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Effect of Base Type Variation on Physicochemical Properties of Ambon Banana Peel (*Musa Paradisiaca* L) Methanol Extract Nanoemulsions Ointment

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Abstract
Ambon banana peel (*Musa Paradisiaca* L) contains flavonoids, tannins, terpenoids and saponins which have potential to be in the wound healing process. One of topical preparations suitable for wound healing is ointment. The ointment base can affect the release of active substances and absorption in the skin layers, since the release of the drug from its base is an important factor in the success of therapy. The aim of this study was to analyze the effect of base type variations on the physicochemical properties of ointments from banana peel methanol extract nanoemulsions. Ambon banana peel extract was obtained by maceration using methanol solvent and made in the form of a nanoemulsion. Ambon banana peel extract nanoemulsion is then added to the ointment preparation with water-soluble, absorption and hydrocarbon base types. Ointments with variations in base types were observed for physicochemical properties including organoleptic, homogeneity, viscosity, pH and spreadability. The data obtained were analyzed statistically using One Way ANOVA. The results showed that variations in base type affected on organoleptic appearance, viscosity and spreadability but had no effect on the pH value and homogeneity. The absorption base produces a formula that meets the requirements for ointment preparations.

Keywords: Ambon Banana Peel (*Musa Paradisiaca* L), Ointment, Base Type, Physicochemical

Introduction

Ambon banana peel extract is known to have a wound healing effects both on cuts and burns *in vivo*. Secondary metabolite compounds responsible for the wound healing process are flavonoids, tannins and saponins (Lovianie *et al*., 2018) [1]. Research by Yulis *et al*. (2020) [2] reported that methanol solvent can dissolve secondary metabolite compounds (flavonoids, phenolics, tannins and saponins) in banana peels more effectively than ethanol solvents and ethanol-acetone mixtures. Yellow Ambon banana peel extract has incision wound healing activity in rabbits and 15% extract concentration is a concentration that can provide a faster incision wound healing effect in rabbits between 5% and 10% concentration (Meilina *et al*., 2022) [3]. One effort to maximize the active substance can penetrate well into the skin is to use a nanoparticle delivery system so that the active substances can go directly to specific tissues and can increase the stability of the active substances (Abdassah, 2017) [4]. A topical preparation suitable for formulating active substances from ambon banana peel as a wound healer is ointment.

Ointment is a semi-solid preparation intended for external use on the skin. The carrier or base material can affect the release of the active substance and absorption in the skin layers, since the release of the active substance from its base is an important factor in the success of therapy. Medicinal material must be dissolved or dispersed homogeneously in a suitable ointment base (Anief, 2006) [5]. Apart from the type of ointment base, drug release is also influenced by the drug concentration (drug dose) in the base, the solubility of the drug in the base, diffusion time and viscosity. High drug solubility in the base will increase affinity and decrease the diffusion coefficient so that drug release becomes slow and vice versa. The concentration of the drug in the base will also affect the viscosity of the ointment where high viscosity will cause the diffusion coefficient of the drug in the base to be low so that the release of the drug becomes small. Faster diffusion times can cause greater drug release and vice versa (Voigt, 1995) [6].

Different compositions between ointment bases cause differences in dosage characteristics so the choice of base type is very important because it will affect the release of the drug. Research by Naibaho (2013) [7] reported that differences in the type of ointment base used in basil leaf extract ointment formulations had an effect on the physical properties. There are three ointment bases used in this study, namely hydrocarbon base, absorption base, and water-soluble base. Based on the above background, researchers are interested in testing the effect of base type variations on the physicochemical properties of ambon banana peel methanol extract nanoemulsion ointment.

Materials and Methods

Tools

The tools used in this study were glassware (Pyrex, Germany), rotary evaporator (Cole-Parmer, US), digital scales (PRECISA), oven (Memmert; Schwabach, Germany), moisture analyzer (OHAUS MB25), pH-Meter (ATC, China), viscometer (NDJ-8S), refrigerator (Samsung, Indonesia), and spreadability test equipment.

Materials

The materials used in this study were ambon banana (Karanganyar, Indonesia), methanol (Repacking by CV Agung Jaya), tamanu oil (PT Darjeeling Sembrani Aroma), Tween 80, PEG 400 (Kimia Market), distilled water (Saba Kimia), propylene glycol (Kimia Market), Vaseline album, Adeps lanae, Sptearyl alcohol (Agung Jaya), cera Alba (Eden®), PEG 4000(Arrow®), phenoxyethanol (CV Cipta Kimia Solo).

Preparation of ambon banana peel methanol extract

900 grams of ambon banana peel was mashed and soaked in methanol solvent with a ratio of 1:5 for 3 days accompanied by stirring every 24 hours. The filtrate obtained was then concentrated using a rotary evaporator at temperature below 60ºC until a thick extract was obtained (Lystiyaningsih and Ermawati, 2014; Behiry *et al*., 2019) [8, 9]. The resulting thick extract was observed for its organoleptic appearance and the yield percentage was calculated using the following formula:

$$\%\ yield = \frac{thick\ extract\ weight}{Initial\ sample\ weight} \times 100\%$$

Preparation of ambon banana peel methanol extract nanoemulsion

The nanoemulsion was made by adding 150 mg of ambon banana peel methanol extract to the SNEDDS system consisting of tamanu oil: tween 80: propylene glycol (1:9:1). The mixture was then homogenized with a vortex for 1 minute, sonicated for 15 minutes and incubated in a waterbath at 45°C for 10 minutes (Ermawati, 2018) [10].

Ointment preparation with base type variation

The ointment preparation is formulated into three formulas consisting of water-soluble, absorption and hydrocarbon bases where each formula will be made in three replications. The method used to make ointment is the melting method. The composition of each formula with a variety of bases can be seen in Table 1.

Table 1: Formulation Design for Ambon Banana Peel Methanol Extract Nanoemulsions Ointment

Materials	Base Type (g)			Function
	F1	F2	F3	
Nanoemulsion extract	18,4	18,4	18,4	Active substance
Vaseline album	-	68,8	68	Base
Adeps Lanae	-	2,4	12	Base
Sptearyl alcohol	-	2,4	-	Humectant
Cera alba	-	6,4	-	Base
PEG 4000	32	-	-	Base
PEG 400	48	-	-	Base
Phenoxyethanol	1,6	1,6	1,6	Preservative
Total weight	100	100	100	

Description: F1 (Water soluble base), F2 (Absorption base), F3 (Hydrocarbon base)

The procedure for making ointment is carried out by weighing all the ingredients and melting the carrier or base for each formula in a water bath using a petri dish. The melted material is put into a warm mortar and homogenized. After the mass is formed, the extract nanoemulsion is added to the mixture and phenoxyethanol is added as a preservative.

Physicochemical evaluation of the ointment

Organoleptic appearance

Organoleptic tests are carried out by visual observation using the five senses to describe the consistency, color and odor of the preparation (Ermawati and Wulandari, 2018) [10]. According to the Indonesian Ministry of Health, the ointment specifications that must be met are choosing a semi-solid form, the color must match the specifications when initially making the ointment and the smell must not be rancid (Sari *et al*., 2016) [11].

Homogeneity

Ointment preparations at the top, middle and bottom are taken, then placed on a glass plate, then rubbed and touched. The homogeneity of ointment preparation is characterized by the absence of solid material remaining on the preparation and having an flat structure (Anonymous, 1979) [12].

Viscosity

Viscosity testing is carried out by inserting the ointment preparation into a beaker glass and installing the rotor on the test equipment, conditioned so that the rotor is immersed in ointment preparations, observed the scale indicated by the needle until it shows a stable number, good viscosity value is between 200 to 400 dPas (Septiani *et al*., 2012) [13].

pH

pH value was measured using a pH meter dipped in 0.5 g of ointment which had been diluted with 5 mL of aquadest. Good ointment pH value is between 4.5-6.5 or according to the pH value of human skin (Sari *et al*., 2016) [11].

Spreadability test

Spreadability test was carried out by weighing 0.5 grams of ointment and placing it on a round glass with another glass placed on top then leaving it for 1 minute. Diameter of the ointment spread was measured. After that, 100 grams of load was added and left for 1 minute then the constant diameter was measured (Pratimasari *et al*., 2015) [14]. The diameter of a good spread of ointment is between 5-7 cm (Sari *et al*., 2016) [11].

Results and Discussion

Quality control results of ambon banana peel methanol extract

Organoleptic appearance

Based on observations made with the five senses, ambon banana peel methanol extract has a thick consistency, blackish brown in color and has a typical banana aroma.

Yield

From 900 grams of extracted banana peel pulp, 40 grams of thick extract were obtained so that the yield was 4.44%.

Physicochemistry evaluation results of ambon banana peel methanol extract nanoemulsion ointment

Organoleptic appearance

Organoleptic testing is very important because it determines the quality of the ointment preparation with the naked eye and looks at the physical results of the ointment from the shape, smell and color of the ointment. The requirements for a good ointment must not be rancid and have a soft consistency (Anief, 2007) [15]. The organoleptic test results can be seen in Table 2.

Table 2: Organoleptic test result of ambon banana peel methanol extract nanoemulsion ointment

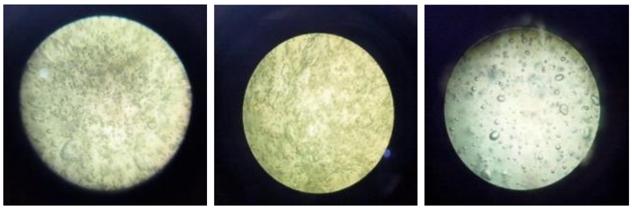
	F1	F2	F3
Color	+	++	+
Odor	Typical ambon banana	Typical ambon banana	Typical ambon banana
Consistency	++	+	+++

Description: F1 (Water soluble base), F2 (Absorption base), F3 (Hydrocarbon base), Ointment color: Yellow, Consistency: semi solid.

The results of organoleptic testing on variations in ointment bases showed differences in the color and consistency of the preparation but had no effect on odor. All three formulas produce the typical smell of Ambon banana peel extract. The order of ointment consistency from the thickest is hydrocarbon base ointment, water soluble base ointment and absorption base ointment. The color of the ointment produced is yellowish where the absorption base ointment has a more intense color compared to the water-soluble base or hydrocarbon base.

Homogeneity

The homogeneity test is used to see the mixability of the active substances in the preparation seen by the presence or absence of coarse granules in the ointment. A homogeneous preparation indicates an even distribution of the active substance in the base (Masadi *et al*, 2018) [16]. Ambon banana peel methanol extract nanoemulsion as the active substance must be dispersed and mixed homogeneously in the dispersion medium (base) in order to provide maximum effect as a wound healer. The observation of ointment homogeneity can be seen in Fig 1.



a Water-Soluble b absorption c Hydrocarbon

Fig 1: Microscopic appearance of homogeneity testing results of ambon banana peel methanol extract nanoemulsion ointment with base type variations

Observation of homogeneity in plain view shows that the three formulas have a homogeneous composition, characterized by the absence of coarse grains in the preparation applied to the glass. This is due to the ointment making process where all the ingredients used to make this ointment are mixed perfectly to produce a homogeneous product. Observations using a microscope also showed that the ointment preparation was homogeneous, but the hydrocarbon-based ointment looked like there were air bubbles, which was probably caused by uneven application during testing. Based on these results, it can be said that variations in base type have no effect on the homogeneity of the ointment preparation.

Viscosity

Viscosity test is carried out to determine the viscosity of a preparation. A good viscosity value is 200 to 400 dPas (Septiani *et al*., 2012) [13]. The viscosity results of the ointment can be seen in Table 3.

Table 3: Viscosity test result of ambon banana peel methanol extract nanoemulsion ointment

Formula	Viscosity value (dPa.s)			
	R1	R2	R3	Mean ± SD
F1	400	400	412	404,00 ± 6,9*
F2	210	250	300	253,33 ± 45,1
F3	410	405	400	405,00 ± 5,0*

Description: F1 (Water soluble), F2 (Absorption), F3 (Hydrocarbon). The *sign indicates a significant difference with F2.

The results of statistical analysis using ANOVA showed a sig of 0.001 (<0.05) which indicates that there is a significant difference between the formulas. Further tests using Post Hoc Bonferroni showed that groups F1 and F3 had significant differences with F2. This can also be seen when organoleptic testing of groups F1 and F3 both have a thicker consistency compared to F2. From these data it can be concluded that differences in base variations affect the viscosity value of the ointment. Absorption base ointment meets the requirements for a good ointment.

pH

pH test is carried out to see the acidity and alkalinity levels of ointment preparation which can ensure that the ointment doesn't cause irritation to the skin or make the skin scaly (Naibaho *et al*, 2013) [7]. The pH measurement results of the ointment can be seen in Table 4.

Table 4: pH test result of ambon banana peel methanol extract nanoemulsion ointment

Formula	pH value			
	R1	R2	R3	Mean ± SD
F1	7,02	6,81	6,92	6,92 ± 0,11
F2	6,66	7,01	6,97	6,88 ± 0,19
F3	7,20	7,21	7,07	7,16 ± 0,0,8

Description: F1 (Water soluble), F2 (Absorption), F3 (Hydrocarbon).

The pH value of a good ointment is 4.5-6.5 or in accordance with the pH value of human skin (Sari and Maulidya, 2016) [11]. The results obtained showed that all formulas didn't meet the requirements for a good ointment pH value, but the absorption base ointment had the closest value. The results of statistical analysis using ANOVA showed a sig of 0.083 (>0.05), which indicated that there were no significant differences between formulas, so it could be concluded that base variations had no effect on the pH value between formulas.

Spreadability test

The spreadability test is carried out to see the ability to spread the ointment on the skin surface. An ointment preparation is expected to have the ability to spread easily at the site of administration without using excessive pressure (Alissya *et al*., 2013) [17]. The easier the ointment is applied to the skin, the surface area of the drug attached to the skin becomes larger so that the absorption of drugs from the place of administration is more optimal or faster. The results of measuring the spreadability of the ointment can be seen in Table 5.

Table 5: Spreadability test result of ambon banana peel methanol extract nanoemulsion ointment

Formula	Spreadability diameter (cm)			
	R1	R2	R3	Mean ± SD
F1	2,8	2,6	3,0	2,80 ± 0,20
F2	4,8	5,4	4,7	4,97 ± 0,37
F3	3,9	4,2	3,9	4,00 ± 0,17

Description: F1 (Water soluble), F2 (Absorption), F3 (Hydrocarbon)

Theoretically, different types of base will provide differences in spreading power because it is related to the consistency of the base produced and also related to the constituent components of the base. Absorption bases have greater spreading power than water-soluble and hydrocarbon bases. The resulting value is also in line with the viscosity, where the smaller the viscosity, the greater the spreadability. The spreadability diameter of the three ointment formulas still doesn't meet the requirements for a good spreadability diameter because it isn't in the range of 5-7 cm. However, from this table it can be seen that F2 has a spreading power that is closest to the requirements. The results of statistical analysis using ANOVA show a sig of 0.000 (<0.05) which indicates there is a significant difference between the formulas. Based on the Bonferroni Post Hoc test, it can be seen that F1, F2 and F3 show differences with each other. Thus, it can be concluded that variations of the base affects the spreadability of the ointment.

Conclusion

Based on observations of physicochemical properties of ambon banana peel methanol extract nanoemulsion ointment, different bases type have an effect on organoleptic appearance, viscosity values and spreadability but have no effect on pH and homogeneity. F2 ointment with an absorption base is the one that most meets the requirements of a good ointment preparation.

Recommendations

Suggestions for further research include testing the physicochemical stability of ointment preparations and testing the wound healing activity.

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