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FORMULATION OF SUNSCREEN *BODY LOTION* FROM MORINGA (*Moringa oleifera* L.) LEAF EXTRACT

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Abstrak

Cara agar terhindar dari radiasi sinar UV ialah dengan memakai lotion tabir surya. Tanaman kelor (Moringa oleifera L.) mengandung 46 jenis antioksidan dan 36 senyawa anti-inflamasi yang berpotensi sebagai tabir surya. Tujuan dari penelitian ini ialah agar dapat mengetahui pengaruh jenis konsentrasi ekstrak daun kelor bagi nilai SPF, untuk menganalisis kualitas lotion yang di hasilkan dan tingkat kesukaan probandus terhadap lotion tabir surya. Penelitian dilakukan di Laboratorium Fisiologi Tumbuhan FMIPA Unud, Laboratorium Kimia Analisis dan Analisis Farmasi FMIPA Unud, dan Laboratorium Penelitian Terpadu Unud. Rancangan yang digunakan dalam penelitian ini adalah Rancangan Acak Lengkap (RAL) dengan menggunakan ekstrak daun kelor konsentrasi 0%; 0,5%; 1%; 1,5% dan 2%. Parameter yang ujikan antara lain; uji organoleptik, homogenitas, pH, viskositas, hedonik serta penentuan angka SPF dengan teknik in vitro. Hasil dari penelitian memperlihatkan jika pengujian pH, homogenitas dan viskositas F0, F1, F2, F3 dan F4 telah memenuhi syarat SNI. Nilai SPF dari masing-masing formula adalah 5,6780; 9,7605; 19,0299; 38,0369; 68,8832. Analisis statistik pH dan viskositas memperlihatkan bahwa adanya perbedaan variasi di setiap formulasi. Analisis statistik uji hedonik memperlihatkan tidak adanya perbedaan variasi di setiap formulasi. Seiring meningkatnya penambahan ekstrak daun kelor lotion tabir surya maka semakin tinggi angka SPF.

***Kata kunci**: kelor, lotion, tabir surya, nilai sun protection factor (SPF)*

Abstract

The way to avoid UV radiation is to use sunscreen lotion. Moringa plant (Moringa oleifera L.) contains 46 types of antioxidants and 36 anti-inflammatory compounds that have the potential as sunscreens. The purpose of this study was to determine the effect of the type of concentration of Moringa leaf extract on the SPF value, to analyze the quality of the lotion produced and the level of probandus preference for sunscreen lotions. The research was conducted at the Laboratory of Plant Physiology, FMIPA Unud, Laboratory of Chemical Analysis and Pharmaceutical Analysis, FMIPA Unud, and the Integrated Research Laboratory of Unud. The design used in this study was a completely randomized design (CRD) using 0% concentration of Moringa leaf extract; 0.5%; 1%; 1.5% and 2%. Parameters tested include; organoleptic test, homogeneity, pH, viscosity, hedonic and the determination of SPF number with in vitro technique. The results of the study show that the pH, homogeneity and viscosity tests of F0, F1, F2, F3 and F4 have met the requirements of SNI. The SPF value of each formula is 5.6780; 9.7605; 19.0299; 38.0369; 68.8832. Statistical analysis of pH and viscosity showed that there were different variations in each formulation. Statistical analysis of the hedonic test showed that there was no difference in variation in each formulation. As the addition of moringa leaf extract to sunscreen lotion, the higher the SPF number.

Keywords: Moringa, lotion, sunscreen, value of sun protection factor (SPF)

1. INTRODUCTION

Indonesia belongs to a country with a hot climate with a very high intensity of solar radiation exposure, namely 4.8 kWh /m ^{2} per day in all regions . Ultraviolet (UV) light has an electromagnetic scale and a less broad range of radiation , namely at a wavelength of 200 to 400 nano meters . The scale of the UV spectrum consists of three parts namely UV A with a wavelength of 320 to 400 nm, UV B with a wavelength of 290 to 320 nm and and UV C with a wavelength of 200 to 290 nm. UV radiation is very harmful to everyone's skin when exposed to long -term exposure, for example *sunburn* , erythema, and skin cancer. To avoid skin problems due to UV radiation , treatment is needed right such as sunscreen (Rosita and Purwanti, 2010).

Sunscreen is a substance that can provide protection for the skin from UV radiation . Sunscreen has 2 methods of protecting the skin. First, sunscreen is able to reflect UV radiation so it doesn't hit the skin. Second , sunscreen is able to absorb UV radiation before it hits the skin (Prima, 2019).

The part of the moringa plant that functions as a natural sunscreen is the moringa leaf. The phytochemical content in Moringa leaves is in the form of flavonoids, which have the ability to act as sunscreens because there are chromophore groups that work by gives color to plants . Chromophore group are conjugated aromatics which have the capacity to absorb UV radiation at each wavelength (Putri et al., 2019).

Lotion is an *emollient* group of sunscreen preparations which has a high water content . *Lotion* is able to provide moisture to the skin, makes the skin feel soft, and is very easy to apply all over the body. *Lotions* are generally composed of several components such as water, oil, emulsifying agents, preservatives and fragrances (Benjamin et al., 2016).

research results (2019) explain that *peel-off The best* mask from the Moringa leaf extract is obtained from a 3% extract. Ningsih (2014) used the active ingredient of Moringa leaf powder as an antioxidant based on *vanishing cream* with the best results obtained from a concentration of 5%. Nining and Evi (2017) used the active ingredient of Moringa leaf extract as an *anti-aging cream* with the best results obtained from an extract concentration of 3%. Gitariastuti et al (2019) added moringa leaf powder to *body scrub preparations* in order to remove dead skin cells and to open pores so that the skin is cleaner and to make scrubs that are rich in antioxidants from Moringa leaves (Tella et al., 2020).

To counteract UV A, a sunscreen *lotion with a PA +++ (Protection Grade of UVA*). PA+ provides little protection, PA ++ provides moderate protection, and PA +++ provides high protection against UVA radiation. Meanwhile, to ward off UV B radiation, it takes 30 SPF (*Sun Protection Factor*). sunscreen in order to provide maximum potential to the skin for people in tropical areas such as Indonesia (Donglikar and Deore, 2016).

2. MATERIALS AND METHODS

2.1 Location and Time of Research

The research was carried out from October-November 2021. Leaf samples were taken Moringa was carried out in Pecatu, South Kuta District, Badung Regency. The process of extracting Moringa leaves was carried out at UPT Laboratory of Genetic and Molecular Resources, Postgraduate Building, UNUD . The process of making sunscreen *lotion , organoleptic tests, homogeneity tests and pH tests were carried out at the Plant Physiology Laboratory,* Department of Biology, UNUD . The viscosity test was carried out at the Laboratory of Analysis of the Department of Pharmacy , UNUD . The *in vitro* test for the value of *the sun protection factor* (spf) was carried out at the Integrated Research Laboratory of FMIPA, UNUD .

2.2 Research Design

The design used in the research namely RAL (completely randomized design) . *Sunscreen lotion* preparations made with a concentration of 0%; 0 ,5 ; 1%; 1.5% and 2%. It takes 30 probands to provide feedback regarding sunscreen *lotion products.* Sunscreen *lotion* preparations are made with five concentrations, namely 0%; 0.5 % ; 1%; 1.5% and 2%. The

organoleptic test is carried out optically by observing the texture, aroma, color and impression on the skin . The homogeneity test was carried out by coating one gram *of lotion* on the object glass and then affixing it with another object glass , repeating three times for each formulation . The pH test was carried out using a pH meter, replication was carried out 3 times at each sample concentration. Viscosity test was measured using a Brookfield viscometer model DVE spindle number 0 2 with an acceleration of 100 rpm, three repetitions for each si formula . Test to determine the SPF value *of the lotion* using *in vitro* uv - vis spectrophotometer . Absorbance readings at wavelengths from 290 to 320 nm, each one wavelength can be repeated three times so that 21 repetitions of 7 wavelengths are obtained at each sample concentration .

2.3 Preparation of Moringa leaf extract

Moringa leaves freshly picked from The tree is washed with water , drained and then weighed to obtain the wet weight and dried until the weight is constant. The sample was pureed using a blender, then weighed in order to determine the dry weight. Maceration was carried out with 96% ethanol solvent at a sample and ethanol ratio of 1:10 for 5 days and while stirring occasionally. Mesarat was filtered using filter paper then concentrated at 40 °C with a *vacuum device rotary evaporator* to get crude extract. Yield is calculated by the formula

$$\% \text{ Yield} = \frac{Bobot\ Ekstrak}{Bobot\ Awal\ Simplisia}\ x\ 100\%$$

2.4 Making *Lotion Preparations* Sunblock

lotion preparation formulation is presented in table 1 which consists of three phases (water, oil, and cooling) . The oil and water phases were placed in separate beakers and melted on a hotplate at 65 ˚C. The oil phase included liquid paraffin, lexemul, cetyl alcohol, dimethicone and lanolin. The water phase includes glycerin , TEA, and distilled water. The water and oil phases were brought together at a temperature (± 65°C) while stirring was carried out thus forming a homogeneous mixture . Nipagin and Moringa leaf extract, which are the cooling phase, are added to the lotion when the temperature reaches *40 ˚C.* In each formula, the concentration of Moringa extract varies by 0%; 0.5 % ; 1%; 1.5% and 2%.

Table 1. Formulation of Sunscreen *Body Lotion preparations.*

Raw material	formulation				
	F0	**F1**	**F2**	**F3**	**F4**
Liquid Paraffin	3	3	3	3	3
Lexemul	3	3	3	3	3
Cetyl alcohol	2	2	2	2	2
Dimethicone	3	3	3	3	3
lanolin	2	2	2	2	2
Glycerin	3	3	3	3	3
TEA	1,2	1,2	1,2	1,2	1,2
Methylparaben	0.1	0.1	0.1	0.1	0.1
Moringa leaf extract	-	0.5%	1 %	1.5%	2%
Aquades add	100	100	100	100	100

2.5 Testing the Physical Properties *of Lotion*

a. Organoleptic Test

Organoleptic checking is carried out by observing optically by examining the color, texture, aroma and effect on the skin of the *lotion preparation.*

b. Homogeneity test

Homogeneity check is carried out by method coat One gr *lotion* on glass object is then affixed with other glass objects . Observations were made visually for the presence or absence of coarse particles. Repeat three times for each formula.

c. pH test

Checking the pH was measured using a pH meter, repeating 3 times for each formula .

d. Viscosity test

Checking the viscosity of *the lotion* was measured using a Brookfield viscometer model DV-E using spindle number 2 at a speed of 100 rpm. Repeat three times for each formula.

e. *In vitro* test value of *sun Protection factor* (spf)

As much as 0.5 g *of lotion* was dissolved little by little with ethanol pa (Pro Analysis) then put into a 10 mL volumetric flask along with

ethanol then sonified for 5 minutes. Liquid in filter using filter paper and pour to the cuvette. Read the absorbance using a uv vis spectrophotometer from a wavelength of 290 to 320 n anometer .

The SPF value *of the lotion* is calculated using the formula:

$$SPF = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times abs(\lambda)$$

Information:
CF = *Correction factors (* 10)
EE = *Erythemal effect spectrum*
l = *Solar intensity spectrum*
Abs = *Absorbance of sunscreen products*
The value of EE x I is a constant which is presented in table 2.

Table 2. *The Normalied Products function* is used in the SPF calculation.

No	Wavelength (λ nm)	EE Xl
1.	290	0.0150
2.	295	0.0817
3.	300	0.2874
4.	305	0.3278
5.	310	0.1864
6.	315	0.0839
7.	320	0.0180
	Total	1

f. Hedonic Test

The hedonic test was carried out involving 30 probands to determine their level of preference for sunscreen *lotion* . The probandus was asked to compare the five formulas based on terms of texture, color, aroma, impression on the skin and the presence or absence of irritation. The assessment category consists of 3 levels, namely dislike , like, and really like.

2.6 Data Analysis

Quantitative data obtained is analyzed by ANOVA *Analysis of Variance* , if different data is obtained $\alpha<0.05$ will be followed by *Post Hoc Duncan Test.*

3. RESEARCH RESULTS

3.1 Extraction of Moringa Leaves

From 2 kg of fresh moringa leaves used, after experiencing the drying process to produce 600 grams of dry powder, then concentrated through a *vacuum rotary evaporator* and obtained 47.17 grams of viscous extract with a yield of 7.861%.

3.2 Organoleptic test

Organoleptic test was carried out in order to know character *lotions* through optical viewing to see the color, texture, fragrance and impression on the skin (Table 3).

Table 3. Organoleptic test results on *body lotion* sunscreen preparations from Moringa leaf extract.

formulation	Color	Texture	Aroma	Impression on skin
F0 (Without EDK)	White	Liquid	Not flavorful	Soft and not sticky on the skin
F1 (EDK 0.5%)	Light green	Liquid	Typical of Moringa leaves	Soft and not sticky on the skin
F2 (EDK 1%)	Green	Liquid	Typical of Moringa leaves	Soft and not sticky on the skin
F3 (EDK 1.5%)	Green	Liquid	Typical of Moringa leaves	Soft and not sticky on the skin
F4 (EDK 2%)	Dark green	Liquid	Typical of Moringa leaves	Soft and not sticky on the skin

Information
EDK: Moringa leaf extract r

F0: formulation 0 without Moringa leaf extract
F1: formulation 1 with 0.5 % Moringa leaf extract
F2: formulation 2 with 1% Moringa leaf extract
F3: formulation 3 with 1.5 % Moringa leaf extract
F4: formulation 4 with 2% Moringa leaf extract

3.3 Requirements for the Quality of Sunscreen Preparations Based on SNI

The quality requirements for testing sunscreen *lotion* based on SNI include homogeneity, pH and viscosity tests as presented in (Table 4). Test the homogeneity of *the lotion* with active ingredients or not with active ingredients show results that look homogeneous. This can guarantee that all materials are distributed evenly and meet SNI requirements . Test the pH on *the lotion* with or without active ingredients have met SNI requirements, namely not less or not more than 4.5-8.0 and there are visible differences in variations in each formulation . Test the viscosity *of the lotion* with active ingredients or not with active ingredients have met SNI requirements of not less or not more than 2.000-50.00 cps and there are visible differences in variations in each formulation .

Table 4. Test the quality requirements for testing sunscreen *lotion based on SNI* .

formulation	Test the Requirements for the Quality of Sunscreen Preparations Based on SNI		
	Homogeneity	**pH**	**Viscosity**
F0 (no EDK)	Homogeneous	5.53 ± 0.3215 **a**	2,000 ± 0.577 **a**
F1 (EDK 0.5%)	Homogeneous	5.48 ± 3.7242 **a**	2.069 ± 59, 475 **b**
F2 (EDK 1%)	Homogeneous	6.80 ± 0.0577 **b**	2,377 ± 5,774 **c**
F3 (EDK 1.5%)	Homogeneous	6.21 ± 5.6871 **a**	2,410 ± 17,321 **cd**
F4 (EDK 2%)	Homogeneous	5.37 ± 4.5622 **a**	2.440 ± 0.000 **s**

Information:
EDK: Moringa leaf extract
F0: formulation 0 without Moringa leaf extract
F1: formulation 1 with 0.5 % Moringa leaf extract
F2: formulation 2 with 1% Moringa leaf extract
F3: formulation 3 with 1.5 % Moringa leaf extract
F4: formulation 4 with 2% Moringa leaf extract
Letters **a, b, c, cd, d** in the column based on *Duncan's Post Hoc test* the results obtained were significantly different between formulations F0, F1, F2, F3 and F4.

3.4 Test *in vitro* value of *Sun Protection Factor* (SPF)

The results of testing with techniques *in vitro* sunscreen body lotion is presented in table 5. Lotion *F0 (* without Moringa leaf extract) has an SPF value of 5.6780 which is classified as moderate protection and can provide resistance for 56 minutes. F1 with the addition of 0.5% Moringa leaf extract has an SPF value of 9.7605 classified as maximum protection and can provide resistance for 97 minutes. F2 with the addition of 1% Moringa leaf extract has an SPF value of 19.0299 and can provide resistance for 190 minutes. F3 with the addition of 1.5% Moringa leaf extract has an SPF value of 38.0369 and can provide resistance for 380 minutes. F4 with the addition of 2% Moringa leaf extract has an SPF value of 68.8832 and can provide resistance for 688 minutes as presented in table 5.

Table 5. The results of the SPF value of sunscreen *body lotion preparations from Moringa leaf extract.*

formulation	SPF	protection type
F0	5.6780	Currently

F1	9.7605	Maximum	F3	38.0369	ultra
F2	19.0299	ultra	F4	68.8832	ultra

3.5 Hedonic test

The degree of acceptance of *body lotion* sunscreen from probandus was obtained from hedonic tests carried out through 30 probandus. The probandus criteria are guided by the 2006 SNI regulations as presented in Table 6 . Based on the observations that have been carried out, it is stated that probandus prefers F0 *lotion* in terms of aroma, texture and impression on the skin. Meanwhile, in terms of color, probandus preferred *lotion* with an extract concentration of 0.5 %. The results of data analysis using SPSS did not show any differences in variation in each formulation.

Table 6. Hedonic test results for *body lotion* sunscreen preparations from Moringa leaf extract.

Parameter	**Sunscreen *Lotion***														
	F0			**F1**			**F2**			**F3**			**F4**		
	JP			**JP**			**JP**			**JP**			**JP**		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Aroma	3	21	6	7	20	3	11	14	5	13	10	6	13	10	7 ± 0.683 **a**
Texture	2	23	5	0	22	8	3	18	9	6	12	12	5	16	9 ± 0.579 **a**
Color	0	17	13	6	18	6	3	14	13	9	12	9	11	12	7 ± 0.711 **a**
Effect on skin	0	22	8	5	15	10	7	12	11	4	16	10	5	14	11 ± 0.669 **a**
Irritation (yes/no)	There isn't any			There isn't any			There isn't any			There isn't any			There isn't any		

Information:
Letter **a** in the column based on the ANOVA test was not significantly different between formulations F0, F1, F2, F3 and F4 of terms of aroma, texture, color and impression on the skin.
JP: Total probandus
1: Dislike
2: Like
3: Really like it
F0: formulation 0 without Moringa leaf extract
F1: formulation 1 with 0.5 % Moringa leaf extract
F2: formulation 2 with 1% Moringa leaf extract
F3: formulation 3 with 1.5 % Moringa leaf extract
F4: formulation 4 with 2% Moringa leaf extract

4. DISCUSSION

The extract obtained weighed 47.17 grams and the yield was calculated and the yield yield was 7.861% . Determination of yield plays a role in order to know the dose of secondary metabolites carried by the solvent but does not determine the type of compound (Via and Iman, 2020).

Assessment of the organoleptic properties of sunscreen *body lotion preparations can include color, texture* , aroma and effects on the skin as shown in Table 3 (Ningrum et al, 2017). Color is the appearance of the *body lotion* sunscreen that is observed by the sense of sight. F0 (without Moringa leaf extract) white *body lotion preparation, this is because it only contains a base without the addition of Moringa leaf extract. F1 (* 0.5 % moringa leaf extract) was light green, F2 (1.5% moringa extract and moringa leaf extract) and F3 (1.5% moringa leaf extract) were green, and F4 (2% moringa leaf extract) was dark green. The more interpolation of extract variations , the color that appears to be getting darker, this is because Moringa leaves contain chlorophyll (Sumenda et al., 2011). The next organoleptic parameter is texture. Texture comes from friction trapped on the surface of the skin. In liquid textured *body lotion preparations* , this is because it contains more water and has a low oil content in the manufacturing process (Benjamin et al., 2016). The next organoleptic parameter is aroma. Aroma is a stimulus that is produced from *body lotion* which is known by using the sense of smell. The sense of smell is the instrument that plays the most role in knowing the aroma of a product. The distinctive aroma of moringa in *body lotion preparations* F1, F2, F3 and F4 is influenced by the addition of moringa leaf extract (Ilona and Rita, 2015). The last organoleptic parameter is the impression on the skin after use. *Body lotions* F0, F1, F2, F3 and F4 are soft, non-sticky, spread easily when applied to the skin . This is due to the addition of liquid paraffin and *dimethicone* in the formulation which causes *the lotion* to be soft, not greasy and easy to apply to the skin (Maria and Anis, 2021).

Homogeneity testing aims to understand the homogeneity aspect of sunscreen *lotion* . Mixed *lotion* produces good quality because it can prove *that* the ingredients used in the manufacturing process are perfectly distributed. From research that has been done on *lotion preparations* F0, F1, F2, F3, and F4 all look homogeneous (Jufri et al., 2006).

The pH measurement aims to determine the degree of acidity in a sample of sunscreen *lotion so as not to cause irritation to the skin. Lotions* that have a pH value that is too alkaline make the skin dry, while *lotions* with a pH value that are too acidic will irritate the skin (Barel et al., 2001). An increase in the concentration of the active ingredients causes a decrease in pH due to the presence of phenolic content which decomposes into polyphenolic compounds contained in the active ingredients of Moringa. The decomposition that occurs affects the increase in H^+ as the active ingredients are added so that the pH decreases (Ulandari and Sugihartini, 2020). Based on the ANOVA test, it shows that there are differences in variations in each formulation.

Based on checking the viscosity of sunscreen *body lotion from Moringa leaf extract, the* average successive viscosity was 2,000; 2069; 2,377; 2.410 and 2.440 as shown in table 5. The viscosity test results obtained are in accordance with SNI 16 4399 1996 namely 2 . 000-50,000 cps. This can prove that the higher the level of active ingredients added, the thicker the preparation and the viscosity value obtained is higher (Zulkarnain, 2013). Based on the *one way* ANOVA test , it shows that there are differences in variations in each formulation.

The effectiveness of a sunscreen product is determined based on the determination of the SPF. In F0 there is no Moringa leaf extract, but it has an SPF of

5.6780. This is due to the fact that when making *the lotion,* it contains lanolin, a natural compound found in sheep's wool , so it can block free radicals that damage the skin . F1 with the addition of 0.5 % Moringa leaf extract has an SPF value of 9.7605 and is classified as maximum protection. F2 with the addition of 1% Moringa leaf extract has an SPF value of 19.0299 belonging to the ultra protection category. F3 with the addition of 1.5% Moringa leaf extract has an SPF value of 38.0369 belonging to the ultra protection category and F4 with the addition of 2% Moringa leaf extract has an SPF value of 68.8832 belonging to the ultra protection category as shown in table 8 (WHO, 2003). As the active ingredients increase , the SPF number increases , because Moringa leaf extract contains flavonoid compounds that have the potential to be used as sunscreens (Putri et al., 2019).

The results of the hedonic test showed that probandus preferred F0 *lotion* (without Moringa leaf extract) in terms of aroma, texture and impression on the skin . Meanwhile, in terms of color, probandus preferred *lotion* with a concentration of 0.5 % Moringa leaf extract . Assessment of sensitivity shows no symptoms of erythema or irritation of the skin, for example irritation or allergies that occur in sunscreen *lotions* . Irritation is usually related to the pH *of the lotion* where the safe pH for the skin ranges from 4.5-8 (Hakim et al, 2018). The sticky effect on the skin is also absent in all formulations because *the lotion* is easy to apply and absorbs quickly into the skin. Based on the *one way* ANOVA test , it shows that there is no difference in variation in each formulation.

5. CONCLUSION

Increasing the concentration of the active ingredient from Moringa leaf extract increases the SPF value. The resulting sunscreen *lotion complies with* SNI 16-4399-1996 for homogeneity, pH and viscosity parameters. The hedonic test conducted showed that probandus preferred F0 *lotion* in terms of aroma, texture and impression on the skin. In terms of color, probandus preferred *lotion* with an extract concentration of 0.5 %.

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