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FORMULATION OF JAVA ACID LEAVES (*Tamarindus indica* L.) ETANOL EXTRACT SALEP DEVICES WITH ABSORPTION, HYDROCARBON, WATER SOLUTION AND WATER WASHABLE BASIS (O/W EMULSION)

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ABSTRACT

Tamarind leaves have flavonoid, tannin and saponin compounds, which can be used as antibacterials. Research has been conducted on the formulation of ointment preparations from tamarind leaf ethanol extract (*Tamarindus indica* L.) using a variety of ointment bases, namely absorption, hydrocarbon, water soluble and washable with water (O/W emulsions). This study aims to determine the physical stability and the appropriate type of ointment base of tamarind leaf ethanol extract ointment preparation. The extraction process in this study used maceration method with 70% ethanol solvent. The formalized preparation was evaluated for physical stability for 10 days at 4°C and 25°C alternately every 24 hours (1 cycle). The evaluation included organoleptic test, pH, homogeneity and spreadability. Absorption ointment made from ethanol extract of tamarind leaves is light brown in color, smells typical of tamarind, homogeneous, has a pH of 4 and has a spreadability of 5 cm. Hydrocarbon ointment is dark brown in color, smells typical of tamarind, homogeneous, has a pH of 3 and has a spreadability of 3.95 cm. Water soluble ointment with ethanol extract of tamarind leaves is dark brown in color, smells typical of tamarind, homogeneous, has a pH of 3 and has a spreadability of 5.3-5.5 cm. Water washable ointment (O/W emulsion) is light brown in color, smells typical of tamarind, homogeneous, has a pH of 4, and has a spreadability of 3.93 cm. Based on the test results in this study, it can be concluded that the formulation of ethanol leaf extract preparation.

Introduction

Tamarind (*Tamarindus indica* L.) is one of the plants that can be used as medicine, where this plant is widespread in Indonesia. Characteristics of tamarind trees have a height that can reach 20 meters. The trunk is woody and branched, the leaves are even-pinnate compound. Each leaf consists of more than 10 pairs of leaflets that sit opposite, each leaflet is ovoid and green. Tamarind plants can be used as therapy for diarrhea, dysentery, antimicrobials, peptic ulcers, spaspolytics, and wound healing (Susilowati , et al., 2020).

This plant also includes having a diverse utilization side, living in a tropical climate, so that tamarind plants can also be found. almost all regions of Indonesia. In a phytochemical identification study conducted on tamarind leaves, it was proven to contain flavonoids, tannins,

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glycosides and saponins. The ethanol extract of tamarind leaves has antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* ATCC at concentrations of 20%, 40%, 60%, 80% and 100%, where the inhibition of growth against the two bacteria formed an inhibition zone diameter of 10.5 mm, 11.25 mm, 12.75 mm, 13.75 mm, and 15 mm on *Staphylococcus aureus*, while *Escherichia coli* formed an inhibition zone with a diameter of 10 mm, 13.5 mm, 13.25 mm, 14 mm, and 15 mm (Makian, et al., 2023). The plant has various benefits ranging from seeds, stems, fruits, and leaves. Tamarind leaves have benefits as a natural sunscreen because they contain flavonoid compounds. The chromophore group on flavonoids has the potential as a sunscreen because it can absorb UV rays. In previous research, tamarind leaf ethanol extract with a concentration of 1000 ppm has a sun protection factor (SPF) value of 29.995 which is included in the ultra category (Anggriyani and Endriyatno, 2024).

In an effort to maximize the utilization of tamarind leaf ethanol extract, formulation is necessary. The choice of ointment base is one of the things that must be considered in making ointments. Based on their composition, ointment bases are classified into absorption, hydrocarbon, water-soluble and water-washable ointment bases (O/W emulsions). Ointment base has 2 phases, namely the water phase and the oil phase. Ointment is a topical drug that contains two basic components, namely the carrier substance and the active substance. The active substance is a component of topical ingredients that has a therapeutic effect, while the carrier substance is the inactive part of the topical preparation which can be liquid or solid that brings the active ingredient into contact with the skin. Ideally the carrier is easy to apply, easy to clean, non-irritating and pleasant (Mulyani, et al., 2020).

Extracts produced from tamarind seeds were made to be an ointment to facilitate it and for easy to used. Extraction is the first step in the process of withdrawing soluble chemical content, so that it is separated from insoluble materials using solvents. Extract is a concentrated preparation obtained by extracting active substances from vegetable simplisia or animal simplisa using an appropriate solvent, where almost or even all of the solvent is evaporated and the remaining mass is treated according to the provisions so that it meets the standards that have been applied (Makian, et al., 2023). Based on the description above, the authors are interested in formulating an ointment preparation from tamarind leaf ethanol extract (*Tamarindus indica* L.) with absorption, hydrocarbon, water-soluble and water-washable (O/W) bases. Absorption ointment base is called fatty ointment base where this ointment base functions as an emollient. Hydrocarbon ointment bases are fatty ointment bases that are also used as emollients and are difficult to wash off. Water soluble ointment base is a non-fatty ointment base and can be washed off with water. The advantages of this base are the non-stimulating nature of PEG, good adhesion and distribution on the skin, and does not inhibit gas exchange and sweat production. Water washable ointment base (O/W emulsions) is an oil-in-water emulsion ointment base that is hydrophilic because it is easily washed off the skin or wiped wet (Anggriyani and Endriyatno, 2024). The use of 4 ointment bases is used to see which base has the best hydrophilic

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properties. Good physical stability from the evaluation test results, namely organoleptic test, homogeneity test, pH test and spreadability test of tamarind leaf ethanol extract ointment preparation (Tamarindus indica L.) for 10 days at 4°C and 25°C alternately every 24 hours (1 cycle) (Ihsaniyah, et al., 2024).

Materials and Methods

Material

The materials used in this study were distilled water, stearic acid, adepslanae, cera alba, tamarind leaves (*Tamarindus indica* L.), 70% ethanol, glycerin, methyl paraben, liquid paraffin, propyl paraben, PEG 400, PEG 4000, cetyl alcohol, tea (triethanolamine) and vaselin album.

Procedures

Sample Collection

Tamarind leaves (*Tamarindus indica* L.) as much as 4 Kg, obtained from Jl. Soekarno hatta, Lampeuneureut, Aceh Besar by picking and selecting young leaves (*purposive sampling*).

Figure 1. Tamarind leaves (*Tamarindus indica* L.)

Plant Determination

Plant determination was conducted at the Biosystematics Laboratory of the Faculty of Mathematics and Natural Sciences, Biology, Syiah Kuala University. The aim was to verify the accuracy of the plant's identity that would be used in the research, thus preventing errors in material collection.

Sample Processing and Extraction

A total of 4 Kg of tamarind leaves, washed and drained, then dried in the sun (not directly) for ± 3 days, then mashed into powder using a blender, then weighed 500 g of tamarind leaf powder and extracted by maceration method with 5000 mL of 70% ethanol solvent (Wahidah, et al., 2020).

The results of the macerate were evaporated using a vacuum rotary evaporator and obtained a thick extract free of solvents.

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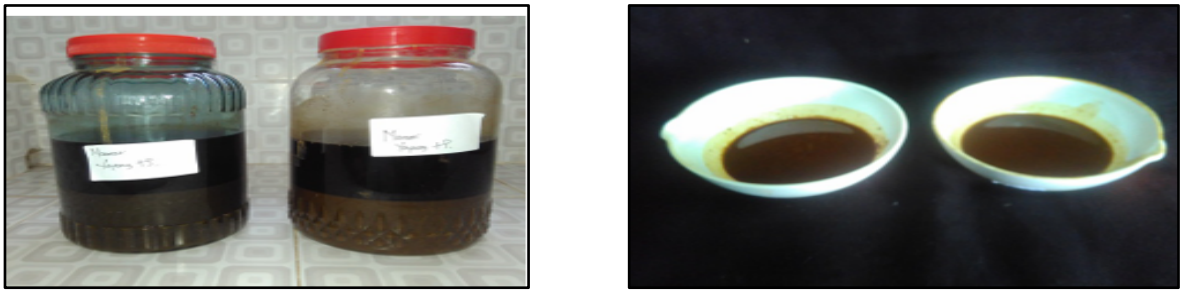

(a) (b)

Figure 2. (a) Maceration Process, (b) Tamarind Leaf Ethanol Extract (*Tamarindus indica* L.)

Ointment Preparation

Ointment preparations were made as much as 40 g for each formula (F1, F2, F3 and F4), using 50% tamarind leaf (*Tamarindus indica* L.) as the active ingredient.

Table 1. Tamarind Leaf Ointment Formulation (*Tamarindus indica* L.)

Material	F1 (g)	F2 (g)	F3 (g)	F4 (g)
Tamarind Leaf Ethanol Extract	20	20	20	20
Adepslanae	0,74	-	-	-
Stearic Acid	-	-	-	1.73
Cetyl alcohol	0,74	0,492	-	-
Glycerin	-		-	1,96
Methyl Paraben	-		0,005	0.030
Liquid Paraffin	-		-	3,68
Propyl Paraben	0,002	0,002	-	0,036
PEG 400	-	-	19,2	-
PEG 4000	-	-	4,8	-
Cetyl alcohol				0,732
TEA	-	-	-	0,12
Vaselin Album	22,52	23,49	-	-
Aquadest	-	-	-	13,07

Description: F1 : Absorption ointment base
F2 : Hydrocarbon ointment base
F3 : Water soluble ointment base
F4 : Ointment base washable with water (O/W emulsion)

Ointment Evaluation Test

a) Organoleptical Test
The organoleptical test carried out is a test of the physical appearance of the ointment preparation which includes dosage form, odor and color.

b) pH Test
A total of 0.5 g of ointment preparation was diluted with 5 mL of distilled water, then the pH stick was dipped for 1 minute. The color change that occurs on the universal pH indicates the pH value of the ointment. The pH of the preparation is said to be good, which is in accordance with the pH of the skin, namely 4.5-6.5.

c) Homogeneity Test
A total of 0.5 g of ointment preparation was taken at the top, middle and bottom. Then it is applied to an object glass or glass chip to test the homogeneity of the ointment

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preparation. Ointment preparations that are not homogeneous will be known by looking at the formation of lumps in the ointment preparation. Homogeneous ointment preparations where the ointment base, active ingredients and other additives are evenly mixed well.

d) Spreadability Test
A total of 0.5 g of ointment preparation was placed between 2 petri dishes, on top of which a 100 g load was added and left for 1 minute. The spread diameter of the ointment preparation was measured, qualified spreadability is 5-7 cm (Anggriyani and Endriyatno, 2024).

e) Stability Evaluation
In this study, the accelerated stability test was carried out using a refrigerator at 4°C and 25°C room temperature alternately every 24 hours (1 cycle) for 10 days (Ihsaniyah et al., 2024).

Results and Discussion

This research begins with the determination of plants in the Biosystematics Laboratory of the Biology Department of the Faculty of Mathematics and Natural Sciences, Syiah Kuala University to ensure that the plants used are true tamarind leaf species (*Tamarindus indica* L.) The processing of tamarind leaves includes washing, drying, and grinding. Washing aims to remove dirt that is attached, then the drying process is carried out to reduce the water content and prevent mold growth, so that it can be stored for a long period of time and the chemical composition in tamarind leaves does not change. Drying is done to reduce water content and stop the enzymatic process that occurs in the sample, besides that the sample will be more durable and make it easier for the solvent to attract active compound components during the extraction process. Furthermore, the process of smoothing the sample aims to increase the surface area of the sample so that the contact between the solvent and the sample in the extraction process is greater (Wahidah, et al., 2024). Stability is the ability of a product to maintain the same properties and characteristics as at the time of manufacture within the limits set throughout the storage and use period. The stability of the preparation can result in a decrease to the loss of drug efficacy, can turn toxic or physical changes in the preparation (color, odor, taste, concentration and others) which result in harm to consumers (Ihsaniyah, et al., 2024).

The stability test of a pharmaceutical preparation, especially a gel preparation which includes appearance, suitability, uniformity, and others are parameters that must be carried out related to the stability of the preparation. The qualitof a good semi-solid preparation is influenced by the base used, the determination of the ointment base is highly dependent on the active ingredients used, especially the active ingredients in the form of natural ingredients which also affect the stability of the preparation, so it is necessary to consider the selection of a base that is compatible with natural ingredients that affect the physical stability of the semi-solid preparation (Susilowati, et al., 2020).

The research aims to determine the formula of a physically stable ointment preparation with several ointment bases, this is intended to determine the base that is suitable for the active ingredient, namely tamarind leaf ethanol extract. Organoleptical testing of the ointment bases used produced different physical

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appearances (Table 2), where the parameters of good ointment quality are semi-solid dosage forms, ointment smells typical of the extract used and is colored like the extract.

Table 2. Organoleptical Test Results

Formula	Physical Characteristics	Result of Observation									
		Room Temperature (25°C)					Cold Temperature (4°C)				
		D1	D3	D5	D7	D9	D2	D4	D6	D8	D10
F1	Shape	Semi solid									
	Odor	Typical of tamarind									
	Color	Yellowish white									
F2	Shape	Semi solid									
	Odor	Typical of tamarind									
	Color	Dark brown									
F3	Shape	Semi solid									
	Odor	Typical of tamarind									
	Color	Dark Brown									
F4	Shape	Semi solid									
	Odor	Typical of tamarind									
	Color	Brown									

Description: F1 : Absorption ointment base
F2 : Hydrocarbon ointment base
F3 : Water soluble ointment base
F4 : Ointment base washable with water (O/W emulsion)

The pH measurement is carried out using a universal pH stick which is done by matching the color obtained with the existing color table. A good ointment preparation should have a pH that matches the pH of the skin, namely 4.5-7 so that the preparation used is safe, because a pH that is too acidic can irritate the skin and a pH that is too alkaline can make the skin scaly. The pH test results are between the pH range of good product and safe to use and does not cause irritation to the skin (Farida, et al., 2022).

In Table 3, hydrocarbon ointment base and water soluble ointment base have a pH of 3, this decrease in pH can occur due to temperature and conditions during storage and observation. The concentration of tamarind leaf ethanol extract and ointment base variations can also significantly affect the pH value of the preparation. This is because the addition of extract is inversely proportional to the addition of water, which results in a decrease in pH value. This decrease is due to the reduced amount of water used in the preparation of ointments due to the addition of tamarind leaf ethanol extract which is also the water phase, the greater the concentration used, the smaller the amount of water added. It is this reduction in water that causes the ointment preparation to be more acidic, where each O/W ointment base contains large amounts of water, while the W/O ointment base contains large amounts of oil.

Table 3. pH Test Results

Formula	Room Temperature (25°C)				
	D1	D3	D5	D7	D9
F1	4	4	4	4	4

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F2	3	3	3	3	3
F3	3	3	3	3	3
F4	4	4	4	4	4
Formula	Cold Temperature (4°C)				
	D2	D4	D6	D8	D10
F1	4	4	4	4	4
F2	3	3	3	3	3
F3	3	3	3	3	3
F4	4	4	4	4	4

Description: F1 : Absorption ointment base
F2 : Hydrocarbon ointment base
F3 : Water soluble ointment base
F4 : Ointment base washable with water (O/W emulsion)

The homogeneity test in Table 4, shows that the preparation of tamarind leaf ethanol extract ointment (*Tamarindus indica* L.) is homogeneous for all preparations and there are no visible lumps. Homogeneous ointment preparations are ointment preparations where the ointment base, active ingredients and other additives are evenly mixed well. The results of the homogeneity test for 10 days at room temperature (25°C) and cold temperature (4°C) did not change and met the requirements, namely if the ointment is applied to a piece of glass it must show a homogeneous arrangement which can be seen by the absence of clumped particles and spread evenly. This means that the variation of ointment base used in the preparation of tamarind leaf ethanol extract ointment has no effect on storage temperature (Ihsaniyah et al., 2024).

Table 4. Homogeneity Test Results

Formula	Result of Observation									
	Room Temperature (25°C)					Cold Temperature (4°C)				
	D1	D3	D5	D7	D9	D2	D4	D6	D8	D10
F1	Homogeneous									
F2	Homogeneous									
F3	Homogeneous									
F4	Homogeneous									

Description: F1 : Absorption ointment base
F2 : Hydrocarbon ointment base
F3 : Water soluble ointment base
F4 : Ointment base washable with water (O/W emulsion)

Testing the spreadability of ointment preparations in Table 5, was carried out to see the ability of the preparation to spread on the skin, where an ointment base should have good spreadability to ensure satisfactory administration of medicinal ingredients. The spreadability of tamarind leaf ethanol extract ointment preparations with various ointment bases has different spreadability values. Ointment preparations that are comfortable to use are ointment preparations that have a spreadability of 5 cm to 7 cm (Wahidah, et al., 2024). The difference in spreadability greatly affects the speed of diffusion of the active substance in passing through the

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membrane. The wider the membrane where the preparation spreads, the greater the diffusion coefficient which results in increased drug diffusion, so that the greater the spreadability of a preparation, the better (Mujahidah, et al., 2020).

Absorption ointment bases and water-soluble ointment bases that have greater spreadability than hydrocarbon ointment bases and ointment bases can be washed with water (O/W emulsions). The water-soluble ointment base has greater spreadability because the water-soluble ointment base contains PEG 400 components so that it has a greater effect on increasing spreadability compared to the absorption ointment base which contains a water-in-oil base. So the higher the amount of PEG 400 in the formula, the greater the diameter of the ointment spread, so that the ointment preparation becomes softer and easier to spread.

Table 5. Spreadability Test Results

Formula	**Room Temperature (25°C)**				
	D1	**D3**	**D5**	**D7**	**D9**
F1	4,9 cm	5 cm	5 cm	4,8 cm	5 cm
F2	4 cm	4 cm	3,94 cm	3,91 cm	3,9 cm
F3	5,3 cm	5,3 cm	5,5 cm	5,4 cm	5,5 cm
F4	3,93 cm	3,93 cm	3,93 cm	3,93 cm	3,93 cm
	Cold Temperature (4°C)				
Formula	**D2**	**D4**	**D6**	**D8**	**D10**
F1	4,9 cm	5 cm	5 cm	4,8 cm	5 cm
F2	4 cm	4 cm	3,93 cm	3,91 cm	3,9 cm
F3	5,3 cm	5,3 cm	5,5 cm	5,4 cm	5,5 cm
F4	3,93 cm	3,93 cm	3,93 cm	3,93 cm	3,93 cm

Description: F1 : Absorption ointment base
F2 : Hydrocarbon ointment base
F3 : Water soluble ointment base
F4 : Ointment base washable with water (O/W emulsion)

Conclusions

Based on the results of the study, it can be concluded that the ethanol extract of tamarind leaves (*Tamarindus Indica* L.) can be formulated into a good ointment preparation with absorption ointment base, because it meets all test parameters, namely organoleptical test, homogeneity, pH and spreadability during 10 days of storage every 24 hours (1 cycle) at room temperature (25°C) and cold temperature (4°C).

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