

Turmeric Rhizome Extract Moisturizing Cream Formulation (*Turmeric Longa L.*) With Two Emulsifier Variations

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ARTICLE INFORMATION

Received: 5 June 2026
Revised : 7 July 2026
Accepted: 10 August 2026
DOI:

KEYWORDS

Emulsifier, Cream, Turmeric (Turmeric longa L.), Moisturizer, Physical stability

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A B S T R A C T

Background: the skin as the outermost organ of the body functions to protect and support aesthetics, so it requires treatment with a moisturizer that maintains moisture and protects against free radicals. **Sample: Turmeric rhizome** (*Curcuma Longa L.*) has the potential to be used because it contains active substances such as curcumin, flavonoids, and vitamin C that have the ability to protect the body from damage caused by free radicals. **Objective:** This study aims to make a cream from turmeric segment extract as a moisturizer with two types of emulsifiers, namely Tween 80 and Span 80, and evaluate its impact on the physical quality and stability of the product. **Methods:** This study was conducted by experimental method and used three types of formulas that had differences in the concentration level of the emulsifier. The physical evaluation includes organoleptic tests, homogeneity levels, pH values, dispersability, binding power, viscosity, stability when rotated in the centrifugation device, and hedonic tests. **Conclusion:** A good emulsifier variation for a moisturizing cream made from turmeric extract is found in the formula F2, which is with a combination of Span 80 and Tween 80 as much as 2.6%:8%. This combination results in a balanced, stable, high-value HLB (Hydrophilic-Lipophilic Balance) mixture, suitable for oil-in-water (O/W) emulsions. Based on the results of physical tests on the product, which include organoleptic aspects, homogeneity, pH, adhesion, dispersibility, viscosity, stability, and hedonics, all of these parameters have met or are in accordance with the recommended standards.

INTRODUCTION

The skin is the outer layer of the body that has a significant role as a protector while providing beauty value. Skin health can be measured from various factors such as color, moisture, elasticity, and texture (Minerva, 2019). However, the skin is easily affected by environmental elements such as pollution, temperature, and ultraviolet rays, so it requires good care. One method to maintain healthy skin is to use moisturizers that function to retain moisture and protect the skin's surface (Guan et al., 2021).

An effective moisturizer can not only restore moisture, but also provide additional protection from the negative effects of UV rays. The effect of ultraviolet rays can be reduced by using creams that contain antioxidants, so that the rays that reach the skin can be minimized (Adzhani et al., 2022). Exposure to UV rays, pollution, and environmental stress can increase the formation of free radicals that can lead to premature aging, skin spots, and collagen damage (Pertiwi et al., 2017). Therefore, adding antioxidants in moisturizers is very important (Suhendy et al., 2021).

One of the natural ingredients that can be a source of antioxidants is turmeric rhizomes (*Curcuma longa L.*). Turmeric has a variety of natural active substances such as curcumin, flavonoids, polyphenols, and vitamin C. These substances play a role in eliminating free radicals and preventing damage to cells (Khoironi, 2020). Research shows that turmeric extract has high antioxidant ability, as seen from the low IC₅₀ value. The classification of antioxidant activity is determined by the IC value₅₀, IC₅₀ values <50 ppm are categorized as very strong, 50–100 ppm is considered strong, 100–150 ppm is moderate, 150–200 ppm is weak, while >200 ppm is categorized as very weak (Mustiqawati & Supardi, 2022).

In addition to the active substance, the selection of emulsifier also affects the stability of the cream. Emulsifiers have the task of combining oil and water, resulting in stable emulsions, and also play a role in physical properties such as viscosity, homogeneity, and distribution ability (Ulfa et al., 2024). The instability of emulsions can lead to problems such as flocculation, creaming, as well as coalescence, therefore, cream formulations need to be carefully planned (Sharon et al., 2013). Using different

emulsifiers, such as Tween 80 and Span 80, can affect the physical and chemical qualities of the cream, such as pH level, viscosity, evenness when applied, and adhesion to the skin (Sopianti, 2023).

As the demand for beauty products from natural ingredients increases, the development of creams made from turmeric rhizome extracts with different types of emulsifiers is becoming an important subject of study. Natural ingredients are considered safer and provide benefits for skin health. However, there is still very little research on making moisturizing creams using turmeric with various emulsifier combinations. Therefore, this study aims to make a cream from turmeric extract with two different types of emulsifiers, as well as to examine the physical properties of the product. This research was conducted with the aim of designing a good variety of emulsifiers for turmeric rhizome extract cream preparations as well as physically testing the cream preparation.

METHOD

Research Time and Place

This research was conducted from June to August 2025 at the Baubau Polytechnic Laboratory and the Bina Husada Laboratory.

Tools and Materials

Various equipment was used in this study, including blenders, porcelain cups, rod mixers, beaker glasses, mortars, mixers, pH meters, analytical scales, *rotary evaporators*, object glass, viscometers, *centrifuges*, watch glass, and *waterbaths*.

The ingredients used include aquadest, turmeric rhizome extract, 96% ethanol, methyl paraben, propylene glycol, propyl paraben, Tween 80, Span 80, and cetyl alcohol.

Research Procedure

Creation of Simplicia

This study uses a sample, namely turmeric rhizomes obtained from one of the traditional markets in the city of Baubau. The manufacture of simplicia from turmeric rhizomes starts from fresh ingredients that are then selected to separate the rhizomes that are still good from those that have been damaged. The selected rhizomes are washed using clean water until they are clean from dirt, then thinly sliced or cut into small pieces to speed up the drying process. After that, the turmeric rhizomes are dried in the sun for three days until they become dry, usable simplicia. (Handayani et al., 2023).

Making Turmeric Rhizome Extract (*Curcuma longa* L.Düssel

Turmeric rhizome simplicia is crushed into a powder, then mixed with a 96% ethanol solvent at a ratio of 600 g of powder to 3 L of solvent. This mixture is stirred and whisked for 2 to 3 hours, then left for two days for the maceration process. The results of the maceration process are filtered using filter paper so that the filtrate separates from the pulp. The filtration results are then heated with a *rotary evaporator* at a temperature of 40°C to 50°C for six hours until a concentrated extract from turmeric root is formed (Cobra et al., 2019).

Formulation of Cream Preparation

The formulation process of the cream preparation is carried out in three formulation versions, F1, F2, and F3, formulated (Table 1.) This stage begins by measuring all the ingredients according to the predetermined recipe. The oil phase is mixed by mixing Span 80 and half alcohol at a temperature of 70 degrees Celsius using a water bath until all ingredients are evenly mixed, resulting in Mixture I. Next, the water phase is prepared by dissolving Tween 80, glycerin, and distilled water until it reaches a total of 100 grams, then methyl parabens are added. This mixture is also heated at a temperature of 70°C until it becomes homogeneous, resulting in Mixture II.

Mixture I is then gradually added to the still hot Mixture II, while continuing to stir until it forms an even cream mass. After that, 5 g of a thick extract of turmeric rhizomes is added to each formula and stirred again until perfectly mixed. The cream that has been formed is then placed in a cream pot container, before a quality and stability assessment is carried out according to the existing instructions (Unique, 2018).

Table 1. Turmeric rhizome cream formula (Unique, 2018)

Material	F1	F2	F3	Uses
Turmeric rhizome extract	5%	5%	5%	Active substances
Glycerine	5%	5%	5%	Hufixan
Span 80	1,26%	2,6%	8%	Emulsifier
Tween 80	4,03%	8%	2,6%	Emulsifier

Acetyl alcohol	4%	4%	4%	Thickener
Methyl Paraben	0,20%	0,20%	0,20%	Preservatives
Aquadest ad	100%	100%	100%	Solvent

Physical Preparation Evaluation

Organoleptic test

Organoleptic testing is a way of evaluating an item by paying attention to its physical properties, such as size, color, and aroma (Tungadi et al., 2023).

Homogeneity test

Homogeneity testing is carried out by placing a sample on top of an object slide, then layering it with another object slide to flatten the sample. After that, it is checked if there are any particles that have not been mixed properly. When the preparation is applied to glass or clear material, no coarse grains are visible, the preparation can be considered homogeneous (Rakmadhani et al., 2023).

Skin pH Test

The skin pH test was carried out using litmus paper. The trick is to take 1 gram of cream, then mix it with 1 milliliter of distilled water. After that, litmus paper is put into the mixture until the pH of the skin can be read. Tests were carried out three times for each type of product, both when the new product was made and after being stored for three weeks (Nealma & Nurkholis, 2020). The skin pH standard for a good cream should be according to the pH of the skin, which is between 4.5 to 6.5 (Yuniarsih & Meilinda Sari, 2021).

Adhesive Strength Test

This test uses a tool to measure the adhesion of the cream. The initial step is to prepare two glass objects, a stopwatch, and a gram scale. First, the cream is applied to a sufficient amount on one of the glass objects. Next, another glass object is placed on top of the cream and pressed for five minutes with a load of 0.5 kg. After that, an additional load of 20 grams is given and it is recorded how long it takes until the two objects separate. The criterion of good adhesion is that the adhesion time is not less than 4 seconds (Cahyani *et al.*, 2017).

Dispersion Test

The cream spread test was carried out by placing 0.5 grams of cream on a petri dish that had been given graph paper. After that, the petri dish is left for 1 minute weighing 50 grams, 100 grams, and 200 grams. After that time, the average diameter of the cream spread was measured from various angles (Purwaningsih et al., 2020). Based on SNI No. 06-2588, a quality cream must have a spreadability of between 5-7 cm.

Viscosity testing

The viscosity test of the cream is measured using a viscometer device. The cream is placed in a container first. Then, the rotor on the tool is operated at a speed of 30 rpm using rotor type 4. The results of viscosity measurements are recorded in centipoise units (cps) as stated by Dina et al., (2017). According to the cream quality standard in SNI 16-4399-1996, the viscosity of creams that are considered good is in the range of 2000 to 50,000 cps.

Stability test

Centrifugation is used to test stability. 10 grams of cream are put into a centrifugal tube and then rotated for five hours by a centrifugation machine at room temperature and speed of 3800 rpm. The results showed that the emulsion mixture did not undergo separation between phases after the centrifugation process was completed. The speed of 3800 rpm indicates that this product remains stable for up to a year at room temperature. The cream is considered stable if there is no phase separation after being tested by centrifugation (Hamsinah et al., 2016).

Hedonic test

Hedonic sensory testing is the method described by Setyaningsih et al., (2010). The goal is to measure how much the panelists like the product, based on sensory traits such as texture, color, aroma, and personal preferences. The results of the assessment are given in the form of numbers, starting with 1 (very dislike), 2 (dislike), 3 (neutral), 4 (like), and 5 (very like).

RESULTS & DISCUSSION

A physical assessment of the cream is carried out to check if its physical properties are suitable, which includes sensory testing, ensuring even texture, measuring acid-base levels, testing its ability to

even out on the skin, and testing its stickiness. The following are the results of the physical assessment of the cream.

Sensory tests are performed to see the physical appearance of moisturizing cream products containing turmeric rhizome extract, including aspects of color, smell, and consistency. Table 1 below shows the results of this sensory test.

Table 1. Organoleptic Tests

Parameters	F1	F2	F3
Color	Yellow Color	Yellow Color	Yellow Color
Aroma	The characteristic smell of turmeric aroma	The characteristic smell of turmeric aroma	The characteristic smell of turmeric aroma
Texture	Soft, smooth with no coarse particles, and easy to apply	Soft, smooth with no coarse particles, and easy to apply	Soft, smooth with no coarse particles, and easy to apply

Source : Primary Data, 2025

The homogeneity of the formulation with turmeric rhizome extract ingredients is presented in Table 2 below.

Table 2. Homogeneity Test

Formula	Homogeneity	Result
F1	Homogeneous	Qualify
F2	Homogeneous	Qualify
F3	Homogeneous	Qualify

Source : Primary Data, 2025

The results of pH testing on the skin of formulations using turmeric rhizome extract are presented in Table 3 below.

Table 3. pH Test

Formula	Skin pH	Result
F1	6,92	Not eligible
F2	5,66	Qualify
F3	5,35	Qualify

Source : Primary Data, 2025

The results of the formulation dispersion test on turmeric rhizome extract are presented in Table 4 below.

Table 4. Dispersion Test

Formula	Dispersion (cm)	Result
F1	7 cm	Qualify
F2	5.6 cm	Qualify
F3	6.4 cm	Qualify

Source : Primary Data, 2025

The results of the formulation adhesion test on turmeric rimban extract are shown in Table 5 below.

Table 5. Adhesive Strength Test

Formula	Adhesive Strength (sec)	Result
F1	2,15	Qualify
F2	2	Qualify
F3	3,2	Qualify

Source : Primary Data, 2025

The viscosity test results of the formulation using turmeric rhizome extract with a viscosity rotation speed of 30 rpm are shown in Table 6 below.

Table 6. Viscosity Test

Formula	Viscosity (Cp)	Result
F1	2674	Qualify
F2	2939	Qualify
F3	3730	Qualify

Source : Primary Data, 2025

Testing the stability of the cream from turmeric rhizome extract was carried out using a mechanical method that utilizes a centrifugator in the Baubau polytechnic laboratory. The results of the preparation stability test can be obtained in Table 7 below.

Table 7. Stability Test

Formula	Result
F1	Phase separation occurs
F2	No phase separation occurs
F3	Phase separation occurs

Source : Primary Data, 2025

The results of the formulation Hedonic test on turmeric rhyme extract are shown in Table 8 below.

Table 8. Hedonic Test

Sample	Hedonic Test Indicator Scores			
	Texture	Color	Aroma	Favorite
F1	36	35	37	40
F2	38	35	37	41
F3	38	34	36	41

Source : Primary Data, 2025

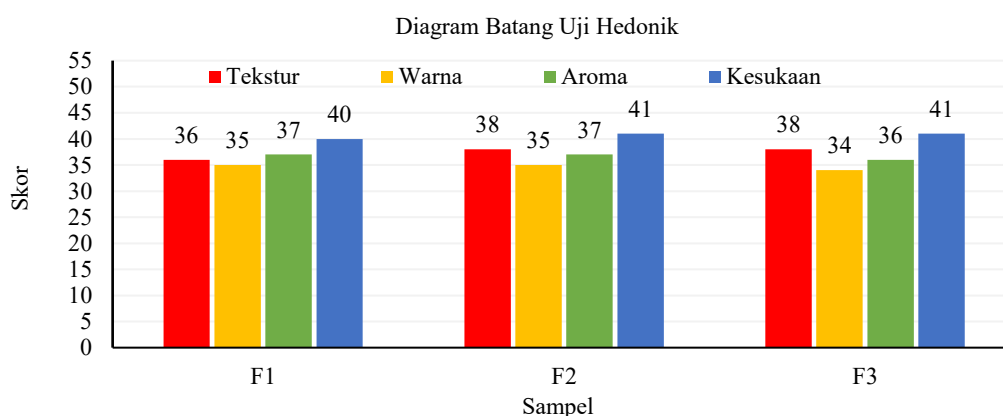


Figure 1. Hedonic test results diagram

Description: F1= Formula 1, F2= Formula 2, F3= Formula 3

Based on the results of organoleptic tests (Table 1), the three cream formulas (F1, F2, and F3) show similar characteristics, namely having a yellow color, a typical turmeric aroma, and a soft, smooth, and easy-to-apply texture. This yellow color is a characteristic of the curcumin content in turmeric which is known to have antioxidant and anti-inflammatory activities. The absence of coarse particles indicates that the active ingredients and the base ingredients of the cream have been evenly mixed, resulting in a preparation with a good appearance and a comfortable to use. This test was carried out by observing it directly, namely by paying attention to the color, aroma, and texture of the cream made from turmeric ethanol extract, a study from (Utari, 2019).

Homogeneity test (Table 2) All three formulas show uniform results. Homogeneity is essential because it signifies that the active ingredients are evenly distributed throughout the entire part of the cream, thus providing a consistent moisturizing effect each time it is used. The cream must have the same texture so that it does not irritate the skin and can be used evenly (Arisanty & Anita, 2018). Uniformity is also an early sign that the way the cream is made has been done with good mixing. Based on the results of the homogeneity evaluation in Table 2, the three formulas showed no difference, and there were no coarse grains after observation, which indicates that the homogeneity is quite good because the cream is free of particles. Creams that have an even texture should have fairly balanced ingredients and no coarse-shaped parts visible (Ida & Noer, 2012).

The pH value of the cream is very important to maintain the safety and comfort of the skin. A good cream pH level must be in accordance with the skin's natural pH, which ranges from 4.5 to 6.5 (SNI-16-4399-1996) (Sugiharto & Safitri, 2020). The pH test of the cream (Table 3) showed variations between the three formulas. F1 formula has a pH of 6.92, this value exceeds the normal skin pH standard (4.5–6.5) so it is declared ineligible. Dry and irritated skin, especially on sensitive skin, can be caused by too high a pH. In contrast, the formulas F2 (pH 5.66) and F3 (pH 5.35) fall within the appropriate pH range, making them safer to use and more compatible with the physiological conditions of the skin.

The pH difference between these formulas is closely related to the comparison of the concentrations of Tween 80 (hydrophilic) and Span 80 (lipophilic) used as emulsifiers.

The results of the dispersion test (Table 4) show that all three formulas have results in the standard range (5–7 cm). The F1 formula has the largest dispersion (7 cm), followed by F3 (6.4 cm), and F2 (5.6 cm). Optimal spreadability means that the cream can be applied easily and spread evenly over the skin, providing a good sense of comfort and benefits. The high figure in F1 may be due to the combination of emulsifiers and moisturizing ingredients that make the texture of the cream lighter. The formula is made safe to use because it meets the dispersability standard as a topical product, ranging from 5 to 7 cm (Arisanty & Anita, 2018).

An adhesion test is carried out to find out how well the cream can adhere to the skin. The results of the test (Table 5) show that the F1 formula has an adhesion of 2.15 seconds, the F2 formula for 2 seconds, and the F3 formula for 3.2 seconds. All three formulas are in the 1–10 second range, which is considered the ideal standard for topical products. These figures indicate that all formulas have good enough adhesion to support the absorption of the active ingredient, while remaining comfortable and easy to remove. The F3 formula exhibits the highest adhesion, which may be due to differences in texture or higher emulsifier content compared to other formulas. Therefore, all formulas are considered to meet the criteria as an effective face cream product. A good adhesion criterion is to have a minimum adhesion time of 4 seconds (Cahyani et al., 2017).

Based on the viscosity measurements at a speed of 30 rpm (Table 6), it shows that the formula F1 has a viscosity of 2674 cP, F2 shows 2939 cP, and F3 reaches 3730 cP. All of these viscosity values are within the proper limits for the quality of the cream preparation, where the viscosity is sufficient to maintain physical stability, and remains easy to pick up and apply to the skin. Variations in viscosity between each formula may be influenced by the combination of ingredients in the cream base, such as the number of emulsifiers and the type of fatty acids used. Despite this, all three formulas show good consistency, thus supporting the convenience of use and effectiveness of the preparation. The desired viscosity for creams should exceed 2000 cps and conform to SNI 16-4399-1996 on cream product quality standards, with viscosity expected to be in the range of 2000-50.000 cps. From the results of viscosity measurements, it can be concluded that all the formulas of the cream developed meet the criteria of physical properties (Thomas et al., 2024).

To perform stability tests, the centrifugation method is used. Centrifugation is carried out for five hours at room temperature and a speed of 3800 rpm after 10 grams of cream are inserted into the centrifugation tube. After centrifugation, there will be no signs of phase separation if the emulsion is still stable. With a speed of 3800 rpm, this product can last for one year at room temperature. If there is no phase separation after the centrifugation process, the cream is considered stable (Anindhita & Arsanto, 2020). The results of the stability test by centrifugation method (Table 7) show a striking difference between the formulas. The F1 and F3 formulas undergo phase separation, indicating that the two formulas are less stable to mechanical forces. In contrast, the F2 formula does not exhibit phase separation, which means it is more stable and has the ability to retain the shape of the emulsion well. The stability of the preparation is strongly influenced by the balance of the emulsifier, since the ratio of Tween 80 and Span 80 determines the ideal HLB value to form a stable oil emulsion in water.

Hedonic test is a method to measure the extent to which a product is accepted by the panelists. This assessment is based on scent, the taste when it touches the skin, the texture and the color. The assessment process was carried out using a scale of 1 to 5, with the categories of very dislike (1) to very like (5) (Cahnia et al., 2022). The hedonic test (Table 8 and Figure 1) showed that the formulas F2 and F3 obtained the highest preference score (41 points), while F1 only achieved a score of 40. In terms of texture, F2 and F3 are both superior with a score of 38, while F1 is lower (36). In terms of color, F2 scored 35, higher than F3 (34). In terms of scent, F2 and F1 are balanced (37), while F3 is lower (36). Overall, the F2 formula is superior to F3 because it has a balance of texture, aroma, and color, in addition to a high level of likability.

Based on the overall test results, it can be concluded that the F2 formula is the best formula. This formula has a pH according to the standard, dispersability and adhesion in the ideal range, good enough viscosity, maintained physical stability, and the highest level of preference of the panelists. This shows that the combination of Tween 80 (8%) and Span 80 (2.6%) is capable of producing a stable oil-in-water (O/W) emulsion that is well received by the panelists. Meanwhile, the F1 formula is less than ideal because the pH is too high and unstable, while the F3 formula although it has good viscosity and adhesion, it is unstable and its color value is lower in the hedonic test.

COVER

Based on the results of the study, it can be concluded that the most effective emulsifier variation for making moisturizing creams from turmeric rhizome extract is found in the F2 formula, namely a mixture of Span 80 as much as 2.6% and Tween 80 as much as 8%. The combination produces a balanced and high enough HLB (Hydrophilic-Lipophilic Balance) value, so that it can form a stable oil emulsion in water (O/W). This stability shows that the F2 formula is better compared to other formulas in maintaining the physical quality of the cream product. In addition, the results of physical tests, including organoleptic tests, homogeneity, pH, adhesion, dispersability, viscosity, stability, and hedonic tests, showed that all parameters met the standards.

THANKS

The author would like to express his sincere gratitude to his beloved parents. Thank you from the author also to Mrs. Evi Mustiqawati, S. Si, M. Biomed, Mrs. Apt. Yuyun as my supervisor and Mrs. Hasty Hamzah, S. Si., M. Si. He has provided invaluable guidance, support and encouragement during the process of writing this scientific paper. Writer

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