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Article

Production of Soap from Neem Seed Oil and *Acacia nilotica* Seed Oil

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Abstract: Neem seed oil and *Acacia nilotica* seed oil were extracted from powdered sample of the seeds using Soxhlet extraction method with n-hexane as the solvent. The powdered seeds gave 37.71% and 3.29% oil yield for both neem seeds and *Acacia nilotica* seeds sample respectively. The parameter analysis revealed that both neem seed oil and *Acacia nilotica* seed oil had the saponification, iodine and acid value of, 144.46 ± 1.41 mgKOH/g and 184.20 ± 2.13 mgKOH/g, 71.38 ± 0.83 gI_2/100g and 137.05 ± 0.55 gI_2/100g, 19.14 ± 0.21 mgKOH/g and 9.05 ± 0.34 mgKOH/g, respectively. The analytical values obtained were in favor of utilization of this oil in soap making. The extracted oil was used to prepare green and milk colour soap for both *Acacia nilotica* seed oil and neem seed oil which are slightly soluble in water. The pH values of 9.63 and 10.52 for both neem oil soap and *Acacia nilotica* oil soap respectively were obtained. The soap has total alkali value of 0.23 ± 0.20 and 0.85 ± 0.02 for neem oil soap and *Acacia nilotica* oil soap with total fatty matter of 18.00 ± 2.00 and 7.33 ± 2.08, respectively. The foam height of the soaps was 2.37 cm and 1.90 cm for both neem oil soap and *Acacia nilotica* oil soap, respectively.

Keywords: *Acacia nilotica;* neem; seed; oil; soap.

1. Introduction

Soap is a product formed from saponification reaction, where esters are split into alcohol and salts. Saponification is more widely used in general terms as alkaline hydrolysis of ester. Soap is sodium or potassium salt of fatty acid produced by saponification reaction using sodium or potassium hydroxide. Based on its chemical properties as an anionic surface active agent (surfactant), soap is used to clean and wash skin and clothing. The fatty acids, stearic, palmatic, myristic, lauric and oleic acids, contribute to lathering and washing properties of the soaps [1], other oils such as lard and tallow from animal sources, coconut, palm oil and olive oil are the most commonest plant oil used in soap production [2].

Palm oil has been widely used as fatty raw material in the manufacture of soap [3]. The chemical characteristics of soap depend on several factors: the strength and purity of alkali, the kind of oil used, completeness of saponification and age of the soap. Such chemical characteristics include moisture content, total fatty acids (TFA), pH, free alkali, and percent chloride. Soap is a substance of ancient origin, the manufacture of which according to the literature [4] has evolved from primitive beginning into a sophisticated chemical process. There are two main processes of soap production which are: (1) cold process of soap production, and (2) hot process of soap production.

(1) Cold process of soap making

Cold process soap (commonly referred to as "CP" soap) is made by combining fatty acid and sodium hydroxide together. Fatty acid can be almost any oil. Cold process soap making is a combination of an art and science. The condensed version of this type of soap making is that there is a certain proportion of lye (sodium hydroxide) and water to fatty acid that form a chemical reaction called "saponification''. During saponification, the oil and lye (sodium hydroxide) mixed and form soap. This process almost takes approximately six weeks to fully complete. Cold process soap making requires the uses of safety equipment such as hand gloves, goggles etc. Cold process is known for its hardness and long lasting quality depending on the oil used, the bar can have great lather.

(2) Hot process of soap making

There is variation on the cold process method. Hot process soap is an interesting take on the cold process method. The simple explanation is that we take the entire ingredient and add it all together into a pot or a container that can be place over a fire source e.g. stove and stir frequently until the soap goes through various stages. The excess water is evaporated off and the soap is ready for use once cooled.

Researchers tested aqueous extracts of *Acacia nilotica* for anti-inflammatory, analgesic and antipyretic activities. The phyto-constituents like flavonoids, polysaccharides and organic acids may be responsible for pharmacological activities. The researcher [5] suggested that antispasmodic action of *Acacia nilotica* is mediated through calcium channel blockade and which is responsible for the blood pressure lowering effect in the in vivo studies. Researchers tested extracts of *Acacia nilotica* against

three test organism: *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Escherichia coli* for their antimicrobial properties by bioassay method using the disk diffusion test. The findings indicated that *Acacia nilotica* have antimicrobial property. The researchers [6] evaluated antimutagenic and cytotoxic effects of different extracts/fractions of *Acacia nilotica* prepared by maceration method. The potency order of different extracts was more or less similar in Ames assay as well as in cytotoxic assay. The activity of extract partially may be due to the presence of gallic acid and other polyphenols.

During the past two decades, the biological activity of neem extracts has been investigated intensively, and six international neem conferences have been held [7,8], covering mainly the application of crude extracts, twigs, stem bark, and root bark, have been shown to possess insect antifeedant, insecticidal, insect growth disrupting, nematicidal, fungicidal [7-10], bactericidal [11,12], anti-inflammatory [13,14], antiworm, immunostimulating, antiviral, antiseptic, anti-inflammatory, antihelminthic, antiworm, antimalaria, antiarthritic, anti-ulcer, antipeptic, antripyretic and antilibido properties. Its extract has been used in poultice to disperse glandular tumors and ulcer while paste in skin disease like eczema and leprosy and scabies's. The extract has also been used in jaundice (hepatitis) and liver complaints. Fruit juice and ripe fruits have been used as purgative, astringent, tonic, eyesore treatment, demulcent and emollient. Oil has been used as pesticide, contraceptive, and antibacterial in tooth paste and soap. The aim of this project is to extract oil from neem seed and *Acacia nilotica* seed to see if these oils can be used to produce soap because other common oils such as palm oil, ground nut oil etc are been used in soap production. Taxonomical classification of neem and *Acacia nilotica* is given in Tables 1 & 2.

Table 1. Taxonomical classification of *Acacia nilotica* (Local name: Bagaruwa)

Kingdom	Plantae
Sub-kingdom	Tracheobionata
Super division	Spermatophyta
Division	Magnoliophyta
Sub class	Rosidae
Order	Fabales
Family	Fabaceae
Genus	Acacia
Species	*Acacia nilotica*

Table 2. Taxonomical description of neem plant (Local name: Dogonyaro)

Kingdom	Plantae
Division	Magnoliophyta
Order	Sapindales
Family	Meliaceae
Genus	Azadirachta
Species	*Azadirachta indica*

2. Materials and Methods

2.1. Sample Collection and Preparation

Acacia nilotica seeds was obtained from Aliero town, Kebbi State, and the neem seeds were obtained from Kebbi State University of Science and Technology school premises. The plant fruits were deshelled and the seeds were obtained, followed by separation of the good seeds. These seeds were washed and air dried, after which both seeds were grounded using mortar and pestle and stored in separate air tight polyethylene bag in a desiccator. Both fresh and powdered samples were used for all analysis.

2.2. Reagent Preparation

I. 1% starch indicator: 1 g of the starch granule was dissolved in 20 mL of distilled water and was make up to 100 mL with distilled water.

II. 10% potassium iodide (KI): 10 g of potassium iodide crystal was dissolved in 20 mL of distilled water, making it up to 100 mL.

III. 15% sulphuric acid: 15 mL of concentrated H_2SO_4 was diluted to 100 mL with distilled water.

IV. 1 M sodium hydroxide: 4 g of sodium hydroxide solid was dissolved in 20 mL of distilled water and was made up to 100 mL with the same liquid.

V. 0.5 M hydrochloric acid: 4.18 mL of concentrated HCl solution was diluted to 100 mL with distilled water.

VI. 0.1 M sodium thiosulphate: 15.81 g of $Na_2S_2O_3$ was dissolved in 20 mL of distilled water, make up to 1000 mL in a volumetric flask.

VII. 1 M H_2SO_4: 200 mL of 5 M H_2SO_4 was diluted to 1 dm^3 with distilled water in a volumetric flask.

VIII. 0.1 M ethanol potassium hydroxide: 0.561 g of KOH was dissolved in 20 mL of ethanol and was made up to 100 mL with the same ethanol in a volumetric flask.

2.3. Moisture Content Determination

The 2 g of the sample was placed in an empty dish, and transferred into air circulation oven at 105 ^{o}C. The dish was removed and re-weighted at interval of 20 min. This process was repeated until a constant weight was obtained.

The percentage moisture content was the calculated using:

Percentage moisture = $(W_1-W_2)/(W_1-W_0) \times 100\%$

Where, W_1 = weight of sample and empty dish, W_2 = weight of dried sample and empty dish, and W_0 = weight of empty dish.

2.4. Ash Content Determination

The 2 g of the sample was transferred into an empty dried crucible. The crucible containing the sample was then heated at a temperature of about 600 ^{o}C until the entire sample in the crucible completely turned to ash. After which it was allowed to cool in a dessicator and then weighed again.

The percentage ash content was calculated using:

Percentage ash content = $(W_2-W_0)/W_1 \times 100\%$

where, W_1 = weight of the sample, W_2 = weight of the sample ash and the empty crucible, and W_0 = weight of the empty crucible.

2.5. Oil Extraction

The extraction of the oils was conducted in a Soxhlet extractor using n-hexane (boiling point of 50 ^{o}C) for six hours [15]. The oil was obtained after the solvent was removed under reduced pressure and temperature which refluxed at 70 ^{o}C to remove excess solvent used in the oil. The extracted seed oil was stored in a sample bottle for subsequent physicochemical analysis.

2.6. Extraction Procedure

The 70 g of the powdered sample was weighed using a digital weighing balance, into a thimble. The thimble that contained the sample was placed into a Soxhlet extractor. The 150 mL of n-hexane (use as the extraction solvent) was then put into a distillation flask and the extractor was connected to a distillation flask, followed by connecting a reflux condenser and the setup was placed on the heating mantle. As the temperature increase steadily the solvent (n-hexane) began to boil and the boiling vapour passes through the condenser then condensed back to liquid, this condensed vapour falls on the porous thimble where it extracts the oil from the sample in the thimble, leading to formation of a homogenous mixture of n-hexane and the oil which was collected at the receiver of the oil Soxhlet extractor setup. This process of extraction was carried out for 6 hours. The homogenous mixture obtained at the receiver was heated, and the n-hexane which is more volatile than the oil gets evaporated. The obtained oil was

further heated in a water bath to completely remove the solvent, which was the cool observed and weighed.

The % oil yield was calculated using:

% oil yield = weight of the oil/weight of the sample ×100%.

2.7. Physicochemical Analysis of the Extracted Oil

2.7.1. Boiling point determination

The 5 cm^3 of the oil sample was measured into a test tube and was heated in a water bath. The heating continued until vapour was given off, the oil temperature boiling point was recorded from the thermometer.

2.7.2. Determination of specific density of the oil

The 10 cm^3 of the oil was measured in a measuring cylinder of a known weight. The weight of both oil and the cylinder was also measured then the weight of the oil was the obtained by subtracting the weight of the cylinder from the weight of both the oil and measuring cylinder. The specific density of the oil is then obtained using:

Density of oil = $(W_1-W_0)/V_0$

where, W_1 = weight of measuring cylinder and the oil, W_0 = weight of measuring cylinder, and V_0 = volume of the oil used.

2.7.3. Determination of iodine value

The iodine value of a fat or oil is the measure of the degree of unsaturation of the fatty acid present in the oil or fat. It also gives an ideal of the oil solubility in soap making. The iodine number is a measure of the amount of halogen which can be absorbed by the unsaturated acids. It can also be define as the percentage of iodine that will be absorbed by chemically unsaturated substance (fat or oil) in a given time under arbitrary condition [16].

Procedure: A 0.5g of the oil was dissolved in 15 mL carbon tetrachloride in 100 mL conical flask. A 5 mL of iodine solution was added to the flask and allowed to stand for 2 hours in the dark at 25 ^oC. A 5 ml of potassium iodide (KI) solution was added and the mixture was titrated with 0.1 M sodium thiosulphate using starch indicator. A blank determination was carried out and the iodine value was calculated using:

Iodine value = C(V2-V1) ×12.69/W

where, C = concentration of sodium thiosulphate, V_1 = volume (mL) of sodium thiosulphate used for the blank, V_2 = volume (mL) of sodium thiosulphate used for the sample, and W = weight of the sample (0.50 g).

2.7.4. Determination of acid value

The acid value of the oil is defined as the number of mg of potassium hydroxide required to completely neutralize 1 g of the oil. It can also be define as the number mg of potassium hydroxide neutralized by the free acid present in the 2 g of an oil or fat. The value is informative on the amount of free acid present in oil under sturdy.

Procedure: 25 cm^3 of ethanol was heated with 2.5 g of oil sample in 25 cm^3 beaker until the mixture began to boil. The heat was removed and was titrated with 0.1 M KOH solution, using two drops of phenolphthalein as indicator with consistent shaking for which a permanent pink color was obtained at the end point. The acid value was determined using:

Free fatty acid (FFA) = CV × 56.1/W

where, V = volume of potassium hydroxide used (titer value), C = concentration of KOH (0.1 M), W = weight of the sample (2.5 g), and M = molar mass of KOH (56.1).

2.7.5. Determination of saponification value

The saponification value is expressed as the number of milligram of KOH required to completely saponify 1 g of fat or oil. It is also define as the measure of the mean molecular weight of the fatty acid present in the fat or oil [17]. The process of saponification is the hydrolysis of triglycerides into glycerol and potassium or sodium salt of fatty acid, using a solution of KOH or NaOH in alcohol. The process measures the amount of alkali required combining with the fatty acid librated by the hydrolysis of the fat; from this the equivalent weight of the fatty acid can be determined.

Procedure: 2 g of the oil was weighed into conical flak, 25 cm^3 of 0.1 M ethanol potassium hydroxide was added. The content was boiled for about 3 min with continuous stirring. The flask was allowed to cool and the then titrated with 0.5 M HCl using phenolphthalein as indicator until pink color disappeared. This process was repeated three times for both the sample and blank titration [17]. The saponification value was calculated using:

Saponification value = $M(V_a-V_b) \times 56.1/W$

where, V_a = titer value of the sample, V_b = titer value of the blank solution, W = weight of the oil used, M = concentration of the acid used, and 56.1 = molar weight of KOH.

Saponification procedure: 35 cm^3 of the oil was measured into a beaker and warmed gently followed by the addition of 35 cm^3 of the alkali solution of 1M NaOH or KOH, then stirred continuously for about 10 min to form homogenous solution. The homogenous solution was then poured into a mould and allowed to harden in open air for 24 hours to form soap bar, and the bar was then analyzed for colour, pH, texture, foam height, and effectiveness in cleaning [18].

2.7.6. pH determination

The pH was determined by pH meter. The 10 g of the soap sample was weighed and dissolved in

100 mL distilled water in a beaker. This was made up to prepare 10% soap solution. The pH reading was recorded and the steps were repeated using various soap samples for comparison.

2.7.7. Foam ability test

About 2.0 g of the soap sample was added to 500 mL measuring cylinder containing 100 mL of distilled water. The mixture was shaken vigorously so as to generate foams. After shaking for about 5 min, the measuring cylinder was allowed to stand for about 10 min. The height of the foam in the solution was then measured and recorded. The steps were carried out on the soaps produced from both need seed oil and *Acacia nilotica* seed oil.

2.7.8. Test for effectiveness in cleaning

To determine cleaning property of the prepared soap, a drop of oil was placed on four separate strips of filter paper. This filter paper was then immersed in a separate test tube containing soap solution (2 g of soap sample in 100 mL distilled water). Each test tube was shaken vigorously for 1 min. The filter paper were removed and rinsed with distilled water, and then the degree of cleanliness in each filter paper was observed.

2.7.9. Determination of total fatty matter (TFM)

About 10 g of the soap sample was dissolved in 150 mL of distilled water and heated followed by addition of 20 mL of 15% H_2SO_4 while heating until a clear solution is obtained. The fatty acid present in the solution was solidified on addition of 7 g of bee wax and reheated. The solution was allowed to cool to form a cake; the cake was removed and weighed.

Total fatty matter was calculated by using:

% TFM = (A-Z)/W × 100% ?

where, A = weight of the obtained cake, Z = weight of the wax, and W = weight of the soap.

2.7.10. Determination of total alkali

The total alkali is determined by titrating excess acid contained in aqueous phase with standard solution of NaOH. The 100 mL of neutralized alcohol was added to 10 g of the soap sample with 5 cm^3 of 1M H_2SO_4 solution and heated till the soap sample dissolved; then titrate the solution against 1M NaOH using phenolphthalein as indicator. The total alkali was calculated using:

% Total alkali = (V_A-V_B)/W × 100% ?

where, V_A = volume of the acid used, V_B = volume of the base, and W = weight of the soap.

3. Results and Discussion

3.1. Sample Analysis

The moisture content, ash content, and percentage oil yield are given Tables 3-5. It can be seen clearly from the results obtained that the percentage oil yield for neem seed oil and *Acacia nilotica* seed oil is 37.71% and 3.29% respectively (Table 5), which show that neem oil with high percentage oil yield is another ready source of oil like palm kernel, melon seed, peanut seed and soya bean with high percentage oil yield for commercial scale, unlike *Acacia nilotica* seed which yield a very low oil percentage of 3.29% which is a very low source of oil for commercial use and require high cost to obtain such oil at a required quantity.

Table 3. Moisture content

Sample	Weight of sample (g)	Constant weight obtained (g)	Result (%)
Neem seeds	2	01.87	6.67 ± 0.76
Acacia nilotica seeds	2	01.91	4.50 ± 0.50

Note: The values are mean and standard deviation of triplicates determination.

Table 4. Ash content

Sample	Weight of sample (g)	Weight of ash (g)	Result (%)
Neem seed	2	0.10	5.17 ± 0.27
Acacia nilotica seed	2	0.17	8.67 ± 0.76

Note: The values are mean and standard deviation of triplicates determination.

Table 5. Percentage oil yield

Sample	Weight of sample (g)	Weight of oil (g)	Result (%)
Neem seed	70	26.40	37.71
Acacia nilotical seed	70	2.30	3.29

Note: The values are mean and standard deviation of triplicates determination.

3.2. Oil Analysis

The colour observed from neem seed oil was yellow and pronounced odour (pungent odour), and *Acacia nilotica* seed oil was greenish in colour with nutty smell (Table 6). However both oils are liquid at room temperature indicating the presence of oleic acid, linoleic acid and other unsaturated fatty acid [19]. The specific density of the oil is 0.960 ±0.010 g/cm^3 and 0.890 ± 0.006 g/cm^3 for both neem oil and *Acacia nilotica* seed oil respectively which is higher than 0.83 ± 0.14 g/cm^3 for dehulled seed oil of *Luffa aegytiaca* mill and lower than 1.18 ± 0.002 g/cm^3 of sponge gourd *Luffa cylindrical* from literature. Oil with low density is an indication that it contains low molecular weight fatty acid; likewise it will have

high saponification value which makes it suitable for soap production.

Table 6. Physical properties of the oil

Parameters	Neem oil	*Acacia nilotica* oil
State at 25 ^oC	Liquid	Liquid
Colour at 25^oC	Yellow	Green
Boiling point (^oC)	75.3	68.9
Odour	pungent	nutty
Specific density (g/cm^3)	0.96 ± 0.01	0.890 ± 0.006
pH	6.72	8.18

Note: The values are mean and standard deviation of triplicates determination.

Iodine value is the measure of proportion of unsaturated fatty acid present in the fat or oil, but the test measured the amount of iodine absorbed per gram of sample. Iodine value of 71.38 ± 0.83 gI_2/100g (less than 100) obtained for neem seed oil show that the oil belong to the class of non dry oils, which are useful in the production of soap (Table 7). The iodine value obtained for *Acacia nilotica* seed oil of 137.05 ± 0.55 which fall within the range of organic oil of 125 to150 gI_2/100g [20] can be use in production of soap.

Table 7. Iodine value

Sample	Volume of acid used for the sample (cm^3)	Volume of acid used for the sample (cm^3)	Result (gI_2/100g)
Neem oil	2.56	25.06	71.38 ± 0.83
Acacia nilotical oil	2.56	45.77	137.05 ± 0.55

Note: The values are mean and standard deviation of triplicates determination.

Acid value measures the extent in which hydrolysis librates fatty acids from their ester linkage to the parent glyceride molecule. Thus the higher the acid values of oil, the lower its storage quality [21]. Acid value of 19.1 ± 0.21 mgKOH/g and 9.05 ± 0.34 mgKOH/g obtained for neem seed oil and *Acacia nilotica* seed oil respectively (Table 8) is higher than 1.20 ± 0.07 mgKOH/g of *J. curcas* seed oil [22] and lower than that of pawpaw seed oil and orange seed oil with acid value of 47.12 mgKOH/g and 51.40 mgKOH/g respectively which are higher than the acceptable limit of edible oil but are useful in soap production. The low acid value signifies a maximum purity and makes it suitable for soap production.

Table 8. Acid value

Sample	Volume of KOH used (cm^3)	Result (mg KOH/g)
Neem oil	8.53	19.14 ± 00.21
Acacia nilotica oil	4.00	9.05 ± 0.34

Note: The values are mean and standard deviation of triplicates determination.

Saponification value of 144.46 ± 1.41 mgKOH/g and 184.20 ± 2.13 mgKOH/g for both neem seed oil and *Acacia nilotica* seed oil respectively (Table 9) is lower than 192.15 mgKOH/g of shea nut oil [23] and higher than that of African pear oil 143.76 mgKOH/g which could be good for soap making [24]. Higher saponification justifies the usage of the oil for soap production.

Table 9. Saponification value

Sample	Volume of acid used for the blank (cm^3)	Volume of acid used for the sample (cm^3)	Result (mg KOH/g)
Neem oil	11.60	21.90	144.46 ± 001.41
Acacia nilotica oil	11.60	24.80	184.20 ± 2.13

Note: The values are mean and standard deviation of triplicates determination.

3.3. Soap Analysis

The mass of soap yield, physical properties of the soap, and total alkali are given in Tables 10-12. Both oils are milky and greenish in colour when dissolve in water for both neem oil soap and *Acacia oil* soap respectively with both slightly soluble in water (Table 11). Although foam generation has little to do with the cleaning ability of the soap, it is of interesting importance to the consumer and is therefore considered as a parameter in evaluating soaps and detergents. The soap total alkali value of 0.23 ± 0.20 and 0.85 ± 0.02 for neem seed oil soap and *Acacia nilotica* seed oil respectively (Table 12) is low and indicates that the soap formed will not be harsh on skin as soap with high alkali value causes skin itching and clothes wear out [25].

Table 10. Mass of soap yield

Sample	Parameter	Result (g)
Neem oil	Soap yield	44
Acacia nilotica oil	Soap yield	30

Note: The values are mean of triplicates determinations.

Table 11. Physical properties of the soap

Parameters	Neem soap	*Acacia nilotica* soap
State at 25 ^{o}C	solid	solid
Colour	milk	green
Colour in solution	milky	greenish
Solubility in water	slightly soluble	slightly soluble

Table 12. Total alkali

Sample	Volume of NaOH used (cm^3)	Result (%)
Neem soap	4.27	0.23 ± 0.02
Acacia nilotica soap	2.26	0.85 ± 0.02

Note: The values are mean and standard deviation of triplicates determination.

The total fatty matter (TFM) of soaps was found to be 18.00 ± 2.00 and 7.33 ± 2.08 for neem seed oil soap and *Acacia nilotica* seed oil soap, respectively (Table 13). These differences in the TFM are responsible for high moisture contents and quantities of the used fatty materials. The lower total fatty matter is due to presence of un-reacted NaOH in the soap formation. However, dry skin needs soap which is high in total fatty matter. This re-hydrates the skin making it smooth, and additionally the high oil content within the soap acts as a lubricant [26].

Table 13. Total fatty matter

Sample	Weight of cake form (g)	Result (%)
Neem soap	2.5	18.00 ± 2.00
Acacia nilotica soap	1.4	07.33 ± 2.08

Note: The values are mean and standard deviation of triplicates determination.

The effectiveness in cleanliness and foam ability are given in Tables 14 & 15. The soaps have the foam height of 2.73 cm and 1.90 cm for neem oil soap and *Acacia nilotica* oil soap respectively (Table 15) which are higher than 1.6 cm and 1.4 cm of castor oil based soap and castor glycerin soap respectively but lower than that of jatropha oil based soap of 4.80 cm and shea nut soap of 4.2 cm.

Table 14. Effectiveness in cleanliness

Sample	Weight of sample used (g)	Result
Neem soap	2	It is more effective than acacia oil soap.
Acacia nilotica soap	2	Its less effective compared to neem oil soap.

Table 15. Foam ability

Sample	Weight of sample (g)	Result (cm^3)
Neem soap	2	2.73
Acacia nilotica soap	2	1.90

Note: The values are mean of triplicates determinations.

For the prepared soap the pH value of 10.52 and 9.63 for both *Acacia nilotica* seed and neem seed oil soap respectively (Table 16), in which the pH value obtained for *Acacia nilotica* seed oil soap is higher than the pH range of 9 – 11 which is considered as high level for any soap by National Agency for Food and Drug Administration and Control (NAFDAC) [27, 28], the pH value obtained for the neem oil soap fall within the range but higher than the pH range of 3 – 5 which are considered as low level by the NAFDAC, this is due to incomplete alkali hydrolysis resulting from the saponification process. Soap with pH range of 9 – 11 or higher are consider to be harsh to skin [25]. This can be overcome by addition of excess fat or oil to reduce the harshness of the soap.

Table 16. pH value

Sample	Weight of sample (g) in 100 mL distilled water	Result
Neem soap	10	9.63
Acacia nilotica soap	10	10.52

Note: The values are mean of triplicates determinations.

4. Conclusions

The results obtained from this research work after the chemical analysis of the oils clearly indicated that both neem seed oil and *Acacia nilotica* seed oil are utilizable for soap making. The analysis and properties exhibited by the soap produced indicated its suitability for commercial production.

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