International Journal of Health Science (IJHS)

E-ISSN: 2827-9603
P-ISSN: 2827-959X

Research Article

Formulation of Liquid Soap Preparation of Sunflower Seed Oil and KOH with Sweet Orange Scent (Citrus sinensi (L.) Osbeck)

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Abstract: This research focuses on the formulation and evaluation of liquid soap using sunflower seed oil and potassium hydroxide (KOH) with a sweet orange aroma. The study aims to determine the optimal ratio of KOH to sunflower seed oil and evaluate the physical properties of the resulting liquid soap, such as organoleptic characteristics, pH, specific gravity, viscosity, foam height, and foam stability. The saponification process was conducted using the hot process method. Three different KOH concentrations (25%, 30%, and 35%) were tested. The results showed that all formulas met the Indonesian National Standard (SNI) for specific gravity, viscosity, and foam height. Formula II (30% KOH) was identified as the best formula due to its highest foam stability (90.67%) and acceptable pH (8), which falls within the recommended range (8–11). These findings indicate that sunflower oil-based liquid soap can be effectively formulated with desired physical properties and potential skincare benefits.

Keywords: Liquid soap, Potassium hydroxide, Saponification, Sunflower oil, Sweet orange.

1. Introduction

Indonesian society is currently faced with various types of pollution that disrupt human health, one of which is skin health. So skin health is an important thing and needs to be considered. Efforts made to maintain skin health are to routinely maintain skin cleanliness by bathing with soap. Exposure to high air pollution such as dust particles, heavy metals, and toxic gases can damage the skin's protective layer, causing inflammation, premature aging, and even disrupting epidermal function (Utami & Pratiwi, 2020). Soap functions as a cleaning agent that can remove dirt, excess oil, and microorganisms from the surface of the skin, and helps maintain the skin's moisture balance if formulated with natural ingredients (Herdiana et al., 2022).

Soap is one of the non-food products that is useful for personal cleaning and skin care. Soaps that are often used in everyday life are liquid soap and solid soap. Currently, most people prefer liquid soap because it is more comfortable to use, hygienic, and economical to use. In general, soap is made through a chemical reaction between sodium or potassium bases and fatty acids from vegetable oils or fats, this process is known as saponification (Saputra, et al., 2019) (Putra et al., 2024) .

Saponification is the process of hydrolysis of fat into fatty acids and glycerol in alkaline conditions. The alkaline condition makers commonly used are Sodium Hydroxide (NaOH) the reaction is in the form of hard soap (solid) and Potassium Hydroxide (KOH) the reaction product is in the form of liquid soap.

Sunflower seeds contain natural fatty oils which can nourish the skin and can be used as a natural emollient to keep the skin moist. The oil contains vitamins, unsaturated fats and is also low in cholesterol. The high vitamin content with antioxidants can be used as a free radical inhibitor and also softens the skin (Simanullang et al., 2021) (Ambarwati et al., 2025) .

Received: 10 May , 2025
Revised: 12 June, 2025
Accepted: 04 July, 2025
Published: 06 July, 2025
Curr. Ver.: 06 July, 2025

There are two methods used in the saponification reaction, namely the hot method (perfect boiling) and the cold method. The hot method (perfect boiling) involves heating a mixture of oil and alkali to produce soap and glycerol, and adding salt to separate the soap and glycerol. In the cold method, the liquid is mixed with a base solution and stirred continuously, and this method is carried out without heating. In this study, the hot method was used because it requires a relatively short time in the process compared to the cold method (Amelia, et al., 2023) (Putra et al., 2024)

This research was conducted to determine the process of making liquid soap from sunflower seed oil with a sweet orange aroma, determine the most appropriate ratio of KOH and sunflower seed oil for making soap, determine the shape, color, odor, pH, viscosity, and yield according to soap quality requirements..

2. Method

This liquid soap research was conducted in the Pharmacy Laboratory of the Faculty of Pharmacy, Pekalongan University. The manufacture of this liquid soap was carried out in 3 stages, namely making soap base, heating soap base, dissolving soap base. The materials used were sunflower seed coconut oil, distilled water, KOH with variations of 25%, 30%, 35% w/w and sweet orange juice of 2% each.

a. Making Liquid Soap

A total of 60 ml of sunflower seed oil was heated to a temperature of 50°C. Next, 30 ml of KOH with a concentration of 25%, 30% and 35% (according to the experimental design) was added. The mixture was stirred using a mixer until a thick soap mass was obtained. Water was added to the thick soap with a ratio of water: soap 2: 1. The stirring process was continued until liquid soap was obtained. Sweet orange juice was added to the liquid soap as much as 2% of the amount of oil. The liquid soap was then stored in a prepared container.

Table 1.

No	Material Name	Formulation		
		FI	FII	FIII
1	Sunflower oil	60 ml	60 ml	60 ml
2	KOH	25%	30%	35%
3	Aquadest	150 ml	156 ml	162 ml
4	Orange juice	2%	2%	2%

b. Observation Parameters

The liquid soap products produced were then analyzed for several parameters such as organoleptic values (shape, odor, color), specific gravity test, pH test, viscosity, foam height and foam stability.

The parameters observed include organoleptic by observing the visual appearance of the liquid soap preparation that has been done, the specific gravity test is carried out using a pycnometer to determine the density of the liquid soap. The pH measurement is carried out using a pH meter which is then compared with the requirements for the quality of liquid soap. Viscosity is measured using a viscometer. Foam height testing is carried out by shaking. 2 ml of liquid soap is put into a test tube, then shaken for 20 seconds and then left for 5 minutes, then the height of the foam formed is measured using a ruler. Foam stability test. The foam stability test is carried out to measure the ability of soap to produce and maintain foam for a certain period of time. The best formula is based on the best test results and meets SNI.

3. Results and Discussion

a. Making Liquid Soap

The main ingredients used in this study are sunflower seed oil and KOH as alkali. The process of making soap using the hot method.

Image 1: soap making process using heating method

In this process, sunflower seed oil and KOH are heated together first. When the KOH solution is added to the heated sunflower seed oil, two layers are formed in the mixture, namely the upper layer is cloudy yellow and the lower layer is clear yellow.

The formation of a cloudy layer indicates that the saponification reaction has begun. The saponification reaction is the triglyceride of an oil with alkali, the sester group in the triglyceride is hydrolyzed and forms a carboxylate salt and glycerol. Stirring is continued until the solution mixture thickens after which it is allowed to cool and distilled water is added with a ratio of distilled water and soap of 2:1. The saponification process in this study did not take too long because it used a concentration of KOH that was not low. The base concentration must be slightly higher than the oil so that the saponification is perfect. If the base used is too concentrated, it will cause the emulsion to break down in the solution so that the phase is not homogeneous, if the base used is too dilute, the reaction will take a long time.

The resulting soap is then tested for physical properties.

b. Soap Preparation Evaluation Results

The liquid soap that has been made is tested to compare the suitability of the quality of the liquid soap that has been made with SNI 06-4085-1996 concerning the quality requirements for liquid bath soap. The results of the test on the quality of the soap can be seen in Table

1) Organoleptic Test

Organoleptic testing is intended to see the acceptability of the product based on the physical appearance of the liquid soap. The assessment includes shape, color, and aroma, which are assessed using the five human senses because until now there has been no tool that can completely replace the sensitivity of the senses in detecting sensory properties (Widyaningsih et al., 2019). Soap is formed from a mixture of fatty acids (glycerides) found in vegetable oils, such as olive oil or sunflower seed oil, with a strong base such as KOH. The reaction that occurs is called a saponification reaction (Rinaldi et al., 2021). The characteristics of good soap organoleptically include having a homogeneous shape, stable color, and a pleasant aroma that matches the additional ingredients used (Yuliani & Handayani, 2020). In addition, organoleptic properties are also influenced by the composition of the formula, temperature during the manufacturing process, and mixing techniques, which can affect the visual and aroma stability of liquid soap (Amalia & Rakhmawati, 2022). The results of the organoleptic test of the liquid soap preparation can be seen in the following table:

Table 2. Organoleptic test results of liquid soap preparations

Formula	Organoleptic		
	Color	Form	Aroma
FI	Weak yellow	Semi solid	Weak Orange
FII	Weak yellow	Semi solid	Weak Orange
FIII	Weak yellow	Semi solid	Weak Orange

Information :
FI : KOH concentration 25%
FII : KOH concentration 30%
FIII : KOH concentration 35%

Organoleptic testing is done by utilizing human senses in identifying the sensory attributes of the preparation because there is no machine or tool that can replace the sensitivity of human senses. Organoleptic observation is done by observing the color, shape and aroma of the liquid soap preparation that has been made.

Image 2: organoleptic test

The results obtained in the image above that organoleptically the liquid soap preparations have a weak yellow color, semi-solid form and weak orange aroma. The dosage form of the preparation is related to viscosity.

2) Specific Gravity Test

Table 3. Specific Gravity Test

Formulation	Specific Gravity
FI	1.04
FII	1.04
FIII	1.05

Based on the results of the specific gravity examination carried out in table 2, all liquid soap formulas meet the Indonesian National Standard for liquid soap preparations, namely 1.01 - 1.10. In this specific gravity parameter, there is no significant difference in each formulation.

3) Ph Test

pH is a very important parameter in soap making, because the pH value determines the suitability of the soap for use (Bidilah et al., 2017) .

Image 3: pH test

Table 4. Ph test results

Formulation	pH test results
FI	7
FII	8
FIII	9

According to the Indonesian National Standard (SNI), the pH of liquid soap preparations that is allowed is between 8 and 11. This pH range ensures that the soap is alkaline enough to clean effectively, but not too alkaline that it can cause skin irritation (Rosmainar, 2021) . The results of tests that have been carried out on the three formulations of the preparation The pH value in the formula ranges from pH 7-9 and meets the SNI for liquid soap preparations. Determining the pH value aims to determine the level of acidity of the liquid soap. In general, liquid soap products have a pH that tends to be alkaline (Rinaldi et al., 2021) .

4) Viscosity Test

Viscosity testing is carried out to determine the thickness of the liquid soap preparation that has been made. Viscosity is the resistance of a liquid to flow (Wardani et al., 2024) . The viscosity of liquid soap is usually measured in centipoise (cP) or pascal second (Pa.s), and the standard viscosity of liquid soap according to SNI 06-4085-1996 is 400-4000 cPs. The unit dPa.s (decapascal second) is equivalent to 10 cP, so the viscosity range of liquid soap in dPa.s is 40-400 dPa.s

Table 5. Viscosity Test

Formulation	Viscosity (d.Pas)
FI	225
FII	212
FIII	196

Based on the results of the viscosity test that has been carried out, the three liquid soap preparation formulas have different results. Where the lowest viscosity is in formula III, this may be due to the influence of the amount of aquadest added to the soap preparation which is more than formula I and formula II.

5) Foam Height Test

Foam height testing aims to see the foam power of the preparation. Stable foam for a long time is more desirable because foam can help cleanse the body, but the use of too much foaming agent can also cause skin irritation.

Image 4: foam height test

According to SNI 06-4085-1966 for liquid bath soap, the foam height of liquid soap preparations ranges from 13-220 mm (Usman & Baharuddin, 2023) . The results of the foam height test that have been carried out on the three preparations have results that are in accordance with SNI.

Table 6. Foam height test result table

Formulation	Foam Height (mm)
FI	70
FII	68
FIII	58

6) Foam stability test

The stability of soap foam indicates the level of effectiveness of the soap's cleaning power, so that a decrease in foam power due to the addition of water indicates that the soap's cleaning power also decreases. This difference in foam power may be caused by the difference in stirring time. This is because in the saponification process, alkali plays a very important

role. The results of the foam stability test for 35-minute liquid soap were 40%, while for 40-minute liquid soap foam stability was 50%.

Tabel 7.

Formulation	Foam Stability
FI	70.03%
FII	90.67%
FIII	80.62%

Based on the data above, it can be seen that a good liquid soap formula is formula 2 with a KOH concentration of 25%. Because the formula II preparation has the highest foam height with good foam stability of 90.67%.

c. Determining the Best Formula

The best formula in making sunflower seed oil liquid soap preparations is determined based on the results of the tests that have been carried out, where in the specific gravity test, viscosity test, foam height test, the three formulations meet the requirements that have been set. In the pH test, Formula I does not meet the requirements because it has a pH value where the pH value for liquid soap preparations ranges from 8-11. In the foam stability test, formula II has the highest foam stability percentage compared to formulas I and III. So in this study it can be concluded that the best formulation is formula II because it meets all the test requirements that have been set and based on the foam stability test it has the best results.

4. Conclusions

The three formulas meet the specific gravity test, viscosity test, foam height test. In the pH test, formula I does not meet the requirements, based on the results of the pH test, it can be concluded that the higher the KOH concentration, the more alkaline the pH produced. Based on the foam stability test, Formula II has the highest results, so it can be concluded that the best formula for sunflower seed oil liquid soap is formula II. Can done study further moisture test on sunflower seed oil liquid soap prepara-tion.

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