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Effect of Mixing Time Variation and Framing Time on the Quality of Coffee Grounds-based Solid Soap

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Abstract

The increase in public consumption of coffee has resulted in an increase in wasted coffee grounds. Coffee grounds have good content for the skin, so they can be reused as a basic ingredient in soap-making. In the soap making process, the mixing and framing stages can affect the quality of the soap. This study aims to determine the effect of mixing time of 24.5 minutes, 25 minutes, and 25.5 minutes as well as framing time of 3 days, 5 days, and 7 days on the physical and chemical quality of solid soap made from coffee grounds. The physical quality parameters observed are colour, texture, cracking, and foam power. The chemical quality parameters are foam stability, pH, moisture content, and free alkali. The method used was the questionnaire method followed by statistical analysis using the Kruskal Wallis test for physical quality tests and the experimental method followed by statistical analysis using the Two-Way ANOVA test for chemical quality tests. The results showed that all variations in mixing time and framing time had an effect on the physical and chemical quality of solid soap and there were significant differences. The panellists assessed the physical quality of the soap to be attractive, hard, with no cracks, and foamy, while the results of the chemical quality test, the soap produced is safe to use by the quality standards of solid soap with a foam stability range of 82%-97%, pH 10.3-11.8, moisture content 6%-14%, and alkali free 0.03%-0.09%.

Keywords: Chemical quality; Coffee grounds soap; Framing time; Mixing time; Physical quality.

INTRODUCTION

Jember is one of the regencies in East Java that produces the best robusta coffee, this was conveyed by the Regent of Jember, Mr. Hendy. In addition, the content of robusta coffee grounds is higher than other types of coffee grounds. The increase in coffee grounds along with the increase in the number of coffee shops, including in the city of Jember, has caused an increase in wasted coffee grounds waste. Starting from the increase in public consumption of coffee, the amount of coffee grounds waste has also increased, and has a great danger of pollution when disposed of in the environment. Coffee grounds when decomposing in landfills produce methane, a potent greenhouse gas, and cause significant global warming (Bejenari et al., 2021).

Coffee grounds are usually treated as waste, whereas coffee grounds can also be a source of raw materials for applications in several industrial fields. As a source of valuable compounds with potential applications in the pharmaceutical, cosmetic, and food industries, coffee grounds are an exciting example of waste utilization in the cosmetics industry i.e. soap. Soap using coffee grounds is one of the practical uses of coffee grounds waste because it has quite good content for skin health, so it can be used as a basic ingredient in making organic soap. In general, people know two types of soap, namely solid soap and liquid soap. Solid soap is considered cheaper, easier to use, and efficient in cleaning the skin compared to liquid body soap (Febriani et al., 2020). Liquid soaps contain more additives and preservatives to maintain their texture and stability.

Solid soap products are used by the wider community, so the product must have soap quality by the product specification standards that have been set, so that it can meet the needs and protect consumers (Idoko et al., 2018). The quality of soap can be reviewed in terms of its physical and chemical aspects. The physical quality of a good soap must have high cleaning power, must have sufficient hardness, and be able to produce a sufficient amount of foam to support its cleaning power (Rashati et al., 2022). Overall, the chemical properties allow the soap to be effective in cleaning various surfaces that have been exposed to dirt, oil, or grease. In the soap making process, the mixing stage is an important stage, where during the process of mixing oil and fat will form pure soap. The mixing time will also affect the perfection of the saponification process that takes place (Setiyawan & Oktavianty, 2022). The framing stage is where a series of processes occur from pure soap that is still in liquid form to solid form (Sitorus, 2021). Therefore, it is necessary to the effect of mixing time and framing time on the quality of solid soap made from coffee grounds.

This study aims to determine the effect of mixing time of 24.5 minutes, 25 minutes, and 25.5 minutes as well as framing time of 3 days, 5 days, and 7 days on the physical and chemical quality of solid soap made from coffee grounds. The physical quality parameters observed are colour, texture, cracking, and foam power. The chemical quality parameters are foam stability, pH, moisture content, and free alkali.

MATERIALS AND METHODS

Study area

The research was carried out at the Toxicology Laboratory of the Biology Education Study Program of FKIP University of Jember and the Laboratory of Instrumentation and Agricultural Environmental Control (IPLP) of the Agricultural Engineering Study Program FTP University of Jember from January to February 2024.

Procedures

Solid Soap Manufacturing

The research on the manufacture of solid soap made from coffee grounds uses variations in mixing time and framing time. Robusta coffee grounds are obtained from coffee shops around the University of Jember. The stages are 235 grams of olive oil, 150 grams of coconut oil, 100 grams of palm oil and 50 grams of coffee grounds mixed into a container and stirred for 5 minutes. Then 74 grams of NaOH is dissolved in 210 grams of cold/cold water in a container made of stainlees steel. The NaOH solution will be hot and whitish in color, then cool in room temperature. Then the cooled NaOH solution is put into the mixture in a container, stirred until thickened with variations in mixing time of 24.5 minutes, 25 minutes, and 25.5 minutes. Next, the mixture in the container is put in 10 cc fragrance and stirred for 5 minutes. Then the dough that has formed is put into a mold and framed with variations of 3 days, 5 days, and 7 days. After that, the soap is stored for 4 weeks then analyzed for quality.

Solid Soap Quality Test

- **Moisture Test**

The soap sample was weighed as much as 4 grams and weighed in weight. Then it is heated in the oven at 105oC for 2 hours, then cooled in a decigator, then weighed again. The moisture content is calculated by the appropriate formula (SNI 06-3532-2016).

- **Free Alkaline Test**

Alcohol as much as 100 ml is boiled in 250 ml of erlenmeyer pumpkin. Next, 0.5 ml of phenolphthalein indicator is added and cooled to a temperature of 70oC then neutralized with KOH 0.1 N in alcohol. Next, add 5 grams of soap and boil over a water bath for 30 minutes. If the solution is not red, the mixture is cooled to a temperature of 70oC and then titrated with a solution of KOH 0.1 N in alcohol, until a color appears. If the solution is red, it is titrated using HCl 0.1 N in alcohol from micro burettes, until the red color quickly disappears and the result is calculated with the appropriate formula (SNI 06-3532-2016).

- **pH Test**

Take 5 g of soap then dissolve it with 5 ml of aquades. Measure the pH of soap with a pH meter and record the resulting pH (American Society for Testing and Materials International, 2015).

- **Foam Stability**

1 g of solid soap is dissolved using 10 ml of aquades in a test tube, shaken for 1 minute, counting the foam formed measured with a ruler (initial foam height). The height of the foam is measured again after 5 minutes to get the final foam height. The stability of the foam is calculated with the appropriate formula (Dhara et al. 2023).

- **Organoleptic Test (color, texture, cracking rate, and foam power)**

This organoleptic test was carried out by 10 panelists. Soap color assessment by assessing the color level of the soap produced without the addition of dyes. Texture assessment is carried out by looking and feeling the texture or appearance of the soap produced. The solid soap cracking test in this study is wet cracking, which is that the soap is used until the weight is reduced by 1/4 of the initial weight, then soaked in water for 1 hour, after which it is lifted and dried for 24 hours, make sure the surface of the soap is dry and then see the cracks. The assessment of foam power is carried out by washing hands with the soap produced and then assessing the amount of foam produced based on the hedonic scale (Sitorus, 2021).

Data analysis

Data analysis using SPSS 27 for testing the physical quality of soap such as color, texture, cracking, and foam power tests using the Two-Way ANOVA test, if there are significant differences, it is further analyzed using DMRT (Duncan's Multiple Range Test). Meanwhile, the chemical quality test of soap such as foam stability, pH, moisture content, and free alkali uses the Kruskal Wallis test, if there is a significant difference, it is further analyzed using the Mann Whitney Test.

RESULTS AND DISCUSSION

Solid Soap Color Test

Based on the results of the SPSS normality test using Kolmogorov-Smirnov and Shapiro Wilk, the data showed a value of <.001. The results showed that the data was abnormal because the sig value < 0.05. Therefore, the data will be followed by non-parametric statistical analysis using the Kruskal Wallis test to determine the significance. The results of the analysis of the Kruskal Wallis test showed that the mixing time and framing time obtained a sig value of 0.001. The results showed that there was a significant difference between the mixing time and framing time with the soap color because the sig value < 0.05. There is a significant difference, so it is necessary to carry out further tests using the Mann Whitney Test presented in Table 1.

Table 1. Average Organoleptic Analysis of Soap Color.

Framing Time	Mixing Time		
	24,5 minutes	**25 minutes**	**25,5 minutes**
3 days	$4{,}50^{e}$	$4{,}50^{e}$	$3{,}10^{a}$
5 days	$4{,}30^{cde}$	$4{,}10^{bcde}$	$3{,}40^{ab}$
7 days	$4{,}40^{de}$	$3{,}70^{abcd}$	$3{,}50^{abc}$
Control		$3{,}80^{abcde}$	

Scale: 1 = not interesting, 2 = less interesting, 3 = quite interesting, 4 = interesting, 5 = very interesting. Note: Numbers followed by different letters indicate a noticeable difference at the 5% level.

The results of the Mann Whitney Test further test analysis in Table 1 show that there is a real difference, this is marked by different letter notation in each treatment. The most interesting soap colors based on the acceptance rate of the panelists were mixing time of 24.5 minutes, framing time of 3 days and mixing time of 25 minutes, framing time of 3 days with an average score of 4.50. The mixing time of 24.5 minutes, framing time of 3 days and mixing time of 25 minutes, framing time of 3 days is significantly different from the mixing time of 25 minutes, framing time of 7 days, mixing time of 25.5 minutes, framing time of 3 days, mixing time of 25.5 minutes, framing time of 5 days, and mixing time of 25.5 minutes, framing time of 7 days.

Solid Soap Texture Test

Based on the results of the SPSS normality test using Kolmogorov-Smirnov and Shapiro Wilk, the data showed a value of <.001. The results showed that the data was abnormal because the sig value < 0.05. Therefore, the data will be followed by non-parametric statistical analysis using the Kruskal Wallis test to determine the significance. The results of the analysis of the Kruskal Wallis test showed that the mixing time and framing time obtained a sig value of 0.001. The results showed that there was a significant difference between the mixing time and framing time with the soap texture because the sig value < 0.05. There is a significant difference, so it is necessary to carry out further tests using the Mann Whitney Test presented in Table 2.

Table 2. Average Organoleptic Analysis of Soap Texture.

Framing Time	Mixing Time		
	24,5 minutes	**25 minutes**	**25,5 minutes**
3 days	$3{,}10^{a}$	$4{,}40^{bc}$	$4{,}70^{bc}$
5 days	$4{,}20^{bc}$	$4{,}80^{c}$	$4{,}80^{bc}$
7 days	$4{,}60^{bc}$	$4{,}70^{bc}$	$4{,}80^{bc}$
Control		$4{,}30^{b}$	

Scale: 1 = very soft, 2 = soft, 3 = moderately soft, 4 = hard, 5 = very hard.
Note: Numbers followed by different letters indicate a noticeable difference at the 5% level.

The results of the further analysis of the Mann Whitney Test in Table 2 showed that there was a significant difference, this was marked by different letter notation in each treatment. The hardest soap texture based on the acceptance rate of the panelists was a mixing time of 25 minutes, a framing time of 5 days, a mixing time of 25.5 minutes, a framing time of 5 days, and a mixing time of 25.5 minutes, a framing time of 7 days with an average score of 4.80. The mixing time of 25 minutes, framing time of 5 days, mixing time of 25.5 minutes, framing time of 5 days, and mixing time of 25.5 minutes, framing time of 7 days were significantly different from the mixing time of 24.5 minutes, framing time of 3 days, and mixing time of 10 minutes, framing time of 1 day (control).

Solid Soap Crack Test

Based on the results of the SPSS normality test using Kolmogorov-Smirnov and Shapiro Wilk, the data showed a value of <.001. The results showed that the data was abnormal because the sig value < 0.05. Therefore, the data will be followed by non-parametric statistical analysis using the Kruskal Wallis test to determine the significance. The results of the analysis of the Kruskal Wallis test showed that the mixing time and framing time obtained a sig value of 0.006. The results showed that there was a significant difference between mixing time and framing time with soap cracking because the sig value < 0.05. There is a significant difference, so it is necessary to carry out further tests using the Mann Whitney Test presented in Table 3.

Table 3. Average Organoleptic Analysis of Soap Cracking Rate.

Framing Time	Mixing Time		
	24,5 minutes	**25 minutes**	**25,5 minutes**
3 days	$2{,}60^{c}$	$2{,}00^{bc}$	$1{,}50^{ab}$
5 days	$2{,}00^{bc}$	$1{,}70^{ab}$	$1{,}30^{ab}$
7 days	$1{,}20^{a}$	$1{,}30^{ab}$	$1{,}20^{a}$
Control		$1{,}70^{ab}$	

Scale: 1 = no crack, 2 = slightly cracked, 3 = moderately cracked, 4 = cracked, 5 = very cracked. Note: Numbers followed by different letters indicate a noticeable difference at the 5% level

The results of the analysis of the Mann Whitney Test further test in Table 3. showing that there is a real difference, this is marked by different letter notation in each treatment. The soap with the smallest crack rate based on the acceptance rate of the panelists was a mixing time of 24.5 minutes, a framing time of 7 days, and a mixing time of 25.5 minutes, a framing time of 7 days with an average score of 1.20. The mixing time of 24.5 minutes, the framing time of 7 days, and the mixing time of 25.5 minutes, the framing time of 7 days are significantly different from the mixing time of 24.5 minutes, the framing time of 3 days, the mixing time of 24.5 minutes, the framing time of 5 days, and the mixing time of 25 minutes, the framing time of 3 days.

Solid Soap Foam Power Test

Based on the results of the SPSS normality test using Kolmogorov-Smirnov and Shapiro Wilk, the data showed a value of <.001. The results showed that the data was abnormal because the sig value < 0.05. Therefore, the data will be followed by non-parametric statistical analysis using the Kruskal Wallis test to determine the significance. The results of the analysis of the Kruskal Wallis test showed that the mixing time and framing time obtained a sig value of 0.006. The results show that there is a significant difference between mixing time and framing time with soap foam power because the sig value < 0.05. There is a significant difference, so it is necessary to carry out further tests using the Mann Whitney Test presented in Table 4.

Table 4. Average Organoleptic Analysis of Soap Foam Power.

Framing Time	Mixing Time		
	24,5 minutes	25 minutes	25,5 minutes
3 days	4,90^{b}	4,70^{b}	4,70^{b}
5 days	4,60^{b}	4,90^{b}	4,50^{b}
7 days	4,80^{b}	4,60^{b}	4,50^{b}
Control		3,60^{a}	

Scale: 1 = not foamy, 2 = less foamy, 3 = moderately foamy, 4 = foamy, 5 = very foamy. Note: Numbers followed by different letters indicate a noticeable difference at the 5% level.

The results of the Mann Whitney Test further test analysis in Table 4 showed that there was a significant difference, this was marked by different letter notation in each treatment. The soap with the most foaming power based on the acceptance rate of the panelists was a mixing time of 24.5 minutes, a framing time of 3 days and a mixing time of 25 minutes, a framing time of 5 days with an average score of 4.90. The mixing time of 10 minutes, the framing time of 1 day (control) was markedly different with all treatments.

Solid Soap Foam Stability Test

Before conducting the Two-Way ANOVA test, you must first conduct a prerequisite test, namely a standard residual normality test and a homogeneity test. Based on the results of the SPSS, the normality test using Kolmogorov-Smirnov obtained a result of 0.193 and Shapiro Wilk obtained a result of 0.386. The results show that the data is normal because the value of the sig is > 0.05. Furthermore, the results of the SPSS homogeneity test using Levene's Test obtained a result of 0.878. The results show that the data is homogeneous because the sig value > 0.05. The results of the analysis of the Two-Way ANOVA test showed that the mixing time obtained a sig value of 0.000. The results show that there is a significant difference between mixing time and foam stability because the sig value < 0.05. At the time of framing it obtained a sig value of 0.001. The results show that there is a significant difference between framing time and foam stability because the sig value < 0.05. The interaction between mixing time and framing time obtained a value of 0.029.

The results show that there is a significant difference between the interaction of mixing time and framing time with foam stability because the sig value < 0.05. There is a significant difference, so it is necessary to carry out further tests using DMRT (Duncan's Multiple Range Test) presented in Table 5.

Table 5. Average stability of solid soap foam

Framing Time	Mixing Time		
	24,5 minutes	25 minutes	25,5 minutes
3 days	97,67^{e}	92,33^{cd}	91,00^{c}
5 days	95,00^{de}	92,00^{cd}	87,33^{b}
7 days	93,67^{cd}	91,67^{cd}	82,00^{a}
Control		97,67^{e}	

Note: Numbers followed by different letters indicate a noticeable difference at the 5% level.

The results of the DMRT (Duncan's Multiple Range Test) further test analysis in Table 5 showed that there was a significant difference, this was marked by different letter notation in each treatment. The soap with the most stable foam based on the results of laboratory tests is a mixing time of 24.5 minutes, a framing time of 3 days with an average score of 97.67. Mixing time 24.5 minutes framing time 3 days is different from mixing time 24.5 minutes framing time 7 days, mixing time 25 minutes framing time 3 days, mixing time 25 minutes framing time 5 days, mixing time 25 minutes framing time 7 days, mixing time 25.5 minutes framing time 3 days, mixing time 25.5 minutes framing time 5 days, and mixing time 25.5 minutes, framing time 7 days.

Solid Soap pH Test

Before conducting the Two-Way ANOVA test, you must first conduct a prerequisite test, namely the standard residual normality test and the homogeneity test. Based on the results of SPSS, the normality test using Kolmogorov- Smirnov got a result of 0.064 and Shapiro

Wilk got a result of 0.075. The results show that the data is normal because the value of the sig is > 0.05. Furthermore, the results of the SPSS homogeneity test using Levene's Test obtained a result of 0.899. The results show that the data is homogeneous because the sig value > 0.05. The results of the analysis of the Two-Way ANOVA test showed that the mixing time obtained a sig value of 0.001. The results showed that there was a significant difference between mixing time and pH because the sig value < 0.05. At the time of framing it acquires a sig value of 0.000. The results show that there is a significant difference between framing time and pH because the sig value < 0.05. The interaction between mixing time and framing time obtained a value of 0.042. The results show that there is a significant difference between the interaction of mixing time and framing time with pH because the sig value < 0.05. There is a significant difference, so it is necessary to carry out further tests using DMRT (Duncan's Multiple Range Test) which is presented in Table 6.

Table 6. Average pH of Solid Soap

Framing Time	Mixing Time		
	24,5 minutes	**25 minutes**	**25,5 minutes**
3 days	$11{,}800^{e}$	$11{,}600^{e}$	$11{,}267^{d}$
5 days	$10{,}733^{c}$	$10{,}667^{bc}$	$10{,}500^{ab}$
7 days	$10{,}333^{a}$	$10{,}300^{a}$	$10{,}300^{a}$

Note: Numbers followed by different letters indicate a noticeable difference at the 5% level

The results of the further analysis of the DMRT (Duncan's Multiple Range Test) in Table 4.12 showed that there was a significant difference, this was marked by different letter notation in each treatment. Soap with a pH that is not too alkaline based on the results of laboratory tests is 25 minutes of mixing time, 7 days of framing time and 25.5 minutes of mixing time, 7 days of framing time with an average score of 10,300. The mixing time of 25 minutes, the framing time of 7 days and the mixing time of 25.5 minutes, the framing time of 7 days are significantly different from the mixing time of 24.5 minutes, the framing time of 3 days, the mixing time of 24.5 minutes, the framing time of 5 days, the mixing time of 25 minutes, the framing time of 5 days, and the mixing time of 25.5 minutes, the framing time of 3 days.

Solid Soap Moisture Content Test

Before conducting the Two-Way ANOVA test, you must first conduct a prerequisite test, namely the standard residual normality test and the homogeneity test. Based on the results of the SPSS, the normality test using Kolmogorov- Smirnov obtained a result of 0.200 and Shapiro Wilk obtained a result of 0.457. The results show that the data is normal because the value of the sig is > 0.05. Furthermore, the results of the SPSS homogeneity test using Levene's Test obtained a result of 0.480. The results show that the data is homogeneous because the sig value > 0.05. The results of the analysis of the Two-Way ANOVA test showed that the mixing time obtained a sig value of 0.001. The results showed that there was a significant difference between mixing time and moisture content because the sig value was <0.05. At the time of framing it obtained a sig value of 0.001. The results showed that there was a significant difference between framing time and moisture content because the sig value was < 0.05. The interaction between mixing time and framing time obtained a value of 0.039. The results show that there is a significant difference between the interaction of mixing time and framing time with moisture content because the sig value < 0.05. There is a significant difference, so it is necessary to carry out further tests using DMRT (Duncan's Multiple Range Test) presented in Table 7.

Table 7. Average Moisture Content of Solid Soap

Framing Time	Mixing Time		
	24,5 minutes	**25 minutes**	**25,5 minutes**
3 days	$14{,}00^{b}$	$9{,}67^{a}$	$9{,}00^{a}$
5 days	$14{,}00^{b}$	$9{,}67^{a}$	$9{,}00^{a}$
7 days	$7{,}33^{a}$	$9{,}00^{a}$	$6{,}67^{a}$

Note: Numbers followed by different letters indicate a noticeable difference at the 5% level.

The results of the further analysis of the DMRT (Duncan's Multiple Range Test) in Table 7 showed that there was a significant difference, this was marked by different letter notation in each treatment. The soap with the smallest moisture content based on the results of laboratory tests was a mixing time of 25.5 minutes, a framing time of 7 days with an average score of 6.67. The mixing time of 25.5 minutes, the framing time of 7 days is significantly different from the mixing time of 24.5 minutes, the framing time of 3 days, and the mixing time of 24.5 minutes, the framing time of 5 days.

Solid Soap Free Alkaline Test

Before conducting the Two-Way ANOVA test, you must first conduct a prerequisite test, namely the standard residual normality test and the homogeneity test. Based on the results of SPSS, the normality test using Kolmogorov- Smirnov got a result of 0.064 and Shapiro Wilk got a result of 0.075. The results show that the data is normal because the value of the sig is > 0.05. Furthermore, the results of the SPSS homogeneity test using Levene's Test obtained a result of 0.899. The results show that the data is homogeneous because the sig value > 0.05. The results of the analysis of the Two-Way ANOVA test showed that the mixing time obtained a sig value of 0.000. The results showed that there was a significant difference between mixing time and free alkali because the sig value was < 0.05. At the time of framing it acquires a sig value of 0.000. The results showed that there was a significant difference between framing time and free alkali because the sig value < 0.05. The interaction between mixing time and framing time obtained a value of 0.030. The results show that there is a significant difference between the interaction of mixing time and framing time with free alkali because the sig value < 0.05. There is a significant difference, so it is necessary to carry out further tests using DMRT (Duncan's Multiple Range Test) presented in Table 8.

Table 7. Solid Soap-Free Alkaline Average.

Framing Time	Mixing Time		
	24,5 minutes	25 minutes	25,5 minutes
3 days	0,05600[b]	0,03733[a]	0,04000[a]
5 days	0,07200[cd]	0,06933[c]	0,06667[c]
7 days	0,09467[e]	0,09200[e]	0,08000[d]

Note: Numbers followed by different letters indicate a noticeable difference at the 5% level.

The results of the DMRT (Duncan's Multiple Range Test) further test analysis in Table 4.16 showed that there was a significant difference, this was marked by different letter notation in each treatment. The smallest soap with free alkali based on the results of laboratory tests is 25 minutes of mixing time, 3 days framing time with an average score of 0.03733. Mixing time 25 minutes framing time 3 days is different from mixing time 24.5 minutes framing time 3 days, mixing time 24.5 minutes framing time 5 days, mixing time 24.5 minutes framing time 7 days, mixing time 25 minutes framing time 5 days, mixing time 25 minutes framing time 7 days, mixing time 25.5 minutes framing time 5 days, and mixing time 25.5 minutes, framing time 7 days.

Discussion

Based on the acceptance rate of the panelists, the highest average value of soap color was soap with a mixing time of 24.5 minutes and a mixing time of 25 minutes. The longer the mixing time, the resulting soap is considered to have a less attractive soap color by the panelists. This is because the increase in mixing time causes the color to get darker (Sitorus, 2021). The longer the mixing time causes the resulting soap to become darker, while the darker the color of the soap is considered less attractive to the panelists. Based on the acceptance rate of the panelists, the highest average value of soap color is soap with a framing time of 3 days. At the framing stage, there is a process in which pure soap liquid becomes a solid form (Sitorus, 2021). Soap at a 3-day framing time is able to produce solid soap and make the resulting color blend perfectly, so that soap with that time is considered to be able to produce an attractive soap color. In addition, with a framing time of 3 days, the soap making process is more efficient. Based on the results of the evaluation, the most optimal soap color is soap with a mixing time of 24.5 minutes and a framing time of 3 days. Soap with a shorter mixing time, causes the color in the soap to be less dark, so it is preferred. Likewise, soap with a framing time of 3 days is preferred because in a short time, it is able to make the soap making process more efficient.

Based on the acceptance rate of the panelists, the average value of the highest soap texture was soap with a mixing time of 25 minutes and a mixing time of 25.5 minutes. The longer the stirring time, the lower the moisture content produced (Hasibuan et al. 2019). The texture of solid soap is affected by moisture content. The higher the moisture content in the soap, the softer the soap texture, while the lower the moisture content in the soap, the harder the soap texture will be (Sinabang et al. 2021). So, the longer the mixing time, the harder the texture of the soap. Based on the acceptance rate of the panelists, the highest average value of soap texture was soap with a framing time of 5 days and 7 days. Framing time greatly affects the moisture content, because the longer the storage time, the moisture content in the soap will decrease due to evaporation in solid soap (Astuti et al. 2021). The longer the framing time, the lower the moisture content in coffee soap (Sitorus, 2021). The higher the moisture content in the soap, the softer the soap texture, while the lower the moisture content in the soap, the harder the soap texture will be (Sinabang et al. 2021). So, the longer the framing time, the harder the texture of the soap. Based on the results of the evaluation, the most optimal soap texture is soap with a mixing time of 25.5 minutes and a framing time of 7 days. Soap with a longer mixing time, causes the moisture content to be lower so that the texture is harder. Likewise, soap with a longer framing time, the moisture content is lower, causing the texture of the soap to become harder.

Based on the acceptance rate of the panelists, the average value of the smallest soap crack rate was soap with a mixing time of 24.5 minutes and a mixing time of 25.5 minutes. Soap, which is denser and harder, is more likely to experience cracking in dry or wet conditions (Sitorus, 2021). The texture of solid soap is affected by moisture content. The higher the moisture content in the soap, the softer the soap texture, while the lower the moisture content in the soap, the harder the soap texture will be (Sinabang et al. 2021). The longer the stirring time, the lower the moisture content produced so that the texture of the soap becomes hard, and the soap is more likely to crack (Hasibuan et al. 2019). Based on the acceptance rate of the panelists, the average value of the smallest soap crack rate was soap with a framing time of 7 days. Framing time greatly affects the moisture content. This happens because the longer the framing time, the moisture content in the soap will decrease due to evaporation in solid soap (Astuti et al. 2021). The higher the moisture content in the soap, the softer the soap texture, while the lower the moisture content in the soap, the harder the soap texture will be (Sinabang et al. 2021). Soap, which is denser and harder, is more likely to experience cracking in dry or wet conditions (Sitorus, 2021). The longer the framing time can cause the moisture content to be lower, so that the texture of the soap is harder, and produce a physical soap that tends to crack. However, based on the average results of organoleptic analysis, the framing time that produces the smallest crack is 7 days. Based on the evaluation results, the most optimal level of soap cracking is soap with a mixing time of 24.5 minutes and a framing time of 7 days. The longer the mixing time, the lower the moisture content so that the texture of the soap becomes hard, and the soap is more likely to crack. Likewise, soap with a longer framing time can cause the moisture content to be lower so that the texture of the soap is harder, and produce a physical soap that tends to crack. However, the results of this study show that the longer the framing time, the lower the cracking produced by soap. This can occur because cracks can be caused by a number of factors such as the shape of the bar (soap), the level of distortion (deviation) of the void during printing (stamping), the composition of the amount of fragrance and additives (Sitorus, 2021).

Based on the acceptance rate of the panelists, the highest average value of soap foam power is soap with a mixing time of 24.5 minutes and a mixing time of 25 minutes. The longer the mixing time, the less soap foam power tends to decrease. This difference in foam power is caused by the difference in alkali content in the soap produced due to the difference in stirring time. The decrease in foam power is also influenced by the content of free fatty acids contained in the soap produced, because the free fatty acids contained in soap can inhibit the clean power of the soap which is characterized by the lack of foam produced (Wijana et al. 2019). Based on the acceptance rate of the panelists, the highest average value of soap foam power is soap with a framing time of 3 days and 5 days. The longer the framing time causes the foam power to decrease. This happens because the power of the foam is formed during the saponification process (Sitorus, 2021). The high foam during the saponification process occurs due to perfectly formed fatty acids and bases. After that, there is a framing process, where the amount of water in the soap will decrease and leave solid ingredients such as fat and alkali, then form a solid and sturdy structure, making the soap dense and durable. If soap with high moisture content is stored in the open, there will be contact with air, so that the soap will shrink in weight and dimension (Susanti and Juliantoro, 2021). So, the foam power will decrease along with the length of framing time. Based on the results of the evaluation, the most optimal soap foam power is soap with a mixing time of 24.5 minutes and a framing time of 3 days. This difference in foam power is caused by the difference in alkali content in the soap produced due to the difference in stirring time. The decrease in foam power is also influenced by the content of free fatty acids which is characterized by the lack of foam produced (Wijana et al. 2019). So, the longer the mixing time, the less foam power will be produced. Likewise, soap with a faster framing time will have more foaming power.

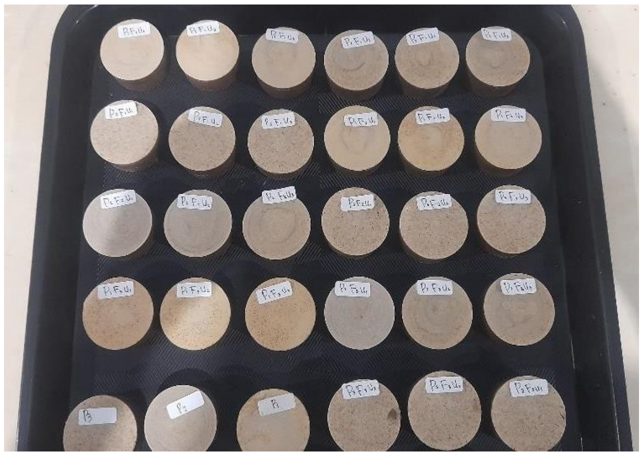

Figure 1. Physical appearance of solid soap.

The results of the various fingerprints show that the mixing time has a real effect on the stability of the foam. The results of the Duncan test showed that the mixing time was noticeably different. The highest foam stability value is a mixing time treatment of 24.5 minutes. The stability value of the foam decreases with the length of mixing time. Damayanti et al. (2021) stated that the stability of foam is affected by stirring, the longer the stirring and the amount of water-soap ratio and the least active ingredient content contained in the manufacture of solid soap, the stability of the foam decreases. The results of the various fingerprints show that the framing time has a real effect on the stability of the foam. The results of the Duncan test show that the framing time difference is noticeable. The highest foam stability value is a 3-day framing time treatment. The stability value of the foam decreases with the length of framing time. The decrease in the stability value of foam is influenced by changes in temperature and shape, and can occur due to the influence of contact of soap with air humidity that occurs during framing time, where CO2 gas in the air can react with the water in the soap (Lestari et al. 2020). This results in soap foam bubbles that form easily bursting and are less stable over time. The longer the framing time, the more the stability of the foam decreases due to the contact of the soap with environmental conditions such as air temperature and humidity (Lubis et al. 2019). The results of the various fingerprints show that the mixing time and framing time have a real effect on the stability of the foam. Based on the evaluation results, the most optimal foam stability value is the mixing time treatment of 24.5 minutes and the framing time of 3 days. The stability value of the foam in this study is in accordance with Dhara et al. (2023) starting from 60-70%.

The results of the variance fingerprint showed that the mixing time had a real effect on the pH content. The results of the Duncan test showed that the mixing time was noticeably different. The value with the highest pH content is the mixing time treatment of 24.5 minutes. With increasing stirring time, it can cause a decrease in the pH of the soap produced. The results of this study are in line with (Agustina & Juliadi, 2021) which states that stirring in the saponification process is intended to increase the interaction between reactant molecules. If there are more interactions between reactant molecules, the amount of soapy oil will also increase so that alkaline residues are reduced and the resulting solid soap products are not too alkaline (Dewi & Setyawan, 2022). The results of the various fingerprints showed that framing time had a real effect on the pH content. The results of the Duncan test show that the framing time difference is noticeable. The value with the highest pH content is a 3-day framing time treatment. The pH content value decreases with the length of framing time. The pH value of soap is influenced by the alkalinity content, the pH value increases as the alkalinity increases and decreases with the increase in acidity, besides that the decrease in pH also occurs along with the framing time (Wijana et al. 2019). Changes in pH values are affected by soap being decomposed by high temperatures when framing time produces acids or bases (Permatasari, 2019). The results of the various fingerprints showed that the mixing time and framing time had a real effect on the pH content. Based on the results of the evaluation, the most optimal soap pH is the smallest pH in this study, which is 10.3 with a mixing time of 25 minutes and a framing time of 7 days. The 25-minute mixing time has the same pH value as the 25.5-minute mixing time. However, the right optimum time in this study is 25 minutes of mixing time because it is considered to have a more efficient time. The pH of safe soap is 9 - 11 (ASTMI, 2015).

The results of the various fingerprints showed that the mixing time had a real effect on the moisture content. The results of the Duncan test showed that the mixing time was noticeably different. The value with the highest moisture content was the mixing time treatment of 24.5 minutes. With increasing stirring time, it can cause a decrease in the moisture content of the soap produced. Based on research conducted by (Hasibuan et al. 2019), water content tends to decrease with longer stirring. Soap with a low moisture content will have a higher level of hardness so that its shelf life will be longer (Dewi & Setyawan, 2022). The results of the various fingerprints showed that framing time had a real effect on the moisture content. The results of the Duncan test show that the framing time difference is noticeable. The values with the highest moisture content were 3-day and 5-day framing time treatments. With increasing framing time, it can cause a decrease in the moisture content of the soap produced. This is because during the framing period, the water content in the soap evaporates which causes the moisture content in the soap to decrease so that the soap lacks water content and the soap hardens (Putri et al. 2023). The results of the various fingerprints showed that the mixing time and framing time had a real effect on the moisture content. The results of this study show that the water content of soap meets SNI, which is a maximum of 15% (SNI, 2016). Therefore, it can be concluded that the moisture content in soap is quite good. Based on the results of the evaluation, the most optimal soap moisture content is the smallest moisture content in this study, which is 6.67 with a mixing time of 25.5 minutes and a framing time of 7 days. The longer the mixing time and framing time, the more the moisture content of the soap decreases. The moisture content decreases as time goes by, resulting in the moisture content in the soap evaporating (Rosi et al. 2021).

The results of the variegated fingerprint showed that the mixing time had a real effect on the free alkali. The results of the Duncan test showed that the mixing time was noticeably different. The value with the highest free alkali is the mixing time treatment of 24.5 minutes. The longer the stirring, the greater the interaction time between the oil and the alkali, the reaction will be closer to equilibrium so that the free alkali level in the soap will be reduced. Based on research that has been conducted by (Hasibuan et al. 2019), the level of free alkali tends to decrease due to the increasing reaction temperature and stirring time in the soap making process. The results of the various fingerprints showed that framing time had a real effect on the moisture content. The results of the Duncan test show that the framing time difference is noticeable. As the framing time increases, the free alkali increases. The large amount of alkali in soap is due to the presence of alkali that does not react with fatty acids in the saponification process when framing time occurs (Setiawati & Ariani, 2020). In addition, the higher the temperature, the greater the free alkali in the soap. The increase in free alkali levels is due to the amount of water that diffuses into the air when framing time occurs in alkaline mixtures (Widiyati & Wahyuningtyas, 2020). The results of the various fingerprints show that the mixing time and framing time have a real effect on free alkali. The amount of free alkali in soap is a maximum of 0.1% for solid soap, this is in accordance with the results of the study obtained. If it is not in accordance with SNI, it can cause irritation to the skin (SNI, 2016). Therefore, it can be concluded that the free alkali levels in this study are quite good. Based on the evaluation results, the most optimal soap-free alkali content is the smallest value in this study, which is 0.03733 with a mixing time of 25 minutes and a framing time of 3 days. The 25-minute mixing time has the same free alkali value as the 25.5-minute mixing time. However, the right optimum time in this study is 25 minutes of mixing time because it is considered to have a more efficient time.

CONCLUSIONS

Based on the results of the analysis, there is a real influence between mixing time and framing time on the physical quality of the soap. Based on the acceptance rate of the panelists, the optimal soap color is a mixing time of 24.5 minutes and a framing time of 3 days. The optimum soap texture is a mixing time of 25.5 minutes and a framing time of 7 days. The optimum cracking rate of soap is a mixing time of 24.5 minutes and a framing time of 7 days. The optimum soap foam power is a mixing time of 24.5 minutes and a framing time of 3 days. Based on the results of the analysis, there is a significant influence between mixing time and framing time on the chemical quality of the soap. It is known that in this study, soap is in accordance with quality requirements. The optimum stability of the soap foam is a mixing time of 24.5 minutes and a framing time of 3 days. The optimum pH content of soap is a mixing time of 25 minutes and a framing time of 7 days. The optimum soap moisture content is a mixing time of 25.5 minutes and a framing time of 7 days. The optimum soap-free alkali content is a mixing time of 25 minutes and a framing time of 3 days.

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