TALLOW TREE (*Allanblackia floribunda)* SEED OIL A BETTER SUBSTITUTE FOR PALM OIL IN SOAP MAKING FOR FAMILY SUSTAINABILITY IN ETCHE AND EMUOHA LGA OF RIVERS STATE, NIGERIA

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ABSTRACT
Tallow tree (Allanblackia floribunda) an underutilized wild fruit tree found in Etche and Emuoha local government areas were investigated for its potential in soap making. Hot water flotation method was used to extract the oil from the seeds and used in soap making. Standard Methods were used to determine the physical and chemical compositions of soap produced. Results showed Total fatty matter of 67% and 65% for A. floribunda and palm oil soap respectively. Moisture and volatile matter content gave values of 21% and 24%, while Matter insoluble in water was 0.5% and 1.0% accordingly, Matter insoluble in ethanol was significantly ($p < 0.05$) higher in palm oil soap 4.0% as against 2.5% in A. floribunda soap. Free caustic alkali was 0.15% for A. floribunda soap and 0.2% in palm oil soap; unsaponifiable matter gave values of 0.1% and 2.0% while Chloride content was 1.5% in both samples. Palm oil soap showed cracking in the cracking test and did not pass staining test while there was no crack in A. floribunda soap which also passed the staining test. Allanblackia floribunda seed oil can be considered economically important in promoting family livelihood. The seed oil is odourless and does not require any form of modification before use in soap making unlike palm oil that needs bleaching and other form of conditioning. A. floribunda oil is therefore recommended as alternative to palm oil in soap making.
Keywords: Allanblackia, palm oil, Soap, Etche, Emuoha

INTRODUCTION
Soap is formed by mixing fats and oils with a base, as opposed to detergent which is created by combining chemical compounds in a mixer (Anyakoha, 2017). Soap ingredients are grouped into primary and secondary materials. The primary materials are fats, oil and alkaline water while the secondary materials are the additives (RMDC, 2002). With its beneficial use, medical, ability to clean our clothes and disinfect our surroundings from harmful bacteria and dirt, soaps remain one of the most useful and fundamental hygiene tools ever created. Application of soap also includes cleaning of textiles fibers, wool and cotton before weaving into cloth.

Palm oil is a key ingredient used in the manufacturing of soaps. Palm oil comes from palm tree fruit. It is normally reddish in colour, due to the high number of carotenoids. The oil adds a unique feeling to cold process soap and it helps to harden the bars but creates low but stable lather. Unrefined red palm oil is a deep orange and will alter the appearance and smell of soap; there are reports of the soap having negative effects on the skin (Abubakar & Chinonso, 2005). Palm oil soap making may slightly speed up saponification and cause batch to reach quicker trace producing a good bar while still offering the same benefit (Ellis (2008).

As Palm oil prices have skyrocketed, an increasing number of soap manufacturers have begun looking for less expensive and more readily available palm oil substitutes. One of the oils that may be a better replacement is Tallow tree (*A. floribunda*) seed oil. *Allanblackia floribunda* is an evergreen forest tree confined to tropical Africa (Sefah; Adubofuor & Oldham, 2010). In Rivers State the tree is common in the wild and is frequently used as a shade tree, timber for roofing and for yam staking while seeds are left to rot away in the forest of Etche and Emuoha local government areas. It is oil rich tree crops that can also be used for soap making; the fats from the seeds of *A. floribunda* are similar in comparison to that of palm oil (Joseph; Wilfred; & James, 2013). *Allanblackia* oil has neutral smell and colour and solid at room temperature. In soap making the seed oil needs no modification such as bleaching or refining before use contrasting palm oil (Okwechime; Giami; & Kiin kabari, 2017). In Ghana, after the top-quality palm oil had been used up making soap for premium brands such as Lux and Key soap by Unilever, the factory started making nice soap from fat extracted from *Allanblackia* seeds, which local people have been using in a variety of ways for generations (Buss & Tissari, 2010). Utilizing *Allanblackia* seed oil in soap making in Etche and Emuoha LGA of Rivers State, Nigeria will not only increase the incomes of hundreds of thousands of men and women farmers but also create jobs for the unemployed youths.

MATERIALS AND METHODS

Design of Study

This study employed research and development (R&D). According to Sugiyono, (2014) research and development method is a method used to produce a certain product, and test the effectiveness of the product.

Study Area

Study area is Etche and Emuoha local government areas of Rivers State. Emohua is a local government area in Rivers State, Nigeria. Its headquarters is in the town of Emohua. The area is located between Latitude 5º 10 ' 0 " N and Longitude 6º 54 ' 0 " E. The area which lies within the tropical rainforest is characterised by eight months and four months of the wet and dry season respectively. The average temperature of the area is between 22ºC and 29ºC with high humidity and rainfall. The major occupation of the people is farming. Emohua consists of fourteen political wards. Etche is one of the 23 Local Government Areas of Rivers State (Etche Culture, 2020) and amongst the 13 federal constituencies representing River State in Nigeria's National Assembly and part of the Rivers East Senatorial District. Okehi is the Council Headquarters and political capitals of Etche. There are 19 political wards in Etche local government. Etche It is also said to have the largest deposit of natural gas, south of the Niger River. The people of Etche are mostly engaged in agriculture, earning the nickname 'the food basket of the State'. Etche is one of the host communities of the government-owned multi-billion-naira palm oil production company Risonpalm, as well as Delta Rubber Production Company.

Materials

Allanblackia floribunda seeds were sourced from Okehi, lgbo, Okomoko and Igbodo in Etche LGA and Rumuewhor, Ubimini, Elibradaand ogbakiri in Emuoha local government area. Palm Oil was purchased from Mile 3 Market in Diobu, Port Harcourt, Rivers State. Reagents/chemicals used were analytical grade (BDH) England obtained from Joechem Chemicals Choba, Port Harcourt, Rivers State.

Sample and Sampling Technique

Randomized sampling technique was adopted. Hence *A. floribunda* seeds were randomly sampled from the forest in different communities mentioned above; trees grow in the wild in the two Local Government Areas.

Methods

Extraction of Allanblackia oil

The Hot water flotation method was used in extracting the oil from the seeds as described by Rosenthal; Pyle & Niranjan (1996); senthal *et al*., (1996) and (Okwechime *et al*., 2017) with slight modification. Dried Seeds were dehulled and pulverized using a Panasonic blender (MCX 105 models) after which the resultant cake was conditioned in a mortar by adding hot and cool water intermittently to form paste. The paste was released into boiling water and allowed to boil for 5 h; oil that floated was removed and dried at 60℃ in an air oven.

Oil analysis

Standard analytical test methods described by AOAC, (2012) were used in determining physical and chemical properties of Allanblackia and palm oils in terms of smoke point, flash point, specific gravity, melting point, moisture and volatile matter, colour (lovibond scale), peroxide value unsaponifiable matter, iodine value, free fatty acid content and saponification value.

Preparation of soap from Allanblackia oil

Six hundred and eighty (680 g) gramme of the Allanblackia and palm oils were weighed separately into a 1 L beaker. The oil was heated and saponification initiated by adding gradually while stirring 100 g NaOH previously dissolved in water and allowed to cool to room temperature. Stirring continued until saponification was completed, complete saponification was achieved by formation of trace. Zero point two percent (0.2%) of sodium sulphate and 0.1% EDTA were added and the molten soap was poured into mould and allowed setting for 24 h (Robertson, 2006).

Soap analysis

Soap analysis was carried out immediately after one day of production. The method described by AOCS, (2012) was followed.

Total Fatty Matter (TFM)

Ten gramme (10 g) of soap was scrapped into a 250 mL beaker and 100 cm^3 of water was added to the mixture and heated on a water bath until the soap melted. 10 mL of 20% H_2SO_4 was added (Acid hydrolysis) with continued stirring followed by addition of 100 mL of petroleum ether shaken and allowed to settle. The solvent layer was taken out into a weighed receiving flask, dried in an air oven until all solvent was removed. The recovered oil was then cooled to room temperature in a desiccator. The TFM was calculated as shown below.

$$\% \text{ TFM} = \frac{\text{oil gain}}{weight of sample} \text{x} 100$$

Moisture content

Ten (10 g) gramme of milled soap sample was put into a dish and placed in an oven for 1 h at 105℃. The mixture was allowed to cool and then re-weighed. The percentage moisture content was calculated.

Moisture content (%) = $\frac{\text{weight loss}}{\text{weight of sample}} \times 100$

Free caustic Alkali

Milled soap sample of weight 10 g was placed in a conical flask and100 cm^3 of neutralized alcohol was added. The flask and the content was placed on a water bath and heated until the soap dissolved. Then 10 cm^3 of 10% Barium chloride solution and 2 to 3 drops of phenolphthalein indicator were added. The whole content was titrated against O.1N H_2SO_4 until the colour changes. The free alkali as Na_20 was calculated as described in AOAC, (2012).

% Free caustic Alkali = $\frac{titre\ difference \times 0.1N}{weight\ of\ sample}$

Chloride Content Determination

Five (5 g) gramme of soap sample was completely dissolved in 100 mL hot distilled water. Then ten millilitres (10 mL) of 20% calcium nitrate was added for complete precipitation. The mixture was quantitatively transferred into a 250 mL volumetric flask and made up to mark with distilled water. It was then filtered and 10 mL of 20% potassium chromate solution was added to 100 mL of the filtrate and titrated with 0.1 M silver nitrate solution to a reddish-brown colour. A blank determination was also carried out. Chloride content was calculated as shown below;

% Chloride = % Chloride $= \frac{V1-V2 \times 0.585}{w}$

Where:

V1 – volume of silver nitrate 0.1 M used for titration of the sample (mL)

V2 – volume of silver nitrate 0.1 M used for titration of the blank (mL)

W – Weight of the soap sample (g)

Matter Insoluble in Alcohol

Five (5 g) gramme of soap sample was dissolved in 50 mL hot ethanol and quantitatively filtered through a pre-weighed filter paper. The residue was dried in the oven at 105˚C for 30 min, cooled and weighed again. The calculation of matter insoluble in alcohol (MIA) was carried out using the method described in AOCS, (2012).

Matter Insoluble in Alcohol (%) $\frac{\text{Ws}-\text{FP}}{w} \times 100$

Where:

Ws = Weight of soap sample and filter paper,

FP = Weight of filter paper only

W = Weight of soap sample

Where:

Determination of Matter Insoluble in Water

After filtering and washing the residue of matter insoluble in alcohol, thoroughly with hot ethyl alcohol, the filter paper and the residue was washed with some portions of distilled water at several times to remove all the water soluble. It was then dried on a sintered glass funnel in an air-oven at a temperature of 105℃ until a constant mass was obtained.

Matter Insoluble in water (%) $\frac{\text{Ws}-\text{FP}}{w} \times 100$

Where:

Ws = Weight of soap sample and filter paper,

FP = Weight of filter paper only

W = Weight of the soap sample

Foaming Test
This was measured by dissolving 2 g of soap in 50 mL of boiled distilled water in a rose mill apparatus. The soap was used to form lather in water, the foam height and time taken for the foam-to collapse was measured as set by Nigeria Industrial Standard (NIS) 515 (2010).

Staining Test
Coloured soap made from *A. floribunda* and palm oil were used in washing white fabric; to see if it will leaves any visible stains on the fabrics after washing and rinsing with water

Soap Cracking Test
A. floribunda and palm oil soap were immersed in distilled water for one hour at 25 – 30 °C, and dried at room temperature for 25 h to check if thereafter; it will crumble, crack or break as described by Eas (2011).

Method of Data Collection
Results of experimental analysis from the laboratory were retrieved in duplicate.

Method of Data Analysis
Data collected from laboratory analysis were analysed using Analysis of Variance (ANOVA) to test the significant difference at probability $p<0.05$ level.

RESULTS
Physical Properties of Allanblackia and Palm oil
Results of the physical properties of *A. floribunda* and palm oil presented in Table I showed a higher red colour 23R in palm oil (after bleaching) while *A. floribunda* oil had a value of 2.5R (not bleached). Slip melt point of the two oils were 34.67b±0.572 and 42.33 ±1.155 respectively for *A. floribunda* and palm oil. The specific gravity of *A. floribunda* was 0.887b±0.001 while that of palm oil had a higher value of 0.888a±0.002.
Moisture impurity and volatile matter was also highest in palm oil (2.29a±0.010) and lowest in *A. floribunda* (0.13b±0.015). The Smoke point was 170.33b±10.26 in *A. floribunda* oil 180.33a±7.640 in the palm oil.

Table I. Physical Properties of Allanblackia and Palm oil

Parameter	ASO	PO
Colour (133.3mm cell)	20.0Y, 2.5R	20.0Y,23R
SMP ℃	34.67^{b}±0.572	36.33^{a}±1.155
SG	0.887^{b}±0.001	0.888^{a}±0.002
MIV	0.13^{b}±0.015	2.29^{a}±0.010
SP	170.33^{b}±10.26	180.33^{a}±7.64

Values with different superscripts (a and b) in the same column are significantly different ($p<0.05$)

KEY: ASO: Allanblackia seed oil, PO: Palm oil, SMP: Slip Melt point, SG: Specific gravity, MIV: moisture and volatiles matter (%), SP: Smoke point, Colour: lovibond scale

N.B: Colour of palm oil was measured after bleaching whereas allanblackia oil was not bleached

Chemical Composition of Allanblackia and Palm oil

Table II shows results of the chemical composition of *Allanblackia* and palm oil. Value obtained from saponification test was highest in *A. floribunda* (199.00^{a}±100) and lowest in palm oil (186.33^{b}±8.006). On the other hand, unsaponifiable matter was lowest (0.19^{b}±0.010) in *A. floribunda* and highest in palm oil (0.47^{a}±0.041). Iodine value and free fatty acids were low in *A. floribunda* 39.90^{b}±0.30 and 0.54^{b}±0.912 respectively. While palm oil had values of 49.86^{a}±1.87 and 16^{a}±0.075 in that order, peroxide value was also more in palm oil 8.88^{a} ±0.088 and 0.49^{b}±0.040 in *A. floribunda.*

Table II: Chemical Composition of Allanblackia and Palm Oil

Parameter	ASO	PO
SV	199.00^{a}±0.100	186.33^{b}±8.006
USM	0.19^{b}±0.010	0.47^{a}±0.041
IV	39.90^{b}±0.30	49.86a±1.87
FFA	0.54^{b}±0.912	16^{a}±0.075
PV	0.49^{b}±0.040	8.88^{a} ±0.088

Values with different superscripts (a and b) in the same column are significantly different ($p<0.05$)

KEY: ASO=Allanblackia seed oil, POS =Palm oil, SV= Saponification value (mgKOH/g), USM= unsaponifiable matter (%)

Physical and Chemical Properties of Soap Made from Allanblackia and Palm Oil

Test results of the physical and chemical properties *Allanblackia* and palm oil soaps are presented in Table III. Allanblackia soap had the highest Total fatty matter of 68.20% while palm oil soap was 62.80%. Moisture content was 12.80% and 15.20% in Allanblackia and palm oil soaps respectively. Insoluble matter in ethanol and water were 0.05% and 0.10%, 0.08% and 0.20% accordingly for Allanblackia and palm oil soaps. Free caustic alkali were 0.05 and 0.20%, unsaponifiable matter was highest 0.30% in palm oil soap and lowest in Allanblackia soap 0.11%. Foam value was 250 cm^3 in Allanblackia soap and 180 cm^3 in palm oil soap. Both soaps had stable foams after 1 h, however, palm oil soap failed staining test.

Table III: Physical and Chemical Properties of Soap

Sample	TFM	MIV	MIE	MIW	FCA	UNSAP	FH(cm^3)	Staining
Allanblackia Soap	68.20	12.80	0.05	0.08	0.05	0.11	250 Stable	Passed
Palm Oil Soap	62.80	15.20	0.10	0.20	0.20	0.30	180 Stable	Failed

KEY: TFM =Total fatty matter, MIV= Moisture and volatile matter, MIE = Matter insoluble in ethanol, MIW = Matter insoluble in water, FCA = Free caustic alkali, as NaOH, max. UNSAP = Unsaponifiable matter, FH = Foam height, ST = Staining, FSB = Foam stability

DISCUSSIONS

Colour determined in both oils tells how much pigment is in them. High red (R) means that the oil will require bleaching the oil before use; Allanblackia oil (2.5R) needs no bleaching which gives it an edge over palm oil (23R). The slip melting point, Specific gravity, moisture content and flash point of both oils (Table I) are within the Alimentarius Codex (1999) standards for physical properties of edible oils. Chemical composition of both oils (Table II) showed saponification values of 199 and 186 mgKOH/g for both oils; these values are lower than saponification value found in palm kernel oil (240-245 mgKOH/g) and coconut oil (255-260 mgKOH), however, they are high enough to give good quality soaps. Unsaponifiable matter of 0.19 and 0.47% are within acceptable NIS, (2010) standards. Iodine value depicted that the seed oils have low unsaturated fatty-acids compared soybean oil and some other edible oils; however, the more saturated the better in soap making. Free fatty acids and peroxide values will determine the keeping quality of the oils.

The physicochemical properties of the soaps are shown in Table III. The total fatty matter (TFM) is an important characteristic describing the quality of soap; the values obtained (68.20 and 62 %) shows that the soaps can be classified as bath soap as specified by International Standard Organization (ISO, 2010). Moisture content of 12.80 and 15.20 % is also within NIS standard; moisture content is a parameter that is used in assessing the shelf–life of a product (Tewari, 2004). Matter insoluble in ethanol and water were 0.05 and 0.1% and 0.08-0.20%, FCA and unsaponifiable matter are all as specified by NIS. Foam test was more stable in soap from Allanblackia oil (250cm^3) than 180 cm^3 found in soap from palm oil. Soap from Allanblackia oil passed the staining test whereas the soap from palm oil failed.

CONCLUSION

Soap making is a lucrative business and needs only little capital to start and considering the availability of a substitute to palm oil which has become expensive and not readily available. Allanblackia *floribunda* an unexploited and underutilized tree crop has the quality comparable to palm oil. In soap making, there is a need to consider what materials are available locally and what soap qualities are desirable to the community. Another factor is cost of locally available soap and the cost of making soap also market for homemade soaps within the community and in other markets. Making soap can be a great addition to business opportunity to the community and for individuals to earn extra income for their family. Allanblackia oil can become a saviour to dying soap industries and a means of livelihood for the people of Etche and Emuoha local government areas in Rivers State.

RECOMMENDATIONS

There is a need to design and develop strategy on collection of seeds and extraction of Allanblackia oil in order to explore and utilize full benefits of this raw material using the available indigenous technology.

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