Scientia Africana, Vol. 22 (No. 1), April, 2023. Pp 211-218 https://dx.doi.org/10.4314/sa.v22i1.18
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PHYSICO-CHEMICAL CHARACTERIZATION OF SHEA BUTTER FROM KAIMA, WESTERN NIGERIA

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Received: 01-02-2023
Accepted: 22-03-2023

ABSTRACT

The characterization of Shea butter is important to enable it meet the standard required for certification. This study aimed at evaluating the quality and physico-chemical characteristics of extracted Shea oil obtained from different types of shea kernels harvested in Kaima local government area of Kwara state with the view to assist local and international producers on the ideal shea kernel for production. The Shea kernels obtained were classified into three; intact and whole (Shea kernel in good condition, microbial and pest-infested Shea kernels and wounded Shea kernels). Moisture content, color, specific gravity (density), acid value, peroxide value, Saponification value, unsaponifiable matter, Anisidine value, iodine value, total lipid content (oil content), free fatty acids profile (using the PORIM test method 2004) were carried out on each sample.Our results showed significant differences (p< 0.0001) between the various Shea butters with the microbial and pest-infested Shea butter having the highest contribution in lowering the quality of the Shea butter. Study revealed that intact and whole Shea kernel butter had good physico-chemical characteristics when compared to the wounded and microbial and pest-infested Shea kernel butter. Free fatty acid (7.13±0.00 %, 10.66±0.03 %, 13.51±0.20 %), Acid value (14.25±0.00 mg/g ,21.32±0.07 mg/g27.01±0.40 mg/g), Peroxide value (6.06±00meq/kg, 15.19±0.03meq/kg, 31.47±0.17meq/kg), P-Anisidine value(18.37±0.07, 15.50±0.00, 13.47±0.17), Total oxidation value (24.26±0.00, 30.24±0.10, 44.08±0.17), Saponification value (227.49±4.46 mg, 164.99±0.00 mg, 181.99±5.00 mg), Unsaponifiable matter (4.51±0.00%, 4.67±0.02 %, 3.06±0.00 %), Iodine value (9.04±0.05 g, 8.74±0.02 g, 8.42±0.01 g), Moisture content (1.00±0.44 %, 0.50±0.29%, 1.00±0.29 %) respectively. This study recommends that Shea butter processors should sort the kernels into categories and process them accordingly to yield different grades for local and international market.

INTRODUCTION

Shea oil is a vegetable oil which is obtained from Shea tree (tree of life) (*Vitellaria paradox*). This oil constitutes an important source of fat and oil present in food, pharmaceuticals and cosmetics. Shea oil is of great importance in the local and international market with increasing demand worldwide for export. Fat is one of the three main macro-nutrients based on long chain organic acids called fatty acids. Fat and oils are classified based on the number and bonding of the carbon atoms in the aliphatic chain. Fatty acids are divided to classes which includes; saturated fatty acids, have no double bond between the carbons in the chain while unsaturated fatty acids have one or more double bond between the carbons in the chain. Fatty acids with multiple double bonds are referred to as polyunsaturated fatty acids. Fats are good sources of essential fatty acids and vitamins which are fat soluble (Obibuzor*et al.*, 2014). Fats also provide energy for human body. They play important roles in maintaining healthy skin, hair, insulating body

organs against shock, maintaining body temperature, and promoting a healthy cell function (Obibuzor*et al.*, 2014).

There is a high demand for oils and fats to feed the ever growing world population and in responds to this high demand, the European union (EU) since the year 2000 allowed chocolate producers to substitute up to 5% of cocoa butter in chocolate with either vegetable fats as Shea butter or palm oil (Cassiday, 2012).

Shea tree (*Vitellarisparadoxa*) is known as karate (Buhryospermumparkii) meaning "tree of life". In part of West Africa, Shea butter is referred to as "Ori" in Western Nigeria and the igbo call it "Okwuma". It has been reported to be a rich source of triglycerides containing mainly from stearic acids and oleic acids which is been utilized for centuries for its amazing ability to renew, repair and protect the skin (Obibuzor*et al*., 2014). Processing of Shea butter kernel into butter as a venture has the potential and capacity to contribute to the world economy and total vegetable fats production when properly harnessed. (Obibuzor*et al*., 2014).

Shea kernel contains relatively large, oil rich seed from which Shea butter is extracted. It takes the Shea tree a long time to start bearing fruits (10-15) years and full production is attained between (20-30) years, due to this factor its commercial plantation is discouraged. Shea tree grows wild across the savannah, including the West African countries of Togo, Ghana, Benin, Niger, Nigeria, Cameroon and further East in Uganda, Sudan, and Ethiopia (Goreja, 2004), Shea butter is propagated by seed and the seed should not be dried but sown as soon as possible because of its short viability. Shea butter melts at body temperature and has good water binding properties. As a plant fat, Shea butter consists of approximate 90% or more of triglycerides and minor unsaponifiable fraction (Esuoso*et al*., 2000). The triglycerides are responsible for Shea butter emollient properties while the unsaponifiable fraction contains the bioactive substances that includes hydrocarbons, tocopherols, sterols, and alcohols and thus responsible for Shea butters medicinal properties (Esuoso*et al*., 2000).

The physico-chemical composition of vegetable oils has often been attributed to environmental factors such as microbial infestation, rainfall, soil fertility, maturation period, agronomic practice and genetic substitution (Maranze*et al*.,2003).

Shea butter according to United States Agency for international development and other companies (USAID, 2005) was classified into five grades. Grade A(raw or unrefined, extracted using water), Grade B (refined), Grade C (highly refined and extracted with solvent such as hexane), Grade D (lowest uncontaminatedgrade) and Grade E (with contaminants). Commercial grades are Grades Grade A, B, C. GradeA Shea butter has a cream to grayish yellow color with nutty aroma, which is removed in other grades such as Grade C. Refined and deodorized Shea butter is useful in manufacturing chocolate and margarines in Europe (USAID, 2005).

Unsaponifiable matter of the shea butter is also useful in the treatment of inflammatory diseases, and also important to pharmaceutical companies in developing treatment for arthritis, eczema and herpes lesions, it is also used in cosmetic industries as raw material and precursor for the manufacture of soaps, candles and cosmetics. Due to its anti-inflammatory properties, anti-microbial properties, it is also an important source of fatty acids and glycerol in diets. (Nahm, 2011). Due to the demand of shea butter in local and

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international market this study is aimed at evaluating the qualityof shea butter processed from different types of shea kernels inkosubosu village in kaima in Kwara state, with the view to assisting the local producers and international market with the grades and type of Shea kernel to be processed to meet with the standard of the international market and end users.

MATERIALS AND METHODS

Plant collection and authentication

Shea kernels (V*itelleriaparadoxa)* were collected from Kosubosu village in Kaima local government area of kwara state, Nigeria. Identification and authentication were carried out in the Department of Plant Biology and Biotechnology, University of Benin, Nigeria (voucher number UBH-V586). The Shea kernels were divided into three groups: Intact kernels, wounded kernels, and infested kernels.

Plant Extraction

The kernels were washed in clean water, parboiled for 30 min on low heat, and air dried for 14 days to avoid germination, black kernels and mould infestation. Thereafter, it was de-husked and winnowed to separate the kernels from the shell. The same method was used in processing the three groups of Shea kernels. The un-refined method of processing described by Shekarau*et al*., (2012) was used (aqueous extraction). The dried kernels were crushedusing mortar and pestle and roasted on low heat using a roasting pan. The roasted kernels were left to cool for 45 minutes; the kernels were milled into a fine paste, left to cool overnight and then kneaded with cold water to extract the fat. The grey-oily scum was scooped from the surface of the aliquot and boiled to separate the oil from the cake. The decanted oil was filtered using a cheese cloth. The oil was occasionally stirred to avoid crystallization of the fat and to ensure uniform and smooth consistency.

Physico-chemical analysis

The Physicochemical characteristics of the oils were carried out. The moisture content, color, specific gravity and free fatty acid value were determined using the official method ofanalysis A.O.A.C (2000)

Acid value, peroxide value, Anisidine value, iodine value, total oxidation value, saponification value and unsaponifiable matter were carried out according to the standard procedure (PORIM test method 2004).

RESULTS

Physico-chemical characteristics of Shea butter for intact, wounded and infested Shea kernel butter.

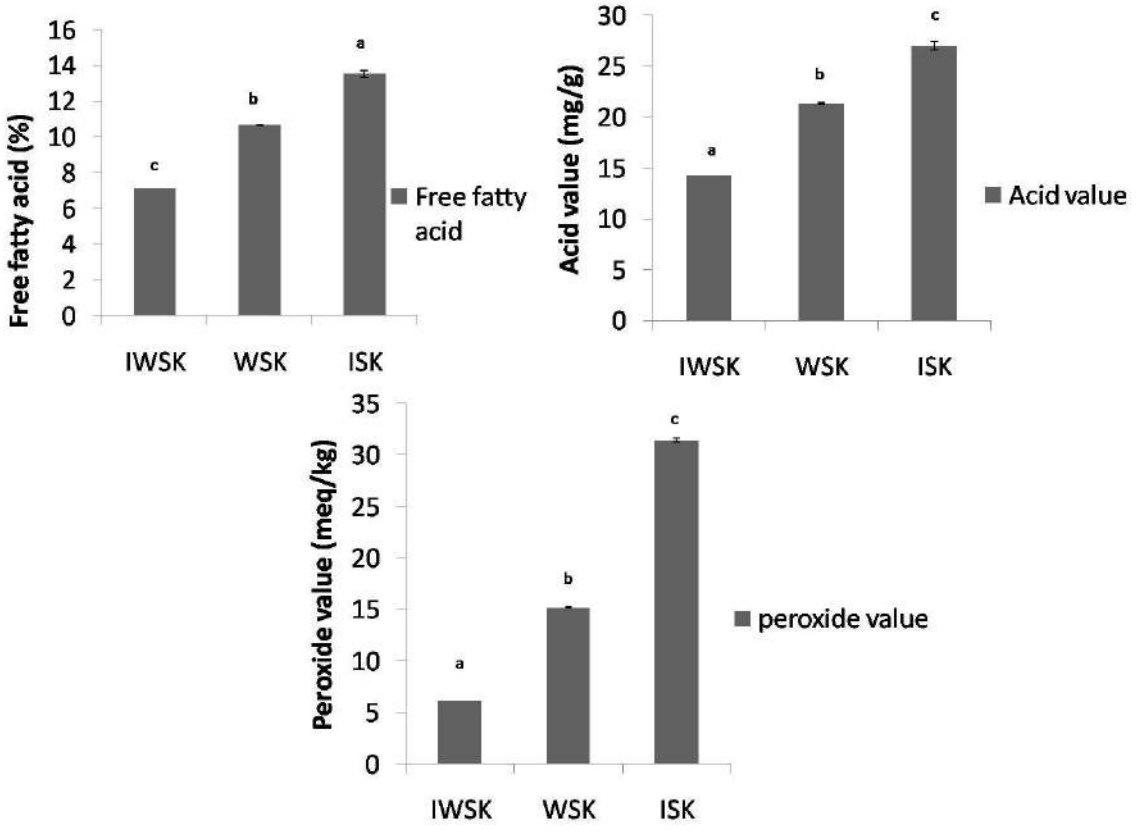

Fig 1: shows the result of free fatty acid, acid value and peroxide value. Data are reported as mean ±SEM of triplicate analysis. Values with different lowercase letters within the column indicate significant difference of p<0.0001. Note: *IWSK= Intact and Whole Shea kernel; WSK= Wounded Shea kernel; ISK=Infested Shea kernel*

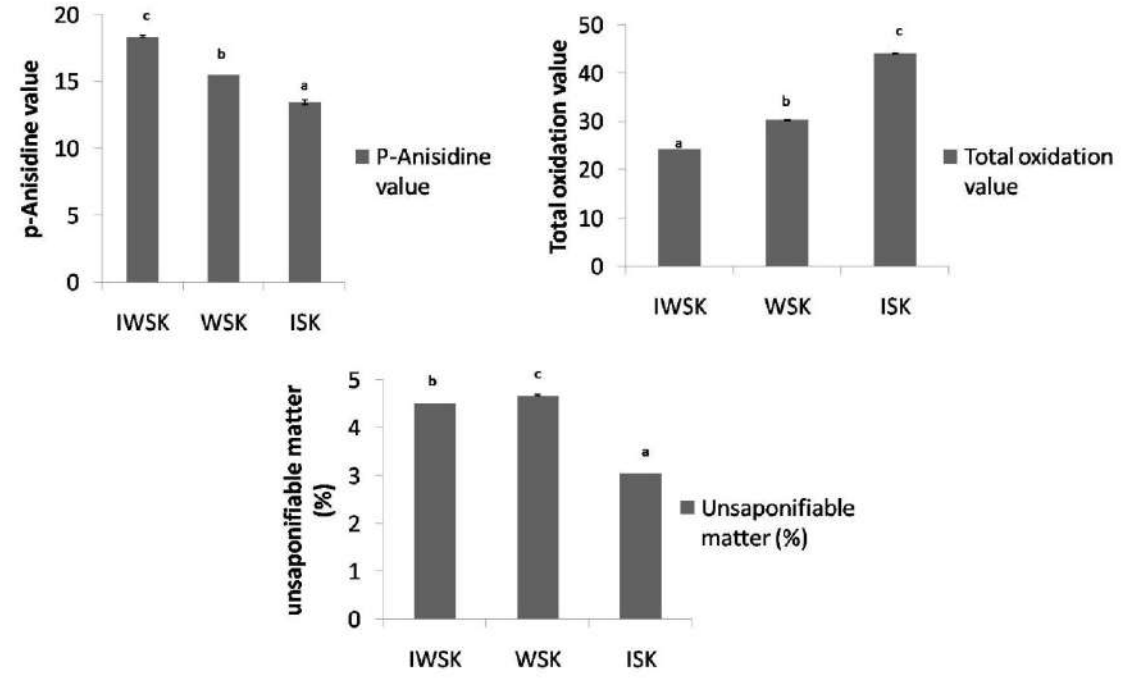

Fig 2: shows the results for P-anisidine value, Total oxidation value andunsaponifiable matter. Data are reported as mean ±SEM of triplicate analysis. Values with different lower letters within the

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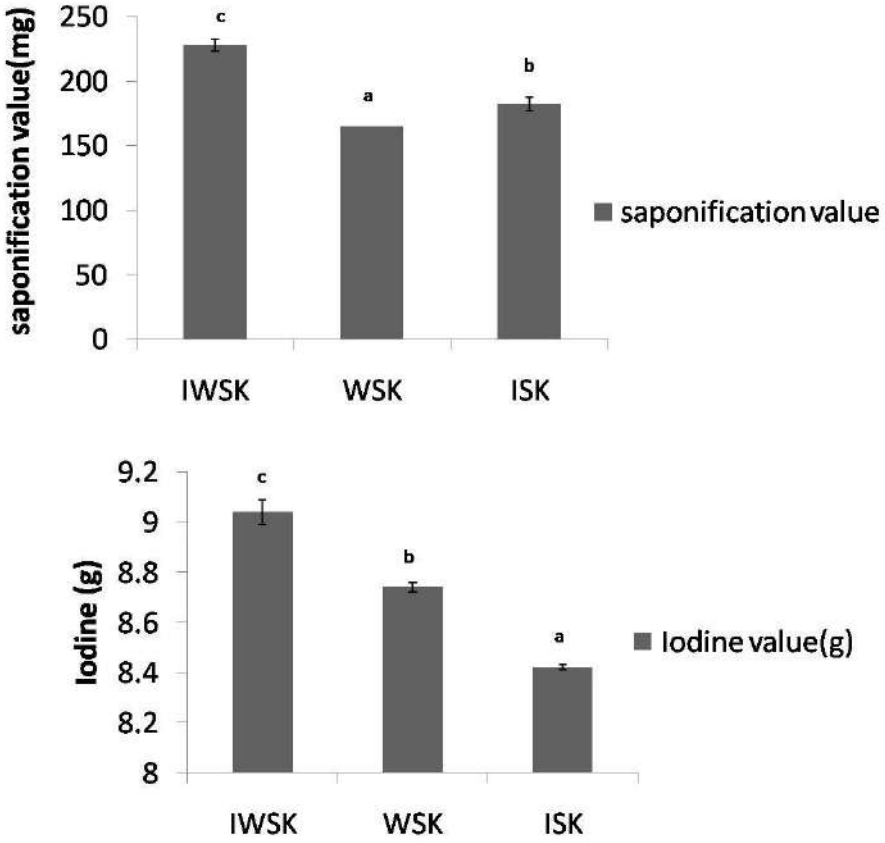

Fig 3: shows the results for saponifiable matter and iodine value. Data are reported as mean ±SEM of triplicate analysis. Values with different lower letters within the column indicate significant difference of p<0.0001. Note: *IWSK= Intact and Whole Shea kernel; WSK= Wounded Shea kernel; ISK=Infested Shea kernel*

Table 1: shows the moisture content and physical properties of the various Shea butters

S/N	Parameters	Intact Shea kernel butter	Wounded Shea kernel butter	Infested Shea kernel butter
1	Moisture content (%)	1.00±0.44 [a]	0.50±0.29 [a]	1.00±0.29 [a]
2	Specific gravity	0.87	0.87	0.95
3	Color	9Y	10Y 2R	8Y 2R

Data are reported as mean ±SEM of triplicate analysis. Values with different lowercase letters within the column indicate significant difference (p<0.0001)

DISCUSSION

It is important to monitor the quality of Shea butter used in pharmaceutical, cosmetics and food industries and this can be achieved by monitoring the method of processing, type of Shea kernel, Shea kernel harvesting technique and kernel storage methods. Compromising any stage can increase the microbial load of the Shea kernel (butter).

The physicochemical characterization of the intact, wounded and infested Shea kernel butter revealed the quality and grade of Shea

butter obtained from kaiama local government in kwara state.

Iodine value is an index for assessing the ability of oil to go rancid (Maliki *et al*., 2020). In this study the wounded and infested sample had low iodine value compared to the intact Shea butter sample, there was a significant difference ($p<0.0001$) among the iodine values of the butters. The low iodine values of butter indicates that the oils contain low level of polysaturated fatty acid, (Nahm, 2011) and the storage procedure used should ensure the protection of oil from oxidative deterioration.

Peroxide value is a vital index in the determination of the level of oxidation in fats and oils. Peroxides are intermediate compounds formed during the oxidation of lipids which may react to form compounds that form rancidity. the peroxide value showed a wide range from 6.06-31.66 (meq/kg), this may arise as a result of the conditions in which the Shea kernels were collected, processed into Shea butter and stored. The variation in value for each group was considered significantly different. the sample intact belong to grade 1 with the highest quality Shea butter while wounded grade 2 and infested grade 3 (Nahm, 2011). Anisidine value is a quality parameter that determines or measures the secondary oxidation of fat and oils. The values obtained in this study were significantly higher for Anisidine value and total oxidation value, suggesting that the butters have undergone various degree of secondary oxidative degradation. (Obibuzor *et al*., 2014).

Saponification value measures the average molecular weight or the chain length of the fatty acid presents, while Saponification matter is the amount of hydrogen peroxide in milligrams required to saponify 1g of fat or oil under specified condition. The Saponification value of the butters was considered significantly different, with intact butter having the highest value. This variation may be due to processing, fruit harvesting and kernel storage methods. (Nahm, 2011).

Unsaponifiable matters in Shea butter samples were significantly different. Obibuzor*et al.*, 2014, emphasized the unusual high amount of unsaponifiable matter as Shea butter's uniqueness. The results from this study showed that the sample contained low levels of unsaponifiable matter compared to previously report by Obibuzor*et al.,* 2014. The content of unsaponifiable matter varies in different oils and it depends on the extent and method of refining.

The moisture content of three samples was considered not significantly different ($p<0.0001$) and values fit into the classified grade 3 butter according to UEMOA standard. High moisture content in plant fats and oils usually leads to increase in microbial loads as well as lipid oxidation resulting in rancidity (Olaniyan, *et al* 2007) (Nahm, 2011). The moisture content value obtained from this study indicates that there is need to improve on the drying methods, processing and storage of kernels.

The color observed in this study ranges from yellow to red, the Shea butter used in this study were unrefined Shea butter. The yellow color observed as expected is possibly due to the retention of β- carotene, since the butters did not undergo refining procedure which leads to removal of carotenoids and thus loss of characteristic color. (Rossi *et al*., 2001). The free fatty acid content of oil or fats gives an index of quality, represented in the proportion lost to hydrolytic degradation. In this study the free fatty acid content and acid value were significantly higher when compared to the intact Shea butter kernel. (Mbaiguinam *et al.*, 2007).

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CONCLUSION

This study showed variation in the quality of Shea butter samples. since seed oils are known to deteriorate when processed inadequately with the principal decomposition reaction been oxidation, it is of great importance that Shea fruits(kernel) should be picked on time, properly stored, processed and packaged to meet international standard for the purpose of pharmaceutical and food industries. the physico-chemical properties of the various Shea kernel butter samples obtained from Kaiama Local government area of Kwara state makes it possible and a potential raw material for industries and can be further refined for consumption.

Acknowledgements

The authors sincerely thank Dr. Obibuzor and Mr Daniel of Nigeria Institute for Oil Palm Research (NIFOR) for their immense contributions.

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