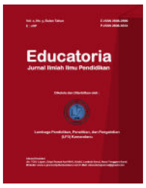

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PATCH FORMULATION FROM THE EXTRACT OF BANANA LEAF SHEATH (*Musa paradisiaca* L.) AND KERSEN LEAF (*Muntingia calabura* L.) WITH HPMC POLYMER

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ABSTRACT: Indonesia possesses rich biodiversity with strong potential as a source of raw materials for traditional medicine. Both banana stalks (*Musa paradisiaca* L.) and kersen leaves (*Muntingia calabura* L.) contain secondary metabolites, such as flavonoids, tannins, and saponins, which are associated with wound-healing properties. This study aims to formulate and evaluate the physical characteristics of a transdermal patch containing a combination of banana stem and kersen leaf extracts using Hydroxypropyl Methylcellulose (HPMC) polymer. The study was conducted as a laboratory experiment. Extraction was performed using the maceration method with 96% ethanol, after which the extracts were formulated into patches with HPMC concentrations of 2.5%, 5%, and 7.5%. Extracted with 96% ethanol, after which the extracts were formulated into patches using varying HPMC concentrations of 2.5%, 5%, and 7.5% with a fixed extract concentration. The results indicated that different HPMC concentrations significantly affected the physical characteristics of the patches, such as thickness, folding endurance, and appearance. Physical evaluation included organoleptic testing, weight uniformity, thickness, fold resistance, pH, and freeze-thaw stability. The results showed that all formulations met the physical quality requirements, with a standard deviation for weight uniformity of ≤0.05, thickness of ≤1 mm, fold resistance of >300 times, a pH of 6, and good physical stability. Variations in extract concentration affected the color of the plaster, with higher extract concentrations resulting in darker colors. Based on the evaluation results, the plaster made from banana leaf sheathand kersen leaf extracts combined with HPMC polymer meets the requirements for a high-quality plaster formulation. Variations in extract concentration affected the color of the patch, with higher extract concentrations resulting in darker coloration. Based on the evaluation results, the patch formulas combining banana stem and kersen leaf extracts with HPMC polymer met the standard physical requirements for an acceptable topical patch formulation.

Keywords: Banana Leaf Sheath, HPMC, Kersen Leaves.

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INTRODUCTION

Indonesia is a country with a rich biodiversity and around 30,000 plant species. A total of 9,600 species have been known to have medicinal potential, but only about 200 species have been used as the main ingredient for the traditional medicine industry (Rani & Mahfur, 2023; Raslina et al., 2016). The implementation of the uses of medicinal plants in Indonesia is still not optimal and not deep enough, so it is necessary to continue research and development (Setiawan et al., 2024). One of the natural ingredients used as a wound treatment is banana leaf sheath extract, which can help the wound drying process faster due to flavonoids, tannins, lignin, and saponins. Ambon banana leaf sheath extract (*Musa paradisiaca* L.) in an ointment with 25% concentration can inhibit the growth of *Staphylococcus aureus* with an average of 11 mm (Salim et al., 2024). In another research by Maddeppungeng et al. (2023), gel from an ambon banana stem could cover wounds in mice four days faster than the comparator. Saponins are one of the secondary metabolites that support recovery by stimulating collagen growth, reducing pain, and helping to stimulate the process of producing new cells.

On the other hand, the only species of *Muntingia,* which is kersen leaf (*Muntingia calabura* L.), is seen to have no selling value by people, so it is less optimal in use. In kersen leaf extract, the total flavonoid content was 13,375 mg QE/g extract, the total tannin content was 13,715 mg QE/g extract, and the total phenolic content was 22,389 mg GAE/g extract (Mudaningrat et al., 2023). Another research said that kersen leaf extract ointment with a concentration of 50% could speed up the wound recovery time of incisions in mice with high blood sugar levels by increasing the formation of new blood vessels. The availability of flavonoids, tannins, and saponins in the kersen leaf supports wound recovery (Yulianti et al., 2021).

Although previous studies have predominantly focused on individual plant extracts or conventional dosage forms such as ointments and gels, research exploring the combination of ambon banana stem extract and kersen leaf extract into an HPMC-based transdermal patch remains limited. Given the potential of these extracts as anti-inflammatory agents, they can be developed into a patch, which is a drug delivery system applied to the skin surface offering benefits such as stable drug release, ease of application, reduced administration frequency, and improved patient compliance. Hydroxypropyl Methylcellulose (HPMC) is selected as the polymer for this research due to its non-toxic, non-irritating properties and its capability to produce patches with a smooth physical texture (Saryanti & Setyadi, 2022).

Based on Wardani & Saryanti (2021), HPMC as a polymer can produce patches with good texture because it does not produce aeration and wrinkles. HPMC with a 1% concentration can produce good physical stability. The concentration of HPMC used affects weight, thickness, absorbency, and folding resistance. Another research mentioned that the formulation patch of a strawberry extract with HPMC produced good physical and chemical characteristics, except in the pH test (Setyaningrum et al., 2024).

This research is designed to make a patch formulation from banana leaf sheath extract (*Musa paradisiaca* L.) extracts and kersen leaf (*Muntingia calabura* L.) with HPMC polymer. The extraction method uses maceration using 96% ethanol solvent in a ratio of 1:5 for 3x24 hours at room temperature (Talia et al., 2025). The maceration method was chosen cause it is considered more practical, safe, and has a lower risk of losing active components due to no heating (Yulianti et al., 2021). The polymer used HPMC in this research because it released the drug relatively quickly from the matrix. The polymer is the main ingredient in the patch because it affects the drug release (Maddeppungeng et al., 2023)

METHODS

Material

The materials used in this study were ambon banana leaf sheath extract (*Musa paradisiaca* L.), kersen leaf (*Muntingia calabura* L.), ethanol 96%, ethanol 95%, HPMC (Hydroxypropil Metilcellulose), propylenglycol, glycerin, and aquadest. Tools used included Scissors, blender (Cosmos CB-282 P), analytical balance (ME204 - Mettler Toledo), rotary evaporator (RE-200E), mortar and stamper, mold, glass jar, stirring, measuring cylinder 5 ml 10 ml, and 25 ml (IWAKI), beaker glass 100ml and 500ml (IWAKI), erlenmeyer 250ml (PYREX), petri dish, porcelain cup 100ml, dropper pipette, oven (Yenaco YNC-OV Drying Oven), refrigerator, ruler, filter paper, pH indicator (Johnson), micrometer scrub (carbon fiber digital thickness gauge), spatula, stove, aluminium foil, laboratory funnel (PYREX), bowl, sieve, and teapot.

This research is designed to develop a patch formulation combining ambon banana stem extract (*Musa paradisiaca* L.) and kersen leaf extract (*Muntingia calabura* L.) using HPMC polymer. Combining these two extracts introduces a novel formulation strategy aimed at leveraging the potential synergistic effects of their distinct bioactive compounds such as flavonoids, tannins, and saponins to enhance therapeutic efficacy in the wound-healing process. The extraction was performed via maceration using 96% ethanol (1:5 ratio) for 3×24 hours at room temperature (Talia et al., 2025). This method was selected because it is practical, safe, and minimizes the risk of degrading heat-sensitive active components (Yulianti et al., 2021). Hydroxypropyl Methylcellulose (HPMC) was chosen as the primary polymer due to its ability to facilitate favorable drug release from the matrix, which is crucial for patch performance (Maddeppungeng et al., 2023). Therefore, this study aims to formulate and evaluate the physical characteristics of a transdermal patch containing a combination of banana stem and kersen leaf extracts with varying concentrations of HPMC polymer.

Determination

The sample materials to be used in this research which are ambon banana leaf sheath extract and kersen leaf were tested through the determination process to verify the identity of the plants to be used and minimize errors in sampling. The sample materials ambon banana stem and kersen leaf extracts underwent botanical determination to verify plant identity and minimize sampling errors. The physical characteristics of the formulated patches were subsequently evaluated in accordance with standard pharmaceutical guidelines and pharmacopeial references (such as the Indonesian Pharmacopeia and standard formulation parameters), assessing parameters including thickness, weight uniformity, folding endurance, moisture content, and surface pH

Simplicia

The banana leaf sheath extract used in this research was freshly cut ambon banana leaf sheath extract (*Musa paradisiaca* L.) meanwhile the kersen leaf were fresh, dark green leaves of kersen leaf (*Muntingia calabura* L.). Ambon banana

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leaf sheath extract as much as 33 kg and kersen's leaf as much as 3.5 kg was collected and then wet sorted. Both of samples was washed clean under flowing water to remove any dirt. The washed ambon banana leaf sheath extract and kersen leaf were drained and cut into smaller pieces. Then aerated in a room protected from direct sunlight for 7 days. Next, it was pulverized with a blender until formed a smooth powder and then stored in a closed container (Indonesian Ministry of Health, 2020)

Extract of Simplicia

Ambon banana leaf sheath as much as 33 kg and kersen leaf as much as 3.5 kg that have been dried and pulverized were extracted using maceration method with 96% ethanol. The maceration process was carried out for 3x24 hours while stirring frequently. The ratio of quantity of samples powder and 96% ethanol used was 1:5. The results of maceration were filtered with filter paper and evaporated using a rotary evaporator to get a viscous extract (Indonesian Ministry of Health, 2020)

Patch Formulation

Table 1. Patch Formulation from Banana Leaf Sheath Extract and Kersen Leaf.

Composition	Concentration (%) b/b			Function
	F1	F2	F3	
Banana leaf sheath extract	2.5	5	7.5	Active substance
Kersen leaf extract	2.5	5	7.5	Active substance
HPMC	3	3	3	Basis
Propylenglycol	5	5	5	Plasticizer, preservatives
Glycerin	1	1	1	Penetration enhancer
Ethanol 95%	Ad 100	ad 100	ad 100	Solvent

Patch Preparation

Prepare tools and materials, pour 4ml of hot water into the mortar, add HPMC and wait for it to expand. Then crushed until homogeneous until a gel is formed. Add a little 95% ethanol, then stir until completely dissolved. Extracts of banana leaf sheath and kersen leaf were added, stirred until completely mixed. Propylengylcol was added and stirred until homogeneous. Glycerin was added, then stirred until homogeneous. Next added 95% ethanol up to 10 ml. The resulting gel then poured into a mold that has been coated with aluminium foil. The preparation was allowed to stand at room temperature for 24 hours until there were no bubbles, then put in an oven at 50°C ± 7 days to dry. The patch was removed from the mold when it was dry, then applied to the ultrafix plaster.

Physical Evaluation

Organoleptic

Patch of banana leaf sheath and kersen leaf extracts were observed by smell, colour, and texture. The observations were conducted to assess the physical characteristics of the prepared patches.

Weight Uniformity

A total of 4 patches were picked randomly from each formulation. Then each patch was weighed and the average weight of the patch in each formulation was calculated. This test was performed to evaluate the weight uniformity of the prepared patches.

Thickness

A total of 4 patches were picked to measure their thickness using a scrub micrometre. Each patch was measured with 3 different points, the average thickness of each patch was calculated.

Folding Resistance

Patches were measured for folding resistance by folding the patch repeatedly in the same place until it was damaged or until reached 300 folds. Patches were categorized as good if they achieved folding resistance up to 200 times.

pH

The patch is diluted using aquadest, then put a universal pH indicator in the patch. Wait a few moments, then observe the result with matched the changes in the standard pH size on the pH indicator package.

Freeze Thaw

The patch was placed in a 4°C refrigerator for 48 hours, then the patch was removed from refrigerator and put into a 40°C oven for 48 hours. This treatment is called 1 cycle and to test the physical stability of the patch, it needs to be done as many as 5 cycles.

RESULTS AND DISCUSSION

Determination

Determination tests of banana ambon plant (*Musa paradisiaca* L.) and kersen's leaf (*Muntingia calabura* L.) were carried out on April 26, 2024 at UPT Herbal Materia Medica Laboratory Batu. The results of the determination test showed that the plants to be used for research samples were correct and original, namely banana ambon plants tested were included in the *Musaceae* family, genus *Musa*, and species *Musa Paradisiaca* L. while the tested kersen leaf are included in the *Elaeocarpaceae* family, genus *Muntingia*, and species *Muntingia calabura* L.

Extraction Result

The research sample used is the banana leaf sheath (*Musa paradisiaca* L.) obtained from Pondoknongko Village, Kabat District, Banyuwangi Regency while kersen leaf (*Muntingia calabura* L.) obtained from Pengantigan Village, Banyuwangi District, Banyuwangi Regency. Banana leaf sheath as much as 33 kg and kersen leaf as much as 4.5 kg were wet sorted and then washed under running water to remove any dirt. The samples were then drained and cut into smalles pieces so the drying process would be faster and easier when mashed. The pieces of ambon banana leaf sheathwere aerated in a closed room for 14 days meanwhile kersen leaf were aerated in a closed room for 5 days to reduce the water content in the sample and keep the active compounds not damaged by direct heating and continued with pulverization into powder so that the surface interaction with solvent is more expansive so that more compounds can be extracted (Kalsum et al., 2023.).

The extraction method used is maceration in order to prevent the damage of compounds contained in banana leaf sheath and kersen leaf which is not resistant to heat such as flavonoids (Safutri et al., 2024). The solvent used is ethanol 96% with the ratio of simplicia powder and solvent which is 1:5 because the more quantity of solvent used, the more pressure is given so as to produce more extract (Adilang et al., 2019). Ethanol is a universal solvent that can bind polar and nonpolar active sompounds. In another case, ethanol is more selective for dissolving compounds like flavonoid, tannins, saponin, alkaloid, and essential oils. Maceration is carried out for 3x24 hours while sometimes stirring so there is contact between the solvent and the interior of the plant cells which makes the compounds come out (Lukito & Hujafad, 2024). The results of maceration were then filtered with filter paper and evaporated with a rotary evaporator to obtain a viscous extract.

Table 2. Extract Banana Leaf Shealth Yield Results.

Result	Banana Leaf Sheath	Kersen Leaf
Wet Weight	33.000 g	4.500 g
Simplicia Weight	6.023 g	1.098 g
Extract Weight	123.25 g	194.4631 g
Yield	2.05%	17.7%

The yield value of banana leaf sheathextract is 2.02% which is in line with previous research, according to (Hamzah et al., 2023), in their research extraction of banana's stem with maceration and 96% ethanol solvent, the yield obtained in the range of 3.76% close to the result of this research. The resulting yield value can be influenced by several factors such as the occurrence of considerable weight loss of simplicial during drying as well as less than optimal solvents in extracting non polar compounds that may be present in banana leaf sheath (Puspitasari & Proyogo, 2024). The yield of kersen leaf extract is 17.7% according to the Indonesian Herbal Pharmacopoeia, the yield of medicinal plants has an average value of 10%, so the yield of kersen leaf can be said to be good and this result is in line with previous research where maceration extracting using ethanol 96% solvent can produce yields from kersen leaf extract of 11,94% that higher than 10% (Nabila et al., 2023). Another study mentioned that the size of the yield value produced was influenced by the extraction method chosen, the results of his research showed that the yield of extracts by sokhletation was more at 10,7% while maceration was 10%. This can be influenced by the heating in sokhletation extraction which causes the solvent's ability to pull compounds to increase (Asworo & Widwiastuti, 2023).

The yield value of the ambon banana stem extract was 2.02%, which aligns with the finding of Hamzah et al. (2023) who reported a yield of 3.76% using identical maceration parameters with 96% ethanol. Mechanistically, this relatively low yield percentage is primarily governed by mass transfer principles during solvent penetration and solute diffusion. The extensive reduction of moisture during the air-drying stage leads to significant structural shrinkage of the plant matrix, which can cause capillaries to collapse and restrict solvent access to intracellular contents. Furthermore, the use of 96% ethanol (a medium-polarity solvent) selectively extracts compounds based on polarity, limiting the dissolution of highly polar water-soluble constituents or non-polar waxes present in the lignocellulosic matrix of the banana stem (Puspitasari & Proyogo, 2024).

Conversely, the yield of the kersen leaf extract was substantially higher at 17.7%, exceeding the baseline average of 10% specified in the Indonesian Herbal Pharmacopeia and corroborating findings by Nabila et al. (2023) and Asworo & Widwiastuti (2023). This higher extractable matter is attributed to the rich presence of polar and semi-polar secondary metabolites such as flavonoids, tannins, and saponins which exhibit high affinity toward the hydroxyl groups of ethanol. Additionally, thermodynamic factors dictate extraction efficiency: while room-temperature maceration relies solely on molecular diffusion driven by concentration gradients, thermal-assisted methods like Soxhlet extraction provide continuous thermal energy that decreases solvent viscosity, increases solute solubility coefficients, and accelerates mass transfer rates.

The thick extracts then tested for organoleptic by visually. Organoleptic tests include smell, color, and texture from the extracts. The results is banana leaf sheath and kersen leaf extracts has a blackish brown color, extract scent, and viscous texture. The viscous extract of both samples produce a blackish brown due to heating during the process of evaporating the filtrate into extracts resulting in oxidation reactions also supported by the presence of tannin and flavonoid compounds in banana leaf sheathand kersen leaf which have a dark colour (Hikma et al., 2024).

Physical Evaluation Result of Patch

Organoleptic

The organoleptic test results of the patch from this research, the F1, F2, and F3 patch showed a scent extracts with a smooth, chewy, and elastic texture. The color of the F1 produces a black color, F2 a deep black, and F3 a deeper black. The results obtained in F1, F2, and F3 show a difference in color due to the quantity of extract from banana leaf sheathand kersen's leaf added to the preparation. The results are in line with research by (Rani & Mahfur, 2023) who made a patch preparation of rambusa leaf extract with HPMC polymer, where the results of the organoleptic test showed that more extract entered in the preparation, the darker color of patch produced.

The color intensity of the patch increased proportionally with higher extract concentrations, a phenomenon consistent with the findings of Rani & Mahfur (2023) regarding rambusa leaf extract patches formulated with HPMC polymer. Mechanistically, this color deepening is attributed to the higher concentration of natural pigments such as chlorophylls, flavonoids, and tannins present in the banana stem and kersen leaf extracts which act as chromophores that absorb specific wavelengths of visible light within the polymer matrix.

Conversely, variations in the extract concentration did not markedly alter other physical parameters, such as thickness, weight uniformity, or folding endurance. This occurs because the overall structural integrity and mechanical properties of the patch are predominantly dictated by the polymer network density of the film-forming agent (HPMC). Since the HPMC concentration was maintained relatively constant across the formulas, the polymer chains successfully sustained a uniform matrix architecture, preventing minor variations in extract solute load from disrupting the physical dimensions and flexibility of the patches. The texture of the patch produced, both F1, F2, and F3 showed a

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smooth texture in the presence of HPMC. Previous research mentioned that HPMC as a polymer can help produce patch with a smooth texture and free of aeration and wrinkles (Setiawan et al., 2024). Based on the concentration of active ingredients, F1 has a better visual than other formulations.

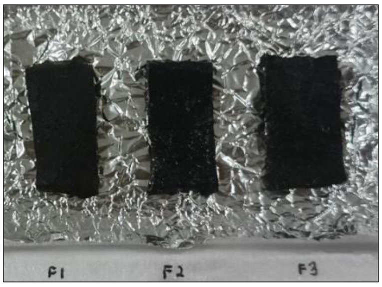

Figure 1. Patch Banana Leaf Sheath and Kersen Leaf.

While previous investigations have widely explored the standalone utilization of either banana stem extracts (Hamzah et al., 2023) or kersen leaf preparations (Nabila et al., 2023) in conventional delivery systems like ointments and gels, these studies predominantly focused on single-extract formulations and lacked optimized transdermal delivery parameters. Furthermore, prior evaluations by Rani & Mahfur (2023) demonstrated that varying extract loads in HPMC-based matrices primarily alters visual aesthetics without compromising overall mechanical strength, yet they did not assess the synergistic potential of combining distinct plant matrices. The present study directly addresses these methodological limitations by combining ambon banana stem and kersen leaf extracts into an integrated HPMC-based patch. By demonstrating that dual-extract integration can be successfully stabilized within a single polymer matrix while meeting rigorous physical and physiological standards, this research advances current knowledge by offering a multi-functional transdermal platform that synergizes distinct phytochemical profiles for enhanced topical delivery.

Weight Uniformity

The weight uniformity test was carried out by weighing 4 patches from each formulation and then calculating the average weight.

Table 3. Weight Uniformity Test Results of Patch from Banana Leaf Sheath and Kersen Leaf Extract.

Weight Uniformity Test (g)		Formulation		
		F1	F2	F3
Replication	1	0.4	0.5	0.5
	2	0.4	0.5	0.5
	3	0.4	0.5	0.5
	4	0.5	0.5	0.5
Average ± SD		0.425 ± 0.0500	0.500 ± 0.0000	0.500 ± 0.0000
Description		Qualified	Qualified	Qualified

The results of weight uniformity test for patch that is F1 has a Standard Deviation (SD) of 0.0500 while F2 and F3 have an SD of 0.0000. From these results, it is known that there is no significant difference between formulations, indicating that the different concentrations of extracts added have no effect on the weight produced. The patch produced have a non-uniform weight on each patch, this can be caused by the inequality of distribution when the preparation mixture is poured into the mold and there are solvents that are still trapped in patch (Suryani et al., 2023). However when viewed from the parameter for patch weight uniformity test is that the patch is said to be good if has SD ≤0.05, so that F1, F2, and F3 can be said to be qualified because have SD ≤0.05 (Salim et al., 2024). This test is carried out to measure the balance of weight between patch so as to ensure that the subtances contained in it are balanced.

Thickness

The thickness test in this study by measuring the thickness of the patch at 3 points using a scrub micrometer, then continuing to calculate the average thickness of each patch in each formulation. This procedure was performed to ensure the uniformity of patch thickness.

Tabel 4. Thickness Test Results of Patch from Banana Leaf Seath and Kersen Leaf.

Thickness Test		Formulation		
		F1	F2	F3
Replication	1	0.3	0.3	0.3
	2	0.3	0.4	0.4
	3	0.4	0.4	0.3
	4	0.4	0.3	0.4
Average ± SD		0.350 ± 0.0577	0.350 ± 0.0577	0.350 ± 0.0577
Description		Qualified	Qualified	Qualified

The results of the thickness test on the patch of banana leaf sheathand kersen leaf showed that F1, F2, and F3 have the same average thickness of 0.350 mm. The thickness test results of each formula are in line with the quality of a good patch which is no more than 1 mm (Setyaningrum et al., 2024). Patch thickness affects the drug release time so that thin patch is easier to penetrate the skin and faster the effect (Asworo & Widwiastuti, 2023). The space of the mold and the technique of pouring the patch solution into the mold can affect the thickness of the resulting patch (Mudaningrat et al., 2023). Differences in extract concentration in this research had no effect on patch thickness.

Folding Resistance

The folding resistance test in this study was carried out by folding the patch repeatedly in the same place until the patch was damaged or reached 300 folds. This test was used to see the flexibility and elasticity of the patch.

Table 5. Folding Resistance Test Results of Patch from Banana Leaf Sheath and Kersen Leaf Extract.

Folding Resistance Test		Formulation		
		F1	F2	F3
Replication	1	>300	>300	>300
	2	>300	>300	>300
	3	>300	>300	>300
	4	>300	>300	>300
Average ± SD		300 ± 0.000	300 ± 0.000	300 ± 0.000
Description		Qualified	Qualified	Qualified

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The results of the three formulation have the same folding resistance of more than 300 folds. A good patch is qualified as a patch that has a folding resistance of ≥200 folds, so the results of the folding resistance test of banana leaf sheath and kersen leaf patch can be said to be qualified (Lukito & Hujafad, 2024). Patch with both high and low extract concentrations can still produce folding resistance up to 300, meaning that these differences do not affect the folding resistance results. According to previous research, good folding resistance results can be caused by the use of propylenglycol as a plasticizer which can help the patch to be more flexible and elastic so that is not easily torn (Nabila et al., 2023).

pH

The pH test in this study was carried out by add 2ml of aquadest to the patch of Banana leaf sheath and kersen leaf, then allowed to set for a few minutes until the patch swelled. The next step is measuring the pH by placing pH paper on the patch. The pH test is carried out to find out the safety of the patch that has been made because the pH should not be too acidic which can cause the skin to become irritated and the pH should not to be base which can cause scaly skin (Lestari et al., 2025; Yulianti et al., 2021).

Table 6. Freeze Thaw Test Results of Patch from Banana leaf sheath and Kersen Leaf Extract.

Test Parameters	Formulation	Before Freeze Thaw	After Freeze Thaw	Description
Organoleptic Test	F1	Black color, extract scent, smooth, chewy, and elastic texture.	Black color, extract scent, smooth, chewy, and elastic texture.	Qualified
	F2	Deep black color, extract scent, smooth, chewy, and elastic texture.	Deep black color, extract scent, smooth, chewy, and elastic texture.	Qualified
	F3	Deeper black color, extract scent, smooth, chewy, and elastic texture.	Deeper black color, extract scent, smooth, chewy, and elastic texture.	Qualified
Weight Uniformity Test	F1	0.425 ± 0.0500	0.425 ± 0.0500	Qualified
	F2	0.500 ± 0.0000	0.500 ± 0.0000	Qualified
	F3	0.500 ± 0.0000	0.500 ± 0.0000	Qualified
Thickness Test	F1	0.350 ± 0.0577	0.350 ± 0.0577	Qualified
	F2	0.350 ± 0.0577	0.350 ± 0.0577	Qualified
	F3	0.375 ± 0.0500	0.375 ± 0.0500	Qualified
Folding Resistance Test	F1	300 ± 0.000	300 ± 0.000	Qualified
	F2	300 ± 0.000	300 ± 0.000	Qualified
	F3	300 ± 0.000	300 ± 0.000	Qualified
pH Test	F1	6 ± 0.000	6 ± 0.000	Qualified
	F2	6 ± 0.000	6 ± 0.000	Qualified
	F3	6 ± 0.000	6 ± 0.000	Qualified

Based on the pH test results, all formulation has pH 6, so the patch can be stated as qualified because it is still in the normal skin pH range of 4.5-6.5 (Talia et al., 2025). The results of the pH test showed that the different concentration of banana leaf sheath dan kersen leaf extracts added did not affect the pH of the patch produced.

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Freeze Thaw

The freeze thaw test was applied to the patch of banana leaf sheath and kersen leaf extracts by store the patch of each formulation in a refrigerator at 4°C for 48 hours followed by store in an oven at 40°C for 48 hours. This treatment was repeated up to 5 cycles. The freeze thaw test is used to find out the stability of the physical condition of the patch before and after storage periods with different temperatures through several tests such as organoleptic tests, weight uniformity, thickness, folding resistance, and pH (Safutri et al., 2024). The results of the freeze thaw of patch from banana leaf sheathand kersen leaf extract are that there is no change both before and after the test, this shows that the physical condition of the patch is still stable after being stored at different temperatures repeatedly.

CONCLUSION

Based on the results of research the difference in the quantity of viscous extract of banana leaf sheath and kersen leaf significantly affects the results of color test and, the patch from banana leaf sheathand kersen leaf extracts with HPMC polymers meet the requirements of a good patch. In conclusion, the combination of ambon banana stem and kersen leaf extracts was successfully formulated into HPMC-based transdermal patches. Variations in the extract concentration visually altered the color intensity of the patches, yielding darker coloration at higher concentrations. Comprehensive physical evaluations demonstrated that the formulated patches met standard quality requirements regarding organoleptic properties, weight uniformity, thickness, folding endurance, surface pH, and freeze-thaw stability. However, this study is limited to physical and macroscopic characterizations without assessing in vitro drug release kinetics or in vivo wound-healing efficacy. Therefore, future investigations should focus on evaluating the drug release profiles, permeation characteristics, and therapeutic efficacy of the combined extract patch to establish its clinical viability for traditional wound-care applications.

RECOMMENDATION

This study aims to optimize the formulation of HPMC-based patches containing banana leaf sheathand kersen leaf extracts. Variations in the concentrations of HPMC and the extracts need to be tested to produce patches with good physical properties. In addition, their antibacterial and wound-healing activities also need to be evaluated. The results of this study are expected to identify the optimal formulation. This research has the potential to support the development of modern herbal preparations.

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Hopefully, this research will contribute to the development of pharmaceutical science, especially in natural-based patch formulations.

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