IRIS
Journal for Young Scientists
ISSN 2278 – 618X **(Print)**
ISSN 2278 – 6384 **(Online)**

http://www.patnawomenscollege.in/journal

Preparation of Soaps using Essential Oils and Comparing its Quality Parameters with Commercially available Soaps

• **Shalu Priya** • **Priyanshi Jaiswal** • **Smriti Saumya**
• **Madhu Rani Sinha**

Received : July, 2022
Accepted : August, 2022
Corresponding Author : **Madhu Rani Sinha**

Abstract: *Soaps are the sodium salts of higher fatty acids and are produced by the alkaline hydrolysis of oils and fats which are the glyceryl esters of higher fatty acids. This process is called saponification. The different oils with different properties produce different soaps. In this research study, three different types of oils i.e., coconut oil, castor oil, and olive oil were used. These oils were then blended with lye (NaOH) and water in different ratios. Then, the formed soap's quality was determined using various parameters of physicochemical properties. Some of the main physicochemical properties include total fatty matter (TFM), volatile and moisture content, alkali content, pH, etc.*

The prepared soaps were then compared with three different market available commercial soaps i.e., CS 1, CS 2, and CS 3 based on their values obtained from the calculations of their respective parameters.

It was observed that the soap prepared from the olive oil was found to be of better quality as compared to other soaps because of the presence of good TFM, alkali content, and pH values.

CS 3 was found to be of the better-quality soaps in the commercial category because of the standard value of TFM.

Keywords: *Alkaline hydrolysis, fatty acids, saponification, glyceryl esters, total fatty matter (TFM), alkali content, pH value, volatile and moisture content, lye.*

Shalu Priya
B.Sc. III year, Chemistry (Hons.), Session: 2019-2022,
Patna Women's College (Autonomous),
Patna University, Patna, Bihar, India

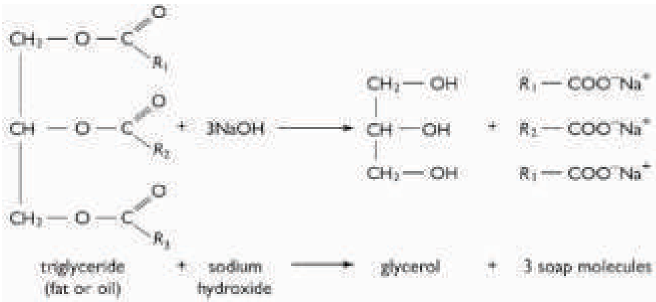
Priyanshi Jaiswal
B.Sc. III year, Chemistry (Hons.), Session : 2019-2022,
Patna Women's College (Autonomous),
Patna University, Patna, Bihar, India

Smriti Saumya
B.Sc. III year, Chemistry (Hons.), Session : 2019-2022,
Patna Women's College (Autonomous),
Patna University, Patna, Bihar, India

Madhu Rani Sinha
Head, Department of Chemistry
Patna Women's College (Autonomous),
Bailey Road, Patna–800 001, Bihar, India
E-mail : madhu.che@patnawomenscollege.in

Introduction:

In our daily life, whether it's bathing or cleaning clothes and utensils, soaps have been used as an unavoidable part. Soaps are prepared of different varieties for different purposes. The basic preparation method includes saponification, which involves the hydrolysis of animal fat/vegetable oil and alkali, after which it gets converted into glycerol and fatty acids. After the release of water, fatty acids react with alkali to form metal salts which are termed soaps. Saponification is an exothermic reaction as heat is evolved when fatty acids react with the lye.



Such properties help in distinguishing the bad and good quality of soaps and give us a basic idea that which one is more suitable for our skin.

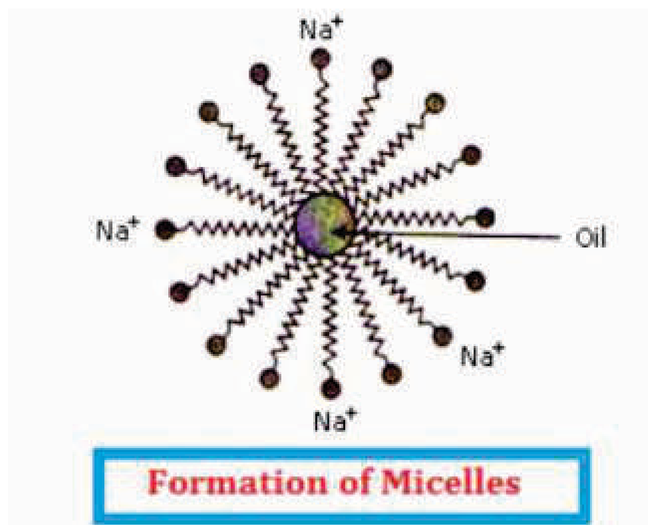
Soaps can be hard as well as soft depending upon the saturation of the fatty acids (Kirk-Othman,1963). A higher proportion of salts of saturated acids such as palmitic and stearic acids give *hard soaps* whereas a higher proportion of salts of unsaturated acids such as oleic acids yield *soft soaps* (David A. Kartz, 2000).

The potassium soaps which are prepared by the hydrolysis of fats with KOH are generally softer than sodium soaps. This is the reason why *luxury soaps, beauty soaps, and shaving soaps* are prepared from potassium hydroxide rather than sodium hydroxide.

Saponification Value and the Quality of Soaps: The saponification value is defined as the number of milligrams of potassium hydroxide required to saponify one gram of fat or oil completely. It gives us an estimate of the molecular mass of the fat or oil. A lower value of saponification number shows the richness of high molecular weight fatty acid residues, and a higher saponification value indicates the presence of lower molecular weight fatty acid residues in the given fat (Bahl and Bahl, 1987).

The saponification value is determined by refluxing a known amount of a sample with the excess of standard alcoholic potassium hydroxide solution and titrating the unused alkali against a standard acid solution. The physicochemical properties of soaps also depend on the saponification value.

Cleansing Properties of Soap: Soaps consist of two groups namely *lipophilic groups* which are large hydrocarbon groups water-repelling and fat-loving and *hydrophilic groups* which are polar and water-loving. The non-polar lipophilic hydrophobic portions of a molecule are directed towards the dirt particles and the polar ends of that molecule are directed towards water molecules. Thus, dirt particles are arrested by these soap molecules in the *micelles* which are then washed away with water (Madan, 2011).



Materials and Methods:

1. NaOH
2. Distilled water
3. Oil (Coconut, Castor, and Olive)
4. Commercial Soaps (CS 1, CS 2, and CS 3)

Soap preparation: Lye (NaOH) was dissolved in distilled water and then cooled at room temperature. Then, it was heated to room temperature and then blended using a blender **Coconut Oil, Castor & Olive oil**. The thick solution is then poured into a shape molder and is left for 24 to 48 hours to obtain the desired soap. The different types of oils used such as coconut oil, castor oil, and olive oil with NaOH and water were taken in the ratio 7:3:1 respectively. After the preparation of the soaps, the quality of the soaps was determined by various physiochemical parameters (Donkor, *et.al*, 1986).

Physicochemical Properties:

Determination of Moisture Content / Volatile Content: 10.0g of soap sample was weighed in a watch glass and placed in the oven at the temperature of 110°C The weight of the watch glass was predetermined. After 1-2 hours it was taken out from the oven and then cooled in the desiccator so that whatever be the moisture contained in the sample was absorbed and then it was weighed again. Then, by using the following equation the moisture or volatile content was determined (Kuntom *et.al*, 1996):

$$\text{Volatile matter/moisture content \%} = \frac{W_3 - W_4 \times 100}{W_2}$$

Where W_4 = weight of the sample after drying along with watch glass.

W_3 = weight of the sample before drying along with watch glass.

W_2 = weight of the sample.

Determination of Total Fatty Matter Content (TFM): 5.0 g of the soap sample was weighed out in a beaker and 100 ml of water was added, it was then shaken thoroughly and then heated directly using a Bunsen burner for about 20-30 min. After that concentrated sulphuric acid was added until the fatty acid layer separated. The solution was then filtered by using a filter paper and was then transferred to a petri dish whose weight was already determined. It was then placed in an oven to make the volatile content evaporate and to make it free from moisture and then the residue was weighed. The total fatty matter content i.e., TFM was calculated by using the following formula:

TFM % = (Y-X) × 100 / weight of the sample

Where Y = weight of the sample after drying along with the petri dish.

X = weight of an empty petri dish.

Determination of pH in the Soap: About 1.0 g of the soap sample was weighed out and dissolved in 99.0 g of distilled water and was allowed to heat up at a temperature of about 70°C The pH was measured using the pH meter.

Determination of Alkali Content in the Soap : 5.0 g of the soap was weighed out and added to a beaker containing 100 ml of distilled water. It was heated using a Bunsen burner, so that the solution gets dissolved, for about 20 to 30 minutes. Then, concentrated sulphuric acid was added so that the fatty acid layer gets separated. 50 ml of chloroform was added to the solution which was then added to the separating funnel. The separating funnel was shaken thoroughly so that the fatty acid layer and the chloroform layer get separated. The chloroform layer was separated and the aqueous layer remained in the funnel and was measured. An aqueous solution of about 10 ml was taken in a titration flask and was titrated against the standard NaOH solution by using methyl orange as an indicator. Then, alkali content was measured by using the obtained volume of the NaOH. (Mohammed and Usman, 2018)

Results and Discussion:

Moisture/Volatile Content: The following

Table 1 shows the moisture and volatile content in the prepared soaps and the commercial soaps i.e., CS 1, CS 2, and CS 3.

A good quality soap should be less volatile and have good moisture content.

Table 1. Volatile matter and moisture content in soap sample

Soap	Weight of the Watch Glass (g)	Weight of the Sample along with Watch Glass before drying (g)(W_3)	Weight of the Sample along with the Watch Glass after drying (g) (W_4)	Volatile Matter and Moisture Content (%)
COCONUT OIL	15.64	25.64	22.40	32.4
OLIVE OI L	22.60	32.60	30.34	22.6
CASTOR OIL	14.76	24.76	21.87	28.9
CS 1	21.93	31.93	29.39	25.4
CS 2	16.31	26.31	23.52	27.9
CS 3	21.66	31.66	30.03	16.3

Total Fatty Matter Content : The Table 2 shows the TFM% of the prepared soap samples and commercial soaps taken. Good quality soaps should have a low percentage of TFM value. If soap is having a high value of TFM, it means that it is less damaging to the skin and does not cause dryness while bathing. If soap is having less TFM value, it means that it is more damaging and harmful to the skin as it captures all the available moisture from the skin and makes it dry.

Dryness of skin leads to skin breakdown because of its sensitivity and becomes a home for infection which is termed xerosis. It has been observed that the soaps having high TFM values show good cleansing properties.

As per the TFM values contained in the soaps, bathing soaps have been categorized into three grades which are as follows:

1. **GRADE 1 -** Soaps having a minimum TFM value of about 76%.
2. **GRADE 2 -** Soaps having a minimum TFM value of about 70%.
3. **GRADE 3 -** Soaps having a minimum TFM value of about 60%.

It was observed that the soap made from Olive Oil contained a greater TFM value as compared to the coconut and castor oils. Among commercial soaps, CS 3 was found to be containing high TFM value than that of CS 1and CS 2.

Table 2. Total fatty matter content in soap samples

Soap	Weight of the Petri Dish (g) (X)	Weight of the Petri Dish with Soap Sample after Drying (g) (Y)	Weight of the Soap Sample (g)	Total Fatty Matter (%)
COCONUT OIL	27.85	28.515	5.0	13.3
OLIVE OIL	31.30	35.30	5.0	80.0
CASTOR OIL	30.24	31.04	5.0	16.0
CS 1	27.67	31.08	5.0	68.2
CS 2	30.27	33.27	5.0	60.0
CS 3	31.20	34.70	5.0	70.0

Alkali Content : The measurement of alkali content is checking the presence of all the alkaline substances present in the soap which can be in the form of carbonates, bicarbonates, hydroxides, etc. in combination with all other substances. If the value of alkali content is above the standard value then the particular soap can irritate the skin which can lead to various skin diseases.

As per the results, soap prepared from Olive Oil had a minimum value of alkali content which makes it most suitable for the skin. Among the commercial taken soaps, CS 3 was found to be more suitable on the parameter of alkali content. (Table 3).

Table 3. The total alkali content in soap samples

Soap	Volume of the Soap (ml)	Burette Reading (ml)		Volume of NaOH (ml)	Alkali Content (%)
		Initial	Final		
COCONUT OIL	10.0	0	3.5	3.5	4.076
OLIVE OIL	10.0	0	2.2	2.2	2.704
CASTOR OIL	10.0	0	2.1	2.1	3.458
CS 1	10.0	0	0.7	0.7	2.360
CS 2	10.0	0	0.6	0.6	2.680
CS 3	10.0	0	1.4	1.4	2.100

pH of the Soap Sample: The pH of a particular substance is the measurement of acidity and alkalinity. In the very same way, our skin also possesses pH. Normal healthy skin has a pH of about 5.4-5.9 and normal bacterial flora. A good quality soap does not contain a value of pH greater than the standard value because it can cause the possibility of dehydration of skin, which in turn, can cause skin irritation. This is because our skin has a particular pH and when a soap of different pH comes in contact with skin, it results in the occurring of different chemical reactions. It was found that all the soaps have healthy pH. While determining the pH value, it should be kept in mind that the temperature range must be 40°C and if it exceeds then the solution will become thick and it will be difficult to measure the pH. As per the results, it was observed that the soap made from olive oil has a pH range under the standard value as compared to the other soaps prepared from coconut and castor oil.

Among the commercial soaps taken, CS 3 had the standard pH range which makes it more appropriate for our skin as compared to that of CS 1 and CS 2 (Table 4).

Table 4. pH of the soap sample

Soap Sample	pH Value
COCONUT OIL	9.9
OLIVE OIL	9.6
CASTOR OIL	10.1
CS 1	9.0
CS 2	9.8
CS 3	7.3

Conclusion:

Based on the results after performing various experiments, it was concluded that:

- Soap prepared from Olive Oil was found to be of the best quality soap because of the high value of TFM contained in it as compared to other soaps which were prepared from Coconut and Castor Oil because of the presence of relatively lower value of TFM.

- Among the commercial soaps taken CS 3 was found to be following the standard value of TFM and falls under the category of good quality soap than CS 1 and CS 2.
- Olive Oil soap contained a good quantity of alkali content, moisture content, and pH and that's the reason why it was found to be of the best quality soap among others.
- While considering the commercially available soaps, CS 3 passed the quality check parameters and was concluded that it was better than CS 1 and CS 2.

References:

Bahl, B.S and Bahl, Arun. (1987). Lipid, *Advanced Organic Chemistry*, page no.-745-748.

David A. Kartz (2000). Study Material, The Science of Soaps and Detergents, page no.-1-10.

Donkor, Peter. (1986). Small Scale Soap Making, TCC, and Intermediate Technology Publications, page no.- 1-88.

Kirk-Othman (1963). Detergency, Soap, and Surfactants, Study Material, *Encyclopedia of Chemical Technology, Interscience*, New York, page no.-5-10.

Kuntom, A., Kifli, H. and Lim, P.K. (1996), "Chemical and Physical Characteristics of Soaps Made from Distilled Fatty Acids of Palm Oil and Palm Kernel Oil", *Journal of American Oil Chemists Society*, page no.-105-08.

Madan, R.L. (2011). Fats, Oils and Detergents, Chemistry for Degree Students, B.Sc. Third Year, page no.-178-179.

Mohammed, U. F., and Usman, A. (2018), Physico-Chemical Analysis of Some Soaps Produced from Five Locally Processed Nigerian Oils, *International Journal of Scientific & Engineering Research*, page no.-531-539.