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Formulation and Sunscreen Activity Test of Lotion of *Buas-Buas* (*Premna Serratifolia* Linn.) Leaf Extract

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ABSTRACT

Excessive UV exposure can cause various skin disorders, so protection from UV rays is needed by using sunscreen. One of the plants that have the potential as a sunscreen is *buas-buas* leaf (*Premna serratifolia* Linn.) which contains flavonoid compounds. Sunscreen formulated in lotion form is the most common preparation found in the market. The purpose of this study was to evaluate the physical characteristics of lotion preparations and to determine the potential of lotion of *buas-buas* leaf extract as a sunscreen. *Buas-buas* leaf extract was obtained through maceration extraction with 96% ethanol solvent. Lotion with the active substance of *buas-buas* leaf extract was made with concentration variations of 1, 2, and 3%. Evaluation of the physical characteristics of the lotion was tested with organoleptic observation parameters, homogeneity, pH, spreadability, and adhesion. Then, it was tested for sunscreen potential using UV-Vis spectrophotometry. Data were analyzed with SPSS Statistics 22 software, namely the One Way ANOVA (Analysis of Variance) test. The results of the study were the three lotion formulas of *buas-buas* leaf extract met all the requirements of the physical characteristics evaluation test. The SPF value of F1 (1%) is 7.12 (extra protection), F2 (2%) is 9.54 (maximum protection) and F3 (3%) is 15.68 (ultra protection). Based on the results of the study, it can be concluded that the lotion of *buas-buas* leaf extract meets the requirements of evaluating the physical characteristics of lotions and has activity as a sunscreen.
Keywords: *Buas-buas* leaf; lotion; *Premna serratifolia*; spectrophotometry; sunscreen

INTRODUCTION

Excessive exposure to UV light can cause a variety of skin disorders such as edema, erythema, hyperpigmentation, skin cancer, and skin DNA damage which further causes wrinkles and loss of skin elasticity (Azzahra et al., 2023; Daud et al., 2022). Therefore, protection from UV rays is required both physically by using umbrellas, jackets, and hats, and chemically by using sunscreen (Hindun et al., 2022). Sunscreens can be made from both synthetic and natural ingredients. However, synthetic sunscreens have side effects such as skin burns, stinging, and allergies, so it is necessary to use sunscreen from natural ingredients (Indarto et al., 2022). One of the natural ingredients that has the potential as a sunscreen is the leaves of *buas-buas* (*Premna serratifolia* Linn).

Buas-buas leaves contain secondary metabolite compounds such as flavonoids, phenolics, alkaloids, saponins, tannins, and terpenoids (Ariani & Niah, 2020; Febryani & Susanti, 2022; Riduana et al., 2021). Based on previous research, the total flavonoid content of ethanol extracts of *buas-buas* leaves is 54.17% and 3.70 ± 0.02% (Isnindar & Luliana, 2020; Puspita & Puspasari, 2021). The ethanol extract of *buas-buas* leaves also has very strong antioxidant activity with IC_{50} of 20.66 μg/mL and 22.1 μg/mL (Isnindar & Luliana, 2020; Puspita, et al., 2020). The SPF value of the ethanol extract of *buas-buas* leaves with a concentration of 100 ppm is 38.28 ± 0.12 which is included in the ultra-protection category (Puspita & Puspasari, 2021). The ethanol extract of *buas-buas* leaves formulated as an active substance with a concentration of 1% in a spray gel preparation as a sunscreen, obtained an SPF value 10.54 ± 0.27 and is included in the maximum protection category (Puspita et al., 2022).

The leaves of *buas-buas* have been utilized in several dosage forms such as preparation of spray gel, transparent soap, and peel-off gel mask (Fitriani, 2017; Puspita, Puspasari, et al.,2020; Puspita & Puspasari, 2022). However, there has been no research related to the leaves of *buas-buas* that are utilized in a lotion dosage form. Sunscreen formulated in the form of lotion is the most commonly found preparation in the market because it has a low viscosity, is not sticky, and is easy to distribute when applied to the skin (Azzahra et al., 2023; Minerva, 2019). Based on the description above, this research needs to be done to formulate the extract of *buas-buas* leaves in the form of sunscreen lotion preparations.

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MATERIALS AND METHODS

Materials

The tools used were UV-Vis spectrophotometry (Shimadzu type 2450®), rotary evaporator (Buchi R-100®), oven (Kris®), Buchner funnel (Rocker®), pH meter (Laqua®), hotplate (Schoot®), analytical balance (Radwag®), maceration vessel, blender (Panasonic), a set of glassware (Iwaki pyrex®), a hand mixer, a vernier caliper, a micropipette (Drawell®) and lotion pot. The materials used were *buas-buas* leaf extract, aquadest, ethanol 96%, methanol pro analysis, stearic acid, cetyl alcohol, liquid paraffin, BHT (Butylated hydroxytoluene), glycerin, TEA (Triethanolamine), nipagin and nipasol.

Methods

Sample Preparation

Fresh samples of 5 kg *buas-buas* leaves were taken which were green and not physically damaged. *Buas-buas* leaves were washed, chopped, and dried using an oven at 50^{0}C, then pulverized using a blender to become simplistic powder (Puspita & Puspasari, 2021).

Extract Preparation

Many simplisia *buas-buas* leaves were weighed and put into a maceration vessel, 96% ethanol solvent was added sufficiently until the simplisia was submerged and then stirred until homogeneous using a spatula. The maceration vessel was closed and left for 1x24 hours while occasionally stirring. The results of maceration were filtered and the residue was squeezed to obtain the macerate (the same treatment was carried out for 3x24 hours). The macerate was concentrated using a rotary evaporator at 50^{0}C and a thick extract was obtained. Calculate the % yield of the extract (Puspita & Puspasari, 2021).

The lotion was made by combining the oil phase and the water phase. The oil phase consisting of stearic acid, BHT, liquid paraffin, and cetyl alcohol was melted in a glass beaker on a hotplate at 70^{0}C . The leaf extract was mixed with glycerin. The aqueous phase was prepared by melting TEA, glycerin mixture with extract, nipagin, and nipasol into another glass beaker on a hotplate at 70^{0}C. The oil phase was put into the aqueous phase solution and stirred using a hand mixer until homogeneous and lotion mass was formed. The finished lotion was put into a container and the physical characteristics of the lotion was evaluated (Kurdiansyah et al., 2022).

Lotion Characteristic Evaluation Test

Organoleptic Test

Lotion was observed including texture, color, and aroma (Ulfa et al., 2019).

Homogenity Test

Lotion weighed as much as 1 g and applied to a glass object then observed the presence or absence of coarse grains. The homogeneity test requirement is that there are no coarse grains in the preparation (Usman, 2022).

pH Test

The pH meter device was calibrated using pH 4 and pH 7 buffer solutions. It was then washed with distilled water and dried with a tissue. pH meter dipped in a container containing lotion and recorded the pH value indicated by the pH meter. The pH requirement according to SNI is 4.5-8 (Iskandar et al., 2021; Oktaviasari & Zulkarnain, 2017).

Spreadability Test

The lotion is weighed as much as 0.5 g and placed on a spherical glass. Another spherical glass was weighed and then placed on it for 5 minutes and the diameter of the spread was recorded. Weights of 50, 100, 150, 200, and 25 g were added alternately for 1 minute and recorded the diameter of the spread (Ulandari & Sugihartini, 2020). Terms of spreadability are 5-7 cm (Daud et al., 2018).

Adhesion Test

The lotion is weighed as much as 0.5 g, placed on an object glass, and then covered with another object glass. A 1 kg load was placed on the object glass for 5 minutes. The object glass is mounted on a test device and released by a load weighing 80 g. Record the time it takes to separate the two object glasses (Ulandari & Sugihartini, 2020). The requirement for good adhesion is >4 seconds. (Syam & Marini, 2020).

Sunscreen Activity Test

Lotion was weighed as much as 0.25 g and then dissolved with methanol p.a in a 25 ml volumetric flask until the limit mark, shaken until homogeneous. The solution obtained was sonicated for 5 minutes and then filtered. The absorbance of the solution was measured every 5 nm interval at a wavelength of 290-320 nm by UV-Vis spectrophotometry (Kurdiansyah et al., 2022; Rusli et al., 2022).

Table I. The Formula of Lotion of *Buas-Buas* Leaf Extract

Ingredients	Control (%)	F1 (%)	F2 (%)	F3 (%)
Buas-buas leaf extract	0	1	2	3
Stearic acid	5	5	5	5
Cetyl alcohol	5	5	5	5
Paraffin liquid	4	4	4	4
BHT	0.1	0.1	0.1	0.1
Glycerin	2.5	2.5	2.5	2.5
TEA	1	1	1	1
Nipagin	0.2	0.2	0.2	0.2
Nipasol	0.1	0.1	0.1	0.1
Aquadest	Ad 100	Ad 100	Ad 100	Ad 100

Statistical Analysis

Data analysis of lotion physical characteristics evaluation was determined by normality test using the Shapiro-Wilk test with 95% confidence level. If the data was normally distributed ($p>0.05$) then continue using the One Way ANOVA test. If the data is not normally distributed ($p<0.05$), then continue using the Kruskal-Wallis test. Data is not significantly influential if $p>0.05$ and different significantly influential if $p<0.05$. Analysis of sunscreen data was done descriptively in the form of SPF value calculation.

RESULTS

Extraction

Extraction was carried out by maceration method using 96% ethanol solvent. Maceration was chosen because it is a cold extraction method or without heating so the extracted compounds are relatively safer (Qonitah et al., 2022). Ninety six % ethanol is a polar solvent, so it can extract polar compounds such as flavonoids and is easy to evaporate. In addition, 96% ethanol can more easily penetrate the cell wall of the sample compared to ethanol with a lower concentration, so that more compounds are extracted (Egra et al., 2019; Qonitah et al., 2022). The yield of the extract obtained was 15.13%. The percentage yield in this study is better than previous research which obtained a yield of *buas-buas* leaf extract of 3.04% (Fitriani, 2017). This difference can occur due to several factors such as the length of maceration time, stirring, and the amount of solvent used (Riduana et al., 2021).

Organoleptic test

Organoleptic tests carried out include scent, texture, and color in lotion preparations. Organoleptic test results can be seen in Table II. Variations in the concentration of *buas-buas* leaf extract as the active substance of the lotion cause differences in color in each formula (Rusli et al., 2022). The scent of the preparation comes from the extract of *buas-buas* leaves which is used as an active substance. The texture of the preparation is semisolid which has met the criteria for lotion characteristics. Negative control is white and smells typical of a lotion base. This is because the negative control does not have the addition of *buas-buas* leaf extract.

Homogeneity Test

Homogeneity test observations were made on each formula visually to see whether there were coarse grains in the preparation (Kurdiansyah et al., 2022). The results of the homogeneity test can be seen in Table II, which shows that the negative control, F1 (1%), F2 (2%), and F3 (3%) produce homogeneous preparations. This can be seen in the absence of granules or coarse particles in the preparation, which means that the lotion is evenly mixed in each part of the preparation.

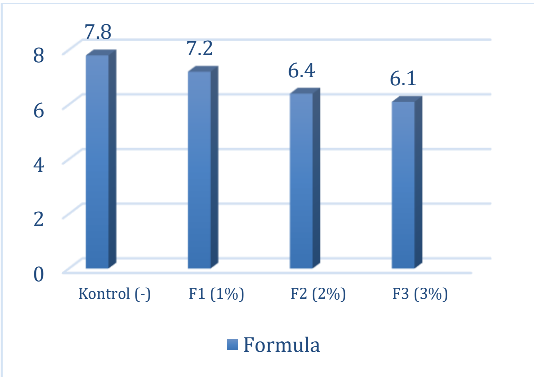

Figure 1. Graph of pH Test Results

pH Test

pH testing aims to ensure the safety of preparation when used to avoid problems on the skin (Rusli et al., 2022). The results of the lotion pH test can be seen in Table II, which shows that all formulas meet the requirements of the pH range of

Table II. Yield Characteristics Evaluation Test of Lotion

Test	Formula of Lotion of *Buas-buas* Leaf Extract			
	Negative Control	**F1(1%)**	**F2(2%)**	**F3(3%)**
Organoleptic	White color, characteristic odor of lotion base, semisolid	Yellowish green color, distinctive odor of buas-buas leaves, semisolid	Brownish green color, distinctive odor of buas-buas leaves, semisolid	Blackish green color, distinctive odor of buas-buas leaves, semisolid
Homogenity	Homogen	Homogen	Homogen	Homogen
pH ± SD	7.8 ± 0.07	7.2 ± 0.07	6.4 ± 0.00	6.1 ± 0.00
Spreadability ± SD (cm)	5.1 ± 0.38	5.3 ± 0.16	5.4 ± 0.13	5.5 ± 0.14
Adhesion ± SD (second)	50.74 ± 4.24	10.84 ± 0.59	10.10 ± 0.80	10.02 ± 0.97

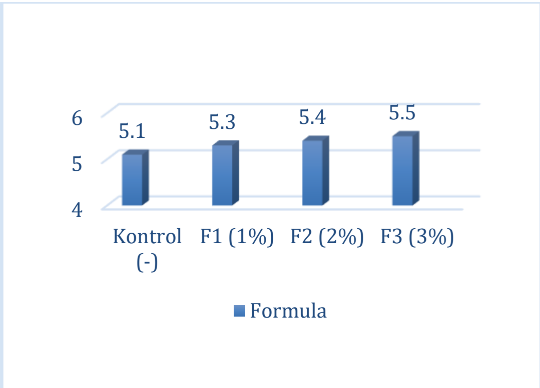

Figure 2. Graph of Spreadability Test Results

topical preparations, namely 4.5-8 based on SNI (16-4399-1996). Negative control pH is higher than F1 (1%), F2 (2%), and F3 (3%) because, in the negative control, there is no addition of the active substance *buas-buas* leaf extract. This can occur because the extract of *buas-buas* leaves which is added as an active substance in lotion lotion has a pH of 4.3, which means that the extract is acidic, so the higher the addition of active substances, the pH of the preparation will be lower. The statistical test show that there is a significant difference ($p<0.05$) in the pH value between formulas, so the addition of *buas-buas* leaf extract will reduce the pH value.

Spreadability test

The spreadability test is carried out to know the ability to spread a preparation when applied to the skin (Oktaviasari & Zulkarnain, 2017). The results of the lotion spreadability test can be seen in Table II, which shows that all formulas meet the requirements of good spreadability of 5-7 cm. The higher concentration of the extract causes the contact time between preparation and the skin to be lower, indicating that the resulting preparation is more dilute. The results of this study are in line with previous research where the higher the concentration of the extract, the viscosity will decrease so that the spreadability will decrease (Arbie et al., 2021; Erwiyani et al., 2021; Iskandar et al., 2021; Tarigan et al., 2020). The statistical test showed that there was no significant difference ($p>0.05$) in the spreadability value between formulas, so the addition of *buas-buas* leaf extract did not affect the spreadability.

Adhesion Test

Adhesion is related to the length of time the preparation can be in contact with the skin surface (Oktaviasari & Zulkarnain, 2017). The results of the lotion adhesion test can be seen in Table II, which shows that all formulas meet the requirements of good adhesion, which is >4 seconds (Syam & Marini, 2020). The results of this study are in line with previous research where the higher the concentration of extracts, the lower the adhesion time (Arbie et al., 2021; Erwiyani et al., 2021). The adhesion of preparation is directly proportional to viscosity and inversely proportional to spreadability, the longer the contact time, the greater the viscosity and the smaller the spreadability (Kurdiansyah et al., 2022). The statistical test results show that there is a significant difference ($p<0.05$) in the adhesion value between formulas, so the addition of *buas-buas* leaf extract affects the adhesion value.

Sunscreen Activity

Sun Protection Factor (SPF) is an indicator that explains the effectiveness of a product against UV rays (Kurdiansyah et al., 2022). The SPF value is determined by measuring the absorbance using UV-Vis spectrophotometry at a wavelength of 290-320 nm with 3 replications. The absorbance obtained was calculated using the Mansur equation with a correction factor of 21.89. The correction factor value is obtained from the

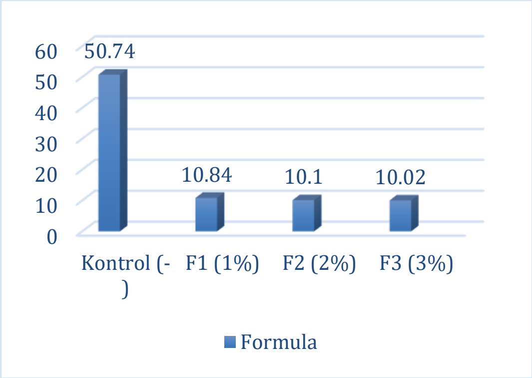

Figure 3. Graph of Adhesion Test Results

calculation results using sunscreen lotion that has a known SPF value. The results of the SPF value test can be seen in Table III, which shows that the negative control cannot act as a sunscreen because there is no addition of extracts, whereas F1 (1%), F2 (2%) and F3 (3%) have the potential as a sunscreen. The higher the concentration of the extract, the higher the SPF value of a preparation (Ulandari & Sugihartini, 2020; Rusli et al., 2022). The higher the SPF value, the more effective the sunscreen activity preparation (Kurdiansyah et al., 2022).

Table III. SPF value of *Buas-buas* Leaf Extract Lotion

Formula	SPF Value	Category
Negative control	0.37	-
F1 (1%)	7.12	Extra
F2 (2%)	9.54	Maximum
F3 (3%)	15.68	Ultra

DISCUSSION

Buas-buas leaf extract acts as a sunscreen because it contains secondary metabolite compounds such as phenols, flavonoids, and tannins. Phenol group compounds such as flavonoids, and tannins have the ability as sunscreens because there are chromophore groups (conjugated double bonds) that can provide protection. They can protect against UV rays by absorbing radiation. UV rays that work by absorbing UV radiation that penetrates the skin (Dwijayanti & Astrin, 2017). The mechanism of sunscreen protection against UV rays is that compounds that absorb UV light energy will be excited from the lowest energy level to a higher energy level. The absorbed UV rays will have a low energy level so that the negative impact of UV rays will be reduced (Yuliawati et al., 2019). Apart from absorbing UV radiation, flavonoids, and tannins also have activity as antioxidants that can capture free radicals due to UV exposure (Bahar et al., 2021; Daud et al., 2019), 2021; Daud et al., 2022; Dwijayanti & Astriani, 2022). Antioxidants can protect and minimize skin cell damage to slow down the aging process and inhibit skin diseases (Sakti et al., 2021).

CONCLUSION

The lotion of *buas-buas* leaf extract (*Premna serratifolia* Linn.) with a concentration of 1, 2, and 3% meets the requirements of evaluating the physical characteristics of lotions including, organoleptic test, homogeneity test, pH test, spreadability test and adhesion test. *Buas-buas* leaf extract lotion has activity as a sunscreen with SPF values F1 (1%) is 7.12 including extra protection, F2 (2%) is 9.54 including maximum protection and F3 (3%) is 15.68 including ultra protection.

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