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Production of Soap From An Indigenous *Moringa oleifera* LAM SEED OIL.

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Abstract

Some physicochemical properties and quality characteristics of *Moringa oleifera L.* seed oil were analysed and the following values were obtained; Percentage yield 39.40 %; Acid value 13.09±0.01 mgKOH/g; Peroxide value 37.79±0.02 meq H_2O_2; Iodine value 51.43±0.02 gI_2/100g; Saponification value 141.98 ± 0.02 mgKOH/g; Free fatty acid 8.32 ± 0.01(% oleic acid). Alkali hydrolysis was performed on the extracted seed oil to produce anionic surfactant (soap). The pH of the prepared soap was 8.53, the soap was cream in colour and slightly soluble in distilled water. Justification of the use for the seed oil for home made and large scale industrial production of soap was discussed

Key words: *Moringa oleifera,* oil extraction, surfactant, pH Test, Foam ability.

Introduction

The Moringa tree, *Moringa oleifera* is native to India but has been planted around the world and is naturalized in many localities. Moringa goes by many names. In the Philippines, where the leaves of Moringa are cooked and fed to babies, it is called "mother's best friend" and "malunggay." Other names for it include the benzolive tree (Haiti), horseradish tree (Florida), Nebedey (Senegal) and drumstick tree (India) [1]. In northern Nigeria it is known in Hausa language as " Zogale" [2].There are about 13 species of Moringa trees in the family *Moringaceae* which are native to India, the Red Sea and/or parts of Africa including Madagascar. Of these species, *Moringa oleifera* is the most widely known. It is a multipurpose tree known as nature's medicine cabinet. [3]. In Burkina Faso, *Moringa oleifera* species and its leaves are used for "to" (dough of cereals flour submitted to heat) and rice sauce preparation [4]. Almost all parts of the plant are potentially useful. The seeds are probably the most useful part of the plant, containing a significant percentage of high quality oil [5].The seeds of *Moringa* contain about 35- 40 % oil. This oil is of excellent quality similar to olive oil, and it takes time to become rancid [1]. It gives high oil yield, which has good antioxidant properties with potential for industrial, nutritional and health applications [6]. The oil which is sometimes known as 'ben oil', is used for a variety of purposes [7, 8] e.g as fuel for cooking purposes and for providing light in developing countries [9]. It is also used in perfumes, as lubricant in watches and other farm machinery and for

making soap [7, 8, 1]. It has various cosmetic values and is used in body and hair care as a moisturizer and skin conditioner. *Moringa* oil is also useful in removing dirt out of the hair and is an efficient natural cleanser. *Moringa* oil blends easily with essential oils and this combined with its non-drying quality and its ease of application on the skin makes it excellent massaging oil. Other uses include soap making and for use in cosmetic preparations such as lip balm and creams. The oil can be considered to have relative potentials for cosmetics just like the African shea nut butter [10].Various extraction methods are employed in obtaining oil from *Moringa* seeds, quality assessment of *Moringa concanensis* seed oil extracted through solvent and aqueous-enzymatic techniques was reported [11]. *Moringa* oil is a non-drying oil with a pale yellow consistency. This research is aimed at the extraction and chemical analysis of *Moringa oleifera* seed oil and its utilization for the preparation of soap and analysis of some of its physical and chemical properties.

Materials and Method

Seed material

Moringa oleifera seeds were obtained from its plant in a test plot in Warra town, Ngaski Local Government Area of Kebbi State, Nigeria. The plant was identified and authenticated by a Botanist at the Biological Sciences Department, Bayero University, Kano (BUK) Nigeria. Confirmation of taxonomic identity of the plant was achieved by comparison with voucher specimen (voucher No.11) kept at the Herbarium of the Department of Biological Sciences and use of documented literature [12].Good seeds were selected and damaged ones were discarded. The seeds were cleaned, de-shelled and well dried and ground using laboratory plastic pestle and mortar prior to extraction.

Oil extraction

Routine extraction of 50 g of ground seeds of *Moringa oleifera* Lam was carried out in a soxhlet extractor using n-hexane (b.p. 40–60 ◦C) for 6 hours. The oil was obtained after the solvent was removed under reduced temperature and pressure and refluxing at 70ºC to remove excess solvent used in the oil [13]. Extracted seed oil was stored in freezer at −2°C for subsequent physicochemical analysis. The extraction was carried out in the Biochemistry Laboratory, Department of Biochemistry, Kebbi State University of Science & Technology, Aliero, Nigeria.

Oil yield

The oil which was recovered by distilling most of the solvent on a heating mantle was then transferred to measuring cylinder. The measuring cylinder was then placed over water bath for complete evaporation of solvent for about 2-3 h in accordance with the literature [14] and volume of the oil was recorded and expressed as oil content in percentage (%).

Physico-chemical analysis

The acid value, iodine value and saponification value determinations were carried out using the methods reported [15, 16, 17]. Free fatty acid was determined according to the official method of AOCS, Ca 5a-40 [38] while peroxide value was determined using the appropriate [18].

Acid value

A mixture of 100cm^{3}of neutral ethyl alcohol was heated with 10g of the oil sample in a 250 ml beaker until it began to boil. The heating was stopped and the content cooled, and titrated with 0.1M KOH, using two drops of phenolphthalein as indicator until a permanent pink color was obtained at the end point.

Acid value was calculated using the expression;

A.V =0.56 x Vol 0.1M KOH.

Saponification value

A sample of oil (2 g) was added to a flask containing 30ml of ethanolic KOH and heated under reflux for 30mins to ensure that the sample was fully dissolved. The solution was cooled; 1 ml of phenolphthalein was added and titrated with 0.5 M HCl until a pink color indicates the end point.

Saponification value was calculated using the expression;

$$SV = \frac{(S-B) \times M \times 56.1}{\text{Sample weight (g)}}$$

where S = sample titre value

B = blank titre value

M = molarity of the HCl

56.1 = molecular weight of KOH

Iodine value

The oil sample (0.4 g) was weighed into a conical flask and 20ml of carbon tetrachloride was added to dissolve the oil. Then 25ml of Dams reagent was added to the flask using a pipette in fume chamber. Stopper was then inserted and the content of the flask was vigorously swirled, and placed in the dark for 2.5 h. At the end of this period, 20ml of 10 % aqueous potassium iodide and 125ml of water were added using a measuring cylinder. The content was titrated with 0.1 M sodium thiosulphate until the yellow color almost disappeared. Few drops of 1 % starch indicator were added and titration continued by adding thiosulphate dropwise until blue coloration disappeared after vigorous shaking. The same procedure was used for blank test.

$$I.V = \frac{12.69C\,(V_1-V_2)}{M}$$

where C = Concentration of sodium thiosulphate

V_1 = Volume of sodium thiosulphate used for blank

V_2 = Volume of sodium thiosulphate used for determination

M = Mass of the sample.

Free fatty acid

About 2g of the oil sample was weighed into a 250 ml Erlenmeyer flask and 20 ml of 95% neutralized

ethanol was added to the flask. The solution was heated gently

to aid the dissolution of the oil in the alcohol, and 2 drops of phenolphthalein solution was added as indicator.

The yellowish solution obtained was titrated with 0.1 M standard sodium hydroxide with vigorous shaking. The color of the solution turned pink and at the point when the pink color persisted for 30 s was taken as the end point. The percentage of free fatty acid (% oleic acid) in the oil was calculated as follows:

$$\% \text{ Free fatty acid (\% oleic)} = \frac{V \times M \times 28.2}{w}$$

where,

V = average volume of NaOH (ml)

M = molarity of NaOH (0.1)

W= Weight of sample

Peroxide value

Chloroform (10 ml) was added to 2 g of the sample in a 500 ml conical flask and stirred to dissolve the oil quickly, 15 ml of glacial acetic acid was added, followed by 1 ml freshly prepared saturated potassium iodide solution. The flask was closed and stirred for 1min. and kept in the dark for 5min, 75ml of water was added and shaken vigorously. 3 drops of starch solution was added as indicator. The liberated iodine was titrated against 0.01 M sodium thiosulphate.

Peroxide value was calculated using the expression;

$$P.V = \frac{(V_1\text{-}Vo) \times C \times 1000}{M}$$

where; Vo = **volume of sodium thiosulphate**

V_1 = Volume of sodium thiosulphate solution used for determination of sample C= the concentration of sodium thiosulphate used, while M= mass of test sample.

Saponification Procedure

50 ml of 200 g/dm^3 alkali solution was poured directly into the beaker containing the oil in the ratio 1:1 (v/v) and superfatting with 15% of the oil. The oil was warmed gently and poured into the beaker followed by the alkali solution to form an intimate mix and then stirred vigorously for 10-15 min using stirring rod. The saponification mixture was then poured into moulds, and the soap was allowed to harden by air-drying for 24 h.

pH Determination

The pH was determined using a pH meter (827 pH Lab Model). 5g of the soap shavings was weighed and dissolved in distilled water in a 50 ml volumetric flask. This was made up to mark to give 10 % soap solution [19] and pH meter was immersed into the solution and the pH reading was recorded.

Foam ability Test

Soap shavings (0.5g) were added to a 100 ml measuring cylinder containing 100 ml of distilled

water. Vigorous mixing was done for 15 min using Votex mixer (Model 3518 J-Kem Scientific England) The mixture was shaken vigorously so as to generate foams. After shaking for about 5min, the cylinder was allowed to stand for about 15mins. The height of the foam in the solution was measured and recorded.

RESULTS

Table 1: Physicochemical and quality characteristics of *Moringa oleifera* seed oil

Parameter	Result
Acid value (mgKOH/g)	13.09 ± 0.01
Saponification value (mgKOH/g)	141.98 ± 0.02
Iodine value (gI_2/100g)	51.43 ± 0.02
Free fatty acid (% oleic acid)	8.32 ± 0.01
Peroxide value (meq H_2O_2)	37.79 ± 0.02
Percentage yield (%)	39.40

The values are mean and standard deviation of triplicates determinations.

Table II: Physical characteristics of *Moringa oleifera* seed oil

Parameter	Observation
Colour	Pale yellow
Odour	Agreeable
Physical state at room temperature	Liquid

Table III: Physico-chemical characteristics of the *Moringa oleifera* seed oil soap.

Parameter	Results
PH	8.53
Foam height(cm)	3.5
Colour of soap solution	Cream
Solubility in water	Slightly soluble

The values are mean of triplicates determinations.

Discussion

The oil content of the *Moringa oleifera* seed oil was 39.40 %, higher than the seed oil content (36.50 %) for 25 Safflower Genotypes Seed Oil reported [20] while oil content of the pawpaw and orange seeds were 25.8 % and 34 % reported respectively [21]. The physico-chemical analysis of *Moringa oleifera* seed oil showed that it has saponification value of 141.98 ± 0.02 mgKOH/g which is lower than the saponification value of the following seed oil; *Afzelia africana* vegetable oil 229.12 mg KOH g^{-1} [22], 252.44-257.59 and 196.82-201.03 mg KOH g^{-1} reported for Coconut (*Cocos nucifera*) and melon (*Colocynthis citrullus*) seed oils respectively which have great potentials in soap manufacturing industries because of their high saponification value [23], Nigerian cotton seed oil 199.42 mgKOH/g [13], Neem seed oil 213 mgKOH/g [24], *Hyptis spicigera* seed oil 154.10 mgKOH/g [25], *Citrus lanatus* 189.35 mgKOH/g [26], *Adansonia digitata* linn seed oil 230.01 mgKOH/g [27] and *Elaeis guineensis* seed oil 246.60 mgKOH/g [28] . However the value is higher than the saponification value of the following oils; *Nepoleana imperials* seed oil 77.06 mgKOH/g [5], Castor seed oil 123.3 mgKOH/g [13] , *Polyalthia longifolia* seed oil 120.00 mgKOH/g [28], Cashew kernel oil 137 mgKOH/g [31] , High saponification value indicate or justify the usage of oil for soap making [13], but almost as high as as that of African Pear seed oil 142.760 mgKOH/g [29].

The iodine value of 51.43 ± 0.02 I_2/100 g which was obtained is lower than the iodine value of the following oils; Hexane extracted groundnut oil, 100.0± 0.05 [32], *Polyalthia longifolia* seed oil 95.00I_2/100 g [30], Shea nut oil 53.6 I_2/100 g [33], *Detarium microcarpum* 55.9 I_2/100 g [34], *Hypertis spicigera* seed oil, 81.22 I_2/100 g [25], *D. microcarpum* seed oil, 58.02 I_2/100 g [26] , higher than the value of *Landolphia owariensis* seed oil 15.10 I_2/100 g [28], and *Elaesis guineensis* seed oil 18.30 e_2/100 g [28]. Cashew nut oil 41.3I_2/100 g [31]. The iodine value that was obtained is below 100 hence it can be referred to

as non - drying oils and they are good or useful in soap production [12]. The acid value obtained 13.09 ± 0.01 mgKOH/g is lower than the following values obtained from other seed oils; African pear seed oil, 15.28 mgKOH/g [29], *Monodora myristica gaertin* seed oil, 14.31 mgKOH/g [27], rubber oil, 15.03 mgKOH/g [35]. However the acid value is higher than the following seed oils: *Hyptis spicigera* seed oil, 2.5 mgKOH/g [36], *Citrus lanatus* seed oil, 5.25 mgKOH/g [26], Avocado pear seed oil, 5.20 mgKOH/g [29], Cashew kernel oil, 10.70 mgKOH/g [31], Shea nut oil, 10.5 mgKOH/g [37] recommended for soap making. The free fatty acid obtained from the analysis of the seed oil was 8.32 ± 0.01 % which is lower than the value of *Callophyllum inophyllum* linn seed oil, 160.3 % [27] , higher than the values reported for the following oils; *Polyalthia longifera* seed oil, 7.73 % [30], *Monodora myristica gaeth Dunat* 7.20% [20], rubber seed oil, 7.55% [38]. Free fatty acid can stimulate oxidative deterioration of oils by enzymatic and/or chemical oxidation to form off flavor component [27]. Hence a moderately low value of free fatty acid may be of an advantage for the stability of the oil. The peroxide value obtained which has a value of 37.79 ± 0.02 mgmeq/kg is lower than; *Polyalthia longifora* seed oil, 730.00 mgmeq/kg [30], *Butyrospermum parkii* oil, 77.5 mgmeq/mg [34], but higher than *Dacroyodes edulis* (G.Don) H.J lam seed oil 20.00mgmeq/kg [26], *Stercula setegera* seed oil 35.0mgmeq/kg [34]. High peroxide value indicates high level of oxidative rancidity of oil and also suggests low levels of anti-oxidant [34]. This value implied that the *Moringa oleifera* oil has a low level of possible oxidative rancidity.

The pH of the prepared soap which was cream in color and slightly soluble in distilled water was 8.53, lower than 9.38 reported for cotton seed oil soap [37], comparably lower than the pH range of 9-11 but favourably higher than the pH range of 3-5, which are considered as high and low levels respectively by the National Agency for Food and Drug Administration and Control(NAFDAC) [39]. This could be due to incomplete alkali hydrolysis resulting from the saponification process. Addition of excess fat or oil or any other superfatting agent can reduce the harshness of the soap and lower the soap pH. Superfatting with 10% excess fat and oil was reported [37]. Superfatting soaps with 1-2% neutral oils or glycerine also resulted in the better quality of soaps that were free of cracks [36]. The foam height of the soap was 4.3 cm lower than that of sesame oil soap , 4.8cm [40] and higher than that of shea nut oil soap, 2.7 cm, [37].

Conclusion

From the results obtained after the chemical analysis and alkali hydrolysis (saponification) of the hexane extract it can be concluded that the oil is utilizable for soap making. The properties exhibited by the soap solution indicated that if the pH is modified by the superfatting agent it will enhance its suitability for home made and large

scale industrial production. However the research has not exploited other tests for surfactant performance, other parameters like Wetting power (wetting capacity estimation) and cleaning performance were therefore suggested for further research. Although the analysis carried out on oil sample is a preliminary work, it provides a basis for further studies on characterization of the oil and elucidation of actual structure using analysis such as NMR, GC-MS, GLC and HPLC.

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