Elemental Composition and Proximate Analysis of Shea Butter Sold in Swali Market, Yenagoa, Nigeria

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Abstract—This study evaluates the elemental and proximate composition of Shea butter sold in Swali market Yenagoa, Bayelsa State, Nigeria. Proximate analysis was carried out using standard method of AOAC (2005) while elemental analysis was determined using Atomic Absorption Spectrophotometer and Flame photometer. The proximate values were: Moisture (5.22±0.113 %), Crude fibre (0.111±0.001%), Crude Protein (42.316±0.000%), Crude fat (97.000±0.000%), Ash content (0.084±0.006%), Carbohydrate (34.096±0.011%). Results of the elemental analysis (mg/100g) showed that Sodium, Potassium, Iron, Magnesium, Copper, Calcium, Zinc and Manganese contents of the Shea butter were: 836.83±0.101, 45.81±000, 0.61±0.111, 2.56±0.111, 0.18±0.000, 31.31±0.113, 0.30±0.101 and 0.23±0.113 respectively. The elemental and proximate values indicated that Shea butter has nutritive components comparable to other popular nutritious food substances. Hence, its consumption for edible and non-edible purposes should be promoted.

Keywords—Shea butter, Swali market, crude protein, moisture, Yenagoa.

I. INTRODUCTION

The African Shea tree (Vitellaria paradoxa) formerly known as (Butyrospermum parkli) is a tree of the Sapotaceae family, it is the only species in genus Vitellaria and is indigenous to Africa (Byakagaba et al., 2011). The English word “Shea” comes from “s’i” the tree name in the Bambara language of Mali. It is known by many local names e.g “kade” or “kadanya” in Hausa language, “karate” in Wolof language of Senegal (Goreja, 2004), “ori” in some parts of West Africa and many others. The Shea fruit consists of a thin, tart, nutritious pulp that surrounds a relatively large, oil-rich seed from which Shea butter is extracted. The Shea tree is a traditional African food plant, it has been claimed to have potential to improve nutrition, boost food supply in “annual hungry season” (Masters et al., 2010) foster rural development and support sustainable land care (NRC, 2006). Shea butter is a fat extracted from the nut of the African Shea tree (V. paradoxa). It is usually yellow in colour when raw with refined, unrefined and ultra refined Shea butter being ivory or white in colour (Alfred, 2002) The Shea tree belongs to Sapotaceae family and was first named by the German botanist Carl Gaertner as V. paradoxa. In 1961, the species already described by Gaertner was renamed as Butyrospermum parkli (Maranz et al., 2003), with the epithet “parkli” referring to Mungo Park who was the great Scot’s explorer introducing Shea butter to Europe (Goreja, 2004). The trees grow wild across a 5000 km wide belt of savanna including West African Countries of Senegal, Mali, Cote d’Ivoire, Burkina Faso, Togo, Ghana, Benin Republic, Nigeria, Niger, Cameroon and further east in Uganda, Sudan and Ethiopia (Byakagaba et al., 2011; Chalfin, 2004; Goreja, 2004). This savanna belt is also called “Shea belt” among traders (Ferris et al., 2001). Among these countries Ghana and Burkina Faso are the main Shea nut exporters (Matt, 2009).
The Shea Tree starts bearing its fruits when it is 10 to 15 years old, full production is attained when the tree is about 20 to 30 years old. It then produces nuts for up to 200 years. The fruit resembles large plums and takes 4 to 6 months to ripen. The average yield is 15 to 20 kilogram of fresh fruits per tree, with optimum yield up to 45 kilogram. Each kilogram of fruit gives approximately 400 grams of dry seeds (Maranz et al., 2003). Fat and oil is considered to be a basic requirement for the human health and well being and Shea butter is a poly saturated fatty acid joined together in groups of three forming a molecule called triglycerides. When fatty acid is taken into the body, it is converted into glucose and stored in the body as energy. It is an essential study with aids to know the health benefits of Shea butter sold in Swali market, Bayelsa State, Nigeria. Shea butter is oil rich in fat extracted from the nuts of the African Shea tree. It exists as solid at room temperature. It is usually yellowish in colour when raw, with unrefined, refined and ultra Shea butter being ivory or white in colour (Lovett and Haq, 2000). Shea butter is a triglyceride (fat) derived mainly from stearic acid and oleic acid. Shea butter is edible in most cases and used in food preparation in some African countries.

Traditionally, the extraction of Shea butter has been done at the village level, where Shea butter is sold in local markets. In recent years, the dried kernels have been exported to processing countries in Europe, Japan and Asia where Shea butter is extracted in large - scale industrial plants (Lovett et al., 2000). Traditional extraction has been usually done by boiling water and skimming off the released oil while commercial one is conducted by pressing or solvent extraction with further refining and deodorizing of Shea butter (Israel, 2014). However, with the increased interest in naturally derived products, organic Shea butter production is preferred and thus efforts have been made to industrially produce Shea butter by following the traditional extraction methods. The Shea butter obtained from the traditional extraction procedure not including a refining stage is called “unrefined Shea butter”. Either at the village or industrial level, Shea butter is extracted from dried Shea kernels.

It is divided into two uses primarily: Medicinal use and industrial use of Shea butter. Shea butter is sometimes used as a base for medicinal ointment. Some of the isolated chemical constituents are reported to have anti-inflammatory, emollient and humectants properties. The butter has been used as a sun-blocking lotion and some of its components have limited capacity to absorb ultraviolet radiation (Israel, 2014). It is mainly used in the cosmetics industry for skin and hair related products (lip moisturizer, skin moisturizers, creams and hair conditioners for dry and brittle hair (Israel, 2014). It is also used by soap makers typically in small amounts (5-7% of the oils in the recipe), because it has plenty of unsaponifiables, and higher amounts results in softer soaps that have less cleaning abilities. The economic importance of Shea butter includes: moisturizes dry skin, treats acne and blemishes through its healing properties attributed to the presence of fatty acid and plant sterols such oleic, palmitic, stearic and linoleic acids. It also reduces skin inflammation, the presence of cinnamic acid that exhibits anti – inflammatory process (Israel, 2014). It has also been reportedly used as an anti – ageing and anti free radical agents. Provides relief to itchy and peeling skin, reduces stretch marks during pregnancy. Helps soothes skin and baby diaper rash. Excellent lips care during harmattan. Repair damaged hair and prevents dandruff. It soothes and helps to soften the hair. Soothes dry and itchy skin, serves as natural hair conditioners because of the presence of vitamin A and E to the end of the hair. Used in the treatment of rheumatism and arthritis (Moharram et al., 2006).

II. MATERIALS AND METHODS

Sample collection

Shea butter was procured from traders at Swali market Bayelsa state, Nigeria on 12th April, 2018 from five different stores.

Chemicals and Reagents

The reagents used in the current study include Sulphuric acid, Sodium hydroxide, Petroleum ether, Nitric acid and Ethanol. All reagents are of Analytical grades.

Apparatus and Equipment

Petri dishes, Crucibles, Conical flask, Beakers, Hot plate, Burette, Round bottom flask, Soxhlet apparatus, Vacuum oven, Furnace, Water bath, Measuring cylinders and 100ml volumetric flask, AAS, Flame photometer.

Sample Preparation

A container was washed, cleaned and sun dried, a composite mixture of the Shea butter was blended together in an electric blending machine (Qlink QBL-20L330) and the homogeneous mixture was stored in a clean glass container with lid and stored at room temperature for further analysis.

Determination of Moisture Content

Three Petri dishes were cleaned with ethanol, dried, labeled A, B & C and pre-weighed using an analytical weighing balance. 2g of Shea butter was weighed in each Petri dish.
The sample was dried in the vacuum oven at a temperature of 50°C for 3 hours, cooled in desiccators and weighed. The drying and weighing was repeated twice until constant weight was achieved. The moisture content was achieved following the method of AOAC (2005).

\[
\% \text{ Moisture content} = \frac{\text{weight of fresh sample} - \text{weight of dry sample}}{\text{weight of fresh sample}} \times 100 / 1
\]

**Determination of Ash Content**

Three crucibles were cleaned with ethanol, dried, labeled A, B & C and pre-weighed using an analytical weighing balance. 2g of Shea butter was weighed in each crucible. The samples were dried in the furnace at a temperature of 650°C for 4 hours, cooled in desiccators and weighed (AOAC, 2005).

\[
\% \text{ Ash Content} = \frac{\text{Mass of crucible + fresh sample} - \text{Mass of crucible} = \text{mass of crucible + fresh sample}}{100} \times 1
\]

**Determination of Crude protein**

1g of Shea butter was weighed into a conical flask, 15ml of H2SO4 was added and heated using a hot plate inside a fume cupboard for 3 minutes until a reddish brown colour was achieved. 50ml of deionized of water was added to the digest. The mixture was filtered using a whatmann filter paper no 14 and a funnel into a 100ml volumetric flask and filled to mark with distilled water.

20ml of digested Shea butter was pipette into a conical flask, 5 drops of phenolpthalin indicator was added to give a reddish pale colour. Then NaOH was titrated against the digested Shea butter till end point was reached.

The conversion factor of 6.25 was used to calculate the amount of protein contained in the Shea butter (AOAC, 2005)

\[
\% \text{ Crude Protein} = \left(\frac{\text{Titrant value} \times 1.401 \times \text{N of base} \times 6.25 \times \text{Vol of NaOH}}{\text{Mass of Sheabutter digested}}\right) \times 100
\]

**Determination of carbohydrate**

Carbohydrates were determined by difference using the method in AOAC (2005)

\[
\text{Carbohydrates} = [100 - (\text{Moisture content} - \text{Crude lipids} - \text{Crude protein})]
\]

**Determination of Crude Fat**

5g of Shea butter was extracted with petroleum ether solvent using soxhlet apparatus heated with a water bath for 4 hours. The crude fat extracted was concentrated in a water bath. The percentage crude oil content was then determined gravimetrically (AOAC, 2005).

**Determination of Crude fibre**

The residue of Shea butter and petroleum ether in the thimble of the soxhlet apparatus were collected in a pre-weighed beaker dried in a vacuum oven at 500°C and kept in a desiccators to cool and weigh.

1 g of Shea butter was weighed into a 30ml digestion tube, 10ml of concentrated sulphuric acid (H2SO4), 5ml concentrated nitric acid (HNO3) and 5ml of per chloric acid (HClO4) was added. The sample was digested in a Gallenkamp Hot plate set at 300°C. The digestion was continued until the solution was colourless this was to ensured the removal of all traces of nitric acid (HNO3).

The samples were allowed to cool and 20ml of deionised water was added with gentle swirling, the solution was filtered using a Whatman filter paper No.42 followed by dilution to the mark with deionized water in a 50ml volumetric flask. The digested Shea butter was analyzed for the selected mineral elements concentration using Buck 211 Atomic Absorption Spectrophotometer and UV/V Spectrophotometer.

**Determination of selected metals**

Sodium (Na), Magnesium (Mg), Potassium (K), Copper (Cu), Manganese (Mn), Iron (Fe), Calcium (Ca), Zinc (Zn) was determined using Buck Scientific 200 AAS (AOAC, 2005)

**III. RESULTS AND DISCUSSION**

**Proximate of composition Shea butter**

*Table 1: Proximate analysis for Shea butter sold in Swali market Yenagoa, Nigeria.*

| Parameters | Mean±SE |
|------------|---------|
| Moisture Content | 5.220±0.113 |
| Ash Content | 0.084±0.006 |
| Crude protein | 42.316±0.000 |
| Crude Fat | 97.000±0.000 |
The results showed that the carbohydrate content ranged between 30 and 40%. According to Pearson (1990), values of total carbohydrates in the range of 40-60% are for edible, domesticated and wild fruits. Carbohydrates are very vital in nutrition because they are good sources of energy (Anhwange et al., 2004). This therefore justifies the promotion of consumption and commercialization of Shea butter sold in Swali market Bayelsa state Nigeria.

The crude fibre content is beneficial in the diet of man because it plays an important role in decreasing many disorders such as constipation, diabetes, cardiovascular diseases and obesity. The value of crude fibre 0.111 when compared to other saturated fats is acceptable W.H.O (2007).

Protein is a large macromolecule consisting of a long chain amino acids held together by peptide linkages. The concentration of protein in the Shea butter is more than sufficient for consumption as advised by W.H.O (2003).

The crude fat (lipid) content of Shea butter has a concentration of 97.000±0.000%. Fat plays a very important role in nutrition and health. They are the second major sources of energy and antioxidant (Arayne et al., 2005).

As represented in Table 2, Shea butter contains very high concentration of Sodium (Na) (836.83±0.101 mg/100g) this makes it useful in the management of high blood pressure. Shea butter contains average amount of Potassium (K) (45.81±0.000 mg/100g) which is very good at managing Osteoporosis and kidney stone. The presence of Calcium and Magnesium in the Shea butter sample makes it useful in blood coagulation (clotting), the strengthening of the bones and teeth and in relieving anxiety (Bhutta et al., 2000). The values obtained for Copper, Zinc, Iron, and Manganese were within acceptable ranges.

The results show that consumption of Shea butter sold in Swali market is safe and has very good health benefits.

V. CONCLUSION

The findings of this study showed that Shea butter has adequate nutritional and health benefits. Hence, its consumption should be promoted among communities. Additionally, previous studies on physicochemical characteristics of Shea butter have shown that it has a very high industrial viability and as such; could be used as a raw material for cosmetics, soap and food processing industries.

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REFERENCES

[1] Alander, J. (2004). Shea butter – A multifunctional ingredient for Food and Cosmetics. Internat Lipid Technology. 16(9): 202-205.
[2] Ando, H., Ryu, A., Hashimoto, A., Oka, M., Ichihashi, M. (1998). Linoleic acid and α-linolenic acid lightens ultraviolet-induced hyperpigmentation of the skin, Archives of dermatological research, 290 (7): 375–381.
[3] AOA)(. (2005). Official methods of Analysis. 18th Edition, Association of officiating Analytical Chemist, Washington DC, Method 935.14 and 992.24.
[4] Arayne, M. S., Sultana, N., Hussain, F. (2005). Interactions between ciprofloxacin and antacids– dissolution and adsorption studies. Drug Metabolic and Drug Interact. 21(4): 29-117.
[5] Ayasse, M. and Paxton, R. (2002). Brood protection in social insects. Chemocology of Insect Eggs and Egg Deposition. Berlin. Blackwell, 12(3): 48-117.
[6] Azoulay, A., Garzon P., Eisenberg, M. J. (2001). Comparison of the mineral content of tap water and bottled waters. Journal Gen Intern Med. 16 (5):168-75.
[7] Bahl, R., Bhandari, N., Hambidge, K. M., Bhan, M. K. (1998). Plasma Zinc as a predictor of diarrheal and respiratory morbidity in children in an urban slum setting. American Journal Clinic Nutrient, 68 (2): 7-41.

[8] Bail, S., Krist, S., Masters, E., Unterweger, Buchbauer, G. (2009). Volatile Compounds of Shea Butter Samples made under Different Production Conditions in Western, Central and Eastern Africa. J. Food Comp Anal. 22(7-8): 738-744.

[9] Benoit S. C., Kemp C. J., Elias C. F., Abplanalp W., Herman J. P., Migrenne S. L., Lefevre A. L., Cruciani-Guglielmacci C., Magnan C., Niswender, K., Irani B. G., Holland W. L., Clegg D. J. (2009). Palmitic acid mediates hypothalamic insulin resistance by altering PKC-0 subcellular localization in rodents. Journal of Clinical Investigation, 119 (9): 2577–2587.

[10] Bhutta, Z. A., Bird, S. M., Black, R. E., Brown, K. M., Gardner, J. M., Hidayat, A. (2000). Therapeutic effects of oral zinc in acute and persistent diarrhea in children in developing countries: pooled analysis of randomized controlled trials. American Journal Clinical Nutrition, 72(5):22-51.

[11] Byakagaba, P., Peter, J., Maxwell, L. V. (2011). Population structure and regeneration status of Vitellaria paradoxa (C.F.Gaertn.) under different land management regimes in Uganda. Agricultural Journal, 6(1) 14-22.

[12] Byakagaba, P.E., Eifu, G., Okallo, J.B.L., Tumwebaze, S.B. and Mwavu, E.N. (2011). Population structure and regeneration status of Vitellaria paradoxa (C.F. Gaertn) under different land management regimes in Uganda. Agric. Journal, 6 (1): 14-22

[13] Das, A. and Hammad, T.A. (2016). Efficacy of a Combination of FCHG49 Glucosamine Hydrochloride, TRH122 Low Molecular Weight Sodium Chondroitin Sulfate and Manganese Ascorbate in the Management of Knee Osteoarthritis. Osteoarthritis and cartilage. 343–350.

[14] David, F. H. (1993). Fatty acid metabolism in health and disease: the role of Δ^2-desaturase. American Journal of Clinical Nutrition, 57: 732–737.

[15] Diezel, W.E., Schulz, E., Skanks, M., Heise, H. (1993). Plant oils: Topical application and anti-inflammatory effects (croton oil test). Dermatologische Monatsschrift , 179:173-177.

[16] Ferris, R., S., B., Collison, B., Wanda, K., Jagwe, J., Wright, P. (2001). Evaluating the marketing opportunities for Shea nuts and Shea nut products in Uganda. FOODNET REPORT submitted to USAID.

[17] Goreja, W.G. (2004). Shea Butter. The Nourishing properties of Africa’s Best-kept Natural Beauty. Amazing Herbs Press, New York, NY.

[18] Israel, M.O. (2014). Effects of tropical and dietary use of shea butter in animals. American Journal of Life Sciences, 2 (5):303-307

[19] Kokatnur, M.G., Oulmann, M.C., Johnson, W.D., Malcom, G. T., Strong, J.P. (1989). Fatty acid composition of human adipose tissue from two anatomical sites in a biracial community. American Journal of Clinical Nutrition, 32 (11): 2198–205.

[20] Koralek, D.O., Peters, U., Andreiole, G. 2006. A prospective study of dietary α-linolenic acid and the risk of prostate cancer (United States). Cancer Causes & Control, 17 (6): 783–791.

[21] Kutsal, E., Aydemir, C., Eldes, N., Demirel, F., Polat R, Taspinar, O., Kulah E. (2007). Severe hypermagnesemia as a result of excessive cathartic ingestion in a child without renal failure. Pediatr Emerg Care, 23:570-582.

[22] Letawe, C., Boone, M., Pierard, G.E. (1998). Digital image analysis of the effect of topically applied linoleic acid on acne microcomedones. Clinical & Experimental Dermatology, 23 (2): 56–58.

[23] Lovett, P. N. and Haq, N. (2004). Diversity of Shea nut trees (Vitellaria paradoxa) in Ghana. Genetic Resources and Evolution 47: 293-304.

[24] Lovett, P.N. and Haq, N. (2000a). Diversity of the sheanut tree (Vitellaria paradoxa C.F. Gaert) in Ghana. Genet. Resour Crop Evol., 47: 293-304

[25] Lovett, P.N. and Haq, N. (2000b). Evidence for anthropic selection of the Sheanut tree (Vitellaria paradoxa). Agroforestry systems, 48: 273-278

[26] Lovett, P.N., Onua, J., Ojok, P., Apunyu, A., Akot, L., Erongot, C. and Masters E.T. (2000). Shea tree improvement in Uganda: germplasm diversity, selection and propagation. First Regional Conference for Eastern and Central Africa, 26-30 June 2000, Liva, Uganda

[27] Masters E.T., Yidana, J.A., Lovett, P.N. (2010). Trade and sustainable forest management. FAO.org. Retrieved 2010-09-14

[28] Sangoremi, A.A. (2013). Effect of heavy metals concentration on fish species in Ala-River, Akure, Nigeria, International Journal of Science Innovations and Discoveries. 3 (4): 465-468.

[29] WHO. (2003). Diet, nutrition and the prevention of chronic disease. Report of a Joint WHO/FAO Expert Consultation. Geneva, World Health Organization.

[30] WHO. (2003). Prevention of recurrent heart attacks and strokes in low and middle income populations: Evidence-based recommendations for policy makers and health professionals. Geneva, World Health Organization.

[31] WHO. (2007). Prevention of cardiovascular disease: guidelines for assessment and management.