Variation of TEA and Stearic Acid Concentration in Robusta Coffee Bean Powder (Coffea Canephora L) Body Scrub Formulation and Irritation Test

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Abstract. The skin is the body's largest organ and is vulnerable to premature aging caused by environmental factors and stress. Using a body scrub made from natural ingredients, such as robusta coffee beans, can help remove dead skin cells. Robusta coffee contains antioxidants like chlorogenic acid and flavonoids, which benefit skin health. This study aimed to develop a robusta coffee powder body scrub cream with different levels of TEA and stearic acid and to test for skin irritation to ensure safety. The goal was to create a stable and safe exfoliating cosmetic. This research involved a quantitative experimental approach to formulate a robusta coffee bean powder body scrub with various concentrations of TEA and stearic acid, and to evaluate its physical properties and potential for irritation. Three formulations were prepared with TEA levels of 2%, 3%, and 4%, and stearic acid levels of 10%, 15%, and 20%. The evaluations included organoleptic tests, homogeneity, pH, spreadability, adhesion, viscosity, cream type, and irritation tests with 12 panelists. Homogeneity tests showed that all three formulations were uniform, and organoleptic assessments indicated similar results across the samples. All formulations were oil-in-water (O/W) types, with appropriate pH values (6.78-7.28), stable viscosity (20214.2-20218.5 cPs), and satisfactory spreadability (5.2-5.5 cm). Although variations in TEA and stearic acid influenced adhesion, none of the formulations caused skin irritation among the panelists. In conclusion, this robusta coffee bean powder body scrub is stable, possesses good physical qualities, and is safe for use.

Key words: [stearic acid, body scrub, robusta coffee beans, TEA, irritation test]

INTRODUCTION

The skin is the outermost layer of the human body, elastic and soft. It is the largest organ and serves multiple functions: protecting the body from harmful chemicals, sunlight, and microorganisms, as well as maintaining the body's balance with its environment (Syaifuddin, 2020). Sweat glands are found on the skin's surface, and they also function as a sensory organ, specifically for the sense of touch, as they contain numerous sensory nerve fibers (Adhisa, 2020).

Skin aging is a natural process that occurs due to the slowing of skin cell renewal and collagen production, which leads to a decrease in the strength of the internal support structure and the skin's natural protective layer (Ramadhania et al., 2018). The process of skin deterioration is characterized by wrinkles, peeling, dryness, and cracking. In addition to a dull appearance, skin also ages more rapidly. Skin health problems can be addressed through exfoliation, which involves removing dirt, oil, or dead skin by massaging the entire body. The results are immediately visible: the skin becomes smoother, firmer, fragrant, and has a healthy radiance (Luthfitashalsabilla et al., 2023). Traditional exfoliation uses cosmetic preparations made from fresh natural ingredients or dried ingredients from plants and fruits, including coffee beans.

Coffee is generally consumed only as a beverage, so innovation is needed to compete with products from other regions. One way to increase the added value of coffee products is to process them into a body scrub. Coffee contains various beneficial substances for the skin, including high levels of antioxidants such as flavonoids and polyphenols. Compounds like dicaffeoylquinic acid and chlorogenic acid in coffee beans act as free radical scavengers. Coffee is widely used for benefits such as removing dead skin cells, reducing cellulite, brightening dull skin, and minimizing the risk of skin cancer. One way to utilize coffee grounds in the beauty industry is to make a body scrub (Octariani et al., 2021). Meanwhile, a coffee body scrub can help smooth the skin and remove dead skin cells (Fitriani Puspitasari et al., 2020). Robusta coffee is a variety known for its strong flavor, higher caffeine content, low acidity, and high bitterness (Wibowo & Handayani, 2022).

A body scrub is a skincare treatment performed while the body is wet, using various mixtures such as herbal scrubs. The purpose of using a body scrub is to remove dead skin cells, cleanse dirt, and open pores so the skin can breathe more freely and appear brighter and whiter. Body scrubs come in several forms, including powder scrubs, cream scrubs, and shaken or liquid scrubs. In this study, a body scrub

cream was developed. Body scrub cream is a skincare product containing abrasive ingredients, often called abrasive cosmetics (Kristiani et al., 2022). This study created a body scrub using a mixture of natural ingredients, specifically coffee beans.

In the cream-making process, adding an emulsifier is important because this ingredient affects the quality and stability of the final product (Opod et al., 2024). One commonly used emulsifier in cream production is Triethanolamine (TEA). TEA can form a stable emulsion when combined with free fatty acids such as stearic acid. Stearic acid functions both as an emulsifier and as a key ingredient in cream production (Saryanti, Nugraheni, et al., 2019). Research conducted by (Opod et al., 2024) titled "The Effect of Variations in Triethanolamine and Stearic Acid on the Physical Stability of Soursop Leaf Ethanol Extract Cream (Annona muricata L.)" found that the use of TEA and stearic acid as emulsifiers produces a cream that meets physical quality stability standards and does not cause skin irritation. Based on this background, a study was conducted on the variation of TEA and stearic acid concentrations in a Robusta coffee bean powder body scrub formulation.

RESEARCH METHODS

This study is a quantitative experimental investigation aimed at developing a robusta coffee bean powder body scrub with different concentrations of TEA and stearic acid. Its physical properties and potential irritation are also being tested. Three formulas were prepared with varied TEA levels (2%, 3%, and 4%) and stearic acid levels (10%, 15%, and 20%). Evaluation involved organoleptic tests, homogeneity, pH, spreadability, adhesion, viscosity, cream type, and irritation tests on 12 panelists.

MATERIALS AND TOOLS

Materials

The materials used in this study include robusta coffee bean powder, stearic acid, propylene glycol, methyl paraben, propyl paraben, distilled water, 2N HCl, Dragendorff reagent, concentrated HCl, magnesium powder, hot distilled water, 1% FeCl3, and methylene blue.

Tools

The tools used in this study include analytical scales, Erlenmeyer, measuring cup, stirring rod, porcelain cup, beaker, glass funnel, dropper pipette, test tube, test tube rack, water bath, filter paper, horn spoon, mortar and stamper, glass plate, pH meter, round glass, 200-gram load, glass object, 1 kg load, and Brookfield viscometer.

Robusta Coffee Bean Powder Body Scrub Preparation Formulation

Table 1. Body scrub formulation

Material	Concentration (%)			Function
	Formula I	Formula II	Formula III	
Serbuk biji kopi robusta	20	20	20	active substance
TEA	2	3	4	emulgator
Asam stearat	10	15	20	emulgator
Propilen glikol	15	15	15	humectant
Metil paraben	0,12	0,12	0,12	preservative
Profil paraben	0,5	0,5	0,5	preservative
Aquadest	ad 100	ad 100	ad 100	solven

Information :

F1: Body scrub formulation with 2% TEA and 10% Stearic Acid
F2: Body scrub formulation with 3% TEA and 15% Stearic Acid
F3: Body scrub formulation with 4% TEA and 20% Stearic Acid

Formulation body scrub

Making a robusta coffee powder body scrub, the ingredients are weighed according to the calculation. Melt the oil phase (stearic acid and propylene glycol in an evaporator cup over a water bath at 70°C until melted. Remove, then dissolve propyl paraben. Melt the water phase (TEA) in an evaporator cup over a water bath at 70°C until melted, and dissolve methyl paraben with hot distilled water. Then remove the melted oil phase, put it into a hot mortar, grind it hard and fast until a creamy scrub is formed, add the

water phase, then add the robusta coffee powder, stir until homogeneous, add the remaining distilled water, stir, then put the body scrub preparation into a container (Aziza & Dewi, 2023).

Characteristic Evaluation

1) Organoleptic
   This is done by observing the shape, color, smell, and taste when the cream is applied to the skin (Mudhana & Pujiastuti, 2021).
2) Homogeneity
   0.1 g of cream is applied to a glass slide and covered with a coverslip. The preparation is considered homogeneous if the texture appears even, does not clump, and does not feel rough to the touch (Mudhana & Pujiastuti, 2021).
3) pH
   pH measurements are performed using a digital pH meter by dipping the electrode into the cream preparation. The pH value corresponding to skin pH ranges from 4.5 to 8 (Budianor *et al*., 2022).
4) Spreadability
   A 0.5 g sample of cream is placed in the center of a slide, then covered with another slide and given a 200 g weight. After 1 minute, the spread diameter is measured. The ideal spread is between 5–7 cm (Tari & Indriani, 2023).
5) adhesion test
   A 0.1 g of cream was applied to a glass slide, covered with another glass slide, and a 50 g load was applied for 5 minutes. The slide was then clamped onto the adhesive tester, and the separation time between the slides was recorded (Kristiani *et al*., 2022).
6) Viscosity
   The test was carried out using a Brookfield viscometer with spindle number 4. A total of 100 mL of cream was put into a beaker, and measurements were taken after the tool was run until the viscosity results appeared (Hajrin *et al*., 2024).
7) Cream type
   A small amount of methylene blue is added to the cream and stirred on a glass slide. If the color is even → type O/A; if blue granules form → type A/M (Nurfita *et al*., 2021).

Irritation Test

The test was conducted on 12 panelists with normal skin. The cream was applied to the inner forearm twice a day (morning and night) for two consecutive days (2 × 24 hours). After 30 minutes, the reactions that appeared were observed and recorded: No reaction → (−), Redness → (+) if a redness reaction or itching accompanied by swelling occurred, a mark (++) was given on the irritation test form that had been given to the panelists (Melinda, 2023).

RESULTS AND DISCUSSION

a. Characteristic evaluation

The sample used in this research was a Coffee bean powder body scrub formulation.
Results based on data in Table 2.

Table 2. Test results of the physical characteristics of the coffee bean body scrub

Test	F1	F2	F3
Organoleptic	Brown, coffee odor, and semi-solid	Brown, coffee odor, and semi-solid	Brown, coffee odor, and semi-solid
Himogeinity	homogeneous	homogeneous	homogeneous
pH	6,78 ± 0,12	7,22 ± 0,08	7,28 ± 0,18
Spreadability (cm)	5,5 ± 0,1	5,3 ± 0,1	5,2 ± 0,1
Adhesion test (second)	5,81± 0,10	6,65 ± 0,20	6,94 ± 0,09
Viscosity (cps)	20214,2 ± 1,78	20216,9 ± 1,77	20218,5 ± 1,20
Cream Type	M/A	M/A	M/A

Source: Processed primary data (2025)

The organoleptic test aims to determine the physical appearance of the preparation, including color, odor, and shape. Organoleptic testing is conducted using the sense of touch and

visual inspection. The results of the organoleptic test on the Robusta coffee bean powder (Coffea canephora L.) Organoleptic observations showed that F1, F2, and F3 were blackish-brown in color, had a distinctive coffee odor, and were creamy. This is consistent with research by Putu Elsabella (2023), which showed that the coffee grounds cream scrub was brownish, had a distinctive coffee odor, and was creamy.

A homogeneity test was conducted to determine whether the ingredients were evenly mixed during the manufacturing process and to determine the evenness of the body scrub's texture when applied to the skin. The results of the F1, F2, and F3 homogeneity tests showed a homogeneous preparation with coarse grains when applied to transparent glass. This is consistent with Purwandari et al. (2018), who stated that coffee body scrub exhibits evenly distributed and homogeneous particles when applied.

The pH test aims to determine the pH of the preparation that matches the skin's pH so that it does not irritate the skin during use (Ainaro et al., 2015). A good topical preparation, according to the National Standardization Agency (1996), is a preparation that has the same pH as the skin's pH, with a topical preparation range of 4.5-8. According to Opod et al. (2024). The results of the F1-F3 pH test increase as the concentration of TEA and stearic acid increases. This is in line with research by Opod et al. (2024), which shows that if the use of TEA increases, it can cause the pH value of the body scrub preparation to increase, whereas if the use of stearic acid increases, the pH value of the body scrub preparation becomes smaller. When TEA is mixed with fatty acids such as stearic acid, it will form an anionic soap with a pH of 8, and stearic acid is neutralized by the presence of triethanolamine, a base, thus affecting the pH of the formulation. The addition of TEA and stearic acid concentrations affected the pH of the body scrub formulation. Based on the one-way ANOVA test data, the results showed a significant value of >0.05. This indicates that the pH value between formulas is not affected by the concentration of TEA and stearic acid. This is in line with April et al. (2023), who stated that this occurs because the difference in TEA and stearic acid concentrations is not too large.

Spreadability is the ability of a preparation to spread when applied to the skin. The greater the spreadability, the more widely the active ingredient will be distributed (Bobiatta et al., 2023). The results of the spreadability test showed results that met the requirements because they showed that the spreadability of the robusta coffee body scrub produced met the quality standards for the spreadability of robusta coffee body scrub, which was around 5-7 cm. Each formula experienced an increase in robusta coffee body scrub. In line with research by Opod et al. (2024), which stated that the addition of stearic acid in cream formulations can increase the viscosity of the preparation. This is because stearic acid, which belongs to the saturated fatty acid group, has the ability to increase viscosity so that the cream becomes denser and stiffer. According to research by Mudhana & Pujiastuti (2021), the spreadability value is inversely proportional to viscosity, namely, the thicker the preparation, the lower the spreadability of the body scrub. The resulting cream becomes thicker if the total stearic acid used is greater, and the use of TEA can also determine the level of viscosity of the body scrub. This indicates that the spreadability between formulas is influenced by the concentration of TEA and stearic acid. The results of the one-way ANOVA test showed insignificant results because the p-value was > 0.05, which means that the three formulas with varying concentrations of TEA and stearic acid in the body scrub preparation did not show any differences, so it can be concluded that variations in the concentration of TEA and stearic acid did not affect the spreadability value in all formulas.

The adhesion test aims to determine the ability of body scrub cream to adhere to the skin. Good adhesion requirements for topical preparations are more than 4 seconds (Tranggono and Latifah, 2007). The results of the Robusta coffee body scrub adhesion test showed a long adhesion time. This test assesses the length of time the cream adheres to the skin, which affects the effectiveness of active ingredient absorption. According to Mudhana & Pujiastuti (2021), creams with high adhesion provide a longer effect. Increasing the concentration of TEA and stearic acid increases viscosity, which is proportional to the cream's adhesion. The adhesion of the preparation is directly proportional to viscosity; the higher the cream's viscosity, the higher the adhesion. The One-Way ANOVA test data obtained a sig p-value < 0.05, indicating there are differences between the body scrub preparation formulas influenced by variations in TEA and stearic acid concentrations. This is in line with research by Opod et al. (2024), which states

that variations in the concentration of TEA and stearic acid affect the adhesive power of cream formulations.

The viscosity test aims to determine the thickness of the body scrub preparation. According to the National Standardization Agency (1996), the ideal viscosity value for topical preparations is in the range of 2,000-50,000 cPs. The results of the viscosity test for the robusta coffee body scrub preparation meet the requirements. This is influenced by the addition of TEA and stearic acid concentrations, where the higher the concentration, the more the viscosity value increases. This is in line with research by Mudhana & Pujiastuti (2021), who stated that the higher the concentration of TEA and stearic acid, the higher the viscosity of the resulting cream. TEA and stearic acid function as emulsifiers that can unite the oil and water phases by reducing the surface tension between the two phases. According to SNI 16-4399-1996 concerning the quality standards of body scrub preparations, the viscosity of a good preparation ranges between 2000 and 50000 cPs (Astuti et al., 2018). The results of the one-way ANOVA test showed insignificant results because the p-value was >0.05, which means that the three formulas with variations in TEA and stearic acid concentrations in the body scrub preparation did not show any differences, so it can be concluded that variations in TEA and stearic acid concentrations did not affect the viscosity value in all formulas.

The purpose of the cream-type test is to determine the type of cream in the preparation. The method used in the cream-type test is staining with methylene blue. The cream-type test with methylene blue showed that all three formulas were evenly dispersed in the dye solution, indicating an oil-in-water (O/W) cream type. This is because hydrophilic methylene blue dissolves in the aqueous phase (Daniar et al., 2022). This test is consistent with previous research on cream preparations with variations in stearic acid and triethanolamine emulsifiers, forming an O/W cream type that is distributed in methylene blue (Genatrika et al., 2016).

b. Irritation Test

Irritation tests were conducted on the skin of volunteers or panelists, who applied the product to the inner lower arm and left it on for 30 minutes, morning and night, for two consecutive days. The results are shown in Tables 3 and 4 below.

Table 3. Irritation Test Results on the First Day of Using Body Scrub Cream

Criteria	Panelist											
	1	2	3	4	5	6	7	8	9	10	11	12
Reddish	-	-	-	-	-	-	-	-	-	-	-	-
Itchy	-	-	-	-	-	-	-	-	-	-	-	-
Oedema	-	-	-	-	-	-	-	-	-	-	-	-

Table 4. Irritation Test Results on the Second Day of Using the Body Scrub Cream

Criteria	Panelist											
	1	2	3	4	5	6	7	8	9	10	11	12
Reddish	-	-	-	-	-	-	-	-	-	-	-	-
Itchy	-	-	-	-	-	-	-	-	-	-	-	-
Oedema	-	-	-	-	-	-	-	-	-	-	-	-

Information : +: reaction occurs
- : no reaction

Based on the data presented in Tables 3 and 4, obtained from testing on 12 panelists, it can be concluded that the body scrub cream formulated with robusta coffee beans demonstrates a good level of safety for use on the skin. This is evidenced by the test results, which showed negative reactions in all panelists, meaning no symptoms or signs of allergic reactions occurred during or after product use. All panelists tested did not experience skin irritation, such as redness, itching, swelling, or other allergic reactions on the inner arm where the product was applied. Therefore, it can be concluded that the formulated robusta coffee bean powder body scrub cream meets the safety criteria for topical use and is suitable for use. This is in line with research by Melinda (2023), which

stated that a body scrub cream formulated with a combination of black glutinous rice flour and cinnamon extract was safe for use because it produced negative results and did not cause allergic reactions such as redness, itching, or swelling on the inner arm of any panelist.

CONCLUSION

Based on the tests conducted on the Robusta coffee bean powder body scrub preparation, it can be concluded that:

a. Variations in TEA and stearic acid concentrations affect the physical properties of the powder body scrub preparation, namely the adhesion test.
b. The Robusta coffee bean powder body scrub formulation does not cause skin irritation.

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