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## Effects of Extraction Methods on the Yield and Quality Characteristics of Oils from Shea Nut

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### ABSTRACT

Shea butter oil was studied with aim of determining the most suitable method for use by rural processors based on oil yield and quality characteristics. This was done by comparing results of physical, chemical and sensory properties of oil extracted by Solvent Extraction Method (SEM) and Traditional Extraction Method (TEM). Results showed that SEM had a higher yield of 47.5% (39.3% greater) than TEM 34.1% while smoke point (233°C) was the same for both methods. Moisture content, flash and fire point values were lower for SEM ( $0.05\pm 0.12$ ,  $253\pm 0.05$ ,  $301\pm 8.10$ , respectively) than TEM ( $0.2\pm 0.06$ ,  $255\pm 0.19$ ,  $303\pm 3.25$ , respectively) indicating better keeping qualities for solvent method. Low acid value observed for TEM ( $0.50\pm 0.06$ ) showed the susceptibility of shea butter oil extracted by SEM ( $1.20\pm 0.13$ ) to rancidity. Acid value for TEM stayed below the accepted threshold of 1% for edible oils. Peroxide Value (PV) obtained for Shea butter oil extracted by TEM was lower than that of SEM, even though both methods possessed acceptable PV. In all, the study showed that shea butter oil extracted by both of the studied methods is capable of serving as a high yielding commercially rich source of vegetable oil. It also showed that solvent method of extraction was more viable in terms of oil yield percentage and other studied quality parameters even though lacking in overall sensory acceptability compared to the TEM which scored higher in terms of general sensory attributes and recommends further studies on sensory acceptability of the SEM.

**Key words:** Shea nut oil yield, shea nut sensory quality, shea nut physio-chemical quality, shea nut characteristics, shea nut oil extraction methods

### INTRODUCTION

The shea tree (*Vitellaria paradoxa*) grows naturally or as a cultivated tree corp in the dry Savannah belt of West Africa. The West Africa subspecies is *V. paradoxa* var. *nilotica* and occurs in 19 countries across the African continent, with Benin, Ghana, Burkina Faso and Cote D'Ivoire, as the major producers (FAO, 1988). It is a perennial tropical tree that grows to the height range of 15-20 m, the fruits fall when fully ripened. The Shea nut butter obtained from the fruits of shell tree is also known as Chamen, Kandayi/Mankade, Osisi/Okwuma and Emi/Orioyo among the Tiv, Hausa, Igbo and Yoruba people of Nigeria, respectively.

The shea fruit contains has a kernel(embryo) from which shea oil is extracted, a green epicarp, a fleshy mesocarp (pulp) and a shell cover (endocarp). The kernel, according to Axtell *et al.* (1993)

contains about 60% edible fat. The kernels can be dried, cracked and crushed to obtain shea oil, which when solidified forms a solid, fatty, butter-like substance called 'shea butter' (Coulibaly *et al.*, 2009), the kernels are processed using any of the methods listed below:

- Traditional extraction method (Jatto *et al.*, 2010)
- Solvent extraction method (Asuquo *et al.*, 2010; Kar and Mital, 1999)

Apart from the methods listed above, other methods have been developed in the industries for the extraction of the Shea butter. Shea butter is used as table oil due to its high nutritive value (Okullo *et al.*, 2010; Olaniyan and Oje, 2007). It also finds use as a non-orthodox traditional plant used for the treatment of leprosy and other ailments in Nigeria and other Africa countries. Industrially, it is used for making soap, cosmetics, lubricants, candles and paints. Pure natural shea butter when used as cream exhibits an exceptional skin healing ability due to its rich vitamin A activity (ASBI, 2004; Olaniyan and Oje, 2007). Apart from Vitamin A, the nut they also contain vitamin E (antioxidant), Sodium, manganese, aluminum, chlorine, calcium, potassium, cerium, selenium and scandium (ASBI, 2004; Olaniyan and Oje, 2007; Alhassan *et al.*, 2011). Shea butter also contains a high proportion of oleic, stearic, palmitic, linoleic() and arachidic acids (Okullo *et al.*, 2010; Ramadhas *et al.*, 2005; Sahoo *et al.*, 2007; Maranz *et al.*, 2004; Badifu, 1989). In Nigeria Shea nut is available from July-August every year and it serves as a means of income to rural people involved in the business of processing it into products such as Shea butter, cosmetic soap and detergent. There is however an increasing need for local research into the processing of shea nut in Nigeria so to help these local based rural processors improve the quality and efficiency of their processing activity for increased profitability. Therefore, Shea nut kernels were processed by solvent and traditional extraction method with objective of determining the method most suitable for use by rural processors based on the yield and quality characteristics of nuts.

## **MATERIALS AND METHODS**

**Materials:** Shea butter (*Butyrospermum parkii*) seeds (nuts) were collected from farm lands and in the bushes from Umenger village in Guma Local Government Area of Benue State Nigeria. Fallen fruits are collected from the ground because it is difficult to distinguish between ripening and fully mature fruit still on the tree. The nuts, which are embedded in a soft fruit, fall to the ground during the harvesting period (typically June through August depending on latitude).

### **Methods**

#### **Sample preparation**

**Pre-treatment:** The Shea fruits gathered from wild contain a lot of foreign materials therefore pre-treatment operations of grading, sorting and cleaning are required in order that the oil can be extracted from high quality, clean kernels.

**De-pulping:** De-pulping is the removal of the fleshy mesocarp. Initial fermentation facilitates this process. Collected Shea fruits are buried in pits which cause the pulp to ferment and disintegrate and produced enough heat to prevent germination of the fruits.

**Drying of nuts:** Traditional extraction method involves sun drying for 5-10 days to reduce the moisture content to about 15-30%. Solvent extraction method involves oven drying at temperature

of 50°C for 4-5 days leaving the moisture content of the kernel at between 6-7%. The drying process facilitates de-husking, which is the process employed to remove the hard shell or coat covering endoderm containing the oil.

**De-husking:** This is done to remove the husks. It involves pounding using a mortar and pestle and then trampling or cracking between two stones.

**Traditional extraction method:** Seeds were cracked using mortar and pestle. The kernels were removed by trampling, weighed and dried before being crushed, ground and kneaded to form a paste. The paste (250 g by weight) was put in hot water (85°C) and allowed to stand for 8 h. A grey coloured mass was formed as the oily fat separated from the oil-water emulsion. The fat was skimmed off from the surface, clarified and heated before solidification. The congealed fat was then moulded in to various forms and carefully packed in glass containers with aluminium foil paper in between the screwed container cover.

**Solvent extraction method:** The seeds were cracked with mortar and pestle. The kernels were removed by trampling, weighed (400 g) and oven dried before being crushed, ground and kneaded to form a paste. Afterwards 250 g of the paste was stored in a labeled airtight container inside a cupboard and later extracted of oil.

The paste was then put in a breaker; 120 mL of hot water at 85°C and 230 mL of n-hexane (solvent) was added. This was allowed to stand for 48 h for the oil to separate and then the oil was decanted. It was solidified and packaged afterwards in glass containers with aluminium foil paper placed in-between the screwed container cover. The flow charts for the pre-treatment and production of Shea nut butter is as shown in Fig. 1 and 2, respectively.

**Determination of percentage (%) yield:** The percentage yield was calculated using the equation as shown below:

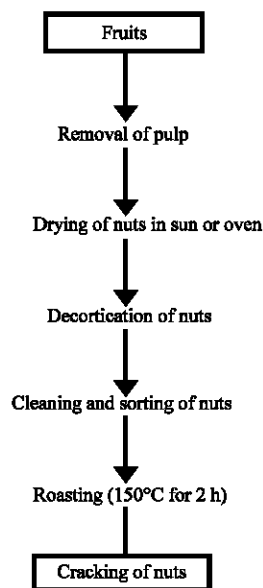


Fig. 1: Flow Diagram for pre-treatment of shea kernels

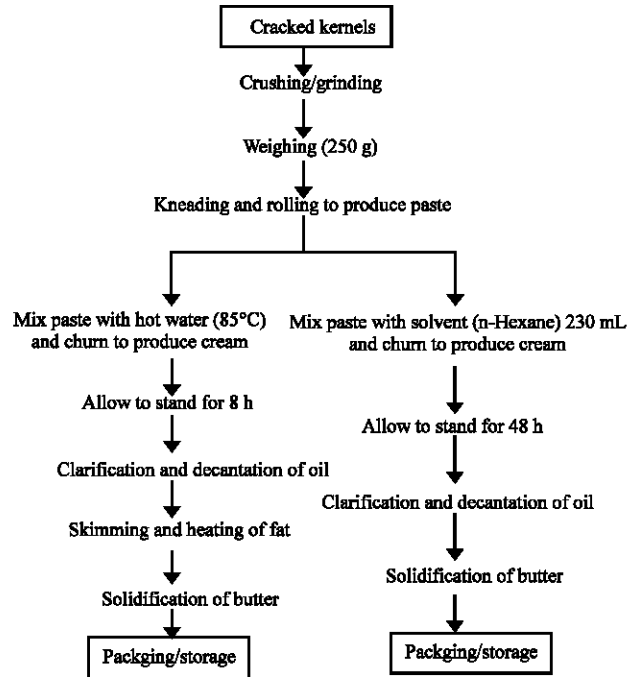


Fig. 2: Flow diagram showing traditional and solvent extraction of shea butter oil

$$\text{Percentage yield of oil} = \frac{\text{Weight of oil}}{\text{Weight (g) of sample (shea nut)}} \times 100$$

### Physical characteristics

**Smoke, flash, fire points and melting points:** Determination of the smoke, flash, fire points and melting point was carried out by the method described by Onwuka (2005):

$$\text{Percentage moisture content (\%)} = \frac{\text{Weight of oil}}{\text{Weight (g) of sample (shea nut)}} \times 100$$

Moisture was determined by the air-oven methods of AOAC (1997).

**Specific gravity and refractive index:** The specific gravity and Refractive Index (RI) were also determined using recommended methods (AOAC, 1997). Pycnometer bottle and refractometer were used to determine refractive index and specific gravity, respectively.

### Chemical characteristics

**Thiobarbituric acid number or value (TBA):** Thiobarbituric acid test is used to determine deterioration in extractable and non-extractable lipids. The method described by Oparaku (2010) was used. A mass of 10 g of oil was macerated into 50 mL of water for 2 min and washed into distillation flask with 47.5 mL water. A 2.5 mL solution of 4N HCl was added to bring the pH to 1.5 and followed by addition of a few glass beads. The flask was heated by means of an electric heating mantle and 50 mL distillate was collected 10 min after boiling commenced. After which 5 mL of the distillate was pipette into a glass stopped tube and 5 mL of TBA reagent (0.2883 g/100 mL of 90%

glacial acetic acid) was added, shaken and heated in boiling water for 35 min. A blank was prepared similarly using 5 mL water with 5 mL reagent. The tubes were cooled in water for 10 min and the absorbance (D) was measured against the blank at 538 nm using 1 cm cells.

$$\text{TBA number} = (\text{mg malonaldehyde per kg sample}) = 7.8 (D)$$

**Acid value:** Acid value is defined as the number of milligram (mg) of Potassium hydroxide (KOH) required to neutralize free acids in a given mass (g) of sample. A mass of 2.50 g oil was weighed and 25 mL of alcohol was added to it. The mixture was shaken and then two drops of phenolphthalein solution were added and agitated vigorously after which it was then titrated with 0.1 M NaOH with vigorous shaking until a persistent pink colour was observed. The 0.1 NaOH in titration corresponds to % free fatty acids and expressed as oleic acid. The acid value was expressed as:

$$\text{Acid value} = \frac{\text{Titer (mL)}}{\text{Weight (g) of sample used}} \times 5.61$$

$$\text{Free fatty acids} = 2 \times \text{acid value.}$$

**Peroxide value:** As a result of changes which fats undertake during storage, emission of unpleasant odour and taste occur. This process is referred to as rancidity. Rancidity therefore is used as a basis for study of shelf-life stability of vegetable fats. Peroxide value is used to monitor the development of rancidity.

Peroxide value was determined by the described by Akubugwo and Ugbogu (2007) with modifications.

The oil sample was weighed (1.0 g) into a clean dry boiling tube and while still liquid 1 g of powdered potassium iodide (KI) and 25 mL of solvent mixture (2:1 v/v glacial acetic:chloroform) was added and the tube was transferred into boiling water and allowed to boil vigorously for 30 sec. The contents were quickly poured into a flask containing 30 mL of water and titrated with 0.002N sodium thiosulphate ( $\text{Na}_2\text{S}_2\text{O}_3$ ) using starch as indicator. A blank determination was similarly prepared. Peroxide value was calculated from the equation:

$$\text{Peroxide value} = \frac{S \times N \times 100}{\text{Weight (g) of sample used}}$$

where, (S is volume of ( $\text{Na}_2\text{S}_2\text{O}_3$ ) used in test-volume of ( $\text{Na}_2\text{S}_2\text{O}_3$ ) used in blank) mL, N is normality of thiosulphate ( $\text{Na}_2\text{S}_2\text{O}_3$ ).

**Saponification value:** Saponification value of an oil sample is defined as the number of mg of Potassium hydroxide (KOH) required to neutralize the fatty acids resulting from the complete hydrolysis of 1 g of the sample. Soap is formed during Saponification as shown below:



The method of BP 2007 as reported by Anderson-Foster *et al.* (2012) was used. Oil sample weighing 2 g was put into a round-bottom flask, 25 mL of 0.5 N ethanolic potassium hydroxide was

added followed by two dispersion beads and the mixture was boiled for 30 min in reflux condenser. The mixture was removed from the heat source and 1 mL of phenolphthalein was added. The mixture was then titrated with 0.5 M hydrochloric acid until a pink color that persisted for more than 15 sec was observed. The saponification values were calculated using the expression:

$$\text{Saponification value} = \frac{B - A \times 28.05}{\text{Weight (g) of sample used}}$$

where, A is H<sub>2</sub>SO<sub>4</sub> for sample mL, B is H<sub>2</sub>SO<sub>4</sub> for blank mL.

**Iodine value:** This could be defined as the weight of iodine absorbed by 100 parts by weight of the sample or it is the measure of degree of unsaturation. In vegetable oil iodine value is constant for particular oil or fat but the exact figure obtained depends on the particular technique employed. The iodine value is mostly used for identification of oil or to assign a particular group to the oil. Wiji's method was employed in the determination of Iodine value (AOAC, 1997; Akubugwo and Ugbogu, 2007). The expression below was used for calculation:

$$\text{Iodine value} = \frac{(b - a)M \times 1.269}{\text{Weight (g) of sample used}}$$

where, a is titre value, b is blank (mL), M is molarity of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> solution.

**Sensory evaluation:** Sensory evaluation was carried out using the 7-point hedonic scale where 7 represents like extremely and 1 represents dislike extremely as described by Ihekoronye and Ngoddy (1985). It was performed by a panel of 15 judges, the judges were chosen on the basis of their familiarity with shea butter. Sensory quality attributes evaluated were appearance, texture, odor and general acceptability.

**Statistical analysis:** Data obtained was subjected to mean and standard deviation using Genstat Discovery Edition 4 statistical package.

## RESULTS AND DISCUSSION

**Results:** Shea butter oil was characterized along the following physico-chemical parameters; yield of oil (%), melting point (°C), smoke point (°C), flash point (°C) fire point (°C), moisture content (%), specific gravity, refractive index, TBA value (mg MDA kg<sup>-1</sup>), peroxide value (mEq kg<sup>-1</sup>), Saponification value(mEqKOH/g), Iodine value (I<sub>2</sub>g/100 g) and some sensory quality attributes; appearance, texture, odour, general acceptability with the results as shown in Table 1-3.

**Percentage yield of oil:** From the results (Table 1), a significant difference (p<0.05) was observed between the solvent extraction method and traditional extraction method in terms of oil yield. The oil yield value for the solvent extraction method (47.5%) was higher than that for the traditional method of extraction (34.1%).

**Moisture:** Although both extraction methods produced relatively low Moisture Contents (MC), solvent method with MC 0.05±0.12 was significantly different (p>0.05) from traditional extraction method which had a MC of 0.2±0.06 (Table 1).

Table 1: Effect of extraction method on the physical properties of shea butter oil

Parameters	Sample A (solvent method)	Sample B (traditional method)	Soya bean (Glycine max) oil
Yield of oil (%)	47.5±0.06 <sup>a</sup>	34.1±0.02 <sup>b</sup>	
Melting point (°C)	33.0±0.00 <sup>b</sup>	34.1±0.00 <sup>a</sup>	35
Smoke point (°C)	223±6.10 <sup>a</sup>	223±5.33 <sup>a</sup>	245
Flash point (°C)	253±0.05 <sup>b</sup>	255±0.19 <sup>a</sup>	324
Fire point (°C)	301±8.10 <sup>a</sup>	303±3.25 <sup>a</sup>	360
Moisture content (%)	0.05±0.12 <sup>a</sup>	0.2±0.06 <sup>b</sup>	0.8
Specific gravity	0.92±0.01 <sup>a</sup>	0.91±5.20 <sup>b</sup>	0.91
Refractive index	1.46±0.01 <sup>a</sup>	1.46±0.01 <sup>a</sup>	1.47

Values are Mean±SD of triplicate determinations. Means with different superscripts within the same row are significantly different (p<0.05). LSD: Least significant difference, Values for soya beans (*Glycine max*) oil were extracted from Okullo *et al.* (2010)

Table 2: Effects of extraction method on the chemical properties of shea butter oil

Parameters	Sample A (solvent method)	Sample B (traditional method)	Soya bean (Glycine max) oil
TBA value (mg MDA kg <sup>-1</sup> )	4.39±0.71 <sup>a</sup>	4.36±0.06 <sup>a</sup>	11.0
Acid value (mgKOH kg <sup>-1</sup> )	1.20±0.13 <sup>a</sup>	0.50±0.06 <sup>b</sup>	1.80
Peroxide value (mEq kg <sup>-1</sup> ) (after 24 h)	2.57±0.03 <sup>a</sup>	0.40±0.32 <sup>b</sup>	4.80
Saponification value (mgKOH g <sup>-1</sup> )	184±0.21 <sup>b</sup>	183±0.32 <sup>b</sup>	4.80
Iodine value (I <sub>2</sub> g/100 g)	61.31±0.25 <sup>a</sup>	59.80±0.17 <sup>b</sup>	120

Values are Mean±SD of triplicate determinations. Means with different superscripts within the same row are significantly different (p<0.05). LSD: Least significant difference, Values for soya beans (*Glycine max*) oil were extracted from Okullo *et al.* (2010)

Table 3: Effects of extraction method on the sensory attributes of shea butter oil

Quality attributes	Sample A (solvent method)	Sample B (traditional method)
Texture	6.00±1.00 <sup>a</sup>	5.30±1.13 <sup>b</sup>
Appearance	4.90±0.79 <sup>b</sup>	5.90±0.91 <sup>a</sup>
Odour/Aroma	4.65±1.34 <sup>b</sup>	5.05±0.94 <sup>a</sup>
General Acceptability	5.30±1.08 <sup>b</sup>	5.75±1.07 <sup>a</sup>

Means with different superscripts within the same row are significantly different (p<0.05)

**Smoke, flash and fire points:** The results in Table 1 shows no significant difference (p>0.05) in the smoke points (223±6.10) and (223±5.33) for solvent and traditional method, respectively. Flash and fire points had the values 253±0.05 and 301±8.10, respectively for solvent method, 255±0.19 and 303±3.25, respectively for traditional method.

**Refractive index:** The refractive indices 1.464±0.01 and 1.461±0.01 were observed for solvent and traditional methods, respectively at temperature of 20°C.

**Specific gravity:** Table 1 shows specific gravity was 0.917±0.01 for solvent method and 0.905±5.20 for traditional method.

**Thiobarbituric acid (TBA) value, acid value, peroxide value, saponification value and iodine value:** Table 2 shows the effects of extraction method on the chemical properties such as Thiobarbituric acid (TBA) value which was 4.39±0.71 and 4.36±0.06 for solvent and traditional method, respectively. There was no significant difference (p>0.05) between the methods. Acid value was 1.20±0.13 and 0.50±0.06 for solvent and traditional method, respectively. The peroxide value, 2.57±0.03 for solvent method and 0.40±0.32 for traditional method were low compared to the value



of soya beans (4.80) reported by Hammond *et al.* (2005). Saponification value was  $184\pm 0.21$  and  $183\pm 0.32$  for solvent and traditional method, respectively. The iodine value obtained for Shea butter oil was  $61.31\pm 0.25$  and  $59.80\pm 0.17$  for solvent and traditional method, respectively.

**Sensory acceptability:** Table 3 shows the effects of extraction method on the sensory properties such as texture which was  $6.00\pm 1.0$  and  $5.3\pm 1.13$  for solvent and traditional method, respectively. Appearance  $6.00\pm 1.0$  and  $5.3\pm 1.13$ , odour/aroma was  $4.65\pm 1.34$  and  $5.05\pm 0.94$  and general acceptability  $5.30\pm 1.08$  and  $5.75\pm 1.07$  for solvent and traditional method, respectively.

**Discussion:** The observed oil yield values fall within the reported range for commercial vegetable oils such as cotton seed (19.50%), soybeans seed (19.0%), palm oil (48.65%) and groundnut (49.0%) (Dawodu, 2009). The values also agree with the 32.80% reported by Kar and Mital (1999) and 45%-55% reported by Elvers *et al.* (1989) for oil extracted by solvent method. These results attest to the usefulness of shea oil for domestic and industrial application, a fact that has already been mentioned in this study. According to Matchet (1963), oil-bearing seed that can yield up to 30% oil can be considered as suitable for industrial applications. Thus the both methods of extraction are suitable for domestic, commercial and industrial applications however, the solvent extraction can be said to be a more efficient method in terms of yield compared to the traditional method.

Solvent extraction method had a significantly lower moisture content value than traditional extraction method meaning that former method optimizes the keeping quality of shea butter oil since oils with high MC are known to undergo rancidity (Fellows, 1997).

Smoke point is an important indicator of the temperature at which an oil sample will fry. Smoke point depends on the free fatty acid content of the oils as there are more volatile than their corresponding triacylglycerols. The melting point observed was  $33.0$  for solvent and  $34.1^{\circ}\text{C}$  for traditional method as compared with soya bean oil ( $35^{\circ}\text{C}$ ) (Hammond *et al.*, 2005). This means that Shea butter is a solid fat below  $35.0^{\circ}\text{C}$ .

The refractive indices  $1.464\pm 0.01$  and  $1.461\pm 0.01$  were observed for solvent and traditional methods, respectively at temperature of  $20^{\circ}\text{C}$ . The observed value for the solvent extraction method is higher than that for the traditional method because of the more viscous appearance of the Shea butter oil extracted by solvent method. However, the observed values do not differ much from the refractive indices of soya bean oil (1.473), castor oil (1.47) (Hammond *et al.*, 2005; Kyari, 2008) and palm oil (1.46) (Akinyeye *et al.*, 2011) and fall within the range reported for some oils in the nut family (1.45-1.49) (Eckey, 1954); 1.447-1.482 (Shahidi, 2005). Refractive index increases with increasing chain length and also with the number of double bonds present in the oil (Nielsen, 1994). The refractive index of oils depends on their molecular weight, fatty acid chain length, degree of unsaturation and degree of conjugation (Shahidi, 2005). Triacylglycerols have higher refractive indices than do their constituent free fatty acids (Shahidi, 2005).

The specific gravity of the Shea butter oil indicates that the oil is heavier than water and will form an upper layer in a water-oil mixture.

The observed TBA values were lower when compared to 11.0 for soya bean oil (Hammond *et al.*, 2005) thereby indicating that the Shea butter oil has a longer keeping quality than the soya bean oil considering that TBA is a measure of the extent in lipids.

A low Acid Value (AV) means that an oil sample contains less free fatty acids thus reducing its exposure to rancidification (Roger *et al.*, 2010; Asuquo *et al.*, 2012; Anderson-Foster *et al.*, 2012). AV is also an indicator for edibility of oil as well as their suitability for industrial use. It is defined

as the number of grams of potassium hydroxide required to neutralize one gram of oil (BP, 2007). The AV observed for Shea butter oil extracted by solvent method was 1.20 while 0.50 was observed from the traditional method. These values were significantly different ( $p > 0.05$ ) and relatively low compared with the AV of soy bean oil (1.80). A higher AV was observed for the solvent method which was above the 1% threshold reported by Kyari (2008). However, the recommended codex value is 0.6 and 10% for virgin and non-virgin edible fats and oils, respectively (Codex Alimentarius Commission, 1993). Therefore using the codex standard, the oil extracted by both methods are suitable for edible purposes as well as use in the manufacture of paints and vanishes even though oils from traditional method seem most suitable for cooking purposes.

High Peroxide Value (PV) ( $> 10 \text{ meq kg}^{-1}$ ) is associated with the development of rancidity in fats and oils, which eventually limits their use in the food industry (Shahidi, 2005). PV is the most common determinant of lipid oxidation (Shahidi, 2005). Hydroperoxides have no flavor or odor of their own, but they are unstable and break down rapidly to other products such as aldehydes that have a strong, disagreeable flavor and odor. Peroxide value measures the milliequivalents of oxygen (hydroperoxides) per gram of oil. The PV obtained for Shea butter oil extracted by traditional method is most acceptable even though both methods possess acceptable PV.

Saponification value is a measure of the alkali-reactive groups in fats and oil and is defined as the mg of KOH needed to saponify 1 g of oil (Shahidi, 2005). The saponification value of 184 (solvent extraction) and 183 (traditional method) obtained for Shea butter oil is lower than those of the common oils such as soya bean (189-195), Peanut (187-196), cotton seed oil (189-198) (Codex Alimentarius Commission, 1993), palm oil (200), groundnut (193) and coconut oil (257) (Kyari, 2008) but falls within the range (178-196) reported by Elvers *et al.* (1989). The saponification value of an oil increases with its lauric acid content. The lauric acid content and the Saponification value of oil serve as important parameters in determining the suitability of oil in soap making. Saponification value is also used in checking adulteration; a low value could suggest non-suitability of oil sample for industrial use. Even though there was no significant difference ( $p > 0.05$ ) in the saponification values of the two samples, the oils from the two methods may not enjoy a comparative advantage with oils from other seeds in terms of their ability to saponify.

The results in Table 2 show that shea butter oil can be classified as a non-drying oil because of its low iodine value. Asuquo *et al.* (2012) notes that non-drying oils have iodine values less than 100. The iodine value of shea butter oil is lower than those of sunflower (110-143), castor oil (83.75) and soybeans (120-143). Iodine is a simple chemical constant used to measure unsaturation or the average number of double bonds in an oil sample. It is defined as the number of grams of iodine that could be added to 100 g of oil (AOAC, 1990; Shahidi, 2005). 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).

Extraction method had varying effects on sensory parameters of texture, appearance, odour/aroma and general acceptability. While the texture and general acceptability for solvent extraction method which was significantly different for traditional extraction method seem more acceptable, appearance and odour/aroma for the same method was not acceptable to the test panelists.

## CONCLUSION

On the whole the result of this study has shown existence of differences in physical, chemical and sensory properties of shea butter oil extracted by solvent and traditional extraction methods.

Shea butter oil extracted by both methods were showed to be capable of serving as a high yielding commercially rich source of vegetable oil with qualities suitable for the production of confectionaries, margarine and a considerable long shelf life. The study results however showed that, Shea butter oil from both of the studied extraction methods would be less competitive compare to other oils for industrial soap manufacture, while the suitability of Shea butter oil for cooking due to its low peroxide values was noted. Solvent method seem the better, more efficient method in terms of oil yield percentage, TBA, saponification and iodine value even though lacking in overall sensory acceptability compared to the traditional method of extraction which scored higher in terms for overall sensory attributes.

We recommend that more studies should be done to find out why the traditional extracted oil was more acceptable in terms of sensory attributes than that gotten by solvent extraction method and protocols developed for improving the sensory acceptability of oil extraction by solvent method.

New studies should also attempt to lower the cost of using solvent extraction method as we as devise innovations for bringing the technology closer to local processors.

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