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Potency of *Ziziphus* and *Polyscias* Leaves as Foaming agent in Antioxidant Soap Production from Nyamplung Seed Oil

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Abstract

The research to find the best antioxidant soap formulation from nyamplung seed oil as the main ingredient had been conducted. However, the additives that were used were synthetic materials which can be iritate skin. This research examines the use of additives from natural ingredients i.e., moringa leaves (Moringa oleifera L.) as an antioxidant, ziziphus leaves (Ziziphus mauritiana L.) and saucer-leaf (Polyscias scutellaria L.) as a natural foaming agent. The purpose of the research was to determine the formulation and antioxidant activity of soap from nyamplung seed oil with the addition of bidara and mangkokan leaves as foaming agentt. The characterization of the formula soap includes total fat, free fatty acids, neutral fat, pH, density, and foam stability. Data analysis used a completely randomized design, ANOVA test and DMRT test with a 95% of confidential level (α=0.05). Determination of the best formulation of soap used the effectiveness index method. Antioxidant activity test on the best formula soap used the DPPH method. The results showed that the two natural additives had a significant effect on the characteristics of the soap. The antioxidant activity test was obtained IC_{50} value of 44.73 ppm, which means that soap has very strong antioxidant activity.

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Introduction

Soap is one of the basic necessities in everyday life where the development of the soap industry currently has various types of soap such as liquid soap, antibacterial soap, antifungal soap, and also antioxidant soap. Based on the types of soap today, liquid soap is preferred because it is easier to use, not easily contaminated, more economical and easier to store (Widyasanti et al., 2019). Soap is a cleaning agent that can be made through saponification by reacting potassium or sodium compounds with vegetable or animal oil. Nyamplung oil (*Callophylum inophylum* L.) is one of the vegetable oils that has the potential in soap production, its quality is the same as palm oil or coconut oil, and its availability is abundant in nature. The content of nyamplung seed oil is 50-73% (Hasibuan & Ma'ruf, 2014).

Previous studies have formulated nyamplung seed oil into antioxidant soap using ketapang (*Terminalia catappa* L.) fruit as an antioxidant compound and the foaming agent using sodium lauryl sulfate (SLS) (Widyaningsih et al., 2018). However, the availability of ketapang fruit is limited to certain areas so it is necessary to substitute ketapang with widely available materials such as moringa leaves (*Moringa oleifera* L). Moringa leaves contain tannins, steroids, triterpenoids, flavonoids, saponins, quinones, anthraquinones and alkaloids, some of which have the potential as antioxidants (Fitriana et al., 2016). The high content of antioxidant compounds in Moringa leaves can be used as an alternative source of antioxidants in soap production (Krisnadi, 2015). Several studies have reported that methanol extract of moringa leaves has an IC_{50} (Inhibitor Concentration 50%) activity value = 49.30 μg/mL (Fitriana et al., 2016), IC_{50} = 10.74 μg/mL (Yati et al., 2018) in the antioxidant test using the DPPH method (1,1-diphenyl-2-2-picrylhydrazyl). This value is a strong range in inhibiting the activity of antioxidant radical compounds (Molyneux P, 2004). Fresh Moringa leaves have higher antioxidant activity than vitamin C (Fuglie, 1999). One of the flavonoid compounds contained in Moringa leaves is quercetin, where quercetin has antioxidant activity 4-5 times higher than vitamin C and vitamin E (Suphachai, 2014). Antioxidants in soap formulations will protect the body from free radicals and play a role in inhibiting the aging process by replacing body cells.

Another ingredient used in previous formulations is SLS as foaming agent. SLS can irritate the skin if used excessively. SLS is a petroleum-based synthetic material which is a non-renewable source and not easily degraded when disposed of in waters. Therefore, a more environmentally friendly foaming agent is needed to replace SLS. Natural foaming agents that have the potential to be used as sources of foam are bidara leaves (*Ziziphus mauritiana* L.) (Bintoro et al., 2017) and mangkokan leaves (*Polyscias scutellaria* L.) (Ashmawy et al., 2020). Bidara and mangkokan leaves contain saponins, a secondary metabolite that can produce foam. Saponins are complex glycosides consisting of hydroxyl compounds which can be hydrolyzed, produce glycones and aglycones. Saponins are also known as natural surfactants because they have a structure similar to soap or detergent, so they are widely used as natural foaming agents (Seri et al., 2020). Based on the information above, bidara and mangkokan leaves have the potential to be used as additives in soap production.

Method

The materials used in this study were nyamplung seed oil (obtained from the Cilacap area), moringa leaves, bidara leaves, mangkokan leaves, potassium hydroxide, anhydrous sodium sulfate, n-hexane, methanol, hydrochloric acid, DPPH (1,1-diphenyl-2-2-picrylhydrazyl), ethyl acetate, 96% ethanol, sulfuric acid, carboxyl methyl cellulose, phenolphthalein indicator. All materials used pro analysis materials from Merck.

Procedure

Extracts of moringa leaves, bidara leaves, and mangkokan leaves were obtained by maceration using methanol for moringa leaves and ethyl acetate for bidara leaves and mangkokan leaves for 24 hours. The maceration process was carried out 2-3 times and the filtrate obtained was then evaporated until a solvent-free extract was obtained.

The making of liquid soap begins with heating nyamplung seed oil to a temperature of 70-80 °C, then adding 30% KOH (w/v) with a ratio of 2:1. The mixture is heated while stirring for 1 hour (Widyaningsih et al., 2018). The temperature is lowered to 60 °C and distilled water is added (a ratio of 1:1 from the reaction results) while continuing to stir until a homogeneous liquid soap is formed. Next, 1.5 g of carboxyl methyl cellulose (CMC) and 3% jasmine fragrance (w/w) are added. The mixture is still stirred for 10-15 minutes. The soap product is divided into several variations by adding methanol extract of moringa leaves as a source of antioxidants with concentrations of 0.1; 0.3; 0.7; 0.5 and 0.9% per total weight, respectively. Then ethyl acetate extract from bidara leaves is added as a source of foaming with concentrations of 0.1; 0.3; 0.5; 0.7 and 0.9% per total weight for each liquid soap from the previous variation of moringa leaf extract concentration. The same treatment was also used with the ethyl acetate extract of mangkokan leaves. As a control, soap was also made without the addition of moringa leaf extract, bidara leaf extract, and mangkokan leaf extract.

Characterization of Total Fat (SNI, 1996)

Determination of total fat of liquid soap products was carried out by sample extraction. The first step was to weigh approximately 1 gram of soap product, put it into a 50 mL beaker and dissolve it with 5 mL of water, add a few drops of methyl red. The sample was added with 20% (v/v) sulfuric acid in excess until all fatty acids were freed from potassium and indicated by the appearance of a red color on the surface of the solution. Then the solution was put into a separating funnel while the sediment was not put into the separating funnel, and extracted with n-hexane. The non-polar layer was collected, while the polar layer was re-extracted with n-hexane. The extraction was repeated until the extract became colorless. The non-polar layer was extracted in stages with distilled water. Each wash used 10 mL of distilled water. The extract was dried with dry anhydrous sodium sulfate, filtered and put into a pre-weighed flask along with boiling stones (W1). The extract in the flask was evaporated at a temperature of 102-105 °C until the weight remained constant (W2). The fatty acid content was calculated using the following equation:

$$\text{Total Fat (\% w/w)} = \frac{(W_2 - W_1)}{\text{Sample weight}} \times 100\%$$

Where: W1 = Flask + boiling stones (g)
W2 = Flask + fatty after drying (g)

Characterization of Free Fatty Acids (SNI, 1996)

First, 10 mL of neutral alcohol was added with 0.1 mL of phenolphthalein indicator and boiled at 70 °C, then neutralized with 0.1N alcoholic KOH (Solution A). A sample of liquid soap was weighed as much as 0.5 g, put into Solution A, heated on a water bath, then boiled for 30 minutes. If the solution is alkaline (red color) then what is being tested is free alkali. The solution was titrated with 0.1N alcoholic HCl until the red color disappeared. Then the free alkali content was calculated using the equation:

$$\text{Free alkali content } (\text{as KOH (\%)}) = \frac{V \times N \times 0.0561}{W} \times 100\%$$

Where: V = volume of HCl 0,1 N (mL)
N = concentration of HCl (N)
W = sample weight (g)
0.0561 = equivalent weight of KOH

If the solution is not alkaline (not red), then the solution is titrated with 0.1 N alcoholic KOH solution, until a red color appears that lasts up to 15 seconds. The calculation to determine free fatty acids uses the equation:

$$\text{Free Fatty Acid} = \frac{V x\ N\ x\ 0.282}{W} x\ 100\%$$

Where: V = volume of KOH 0,1 N (mL)
N = concentration of KOH (N)
W = sample weight (g)
0.282 = equivalent weight as oleic acid

Characterization of Neutral Fat (SNI, 1996)

The used free fatty acid test solution was added with 5 mL of 0.5 N alcoholic KOH, then refluxed for 30 minutes. After that, it was titrated with 0.5 N alcoholic HCl until the red color disappeared. The titration was repeated using a blank of 0.5 N alcoholic KOH. The amount of neutral fat can be calculated using the following:

$$\text{Neutral Fat} = \frac{(\text{V2-V1})\ x\ N\ x\ 0.0561}{0.1981\ x\ W} x\ 100\%$$

Where: V1 = volume HCl + sample (mL)
V2 = volume HCl for KOH blanko (mL)
N = concentration of HCl (N)
W = sample weight (g)
0.0561 = equivalent weight of KOH
0.1981 = average saponification number of nyamplung oil (g)

Characterization of Density (SNI, 1996)

The determination of density of liquid soap is carried out using a pycnometer. The liquid soap product is put into the pycnometer and then left at a temperature of 25 oC for 30 minutes in a thermostat. The pycnometer is lifted, the outside is cleaned and left at room temperature and then weighed. The treatment is repeated using distilled water as a substitute for the sample. The calculation of specific gravity is determined by the following equation:

$$\text{Density} = \frac{W}{W1}$$

Where: W = sample weight (g)
W1 = water weight (gram)

Characterization of pH (SNI, 1996)

Liquid soap product is weighed as much as 1 mL, then dissolved in 9 mL of aquadest and shaken. Before the measurement is carried out, the pH meter is calibrated first using buffer solutions of 4.0 and 6.8. The electrode on the pH meter is cleaned, dipped in aquadest and then dipped into the sample to be examined at a temperature of 25 °C. The value on the pH meter scale is read after the number is stable and recorded. If the reading from two measurements has a difference of more than 0.2, the measurement is repeated.

Characterization of Foam Stability (Murti et al., 2018)

1 mL of soap solution was put into a test tube and then 9 mL of distilled water was added. The test sample was shaken for 1 minute and the foam height was measured after shaking. The sample was left for 1 hour and the foam height was measured again. Foam stability was determined using the following equation:

$$\text{Foam Stability (\%)} = \frac{\text{final foam height}}{\text{initial foam height}} \times 100\%$$

Determination of the Best Soap Formulation

Priority data is the percentage of foam stability data. The soap with the best percentage of foam stability is considered capable of replacing synthetic foaming agents (SLS). Other characteristics (total fat, free fatty acids, pH, specific gravity, unsaponifiable fat) are compared to SNI standards. This data will be sorted by formula from the best soap 1 to the best 4

Antioxidant activity test using the DPPH method (Fitriana et al., 2016)

The first step is to make a DPPH solution (Molyneux, 2014), 1.97 mg DPPH is dissolved in methanol up to 100 mL to obtain a solution with a concentration of 0.05 mM. The second step is to determine the percentage of immersion by making antioxidant test solutions of various concentrations (1, 2, 4, 8, and 16 ppm) from antioxidant liquid soap where the best variation is determined by its antioxidant activity by adding 4 mL of 0.05 mM DPPH solution to 1 mL of antioxidant liquid soap. The mixture is left to stand and then its absorbance is measured. As a comparison, a 5ppm ascorbic acid solution is used with the same treatment as the test solution. The third step is to determine IC_{50} where the antioxidant activity of the best characteristic antioxidant liquid soap is expressed by the percentage of free radical inhibition (percent inhibition) which can be calculated using the following equation (Fitriana et al., 2016):

$$\text{Inhibition} = \frac{A1\text{-}A2}{A1} \times 100\%$$

Where: A1 : control absorbance
A2 : sample absorbance

The concentration values of antioxidant liquid bath soap (1, 2, 4, 8, and 16 ppm) and the soap antioxidant inhibition (percent inhibition) were plotted on the x and y axes respectively in the linear regression equation. The linear regression equation obtained was used to find the IC_{50} (Inhibitor Concentration 50%) of antioxidant liquid bath soap where the y value is 50 and the x value as the IC_{50}.

Results and Discussion

Total fat

Total fat is the number of fatty acids contained in soap. The amount of total fat indicates the cleaning efficiency of soap, emulsion stability, and maintains the consistency of soap cleaning (Chasani et al., 2022). Figures 1 and 2 show the amount of total fat in the formulated soap with varying concentrations where the more the concentration of additives added, the greater the amount of total fat from the soap produced. Additives in the form of methanol extract contain secondary metabolite compounds in the form of steroids, an organic compound of sterol fat that cannot be hydrolyzed, thus increasing the amount of fat contained in the soap (Widyasanti et al., 2019). The results of the analysis showed that the addition of 0.9% methanol extract of moringa leaves and 0.5% ethyl acetate extract of bidara leaves and 0.9% mangkokan leaves showed a significant effect of 31.19% and 28%.

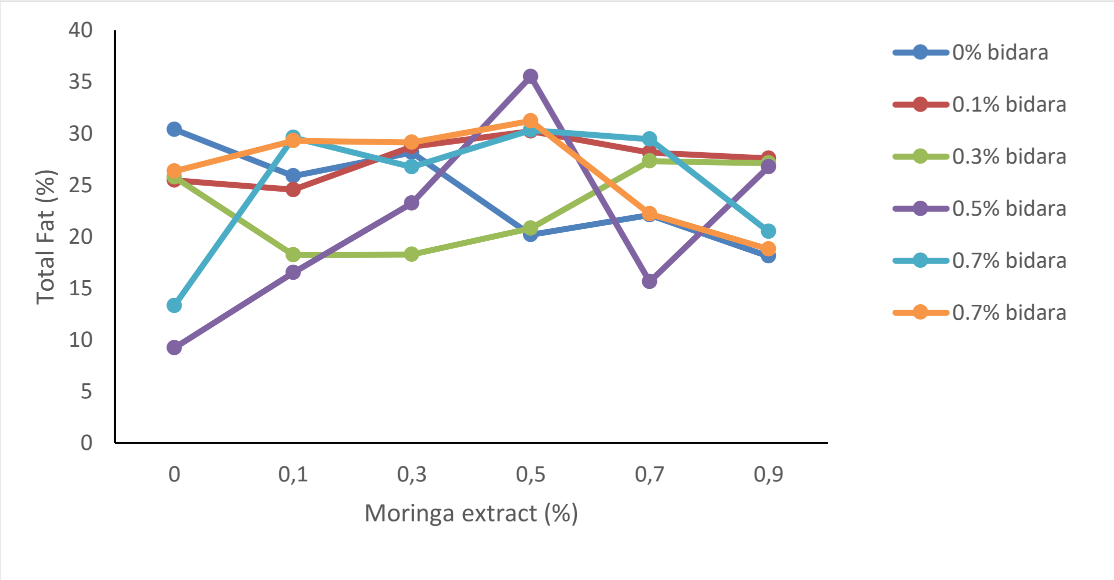

Figure 1. The amount of fatty acids in antioxidant soap formulated using bidara leaf extract as a foaming agent

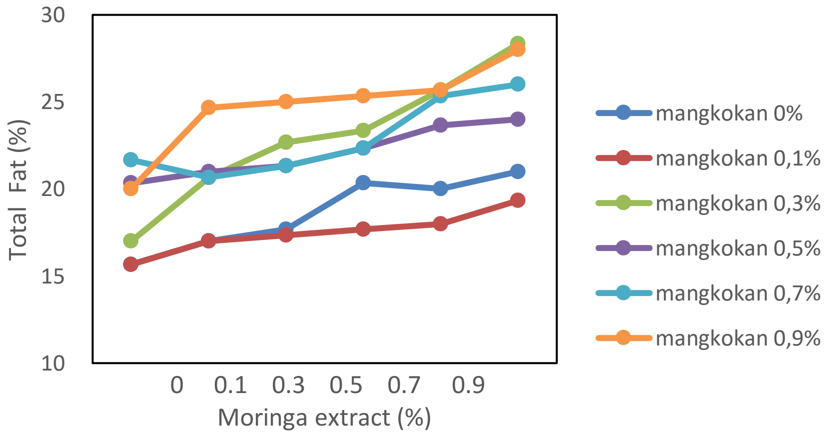

Figure 2. The amount of fatty acids in antioxidant soap formulated using mangkokan leaf extract as a foaming agent

Free Fatty Acids

The amount of free fatty acids is fatty acids found in free form that are not bound to potassium or triglycerides. The level of free fatty acids permitted in liquid soap preparations is less than 2.5% (SNI, 1996). Free fatty acids in soap will affect the cleaning properties of the soap because high levels of free fatty acids can reduce the cleaning power of the soap and make the soap smell rancid.

The results of the free fatty acid characterization can be seen in Figure 3 and Figure 4. Figure 3 shows that the free fatty acid content of antioxidant soap with bidara leaf extract foaming agent is less than 2.5%, as well as mangkokan leaf extract, but the percentage of free fatty acids tends to be unstable. The measurement results showing low free fatty acids prove that the saponification reaction is running optimally. Overall, the formulated soap tends to increase from low to high concentrations. The increase in free fatty acids is due to the terpenoid compound content in the extract. These compounds will react with KOH and make the alkali content saponify less free fatty acids in the soap. High levels of free fatty acids can reduce the cleaning power of soap and make the bath soap smell rancid (Adiwibowo, 2020).

However, the free fatty acids in the formulated soap still comply with the SNI 06-4085-1996 quality standard, which is less than 2.5%. The best soap formulation is in the addition of 0.5% methanol extract concentration of moringa leaves and 0.9% ethyl acetate extract of bidara leaves. While in antioxidant soap with mangkokan leaf extract foaming agent is in the concentration of moringa leaf extract of 0.9% and mangkokan leaf extract of 0.9%.

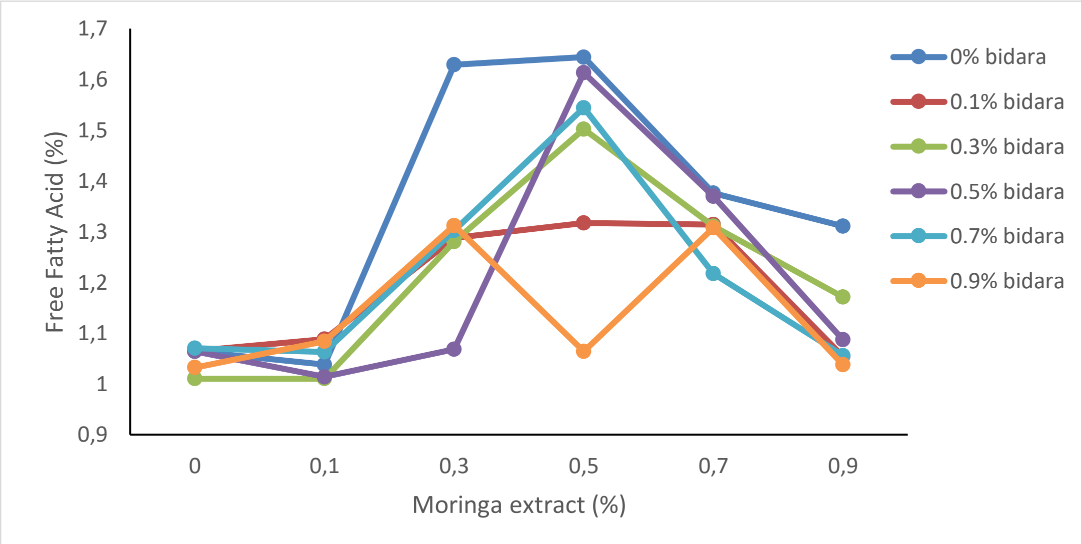

Figure 3. The amount of free fatty acids in soap resulting from the formulation using bidara leaf foaming agent

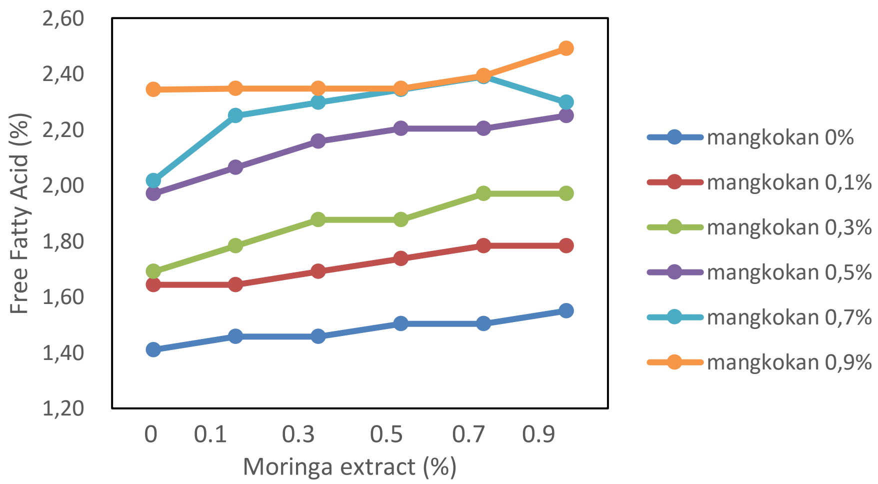

Figure 4. The amount of free fatty acids in soap resulting from the formulation using mangkokan leaf foaming agent

Neutral Fat

Neutral fat is fat that is not saponified by KOH. High levels of neutral fat can reduce the cleaning ability of soap (Widyasanti et al., 2019). The results of neutral fat in soap from various concentration formulations can be seen in Figures 5 and 6.

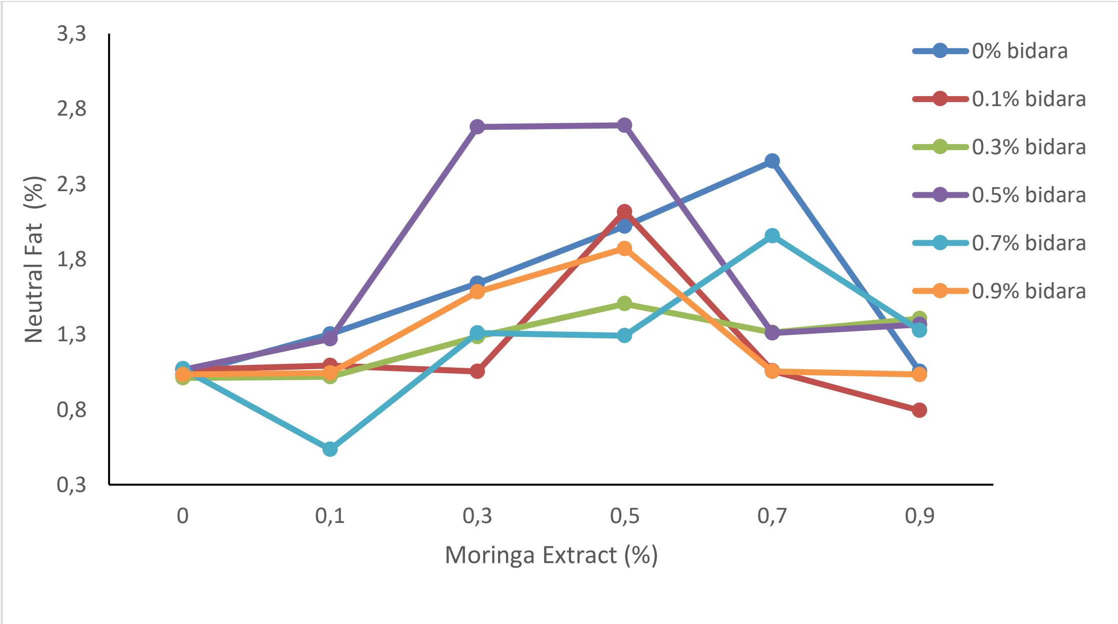

Figure 5. Neutral fat in soap formulated with mangkokan leaf extract as a foaming agent

The amount of neutral fat in soap with the addition of moringa leaf extract and bidara leaf showed an increasing tendency with increasing concentration of each added extract. Moringa leaf extract, bidara leaf extract, and mangkokan leaf extract contain chlorophyll which can affect the level of unsaponifiable fraction in formulated soap (Widyasanti et al., 2016). Unsaponifiable fractions include sterols, pigments or dyes, and hydrocarbons found in plant extracts (Estiasih et al., 2015). This unsaponifiable fraction can increase the amount of neutral fat in soap. The value of neutral fat in formulated soap with the addition of methanol extract of moringa leaves and ethyl acetate extract of bidara leaves was relatively higher compared to control soap. The results of the analysis showed that the addition of moringa leaf extract and bidara leaf extract had a significant effect on the amount of neutral fat, namely neutral fat of 2.49% was obtained in soap with the addition of 0.7% moringa leaf extract and 0.9% bidara leaf extract. Meanwhile, in antioxidant soap with mangkokan leaf extract as a foaming agent, this occurs when 0.9% moringa leaf extract and 0.9% mangkokan leaf extract are added, with a neutral fat content of 4.35%.

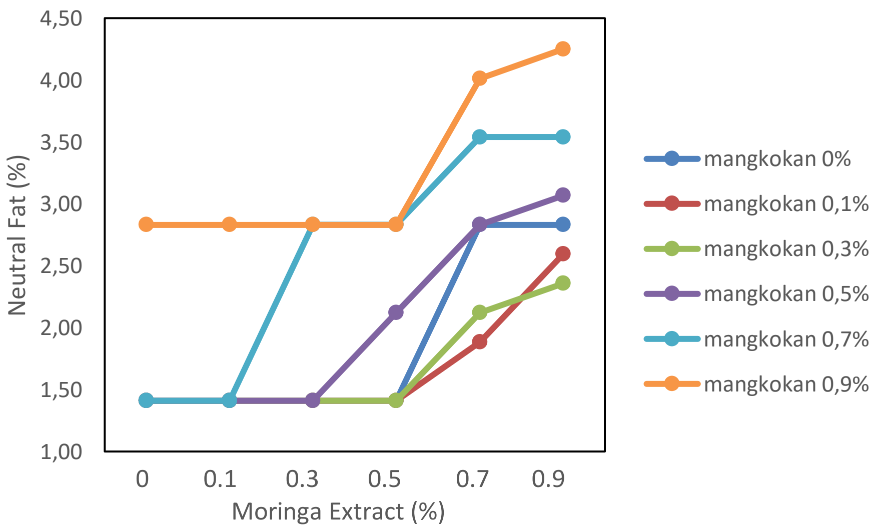

Figure 6. Neutral fat in soap formulated with mangkokan leaf extract as a foaming agent

Density

Density is the comparison of the weight of a substance in the air at a temperature of 25 °C to the weight of water at the same volume and temperature. The results of the characterization of the specific gravity of soap from the formulation of various concentrations can be seen in Figure 7 and Figure 8.

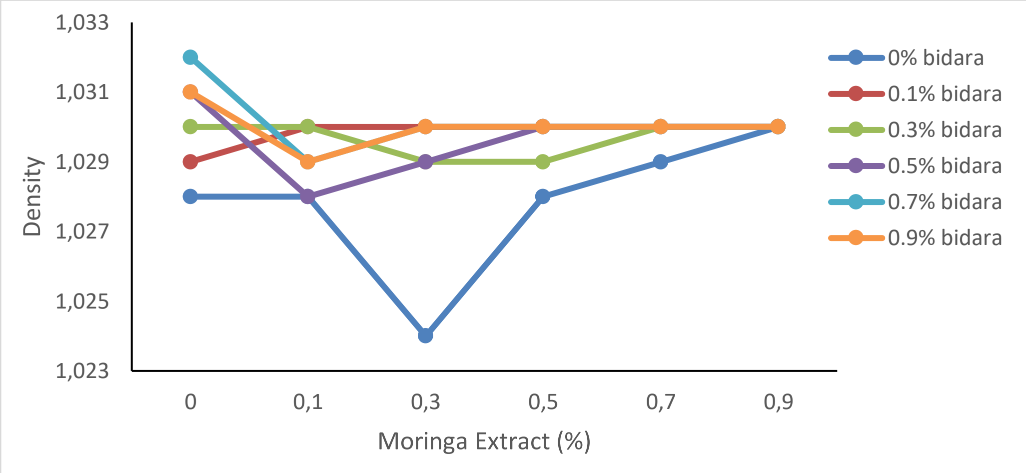

Figure 7. Density of soap formulated with bidara leaf extract as a foaming agent

The addition of methanol extract of moringa leaves and ethyl acetate extract of bidara leaves and mangkokan leaves resulted in a relatively higher density value compared to the control soap. Changes in density values are influenced by the type and concentration of ingredients in the solution (Indrawati et al., 2022). The higher the concentration of extract, the higher the density of the soap. The results of the characterization of the formulated soap also showed that the density value was in accordance with the quality requirements in SNI 06-4085-1996 of 1.01 g/mL-1.10 g/mL. The results of data analysis showed that the addition of methanol extract of moringa leaves and ethyl acetate extract of bidara leaves had a significant effect on the density value of the soap with a concentration of methanol extract of moringa leaves of 0.9% and a concentration of ethyl acetate extract of bidara leaves of 0.9%. Meanwhile, in soap with mangkokan leaf extract as a foaming agent, a significant effect was shown in soap with a density value of 1.04 g/mL at a concentration of 0.9% moringa leaf extract and a concentration of 0.5% mangkokan leaf extract.

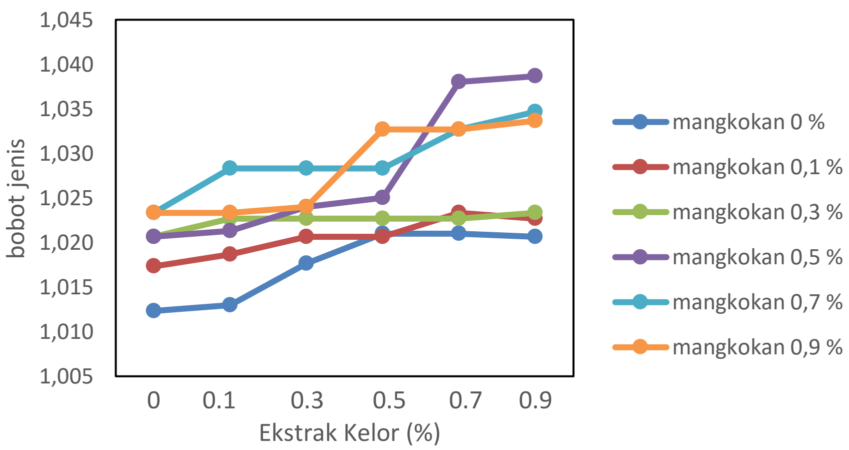

Figure 8. Density of soap formulated with bidara leaf extract as a foaming agent

pH

pH is an important parameter in determining the quality of soap, because the pH of the soap can be used to determine the potential of the soap to irritate the skin. The results of pH measurements on the formulated soap can be seen in Figure 9 and Figure 10 which show relatively higher results than the control soap. pH tends to decrease from low to high concentration formulated soap. Moringa leaf extract contains vitamin C (Krisnadi, 2015), where vitamin C is acidic, so that increasing the addition of moringa leaf extract to the formulation causes the pH of the soap to decrease. The decrease in soap pH can also be caused by moringa leaf extract and bidara leaf extract which are acidic. Moringa leaf extract has a pH of around 4.3-4.6 (Diantoro et al., 2015) and bidara leaf extract has a pH of around 6.3-7.5 (Elfasyari et al., 2019) so that the addition of extract to the formulation lowers the pH. In addition, the presence of terpenoid compounds in moringa leaf extract and bidara leaves also lowers the pH of the soap. Terpenoid compounds are one of the compounds that are acidic because they contain hydroxyl and carbonyl groups. However it is not happen in antioxidant soap with mangkokan leaf extract foaming agent because mangkokan leaf extract does not contain vitamin C which is acidic, so it will not lower the pH of the formulated soap.

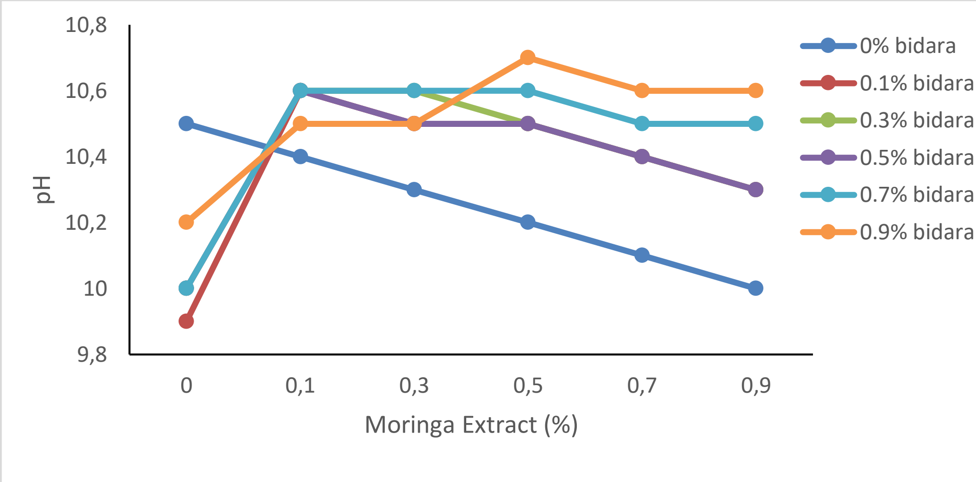

Figure 9. The pH value of soap formulated with bidara leaf extract as a foaming agent

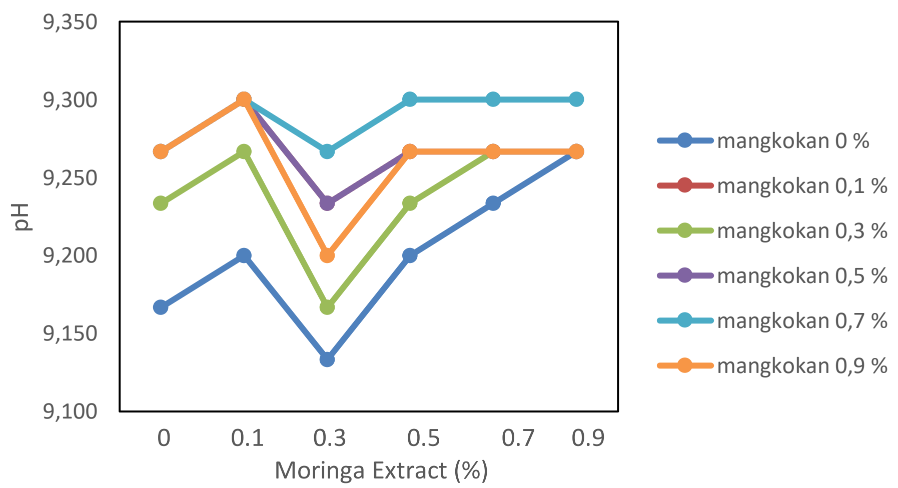

Figure 10. The pH value of soap formulated with mangkokan leaf extract as a foaming agent

The decrease in pH can also be due to the decomposition of phenol groups found in moringa and bidara leaf extracts. Phenol is a compound that is acidic, easily oxidized, volatile, and sensitive to light and oxygen (Trissanthi & Susanto, 2016). The results of the soap pH analysis are in accordance with the SNI 06-4085-1996 range, namely 8-11, so that the soap is included in the category of safe for the skin (Pine et al., 2022). In general, soap has a pH that tends to be alkaline. A soap pH value that is too low can increase the absorption power of the soap on the skin which causes irritation, while a pH value that is too high can also cause the skin to become dry (Mahayuni et al., 2023).

The results of data analysis showed that the addition of moringa leaf extract and bidara leaf extract had a significant effect on the pH value. A significant effect occurred in soap with a concentration of 0.1% moringa leaf methanol extract and 0.9% bidara leaf extract with a pH value of 10.58. While for antioxidant soap with a foaming agent of mangkokan leaf extract, a significant effect occurred in the soap formula with a moringa leaf extract content of 0.9% and a mangkokan leaf extract of 0.7%, with a pH of 9.30.

Foam Stability

Foam is a gas dispersed in a liquid dispersing medium with stable properties and plays a role in the cleaning process. Foam stability is influenced by the presence of a foaming agent, namely surfactants (Mahayuni et al., 2023). The foam contained in the soap will affect the level of consumer preference. Soap with abundant and stable foam is generally preferred by consumers. Foam stability testing in soap is carried out by relating foam volume to time (Murti et al., 2018).

Foam height measurement is one way to control the quality of soap products so that the preparation has the appropriate ability to produce foam. There is no minimum or maximum foam height requirement for a soap preparation, because foam height does not indicate the soap's ability to clean. This is more related to the psychological and aesthetic perceptions preferred by consumers. The foam stability results in the formulated soap are in Figure 11 and Figure 12.

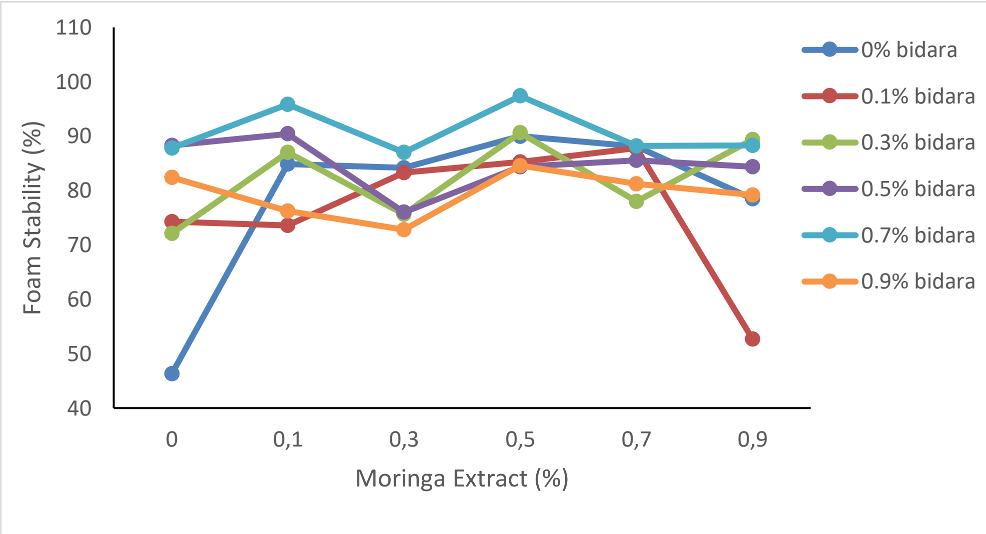

Figure 11. Foam stability in soap formulated with bidara leaf extract as a foaming agent

The results of the foam stability test with the addition of methanol extract of moringa leaves and ethyl acetate extract of bidara leaves were greater than the control soap and increased with the increasing concentration of the two extracts added. This is different from antioxidant soap with foaming agent from mangkokan leaf extract which actually decreased with increasing concentration of mangkokan leaf extract added. A decrease also occurred in antioxidant soap with foaming agent from mangkokan leaf extract with increasing levels of moringa leaf extract added. This actually happened the other way around in antioxidant soap with foaming agent from bidara leaf extract which tended to increase with increasing levels of moringa leaf extract added. The higher foam stability value in the formulated soap was due to the saponin content in bidara leaf extract as the foaming agent (Pandey, 2012).

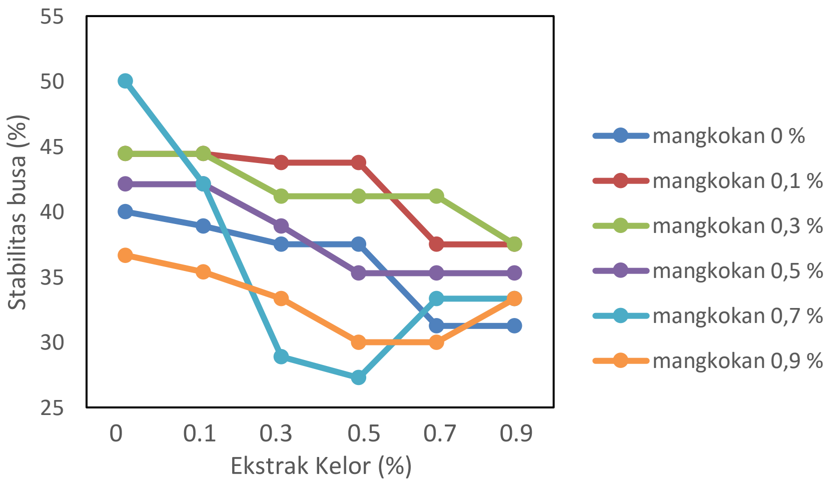

Figure 12. Foam stability in soap formulated with mangkokan leaf extract as a foaming agent

The foam stability value of the formulated soap is due to the saponin content in bidara leaf extract as a foaming agent (El Maaiden et al., 2020). Saponin has foaming properties when dissolved in water, even its foam stability is not inferior to synthetic surfactants, so it can be used in soap making as a natural foaming agent and makes soap more environmentally friendly (Góral & Wojciechowski, 2020). The stability of soap foam is influenced by the concentration of the added substance and its viscosity. The higher the addition of the concentration of methanol extract of moringa leaves and ethyl acetate extract of bidara leaves, the increase in foam stability in the formulated soap and control soap with the addition of additives. This shows that with the addition of more extract concentrations, the saponin content in each soap will increase, so that the foam in the soap is more stable. However, this does not happen in soap with foaming from mangkokan leaf extract. The soap formulation with the best foam stability is the addition of moringa leaf extract with a concentration of 0.3% and ethyl acetate extract of bidara leaves with a concentration of 0.5% with a foam stability of 93.15%. While in soap with foaming agents from mangkokan leaf extract, namely at a mangkokan content of 0.7% and moringa 0.5% with a decrease in foam stability of up to 27.27%.

The Best Soap Formula

The best soap formulation is determined by the effectiveness index method by sorting variables based on priority and contribution to the results. The order of priority and contribution in the study is the fatty acids (%), free fatty acids (%), neutral fat (%), specific gravity, pH, foam stability (%). The best formulated soap has a high product value. The best soap formula data in Table 1 shows that the soap with the best foam stability with characteristics that are most in accordance with SNI standards is antioxidant soap with antioxidant ingredients from 0.9% moringa leaf extract and natural foaming agents from 0.9% bidara leaf extract.

Table 1. Characteristics of soap with the best foam stability parameters and quality requirements of SNI 06-4085-1996

Karakteristik	Hasil Pengujian	SNI 06-4085-1996
Lemak total	29,52%	64-70%
Asam lemak bebas	2,49 %	< 2,5%
Lemak netral	1.99 %	< 2,5%
Bobot jenis	1,034 g/mL	1,01-1,10 g/mL
pH	10,48	8-11
Stabilitas busa	93,47 %	

Antioxidant Activity

Antioxidant activity test was conducted on the best antioxidant soap. The best antioxidant soap as per Table 1 is antioxidant soap with a formula of 0.9% moringa leaf extract and a foaming agent from 0.9% bidara leaf extract. The results of the antioxidant activity test showed an IC_{50} value of 59.06 ppm for the control soap without any additives, an IC_{50} of 54.73 for the moringa leaf extract control soap and an IC_{50} of 58.11 ppm for the bidara leaf extract control soap. The results of the analysis of the percentage value of the inhibition of the best formulation soap solution using the DPPH method obtained an IC_{50} value of 44.47 ppm. This value is a very strong category because the IC_{50} value is less than 50 ppm. An antioxidant with a very strong category if the IC_{50} is less than 50 ppm, strong if the IC50 is 100-50 ppm, moderate if the IC_{50} is 100-150, and weak if the IC50 is more than 150 ppm (Molyneux P, 2004). Ascorbic acid used as a comparison or positive control is an antioxidant that is stronger than the best characterization soap with a smaller IC_{50} value of 35.32 ppm.

Phenolic compounds are able to capture free radicals by providing hydrogen atoms to free radicals, thus producing stable free radicals. Phenolic content increases because the concentration of the extract increases to optimal conditions. Moringa plants contain many free radical inhibitor molecules such as phenolic compounds (phenolic acids, flavonoids, quinones, coumarins, lignans, stilbenes, tannins), nitrogen compounds (alkaloids, amines, and betalins), vitamins, terpenoids (including carotenoids), and several other endogenous metabolites that are rich in antioxidant activity (Suphachai, 2014). This explains that the ability to capture free radicals from the formulated soap is included in the very strong group because the IC_{50} value is less than 50 ppm.

Conclusion

Methanol extract of moringa leaves and ethyl acetate extract of bidara leaves and mangkokan leaves can be used as additives in making liquid soap from nyamplung seed oil. The best soap formula is soap with a concentration of 0.9% moringa leaf extract and 0.9% bidara leaf extract. The antioxidant activity of soap with the best formulation shows very strong antioxidant activity with an IC50 value of 44.73 ppm.

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