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Preparation of Soaps by Using Different Oil and Analyze their Properties

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Abstract

The molecule of soap consists of two dissimilar ends, a hydrophilic end (polar head) which binds with water and another end which is hydrophobic end (non-polar hydrocarbon tail) that binds with oil. The soap is made by the saponification process, which reacts with the oil that contains triglycerides and lye (NaOH). Oils with different properties make them distinct from each other as the composition of fatty acids is incompatible. In the present study in the process of preparation of soaps, dissimilar oils of 5 types i.e., coconut oil, palm oil, castor oil, olive oil and gee oil were utilized. In order to prepare various soap samples, the oils were blended in different ratios which are then checked to analyze the soap's quality. In this study amount of volatile matter and moisture content, total fatty mater content, alkali content and pH were determined. The obtained results were compared with some of commercially available soaps such as baby soap (BS-1), elder soap 1 (ES-1), elder soap 2 (ES-2), elder soap 3 (ES-3) and elder soap 4 (ES-4). With the observed studies, the soap made using olive oil was found to have better properties that the others. It has the good alkaline content, TFM value and pH values.

Keywords: Soap; Saponification; Oil; Volatile; Alkaline; pH

Introduction

Man's day to day activities include luxurious baths to laundry where soap is an integral part. Although the preparation of soap is same worldwide, it is produced in different varieties for various purposes. The chemical composition of a soap is a blend of sodium/potassium salts of the long chain fatty acids, which is made by saponification reaction by the hydrolysis of animal fat and alkali. It is also possible to utilize vegetable oils. Potassium alkali is used to make liquid soaps rather than sodium alkali as soaps produced are hard compared to potassium alkali. After hydrolysis of animal/vegetable oils, they are changed into glycerol and fatty acids. Following the release of water, the fatty acids react with the alkali to form metal salts called soaps. It is known that there are more than 100 oils that are used in soap production which occur in most varieties [1]. But unfortunately, most of the soaps form non-saponifiable fatty acids and cannot be suitable for soap production. In soap production, mixtures of oils are usually used to produce a high-quality product. Some components of these combinations may not undergo hydrolysis saponification and may be left out in the soap as unreacted fatty acids [2]. Skin irritation can be caused with the short chain fatty acids in soaps. As there occurs a tendency to bleach the skin with the soap production, it is necessary to wash out the unreacted use of alkali. Unfortunately, for profit, most soap producers sacrifice quality and retain unreacted soap alkali [3]. Sometimes, in order to produce a soap that bleaches, the alkali is left in the soap. Soap is a mixture of Na^+ or K^+ ions with fatty acids chemically. It is possible to classify fatty acids into saturated and unsaturated fatty acids. The most abundant saturated fatty acids are palmitic and stearic acids, whereas the most abundant unsaturated fatty acids are oleic and linoleic acids. Production of quality soap consists largely of choosing the right proportions of the right oils with their different fatty acids.

Most commercial soap produces quality skimps due to cost and use oils of low quality such as beef fat tallow. Most of these oils of low quality contain non-saponifiable fatty acids [4]. Using them leaves as unsaponified fatty acids a lot of fatty acids in the soap. This lowers the quality of the produced soap. Soaps made from saponifiable oils of high quality such as olive, hemp and palm oil leave fatty acids well below the maximum accepted levels set by the standard authorities. Saponification reaction involves soap producing hydrolysis of fats and alkali oils.

Inhalation and ingestion of Potassium hydroxide causes toxicity. It is corrosive and causes irritation to skin, eyes and respiratory tract. Soaps which contains large amount of unreacted lye in them have the potential of bleaching the skin. Commercial manufacturers of a soap sometimes will retain excess of lye intentionally to produce a bleaching soap [5]. Poor methods of preparation is also one of the reasons to retain excess lye. Regardless of the intent behind the retaining of lye in soaps, it should not be more than the maximum acceptable level as prescribed by standard boards. Other than the components of soap matter which is not soluble in soap are referred as foreign substances. The presence of these substances should be reduced are avoided as some of them may be harmful effects. The constituents of the soap which are volatile are referred as Volatile matter. Soaps which contain Volatile substances as components will have less quality as the components will vaporize easily and leads to reduction in the quality [6]. So, use of volatile components in soaps should be avoided as much as possible. As specified in commercial transactions the total fatty matter (TFM) is one of the most significant features which describes the quality of soap. This total amount of fatty foods is often referred to as fatty acids, which can be separated from the sample after the split with mineral acid, usually HCl. This is the technique and idea that we used here to determine the total fat content in soap. Total fatty matter is used to categorize the soaps. The soaps which use TFM will contain less as TFM is associated with hardness. But as humidity, the finished fillers of commercial soaps, especially laundry soap, as well as to reduce

rates or to give special properties, include fillers, emollients, preservatives, etc. Also, TFM may be up to 50%. Fillers, usually dry powders able to make soap harder which effects on skin harshly and because of more affinity it may become mushy in water. Such low TFM substances are usually associated with rigidity and low quality. Bureau of Indian Standards (BIS) are classified bath or toilet soaps as common, baby, transparent and antibacterial soaps. The last three named soaps are specially targeted to specific users. Toilet soap is a enhancing by law and it must fulfill the necessities of the relevant Indian standard [7]. BIS categorized toilet soaps in to three grades based on the total fatty matter present in them. If TFM is beyond 76%, grade I, it has good quality. TFM above 60% fits to grade II and TFM above 50% fits to grade III. According to International Standards (ISO), good quality soaps must have TFM above 76%. In the current study, the total alkali content and total fatty matter content of different soap samples were determined and likened with standard values [8]. These values are essential in determining the quality of a soap and suitability in the cleansing applications.

Objective of this study is to analyze synthesized soap and compare it with commercially available soap. To achieve this goal, levels of some quality parameters of soap were determined such as volatile matter and moisture content, total fatty matter content (TMF), Alkali content and pH in soap.

Materials and Methods

Soap preparation

Lye (NaOH) was dissolved in distilled water then cooled to room temperature, then it was mixed together with oil and heated to room temperature again. Then it was carefully poured into lye water and blended until to "trace" form. Then it was allowed to mold. The different types of oil were used to synthesis soaps such as coconut oil, olive oil, castor oil, gee oil and palm oil with composition of NaOH, H_2O, oil (1:3:7) respectively.

Determination of volatile matter and wet content

Soap (10.0 g) was weighed to the nearest 0.01, placed in an oven. The temperature was controlled at 110°C. Consequently, it was weighed after cooled in desiccator [9]. Until the differences in the mass between two successive weighing is achieved less than 0.01 g, the operation was repeated.

Following this equation, the volatile matter and moisture content was determined.

$$\frac{m1-m2}{m1-m0}\times 100$$

m0-mass in grams of the dish, m1-test portion with dish before heating, m2-test portion with dish after heating.

Determination of total fatty matter content (TMF)

Soap (5.0 g) was weighed out and the water (100 ml) was added, then it was shaken well and heated directly for (20-30 min). Then concentric sulfuric acid was added until fatty acid layer separated. Solution was filtered by using filter paper and transferred to a pre weighed petri dish. Finally, content was evaporated in electric oven and residue was weighed [10].

Calculation of the total fatty matter content (TMF) is done with the following equation.

TMF=(y-x) × 100 × weight of soap sample.

x-weight of petri dish, y-weight of petri dish and soap after drying

Determination of alkali content in soap

Soap (5.0 g) was weighed out and the water (100 ml) was added, it was dissolved well and heated directly (20-30 min). Then concentric sulfuric acid was added until fatty acid layer separate. Then chloroform (50 ml) was added and solution was added to the separation funnel. Separation funnel was shaken thoroughly until separate chloroform and fatty acid layers. Chloroform layer was separated, and aqueous solution was measured. Aqueous solution (10 ml) was taken to the titration flask and titrated against standard NaOH, methyl orange was added as an indicator. Then alkali content was determined using the obtained volume of NaOH [11].

Determination of pH in soap

Soap (1.0 g) and distilled water (99.0 g) was weighed out and distilled water was heated up to 70°C. Then soap was added to the distilled water and stirred well until soap dissolved. Then solution was cooled in ice bath (40°C) and pH was measured by using pH meter (Table 1) [12].

Results and Discussion

This table shows the moisture content and volatile matter in soap. The ES-1, ES-4 and ES-3 is in good quality according to standard value. But the volatile matters should be very much less in homemade soap because it does not contains any preservatives, colors, essences which give smell to them (Tables 1 and 2).

Soap	Initial Weight of Soap with Watch Glass (G)	Final Weight of Soap with Watch Glass (G)	Volatile Matter and Moisture Content %
Coconut oil	34.04	24.813	92.27
Gee	42.573	40.628	19.45
Olive oil	52.348	43.928	84.2
Castor oil	34.576	32.228	23.48
Palm oil	48.349	44.197	41.52

BS-1	30.3	21.21	90.9
ES-1	33.81	33.07	7.4
ES-2	48.028	45.763	22.65
ES-3	52.097	50.913	1.84
ES-4	44.522	43.412	11.1

Table 1: Volatile matter and wet content in soap sample.

Soap	Sulphuric acid volume (ml)	Water volume (ml)	Required NaOH volume (ml)	Alkali content
Coconut oil	0.5	47	9.05	4.076
Gee	0.4	87	2.35	3.652
Olive oil	0.3	58	2.2	2.704
Castor oil	0.4	75	4.77	3.458
Palm oil	0.5	68	4	4.48
BS-1	0.6	64	3.4	5.488
ES-1	0.6	91	5.6	5.312
ES-2	1.8	82	45.68	4.026
ES-3	--	--	--	--
ES-4	0.7	84	8.45	6.044

Table 2: Total alkali content in the soap samples.

Total alkalinity is a measurement of all alkaline substances in the soaps ie., primarily carbonates, bicarbonates and hydroxides in addition of other substances. The ES-1, BS-1 and ES-4 have higher total alkaline content than standard value and other all seven soaps are in below maximum level of alkaline content. According to the results Olive oil is given minimum amount of total alkalinity to soap (Table 3).

Soap	Weight of china dish (g) (X)	Weight of china dish with content (g) (Y)	Total fatty matter content (Y-X)100 × 5
Coconut oil	54.041	54.068	13.3
Gee	53.25	53.356	53
Olive oil	50.163	50.324	80.5
Castro oil	48.794	48.822	14
Palm oil	52.681	52.714	16.5
BS-1	55.14	55.31	85
ES-1	51.521	51.568	23.5
ES-2	50.817	50.834	8.5
ES-3	50.921	50.939	9
ES-4	52.774	52.923	74.5

Table 3: Total fatty matter content on soap samples.

Higher TFM confirms that soaps are less damaging to the skin and do not cause dryness in bars for "bathing". Less TFM means very harmful soap, soap captures all the moisture in the skin that makes it dry. While dry skin progresses, it becomes more sensitive to skin breakdown, and causes the infection and rashes. This disorder is sometimes referred to as xerosis. Bathing soaps are categorized into three grades, Grade 1: Soaps should have a minimum of 76% TFM, Grade 2: soaps should have a minimum of 70% TFM and Grade 3: 60% minimum TFM.

For washing soaps, they are categorized in two grades. Grade 1: 62% lowest TFM and Grade 2: 50% of lowest TFM according to Ghana Standards Authority (GSA, 2008). Basically, higher the TFM of soap better is its cleansing capacity.

The soaps made using Olive oil and BS-1 have TFM value more than minimum TMF value and ES-4 have TMF value near to minimum TFM value. These 3 soaps can conclude as good soap when consider TMF value. When TMF value is less than standard value it causes skin dryness. When TMF value was found it is difficult to evaporate the content in it, approximately it takes 1 week. When TFM value was determined the fatty matter are stick in beaker wall, glass rod wall and on filter paper, it is affected to the accuracy of the data that was finally calculated (Figure 1).

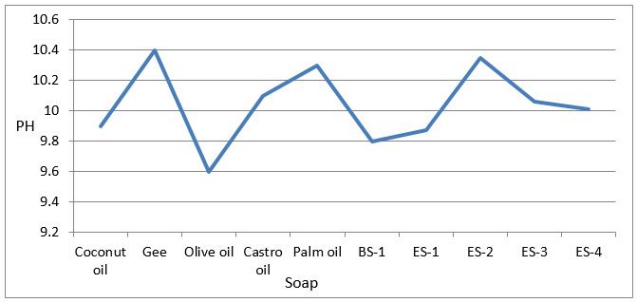

Figure 1: Graphical representation of pH in soap.

The pH measures the acidity or alkalinity of a substance. The skin also contains pH. Once materials with completely different pH levels acquire contact, chemical reactions often occur. The soaps, lotions and different merchandise you employ will have an impact on the pH, and thereby the health of the skin. All the soaps have healthy pH values. When determined, the pH of the soap, must be at 40°C, if the temperature exceeds the solution becomes thicker and it's difficult to measure the pH.

The olive oil soap is best soap among the prepared soaps, that have good alkaline content, TFM value and pH value. The ghee oil is a saturated fat and it is animal fat it gives hardness to soap quickly than other oils. The coconut oil is cheapest oil and it is very common oil, the olive oil, sunflower oil is very expensive and they are not common oil hence they are not very much suitable to prepare soap commercially. The palm oil, coconut oil is beneficial when soap is produced commercially but they are not good for skin health. According to the results obtained ghee oil is also suitable for preparation of soap. Most people have heard about saturated fats and their link to obesity and heart disease and other ailments.

To aid the soap to last longer in the shower, the bars soaps are provided with soaps hardness. The Common saturated fat used to hardness the soap is coconut oil. The improved water solubility helps to make more suds and enhances the ability to clean. Unfortunately, soaps made from coconut oil would dry the skin, to overcome that some conditioning and moisturizing components have to be added. Palm oil is another common saturated fat. It is similarly a good fat to skin sensitivity. A common recipe for homemade vegan soap consists of palm, coconut, and olive oil. Unsaturated fats are the best components for balancing saturated fats in a soap formula.

These are usually vegetable oils, on the other hand, which are liquid at room temperature and mainly contains bent and branched chain molecules. They have the property of acting as emollients or moisturizers in soap formulae. In the right amounts, they can effectively offset the drying abilities of saturated fats and create a bar soap that is hard, conditioning, sudsy as well as white. Olive oil is one of the finest conditions of oils. It is mainly composed of oleic acid, but most of the conditioning action comes from the unsaponifiable, which are organic ingredients in the oil that alkali does not act on.

Conclusion

Based on the results it was realized that ES-1, ES-3 and ES-4, coconut oil, olive oil, Palm oil, BS-1, castor oil, ES-2, contains more amount of moisture content and volatile matter falls above the minimum accepted value as prescribed by the standard authority. Based on the results obtained from the analysis, it can be decided that except ES-1, BS-1, ES-4, alkaline content is less than the Ghana standards board and can therefore be classified as good quality. The olive oil soap, BS-1 and ES-4 contain higher TFM value than the standard TMF value which should not be less than 63. For other soaps TMF value is less than 63 hence we can conclude that Olive oil soap, baby soap and ES-4 is good when TFM value was considered. The pH of healthy skin is between 4.5 and 5.5. The too alkaline soap is truly good for skin, hence all the tested 10 soaps have healthy pH value.

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