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Organic Olive Oil Soap Prepared Via Saponification Method

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Abstract : Domestic soaps sold in the market were found to be unsuitable for those with dry and sensitive skin problems. In this study, the production of olive oil handmade soap was attempted with the presence of glycerin and sodium hydroxide via a cold saponification process. The soap was then tested by three methods; by using Fourier-transform infrared spectroscopy result, curing method of weight determination, and pH value. All these three methods aim to ensure that the soap that has been produced is completely ready for use by the public. The yield of the soap was 94.3 g and the pH value of the soap was 8. This pH value is in the safe range for use on human skin which is between pH 6 to 8. Based on the composition and class of components in the soap shown by the IR spectrum, there are no harmful components resulted from the reaction between olive oil and NaOH. Carbonyl group was found in the spectrum and it is subject to the agreement of triglyceride fatty acids compound. The time taken needed for soap to stop losing weight increases as the water content in the soap changes and increases too. Based on all these studies, this soap was found to be ready for use in the sixth week. Therefore, it can be concluded that the soap produced is a high-quality soap to be used by the public based on its healthy pH value, IR spectrum analysis comply with the agreement, and the curing test.

Keywords: Saponification, Olive Oil, Organic Soap, Fatty Acids, IR Spectrum

1. Introduction

Nowadays, most soaps sold in supermarkets have been separated from the glycerin content and added some other ingredients such as triclosan and sodium lauryl sulfate. Both of these substances have been identified to thin human skin, as well as make our skin drier [1]. As a result, those who suffer from allergies, antibiotic resistance, endocrine disruption, acute or chronic toxicity are not suitable to use domestic soap because the use of soap with triclosan and sodium lauryl ether sulfate (SLES) will change

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their disease to be more serious. Skin exposure to sunlight as well as to pollution of the environment has been the cause of such diseases suffered by society.

As a result, organic soaps are the choice of many people to treat these problems. Organic soaps that use organic substances as the main ingredients produce more quality and effective soap to be used. In this study, olive oil is considered as the main ingredient, has several unique characteristics that distinguish it from other plants [2]. Olive oil is popular around the world since it is rich in vitamins and nutrients that are good for the skin such as vitamin E, vitamin A, and minerals [3]. Recent research believes these nutrients can help and treat human skin problems, by lightening, moisturizing, softening, and also smoothing.

However, soap production using the saponification method must be done with caution. This process can lead to dangerous conditions if handled incorrectly because it involves sodium hydroxide lye solution. Some colorants will differ from their proper color if reacting with a high pH environment, making soap production more likely to fail because it is not suitable for public use [4]. Other limitations to be faced are, a full cure of this soap requires patience as it takes quite a long time up to six weeks to, so the soap can last longer in the shower.

Therefore, this research aims to formulate and produce a soap via the saponification method with olive oil and lye as the reactants. The use of olive oil in the production of this soap is to moisturize the dry skin, as well as to treat sensitive skin problems such as eczema that are affected by the use of harmful chemicals like Triclosan and SLES [3]. Hence, to ensure this soap in good quality, the functional group of soap will be considered through the IR spectrum of FTIR analysis to identify the appropriate soap compounds such as fatty acids present in the soap. Soap is ready for use by the public after the pH value and weight of soap are observed every week. The soap weight measurement will be done during the curing test until the soap has completely stopped losing weight.

2. Materials and Methods

In order to ensure safety during the production of soap, saponification is a better choice than hot process soap to choose from. Although the saponification process takes quite a long time for it to be cured, it is cleaner, has a polished finish, and does not require controlling a constant high temperature for two hours straight before being poured into the mold. Furthermore, saponification allows users to know the amount of free fatty acids present in the soap.

2.1 Materials

In this study, only a few things was required for soap production via saponification process. The material and reagents involved were pure olive oil, sodium hydroxide (NaOH), distilled water, rose essential oil. All these items were purchased from Shopee (online shopping platform) and Speedmart Mini Market.

2.2 Preparation of NaOH solution and Organic Soap

A 100% purity of 39 g NaOH was dissolved in 114 g distilled water and left to cool for a few minutes before proceeding to mix with olive oil. The NaOH solution was poured and mixed well with 300 g of olive oil. Once the color has been changed, a few drops of rose essential oil was added to the soap solution. The mixture was mixed until homogenous mixture was formed. The mixture was then left in a cool and dry place for a few weeks after being poured into the mold of 18 cm x 18 cm x 3 cm. The drying process required four to six weeks to ensure the mold is completely dry.

2.3 Curing process of soap

The soap was left at a cool and dry place for a period of four to six weeks in total. However, the expected time can increase if the weight continues to change. The weight of the soap was measured using an analytical balance. The curing test of the soap mold was performed once a week starting from the first week the soap mold was formed. When the water content in the soap has been fully absorbed by the environment, the soap stops losing weight, and the soap was ready for use.

2.4 Determination of pH

For six weeks in a row, the pH of the soap was measured using a pH strip to ensure the pH value always falls within a specific range of normal. A few drops of water were dripped on the soap before the pH strip was placed to measure the pH value. The strip then was compared its color with the pH scale provided.

2.5 FTIR Analysis

The soap was analyzed for FTIR spectroscopy to identify the presence of functional groups. The range of FTIR used was 4000 cm^{-1} to 400 cm^{-1}. A sample place was pre-cleaned using ethanol to avoid any errors during the test. The sampling place used to place a small amount of soap taken by a spatula. Then, infrared light was enabled to penetrate the sample to identify the total beam and selected frequencies. The sample result was displayed on the FTIR computer after a few minutes and the data was recorded.

3. Results and Discussion

Soap has undergone three observations over several weeks to achieve the objectives of the study. The observations made on this soap are namely determination of weight during the curing test, pH value, and IR spectrum from the FTIR analysis. All data collected were recorded up to the sixth week.

3.1 Curing Test Time by Weight Determination

To ensure the soap is fully ready for use, weight measurements are determined every week. The first reading was recorded after 24 hours of soap has been poured into the mold. **Table 1** shows the result from the determination of weight in six weeks.

Table 1: Determination of weight in six weeks

Week	Weight (g)
1	103.8
2	98.1
3	97.5
4	95.7
5	94.5
6	94.3

From the data above, after the soap was left to cool in a dry and ventilated area for the first 24 hours, the soap weight is 103.8 g. This is followed by the next week until the sixth week, the weight of the soap decreasing to 98.1 g, 97.5 g, 95.7 g, 94.5 g, and 94.3 g. The time required for the curing process is influenced by the varying amount of liquid used in the soap. From the data, it can be concluded that the soap weight is decreasing rapidly from the first week to the second week. While at the 5th week and 6th week, the soap weight seems to stop decreasing which makes it is ready for use.

In this study, the soap contains glycerin; which makes the soap mushy. Glycerin attracts and retains the moisture from surroundings via absorption, then draws the water vapor into the soap, which makes the glycerin is a humectant product [6]. The water vapor that has been brought into the soap then will evaporate as time goes by, so the soap can withstand when being exposed to the water. This process is known as the curing soap process for bar soap. The amount of liquid water decreasing during the curing process and will stop when it is completely evaporated, which can be measured by weighing the bar soap. We can conclude that the more the water content in the soap, the more time taken needed to cure the soap.

3.2 pH Analysis

The pH value is used to scale the acidity or basicity of the soap. The pH of the soap also requires to be identified for its pH value to meet its basic characteristics of being alkaline on a healthy scale. **Table 2** shows the data of determination of pH in six weeks.

Table 2: Determination of pH in six weeks

Week	pH Value
1	9
2	9
3	8
4	8
5	8
6	8

Based on the data, the pH value of the soap remains at pH 9 for two weeks after the soap production. However, the pH value decreases on the third week from 9 to 8. The value remains same until the 6^{th} week, which is the last week of determination.

Generally, a normal range of bathing soap will fell in the range of 9-11 [7]. However, this study aims to produce a soap that is suitable for use with sensitive and dry skin. Therefore, soaps that are too alkaline do not meet the objectives and goals of the study. The remaining NaOH that does not fully react in the mixture is one of the reasons the pH becomes too low or too high [8]. A neutral pH organic soap is skin and eco-friendly as it will not thin the skin layer nor lead to environmental pollution.

3.3 FTIR Analysis

All chemical compounds present in the soap can be identified using FTIR spectroscopy to obtain the IR spectrum. The IR spectrum indicates the molecular vibrational spectrum when infrared rays penetrate a prepared soap sample. **Table 3** below corresponds state the peak of the IR spectrum of the functional group present in the organic soap that was obtained from **Fig. 1** IR region.

Table 3: Peak of IR-spectrum indicates functional group

Product	Peak (cm^{-1})	Standard Peak Reference (cm^{-1})	Functional Group	Compound Class
Olive oil organic soap	3400	2400 - 3640	O-H stretching	hydroxyl group
	2989	2840 -3000	C-H stretching	alkane group
	2874			
	2219	2100-2260	-C≡C- stretching	Alkynes group
	2162			
	1707	1670-1780	C=O stretching	Ester/carbonyl group
	1603	1600-1675	C-C=C stretching	Alkenes group
	1208	1030-1230	C-N stretching	Amines group

1148 1088	1050-1150	C-O stretching	Alcohols group

From both **Table 1** and **Fig.1**, the identified fatty acids are divided into several compound classes. The presence of OH functional group was identified by the vibration band 3400 cm^{-1}. Meanwhile the vibration band at 2989 to 2784 cm^{-1} indicated the presence of CH functional group and 1707 cm^{-1} was the peak of C=O stretching. All the vibration band of the IR-spectrum show that the production of olive oil organic soap is in the range of the standard peak.

Thus, when compared to the study of Arvey et. al., 2015 [9], the peak that is assigned for (O – H) and (C = O) stretching exceeds the standard peak reference set. For the hydroxyl group in the Arvey et. al., 2015 studies [9], the (O-H) stretching is assigned to be at peak 3006.30 cm^{-1} , and (C = O) stretching of the carbonyl group is happened at the peak 2855.47 cm^{-1} . The results of the data study between these two results found that the IR spectrum of olive oil soap is in agreement within the triglyceride fatty acids structure base on its absorbance collected.

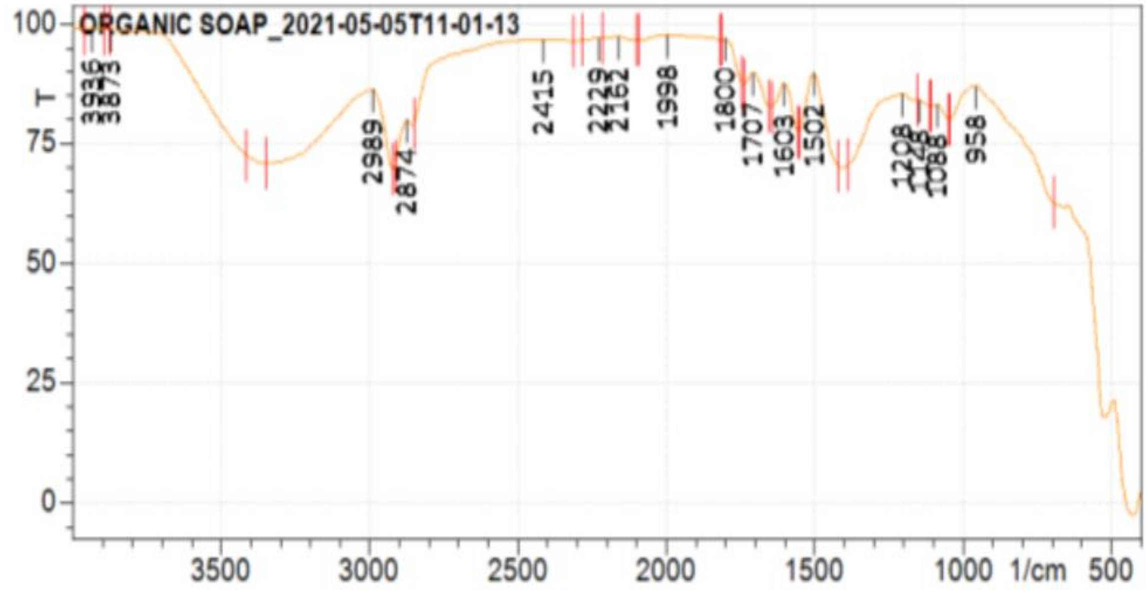

Figure 1: FTIR spectrum for organic soap from olive oil with peak

4. Conclusion

Organic handmade soap has been the choice of many since the public began to realize the dangers of triclosan and SLES to the skin. The study found that the soap was ready for use after six weeks when the soap had stopped losing weight up to 94.3 g. Moreover, the pH value of the organic soap is 8, considered on a neutral scale of pH, which makes it suitable for use on all skin, especially dry and sensitive skin. A good soap should be alkaline and in the range of 8 to 11 of pH value. The IR spectrum was displayed at a wave range of 4000 cm^{-1} to 400 cm^{-1} . Then, the vibration band of C = O (carbonyl) was recorded on the wave at 2874 cm^{-1} to 1707cm^{-1} , indicating the fatty acids compounds present in the soap. In conclusion, this study was successful because the soap had achieved the objectives of the study required for use on human skin. The production of organic soap via the saponification process in this study produces high-quality soap based on the results received due to the curing time for the weight determination, pH value, and fatty acids compound present in each soap bar.

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