tendency to resist flow. The relationship between viscosity and shear rate is used for classifying foods as newtonian, non-newtonian, pseudoplastic or thixotropic. This finds relevance in food processing, quality control and sensory studies (26, 27); although organoleptic properties are largely a matter of personal perception and cannot be properly determined with analytical instruments.

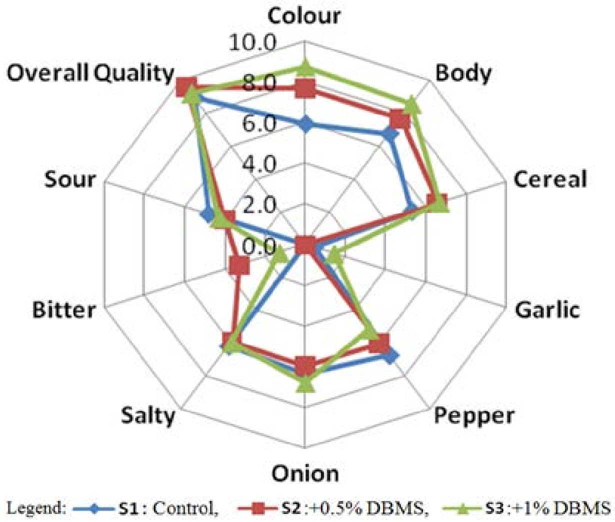

Figure 3. Sensory profile of soup samples

The three soup samples show an almost equal score for sourness and saltiness; although the score for S2 was lower and differs significantly (p≤0.05) from that of S1 and S3. It was further observed that the soup samples became less peppery as the incorporation of DBMS increased, showing soup sample S3 as the least peppery. Overall acceptability scores were 9, 9.2 and 9.6 for S1, S2 and S3 respectively; showing soup sample S2 as the most acceptable.

The hunter colour values of the soup samples were significantly different (p≤0.05) (Table 1). The total colour values (ΔE) of the samples were observed to increase as the incorporation of DBMS increased; showing significant differences (p<0.05). The lightness (L value) of soup S1 differs significantly (52.74) from that of S2 (45.73) and S3 (42.58). Higher "L" value observed for S1 indicates that it is lighter than the other two samples. This was also reflected in the sensory score which indicated a lighter shade of buff color for S1 than the other two samples. The value "a" which indicates redness was indicated for S2 and S3, whereas S1 showed a trace of greenness (-a). The value "b" which indicates yellowness was however found to be more for S2 and S3 compared to S1.

Table 1. Effect of incorporation of DBMS on the colour of moringa soup

Sample	L	a	b	ΔE
S1	52.74^{c}	-0.32^{a}	12.31^{a}	45.78^{a}
S2	45.73^{b}	3.69^{c}	18.12^{c}	53.06^{b}
S3	42.58^{a}	1.9^{b}	15.78^{b}	55.59^{c}

S1-Control; S2-0.5% of DBMS added; S3-1% of DBMS added
Values on the same column followed by different superscript letters are significantly different (p≤0.05). The colour parameters measured were lightness (L), redness (+a), greenness (a), yellowness (+b) and blueness (-b). A white tile of known L, a, and b values was used as standard. Total colour difference was estimated as: $\Delta E = (\Delta L^2 + \Delta a^2 + \Delta b^2)^{1/2}$ where ΔL, Δa and Δb were the respective differences between the standard plates.

4. Conclusions

Incorporating DBMS affects the quality and microstructural characteristics of moringa soup. The best overall acceptability was obtained at 0.5% optimal level of incorporation. Soup enriched with DBMS flour soup is richer in protein. Preparation of a DBMS enriched soup mix with acceptable sensory attributes is a means of promoting the consumption of moringa seeds as a valuable but underutilized protein resource.

Acknowledgements

Dr B.S. Ogunsina acknowledges the Fellowship of United Nations University from which interest to work on *Moringa oleifera* seeds emanated and the entire Management and Staff of Central Food Technological Research Institute (CFTRI), Mysore, India where the work was carried out.

References

[1] Fahey. J.W. (2005). *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic and prophylactic properties. Part 1. Trees for Life Journal. http://www.tfljournal.org/article.php/20051201124931586. Accessed on January 4, 2014.

[2] Mehta, L.K., Balaraman, R., Amin, A.H., Bafna, P.A., Gulati, O.D. (2003). Effect of fruits of *Moringa oleifera* on the lipid profile of normal and hypercholesterolaemic rabbits. *Journal Ethnopharmacology*, 86(2-3), 191-195.

[3] Gilani, A.H., Aftab, K., Suria, A., Siddiqui, S., Salem, R., Siddiqui B.S. (1994). Pharmacological studies on hypotensive and spasmolytic activities of pure compounds from *Moringa oleifera*. *Phytotherapy Research*, 8(2), 87-91.

[4] Rajangam, J., Azahakia-Manavalan, R.S., Thangaraj, T., Vijayakumar, A. and Muthukrishan, N. (2001). Status of Production and Utilisation of Moringa in Southern India; International Conference on Development Potential for Moringa products; October 29th - November 2nd, Dar Es Salaam, Tanzania www.Moringanews.org/actes/rajangam_en.doc. Accessed January 4, 2014.

[5] Foidl, N., Makkar, H.P.S., and Becker, K. (2001). The potential of *Moringa oleifera* for agricultural and industrial uses. In: The Miracle Tree/The Multiple Attributes of Moringa (Ed. Lowell J Fuglie) CTA. USA. http://miracletrees.org/moringa.doc/the_potential_of_moringa_oleifera_for_agricultural_and_industrial_uses.pdf. Accessed on March 11, 2014.

[6] Siddhuraju, P. and Becker, K. (2003). Antioxidant properties of various solvent extracts of total phenolic constituents from three different agro-climatic origins of drumstick tree (*Moringa oleifera* Lam) leaves. *Journal of Agriculture and Food Chemistry*, 51(8), 2144-2155.

[7] Singh, H.P. (2011). Exploring R and D potential of moringa for nutrition and health care. *Indian Horticulture*, 56(1), 3-8.

[8] Ogunsina, B.S; Radha, C and Govardhan Singh, R.S. (2010). Physico-chemical and functional properties of full fat and defatted *Moringa oleifera* kernel flours. *International Journal of Food Science and Technology*, 45, 2433-2439.

[9] Oliveira, J.T.A., Silveira, S.B., Vasconcelos, K.M., Cavada, B.S., Moreira, R.A. (1999). Compositional and nutritional attributes of seeds from the multiple purpose tree - *Moringa oleifera* Lamarck. *Journal Science of Food and Agriculture*, 79(6), 815-20.

[10] Ferreira, P.M.P., Farias, D.F., Oliveira, J.T.A. and Carvalho, A.F.U. (2008). *Moringa oleifera*: Bioactive compounds and nutritional potential. *Revista de Nutrição*, 21(4), 431-437.

[11] Ogunsina, B.S. and Radha, C. (2010). A Comparative study of the functional and physico-chemical properties of debittered Moringa oleifera seeds and soybeans flours. *Ife Journal of Technology*, 19(1), 85-92.

[12] Vasconcelos, I.M., Maia, A.A.B., Siebra, E.A., Oliveira, J.T.A., Carvalho, A.F.F.U. and Melo, V.M.M. (2001). Nutritional study of two Brazilian soybean (*Glycine max*) cultivars differing in the contents of antinutritional and toxic proteins. *Journal of Nutrition and Biochemistry,* 12(1), 55-62.

[13] Ogunsina, B.S., Indira, T.N., Bhatnagar, A.S., Radha, C., Sukumar, D. and Gopalakrishna, A.G. (2014). Quality characteristics and stability of Moringa oleifera seed oil of Indian origin. *Journal of Food Science and Technology*, 51(3), 503-510.

[14] Ogunsina, B.S. (2009). Value addition to drumstick (*Moringa oleifera*) seeds using various adaptable technologies. A report of the United Nations University's Research fellowship Undertaken at Central Food Technological Research Institute, Mysore, India . pp 78.

[15] Ogunsina, B.S., Radha, C. and Indrani, D. (2011). Quality characteristics of bread and cookies enriched with debittered *Moringa oliefera* seed flour. *International Journal of Food Science and Nutrition*, 62(2), 185-194.

[16] Rahman, M. A. Saifullah, M. and Islam, M. N. (2012). Fish powder in instant fish soup mix. *Journal of Bangladesh Agricultural University*, 10(1), 145-148.

[17] Dalby, A. (2003). *Food in the Ancient World from A-Z.* Routledge, London pp307. www.foodtimeline.org/foodsoups.html. Accessed on July 18, 2015.

[18] Abeysinghe, C.P. and Illeperuma, C.K. (2006). Formulation of an MSG (Monosodiul Glutamate) free instant vegetable soup. *Journal of Natural Science Foundation,* 34(2), 91-95.

[19] Toussaint-Samat, M. (1992). *Food in History Barnes and Noble Books*. New York pp177. www.foodtimeline.org/foodsoups.html. Accessed on July 18, 2015

[20] Bamidele, O.P., Ojedokun, O.S. and Fasogbon, B.M. (2015). Physico-chemical properties of instant *ogbono* (*Irvingia gabonensis)* mix powder. *Food Science and Nutrition*, 3(4), 313-318,

[21] Wartha, G.C., Sharangdhar, S.T., Koli, J.M., Metar, S.Y. and Sharangdhar, M.T. (2013). Preparation of fish soup powder from tilapia fish. *Ecology, Environment and Conservation Paper,* 19(2), 425-428.

[22] Chandramouli, P., Divya, V.S., Bharathi; Sivakami, A.; Bharathiraja, B., Jayamuthunagai, J. (2012). Standardisation and nutritional analysis of soup powder prepared from *Moringa oleifera, Solanum trilobatum and Centella asiatica. International Journal of Future Biotechnology,* 1(1), 1-16.

[23] Abdel-Haleem, A.M.H. and Omran, A.A. (2014). Preparation of dried vegetarian soup supplemented with some legumes. *Food and Nutrition Sciences*, 5, 2274-2285.

[24] Warang, M. D., Mulye, V. B., Sapkale, P. H., Bondre, R. D. and Mohite, A. S., (2008). Fish soup powder production from *Protonibea diacanthus. The Asian Journal of Animal Science,* 3(1), 20.

[25] Charles, H., Godfray, J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M. and Toulmin C. (2010). Food Security: The challenge of feeding 9 billion people. *Science*, 327, 812-818.

[26] Fellows, P. (2000). *Processing Technology Principles and Practice*. 2nd Edition, Woodhead Publishing Limited and CRC Press LLC, Washington DC. Pp 98.

[27] Ibanoglu, S. and Ibanoglu, E. (1998). Rheological characterization of some traditional turkish soups. *Journal of Food Engineering*, 35, 251-256.