

Potential Effect of *Musa paradisiaca* Peel Extract on Skin Hydration

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Abstract: Dry skin is a common skin aging process in a tropical country, like Indonesia. The aging process is related to the increase in the level of the radical compound or known as oxidative stress. The use of moisturizers with active components from plants that are rich in antioxidants such as Kepok banana peels are not yet fully studied. This study aims to reveal the antioxidant activities and effectiveness of Kepok banana peel (*Musa paradisiaca* L.) extract in a moisturizing formulation to increase skin hydration. Banana peel extract formulated into cream dosage forms. Evaluation of the cream forms, including homogeneity, pH, emulsion type, cream stability, and irritation test. Then, determine skin hydration level on day 0 (before application), 7th, 14th, 21th, 28th day after topical application. Significant increase in skin hydration after the use of Banana peel extract cream for 4 weeks, the highest in the F3 formula (7,5% Kepok banana peel extract cream) Kepok banana peel has antioxidant activity and the cream formulation of kepok banana peel has been shown to improve skin hydration.

1 INTRODUCTION

Skin dryness or xerosis is a skin problem found in countries with tropical complications such as Indonesia and the incidence of xerosis increases with aging. Increasing age will decrease the number and function of the main lipid barrier, so that it will aggravate the problem of skin dryness (Robert Baran, 2010).

The regulation of skin hydration is related to the balance between the exit and entry of fluid in the stratum corneum (SC). The entry of endogenous fluid comes from the diffusion process from the dermis to the skin surface and also the secretion of sweat glands. Exogenous intake increases when humidity is relatively high. Defects or deficiencies in the skin barrier layer will cause increased evaporation from water, known as TEWL (trans-epidermal water loss) (Baumann, 2012).

Skin moisture is correlated to three factors; the speed of fluid reaching the stratum corneum of the lower layer (eccrine glands, transepidermal transfer), the speed of fluid evaporation and the ability of the stratum corneum to hold fluids depends on the integrity of the hydro lipid layer, the presence of

NMF, sufficient availability of intercellular water, membrane integrity cells and intercellular semen derived from supporting lipids.

In healthy skin, skin cells namely corneocytes will be separated from neighboring cells / those next to it, which will fall into the surrounding environment and be replaced with cells that are younger than the deeper layers. This regular process will cause corneocytes or skin cells to loose from the surface of the skin or called desquamation. Desquamation is regulated by two intercellular components, namely corneodesmosomes and lipids. The intercellular action of these two components will maintain skin thickness. Corneodesmosomes bind corneocytes to maintain cohesion from intercellular and tissue integrity. For the effectiveness of desquamation, corneodesmosomes must eventually be broken down. This process is called corneodesmolysis. The corneodesmolysis is effective in eliminating corneodesmosomes. In contrast to xerotic skin, corneodesmosomes persist and interfere with regular desquamation processes. In acute and chronic conditions of dry skin, this disrupted process manifests with clear skin formation, such as whitish powdery flakes on the

surface of the skin (Norman, 2008). However, free water content needs to control the corneodesmolysis process. Adequate levels of fat are needed to maintain the water content. Skin is not properly hydrated cannot provide this water. For that deficit in skin hydration and fat components contribute to xerosis. Therefore, the ability of the skin to retain moisture and maintain an effective barrier is crucial for xerosis in the skin of elderly patients (Norman, 2008).

To overcome dry skin problem, TEWL (trans-epidermal water loss) should be reduced by providing hydrated and moisturizing ingredients that are water soluble and lubricating and occlusion which is not soluble in water. Moisturizer is believed to prevent water loss through transepidermal through the occlusion. Although the Stratum corneum (SC) acts as dead tissue, it also acts as an active membrane that acts as a brick and mortar. Loss of intercellular lipids/fats such as ceramides, cholesterol and fatty acids that form bilayers, damaging water-limiting formations that cause dry skin. Dry skin occurs if the moisturizing content <10% and loss of continuity of the stratum corneum occurs (Sethi, Kaur, & Gambhir, 2016).

This research is important because most of the skin moisturizer uses synthetic ingredients while some studies show it has side effects on long-term use. For this reason, a study is needed to replace the synthetic ingredients with active components of herbs with good assistance to reduce side effects (Okereke J.N., 2015).

The interesting thing from this research is that we can utilize the kepok banana peels that are released daily as organic waste into skin moisturizing ingredients that have a beneficial selling value. Based on government data the production of bananas in Indonesia in 2011 reached 6,189,052 tons. Banana peels is 1/3 from unripe bananas, so the amount of banana peels was 2,063,017 tons per year in Indonesia. Kepok banana was chosen in this study because it has a thicker skin compared to other banana peels. Banana peels have higher antioxidant activity compared to their flesh (Riska Afliani, 2014) but the research is still limited to the antioxidant test of ethanol extract of meat and peel of banana (*Musa paradisiaca* L.) with DPPH method, there has been no analysis conducted on the effectiveness of tannin on kepok banana peel on increasing skin moisture.

Banana kepok has many types, but the famous ones are yellow kepok banana and white kepok. Yellow kepok flesh is yellow, while white kepok is white. The pulp is rather hard. Yellow banana has a

sweeter and tastier taste than white kepok. Kepok banana is not fragrant. Fruit skin is very thick. The ripe fruit is yellowish-green. In one bunch there can be up to 16 combs and on each comb, there are up to 20 bananas. The weight of each sign is around 14-22 kg. Fruit suiTable to be eaten in processed form (Cahyono, 2009).

Banana plants are widely used for various purposes of human life and are known as multipurpose plants because, in addition to the fruit, other plant parts can also be used, ranging from tubers to their leaves (Cahyono, 2009). In the field of medicine, bananas are known for their beneficial effects on digestion and cell rejuvenation effects. Bananas help retention of calcium, phosphorus, and nitrogen, which helps to regenerate tissue. Also, bananas have benefits to overcome constipation and diarrhea, overcome dysentery, reduce the symptoms of arthritis and gout, treat anemia, uremia, treat menstrual problems, and allergies (Arya, 2014). The efficacy of raw and ripe of banana peel have been studied by Okorie et al (2015). They suggested that mineral has play role, where as the composition described in Table 1.

Table 1. Mineral composition of raw and ripe banana peel.

Mineral	Raw peel	Ripe peel
Ca	11.02 ± 1.44	6.01 ± 0.27
Mg	3.04 ± 0.06	2.31 ± 0.44
K	9.89 ± 1.17	9.83 ± 1.17
Na	6.18 ± 0.03	6.09 ± 0.13
P	0.61 ± 0.01	0.49 ± 0.01
Zn	0.95 ± 0.07	1.86 ± 0.23
Cu	0.49 ± 0.01	0.85 ± 0.07
Pb	0.07 ± 0.03	0.40 ± 0.01
Fe	215.75 ± 8.13	20.40 ± 0.57

Based on the literature studies, the benefits of kepok banana peel extract on skin moisture with application to the skin and analyzed with skin analyzer have been proposed to be the objective of this research.

2 MATERIALS AND METHODS

2.1 Raw Materials and Reagents

Table 2. *Musa paradisiaca* L .Peel Extract Cream Formulation

Ingredients	F0	F1	F2	F3
Banana Peel Extract (g)	-	2,5	5,0	7,5
Acetyl alcohol (%b/b)	4	4	4	4
Glycerin (%b/v)	15	15	15	15
TEA (%b/v)	1,5873	1,5873	1,5873	1,5873
Stearate Acid (%b/b)	6	6	6	6
Methyl paraben (%b/b)	0,2	0,2	0,2	0,2
Propyl paraben (%b/b)	0,02	0,02	0,02	0,02
Aquadest	100	100	100	100

Kepok banana peels (*Musa paradisiaca* L.), Methanol, Ethanol 96%, Acetyl Alcohol, Glycerin, TEA, Stearic Acid, Methyl Paraben, Propyl Paraben, Fragrances, Aquades, DPPH, and Quercetin.

2.2 Preparation of Sample

Kepok bananas are peeled and cut into small pieces. Then it is drained and dried in an oven at 55 °C until it is dry which is characterized by simplicia which is easily broken. Dry simplicia powder macerated with 96% ethanol solvent with sample: solvent ratio: 1:10 for 5 days. The maserate product is filtered and then evaporated to remove the solvent using a rotary evaporator at 50 °C until a thick extract is obtained.

2.3 Making Peel Extract Test Solutions

Extract weighed as much as 25 mg and dissolved with methanol up to 25 mL, obtained a solution with a concentration of 1000 ppm. Taken 0.25 mL; 0.5 mL; 0.75 mL; 1 mL; 1.25 mL of the 1000 ppm extract solution, obtained concentrations of 50, 100, 150, 200, 250 ppm. Incubated for 30 minutes then absorbance was measured using a UV-Vis

spectrophotometer at a maximum wavelength of 515.5 nm.

2.4 Peel Extract Cream Formulation

The extract of *Musa paradisiaca* L has been modified to four-types of cream formulation in order to evaluate the effect of concentration. The cream composition was shown the Table 2.

2.5 Making Cream

The oil phase materials (stearic acid, acetyl alcohol, and propyl parabens) and the water phase (TEA, glycerin, methylparaben and distilled water) are separated. The oil phase and the water phase are heated to a temperature of 70°C-80°C. After everything is fused, put the water phase little by little into a hot mortar containing the oil phase, mixed with intermittent shaking to form a cream base. Put *Musa extract paradisiaca* L. in mortar, mixed with a cream base little by little, mixed until homogeneous and put in a container.

2.6 Evaluation of the Physical Quality

Evaluation of the physical quality of the cream preparations includes observing the homogeneity of the preparations, determining the type of preparation emulsions, measuring the pH of the preparations, observing the stability of the preparations.

2.7 Determination of the Homogeneity

A certain amount of preparation if applied to a piece of glass or other suitable transparent material, the preparation must show a homogeneous arrangement and no visible grain.

2.8 Determination of the Type of Emulsion

A certain number of preparations are placed on the beaker, 1 drop of methyl blue is added to the preparation and then stirred. If the methyl blue is spread evenly it means that the preparation is a type of emulsion m / a, but if only the blue spots means the preparation is a type of emulsion a / m.

2.9 Measuring the pH

Determination of the pH of the preparation is done using a pH meter. The instrument is calibrated using a neutral solution (pH 7.01) and an acidic buffer (pH

4.01) until the instrument shows the pH value. Then the electrodes are washed with distilled water. Then dried with tissue. The sample is made in a concentration of 1%, weighing 1 gram of the preparation and dissolved in 100 ml distilled water. Then the electrode is dipped in the water solution. Leaving the device shows the pH value to a constant. The number indicated by the pH meter is the pH of the preparation. Observations were made at room temperature (15 ° C-30 ° C) for 12 weeks.

2.10 Observation of Cream Stability

A total of 100 g of each preparation formula is put into a plastic pot. Furthermore, observations were made in the form of changes in consistency, color and aroma when the preparation was made and in storage for 12 weeks. In this study, the stability of the preparation at room temperature (15°C- 30°C) was observed for 12 weeks of storage.

2.11 Moisturizing Activity Test of *Musa Paradisiaca L.* Extract

2.11.1 Irritation Test

All samples that met the criteria were tested patched. Patch tests were carried out by applying the results of the Kepok banana extract cream formulation with the highest active ingredient (F3) on the back of the right ear and the back of the left ear for F0 basis as a comparison. Testing is carried out for 24 hours for each volunteer. Symptoms that arise are observed, the skin reaction immediately after sticking and touching the skin, such irritation is called primary irritation, but if this reaction occurs several hours after touching and sticking to the skin, then this irritation is called secondary irritation (Ditjen POM, 1985)

2.11.2 Moisturizing Activity Test

Samples that did not experience allergies and irritations, then conducted an application trial of Kepok banana peel extract cream for 4 weeks. The grouping is divided into: Group I: 10 people testing for the blank formula (F0) , Group II: 10 people testing for the formula 2.5% (F1) , Group III: 10 people testing for the 5% formula (F2), and Group IV: 10 people testing for the 7.5% formula (F3)

Kepok banana peel extract cream was applied to the volar region of the right arm with a size of 3 x 4 cm by 1 ml (using a syringe). To reduce bias, samples are asked not to use cosmetic products in

the test area 2 weeks before the study and protect the test area from direct sunlight. Skin hydration measurements were performed at the beginning of the study using a skin analyzer on day 0 (before the application of extract cream), day 7, day 14, day 21 and day 28. Before measurement all samples were asked to be in the lab for 15 minutes at 25°C so that the skin can acclimatize at room temperature.

2.12 Data Processing and Analysis

The data that has been collected was processed using the SPSS software and data was discussed in accordance with the existing literature.

3 RESULTS AND DISCUSSION

Based on the extraction of Kepok banana peel samples carried out by maceration technique with 96% ethanol for five days started from a dried simplisia 600 gr will resulted a brownish thick extract 85 gr with yield of 14.16%, and smells of banana.



Figure 1. *Musa paradisiaca L.* sliced peels after maceration (a) and thick peels extract (b)

The cream was made by a modified standard formula. Kepok banana peel extract was used to make cream preparations in a concentration of 2.5%; 5%; 7.5% and blank. Cream preparations obtained in the form of whitish-yellow cream with the smell of bananas.



Figure 2. Cream preparation of blank (F0), peel extract 2.5 % (F1), 5% (F2), 7.5% (F3).

The homogeneity examination results on Kepok banana skin cream were found to be homogeneous, there were no coarse grains. The results of the type of cream emulsion test showed that the methyl blue color could be homogeneous or spread evenly in the cream so that it could be proven that the cream preparations made had an oil-type emulsion in water (m/a).



Figure 3. Cream homogeneity of blank (F0), peel extract 2.5 % (F1), 5% (F2), 7.5% (F3).

The results of the cream preparation emulsion test showed that the methyl blue color can be homogeneous or evenly distributed in the cream so that it can be proven that the cream preparations made have an oil-in-water emulsion type (m/a). Each formula that has been observed for 90 days gives good results that is not experiencing changes in color, odor and phase separation.

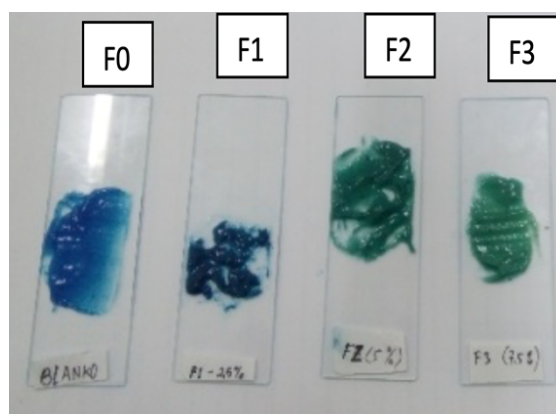


Figure 4. Cream emulsion test of blank (F0), peel extract 2.5 % (F1), 5% (F2), 7.5% (F3).

The pH measurements made at the time after the preparation is complete, then after the deposit of the first week to 12 weeks. The results of the measurement of the pH of each formula showed that with increasing concentrations of Kepok banana peel extract, the pH of the preparations was getting lower, but the change was still within the standard pH requirements for cream preparations, namely between pH 5-8 (Tranggono, 2007). The observation of pH measurements is described in Table 3 to evaluate the effect of concentration.

Table 3. The pH of blank (F0), peel extract 2.5 % (F1), 5% (F2), 7.5% (F3) observed during 12 weeks.

pH in Avg for 12 weeks	Formula			
	F0	F1	F2	F3
0	7.7	7.3	7.2	7.2
1	7.5	7.2	7.2	7.3
2	7.2	7.0	7.2	7.3
3	7.0	7.1	7.3	7.2
4	7.1	7.2	7.2	7.1
5	7.2	7.1	7.2	7.1
6	7.1	7.1	7.3	7.1
7	7.2	7.2	7.2	7.0
8	7.1	7.1	7.3	7.1
9	7.0	7.0	7.4	7.1
10	7.0	7.1	7.4	7.2
11	7.0	7.1	7.3	7.1
12	7.1	7.0	7.4	7.1

The instability of the formulation can be detected in several ways with a change in physical appearance, color, odor and phase separation from the formulation. Generally, an emulsion is considered physically unstable if all or part of the inner phase liquid is not emulsified and forms a different layer on the surface or base of the emulsion. Therefore, it needs to do an evaluation test for 3 months and is considered as the minimum stability that must be had by an emulsion.

Table 4. Stability of blank (F0), peel extract 2.5 % (F1), 5% (F2), 7.5% (F3) observed during 90 days. Change of stability indicated by (-) symbol.

Stability for 90 days	Formula			
	F0	F1	F2	F3
0	-	-	-	-
7	-	-	-	-
14	-	-	-	-
21	-	-	-	-
28	-	-	-	-
90	-	-	-	-

Based on the data obtained, it shows that each formula that has been observed for 90 days gives good results that are not experiencing changes in color, odor and phase separation.

The stability of a pharmaceutical preparation can be seen from the presence of changes in color, odor and phase separation during storage (Florence T.A, 2009). These changes can occur if the ingredients contained in the preparation are oxidized. Emulsion instability phenomena, in general, are creaming, coagulation, coalescence, and Ostwald ripening. In creaming the sedimentation process occurs, while coalescence describes the aggregation that forms where particles form a homogeneous layer. If the coalescence process occurs perfectly, then the emulsion will separate into two phases, which is the most stable stage (Mitsui, 1998).

According to Ansel (1989), an emulsion becomes unstable due to the clumping of globules from the dispersed phase. Damage or failure of an emulsion preparation can be observed with a change in color and odor changes. To overcome the damage to ingredients due to oxidation can be done by adding an antioxidant. Damage can also be caused by fungi or microbes, to overcome this can be done with the addition of preservatives. The preservatives used in the formulation of banana peel extract cream are methylparaben and propylparaben.

Irritation test results carried out on the skin of volunteers obtained that there were no visible side effects in the form of redness, itching and gauze on the skin caused by the preparation of banana skin extract cream which is applied to the skin. The results of irritation tests on volunteer skin applied to the thin skin on the back of the ear are left for 24 hours.

In the results of this study, it was seen the increase in water content in each of the volunteer skins, but the highest was in formula F3 (cream of banana peel extract 7.5%). Analysis of the effectiveness of water content was done by using Aramo skin analyzer, test parameters measuring moisture content (moisture). Its use is applied to the skin of banana peel extract every morning and night.

The results on the water content obtained show good results on blanks and cream preparations with various concentrations. Where the increase in water content is one of the parameters for measuring anti-aging creams. The measurements of moisture on the skin of volunteers is showed in the Table 5.

Table 5. Data from the measurement of water content of Peel bana extract on the faces of volunteers after use for 4 weeks. Where as the indication of dehydration 0-29; Normal 30-50; Hidrated 51-100 (Aramo, 2012)

Formula	Average Hydration (%)				
	Initial	During Application (Weeks)			
		I	II	III	IV
F0	31,6	31,9	32,3	32,5	32,7
F1	31,4	33,2	33,7	34,5	35,3
F2	31,7	34,2	35,5	36,4	37,5
F3	32,1	35,4	37,1	38,5	39,1

Based the data shown in Table 5, there is a significant increase in skin hydration after the use of Kepok Banana peel extract cream for 4 weeks. There are differences in the mean skin hydration in the examined groups (F0 and F1, F0 and F2, F0 and F3, F1 and F2, F2 and F3). The data from Table 5 has been evaluated to get more clear representation of the hydration observed for 4 weeks as shown in figure 5.

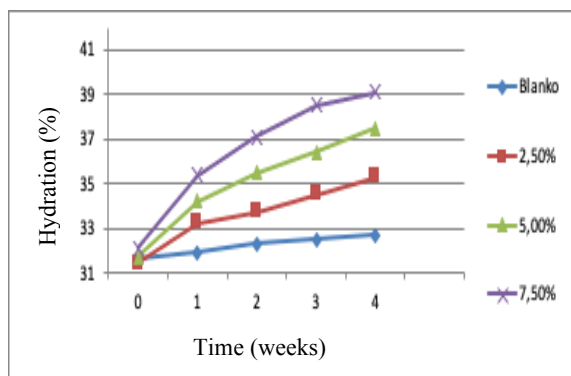


Figure 5. Representation of the increase on the hydration due to the topical application of modified cream of peel banana extract observed for 4 weeks.

Data obtained on each parameter of water content was tested for normality with Kolmogorov-Smirnov, obtained p-value <0.05 , so it can be concluded that the data were not normally distributed so that the Wilcoxon non-parametric test was conducted, and then continued with the Kruskal-Wallis test to find out if there were differences the level of skin hydration before and after the use of the cream for 4 weeks and whether there are differences between formulas in restoring the skin to find out which formulas there are significant differences.

The volunteers who applied banana peel extract, there were significant differences in skin hydration before and after the use of the cream for 4 weeks. There is a minimum average difference between the 2 groups examined, the difference is between the first group and the second group examined (F0 and F1, F0 and F2, F0 and F3, F1 and F2, F2 and F3).

According to phytochemical test studies on banana peels carried out by Lumowa and Bardin (2018), it was found that Kepok banana peels contained flavonoids, alkaloids, tannins/polyphenols saponins, and triterpenoids. Flavanoid can increase extracellular collagen, where the increase also causes increased moisture and elasticity in the skin (Reveny, 2016). Banana plants have many benefits, including effects for cell rejuvenation. Bananas help retention of calcium, phosphorus, and nitrogen, which helps to regenerate tissue. (Arya, 2014).

4 CONCLUSION

The improvement of skin hydration by Kepok Banana peel extract formulated cream showed a significant improvement ($p < 0.05$) with an increase

in the mean difference in dryness scores from baseline to the end of each treatment interval of 28 days. Kepok Banana peel extract has been proven to improve skin hydration

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