



PRODUCTION AND ACCEPTABILITY OF BAR SOAP USING USED COOKING OILS

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ABSTRACT

Palm kernel oil is commonly used for preparing bar soap using alkaline solutions. However, the use of this purpose is expensive as palm oil is imported from few major countries. Hence, the search for alternative raw material that can substitute palm oil for soap production is imperative. The use of cooking oils (UCOs) is good options in this regard. From the present study, bar soaps were prepared using UCOs and sodium hydroxide solution. Data collected were subjected to Analysis of Variance (ANOVA) and Tukey Test used to determine the significant difference among the samples in duplicates. The study recorded a significant ($p < 0.05$) difference between product sampled and the control. From the result bar soap was accepted by the panelists. The statistical analysis of five hedonic scales was used for evaluating attributes such as colour, texture, frothing level, Scent and overall acceptability. It revealed that respondent accepted sample A ration as best product when compared with others. Sample B was appreciated next to sample A, followed by sample C and D respectively. The pH, moisture content, free caustic alkali, total alkali content and total fatty matter values of the soaps were found to be in range of 9.67 to 10.52, 6.87 to 14.95%, 0.16 to 0.24%, 0.77 to 1.12%, 75.39 to 88.52%, 82.37 to 87.67%, 0.37 to 0.75%, and 0.12 to 0.19%, respectively. The results obtained were comparable with the physicochemical properties of the commercial soap products used in the study. Moreover, the observed data were comparable with similar data reported in literature and East African Standards (EAS) confirmed that UCOs can be use as raw materials for good quality bar soap production as alternative to the use of imported palm oil.

Key words: Production; acceptability; bar soap; used cooking oil.

Introduction

Soap is the sodium (Na) or potassium (K) salt of a long chain fatty acid (at least 12 carbons hydrocarbon chain and linked with carboxylic acid functional group). Soap could be solid and liquid depending on ingredients for its preparation. Solid soaps typically consist of sodium salts of fatty acids and liquid soaps consist of potassium salts of fatty acids (Betsy *et al.*, 2013). The soap cleansing action can be attributed to the presence of long hydrocarbon chains attached to a carboxyl group (carboxylate anion). The hydrocarbon chain has an affinity for grease (dirt) and the carboxyl group for water. Thus, the dirt is dissolved in the alkyl groups of the soap molecules while the ionic end allows it to be dissolved in water. In this process, there is removal of dirt from clothes and skins of human body (Shoge, 2011). The common soap preparation methods that are being used today have evolved from ancient methods with some modifications through times. The methods involve treatment of raw materials such as lard and tallow (from animal sources), coconut, palm and olive oils (from vegetable sources) with alkaline solutions such as NaOH or KOH

(Mabrouk, 2005). Almost all soap making process involves use of oils from plant sources (palm oil) and animal fats (e.g., tallow). Palm oil is bought locally or imported by soap manufacturing industries in many countries mainly from two major exporting Asian countries (Malaysia and Indonesia) (Atiku *et al.*, 2014). Current trends show that these raw materials can be used for other competitive purposes such as biodiesel production in developed countries of the western world (Arifin, 2009). These competitive uses of palm oil and animal fats are expected to create severe scarcity of raw materials for soap industries. Therefore, the continuous and sufficient supply may be difficult to soap manufacturing industries. This calls for search of alternative raw materials for soap production urgently. The used cooking oils (UCOs) could be good options in this regard (Araujo *et al.*, 2013). The used cooking oils are left over of oils and fats that have been used for cooking or frying in food processing industries, restaurants, boarding schools' kitchens, fast food making institutions (Road side food vendors) and at consumer (household kitchen) level. These are usually deposited to environment as wastes after repeated uses for cooking and frying. In

the environment, many environmental problems such as sanitary sewer; over flowing as a result of blockade of sanitary sewer systems in cities, clog sewer and septic system, and unnecessarily increased organic load on water bodies. These oils also contaminate water and land resources (Arjun *et al.*, 2008). The used Cooking Oils have also been reported to cause serious human health hazards such as heart diseases, stroke, Parkinson's disease, Alzheimer's disease, liver disease, gastrointestinal disorders and even mutagenesis in human body (Nawal *et al.*, 2014). With the increasing numbers of fast food processing industries, hotels and restaurants in the present modern world, it is expected that considerable amounts of used cooking oils may be discarded into human environment and cause pollution. In developing world and countries, used cooking oils are treated as wastes in Ethiopia, and disposed into environment without concern by users or authorities. This study was initiated to prepare laundry soap materials by treating used cooking oils samples with sodium hydroxide, and evaluate the physicochemical properties and cleaning powers, see the possibility of this approach in minimizing pollution of used cooking oils in the environment. The re-use of used cooking oils as raw materials for soap production is expected to have two advantages; the first is its use as substitute for palm oil and animal fat for ecofriendly laundry soap production, and secondly used as disposal options or to avoid environmental problems (Dimple *et al.*, 2017). However, before using the collected used cooking oils directly for soap making, their suitability (quality) need to be evaluated. Therefore, this research work is based on proper collection and reuse of cooking oils for other purposes such as soap making as a very important option in order to minimize environmental pollution as well as extending the finite

natural resources through reuse of these wastes for other (new) purposes (Akinyeye *et al.*, 2011).

Materials and method

The research was carried out at the clothing laboratory unit of Home and Rural Economics Department, Oyo State College of Agriculture and Technology, Igboora. The raw materials used were cooking oils collected from three different locations; food processing kitchen hostels (Polytechnic Ibadan, University of Ibadan and Wesley College School of Science Elekuro, Ibadan), local food vendors (Iyadunni food vendor, Igboora, Oreoluwa food vendor, Ibadan and Opeyemi food vendor, Ibadan) and hotels (De link Hotel, Igboora, Premier Hotel Mokola, Ibadan and Boluwaji Hotel Iyana Church, Ibadan). All the three locations were in Ibadan and Igboora. Other bar soap chemicals are purchased at Ogunpa market in Ibadan, Oyo State. Data were collected through the use of processed bar soap product with used cooking oils. A well- structured questionnaire was administered to the respondents for assessment in evaluating the sensory attributes of the products. Proximate analysis of the product sampled was also determined in laboratory. Results obtained were analysed. Data collected were analysed through descriptive tools such as frequency, percentages and cumulative score. In addition, the parameter assessment includes; colour, texture, frothing level, scent and overall acceptability using 5 hedonic scales (Excellent, Very Good, Good, Like Moderately and Poor). The three used cooking oils and palm kernel oil (PKO) were measured to desirable standard with other processed soap chemicals for the bar soap production. The raw materials used with their measurement and preparation methods were explained from the table below the page:

Table 1- Production of bar soap with Palm Kernel Oil (PKO) as Control

Materials	Quantity
Palm Kernel Oil	2litres
Caustic soda	500gram
Soda ash	500gram
Sodium sulphate	250gram
Sodium silicate	40mils
Botax	50gram
Kaolin	250gram
Frangrance	40mils
Colouring (Yellow)	20gram

**Table 2- Production of bar soap with used cooking oil from school hostel kitchens**

Materials	Quantity
Used cooking Oil	2litres
Caustic soda	500gram
Soda ash	500gram
Sodium sulphate	250gram
Sodium silicate	40mils
Botax	50gram
Kaolin	250gram
Frangrance	40mils
Colouring (Yellow)	20gram

Table 3- Production of bar soap with used cooking oil from food local vendors

Materials	Quantity
Used Cooking Oil	2litres
Caustic soda	500gram
Soda ash	500gram
Sodium sulphate	250gram
Sodium silicate	40mils
Botax	50gram
Kaolin	250gram
Frangrance	40mils
Colouring (Yellow)	20gram

Table 4- Production of bar soap with used cooking oil from hotels

Materials	Quantity
Used Cooking Oil	2litres
Caustic soda	500gram
Soda ash	500gram
Sodium sulphate	250gram
Sodium silicate	40mils
Botax	50gram
Kaolin	250gram
Frangrance	40mils
Colouring (Yellow)	20gram

i. The production procedure is of different stages; first step is measuring three litres of water each into two cleaned separate washing bowls with each containing five litres of water at a time.

ii. A quantity of 500gram caustic soda each was measured into three litres of water bowls each.

iii. Another three litres of water was also measured into two different water basins of five litres capacity.

iv. In each of the water basin was measured into 500gram soda ash and the same process was repeated with 250gram sodium sulphate measured into each water contained bowls.

v. All the content were covered and left for seventy-two hours (3 days) for fermentation.

vi. On the third day, palm kernel oil of 2litres was measured and preheated for about five minutes.

vii. The palm kernel oil was poured into separate mixing bowls of ten litres capacity; then the fermented products were thoroughly mixed with other chemicals (botax, kaolin and frangrance) before blending with the preheated oil.

viii. During blending, careful habit was adopted in preventing lumps and the slurry content from passing. After effective pap like slurry blending, colour was added and poured into the moulder that are laid with nylon.

ix. The contents were left for twenty- four hours to cool, dry and very strong before harvesting for packaging and usage.

Saponification value

The saponification number (value) is the milligrams of potassium hydroxide (KOH) required to saponify 1 gram of fat or oil (Kumar, 2014). Two grams of the oil sample was weighed into a clean dried conical flask and 25 ml of alcoholic potassium hydroxide (KOH) added. The flask was heated for an hour with frequent shaking. 1 mill of 1% phenolphthalein indicator was added and hot excess alkali was titrated with 0.5 mol/L hydrochloric acid (HCl) until it reached the end point where it turned colorless. A blank titration was carried out at the same time and under the same condition (Rudy, 2006). The saponification value was calculated using the equation below.

$$\text{Saponification Value} = \frac{(S-B) \times M \times 56.1}{W}$$

Where B and S are titre values of blank and sample, respectively, M is the Molarity of Hydrochloric acid (HCl) and 56.1 is the molecular weight of Potassium Hydroxide (KOH).

Determination of iodine value

Iodine value (iodine number) is the amount (in gram) of iodine absorbed by 100 grams of the oil or fat. The value gives an idea of the average degree of unsaturation of an oil/fat or number of carbon-carbon double bonds. Thus, the higher the iodine value, the greater the number of C=C double bonds and also reflects susceptibility oil to oxidation or low stability as oil fats with a greater number of double bonds provide more sites for oxidation (Odoom and Edusei, 2015). One gram of oil sample was weighed in a 250 ml beaker, and 10 ml of carbon tetrachloride was added to the oil. Then, 20 ml of base solution was added and allowed to stand in the dark for 30 mins. After 30 mins, 15 ml of (10%) potassium iodide and 100 ml of water was added. The resulting mixture was then titrated with 0.1 mol/ml thiosulphate solution using starch as indicator just before the end point. A blank was also prepared alongside the oil samples. The iodine value was obtained using the following equation (Nawal, *et al.*, 2014)).

$$\text{Iodine value} = \frac{(B-S) \times M \times 12.69}{W}$$

Where, B and S are titre values of blank and sample, respectively. M is the molarity of $\text{Na}_2\text{S}_2\text{O}_3$, 12.69 is the conversion factor from Meq $\text{Na}_2\text{S}_2\text{O}_3$ to gram iodine molecular weight of iodine and W is the weight of oil.

Physicochemical tests and experimental details

The physicochemical characteristic of soap depends on several factors such as physicochemical characteristics including pH, moisture content, free caustic alkalinity and total fat matter (TFM) (Atiku, *et al.*, 2014). The physico-chemical properties of the soap samples were analyzed using standard procedures (Vivian *et al.*, 2014). The experiments were carried out in triplicates.

i. Determination of pH

pH refers to the degree of acidity or basicity of a given solution (Oghome *et al.*, 2012). The powder of commercial soap bars (10 g) were weighed and dissolved in distilled water. The solution was made up to 100 mL for 10% soap solution preparation. The pH meter was calibrated using a buffer solution of pH 7 and 10 before measuring the pH of the solutions. The meter used for pH determination was Hanna pH-211 microprocessor pH meter. Two grams each of prepared soap was dissolved in 10 mL of distilled water and retained till sample dissolved, and the pH values determined.

ii. Determination of moisture content

The moisture content (MC) is the quantity of water present in soap. It is determined by heating soap samples at $103 \pm 2^\circ\text{C}$ until constant mass was observed. 5 g soap material was put in clean and dried dish and dried in an oven for 2 hours and temperature of 101°C . The heating was repeated until a constant weight was reached. The % moisture was calculated using the equation below:

$$\% \text{ moisture} = \frac{C_S - C_L}{C_S - C_W} \times 100$$

Where, C_W = weight of crucible, C_S = weight of crucible + sample, C_L = weight of crucible + sample after floating

iii. Determination of free caustic alkali

The key to make good soap is ensure that there is no free or excessive alkali. Free caustic alkali was determined by the method described by Milwidsky and Gabriel (Akinola *et al.*, 2010). The free caustic alkali content of sodium soaps of ordinary quality is the quantity of free caustic alkali, expressed as a percentage (rn/n) of sodium hydroxide (Anyasor *et al.*, 2009). It is one of the parameters that determine the abrasiveness of any given soap materials. This mostly results from improper or incomplete saponification (Onyegbado *et al.*, 2002). 5 grams of finished soap was weighed and dissolved in 30 mL of ethanol. Few drops of phenolphthalein indicator and 10 mL of 20 %



BaCl₂ were added into the soap solution. The resulting solution was then titrated against 0.05 M H₂SO₄ (aq) till the solution becomes colorless. For free caustic alkali the volume of the acid obtained was calculated using the equation below (Carlos *et al.*, 2011):

$$FCA = \frac{0.31}{W} \times V_A$$

Where, V_A = Volume of acid added in the experiment,
W = Weight of soap used in the experiment

iv. Determination of % chloride

The chloride content of commercial soaps is the quantity of sodium chloride or potassium chloride, expressed as a percentage by mass (rn/rn). The determination of percentage chloride in soap is very important (East African Standard, 2013). This is because excess chloride causes soaps to crack. One cause of high chloride content in soaps could be the use of chlorinated water to dissolve NaOH pellets for soap preparation (Taiwo, *et al.*, 2008). 10 grams of soap samples were dissolved in distilled water. The solution was made up to 100 mL by adding water and then heated to dissolve sample. The resulting solution was transferred into a 250 mL volumetric flask. 20 mL of 15% (Ca(NO₃)₂) solution was added to the mixture, and was shaken to dissolve the soap completely. Distilled water was added to the solution up to the 250 mL mark. The solution was then filtered and methyl red was added to 100 mL of the filtrate. The solution was titrated against 10 N H₂SO₄ (aq) until a pink color was obtained. Finally, the resulting solution was titrated against 0.1 M AgNO₃ using K₂Cr₂O₇ as indicator till a brick red colour is obtained. The equation below was used for calculating the % chloride:

$$\% \text{ Cl} = \frac{\text{Titre volume}}{\text{Weight of soap}} \times 0.585$$

v. Determination of total alkali content

Total alkalinity is the total alkaline material present in soap. It is expressed as a percentage (n/rn) of sodium hydroxide or potassium hydroxide according to whether sodium or potassium soaps are concerned (Oghome *et al.*, 2012). It was determined by titrating excess acid contained in aqueous phase with standard volumetric NaOH solution. 10 grams of soap samples were mixed with 100 mL of neutralized ethanol. 5 mL of 1 N H₂SO₄ (aq) solution was added to the mixture and heated till the soap sample dissolved. The flask was gradually cooled to room temperature, and the remaining amount of sulphuric acid (after hydrolysis and neutralization of all alkaline components in soap)

was estimated by back titrating test mixture with standard 1N NaOH using phenolphthalein as an indicator. The total alkali was obtained with the equation below:

$$\% \text{ Total alkali} = \frac{V_A - V_B}{W} \times 3.1$$

Where, V_A = volume of acid added in the experiment,
V_B = volume of base at the end point, W = weight of soap used in the experiment.

vi. Determination of total fatty matter

Total Fatty matter (TFM) is defined as total amount of fatty matter, mostly fatty acids, that can be separated from a sample after splitting with mineral acid, usually HCl (Betsy *et al.*, 2013). TFM was one of the crucial characteristics describing quality and nature of soap. This is the reason why TFM is always specified in commercial soap. In the present study, determination of TFM was done following a method described in EAS (2013), with slight modifications. The tests were carried out by reacting soaps samples with acid in the presence of hot ethanol and measuring the fatty acids obtained. 10 grams of soap samples was mixed with 150 mL of warm neutralized ethanol, and was heated; the soap materials were dissolved. The dissolved solution was then filtered, and the residue was dried in oven at 110°C for 1 hour and weighed again. The total fat matter was obtained using the equation below:

$$\frac{100 - (MC + MIA)}{1.085}$$

Where, MC = moisture content and MIA = matter insoluble in alcohol.

vii. Test of cleaning power and lather formation of the prepared soap materials

The cleaning power of the prepared soap bars was evaluated using pieces of cotton clothes that were stained with Chicken sauce (*Doro wot* in local language). Their lather foaming abilities were evaluated in distilled water by adding equal amount of soap solution in test tube and shaken vigorously by placing a stopper in the tube. For the sake of comparison, the same procedures were done with randomly selected threes commercial laundry soaps purchased from local market.

Sensory analysis

The sensory evaluation was done on four different samples: Sample A, B, C and D. Thirty -five (35) consumers were randomly selected for the sensory. Consumers' were asked to evaluate the four coded samples on a 5-point hedonic scale with 1= Excellent, 2= Very good, 3= Good, 4= Fair, 5= Poor in an



experiment for sensory evaluation on the parameters (colour, texture, frothing level, Scent and overall acceptability).

Statistical analysis

Data were subjected to Analysis of Variance (ANOVA) and Tukey Test was used to determine the

significant difference among the various samples in duplicates. Data were analyzed using the software, Statistical Package for Social Sciences (SPSS) version 22.00 (SPSS inc., Chicago), IL, USA at the 0.05 level of significance.

Proximate analysis of bar soap produced with used cooking oils

Table 5. Iodine and saponification value of used cooked oils (UCOs)

Type of UCOs	Iodine value (g I ₂ /g)	Saponification value (mg KOH/g)
Palm Kernel Oil	29.17±0.34	201±0.52
UCOs obtained from hostel kitchens	32.07±0.45	203±0.54
UCOs obtained from local vendors	30.05±1.00	207±2.00
UCOs obtained from hotel	31.23±0.67	193±0.51

Table 6. The pH values of the prepared and commercial soaps used

Type of soap used	pH of the solutions prepared
Soap product prepared from	
PKO	9.67±0.16
UCOs obtained from hostel kitchens	9.87±0.36
UCOs obtained from local vendors	10.52±0.44
UCOs obtained from hotels	9.77±0.25
Commercial soap	
Imperial leather	10.37±0.14
Canoe	12.47±0.34
Sunlight	11.17±0.21

Table 7. The moisture contents of the prepared soap samples and commercial laundry soaps used

Type of soap used	Moisture contents (%)
Soap product prepared from	
PKO	6.87±0.36
UCOs obtained from hostel kitchens	10.71±0.42
UCOs obtained from local vendors	14.95±0.66
UCOs obtained from hotels	6.69±0.33
Commercial soap	
Imperial leather	15.37±0.11
Canoe	4.47±0.34
Sunlight	7.57±0.42

Table 8. The free caustic alkali contents of the prepared soap materials and commercial soap used

Type of soap used	Free caustic alkalinity (%)
Soap product prepared from	
PKO	0.16±0.02
UCOs obtained from hostel kitchens	0.17±0.02
UCOs obtained from local vendors	0.24±0.03
UCOs obtained from hotels	0.20±0.03
Commercial soap	
Imperial leather	0.12±0.005
Canoe	0.16±0.008
Sunlight	0.19±0.01

**Table 9. The total alkali contents of the prepared soaps and commercial soaps used**

Type of soap used	Total alkali (%)
Soap product prepared from	
PKO	0.84±0.01
UCOS obtained from hostel kitchens	0.92±0.04
UCOs obtained from local vendors	1.12±0.06
UCOs obtained from hotels	0.77±0.01
Commercial soap	
Imperial leather	0.37±0.01
Canoe	0.75±0.03
Sunlight	0.63±0.02

Table 10. Total fatty matter of the soap samples prepared from used cooking oils and that of commercial soaps

Type of soap used	Total fatty matter (%)
Soap product prepared from	
PKO	79.85±0.66
UCOS obtained from hostel kitchens	88.52±1.23
UCOs obtained from local vendors	82.49±0.80
UCOs obtained from hotels	75.39±0.45
Commercial soap	
Imperial leather	82.37±0.79
Canoe	87.67±0.84
Sunlight	88.31±0.95

Table 11. Cleaning power and lather formation of the prepared and commercial laundry soaps used

Type of soap used	Cleansing power	Lathering formation
Soap product prepared from		
PKO	Good	Good
UCOS obtained from hostel kitchens	Good	Medium
UCOs obtained from local vendors	Good	Medium
UCOs obtained from hotels	Medium	Medium
Commercial soap		
Imperial leather	High	Good
Canoe	Medium	High
Sunlight	Medium	Good

Table 12: The sensory analysis of the bar soap produced from PKO and Used Cooking Oils

Samples	Colour	Texture	Frothing level	Scent	Level of acceptability
A	6.37±0.80	4.45±0.93	4.72±0.80	3.26±0.70	5.60±0.70
B	5.62±0.70	3.96±0.80	4.41±0.10	5.70±0.60	4.70±0.70
C	5.15±0.80	4.50±80	5.98±0.80	6.30±0.90	5.45±0.90
D	6.78±0.80	4.69±80	5.40±0.80	6.50±0.90	4.40±0.90
LSD	0.23	0.342	0.021	1.481	0.061

Product A (100% PKO), Product B (Used cooking oil from school hostel kitchen), Product C (Used cooking oil from street food vendors) and Product D (Used cooking oil from hotels)

Colour is one of the sensory attributes consumers explore in purchasing new products due to its aesthetic appeal. The panelists rated the colour of the various bar soap from 5.15 to 6.78, thus, rated from

excellent to poor. From the hedonic scale, product A (100% PKO), was rated excellent while the rest was rated very good and good.

From the results, sample A (100% PKO) was significantly ($p>0.05$) different from the other products. Thus findings was similar to the work of (Rudy, 2006) who concluded that colour is vital quality trait of bar soap. Colour is the foremost and most important sensory attribute that influences consumer preference and acceptance for any product especially in food products (Nawal, *et al*, 2014).

From the texture, product D (used cooking oil from hotels) gave the highest mean score and product B (used cooking oil from school hostel kitchens) recorded the least mean score of 3.96. The texture was determined by electronic machine in laboratory. All bar soap samples recorded a significant ($p<0.05$) different from each other.

Frothing level influence, the consumers' acceptance of the bar soap products. The bar soap sample C (used cooking oil from street local food vendors) recorded the highest mean score of 5.98 that is "Good", followed by sample A with a score of 5.72 and Sample B had the lowest mean score rating according to the respondents with the score of approximately 4.41. It was observed from the result that there was a significant ($p>0.05$) difference between the bar soap samples.

The scent of the different samples ranged from 3.26 ± 0.70 to 6.50 ± 0.90 . The products were thus rated as being "Excellent" to "Poor". Product D (used cooking oil from hotels) was rated very good by the panel compared to the other samples. There were significant ($p<0.05$) differences in scent among the various samples. This could be as a result of variation among the oils used in the preparation of the bar soaps. The quality of the bar soaps (colour, texture, frothing level, and scent) had influence the overall acceptability of samples. There was a significant ($p<0.05$) difference between all bar soap and the control sample. Sample A (100% PKO) had the highest mean score (5.60) followed by sample C (used cooking oil from street local vendors), With a mean score of (5.45) that is "Good".

Sample A (100% PKO) was accepted most by the panel followed by sample C compared to the other two samples (B and D).

Conclusion

The prepared soaps were found to show promising cleaning power and lather formation comparable to commercial samples purchased from local market. Analyses of physiochemical properties of the prepared soaps were comparable to those commercial samples and standards reported in literature. Comparability of the physicochemical properties (data) obtained from

the prepared soaps and the commercial soap samples indicated that used cooking oils can be used to prepare laundry bar soaps of acceptable quality both in small and large scales. Thus had double advantage. Some of the advantages are to minimize environmental pollution caused by used cooking oils; and the replacing of palm oil and animal fats in soap making which may be scarce (and expensive) in the near future because of their utilization as food processing material and raw materials for biodiesel. From the result, quality soaps were produced with used cooking oils and sample C product from oils in the street local food vendors was best accepted by consumers.

Recommendation

The following recommendations were suggested based on the samples product judged as stated below;

1. The used cooking oil should not be disposed of to prevent wastage and may be converted to other useful products such as laundry soap production and biofuel
2. Small scale industry are established through usage of used cooking oils that reduce idleness and unemployment level rate of youth in the society.
3. Government should support good research work in terms of financial assistance through loan and encouraging environmental condition with good policy.

References

- Akinola, F, Oguntibeju, O; Adisa, W, Owojuyigbe, S. (2010). Physico-chemical properties of palm oil from different palm oil local factories in Nigeria. *Journal of Food and Agriculture and Environment* 8:264-269.
- Akinyeye, R.O, Adeyeye, E.I, Fasakin, O., Agboola, A. (2011). Physico-chemical properties and anti-nutritional factors of palm fruit products (*Elaeis Guineensis* Jacq.) from Ekiti State Nigeria. *Electronic Journal of Environment, Agriculture and Food Chemistry* 10:2190-2198.
- Anyasor, N., Ogunwenmo, O., Oyelana, A., Ajayi, D., Dangana, J. (2009). Chemical analysis of groundnut oil. *Pakistan Journal of Nutrition* 8: 269-272.
- Araujo, C.D., Andrade, C.C., Silva, E.S., Dupas, F.A., (2013). Biodiesel production from used cooking oil: A review. *Renew. Sustain. Energy Reviews* 27:445-452.
- Arifin, S. F. (2009). Production of biodiesel from waste cooking oil and Round bond palm oil using batch transesterification process, University Malaysia Pahang, Thesis.



- Arjun, B., Chhetri, K., Chris, W., Rafiqul., I. (2008). Waste cooking oil as an alternate feedstock for biodiesel production. *Energies* 1:3-18.
- Atiku, F.A., Fakai, M., Kebbi, A. B., Birnin-Yauri, A.U, Musa, M.A. (2014). Production of soap using locally available alkaline extract from Millet Stalk: A study on physical and chemical properties of soap. *International Journal of Advanced Research in Chemical Science* 1:1-7.
- Betsy, K.J., Mary, J., Reshma, F., Jaya, T. V. (2013). Determination of alkali content and total fatty matter in cleansing agents. *Asian Journal of Science and Applied Technology* 2:8-12.
- Carlos, A., Guerrero, F., Guerrero-Romero, A., Fabio Sierra, E. (2011). Biodiesel Production from Waste Cooking Oil, Biodiesel - Feedstocks and Processing Technologies, Margarita Stoytcheva and Gisela Montero, Intech Open,
- Dimple, S.A., Rean, M., Nazim, M., Vitra, R. (2017). Potential of used frying oil in paving material: solution to environmental pollution problem. *Environmental Sciences and Pollution Research* 24:12220-12226.
- East African Standard (EAS) (2013). Laundry soap - Specification East African community; Arusha; Tanzania.
- Mabrouk, S.T. (2005). Making useable, quality opaque or transparent soap. *Chemical Education* 82(10):1534-1537.
- Nawal, A., Shaista, A., Zubaida, B. (2014). Characteristics and fatty acid composition of commonly consumed cooking oil marketed locally in Riyadh city. *International Journal of Biosciences* 4:227-238.
- Odoom, W., Edusei, V. O. (2015). Evaluation of Saponification value, Iodine value and Insoluble impurities in Coconut Oils from Jomoro District In the Western Region of Ghana. *Asian Journal of Agriculture and Food Sciences* 3:494-499.
- Oghome, P., Eke, M.U, Kamalu, C.I.O (2012). Characterization of fatty acid used in soap manufacturing in Nigeria: Laundry, toilet, medicated and antiseptic soap. *International Journal Modern Engineering Research* 2:2930-2934.
- Onyegbado, C.O, Lyagba, E.T, Offor, O.J. (2002). Solid soap production using plantain peels ash as source of alkali. *Journal of Applied Science and Environmental Management* 3:73-77.
- Rudy, P. (2006). Rendered fats and oils as a biodiesel feedstock Industry faces opportunities, challenges in sustaining growth. *Biofuel* 17:431-433.
- Sani, N.A, Hassan, L.G. (2007). Preparation and analysis of the physical and chemical properties of vegetable oil from *Lageneria siceraria* (bottle ground) seed oil, 2007.
- Shoge, M.O. (2011). Quality of soaps using different oil blends. *Journal of Microbiology and Biotechnology Research* 1:29-34
- Taiwo, A, Oluwadare, I, Shobo, A, Amolegbe, S (2008). Physical and chemical characteristics of soap. *Science Research and Essay* 3:515-517.
- Vivian, O.P, Nathan, O, Osano, A, Mesopirr, L, Omwoyo, W.N (2014). Assessment of the physicochemical properties of selected commercial soaps manufactured and sold in Kenya. *Open Journal of Applied Science* 4:433-440.