Preparation Of Soap from Palm Kernel Oil (Pko) And Potash

Ibrahim Jimoh Department of Pure and Industrial Chemistry, Faculty of Physical Sciences, College of Natural and Pharmaceutical Sciences, Bayero University Kano, P.M.B. 3011, Kano State, Nigeria. ibrahimjimoh133@gmail.com;

Abdullahi Jimoh School of Engineering, Science and Technical, Federal Polytechnic, Daura, P.M.B 1049 Katsina, Nigeria. abdullahijimoh0101@gmail.com

ABSTRACT

The soap was prepared from Palm Kernel oil with Potassium hydroxide and other additives using cold method. The staining property, solubility property, lather formation and cleaning action of the sample Soap were accessed. The pH-values of the sample Soap were obtained, ranging from 9.06-9.08. The soap prepared with additives mentioned and a pH Value does not irritate the skin and has good lather forming characteristics.

Keywords: Soap, palm kernel, potash.

Introduction

Soap is a surfactant used in conjunction with water for washing and cleaning, it is available in solid bars and other form of the viscous liquid. Chemically, Soap is a salt of fatty acid. It is made by the reaction between a fat and strong alkali such as sodium hydroxide, potassium hydroxide or soda ash (Sodium carbonate). The chemical reaction that yields the soap is known as saponification. In the saponification process of fat to form soap, the water hydrolyzes the fat thus converting it to free glycerol and fatty acid salt (Soap).

$(C_{17}H_{35}COO)_3C_3H_5 + 3NaOH$ Saponification $3C_{17}H_{35}COONa + C_3H_5(OH)_3$

Fat Soap Glycerol

The exact origins of soap are unknown, though Roman source claims that it dates back to at least 600BC, when Phoenicians prepared it from goats tallow and wood ash (Garzena, 2004). Soap was used by Celts, ancient inhabitants of Britain. Soap was used widely throughout the Roman Empire, primarily as a medicine. To mention a soap as a cleanser does not appear until second century A. D by the eight century, soap was common in France, Italy, and Spain. But it was rarely used in the rest of Europe until as the 17th century. (Garzena, 2004).

Soap is composed of the following reagents:

Water: This should be in the form of distilled water or deionized water.

Lye: This is alkali which is either in the form of potassium hydroxide or sodium hydroxide

Fat/Oil: Fat is a solid substance obtained from animals, treated in the production of soap and other products, while oil is a liquid substance obtained from vegetables Oil such as Palm Kernel Oil.

Colorant: Several colors are used to color soap which are either from organic or inorganic origin such as Carmosine red, sunset yellow, Allura red etc.

Perfumes: This is used to give a beautiful scent to the soap.

Soaps are classified based on the nature of the oils used in producing the soap as:

Drying soap: These are soaps that are in solid form and are formed using dry oil. E.g. cotton seed, mustard, rice barn, Soya corn, coconut oil, castor oil, olive oil, palm Kernel oil etc.

Non-Drying soap: These are soaps of liquid form e.g. baby soap, imperial leather soap, and are formed usually by the use of non-drying oil. The drying oil can sometimes be used but it was the possibility to return to its original stage after the soap has been produced. (Gupta, 1990)

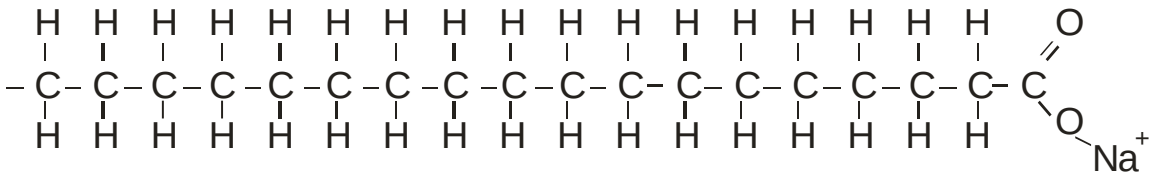
There are two manufacturing processes of soap, the cold process and the hot process. The cold process of making soap is done without heating the soap batter, while the hot process requires that the soap batter must be heated.

Cold Process: Although the cold-process of soap making takes place at room temperature, the fats are first heated to ensure the liquidification of the fats used. Then, when the lye water solution is added to the fats, it should be at the same temperature with the melted oils and both are typically between 27^0C-28^0C. An external heat source is not necessary but the molded soap should be incubated by being wrapped in blankets or towels for 24hours after being poured into mold. Milk soaps are the exception and do not require insulation, which may cause the milk to sour. The soap will continue to exothermically give off heat for many hours after being molded. During this time, it is normal for the soap go through a "gel phase" where the opaque soap will turn semi-transparent for several hours before turning opaque again. The soap may be removed from the mould after 24hous but the saponification process takes several weeks to complete.

Hot Process: Unlike cold process of soap making, all hot processed soap experiences a "gel phase" as a result of being heated, such as in a double boiler or crock pot. Hot processed soap may be used soon after being removed from the mould because the temperature accelerate the saponification process and also drive-off excess water. The soap is thoroughly cooked until saponification is completed. The hot processed soap comes out on the sticky side at first until it is exposed to air for a few days. The major difference between hot and cold process of soap making is that the hot process is done at time of preparation of potassium hydroxide or sodium hydroxide while for the cold process; it takes a day before use after the preparation.

Most soap removes grease and others dirt, because some of their components are surface-active agents, or are surfactants here a molecular structure that act as a link between water and dirt particles from neither the underlying fabrics nor other surface to be cleaned. Dirty clothe, skin or other surfaces have particles of dirt suspended in a layer of oil or grease. Polar water molecules cannot remove the dirt embedded in non-polar oil or grease. One can remove the dirt with soap, because of its dual nature.

In the cleaning action of soap, the soap molecule has a polar, water soluble (Hydrophilic head) and a long, oil soluble non-polar (hydrophobic tail) Fig 1.0.



The hydrophobic part of the soap dissolves in oily surfaces when enough soap molecules have oriented themselves around an oily droplet with their hydrophobic tail dissolved in the oil. The oil droplet together with the suspended dirt particles are removed from the surface of the cloth or skin. The oil droplet is now strongly attracted to water and solvated by the water. The solvated oil droplet is called micelle.

Palm oil was long recognized in West African countries, and among West African people, it has long been in widespread use as cooking oil. European merchants trading with

West Africa occasionally purchase palm oil for use in Europe. But despite the fact that the oil is cheap, the oil is rare outside West Africa. Palm oil become highly sought-after commodity by the British traders, for use as an industrial lubricant for the machines of the Britain's industrial revolution, as well as forming the basis of soap products, such as lever Brothers, sunlight soap and the American palm oil branch. In 1870, palm oil constituted the primary export of some West African countries such as Ghana and Nigeria. Although, it was overtaken by cocoa in the 1886. Palm oil and palm kernel oil are composed of fatty acid esterifies with glycerol just like any ordinary fat. Both are high in saturated fatty acid, about 50% and 80% gives its name to the 16 Carbon saturated fatty acid (Palmitic acid) found in the palm oil, Mono Unsaturated oleic acid is also a constituent of palm oil while palm Kernel oil is the contains mainly lauric acid. Palm oil is the largest natural source of tocotrienol which is part of the vitamin E family. Palm oil is also high in Vitamin K. The fatty acid content of palm kernel oil are: Lauric(G1)48.2%; Myristic(G4) 8.2%; Palmitic(G6)3.4%; Capric(G0) 3.3%; Caprylic (C8) 2.5%; Stearic(G8) 15.3%; Oleic(G8)2.3%; Linoleic (G8) 0.4%. Fatty acids are saturated and unsaturated aliphatic carboxylic acids with carbon chain length in the range of C6 up to C24. An example of fatty acid is palmitic acid: CH3 – (CH2) 14 – COOH. Splitting of oils and fats by hydrolysis or under basic conditions of Saponification yields fatty acids with glycerin (Glycerol) as a by-product.

Materials And Methods

Apparatus

pH meter, Breakers, Cornical flask, Glass rod, Measuring cylinder, Volumetric flask, Heating mantle, Weighing balance, Hand mask, Viscometer

Reagents.

Potassium Hydroxide (KOH), Sodium hydroxide (NaOH), Palm kernel oil (PKO), Potassium Carbonate (K CO), Hydrochloric acid (HCl), Distilled water, Ethanol, Perfumes, and Colorants.

Preparation Of Reagent

4.1M Sodium hydroxide: 3.3g sodium hydroxide was dissolved in 20Cm^3 of distilled water.

3.0M Potassium carbonate: 3.3g potassium carbonate was dissolved in 20Cm^3 of distilled water.

0.5M Ethanol Potassium hydroxide: 7g Potassium hydroxide was dissolved in 10Cm^3 ethanol in a 250Cm^3 volumetric flask.

Processing Of Palm Kernel Oil

Palm oil products are made milling and refining processes, first using fractionation with crystallization and separation processes to obtain a solid stearin and liquid olein. By melting and be gumming, impurities can be removed and then the oil filtered and bleached deodorized palm oil. Free pure fatty acids used as an important raw-material in the manufacture of soap, washing powder and other hygiene and personal care products.

Production Of Soap

100cm^3 of palm kernel oil (PKO) was measured, melted and then mixed with 100cm^3 of 4.1M sodium hydroxide, stirred in one direction at a room temperature for 15minutes until a viscous mixture is obtained. Followed by addition of additives such as 1g of colorant (Light green and dark green, etc), 5cm^3 of perfumes. The mixture was left to solidity for one week to obtain the solid soap. (willcox, 2000)

Soap Prepared With Sodium Hydroxide And Potash

20cm^3 of palm kernel oil was weighed into a breaker containing 10cm^3 of potassium carbonate (natural potash) and 10cm^3 of 3.0M sodium hydroxide was filtered and added with continues stirring until viscous mixture was obtained. Mixture was left to solidify. (Garzena, 2004) (willcox, 2000)

Determination Of Saponification Value

250cm^3 capacity round bottom flask was weighted and 1g of warmed palm kernel oil was introduced into the flask. 25cm^3 of 0.5M ethanol potassium hydroxide solution was also added. The mixture was refluxed for an hour after which the heating was stopped and 5 drops of phenolphthalein indicator was added. The resultant hot soap was titrated against 0.5M hydrochloric acid. The experiment was

repeated three times and the average value was taken. A blank titration was also carried out by titrating 25cm^3 of 0.5M ethanol potassium hydroxide against 0.5M hydrochloric acid.

Coloration And Staining Properties Of Soap

Coloration is a process of imparting colour to a substance for the purpose of beautification, attraction and quality products. 1g of light green colour was used in this saponification process obtain a green coloured soap.

However, staining is the ability to leave or make colour patches or dirty marks on some things especially ones that are difficult to remove. A while cotton fabric was cut and the soap was used to wash it.

Determination Of pH.

pH is the measure of the acidity or alkalinity of a solution calculating as the common logarithm of the reciprocal of hydrogen ion concentration in which per cubic decimeter of solution and numerically equals to 7 or neutral solutions. pH increases with increasing alkalinity and deceases with increasing acidity.

The pH value of the prepare soap was determined using pH meter. The pH value was determined by immersing the pH meter into the viscous sample of the soap which the pH meter has been standardized with distilled water. The same procedure was done for all the prepared samples and the results obtained are shown in Table (i)

Foaming Property

Foaming is the ability of soap to form lather while using. The sample of the soap made was soak and rub in a container of water for 2 to 3 minutes and the results obtained are shown in Table (ii).

Results And Discussions

Table (i): The pH-Values, weight and the melting point of the soap.

Formula of soap	Colour	Weight (g)	pH-value
H3 (CH2)10 COONa$^+$	Blue	21.99	9.06
H3 (CH2)10 COOK$^+$	Blue	22.27	9.08

From the Table (i) above, it can be seen that there is no much variation in the pH-value of the prepared soap, and all the pH-values are within the required range. This indicates that the additive does not affect the pH of the soap.

However, for efficient soap making, pH-values must be within the range of 7-10 as reported by the International Organization of Soap Makers. The finished soap is alkaline to some degree, but soap with pH value above 10 is likely to cause a burning skin.

Table (ii): The foaming property of the soap

Formula of soap	Hard water	Soap Water
CH3 (CH2)10 COONa$^+$	Moderately foam	Heavily foam
CH3 (CH2)10 COOK$^+$	Moderately foam	Heavily foam

For efficient use and quality soap, lather formation is very vital. For the Table (ii) above, it can be seen that both the soap made do foam a heavily lather with soft water and moderate lather with hard water.

Table (iii): The solubility property.

Formula of soap	Soap Water	Hard water	chloroform
CH3 (CH2)10 COONa$^+$	Soluble	Insoluble	Soluble
CH3 (CH2)10 COOK$^+$	Soluble	Insoluble	Soluble

Table (iv): The Cleaning Property

OIL	Formula of soap	Hard water	Soft water
PKO	$CH_3(CH_2)_{10}COONa^+$	Moderately clean	Well Clean
PKO	$CH_3(CH_2)_{10}COOK^+$	Moderately clean	Well Clean

Saponification Value Of Palm Kernel Oil (Sample A)

Today, with easy access to the exact composition of oil, and the molecular weight of the oil, it is easy to determine the exact amount of lye (NaOH) needed to completely solidify a measured amount of specific oil, so that there will be no any extra lye in the soap and the soap will not irritate the skin. The number of milligrams of lye (NaOH) required to completely saponify one gram of a specific oil is referred to as the saponification value. Therefore, saponification value is calculated using titration process and the result is show in Table (v).

TABLE (v): SAMPLE A

Burette readings	1st	2nd	3rd
Final	5.20	5.00	5.10
Initial	0.00	0.00	0.00
Vol. of A used	5.20	5.00	5.10

Therefore, Average titre value = $\frac{5.20+5.00+5.10}{3}$

$= 5.10$

Sample B (Blank)

Burette readings	1st	2nd	3rd
Final	13.80	14.00	13.90
Initial	0.00	0.00	0.00
Vol. of B used	13.80	14.00	13.90

Therefore, titre value = $\frac{13.80+14.00+13.90}{3}$

$= 13.90$

Saponification value is not in any way useful for identification purpose but is useful in determining the mean molecular weight of constituent fatty acid. Titre value of sample A = 5.10; Titre value of sample B = 13.90

Therefore, saponification value = $\frac{(B - A)\ 25.00}{\text{Weight of sample (g)}}$

$= \frac{(25.00x13.90-25.00x5.10)}{1}$

$= 220$

Since 218.6 – 230 is the saponification value range of Palm Kernel Oil, therefore the value obtained is within the range.

Conclusion

The research has shown that soap can be produced from palm kernel oil with good foaming characteristics. The properties of the soap depend to a very large extent on the level of the oil present. The result also showed that soap with pH values of 9.06-9.10, heavily lather formation, which does not stain a white fabric is a good and quality soap which does not burn or irritate the skin.

References

1. Aldrich, (2003): Handbook of fine chemicals and Laboratory Equipments, *Sigma Aldrich, Wisconsin, USA*. Second edition, pp 141-150
2. Garzena Patrizia-Tadiello Marina (2004):Soap: Natural ingredients, Method, and Recipes for Natural Handmade Soaps. *Programmer Publishing*. Pp 85-93
3. Gupta, S. (1990): "Chemical and Physical Properties, Raw Materials "In Soap Technology for the 1990s L. Spitz (Ed), *American Oil Chemical Society*. Pg 48-93.
4. Willcox, Mechieal (2000): "Soap" in Hilda Butter: Pouchers Performes, Cosmetics, and soap. 10th Edition, Dordrecht: *Kluver Academic, London*. Pp 40-48
5. www.google.com Encarta Editor "choice of soap factory" 7-08-2008.
6. www.soapcratter.com"nature of the oil used in soap making" 8-03-2008.
7. www.techsoapcratter.com"small scale preparation of soap" 8-03-2008.
8. www.woltonfeed.com "Soap Making General Instructions 7-08-2008.