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Test of sunscreen activity of pineapple weevil ethanol extract (ananas comosus (L.) merr.) in gel and lotion preparations

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ABSTRACT Pineapple weevil waste is a residual part of the pineapple flesh, which is usually thrown away and not used because of its hard inside. Sunscreen is a skin care product that serves to protect the skin from the dangers of the sun's rays. This study aimed to identify the activity of gel and lotion sunscreens from pineapple weevil extract. This research method is pineapple weevil extract formulated into gel and lotion preparations, evaluation of the physical quality of preparations including organoleptically, homogeneity, pH, viscosity, dispersion, and adhesion, as well as determination of SPF values of gel and lotion preparations using UV spectrophotometry. The study results were obtained from organoleptic gel preparations with a yellow color, gel shape, homogeneous, pH 7-7.6, viscosity 4340-5650 Cpoises, spreading power 6.6-7cm, adhesion -7-4.46 seconds. At the same time, the lotion preparation has a yellow color, lotion shape, homogeneous, pH 7.3, a viscosity of 1530 Cpoises, a spreading power of 7cm, and adhesion of 4.06 seconds. The SPF value obtained by the pineapple weevil sunscreen gel, which is 30.15, is included in the ultra protection. Meanwhile, pineapple weevil sunscreen lotion, which is 42.23, is included in the ultra protection. Overall, the pineapple weevil gel and lotion have good physical quality and efficacy as sunscreen.

1. INTRODUCTION

Pineapple (Ananas comosus (L.) Merr.) is one type of fruit that is in demand by the community, both locally and globally. Pineapple is a plant that thrives in Indonesia. Pineapple is a plant thought to have originated in South America that was discovered by Europeans in 1493 on the island of Caribean (Lawal, 2013). Pineapple weevil waste includes organic waste that still contains many nutrients that can be utilized. It will pollute the environment without proper handling (Kibria, 2023).

In the study Hikal et al. (2021), pineapple fruit (Ananas comosus (L.) Merr.) contains ananasic acid, citric acid, saponins, flavonoids, polyphenols, and bromelain enzymes. In addition, pineapple fruit also contains vitamin C and vitamin A (retinol). These two vitamins have long been known to act as antioxidants that can stop the chain reac- tion of forming free radicals in the body. The study Zulfa & Fatchurrohman (2019) found that pineapple skin ethanol extract has sunscreen activity with an ultra-category SPF value. Based on research Hashib et al. (2019) on pineapple fruit which contains the highest antioxidants found in pineapple weevils compared to other parts, which is 83.4%. Pineapple weevil is an organic waste that still contains many nutrients that can be utilized. It will pollute the environment without proper handling (Dohude & Thandapani, 2020; Fitriyanti et al., 2019).

Sunscreen is a cosmetic ingredient that can physically or chemically inhibit the penetration of ultraviolet rays into the skin (Yulianti et al., 2015). The ability of a sunscreen to protect the skin and prevent sun exposure can be determined by its effectiveness using sun protection factor (SPF) values. The higher the SPF value of a sunscreen ingredient, the better its protective ability against the skin Ayuchecaria et al. (2022). Indonesia is an archipelagic country that has a tropical climate that gets more sunlight, so that it can increase the risk of skin damage due to sunlight. Chronic exposure to ultraviolet rays from the sun will result in changes in skin structure and oxidative stress on the skin (Hernández et al., 2019).

The sun emits rays containing ultraviolet (UV) radiation that humans cannot see and feel directly. Ultraviolet rays from the sun have good benefits, including the formation of cholecalciferol (Vitamin D3) (Prietl et al., 2013). Sunlight can cause problems on the skin, especially in the tropics, which are illuminated by the sun with a more prolonged intensity. The problem is caused because the sun's rays have radiation. Excessive exposure to ultraviolet radiation can cause skin disorders such as hyperpigmentation, sunburn, early exposure, black, scaly skin, and skin cancer (Gupta et al., 2016).

The skin is the part that covers the body's surface and functions as a protector from ultraviolet rays emitted by the sun (de Gálvez et al., 2004). If the skin is exposed to

sunlight, two types of melanin reactions will arise, such as the rapid addition of melanin to the surface of the skin and the formation of new melanin additions. However, if the skin is exposed to UV rays continuously, it can damage the skin (Zulfa & Fatchurrohman, 2019), resulting in damage to the skin (Panich et al., 2015). Therefore, to keep the skin from the adverse effects of UV radiation, it is necessary to protect using sunscreen. Few sunscreens use active substances from active compounds of natural ingredients because synthetic chemicals dominate them. Using sunscreens from synthetic chemicals can irritate and cause contact allergies (Elcistia & Zulkarnain , 2019).

Sun Protecting Factor (SPF) is the value listed on the sunscreen product label that states the efficacy of a sunscreen preparation. SPF is a universal indicator of a substance or preparation that is an ultraviolet protector. The higher the SPF value of a sunscreen product, the higher it is to protect the skin from the adverse influence of the sun's ultraviolet rays (Dutra et al., 2004). SPF compares the minimum dose required to cause erythema on the skin smeared with sunscreen preparations and those not.

Sun Protecting Factor (SPF) measures sunscreen's ability to prevent skin damage. Sunscreen with SPF states the length of time a person's skin is in the sun without having burns, while the SPF number states how many times the natural endurance of a person's skin is doubled so that it is safe under the sun without being exposed to burns. Sunscreen preparations are based on the pricing of SPF (Sun Protected Factor), which describes the ability of sunscreen products to protect the skin from erythema. The effectiveness of a sunscreen preparation can be shown one of them is with the SPF value, which is defined as the amount of UV energy needed to achieve a Minimum Erythema Dose (MED) on the skin protected by a sunscreen, divided by the amount of UV energy needed to achieve MED on the skin that is not given protection. MED is defined as the lowest period or dose of UV light radiation needed to cause the occurrence of erythema (Dutra et al., 2004).

The price of SPF can be determined in vitro and in vivo. In vitro, UV light absorption activity can be tested with UV spectroscopy techniques measured in the UV light wavelength range (200-400 nm). The SPF value compares Minimal Erythema Dose (MED) on sunscreen-protected human skin with MED without sunscreen protection. Sun Protection Factor (SPF) is a universal indicator that explains the effectiveness of a product or substance that is a UV protector. The higher the SPF value of a product or active substance of sunscreen, the more effective it is to protect the skin from the adverse influence of UV rays (Dutra et al., 2004).

Gel is a semi-dense system (mushy mass) consisting of a suspension made from small inorganic particles or large organic molecules penetrated by a liquid. If the gel mass consists of a separate network of particles, the gel is classified as a two-phase system (e.g., aluminum hydroxide gel). In a two-phase system, if the particle size of the dispersed phase is relatively large, the gel mass is sometimes expressed as magma, where the mass is thixotropic, meaning that the mass will thicken if it is allowed to stand still and will melt again if shaken (Bilal et al., 2023).

Gels are semi-solid in the form of either a suspension of inorganic fine particles or large organic molecules that interpenetrate with each other with liquids. Because gelling agents do not dissolve completely or because they form aggregates that can refract light, this system can be transparent or cloudy (suspension of dispersed colloidal particles or colloidal gels that have a 3-dimensional structure) (Goeswin, 2015).

Gels are formulated as dispersed systems, consisting of at least two phases: a solid phase and a liquid phase (lyophile gel) or a gaseous phase (xerophile gel). The gel is generally a transparent and translucent semi-dense preparation containing active substances in a dissolved state (Bilal et al., 2023). Polymers commonly used to make pharmaceutic gels include tragakan natural gom, pectin, carrageen, agar, and alginic acid, as well as synthesis and semisynthetic materials such as methylcellulose, hydroxy ethyl cellulose, methyl carboxy of sodium cellulose and carbopol which combines synthetic vinyl polymers with ionized carboxyl groups. A melting process makes gels or a particular procedure is required concerning the expanding properties of the gel (Lachman, 1986).

Lotions are preparations for solutions, suspensions, or emulsions intended for use on the skin. Lotion can be defined as a diluted cream. Lotions are emulsions, but their wax and oil content is lower than creams. This causes the lotion to be thinner and less oily, giving a sense of comfort and goodness. As an emulsion, lotions have as many difficulties in their manufacture as creams, but lotions are easier to make than creams because they are thinner, and their heating and cooling times are shorter.

The function of lotions is to retain skin moisture, soften and cleanse, and prevent water loss. The components that make up the lotion are moisturizers, emulsifiers, active ingredient bases, solvents, fragrances, and preservatives. Lotions are made by mixing soluble ingredients in the fat phase with heating and stirring. In general, the carrier of lotions is water. Its viscosity allows for even and rapid wear on a wide skin surface. Lotions are intended to dry immediately after use (Ansel, 2005).

2. METHOD

2.1 Making Extracts

Making pineapple weevil extract is carried out by maceration. 500 g of simplicity powder is put into a vessel, poured with 75 parts of 96% ethanol solvent, as much as 3750 mL, allowed to stand for five days protected from light while occasionally stirring, then squeezed so that maserat I am obtained. Then the obtained pulp is rinsed with 25 parts of 96 % ethanol, as much as 1250 mL, and transferred into a closed vessel (maserat I and maserat II) to leave in a cool place protected from sunlight for two days. Enap pour or filter so that maserat results are obtained, then concentrate on a rotary evaporator at no more than 50°C until a viscous extract is obtained.

2.2 Made of Sunscreen Gel Preparations

PPreparations are made based on the standard formula of the Na-CMC gel base, can be seen in the Table 1 below:

Ingredients are weighed according to the above formulation. Pineapple weevil ethanol extract is dissolved in part of the water until it dissolves; dissolve Na-CMC with boiling water until fluffy and homogeneous, and then add ethanol extract that has been dissolved with aquadest. Glycerin is added, and propilenglikol by stirring continuously until a homogeneous gel is formed and packaged in a gel container (Ermawati et al., 2022).

TABLE 1. Made of sunscreen gel preparations

No	Name of Ingredients	Formula	
		F0	F1
1	Ethanol extract of pineapple weevil	-	2%
2	Na-CMC	5%	5%
3	Glycerin	10%	10%
4	Propilenglicol	5%	5%
5	Aquadestad	100%	100%

Description:
F1=blank
F2=ethanol extract gel preparation of pineapple weevil with a concentration of 20000 ppm

2.3 Made of Sunscreen Lotion Preparations

The design of the formula for making lotion preparations from pineapple weevil ethanol extract can be seen in the Table 2 below:

TABLE 2. Formula for making lotion preparations from pineapple skin ethanol extract

No	Name of Ingredients	Formula	
		F0	F1
1	Ethanol extract of pineapple weevil	-	2%
2	Cera alba	7%	7%
3	Tween 80	7%	7%
4	Cetyl alcohol	3%	3%
5	Paraffin Liquid	10%	10%
6	Metyl paraben	0,18%	0,18%
7	Propyl paraben	0,02%	0,02%
8	Oleum rosae	3 tts	3 tts
9	Alpha-tocopherol	2 tts	2 tts
10	Aquadest ad	100%	100%

Description:
F_0=blank
F_1=Lotion formula contains 20000 ppm ethanol extract of pineapple weevil

2.4 Physical Quality Characteristics of Sunscreen Preparations

a. Organoleptic
Observations include observing colors carried out visually, observing odors by smelling odors from the preparations, and observing forms by looking at the resulting dosage form.
b. Homogeneity
The gel and lotion to be tested are applied on the glass of the object, then covered with the glass of another object, and it is seen whether the gel is homogeneous (Ministry of Health RI, 1979).
c. pH Examination
The determination of the pH of the preparation is carried out using a pH meter tool. The tool is first calibrated using a neutral standard dapar solution (pH 7.0) and an acidic pH solution (pH 4.0) until the tool shows the pH price. Then the electrodes are washed with distilled water, then dried with a tissue. The sample was made in a concentration of 1%, weighed 0.5 grams of the preparation, and dissolved in 50 ml of distilled water. Then the electrode is dipped in the solution, allowing the tool to show the pH price until it is constant. The number indicated by the pH meter is the pH of the preparation. The pH requirement of the preparation is 4.5-8.
d. Viscosity Measurement
100 g of gel and lotion preparations are put into the container, and then a spindle is inserted until the dyeing limit and the rotor is run. Viscosity was measured using Brookfield with spindle No four at a speed of 250 rpm. The viscosity requirement of the preparation is 2000-50,000 Cps.
e. Spreading Power Checking
Gels and lotions of 0.5 grams are laid glass data, covered with other glass. Next, it is given a load of 50 grams. Leave for 1 minute. It measured the gel spread diameter (Tambunan, 2019). Good gel dispersion between 5-7 cm (Bilal et al., 2023).
f. Adhesive Test
Gels and lotions are applied on a glass object to taste, then covered with another glass object, then given a load of 50 grams left for 5 minutes. Then the load is lifted, and the attached glass object is removed while recording the release time of the two glass objects.
g. Determination of Sun Protection Factor (SPF) Value of Gel Preparations
Determination of the SPF value of the preparation is carried out by measuring the absorption of the sample at wavelengths between 290–320 nm with an interval of 5 nm using a UV-Vis spectrophotometer, with aquadest as a blank. 0.2 grams of the preparation is dissolved in 10 ml of aquadest. The last solution measured its uptake with a UV-Vis spectrophotometer at wavelengths 290, 295, 300, 305, 310, 315, and 320 nm. The absorption obtained is then calculated based on the development of Mansur's research in (Dutra et al., 2004) with the formula:

$$SPF = CF \times Abs \times EE \times I$$

Information: CF = correction factor (10)
EE = spectrum of erythemal effects
Abs = uptake of sunscreen products
I = intensity of the beam spectru

3. RESULTS AND DISSCUSION

3.1 Results of Making Pineapple Weevil Extract

The extraction of pineapple weevil simplicia was carried out by maceration using ethanol 96% of 500 kg of pineapple weevil simplisia obtained a viscous extract of 110.42 grams.

3.2 Results of Physical Quality Characteristics of Sunscreen Gel Preparations

Physical characteristics of sunscreen gel preparations by conducting treatment from the results of organoleptic test-

ing, homogeneity, pH, Viscosity, spreading power, and adhesion.

Organoleptic tests of sunscreen gel preparations aim to see the preparation's color, smell, and shape as a form of preparation stability.

Homogeneity tests are carried out to determine whether the ingredients in the formulation are mixed well. The results of the homogeneity examination of the gel formula showed that all gel preparations did not show uneven color or coarse grains when the preparation was applied to the glass of the object. This shows that the gel preparation meets the quality requirements for the homogeneity of the sunscreen gel preparation.

pH testing is carried out to determine the safety of preparation, especially topical preparations. pH testing was carried out using a pH meter. The results of the pH examination of the gel formula showed that the blank gel preparation pH 7 and the gel preparation of pineapple weevil ethanol extract pH 7.6. Based on the pH value obtained, the formula has met the criteria according to the requirements, namely in the range of 4.5-8.0 (SNI, 1996). The pH of the preparation must match the physiological pH of the skin. If the preparation has a pH that is too alkaline, it will cause dry skin; if the pH is too acidic, it will irritate the skin (Tranggono, 2007).

Viscosity is a statement of the resistance of a liquid to flow. The higher the viscosity, the more excellent the resistance (Martin, 1993). The purpose of this viscosity test is to assess the viscosity of the sunscreen gel preparation. the viscosity value of the gel preparation is in the expected viscosity range, namely the blank gel preparation has a viscosity of 4340 cPs, and the gel preparation of pineapple weevil ethanol extract is 5650 cPs. The requirement for the viscosity of the preparation is 2000- 50,000 Cps.

Sunscreen gel preparations also need the spreading power of the preparation because the spreadability of preparation is one of the essential things in manufacturing pharmaceutical gel preparations because the better the spreadability, the better the spread of the drug evenly. The simplest way is to put the gel on a petri dish of as much as 0.5 grams, then place a flat surface petri dish on top of the gel then, give a load of 50 grams, and leave it for 1 minute and the spreadability of the gel is measured (Tam- bunan, 2019). The results of the spereading power of the gel formula showed that the blank gel preparation is 6.6 cm and the gel preparation of pineapple weevil ethanol extract is 7 cm. Good gel dispersion between 5-7 cm (Garg et al., 2022).

The gel's adhesiveness was carried out to determine the bond between the gel and the skin. The higher the stickiness of the gel, the stronger the bond between the gel and the skin, thus allowing higher absorption of the drug by the skin. On the other hand, if the bond between the gel and the skin is not optimal, the drug will be easily removed from the skin. Good adhesion of the preparation is not less than 4 seconds.

The results of evaluating the adhesiveness obtained for the blank preparation were 4.17 seconds, and the pineapple weevil extract gel preparation was 4.46 seconds. This indicates that the blank and pineapple weevil extract gel preparations can adhere well to the skin.

In this study, pineapple weevil sunscreen gel preparations had an SPF value 30.15 (ultra protection). While the blank SPF value shows 0.48 results, this result does not fall into the protection category, so it can be concluded that the blank gel preparation does not affect sunscreen activity.

3.3 Results of Physical Quality Characteristics of Sun screen Lotion Preparations

Characteristics of sunscreen lotion preparations by observing the physical properties of the preparation from the results of organoleptic testing, PH, viscosity, dispersal power, adhesion of the preparation, and test of the SPF value of the preparation.

The result of Organoleptic Lotion Preparations. The organoleptic test aims to see the preparation's physical appearance, including the color, smell, and dosage form, which is carried out visually and using the sense of smell.

The results of the homogeneity test of lotion preparations on table of homogeneity examination results of sunscreen lotion preparations A homogeneity test was carried out to determine whether the ingredients in the formulation were well-mixed. The results of the homogeneity examination on the lotion formula showed that the lotion preparation did not show any uneven color or coarse grains when the preparation was applied to the slide. This indicates that the lotion preparation meets the requirements for homogeneity of sunscreen lotion preparation.

pH testing is carried out to determine the safety of prepa- ration, especially topical preparations. Based on the results above, the pH of the lotion preparation meets the standard as a topical preparation; namely, the pH requirement of the preparation is 4.5-8. The results of the pH examination of the lotion formula showed that the blank gel preparation pH 7 and the lotion preparation of pineapple weevil ethanol extract pH 7.3. The pH of the preparation must match the physiological pH of the skin. If the preparation has a pH that is too alkaline, it will cause dry skin; if the pH is too acidic, it will irritate the skin (Tranggono, 2007).

Viscosity measurement is carried out to determine whether or not the preparation is easy to apply on the skin's surface. Viscosity is related to consistency. Viscosity should be able to make the preparation easy to apply and be able to stick to the skin. Preparations with a higher consistency will affect the application of their use Viscosity is a statement of the resistance of a liquid to flow from a system under pressure used. The thicker a liquid is, the greater the force required to flow. The viscosity of lotions is influenced by the conditions of the disperse phase and the dispersing medium, the influence of the emulator used, and the addition of other stabilizing agents (Zulkarnain et al., 2015). The viscosity value of the lotion preparation is in the expected viscosity range, namely the blank lotion preparation has a viscosity of 1330 cPs, and the lotion preparation of pineapple weevil ethanol extract is 1530 cPs.

The results of the Spreading Power Examination Of Sunscreen lotion preparations showed that the blank lotion preparation is 6.9 cm and the lotion preparation of pineapple weevil ethanol extract is 7 cm.

The adhesion measurement aims to determine the length of time it takes for the lotion to adhere to the skin. Sunscreen preparations are expected to adhere to the skin for a long time to protect the skin from ultraviolet rays longer. The longer the lotion is attached to the skin, the more active substances are diffused into the skin to make its use more effective. Good topical adhesion requires more than 4 seconds. Based on this, the lotion prepara-

tions in this study meet the requirements. The results of evaluating the adhesiveness obtained for the blank preparation were 3.73 seconds, and the pineapple weevil extract lotion preparation was 4.06 seconds. This indicates that the blank and pineapple weevil extract lotion preparations can adhere well to the skin.

The SPF value of the lotion formula blank is 0.5, and extract lotion preparation is 42.23. From the results obtained, it can be seen that the addition of pineapple weevil extract significantly changed the SPF value in the lotion preparation, where blank did not have sunscreen effectiveness while lotion had sunscreen effectiveness in the ultra protection category. A sunscreen is said to be able to protect if it has a minimum SPF value of 2 and a good category if it has an SPF value above 15, which is classified as an ultra-protection cat- egory sunscreen. An SPF value above 15 will provide better protection from the risk of long-term skin damage, such as skin cancer (Gordon, 2013).

4. CONCLUSION

The study results were obtained from organoleptic gel preparations with a yellow color, gel shape, homogeneous, pH 7-7.6, viscosity 4340-5650 Cpoises, spreading power 6.6-7cm, adhesion -7-4.46 seconds. At the same time, the lotion preparation has a yellow color, lotion shape, homogeneous, pH 7.3, a viscosity of 1530 Cpoises, a spreading power of 7cm, and adhesion of 4.06 seconds. The SPF value obtained by the pineapple weevil sunscreen gel, which is 30.15, is included in the ultra protection. Meanwhile, pineapple weevil sunscreen lotion, which is 42.23, is included in the ultra protection. Overall, the pineapple weevil gel and lotion have good physical quality and efficacy as sunscreen.

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