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Effect of Infusion Duration of Pandan Leaves with Waste Cooking Oil in Soap Making Process

Muhammad Danial Rasyidi[1], **Siti Aida Ibrahim**[1]*

[1]Department of Mechanical Engineering Technology, Faculty of Engineering Technology,
University Tun Hussein Onn Malaysia, Pagoh Education Hub, 84600, Panchor, Johor, MALAYSIA.

*Corresponding Author Designation

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Abstract: The aim of this study was to investigate the feasibility of using waste cooking oil as a resource for soap production through the infusion of pandan leaves. The infusion process was carried out for 2, 4, and 6 weeks using the cold process method, which is a simple and traditional technique that does not require specialized equipment. The process of synthesize of soap need cooking oil, lye (NaOH) and water as main materials. Parameter for making soap had been set such as type of soap making process, type of cooking oil and type of lye had been set up in this study. The study included the analysis of the oil's color and viscosity. The colour of cooking oil brighter than waste cooking oil and infused waste cooking oil with pandan leaves and the viscosity of cooking oil slightly lower than waste cooking oil and infused waste cooking oil with pandan leaves. Next, other characteristics, as well as the visual observation of the soap's appearance such as lye pocket, glycerine river and jellying were evaluated. The pH value, moisture content, foam stability, and foam height of the soap were also evaluated. The results showed that the pH values were similar to those of most commercial soaps, with values ranging from 9 to 10. The moisture content of soap made with infused waste cooking oil was slightly higher than that of soap made with waste cooking oil or cooking oil alone, due to the antioxidant-rich nature of pandan leaves and their high-water content. The foam stability of soap made with waste cooking oil was better than that of soap made with waste cooking oil or cooking oil alone, likely due to the foam-enhancing effects of pandan leaves, which contain high levels of saponin.

Keywords: Soap Manufacture, Ph Value, Foam Stability, Moisture Content

1. Introduction

Soap is a cleaning agent that is made by combining fats or oils with an alkali, such as lye. Soap is used to clean a variety of surfaces and can be used to remove dirt, oil, and bacteria. It is available in

Corresponding author: saida@uthm.edu.my

many forms, including bars, liquids, and powders, and can be fragranced or unscented. Soap can be used for washing hands, body, and household surfaces, and is an important part of personal and domestic hygiene. palm olive oil that has been collected from several frying shops and sieved through a filter to remove any particulates. This research aims to address the environmental concerns related to the production and disposal of waste cooking oil. The study proposes a solution to this problem by using waste cooking oil in soap making, infused with pandan leaves. The research objectives are to synthesize soap using the cold process method, investigate the effect of infusion duration time between pandan leaves and waste cooking oil, and determine the characteristics of the soap in terms of pH, foam stability, and moisture content. The study will be guided by several guidelines, including the use of recycled frying oil, sodium hydroxide, and previously used cooking oil. The effect of infusion duration time, which is two, four, and six weeks, will also be evaluated. The quality of the cooking oil will be evaluated based on its viscosity and color. The characterization of the soap will be done by analyzing its moisture content, foam stability, and pH value. The purpose of this study is to assess the characterization of a bar soap containing waste cooking oil. This research will contribute to the understanding of the benefits and limitations of using infused waste cooking oil in soap making and provide valuable information for implementing this approach on a larger scale.

1.1 Infusion process

The infusion process between cooking oil and herbs refers to the process of extracting the flavor and fragrance compounds from herbs and transferring them into the oil. This process can be used to create flavorful oils that can be used in cooking and baking, as well as for salad dressings, marinades and more. Infusing waste palm cooking oil with pandan involves steeping pandan leaves in used cooking oil to extract their flavor and aroma. Compounds such as essential oils, chlorophyll and other plant pigments present in the pandan leaves are dissolved in the oil, providing a fragrant and sweet scent. Using waste palm oil for this infusion process is controversial because waste palm oil can have harmful contaminants and could be more prone to oxidation. Dried pandan leaves to avoid any spoilage on the oil, and heating the oil to a moderate temperature before adding the leaves can help to speed up the infusion process, but it could be harmful for your health consuming [2].

1.2 Saponification process

Saponification occurs when triglycerides are mixed with a strong base to generate fatty acid metal salts. The hardness, aroma, cleansing, lather, and moisturizing abilities of soaps are all determined by the distribution of unsaturated and saturated fatty acids [11]. Saponification is a chemical reaction in which sodium hydroxide (lye) breaks down a fat molecule into four smaller molecules, three of which are soap and one of which is glycerol. Saponification seems to be the name for a chemical process that occurs when an acid reacts with a base to generate a salt. A base is any substance that donates electrons or hydroxide ions (OH^-) and/or accepts protons, while an acid is any molecule or ion that donates protons or hydrogen ions (H^+) and/or accepts electrons. When soap is made, an oil or fat (the acid) is combined with sodium hydroxide or lye (the base) to make soap (which is a salt). There seem to be a variety of acids that will saponify when they react with a base [10].

2. Materials and Methods

The materials used in this research were waste cooking oil, NaOH and water as main materials in soap making process. In addition, pandan leaves also used as an additive in soap making process.

2.1 Waste Cooking Oil Characterization

Cooking oil can undergo chemical changes through usage and storage, leading to a change in its appearance and texture. Observing the color and viscosity of used cooking oil can indicate its quality and usability. Darker color and thicker texture can indicate spoilage, while lighter color and thinner texture suggest freshness. Monitoring these characteristics is important for food safety and ensuring optimal cooking results.

2.1.1 Waste Cooking Oil Colour Observation

Labeled one test tube "CKO" for cooking oil, another "WCO" for waste cooking oil, and the last "PCO" for infused cooking oil with pandan leaves. Poured a sample of each type of oil into its respective test tube. Placed all of the test tubes in the test tube rack. Observed the difference in color between the samples using the naked eye and distinguished between each sample based on its color.

2.1.2 Waste Cooking Oil Viscosity Measurement

Brookfield Viscometer DV-II+Pro was used to measure the viscosity of the cooking oil samples. Poured 150 ml of cooking oil into a beaker and placed the beaker under the viscometer. Started the viscometer and allowed it to run for 20 minutes. Recorded the data from the viscometer every 5 minutes, resulting in 4 data points for each cooking oil sample. This was done because the data from the viscometer can frequently change and is not always stable. Calculated the average viscosity of the samples by using equation: total c force divided by total time test run.

$$Viscosity = \frac{total\ c\ force}{total\ time\ test\ run} \quad (1)$$

After collecting the data for the first sample of cooking oil, repeated the process with the other two samples of waste cooking oil, as well as the sample of waste cooking oil that had been infused with pandan leaves. Analyzed the collected data to support the viscosity analysis and tabulated the results using a table-based format.

2.2 Infusion Process between Pandan Leaves and Waste Cooking Oil

The infusion process varied the infusion period from 2 weeks to 4 weeks to 6 weeks in order to determine the optimal time for producing a pleasant-smelling soap. A pot, spoon or spatula, strainer or cheesecloth, and clean container were needed for the process. The pandan leaves were prepared by washing and cutting them into small pieces if using fresh leaves or soaking and cutting them if using dried leaves. The used cooking oil was heated in a pot over medium heat until it was warm, and the pandan leaves were added and stirred well. The oil was allowed to infuse for the desired amount of time, stirring occasionally to ensure the pandan leaves were fully immersed. The longer the infusion time, the stronger the flavour would be. Once the desired time had passed, the oil was strained into a clean container using a strainer or cheesecloth, discarding the pandan leaves. The infused oil was allowed to cool completely before 40 being stored in an airtight container at room temperature, where it would keep for several weeks which were 2,4 and 6 weeks.

2.4 Visual Observation of Soap

Visual observation is an important aspect of soap making, as it can provide valuable information about the progress and quality of the soap. During the soap-making process, the appearance of the mixture can change as the chemical reactions take place. Visual observation is an important tool for monitoring the soap-making process and ensuring that the final product is of good quality.

2.4.1 Glycerine River, lye pocket and gelling

There were several methods used to perform visual observations of soap. A few examples included examining lye pockets, glycerin rivers, and gelling. Lye pockets were observed by slicing the soap into thin sections and looking for small, dark areas that indicated the presence of excess lye. These pockets indicated that the soap was not fully saponified during the soap-making process. Glycerin rivers were visible as clear or translucent streaks running through the soap and were caused by a variety of factors such as the soap recipe, temperature, and pouring method. Jellying, or a soft, spongy texture, was caused by high humidity or a high glycerin content in the soap. A sharp knife or blade, a well-lit area, and possibly a magnifying glass or microscope were used to perform these visual observations.

2.4 Psychochemical Properties of Soap

Psychochemical properties of soap, including pH, foam stability, and moisture content, were studied in relation to its cleaning ability and skin friendliness. The pH of soap was a measure of its acidity or basicity, with a neutral pH of 7 being gentlest on the skin. Foam stability referred to the ability of the soap to maintain its lather over time, and moisture content was a measure of the water content in the soap.

2.5.1 pH value

pH value of soap samples was determined using official method of AOCS G 7-56. pH value of soap tested by using a pH meter, you will need a pH meter, a small beaker or glass jar, a sample of soap, and distilled water. First, fill the beaker or jar with distilled water and add a small piece of soap. Stir the soap and water gently to dissolve the soap. Next, turn on the pH meter and calibrate it according to the manufacturer's instructions. Dip the pH meter's electrode into the soap solution and wait for it to stabilize. Then, read the pH value from the display. It is important to use distilled water for this test to avoid interference from minerals or impurities in tap water.

2.5.2. Moisture Content

The moisture content of soap samples was tested using the standard AOCS Db 1-48 method [11]. A piece of soap was cut and placed in a ceramic crucible before being weighed using a JOAN LAB High precision 0.1mg Laboratory Electronic Analytical Balance. The samples were then placed in crucibles and dried for one hour at 105°C before being cooled to room temperature. After 5 minutes of cooling, each sample must be reweighed to determine its weight after the heating process. Using equation 2, the moisture content percentage of each sample was then determined.

$$Moisture\ content(\%) = \frac{w-d}{w} \times 100 \tag{2}$$

where w is the weight of samples with crucible before heating process and d is the weight of samples with crucible after the heating process.

2.5.3Foam Stability

In order to evaluate the foam stability of soap, the Ross-Miles foam stability test was conducted. A specific amount of soap was added to a graduated cylinder filled with water and placed in a foam generator. The foam generator agitated the soap and water, creating a foam. The volume of the foam was measured at intervals of 30 seconds until the foam collapsed. The volume of foam produced at each interval was recorded, and a graph was plotted to show the foam stability of the soap over time. This allowed for the determination of the foam stability of the soap under the conditions of the test

3. Results and Discussion

In the context of soap making, results and data analysis refer to the observations and measurements made during the soap making process, and the process of examining and interpreting those observations and measurements.

3.1 Waste Cooking Oil Characterization

Table 1: Waste cooking oil characterization

Sample	Viscosity Measurement	Colour Observation
CKO	63.21	Golden Yellow Grease
WCO	65.46	Brown Grease

PCO	66.37	Darker and Greenish

3.1.1Colour Observation

According to Table1, the colour of cooking oils varied based on their specific nature. The analysis done by visual observation for three samples on their colour. First, colour of unused cooking (CKO) oil is golden yellow, whereas the colour of waste cooking oil (WCO) is brown, and the colour of waste cooking oil infused with pandan leaves (PCO) is darker and greenish. Figure 1 shown the differences of colour for three samples

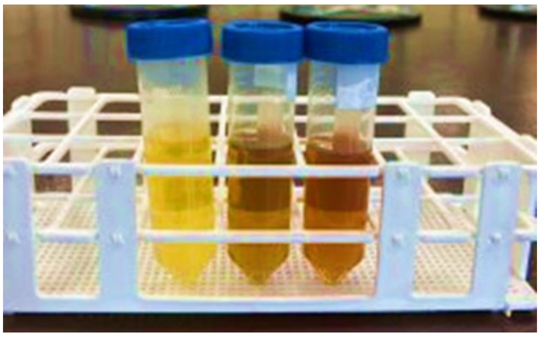

Figure 1: The different of colour for three samples

Cooking oil can undergo a change in color due to the process of rancidification, which is the total or partial autoxidation or hydrolysis of fats and oils when exposed to air, light, moisture, or bacterial action. This results in the formation of short-chain aldehydes, ketones, and free fatty acids, which can affect the color of the oil [4]. Additionally, carbon accumulation from food particles after frying can also result in a change in color of the oil. When hydroperoxides, a product of oxidation, breakdown they can have a negative impact on the color and quality of the oil. In contrast, waste cooking oil that has been infused with pandan leaves can become darker and more greenish, due to the release of chlorophyll and carotenoid pigments from pandan leaves during the infusion process, as these pigments are soluble and can dissolve into the oil.

3.1.2Viscosity Measurement Analysis

The viscosity of cooking oil, waste cooking oil, and pandan leaves infused waste cooking oil was measured and reported in Table 1. The results show that the viscosity of cooking oil is lower than that of waste cooking oil, with a value of 62.21 for cooking oil and 65.46 for waste cooking oil. However, the viscosity of pandan leaves infused waste cooking oil was even higher, with a value of 66.37. These findings are unexpected, as it is commonly known that the viscosity of vegetable oil is inversely proportional to temperature, and heat is applied to waste cooking oil during the cooking process. There are a few possible explanations for this discrepancy. One possibility is that the presence of foreign matter in waste cooking oil can cause the viscosity to increase. Additionally, the color of the oil may also play a role in determining the viscosity. Another reason is that the chlorophyll from pandan leaves were extracted and dissolved into the waste cooking oil during infusion, making it more viscous than the other two samples [5].

3.2 Curing Process

The curing process for soap made with infused waste cooking oil, such as pandan leaves, takes longer, up to seven weeks, compared to regular soap, which typically takes four to six weeks. This is because the infused ingredients slow down the chemical reaction, called saponification, between oils and alkali in the soap-making process [12]. Additionally, the infusion ingredients also slow down the evaporation process, making it take longer for the soap to harden and improve its lather and feel when used.

3.3 Soap Visual Observation Analysis

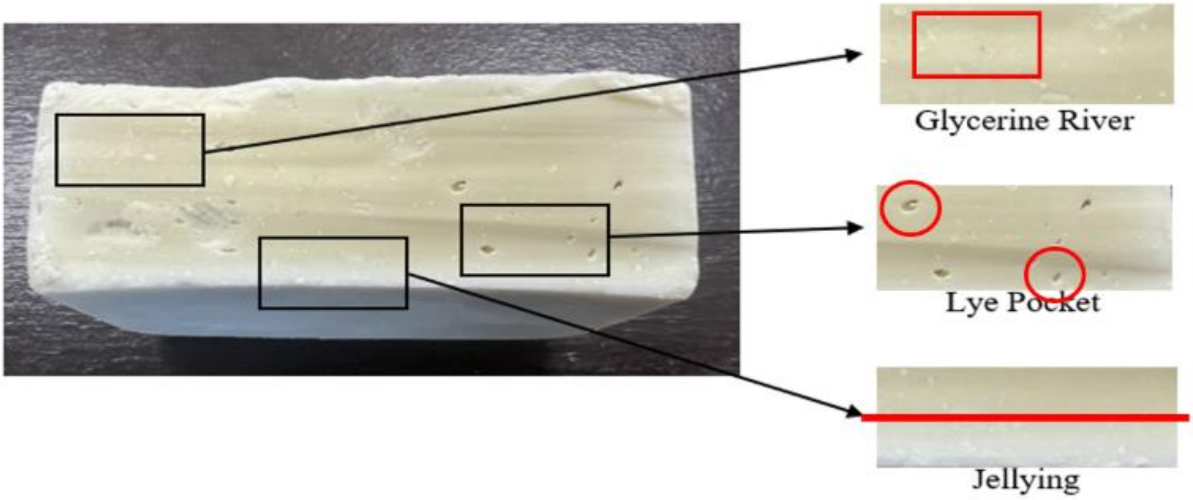

Figure 2: Inner soap structure

Soap-making process may have several imperfections as shown in Figure 2, including the Glycerine River, Lye Pocket and Jellying. The Glycerine River is a visible layer of glycerine that runs through the soap and gives it a transparent or translucent appearance, typically formed when the soap is cooled too quickly during the manufacturing process. The use of infused waste cooking oil in soap-making may impact the likelihood of Glycerine Rivers occurring. Lye Pocket is a small pocket or cavity that forms in soap, caused by an excess of lye in the soap mixture. It occurs when the soap is not properly mixed, or the recipe is not followed correctly. The use of waste cooking oil in soap-making does not necessarily increase the risk of Lye Pockets. Jellying is a process that occurs when soap is cooled too slowly or exposed to high humidity and causes the soap to become soft and jelly-like with a mottled or uneven appearance. It does not affect the performance of the soap, but it can make it difficult to handle. Factors such as temperature and humidity during the cooling process may influence the likelihood of Jellying. Pandan leaves do not affect the occurrence of these imperfections in soap but following proper soap-making techniques and controlling the cooling rate, mixing and measurement of ingredients is important to ensure the quality and safety of the soap [9].

3.4 Soap Psychochemical Properties Analysis

Soap psychochemical analysis is the evaluation of the pH value, moisture content, and foam stability of the soap. The pH value measures the acidity or basicity of the soap, moisture content is the amount of water present in the soap, and foam stability is the ability of the soap to maintain a stable foam when used. Table 2 shown the results of soap psychochemical properties analysis for each soap samples.

Table 2: Soap psychochemical analysis

Sample	Infusion time Duration (Weeks)	Moisture content	pH value	Foam Height (cm)
W2	**2**	7.17 %	10.3	4.7
W4	**4**	7.19 %	10.6	4.9
W6	**6**	7.68 %	10.2	5.0

3.5.1Moisture Content

The moisture content of the soap samples in Table 2 was found to be in the range of 7.17%-7.68%. The highest moisture content was observed in the sample from week 2, and the lowest moisture content was observed in the sample from week 6. The result is directly proportional to the infusion time of pandan leaves, due to its antioxidant-rich nature. High moisture content can lead to hydrolysis of soap during storage, which decreases the shelf life of the product [8]. This can be achieved by using a lower proportion of water than lye during the cold process of soap production.

3.5.2 pH value

The pH value of the soap samples (W2, W4 and W6) in Table 2 were similar to each other with values of 10.3,10.6 and 10.2 respectively, indicating that the duration of infusion process did not affect the pH value of the soap. High pH values in soaps can be caused by incomplete hydrolysis in the saponification process and can be counteracted by adding more oil. The pH value of the soap also drops over time during the cold-curing process. Pandan leaves have a neutral pH value which is in the range of 7.1 to 7.6. The pH value of the soap is slightly basic and similar to the majority of commercial soaps [7]. The higher values of pH indicate that the soap is corrosive to the skin, although it can act as a barrier against bacteria and viruses.

3.5.3 Foam Height and Stability

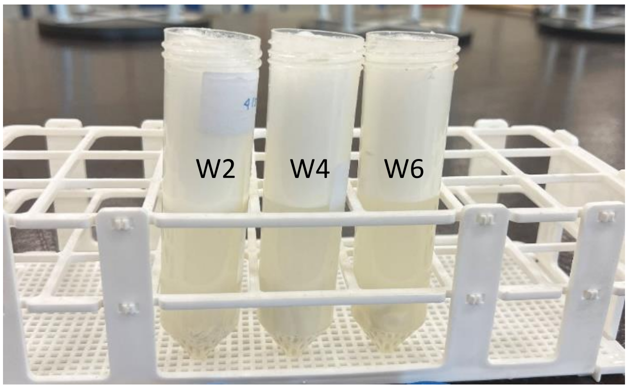

Figure 3: Foam Height Analysis

The foam height of three samples (W2, W4 and W6) in are different as shown in Figure 3. Sample W2 has the lowest height at 4.7 cm, while W4 and W6 have 4.9 cm and 5.0 cm respectively. The addition of infused cooking oil with pandan leaves to soap results in a significant increase in foam volume and stability as per a study published in the Journal of the American Oil Chemists' Society. The infusion time duration of pandan leaves with waste cooking oil can increase foam stability. The mechanism behind the foam-enhancing effects of pandan is thought to be related to its high saponin content and high oil content [6].

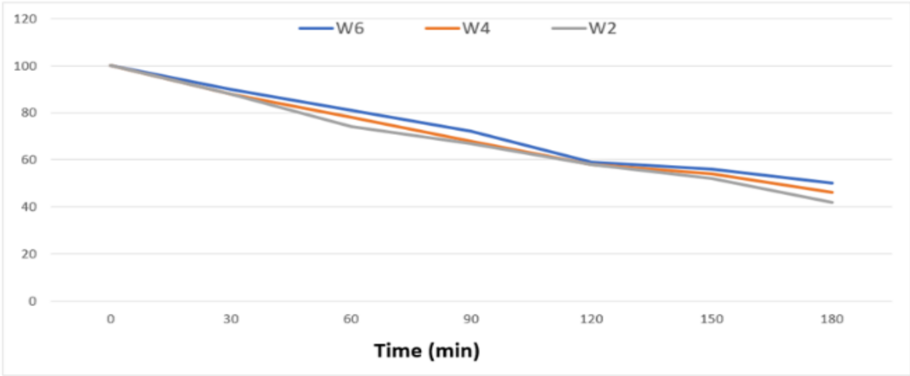

Figure 4: Foam Stability of three samples

In Figure 4 shown the graph of foam stability of soap for three samples. The W6 samples slightly produced more foam stability. This result occurs because the addition of pandan leaf extract to soap also significantly increased the foam height and stability of the soap

4 Conclusion

In conclusion, the soap-making experiment using infused pandan leaves and waste cooking oil was successful in synthesizing a soap using the cold process method. The objective of the experiment, which was to investigate the effect of infusion duration time on the final soap product and to determine the feasibility of using waste cooking oil in soap-making, was achieved. The results showed that the infusion duration time had an effect on the final soap product, with longer infusion times resulting in a stronger scent and colour. The characterization of the soap, as tested through lye pockets, glycerin rivers, and jellying, showed positive results, indicating that the soap was structurally sound. Additionally, the pH value of the soap was found to be higher than that of commercial soap, indicating that it a little bit more irritating to the skin. The presence of pandan did not negatively affect the foam stability or moisture content of the soap, and the moisture content and foam stability was directly proportional to the infusion time because pandan leaves rich with antioxidant.

Overall, the use of infused pandan leaves and waste cooking oil in the soap-making process shows promise as a sustainable and natural alternative to traditional soap ingredients. The use of waste cooking oil helps to reduce waste and gives value to a material that would otherwise be discarded, while the infusion of pandan leaves adds a natural scent and colour to the final product. Further research could be conducted to optimize the infusion duration time and to evaluate the performance and effectiveness of the soap in various applications

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