Jurnal Akta Kimia Indonesia
INDONESIA CHIMICA ACTA

PAPER

View Article Online
View Journal View Issue

Cite this: *Indo. Chim. Acta.*, 2023, **16**, **1**.

Received Date:
10th May, 2023
Accepted Date:
29th August, 2023

Keywords:
Liquid soap;
Aloe vera gel;
SLS (Sodium Lauryl Sulfate);

DOI:
http://dx.doi.org/10.20956/ica.v16i1.26653

Antiseptic Liquid Soap from Corn Oil (*Zea mays* L) and Aloe Vera Extract with The Variation of SLS (Sodium Lauryl Sulfate)

Neny Rasnyanti M Aras[1], Santi[1*], Riska Amaliah Nur[1], Isma[1] and Yusriadi[1]

Abstract. Liquid soap is a cleaning agent made from a chemical reaction between potassium hydroxide and fatty acids from vegetable oils and animal fats. This study aims to determine the quality and formulation used in making antiseptic liquid soap from aloe vera with the variation of Sodium Lauryl Sulfate (SLS). In this study, liquid soap was made by adding variation of SLS (Sodium Lauryl Sulfate), as a foam booster and citric acid as a substance that can control the pH of the soap. The resulting liquid soap product was analyzed for pH value, foam stability, free alkali content/FFA, viscosity, density, ALT and bacterial test. The results showed that each soap formula produced match with the requirements of SNI 2588-2017 for pH and FFA criteria. In addition, for the stability of the liquid soap foam increases in each formulation, starting from 16.66% to 76.92%, while the viscosity values obtained at 25 °C for each soap formulation ranged from 1,112.20 to 2,161.25 cP. The stability of the liquid soap foam increases in each formulation, with the best formulation is F3 at 76.92% yet the best formulation is the F2 for bacterial test criteria.

Introduction

Soap holds a vital role in personal hygiene across industries, services, and households, with rising demand due to COVID-19 safety measures. Studies explore herbal-infused soap development, like aloe vera's antibacterial and wound-healing properties (De Silva, 2022). Soap production involves saponification, blending triglycerides with a potent base to form fatty acid metal salts. Ratios of unsaturated to saturated fatty acids shape its characteristics. Plant and essential oil extracts enrich sensory appeal (Dwynda and Zainul, 2018) (Vidal, N. P et al., 2018) (Syafei, 2018). Comprising sodium or potassium salts and fatty acids, soap cleans skin and exists in solid or liquid forms. Liquid soap emulsifies water, dirt, and oil, effectively cleansing and leaving a pleasant scent (Stefanie et al., 2017). Soap production initiates with oil and KOH mixing for saponification, optimizing reaction progress within temperature limits (Sari and Ferdinan, 2017).

Conventional soap products often include Sodium Lauryl Sulfate (SLS) as a surfactant to enhance foaming. As reported by Sasongko and Mumpuni (2017), the properties of soap foam are influenced by the presence of active soap components, surfactants, or foam stabilizers. The inclusion of surfactants and diethanolamide not only heightens foam but also fosters foam stability, contributing to a softer soap texture. However, excessive SLS usage can irritate the skin. The soap-making process in this study excluded SLS to mitigate potential skin irritation. To enhance lathering, castor oil was combined with coconut oil. Coconut oil, rich in saturated fatty acids, particularly lauric acid, contributes to robust foam formation in soap products (Srivasta, 1982).

Sodium lauryl sulfate (SLS) ($C_{12}H_{25}NaO_4S$) is a synthetic compound widely employed as an excipient in dentifrices due to its remarkable foaming, wetting, and dispersing capabilities. The molecular structure of SLS is amphiphilic, featuring a hydrophilic sulfate head and a hydrophobic 12-carbon tail. As an anionic molecule, SLS functions as a surfactant or detergent, effectively producing a potent cleansing action through its surface-active properties. By reducing the surface tension of liquids, SLS migrates to the liquid's surface and aggregates with other SLS molecules, thus facilitating smoother liquid

[1]*Departement of Chemical Analysis, Manufacturing Industry Community Academy of Bantaeng, Bantaeng 92461, Indonesia;* ***Email: neny.rasnyanti@gmail.com***

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

spreading and mixing processes. (Paul et al., 2020). Furthermore, the utilization of SLS exhibited a substantial influence on the free alkali examination, leading to free alkali levels that aligned with the standards set by SNI 1996. This is because the main ingredient in making this liquid bath soap is anionic surfactant, namely sodium lauryl sulfate, so there is no need to add excess amounts of alkali in the saponification process. In this study liquid hand washing soap will be made because this soap is relatively safe from bacterial contamination due to contact between soap users.

Liquid soap is a liquid formulation designed for skin cleansing. It is made from soap-derived components enhanced with surfactants, preservatives, foam stabilizers, approved scents, and dyes. It can be employed for bathing without inducing skin irritation. Liquid soap boasts an appealing appearance and is more convenient than solid soap. Apart from its cleansing properties, soap also holds the capacity to eliminate skin bacteria, as evidenced by Sharma et al. (2016).

De Silva (2022) study focuses on developing a herbal soap infused with aloe vera gel, tea extract, and citronella oil through coconut oil and NaOH saponification at 40 °C. A trial-and-error approach optimized the soap with 8% w/w aloe vera gel, 4% w/w citronella oil, and 4% w/w black tea extract. Analyzing density, NaOH ratio, free alkali, and total fatty matter (TFM) (SLS 34:2009), the soap exhibited a brownish golden color, soft texture, mild aroma, and soothing effect. Density, NaOH ratio, free alkali, and TFM were 0.95 mg/mL, 4.16, 0.007 mol/dm3, and 79.6%, aligning with common soap formulations (De Silva, 2022).

Recent research seeks safe antimicrobials from plant bioactives due to inefficacy and harm of synthetic ones (Anyanwu and Okoye, 2017) (Nasir et al., 2015). Enhancing application is vital for replacing harmful synthetic agents (Tyowua et al., 2019), even in cosmetics (Campa and Baron, 2018).

Aloe vera, abundant in nutrients and compounds, houses anthraquinones akin to tetracyclines that hinder bacterial protein synthesis by blocking ribosomal A. Polysaccharides foster leukocyte phagocytic activity, aiding bacterial eradication. Aloe vera extract surpasses synthetics against bacteria (Tyowua et al., 2019).

Additives are included in formulations to increase the antibacterial activity of soap (Chan, 2017). Aloe vera has antioxidant, moisturizing, and softening properties (Dissanayake et al, 2022). The concentration of aloe vera has an adverse effect on the pH of the soap since higher concentrations of aloe vera cause lower pH of soap. This decrease in pH occurs because aloe vera gel is acidic with a pH range of 4.3 ± 0.09 (Ikram et al., 2021).

Aside of aloe vera, making hand soap also use corn oil because corn oil is useful for relieving irritation and rough skin so that soap made from corn oil can provide moisture to the skin and has a stable foam. Prior research on aloe vera and corn oil-based antiseptic liquid soap showed increased free alkali levels and high pH, leading to potential skin irritation due to excessive KOH or incomplete oil reaction. This study addressed these issues by incorporating citric acid to meet SNI 06-4085-1996 standards. A previous study by Nur found that adjusting aloe vera gel quantity and heating temperature yielded soap with both high free alkali content and low foam. Optimal results were achieved with 6 ml aloe vera gel and a heating temperature of 70 °C (Nur, 2020). In addition controlling pH and formulation components is crucial for effective and skin-friendly liquid soap production.

Experimental

Material and Methods

The materials used in this study were aloe vera, coconut oil, corn oil, KOH (Potassium Hydroxide) p.a, SLS (Sodium Lauryl Sulfate) in cosmetic grade, citric acid, distilled water, 96% alcohol p.a, phenolphthalein indicator (PP), ethanol, PCA (Plate Count Agar) media, and BPW (Buffer Peptone Water) by Merck .

The tools used in this study were hotplate, 110 °C thermometer, beaker glass, stirring rod, pipette, measuring cup, graduated pipette, volume pipette, bulb, spatula, magnetic stirrer, analytical balance, oven, desiccator, pycnometer, viscometer, petri dish, test tube, pH meter, burettes, erlenmeyer, funnels, volumetric flasks, clamps and statives.

Procedures

Sample preparation

Coconut oil and corn oil are heated with a ratio of 3:2 as much as 30 g at 70 °C for 5 minutes. After that, added 6 g of KOH, 7 mL of 25% citric acid, 25 mL of distilled water then stirred until homogeneous. Finally, 6 ml of aloe vera gel was added and SLS solution was added with variations (0,4,5,6) g.

Characterizations

Testing of pH, FFA (Free Fatty Acid) or free alkali content, TPC (Total Plate Count), conducted based on (SNI 2588:2017. The viscosity test was carried out using an Oswald viscometer while the density test used a pycnometer.

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Foam stability test

The foam test was carried out by mixing 1 sample of soap with 10 mL of distilled water, then shaking and measuring the height of the foam that formed after five minutes, the height of the foam was again measured.

Total Plate Count (TPC)

The TPC test is conducted by first diluting the tested soap sample which aims to minimize the concentration of bacteria then the process of planting it on agar media and the number of growing bacterial colonies can be counted after the incubation process at the specified temperature and time.

Antibacterial test

Antibacterial test in this study was carried out by sterilizing the cotton buds to be used by passing them over a Bunsen, then the bacteria on the hands were taken by applying the cotton buds to the palms of the hands, the back of the hands and between the fingers. The cotton buds were rubbed on the surface of the agar in zig-zag pattern. The samples were then incubated at 37 °C and the number of growing bacterial colonies was counted at 24 and 48 hours.

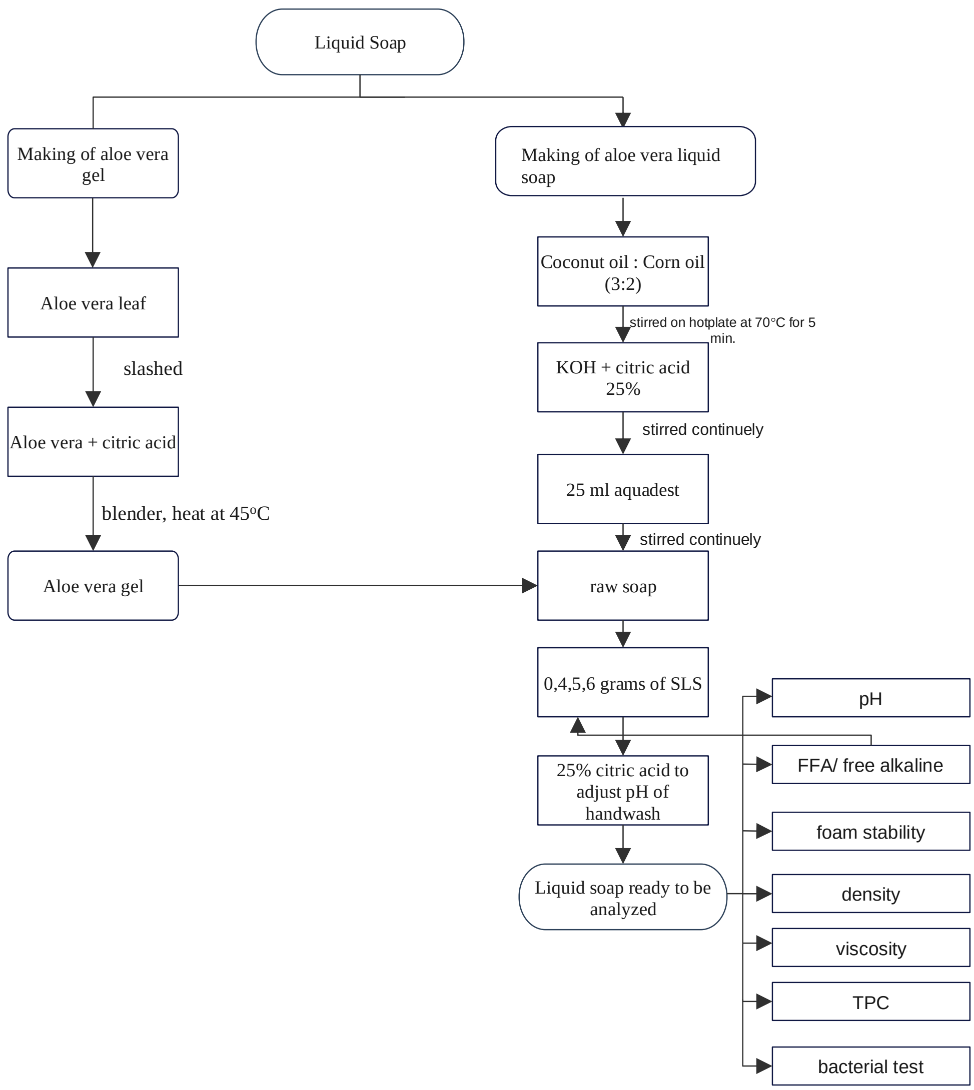

Figure 2. Schematic procedure making of liquid soap

Result and Discussion

In this study, SLS was varied in each formulation. The addition of SLS used was 0, 4, 5, and 6 g while the citric acid used was 7 mL in each formulation. The addition of the SLS variation in this study aims to produce foams soap while the addition of citric acid is to control the pH and its effect on the free alkali content.

Making soap in this study was carried out in two stages, firstly the aloe vera gel preparation stage and the soap making stage. In the aloe vera gel preparation stage, aloe

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

vera gel is sterilized by heating to a temperature of 45 °C because based on the literature it is stated that if the temperature is higher, the aloe vera gel will turn into browning, in other word the enzymatic reaction can damage the saponin content in aloe vera. After heating process, this gel is cooled and 7 mL citric acid is added to stabilize its physical form.

The second stage is the process of making soap. At this stage coconut oil and corn oil mixed at a ratio of 3:2 then heated at 70 °C. Coconut oil is used because it has good cleansing power while corn oil aims to provide moisture and produce soap with a stable foam. The oil mixture is stirred with KOH on the hotplate. This heating and stirring process aims to accelerate the saponification reaction between the oil and KOH. After that, citric acid was added to the oil and KOH mixture drops by drops until achieve netral pH solution while continuing to stir with a magnetic stirrer. 25 g of distilled water was added to the mixture and then added aloe vera gel while still stirring until homogeneous. After stirring for 3 hours where the mixture began to thicken, the SLS which had previously been dissolved with hot distilled water was added to the mixture and stirring was carried out until the stirring time was 5 hours. The reactions that occur in the process of forming liquid soap are as follows.

$$\underset{\text{Fat}}{C_3H_5(COOR)_3} + \underset{\text{Base}}{3KOH} \longrightarrow \underset{\text{Soap}}{3KCOOR} + \underset{\text{Glycerol}}{C_3H_5(OH)_3} \quad (1)$$

The soap obtained in this study resulted ±50 g of white liquid soap in each formulation. The soap produced in this study was then analyzed to determine the quality of the soap produced.

Table 1. Handsoap samples analysis

No	Parameters	F0	F1	F2	F3	Commercial	SNI 2588-2017
1.	pH	8,40	8,40	8,39	8,39	4,08	4-10
2.	FFA *(Free Fatty Acid)* (%)	0,55	0,50	0,51	0,51	5,91	Max 1
3.	Density (25 °C) (g/mL)	1,0168	1,0125	1,0198	0,9871	1,0207	-
4.	Viscosity (cP)	2.161,25	1.773,15	1.446,68	1.112,20	1.462,12	-
5.	Foam (%)	16,21	58,53	69,33	75,95	86,42	-
6.	TPC (Total Plate Count) (colony/ml)	$<1\times10^1$	$<1\times10^1$	1×10^2	$<1\times10^1$	$<1\times10^1$	Max 1×10^3

Figure 2. Liquid Soap from Corn Oil (*Zea Mays* L) and Aloe Vera Extract

Handsoap samples parameters

1. pH

The pH value or degree of acidity is one of the most important soap quality requirements in determining the quality of a soap. Testing the pH value in soap aims to determine whether the soap produced is alkaline or acidic. Soap with high or low pH can increase the adsorption capacity of the skin so that the skin becomes irritated such as peeling, itching, and dry skin.

Table 1 shows the pH value of the soap ranging from 8.39-8.40. The pH value of the soap obtained in all liquid soap formulations match with the quality requirements set by SNI 2588-2017, at 4 to 10. Compared to previous

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

research conducted by Nur (2020), the pH value of soap has decreased while in previous research the pH was at 9 to 12. This is due to the addition of citric acid as a pH controller in each soap preparation while the difference in SLS concentration did not affect the pH test results because it is neutral base surfactant.

2. FFA (Free Fatty Acid) and free alkali

Free alkali is the amount of alkali that does not completely react with fatty acids during the formation of soap paste where the presence of free alkali indicates that there is a lack of fatty acids in the soap formula. During this assessment, no traces of free alkali were detected. This determination was derived from the fact that upon the addition of phenolphthalein, the solution did not exhibit a pink color change, thereby indicating a negative outcome for free alkali presence. When compared to the previous research conducted by Nur (2020), the free alkali content has decreased. The previous research produced free alkali where the value still did not match the quality requirements for soap based on SNI 2588-2017. This level of free alkali is possible because the alkali used in soap making, KOH, has completely reacted with free fatty acids in the formation of soap paste.

Determination of FFA levels in soap in this study was carried out using the titration method by filtering the filtrate from a mixture of soap and neutral alcohol added with phenolphthalein and then titrated with a standard acid solution. The reactions that occur in the determination of FFA of soap are as follows.

$$\text{R-COOH}_{(aq)} + \text{KOH}_{(aq)} \longrightarrow \text{R-COOK}_{(aq)} + \text{H}_2\text{O}_{(l)} \quad (2)$$

The solution used in this titration process is KOH solution which has been standardized with oxalic acid. The reaction that occurs during the standardization process of KOH solution by a primary standard solution of oxalic acid is as follows.

$$\text{H}_2\text{C}_2\text{O}_{4(aq)} + 2\text{KOH}_{(aq)} \longrightarrow \text{K}_2\text{C}_2\text{O}_{4(aq)} + 2\text{H}_2\text{O}_{(l)} \quad (3)$$

In Table 1 it can be seen that the results of the free fatty acid ranged from 0.50% to 0.51%. This shows that the content of free fatty acids in soap is in accordance with the value required by SNI 2588-2017, which is a maximum of 1%.

3. Density

Density is the ratio of the weight of liquid soap to the weight of water at the same volume and temperature. The higher the density of an object, the greater the mass of each volume where a substance regardless of volume will have the same density.

In Table 1 it can be seen that the density obtained at 25 °C in each soap formulation ranged from 0.9871-1.0198 g/mL while for the commercial soap tested the density values were obtained at 1.0207 g/mL. From the results of the density test for these four soap formulations, it can be seen that the density of the liquid soap produced is not much different in each formulation so that it can be stated that the difference in the concentration of SLS added has no effect on the density of the soap because the density its self only about 1.01 g/cm^3 and just 4 to 7 g or approximately 6 to 7.5 % of the total amount was added in the formulation of liquid soap. In SNI 2588-2017 hand sanitizer liquid soap, the required density value is not specified. Therefore, this research compared with the density of commercial soap. The density obtained in the four liquid soap formulas is close to the density value of commercial soap.

4. Viscosity

Viscosity is the thickness of the fluid layers when they slide over one another. The purpose of measuring viscosity in this study was to determine the viscosity of each liquid soap formulation produced. Soaps with smooth flow possess low viscosity, whereas those with difficult flow exhibit high viscosity.

In Table 1 it can be seen that the viscosity values obtained at 25 °C for each soap formulation ranged from 1,112.20 to 2,161.25 cP. From the viscosity tests of the four soap formulations, it can be seen that the viscosity of the liquid soap produced tends to decrease due to differences in the concentration of SLS. The highest viscosity is soap without SLS at 2,161.25 cP and the lowest viscosity is the soap with the addition of SLS of 6 g at 1112.20 cP. According to Kusrini et al. (2023), the addition of a thickening agent, better known as a thickener, serves to increase the viscosity of liquid hand soap and also plays a role in controlling the flow rate (viscosity) of the detergent formulation. Thickening agents include anionic surfactants, gums, starches, or polymeric materials.

The SNI for liquid hand soap does not stipulate the required soap viscosity. Therefore, a viscosity test was compared with commercial soap. The commercial soap viscosity value at 1,462.12 cP. Among the soap formulations tested, the F2 formula exhibits a viscosity profile that close to the commercial soap's viscosity. However, a comparison with a prior investigation by Handayani (2018) that focused on the production of liquid soap from orange peel extract reveals a notable discrepancy. In Handayani's study, the viscosity of the soap increased proportionally with higher concentrations of

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

SLS that contrasts with the outcomes of this study. This is because the lacking homogenization process, or might be due to the addition of citric acid. The additional of citric acid also can contribute to the level of soap viscosity.

5. Foam stability

Foam testing is one of the most important parameters in determining the quality of cosmetic products, including soap products. The purpose of foam testing in this study is to see the foaming power of liquid soap. Stable foam is favorable because it can assist in the cleaning process (Rinaldi, 2021).

Based on the results, it can be seen in table 1 that the stability of the liquid soap foam increases in each formulation, starting from 16.66% to 76.92%. An increase in the concentration of the addition of SLS would increase the amount of foam in the soap preparation because SLS is an anionic surfactant. These surfactants have an alkyl group attached to an anion. This anion causes the characteristics of the surfactant to become more hydrophilic and has excellent cleaning properties and increasing foam stability. In SNI 2588-2017 there are no requirements in assessing the stability level of soap foam, so that commercial soap is used as a comparison soap. The commercial soap tested obtained a foam stability at 85.36% if compared with commercial soap, the foam stability value produced in the F3 formulation is the formulation that is closest to the stability value of commercial soap foam.

The increase in the value of foam stability in each liquid soap formulation is influenced by the concentration of surfactant. SLS is a surfactant that has good cleaning ability, is less irritating to the skin and can reduce the surface tension of water so that it can clean oil and dirt attached to the body's skin.

6. TPC (Total Plate Count)

TPC (Total Plate Count) is the determination of the number of microbes present in a sample where these microbes are grown in a medium so that several microbial colonies can be counted. The TPC test in this study was carried out using the pouring technique method. From Table 1 it can be seen that the TPC value of the results of all formulations are in the range of 1×10^2 - $<1 \times 10^1$. The TPC value of the soaps are in accordance with the quality requirements of SNI 2588-2017, which is the maximum TPC at 1×10^3. The TPC obtained for each soap formulation is the same as the TPC test results for commercial soap, which is $<1\times10^1$. All of the formulations that has been made, only the F2 formulation grows one bacterial colony, while for the formulations F0, F1, F3 and commercial soap there are no bacterial colonies that grow. Bacterial colonies that grew in the F2 formulation were made possible by contamination during the testing process because the simplo samples did not show any growing bacterial colonies. The control formulation, F0, the TPC also at 0, it can be stated that the treatment of variations in the addition of SLS to each soap formula has no effect on the TPC test.

(a) (b) (c) (d)

Figure 2. Inhibition Zone in various of soap formulation range from (a) F0, (b) F1, (c) F2, dan (d) F3

7. Antibacterial test

Bacterial test is a test conducted to determine the ability of soap to kill bacteria caused by the presence of aloe vera with the functions as an antibacterial. From table 2 it can be seen that each formulation has an antiseptic ability which based on the percentage of lethal bacteria produced is quite high in each formula. The use of citric acid and variations of SLS effect on the results of the bacterial test in each soap formulation but compared with F0 formula, as control (without the addition of SLS), the percentage of bacterial lethality have slightly different from formulas F1, F2 and F3.

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Table 2. Antibacterial test analysis

Formulations	Bacterial Decrease Percentage	
	24 hours	**48 hours**
F0	83,33%	87,5%
F1	80%	78,94%
F2	88,09%	86,66%
F3	87,5%	83,33%
Commercial	-	100%

The antiseptic ability of each soap formula is caused by the content of aloe vera gel which contains saponin compounds that can kill bacteria or germs on the hands. The reduction percentage count of bacteria had no much different in each formulation because the amount of aloe vera gel added was the same. However, if we look at the data from the calculation of the percentage of killing bacteria, the best formula is the F2 formula because it is the formulation with the highest percentage of killing bacteria. The percentage value that kills bacteria in the F2 formula is also the formula with the percentage that kills bacteria closest to the percentage that kills bacteria produced by commercial soap after 48 hours incubation. The percentage value of killing bacteria produced in each formula after the incubation process can be caused of the additional aloe vera gel contain saponin which functions as an antibacterial can work properly.

In terms of its antibacterial efficacy, F2 outperforms than F3. This could be attributed to the optimized saponification process within this formulation (F2), the soap formation is at perfection formation for reacting with other components. Holding the same stirring speed among formulations, it is plausible that in the F2 formulation, there is an increased probability of optimal interaction both with bacteria and other components during the soap formation process. If the interaction between the components of the soap and the bacteria is getting better, the antibacterial efficacy of the soap concurrently enhances.

The zone of inhibition was seen after incubation, where the clear area around the disc showed bacterial colonies in that area died or failed to propagated. This can be explained based on the chemical content in the soap that is made.

Corn oil is a basic ingredient in soap making. Any type of soap has two sides of the molecule, one side is attracted to water and the other side is attracted to fat.

Upon encountering water and fat, soap will disintegrate the lipid coating, prompting fat particles to disperse and blend with water. In such conditions, bacteria or germs are incapacitated within seconds.

The addition of SLS as a surfactant will help the effectiveness of the soap. Soap requires water as a trigger to activate the surfactant. When surfactants meet fat-based lipids, the lipids in bacteria or viruses will be damaged. Activation of the surfactant relies on the presence of water. When surfactants interact with lipid-based bacterial or viral components, the lipids within the microorganisms undergo damage. This SLS is basically the product of palm oil, corn oil or coconut oil combined with based or alcohol group.

On the other hand, the addition of aloe vera which contains several active compounds that have antibacterial properties makes the cleaning power of the soap more optimal. The presence of antibacterial activity of liquid soap may be due to the content of secondary metabolites contained in aloe vera, namely saponins, flavonoids, terpenoids, tannins, and anthraquinones (Kumar et al., 2012). Saponins disrupt bacterial cell membranes (Xue et al., 2017), flavonoids target bacterial cell walls and diminish cell density (Dzoyem et al., 2013) in (Sari and Ferdinan, 2017), and terpenoids weaken bacterial cell walls by disrupting their membrane network. According to the results of the study (Sari and Ferdinan, 2017), Aloe vera leaf extract liquid soap affirm the antibacterial activity of aloe vera leaf extract liquid soap against G-positive bacteria (*Staphylococcus aureus*, *Staphylococcus epidermidis, Bacillus subtilis*, and *Bacillus cereus*) and G-negative bacteria (*Salmonella typhimurium*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, and *Escherichia coli*).

Conclusion

Based on this research, it was obtained that soap formula with the best quality according to the SNI 2588-2017 is formula F2. The results of the quality analysis of the four liquid soap formulations show that the liquid soap produced complies with the quality requirements for hand sanitizer liquid soap based on SNI 2588-2017. The

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

additional SLS (Sodium Lauryl Sulfate) in each formulation effect on the stability of the liquid soap, viscosity, and antibacterial test while citric acid aloe vera gel influence on the soap neutrality pH test at around pH 8.

Conflict of Interest

The authors declare that there is no conflict of interest.

Acknowledgements

Our gratitude goes to the Ministry of Industry, who always encourages lecturers to conduct research and publish in reputable national and international journals. This article is the collaboration of the lecturer and guiding students as the in chemical analysis study prog. We also thank those who have assisted in carrying out this research, in particular the Laboratory of Chemical Analysis Study Prog, AK-Manufaktur Bantaeng, South Sulawesi.

References

Anyanwu, M. U., and Okoye, R. C. (2017). Antimicrobial Activity of Nigerian Medicinal Plants. *Journal of Intercultural Ethnopharmacology*, *6*(2), 240–259.

Campa, M., and Baron, E. (2018). Anti-Aging Effects of Select Botanicals: Scientific Evidence and Current Trends. *Cosmetics*, *5*(3), 1–15.

Chan, A. (2017). Formulasi Sediaan Sabun Mandi Padat dari Ekstrak Buah Apel (Malus domesticus) Sebagai Sabun Kecantikan Kulit. *Jurnal Ilmiah Manuntung*, *2*(1), 51.

De Silva, S. I. S., Bulathgama, B. E. A. U., Somarathna, K. T. A. G., Ranasingha, R. D. A. K., Priyankara, H. A. C., Karunarathna, K. H. T., Rajawatta, K. M. W., & Chandana, E. P. S. (2022). Development of an Aloe vera (Aloe barbadensis) Enriched Herbal Soap and Assessment of Physico-Chemical Properties and Consumer Preference. *International Symposium on Agriculture and Environment 2022.*

Dimpudus, S. A., Yamlean, P. V. Y., & Yudistira, A. (2017). Formulasi Sediaan Sabun Cair Antiseptik Ekstrak Etanol Bunga Pacar Air (Impatiens balsamina L.) dan Ujiefektivitasnya terhadap Bakteri Staphylococcus aureus secara In Vitro. *Pharmacon, 6*(3), 208-215.

Dissanayake, N. U. S., Pupulewatte, P. G. H., and Jayawardana, D. T. (2022). Formulation and Evaluation of a Laterite Soil Based Scrubbing Effect Herbal Cleansing Bar. *Journal of Drug Delivery and Therapeutics*, *12*(1-S), 91–96.

Dwynda, I., & Zainul, R. (2018). *Boric Acid ($H_3(BO_3)$): Recognize The Molecular Interactions in Solutions*. Thesis. Padang: Univeristas Negeri Padang 2018.

Dzoyem, J.P., Hamamoto, H., Ngameni, B., Ngadjui, B.T., Sekimizu, K. (2013). Antimicrobial Action Mechanism of Flavonoids from Dorstenia Species. *Drugs Discoveries and Therapeutics*, *7*(2), 66-72

Handayani, S., Hidayati, N., & Aprilianti, R. V. (2018). Formulasi Sabun Mandi Cair Ekstrak Kulit Jeruk Manis Varietas Siam (Citrus sinensis L.) dengan Variasi Konsentrasi Surfaktan Sodium Lauril Sulfat. *Cerata Jurnal Ilmu Farmasi, 9*(II), 43-48.

Ikram, A., Qasim, R.S., Saeed, F., et al (2021). Effect of Adding Aloe Vera Jell on The Quality and Sensory Properties of Yogurt. *Food Science and Nutrition*, *9*(1), 480-488.

Kumar, H.N.K., Chandana, E., Preethi, S.D., Chauhan, J.B. (2012). In Vitro Antimicrobial Activity and Phytochemical Screening of *Aloe vera* Linn. *Int J Curr Pharm Res*, *4*(3), 45-47.

Kusrini, E., Wilson, L. D., Padmosoedarso, K. M., Mawarni, D. P., Sufyan, M., and Usman, A. (2023). Synthesis of Chitosan Capped Zinc Sulphide Nanoparticle Composites as an Antibacterial Agent for Liquid Handwash Disinfectant Applications. *Journal of Composites Science*, *7*(2), 52.

Lestari, U., Syamsulrizal, Handayani, W.T. (2020). Formulasi Dan Uji Efektivitas Daya Bersih Sabun Padat Kombinasi Arang Aktif Cangkang Sawit Dan Sodium Lauril Sulfat. *Journal of pharmaceutical science and clinical research*, *2*, 136-150.

Nasir, B., Fatima, H., Ahmad, M., and Ihsan-ulHaq. (2015). Recent Trends and Methods in Antimicrobial Drug Discovery from Plant Sources. *Austin Journal of Microbiology*, *1*(1), 1002.

Nur, Riska Amaliah. (2020). *Formulasi Sabun Cair Antiseptik Dari Minyak Jagung (Zea Mays L.) dan Gel Lidah Buaya (Aloe Vera)*. Laporan Tugas Akhir. Bantaeng: Akademi Komunitas Industri Manufaktur Bantaeng 2020.

Rinaldi, Fauziah, Mastura.R. (2021). Formulasi Dan Uji Daya Hambat Sabun Cair Ekstrak Etanol Serai Wangi (*Cymbopogon nardus* L) Terhadap Pertumbuhan *Staphlylococcus aureus*. *Jurnal Riset Kefarmasian Indonesia*, *3*(1), 2021.

Paul, T. J., Taylor, T. A., and Rajendra Santosh, A. B. (2020). The Potential of Saponin from Jamaica's *Blighia sapida* (Ackee) as a Substitute for Sodium Lauryl Sulphate in Toothpaste. *Medical Hypotheses*, *137*, 109555.

Sari, R., and Ferdinan, A. (2017). Antibacterial Activity Assay of the Liquid Soap from the Extract of Aloe vera Leaf Peel. *Pharmaceutical Sciences and Research*, *4*(3).

Sasongko, H., and Mumpuni, A. S. (2017). Pengaruh Penambahan Sukrosa Terhadap Mutu Sabun Transparan dari Ekstrak Etanol Herba Pegagan (Centella asiatica L.). *Pharmaciana*, *7*(1), 71.

Sharma, A., Bruce, K. L., Chen, B., Gyouneva, S., Bahrens, B. H., Bommarius, A. S. dan Chernoff, Y. O. 2016. Contributions of the Prion Protein Sequence, Strain, and Environment to the Species Barrier. *J Biol Chem*, *291*(3), 77-88.

Srivasta, S.B. (1982). So*ap, detergent and parfume and industry (soap and detergent manufacturing guide). 43rd Publication on Small Scale Industries*. New DelhiIndia: Small Industry Research Institute.

Syafei, N., Hidayat, D., Emilliano, E. and Men, L. (2018). Analysis Cracking Corrosion on Carbon Steel Pipes

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

API 5L-X65 In Solution 7700 mL Aquades, 250 mL Acetic Acid and 50 mL Ammonia with Gas CO_2 and H_2S in Saturation Condition, *EKSAKTA: Berkala Ilmiah Bidang MIPA*, *19*(2), 21-31.

Tyowua, A. T., Vitalis, T. B., Terhemen, M. M., and Mbaawuaga, E. M. (2019). Aloe Vera (Aloe barbadensis Miller) Extract as a Natural Antimicrobial Agent in Hand-Washing Liquid Soap. *Nigerian Annals of Pure and Applied Sciences*, *1*, 96–107.

Vidal, N, P., Adigun, O, A., Pham, T, H., Mumtaz, A., Manful, C., Callahan, G., Stewart, P., Keough, D., and Thomas, R, H., (2018). The Effects of Cold Saponification on The Unsaponified Fatty Acid Composition and Sensory Perception of Commercial Natural Herbal Soaps. *Molecules*, *23*(9), 1–20.

Xue, P., Yao, Y., Yang, X.S., Feng, J., Ren, G.X. (2017). Improved Antimicrobial Effect of Ginseng Extract by Heat Transformation. *Journal of Ginseng Research*, *41*, 180-187.

This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.