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Physico-chemical, GC-MS Analysis and Cold Saponification of Baobab (*Adansonia digitata* L., Malvaceae) seed oil

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Abstract:- *The hexane extract of Adansonia digitata seed oil yielded 29.33±0.01%. Physicochemical properties of oil revealed the following results; acid value, iodine value and saponification value of 0.47±0.01 mgKOH/g, 23.03±0.07 gI_2/100g and* 156*±0.01 mgKOH/g respectively. The spectral analysis from the GC-MS fragments revealed the* following *fatty acids; palmitic acid, stearic acid, myristic acid, linoleic acid, behenic acid and veleric acid The light cream soap produce from the Adansonia digitata seed oil revealed the pH and foam height of 12.10±0.01 and 11.00±0.01 respectively. The results indicated that the hexane extract of the Baobab seed oil has potential in pharmaceutical soap and other cosmetic industries.*

Keywords:- *Baobab seeds, Soxhlet extraction, Physicochemical, GC-MS,* Soap *production.*

1. INTRODUCTION

Baobab (*Adansonia digitata* L., is a tree specie commonly found in Africa [1]. It is called different names in many languages; Arabic (amaraya, hamao, gungole (fruit), humier (fruit), teidoum, tabaldi, tebeldi) ; English (upside-down tree, baobab, guinea tamarind, monkey bread tree, lemonade tree, cream-of-tartar tree, sour gourd); French (pain de singe, baobab, calebassier, arbre aux calabasses, mapou zombi, mapou etranger); Hausa (kuka); Hindi (gorakh-imli, gorak lichora, gorak amla, gorak ali, gorakh-cinch, kapla-vriksha, khura-sani-imli); Swahili (mbuyu); [2] .Baobab tree belong to the family Bombacaceae and the genus *Adansonia* [3] .Baobab seeds may be eaten raw or roasted. They have a pleasant nutty flavour and are a good coffee substitute, when roasted and ground. The seeds have very high oil content [4]. Comparison of the quality parameters of the seed and condiment oil of *Adansonia digitata* was reported [5]. The seed oil is used in the production of biofuel [6] .Increase in the demand for baobab seed oil worldwide by the cosmetic industries has been reported in recent years thereby increasing the commercial value and importance of this coveted African tree [7].

2. MATERIALS AND METHODS

2.1. Sample Collection and Preparation

The Baobab seed was procured from commercial producers at Jega town of Kebbi State, Nigeria. The dried seeds were crushed into powder using mortar and pestle and were stored in a plastic container for oil extraction.

2.2. Oil Extraction Procedure

The hexane extract was obtained by complete extraction using the Soxhlet extractor (GG-17, SHUNIU). The 10 g of each powdered kernel sample was put into a porous thimble and placed in a Soxhlet extractor, using 150 cm^3 of n-hexane (with boiling point of 40-60°C) as extracting solvent for 6 hours repeatedly until required quantity was obtained. The oil was recovered by evaporation using Water bath at temperature of 70 degrees Celsius to remove the excess solvent from the extracted oil. The oil was then stored in refrigerator for subsequent physicochemical analysis.

2.3. Percentage Yield

The oil which was recovered by complete distilling of most of the solvent on a heating mantle was transferred to a beaker. The beaker was then placed over water bath for complete evaporation of solvent for about 2 hours and volume of the oil was recorded and expressed as oil content (%) in line with literature report [8]

Figure a: *Baobab seed oil (Hexane extract)*

Fig b: *Baobab seed oil soap (Freshly prepared)*

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Figure c: *Dried Baobab seed oil soap*


Figure d: *Moulded Baobab seed oil soap*

2.4. Physico-Chemical Analysis

The physico- chemical analysis of the Baobab seed oil was carried out using the methods reported [9]. [10]. [11].

2.5. GC-MS Analysis

The analysis of the fatty acids in the Baobab seed oil sample was done at National Research Institute of Chemical Technology (NARICT), Zaria, Nigeria, a Shimadzu QP2010 plus series gas chromatography coupled with Shimadzu QP2010 plus mass spectroscopy detector (GC-MS) system was used. The temperature programmed was set up from 70°C to 280°C. The carrier gas used was helium. The injection volume was 2 µL with injection temperature of 250 °C and a column flow of 1.80 milliliter per minute for the Gas Chromatography. For the mass spectroscopy, ACQ mode scanner with scan range of 30-700 atomic mass per unit at the speed of 1478 was used. The NIST05 mass spectral library was used for mass spectra comparison [12].

2.6. Preparation of Baobab Seed Oil Soap

Saponification Procedure: 20 grams of sodium hydroxide pellets was dissolved in 100cm3 volumetric flask and the volume made to the mark with distilled water. The required quantity of alkaline solution was mixed with Canary melon seed oil (ratio 1:1 v/v). The oil was warmed gently and poured into the beaker followed by the alkali solution to form an intimate mix and then stirred frequently using stirring rod until reaction reached equilibrium this took 5 minutes [13]. The saponification mixture was then poured into mould and allowed to dry (cure) for 24hours.

2.7. pH Determination

The pH was determined using pH meter (827PH Metronm Model). A 5g of the soap shavings were weighed and dissolved with distilled water in a 100ml volumetric flask. The electrode of the pH meter was inserted into the soap solution and the pH reading was recorded [14]

2.8. Foam Ability Test

A 2g of the soap was added to a 500 cm^3 measuring cylinder containing 100 cm^3 of distilled water. The foams were generated by shaking the mixture vigorously after which the cylinder was allowed to stand for 10 minutes. The height of the foam in the solution was then measured [14].

3. RESULTS

Table 1: *Physicochemical properties of Adansonia digitata Seed Oil**

Parameters	Values
Oil yield (%)	29.33±0.01
Acid value mgKOH/g	0.47±0.01
Iodine value gI_2/100g	23.03±0.07
Saponification value mgKOH/g	156±0.01

Values are expressed as mean and ± standard deviation of triplicate determinations *

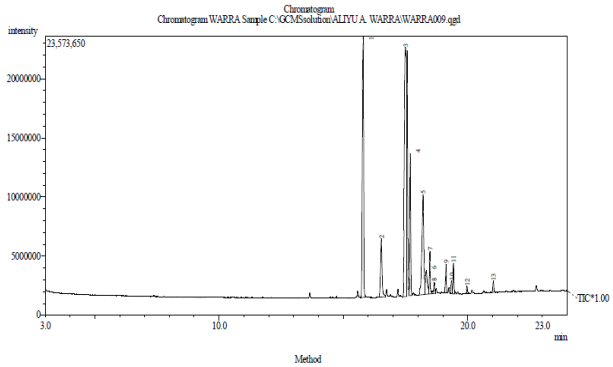
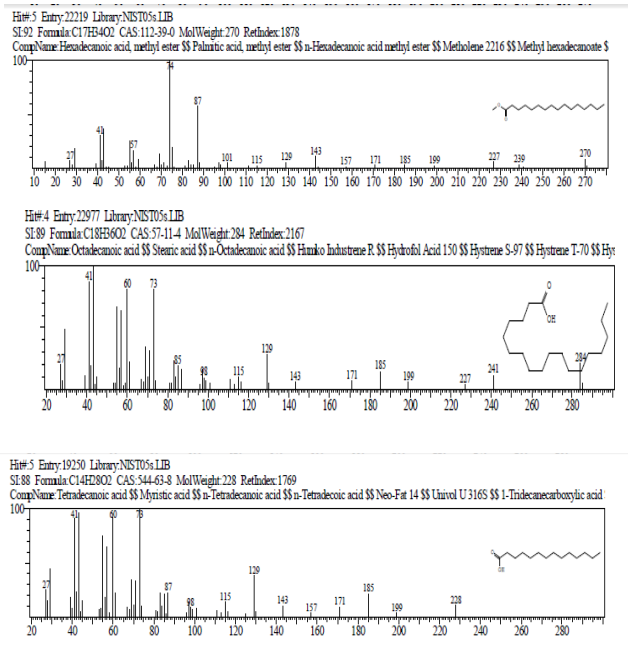


Figure 1: *Typical GC-MS total ionic chromatogram (TIC) of hexane extract of Adansonia digitata seed oil.*



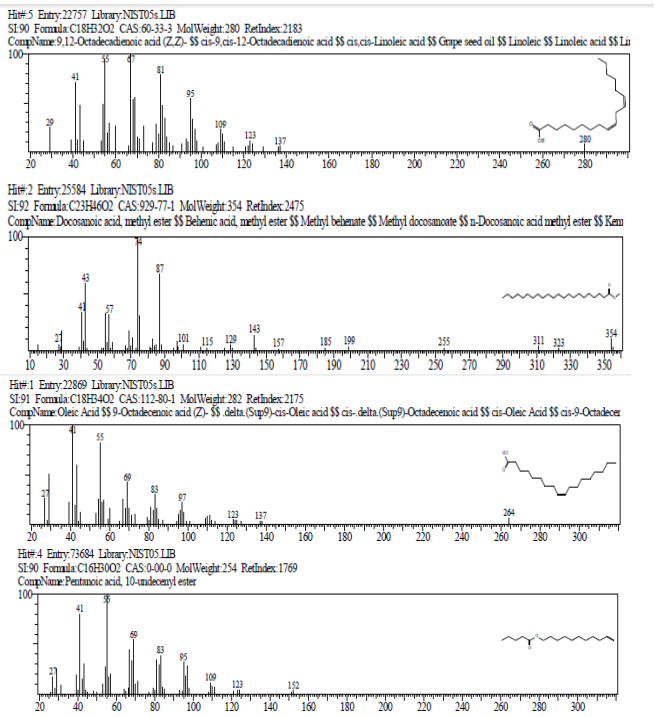


Figure 2: *GC-MS Fragments*

Table 2: *Major fatty acids derived from hexane extract of Adansonia digitata seed oil*

S/N Name of fatty acid	MF	MW	RI	SI%	to T.C.
1. Hexadecanoic acid	$C_{17}H_{34}O_2$	270	1878	92	
2. Stearic acid	$C_{18}H_{36}O_2$	284	2167	89	
3.Myristic acid	$C_{14}H_{28}O_2$	228	1769	88	
4.Linoleic acid	$C_{18}H_{32}O_2$	280	2183	90	
5.Behenic acid	$C_{23}H_{46}O_2$	354	2475	92	
6.Oleic acid	$C_{18}H_{34}O_2$	282	2175	91	
7.Veleric acid	$C_{16}H_{30}O_2$	254	1 769	90	

Note: S/N = Serial number, M.F.=Molecular formula, M.W. = Molecular weight,

RI= Retention index SI% = Similarity index, T.C. = Target compound.

Table 3: *Physicochemical properties of Adansonia digitata seed oil soap **

Parameters	Observation/ Values
Colour of soap	Light cream
pH of soap	12.10±0.01
Foam height (cm^3)	11.00±0.01
Mass of oil sample (g)	8.2
Mass of wet soap (freshly prepared) (g)	9.6
Mass of dry (cured) soap (g)	17.3

*Values are expressed as mean and ± standard deviation of triplicate determinations **

4. DISCUSSION

The oil yield (%) was 29.33±0.01 lower than 50.42±0.01 reported for canary melon seed oil [15] and 50.28±0.0 reported for onion seed oil [16] recommended for soap and other cosmetic industries. The results of the physicochemical analysis of *Adansonia digitata* seed oil showed ascid value of 0.47±0.01 mgKOH/g , this value is lower than 0.81± 0.01 mgKOH/g reported for cotton seed oil [17] and 2.39 ± 0.065 reported for castor bean seed oil [18] higher than 0.03±0.01 reported for onion seed oil [16] suitable for cosmetic production. Iodine value of 23.03±0.07 gI_2/100g was obtained which is lower than 119.8 g I2/100g reported for *C. lanatus* [19] and 86.60 ± 0.02 I2/100g (less than 100) reported for wild castor seed oil [20] which made the oil to be classified as Non-drying for the manufacture of soaps [22].

Saponification value obtained was 156±0.01 mgKOH/g lower than 171.1 mgKOH/g. reported for Palm oil [23] and higher than 148.8 ± 1.168 mgKOH/g reported for neem seed oil [24] all suitable for soap making .

The spectral analysis from the GC-MS fragments revealed the following fatty acids; palmitic acid, stearic acid, linoleic acid, behenic acid which were reported previously as having potential in cosmetic, perfumery and pharmaceutical industries [20]; [25]. Myristic and veleric acids were also detected, the former, myristic acid(tetradecanoic acid), is a saturated fatty acid A myristate is a salt or ester of myristic acid. Myristic acid is named after the nutmeg *Myristica fragrans*. The ester isopropyl myristate is used in cosmetic and topical medicinal preparations where good absorption through the skin is desire. There was literature report on safety of the inorganic salts and esters of various fatty alcohols of myristic acid [26]. Most of the esters were known to be useful as skin conditioning agents in many types of cosmetics in a range of concentrations. The latter (Veleric acid) or pentanoic acid, is a straight-chain alkyl carboxylic acid. Volatile esters of valeric acid tend to have pleasant odors and are used in perfumes and cosmetics.

The light cream soap produce from the *Adansonia digitata* seed oil revealed the pH of 12.10±0.01 higher than 11.03± 0.02 reported for canary melon seed oil soap (Warra et al.,2015) higher pH can be regulated by superfatting.

Foam height of 11.00±0.01cm^3 was re recorded, the value is higher than 4.5cm^3 reported for Gingerbread plum seed oil soap (Warra, 2012). From the calculated values of mass of the oil used and quantity of soap obtained, it showed that 8.2g of *Adansonia digitata* seed oil will yield 17.3g of soap.

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5. CONCLUSION

The results indicated that the hexane extract of the Baobab seed oil has potential in pharmaceutical soap and other cosmetic industries.

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