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EXTRACTION AND CHARACTERIZATION OF SHEA BUTTER OIL

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ABSTRACT: Shea butter oil was extracted from its seeds bought at Karno (a Satellite town) in the Federal Capital City, Abuja with a soxhlet extractor using n-hexane as solvent. The oil was purified by bleaching and degumming. It was characterized for the following parameters: saponification value (185.20), ester value (183.4), viscosity (17.78 poise), refractive index(1.6), iodine value (63.45), acid value(1.79), unsaponifiable matter (5.68%), melting point (51-56°C), specific gravity (0.92) peroxide value (14.2), colour (milky-cream) and moisture content (10%). The observed values of the parameters are within values obtained for similar vegetable oils such as avocardo pear oil, white melon oil, palm kernel oil, rubber seed oil and castor seed oil except for unsaponifiable matter value. The values of the parameters suggest the potentials of the oil for domestic and industrial applications.

INTRODUCTION

Worldwide, natural vegetable oils and fats are increasingly becoming important in nutrition and commerce because they are sources of dietary energy, antioxidants, biofuels and raw materials for the manufacture of industrial products. They are used in food, cosmetics, pharmaceuticals and chemical industries. Vegetable oils account for 80% of the world's natural oils and fat supply (FAO, 2000). With increasing awareness of the importance of vegetable oils in the food, pharmaceutical and cosmetic industries, there is need to search for indigenous plant species that can provide such oils and characterize them. *Vitellaria* paradoxa (the shea tree), an indigenous wild tree is one such plant of African savanna parkland (Hall *et al*. 1996). *Vitellaria* paradoxa tree has been included in the priority list of African Genetic Resources by the FAO (1977).

Shea butter oil botanically called *Butyrospermum parkii* is a soft paste of melted fat with a milky colour in solid form and brownish when melted. It has a characteristic odour. It contains fatty acid triglyceride and a high amount of unsaponifiable matter, which ranges from 2.5% to 15% (Eka, 1997).This exceptionally rich vegetable extract contains fatty acids, phytosterol and unsaponifiable matter which stimulate the skin's natural renewal process. The composition of the product depends on several criteria particularly the geographical occurence, its botanical origin, handling of the seeds and processing e.g drying time, ripening (Asintoke, 1987). According to Tella (1979), shea butter oil contains cinnamic acid, a substance that helps protect the skin from harmful ultra-violet rays. Equally, unrefined shea butter oil is superior in that it retains all its natural vitamins, especially vitamins A and E. Crude shea butter has natural anti-oxidant properties due to its tocopherol content (Asintoke, 1987). Shea buter oil has the following fatty acid composition-palmitic acid (C_{16}) 8.5%, stearic acid (C_{18}) 35.9%, oleic acid (C_{18}) 49.9% and linoleic acid (C_{18}) 5.3% (Tooley, 1971).

The V. paradoxa nuts/seeds are usually processed into shea butter oil that constitutes an important source of fat (Okullo *et al., 2004). The* shea butter fat can also be used in soap making, cosmetics and traditional medicine in many rural areas, (Maranz *et al.,* 2004), (Alander, 2004). Due to its richness in food nutrients, the shea butter oil has found market as baking fat, like other fatty spreads in Europe and Asia (Akhter *et al.,* 2008) . The use of shea butter oil alone for cosmetics in U.S.A. has been growing at an annual rate of 25%.

Differences in the variation of the physico-chemical composition of vegetable oils have often been attributed to environmental factors such as rain-fall, soil fertility, maturation period, agronomic practices and genetic substitution (Sonau *et al.,* 2006).

With the increasing global demands for shea butter oil, characterization of the shea butter oil originating from Nigeria which is part of the West Africa is essential. These properties determine the end use of the oil. This study therefore, investigates the physico-chemical composition of shea butter oil from Nigeria. This will fill the gap currently existing in literature on the physico-chemical properties of shea butter oil obtained from Nigerian soil.

MATERIALS AND METHODS

Shea butter (*Butyrospernum parkii*) seeds (nuts) were obtained from Karno, (a satellite town) in the Federal Capital City, Abuja, Nigeria. The seeds were dehulled, cleaned and dried under the sun for a day and later dried in the oven for three hours at 50°C to ensure that water and moisture were removed. The seeds were immediately grounded using mortar and pestle into a paste in order to weaken and rupture the cell. The paste was stored in a labeled airtight container for oil extraction. All chemicals and reagents used were of analytical grade. In all cases, distilled water was used.

Oil Extraction

Oil from the paste was extracted with n-hexane solvent for five hours using soxhlet apparatus.

Degumming and Purification

The oil was heated to 60^0C and activated carbon added. This decolourized the oil. The bleached oil was mixed with water thoroughly and heated again to 60^OC, stirred vigorously for 15 minutes, filtered, cooled and the sludge on the filter paper was discarded. The extracted oil (purified) was transferred into a glass bottle and stored in a refrigerator until all analyses were completed.

Physico-chemical Characterization

Standard procedures of American oil Chemists society were used for indices values (AOAC, 1997) procedures were applied for acid value (standard 969.17, 1997), iodine value (standard 965.33, 1997), saponification value (standard 920.16, 1997). Refractive index, colour, viscosity, melting point and specific gravity were determined using recommended methods (AOAC, 1997). Viscometer, refractometer and tintometer were used to determine viscosity, refractive index and colour respectively. The unsaponifiable matter in the oil was determined using standard methods (AOAC, 1997) while the ester value was obtained by substracting the acid value from the saponification value. The percentage of moisture content in the seeds was determined following the method recommended by AOAC (1997).

Solubility Studies

Solubility studies were carried out in six solvents. This was done by dissolving 0.2g of the oil in the solvents at room temperature and at the boiling points of the solvents.

RESULTS AND DISCUSSION

RESULTS

Shea butter oil was characterized along the following physico-chemical parameters and the results are shown in Table I.

S/N	PARAMETERS	SHEA BUTER OIL
1	Colour	Milky -cream
2	Clarity (opacity)	Fat (solid)
3	Odour	Milky odour
4	Taste	Tasteless
5	Refractive index	1.6
6	Viscosity	17.78 poise
7	Specific gravity	0.92
8	Melting point	51- 56°C
9	Peroxide value	14.2
10	Moisture content	10%
11	Saponification value	185.20
12	Iodine value	63.45
13	Ester value	183.4
14	Acid value	1.79
15	Unsaponifiable matter	5.68%
16	Solubilities	
	(i) Chloroform	Soluble
	(ii.) Petroleum ether	Partially soluble
	(iii)Carbon tetrachloride	Partially soluble
	(iv) Ethanol	Soluble
	(v) Water	Insoluble
	(vi) Hexane	soluble

Table 1: Physico-chemical properties of shea butter oil

DISCUSSION

The viscosity value obtained (17.78 poise) for shea butter oil in this study falls within the category of most oils e.g castor oil (13.02 poise) and crambe oil (27.20 poise) while the refractive index (1.6) does not differ much from the refractive indices of castor oil (1.47), rubber seed oil (1.46), blighia sapida (1.449), and detarium microcarpum (1.465) (Kyari, 2008) (Dhellot *et al.,* 2006) (Anhwange *et al.,*2004). The physico-chemical composition of shea butter oil obtained in this study also conforms to the regional standards for shea butter oils (Regional Technical Committee, 2007)

Acid value corresponds to the amount of potassium hydroxide needed to neutralize free fatty acid. The lower the acid value of an oil, the fewer free fatty acids it contains which makes it less exposed to the phenomenon of rancidification (Roger *et al.,*2010) . The acid value obtained for shea butter oil is 1.79, while that of other edible oils such as Amaranthus hybridus is (2.84). Acid value varies according to the extraction method-Soxhlet (Horowitz, 1948), Bligh and Dyer (Bligh and Dyer, 1959) and Folch (Omoti and Okyi, 1987) (Folch *et al.,* 1957) with high acidity by soxhlet method due to the onset of oxidation (Codex, 1993). Low acid value implies a rather stable oil at the extraction temperature (Codex, 1993).

Extraction method	Soxhlet	Bligh and Dyer	Folch
Acid value (var 1)	3.92±0.12	2.92±0.57	2.38±0.43
Acid value (var 2)	3.7±0.08	2.39±0.07	1.74±0.7

Table 2: Acid value for *Amaranthus hybridus* by different extraction methods, Dhellot *et al.,* (2006)

The saponification value helps determine the quantity of potassium (in mg) needed to neutralize the acids and saponify the esters contained in 1g of lipid (Roger *et al.,* 2010). The saponification value (185.20) obtained for shear butter oil is lower than those of the common oils such as soyabean (189-195), Peanut (187 - 196) and cotton seed oil (189-198) (Codex, 1993). The higher the saponification value of an oil the higher the lauric acid content of that oil. The lauric acid content and the saponification value of an oil serve as important parameters in determining the suitability of an oil in soap making.

The unsaponifiable matter of shea butter seed oil is 5.68%. This value is close to that reported by (Dhellot *et al.,* 2006) which was 5.1%. The unsaponifiable matter obtained in this study is however higher than those of other oils such as avocardo pear (2.8%), dacryodes edulis (2.3%), red egusi seed (1.6%), cannarium schweinfuhil Engl (1.3%), sesame (1.2%), white melon (1.1%), corn oil (0.92%), palm kernel oil (0.22%), coco kernel oil (0.09%), rubber seed oil (0.7%) and castor seed oil (0.5%) (Kapseu *et al.,* 1997) (Asuquo,2008).

Iodine value measures the degree of unstauration in a fat or vegetable oil (i. e. the number of double bonds) (Daintith, 2008). It determines the stability of oils to oxidation as well as allows the overall unsaturation of the fat to be determined quantitatively. Knowledge of the iodine value enables the combustion temperature of the oil to be evaluated (Roger *et al.,* 2010). The iodine value obtained for shea butter oil (63.45) classified the oil as a non-drying oil. Non-drying oils have iodine values less than 100 (Asuquo, 2008). The iodine value of shea butter oil is lower than those of sunflower (110-143), castor oil (83.75), soybeans (120-143), coula edulis (90-95) and rubber seed oil(134.51) (Abayeh *et al.,*1999). The low iodine value for shea butter oil indicates that the oil is rich in saturated fatty acids, which ensures stability against oxidation and rancidification of foods prepared with the oil (Goh, 1994).

The peroxide value obtained for the oil (14.2) is higher than 10 which characterizes a number of conventional oils e.g *amaranthus hybridus* (Codex, 1993).

Ester value represents the number of milligrams of potassium hydroxide required to saponify the esters present in 1g of the oil. It is obtained as the difference between the saponification value and the acid value. For shea butter oil, the ester value was found to be 183.4 which is in between that obtained for castor oil (174.09) and rubber seed oil (191.93), which are all vegetable oils (Asuquo, 2008).

The specific gravity of the oil was found to be 0.92. This is in agreement with that reported in literature (Lewkowitsch, 1969). The percentage moisture content obtained for shea butter oil (10%) is higher than those reported for castor oil (8%) and rubber seed oil (8.6%) (Asuquo, 2008).

CONCLUSION

This study was undertaken to determine the physico-chemical characteristics of the oil obtained from shea butter seeds from Karno, a satellite town in the Federal Capital Territory, Nigeria. The properties are in agreement with the properties of shea butter oil in the West African sub-region. The study has helped in filling the literature gap in this area of oil studies for Nigeria and globally. It also places Nigerian shea butter oil in the world map for various uses including domestic and industrial applications.

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