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Formulation and Physical Evaluation of Depilatory Cream from with Variation Concentrations of Turmeric (*Curcuma longa*) and Bromelain Enzyme

Diah Ratnasari[1*], Janatun Na'imah [2], Nastiti Trikurniadewi [3], Irani Agustin[4], Danu Prastiyo[5]
[1,2,4,5]D3 Farmasi Universitas Muhammadiyah Gresik, Proklamasi 54, Gresik, 61111, Indonesia
[3]D4 Teknologi Laboratorium Medis, Universitas Muhammadiyah Gresik, Proklamasi 54, Gresik, 61111, Indonesia
[1]diahratnasari@umg.ac.id *; [2]janatunnaimah@umg.ac.id ; [3]nastititrikurniadewi@umg.ac.id, [4]iraniagustin3@gmail.com ; [5]prastiyozdanu0@gmail.com

ABSTRACT

The Indonesian cosmetics industry market is predicted to grow by 5.91% per year, including skin care products. One type of skin care is removing unwanted hair from the skin because this hair can interfere with appearance, especially for women. One way to remove this hair is by using hair removal cream (depilatory cream). One natural ingredient that has depilatory properties is turmeric. Depilatory cream also requires sulfhydryl protease enzymes that can break down the molecular structure of proteins contained in hair into amino acids. One protease enzyme is bromelain. The purpose of this study was to obtain the best formula for depilatory cream with varying levels of turmeric and bromelain enzymes based on physical evaluation results. The research method used was experimental research with stages of turmeric extraction, bromelain enzyme isolation, depilatory cream formulation, and physical evaluation of the depilatory cream. The results showed that Formula 1 was the best turmeric-based depilatory cream formula with bromelain enzyme based on physical evaluation results.

Keywords: turmeric, bromelain enzyme, hair removal cream

1. INTRODUCTION

The cosmetics industry is one of three National Priority Industries. The Indonesian cosmetics industry market is predicted to grow by 5.91% per year, including skin care products (RI, 2023). One type of skin care is removing unwanted hair from the skin. Although unwanted hair is not harmful to health, it can interfere with appearance and reduce self-confidence. Removing unwanted hair from the human body is commonly done by both men and women (Gupta et al., 2023; Verma et al., 2011). About 88% of hair consists of protein. The type of protein in hair includes hard, fibrous keratin because it has strong disulfide bonds that are difficult to separate, requiring a depilatory agent (Abhale et al., 2023; Gupta et al., 2023). Depilatories are cosmetic products intended to remove unwanted hair from the skin (BPOM, 2020; Gupta et al., 2023). One natural ingredient that has depilatory activity is turmeric (Kurniawan et al., 2020).

In 2022, Gresik Regency was the No. 1 producer of turmeric in East Java, with a total production of 24,817,192 kg (BPS, 2023). The use of turmeric is still very minimal, limited to kitchen spices or herbal medicine. The low public awareness of its potential contrasts with its abundant natural resources,

* **Diah Ratnasari**
Tel.: -
Email: diahratnasari@umg.ac.id

highlighting the need to increase the commercial value of turmeric (Kurniawan et al., 2020). Turmeric contains curcumin. This compound has antiandrogenic effects that inhibit the binding of DHT to androgen receptors in hair follicles, thereby reducing blood flow to the follicles. This potential effect can slow hair growth, causing the hair that does grow to become increasingly thin (Abdel-Kader et al., 2022; Kurniawan et al., 2020; Pelikh & Keck, 2020).

Depilatory ability requires protease enzymes (Shanker et al., 2021). Sulfhydryl protease enzymes are capable of breaking down the molecular structure of proteins contained in hair into amino acids. One such protease enzyme is bromelain (Maryam, 2011). The highest bromelain enzyme activity is obtained from pineapple (Abreu & Figueiredo, 2019; Kumaunang & Kamu, 2011; Nathania & Bratadiredja, 2018). The bromelain enzyme content for anti-inflammatory purposes is 2-10% (Tara, 2019), while for depilatory purposes it has not yet been determined. The effectiveness of bromelain enzyme has been tested. Bromelain enzyme is capable of removing hair from cow skin (Mohan et al., 2016).

Depilatory creams are widely available on the market, but depilatory creams made from natural ingredients that are harmless to health are still rare (Kurniawan et al., 2020). In 2019, a man used a chemical-based depilatory cream that caused his thigh skin to burn and blister (Saputra, 2019). Ideally, a depilatory cream should be non-toxic, free of fabric dyes, fast and effective, causing hair removal in as little as five minutes, and odorless. The advantages of depilatory cream formulations are: 1) They offer pain-free hair removal compared to threading, plucking, waxing, or shaving; 2) Hair is easily dissolved and washed away with the cream without causing pain; 3) The cream does not damage the skin or cause cuts compared to regular shaving; 4) It is easy to use; 5) Can be done at home (Gupta et al., 2023).

In Gupta's (2023) study, a depilatory cream was formulated using natural ingredients such as turmeric powder, neem extract, tulsi extract, ginger powder, and papaya powder, but using thioglycolic acid. Thioglycolic acid is a chemical compound used to accelerate depilatory activity. Some thioglycolic compounds (including their salts) can cause allergic contact dermatitis (rash, itching, redness) in sensitive individuals (Ghanem et al., 2025). However, this study did not use these chemical compounds to avoid such side effects.

Kurniawan's (2020) research also utilized turmeric as a depilatory preparation, but in paste form. Both Kurniawan's (2020) and Gupta's (2023) research used turmeric as a depilatory agent but did not utilize bromelain enzymes to aid the depilatory process.

The use of bromelain enzyme in this study was used to replace thioglycolic acid to increase depilatory activity. Mohan's (2016) research conducted experiments such as testing enzyme activity in crude bromelain extracts, studying the kinetics of activity and stability of crude Bromelain enzyme extracts, and applying crude Bromelain extracts for hair removal on cow skin. The results showed that the activity of crude bromelain enzyme from fruit was 4.71 U mL−1, with a maximum activity of 4.429 U mL−1. The kinetic study showed that the optimal enzyme activity time was 40 minutes, and the use of bromelain enzyme resulted in good hair removal after 24 hours of treatment.

Based on the above issues, one possible innovation is to process turmeric and bromelain enzyme into herbal depilatory cream. The use of local resources is urgently needed so that the community can use safe depilatory creams. Therefore, this study formulated and evaluated the physical properties of depilatory cream made from turmeric and bromelain enzyme for hair removal.

This study contributes scientifically to the development of topical preparations in the form of natural depilatory creams as a safer alternative to synthetic chemical-based depilatory products such as calcium thioglycolate. Until now, synthetic depilatory agents have been known to work by damaging the disulfide bonds in hair keratin, but they carry the risk of causing irritation, contact dermatitis, and skin barrier disorders. Therefore, the exploration of natural ingredients with keratolytic or proteolytic activity is an innovative approach in the formulation of depilatory preparations.

The scope of this study focused on the physical parameters of depilatory cream preparations. The evaluation included organoleptic observations (color, odor, consistency), homogeneity, pH, spreadability, washability, viscosity, and cream type testing.

2. METHODS

This type of research is experimental research involving the extraction of turmeric, isolation of bromelain enzyme, formulation of depilatory cream from turmeric with bromelain enzyme, followed by physical evaluation including organoleptic test, pH test, homogeneity test, viscosity test, washing power test, spreading power test, and cream type test. This research was conducted at the Pharmaceutical Technology Laboratory of Muhammadiyah University Gresik.

2.1 Tools and Materials

The equipment used in this study included analytical scales, weighing scales, maceration vessels, wooden spatulas, measuring cups, beakers, Erlenmeyer flasks, rotary evaporators, cloth, measuring flasks, blenders, centrifuges, freezers, mortars, stampers, pH indicator paper, Brookfield viscometers, glass objects, cover glasses, Whatman filter paper (150 mm), and a microscope.

The materials used in this study included turmeric, pineapple, cetyl alcohol, calcium hydroxide, glycerin, BHT, liquid paraffin, white petrolatum, stearic acid, rose oil, 96% ethanol, distilled water, black plastic, and cloth.

2.2 Work Procedures

(1) Preparation of turmeric extract

Weigh 200 grams of turmeric powder. Maceration is carried out by adding 2 liters of 96% ethanol to 200 grams of powder in an Erlenmeyer flask, covered with black plastic, and soaked for 3 days with occasional stirring. After 3 days, the mixture was filtered using cloth and evaporated using a rotary evaporator (Suharsanti et al., 2020).

(2) Isolation of bromelain enzyme

The pineapple fruit is cut into small pieces. The fruit pieces are weighed and crushed in a mortar and pestle to extract the juice. After extracting the juice, the crude enzyme from the fruit residue is further extracted by adding 20 mL of distilled water to it. The juice is then filtered using Whatman filter paper (150 mm). The filtrate is centrifuged at 10,000 rpm at 4°C for 10 minutes to remove insoluble substances. The supernatant is collected and stored at 4°C. The crude extract is ready for use (Mohan et al., 2016).

(3) Making depilatory cream

Based on the European Patent Specification (2020) with International publication number: WO 2017/122020 (20.07.2017 Gazette 2017/29), it is explained that the concentration of the active ingredient in depilatory creams is 0.5 to 10% of the total weight of the cream composition (Marie, 2020). Therefore, the third equation of the formula in this study is that the total concentration of turmeric extract and bromelain enzyme is 10%. The difference between the three formulas is the variation in the concentration of turmeric extract and bromelain enzyme. The turmeric concentrations, respectively, for F1, F2, and F3 are 0.5%, 1.5%, and 2.5%. The difference in turmeric concentration between formulas is 1% to provide significant results. The depilatory cream formulas used in this study are presented in Table 1.

Table 1. Depilatory Cream Formula

No.	Name of Material	Formula % b/b		
		F1 (%)	F2 (%)	F3 (%)
1	Turmeric extract	0.5	1.5	2.5
2	Crude pineapple fruit extract (bromelain enzyme)	9.5	8.5	7.5
3	Cetyl alcohol	3	3	3
4	Calcium hydroxide	5	5	5
5	Glycerin	27.5	27.5	27.5
6	BHT	0.1	0.1	0.1
7	Liquid paraffin	25	25	25
8	Vaseline album	4	4	4
9	Stearic acid	5	5	5
10	Rose oil	0.5	0.5	0.5
11	Aquadest	ad 100	ad 100	ad 100

The steps for making a depilatory cream from turmeric with bromelain enzyme are as follows:

(1) Heat the oil phase (cetyl alcohol, liquid paraffin, white petrolatum, and stearic acid) in a porcelain dish at 75°C until melted.
(2) In a separate porcelain dish, heat the water phase (calcium hydroxide, glycerin, and distilled water) at 75°C until everything is homogeneous.
(3) Heat the mortar.
(4) Add (1) + (2) to (3) and stir quickly and vigorously until a cream base is formed.
(5) Grind BHT until smooth + turmeric extract, stir until homogeneous + (4)
(6) (5) + bromelain enzyme, stir until homogeneous
(7) (6) + rose oil, stir until homogeneous
(8) (7) into a container

This method refers to similar studies (Gupta et al., 2023; Shanker et al., 2021). The temperature of 75°C was set because it was adjusted to the highest melting point so that all ingredients could melt completely. The melting points are: cetyl alcohol 45-52°C; white petrolatum 38-60°C; stearic acid ≥ 54°C (Kurniawan et al., 2020).

(4) Physical evaluation of depilatory cream

a. Organoleptic Test

This evaluation aims to examine the physical appearance of the cream, including its color, smell, and texture, using the five senses (Ratnasari & Puspitasari, 2018; Utari, K.D.P, I.G.A.N.P Unique, N.W.G. Aryani, C.I.S Arisanti, 2019).

b. pH Test

This evaluation is to determine the pH of the depilatory cream. This test uses a pH meter (Ratnasari & Puspitasari, 2018).

c. Homogeneity Test

This evaluation is examined microscopically to observe the uniformity of particle size. This test uses a microscope (Ratnasari & Puspitasari, 2018).

d. Viscosity Test

The viscosity of the formulated cream was determined using a Brookfield Viscometer Spindle No. 5 and a spindle speed of 10 rpm at 25°C. The corresponding readings on the viscometer were recorded (Verma et al., 2011).

e. Washing Power Test

Apply depilatory cream to the skin. Observe the ease of washing off the cream and evaluate it manually (Gupta et al., 2023).

f. Spread Power Test

Transparent glass is placed on graph paper. 0.5 g of cream is placed on the glass, then covered with another piece of transparent glass and left for ± 5 seconds to determine the diameter of the area formed. Then, weights of 50, 100, 200, 300, ad 1,000 g are added on top of the transparent glass, and the diameter of the area formed is observed. The specification of the preparation is that the cream can spread easily and evenly (Ratnasari & Puspitasari, 2018). The requirement for good spreadability is 5-7 cm (Murdiana et al., 2022)

g. Cream Type Test

One drop of cream preparation is placed on a glass slide, plus one drop of methylene blue solution, mixed evenly, observed under a microscope, a homogeneous blue color forms on the outer phase indicating the formation of an oil-in-water (o/w) emulsion, whereas if blue spots appear on the inner phase, this indicates a water-in-oil (w/o) emulsion (Ratnasari & Puspitasari, 2018).

(5) Data analysis

The data obtained from each physical evaluation test was analyzed descriptively and quantitatively to compare the physical quality results of each formula. One-way analysis of variance (ANOVA) was performed to examine the relationship between treatment groups.

Determination of the best formula using a quantitative scoring method. The weight of each parameter (pH, viscosity, spreadability, and washing power) is 25%. Score assessment (1–3; 3 = best). Next, the score results are multiplied by the weight of each test parameter to obtain a total score to determine the ranking (Putri, 2020).

3. RESULT AND DISCUSSION

1. Turmeric Extraction

Turmeric extraction was carried out using the maceration method. This method was performed by soaking 400 g of turmeric powder in 3 L of 96% ethanol solvent in a maceration vessel for 5 days. Six maceration vessels were used in this study. During the maceration process, stirring was carried out occasionally every day to accelerate the extraction process, which caused collisions that made it easier for the solvent to enter the raw material cells, so that more active compounds were dissolved by the solvent. This method was used to extract the active compound, curcumin, which is used as an active ingredient with depilatory activity. The extracted maserate was evaporated conventionally using a water bath at a monitored temperature of 40-60ºC. The temperature is controlled to prevent damage to the active compounds. Then, 356.05 g of 96% ethanol turmeric extract is obtained, with an extraction yield of 14.83%. The turmeric extract obtained is dark yellow in color, thick in consistency, and has a distinctive turmeric smell.

Figure 1. Thick Turmeric Extract

2. Isolation of Bromelain Enzyme

Isolation of bromelain enzyme from pineapple flesh was carried out using the extraction method. The aim was to extract the enzyme from the cells of the pineapple flesh tissue. The extraction method involved mashing the pineapple flesh and taking the liquid filtrate. Then, 0.5 M phosphate buffer pH 7 is added as a buffer and left for 2 hours at 4oC. Next, the pineapple tissue residues are separated from the crude enzyme by centrifugation for 15 minutes at 3000 rpm (Verma et al., 2011). The centrifugation yielded a precipitate consisting of pineapple tissue residues, while the supernatant was the crude bromelain extract/enzyme obtained in an amount of 730 mL with characteristics of a clear yellow color, liquid form, and a distinctive pineapple odor.

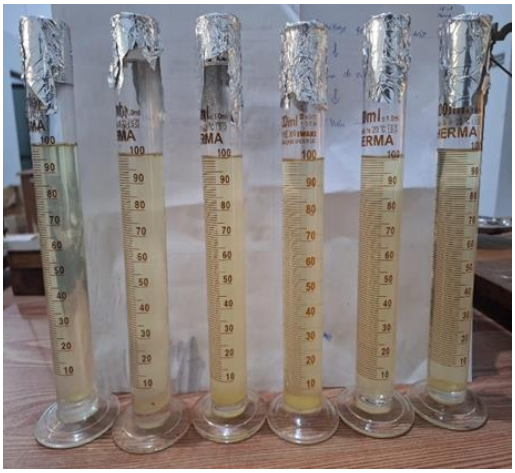


Figure 2. Bromelain Enzyme

3. Making Depilatory Cream

The depilatory cream formulas are listed in Table 1. The commonality among these three formulas is that the cream base and total content of turmeric extract and bromelain enzyme are 10%. The difference between these three formulas is the variation in the content of turmeric extract and bromelain enzyme (Table 1). The results of the three depilatory cream formulas made from turmeric with bromelain enzyme are presented in Figure 3.

F1 F2 F3

Figure 3. Depilatory Cream

4. Physical Evaluation of Depilatory Cream

a. Organoleptic Test

This test aims to examine the physical appearance of the cream, including its color, smell, and texture, using the five senses (Gupta et al., 2023). The cream specifications that must be met are a homogeneous color, a pleasant smell, and a soft consistency. This test was replicated three times. Table 2 shows that the organoleptic test results of all depilatory cream formulas have met the requirements.

Table 2. Results of Organoleptic Testing

Parameters	F1	F2	F3
Color	Brownish red	Dark red	Red darkness
Odor	The scent of roses	The scent of roses with a hint of turmeric	Faint smell of turmeric
Texture	Soft	Soft	Soft

The color of the depilatory cream in the three formulas differs. The depilatory cream in formula 1 has the lightest color, while the depilatory cream in formula 3 has the darkest color. This is because the turmeric content in formula 1 is the lowest (0.5%) with the highest bromelain enzyme content (9.5%), while the turmeric content in formula 3 is the highest (1.5%) with a bromelain enzyme content of 8.5%. The smell of the depilatory cream in all three formulas is rose, but the smell in formula 3 is a mixture of rose and turmeric. This is because the turmeric content in formula 3 is the highest. The texture of the depilatory cream in all three formulas is soft after application to the skin. Table 2 shows that as the days progressed, there was a change in color to a darker shade in all formulas due to the cream being in an alkaline environment (Nathania & Bratadiredja, 2018).

b. pH Test

This pH evaluation is to determine the pH of the depilatory cream. This test uses a pH meter with 3 replicates. The pH test results for each formula are listed in Table 3.

The pH test results show that F1 has the lowest pH value of 10.06, while F3 has the highest pH value of 10.47. This is because turmeric extract has a basic pH of 9.5± 0.5. F3 has the highest turmeric content of the three formulas, so the higher the turmeric extract content, the higher the pH value of the depilatory cream preparation. This is similar to the study by Tara (2019) which produced a pH value of 10.5-12.7 for cream. This is in line with the requirements for rapid hair removal, as hair removal preparations usually contain strong base reducing agents as their active components, causing hair fibers to swell and resulting in the cleavage of cystine bridges between adjacent polypeptide chains as the initial step for complete hair degradation (Abhale et al., 2023).

Table 3. pH Test Results

Replicates	F1	F2	F3
1	10.03	10.2	10.44
2	10.07	10.1	10.48
3	10.08	10.3	10.49
Average +SD	10.06 ± 0.026	10,20 ± 0,10	10.47 ± 0.026
%CV	0.26%	0.98%	0.25%
$F_{Calculated} \approx 56.2$			
F_{table} ($\alpha = 0.05$; df 2.6) ≈ 5.14			

All formulas showed very small variations (%CV<2%), indicating excellent reproducibility of measurements. The addition of a buffer should be considered to maintain pH stability. The appropriate buffer used for depilatory creams is a carbonate–bicarbonate system to reduce pH fluctuations during storage.

F calculated > F table, then there is a significant difference ($p < 0.05$) between the pH of F1, F2, and F3. The pH values of all formulas are in the strong base range (10–10.5). Based on the regulations of the Food and Drug Supervisory Agency (BPOM, 2008)., the pH of depilatory preparations is 7-12.7 with an active ingredient of thioglycolic acid, whereas in this study, this chemical compound was not used, resulting in a lower potential for irritation. The pH of the three formulas meets the requirements. F1 has the lowest pH (closest to pH 10), making it relatively safer than F2 and F3, and thus has a lower potential for irritation. The best pH, in order, is F1>F2>F3.

c. Homogeneity Test

This evaluation was examined microscopically to determine the uniformity of particle size. This test uses a microscope (Ratnasari & Puspitasari, 2018). This homogeneity test is carried out by applying the cream that has been made on a clean and dry object glass so that it forms a thin layer, then covered with another object glass, then observed under a microscope to see whether the color is uniform or not. The cream is considered homogeneous if, upon observation using a microscope, the cream has uniform particle size (Abdel-Kader et al., 2022). This test was replicated three times. Table 4 shows that all formulas are homogeneous. This means that the ingredients used to make the cream are perfectly mixed. This indicates that all formulas meet the requirements.

Table 4. Homogeneity Test Results

Formulation	Results
F1	homogeneous
F2	homogeneous
F3	homogeneous

d. Viscosity Test

The viscosity of the formulated cream was determined using a Cone and Plate Viscometer at a speed of 100 rpm using a CP-52 spindle. The corresponding readings on the viscometer were recorded (Verma et al., 2011). The viscosity test results for F1, F2, and F3 are presented in Table 5.

Table 5. Viscosity Test Results

Replicates	F1	F2	F3
1	340.1	291.0	542.6
2	342.1	277.2	524.9
Average +SD	341.10 ± 1.41	284.10 ± 9.76	533.75 ± 12.52
%CV	0.41%	3.43%	2.35%
$F_{Calculated} \approx 368$			
F_{table} ($\alpha = 0.05$; df 2.3) ≈ 9.55			

Viscosity is a parameter for measuring thickness that indicates the amount of friction in a fluid; viscosity indicates the resistance of a liquid to flow. The average viscosity values of F1, F2, and F3 were 341.10 ± 1.41 cps, 284.10 ± 9.76 cps, and 533.75 ± 12.52 cps, respectively. The average viscosity values of the three formulas meet the viscosity requirements for semisolid preparations, which are 40-40,000 cps (Erawati et al., 2021). Calculated F > Table F, indicating a highly significant difference ($p < 0.01$) in viscosity values between formulas. F1 has the most optimal viscosity. The viscosity of F1 is relatively stable because there are no significant differences between replicates. The viscosity of F2 is the lowest, making the cream too thin. The viscosity of F3 is too high, making the cream too thick and difficult to spread on the skin. The best viscosity values, in order, are F1 > F2 > F3.

e. Washing Power Test

The depilatory cream was applied to the skin and then the ease of washing off was assessed manually (Verma et al., 2011). To facilitate observation, the washing power test results were obtained from the time required for the cream to wash off completely after it was applied to a 2 cm diameter area of skin. The washing power test results are listed in Table 6.

Table 6. Qualitative Washing Performance Test Results

Replicates	F1	F2	F3
1	A little difficult to wash with water	A little difficult to wash with water	A little difficult to wash with water
2	A little difficult to wash with water	A little difficult to wash with water	A little difficult to wash with water
3	A little difficult to wash with water	A little difficult to wash with water	A little difficult to wash with water

The washing power test results for the three depilatory cream formulas showed that they were somewhat difficult to wash off with water. Calculated F > Table F, indicating a highly significant difference ($p < 0.001$) between the washing power test results for F1, F2, and F3. F1 had the fastest washing time (24.37 seconds) when compared to F2 and F3 (25.94 and 25.60 seconds, respectively). This is because turmeric is insoluble in water or non-polar (Abreu & Figueiredo, 2019)(Maryam, 2011). F1 has the lowest turmeric content compared to F2 and F3. This is why the higher the turmeric content, the longer the washing time. F1 has the fastest time, making it the easiest to clean. The faster the washing time, the better the user experience. The best washing performance results, in order, are F1 > F3 > F2.

Table 7. Quantitative Washing Performance Test Results

Replicates	F1 (s)	F2 (s)	F3 (s)
1	24.35	25.98	25.57
2	24.38	25.93	25.61
3	24.39	25.92	25.63
Average +SD	24.37 ± 0.021	25.94 ± 0.032	25.60 ± 0.031
%CV	0.086%	0.12%	0.12%
$F_{Calculated} \approx 2386$			
F_{table} ($\alpha = 0.05$; df 2.6) ≈ 5.14			

f. Spread Power Test

The spreadability test aims to determine the cream's ability to spread on the skin surface. The spreadability test was replicated three times for each formula. The results of the spreadability test with added weight are presented in Table 8.

Table 8. Results of Dispersion Tests With Added Weight

Weight (gram)	F1	F2	F3
Only glass	2.8	2.8	2.05
50	3.3	3.2	2.15
100	3.8	3.9	2.6
200	4.1	4.3	2.65
500	4.8	4.5	3.15
600	5.3	4.8	3.2
700	5.4	4.9	3.35
800	5.4	4.9	3.45
900	5.4	4.9	3.75
1000	5.4	4.9	3.75

The results of the spreading power test in Table 8 show that with the addition of load, the spreading power becomes wider. Details of the maximum spreading power replication in each formula (at a load of 1000 grams) are presented in Table 9.

Table 9. Maximum Spread Power Test Results

Replicates	F1	F2	F3
1	5.4	4.90	3.76
2	5.4	4.89	3.75
3	5.5	4.92	3.74
Average +SD	5.43 ± 0.058	4.90 ± 0.015	3.75 ± 0.010
%CV	1.07%	0.31%	0.27%
$F_{Calculated} \approx 1736$			
F_{table} ($\alpha = 0.05$; df 2.6) ≈ 5.14			

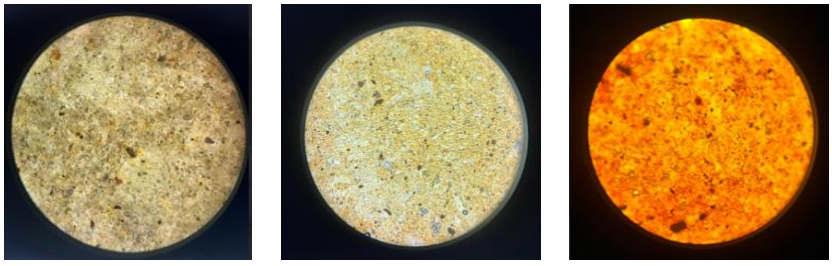
The maximum spreadability test results for depilatory creams F1, F2, and F3 were 5.43 ± 0.058 cm, 4.90 ± 0.015 cm, and 3.75 ± 0.010 cm, respectively. All formulas showed low variation (%CV < 2%), indicating good testing precision. The calculated F value was greater than the table F value, indicating a highly significant difference ($p < 0.001$) in spreading power between the formulas.

F1 has the widest spread because it has the highest bromelain enzyme content, which is 9.5%. The wider the spread produced by a cream, the better its spreadability when applied (Gupta et al., 2023).

The spreading power test of F1 meets the requirements for good spreading power, which is 5-7 cm. F2 and F3 do not meet the requirements for good spreading power. F1 is within the ideal range, F2 is slightly below 5 cm, and F3 is too small because the preparation is too thick. F1 shows the most stable and ideal spreading power consistency. The best spreading power, in order, is F1>F2>F3.

g. Emulsion Type Test

One drop of cream preparation is placed on a glass slide, plus one drop of methylene blue solution, mixed evenly, then observed under a microscope (Gupta et al., 2023). The emulsion type is classified as oil-in-water (O/W) if a homogeneous blue color is observed in the preparation, whereas if the blue color appears as spots and is uneven, the emulsion type is water-in-oil (W/O). The emulsion type test results are presented in Figure 4.



F1 F2 F3

Figure 4. Cream Type Test Results

Table 10. Results Of Depilatory Cream Testing

Formula	Cream Type
F1	A/M
F2	A/M
F3	A/M

The test results show that no blue color is visible in the preparations of Formulas 1, 2, and 3. This indicates that the type of depilatory cream emulsion is water in oil (W/O). This is because turmeric extract has non-polar properties and therefore does not mix with methylene blue. Additionally, the HLB value of this depilatory cream system is 6.38. This HLB value is slightly above the HLB range for water-in-oil (W/O) emulsion types, which is 4-6 (Shoaib Alam, Mohammed S. Algahtani & Ahmad, 2020) so this depilatory cream still tends to form a water-in-oil (W/O) cream type.

5. Determining The Best Formula

Determination of the best formula using a quantitative scoring method. The weight of each parameter (pH, viscosity, spreadability, and washing power) is 25%. Score assessment (1–3; 3 = best). Next, the scores are multiplied by the weight of each test parameter to obtain a total score to determine the ranking (Putri, 2020). The test parameters used are the results of pH, viscosity, spreadability, and washing power tests.

Based on Table 11, the best formula for depilatory cream preparations with varying concentrations of turmeric and bromelain enzyme is formula 1, based on the results of the pH, viscosity, spreadability, and washing power test parameters.

The optimization model obtained in this study can be used as a basic framework in the development of depilatory creams with herbal active ingredients, such as plant extracts that have keratolytic or proteolytic activity, while maintaining the physical stability of the preparation.

Table 11. Test Parameter Score Assessment

Para-meter	F1			F2			F3		
	Score	Weight	ΣScore	Score	Weight	ΣScore	Score	Weight	Σ Skor
pH	3	25%	1	2	25%	0.5	1	25%	0.3
Viscosity	3	25%	1	2	25%	0.5	1	25%	0.3
Spread power	3	25%	1	2	25%	0.5	1	25%	0.3
Washing power	3	25%	1	1	25%	0.3	2	25%	0.5
Total score			3			1.8			1.3
Rangking	1			2			3		

The limitations of this study include the absence of cycling tests, efficacy tests, and safety tests for the depilatory cream. As a result, the findings are restricted to the formulation and initial evaluation stage and do not provide information on the product's long-term stability, performance consistency, or potential degradation under repeated use or varying environmental conditions. The lack of efficacy testing also limits the ability to determine the actual effectiveness of the depilatory cream in removing hair when applied under real-use conditions.

CONCLUSION

This depilatory cream formula consists of varying levels of turmeric with bromelain enzyme. In this study, physical evaluations were conducted, including organoleptic testing, pH testing, homogeneity testing, viscosity testing, washing power testing, spreadability testing, and cream type testing to obtain the best depilatory cream formula. The organoleptic test results showed that F1 had the best physical appearance, namely orange-red color, rose scent, and soft texture. The pH test results showed that all formulas had a pH in the alkaline range (≥10), which is in accordance with the pH requirements for depilatory preparations, which are 7-12.7. The viscosity test results showed that F1 had a more optimal viscosity balance (341.10 ± 1.41). The viscosity of F1 was relatively stable because there were no significant differences between replicates. The washing power test results showed that all three formulas were classified as "somewhat difficult to wash off," with a time range of 24–26 seconds. There were no significant differences between the formulas in this parameter. The spreading power test results show that all formulas experience an increase in spread diameter as the load increases. The spreading power of F1 (5.43 ± 0.058) meets the requirements for good spreading power, which is 5-7 cm, while F2 and F3 do not meet the requirements. The cream type test results showed that all formulas produced an oil-in-water (O/W) type. Based on the quality ranking analysis of the pH, washing power, spreading power, and viscosity test parameters, F1 was the best formula. The results of this study contribute to the development of science and technology of natural-based semisolid preparations, particularly specific combinations of extracts in the optimization of depilatory cream formulas.

ADVISE

Future researchers should develop formulas by adding other natural ingredients that have depilatory properties so that their effectiveness is equivalent to synthetic products. In addition, future research should conduct cycling tests, effectiveness tests, or quantitative safety evaluations in order to obtain comprehensive data on depilatory performance in terms of hair removal ability, safety, and long-term stability.

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