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Comparative Test on The Anti-Solar Activity of Basil Leaf Extract Cream (*Ocimum basilicum* L.) and Jicama Starch (*Pachyrhizus erosus* L.)

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Abstract

Sunscreen is a material that can absorb or reflect ultraviolet (UV) radiation to protect the skin from the negative impact. Sunscreen derived from synthetic compounds can cause long-term toxic side effects, so natural materials can be a safer alternative to sunscreen. Basil leaves (*Ocimum basilicum* L.), and jicama tubers (*Pachyrhizus erosus* L.) have sunscreen activity because they contain flavonoids that absorb UV. This study aims to compare the sunscreen activity of basil leaf extract cream with jicama tuber starch cream and determine the concentration of basil leaf extract or jicama tuber starch with the highest SPF value. Basil leaves were extracted by maceration using ethanol solvents, while jicama tubers were made into starch powder. Basil extract and jicama starch were formulated into a cream preparation. Then, an evaluation of the preparation was carried out. The SPF value was determined in vitro using a UV-Vis spectrophotometer instrument at a wavelength of 290 to 320 nm. The results of the evaluation of the cream preparation meet the requirements for the entire test. The results of measuring the SPF value of basil leaf extract sunscreen cream with concentrations of 15%, 20%, and 25% were 9.40 (maximum), 10.66 (maximum), and 15.41 (ultra). The results of measuring the SPF value of jicama tuber starch sunscreen cream with concentrations of 15%, 20%, and 25% were <2, so it is ineffective as a sunscreen. Basil leaf extract sunscreen cream with a concentration of 25% showed the best SPF value with an ultra sunscreen ability level.
Keywords: Basil leaf, Cream, SPF, Sunscreen, Jicama starch, UV.

INTRODUCTION

Indonesia is a tropical country on the equator where the sun shines all day (Sari and Yuniarti, 2023). Sunlight consists of ultraviolet (UV) light wavelengths and visible light. Solar UV radiation consists of UVC (100-290 nm), UVB (290-320 nm), and UVA (340-400 nm). Most UVC rays are filtered by the atmosphere, so they cannot reach the Earth's surface (Kockler *et al*., 2012). Exposure to UV rays from the sun, especially UVB, in the long term, can cause various health effects, such as sunburn and photoaging, as well as skin cancer (Smaoi *et al*., 2017). One way to overcome the negative impact of UV rays is using sunscreen (Sopyan *et al*., 2017). Sunscreen is widely available in cream form because of its advantages: It does not leave marks after application, provides a cooling effect on the skin, is non-sticky, and spreads well. The effectiveness of sunscreen is indicated by the Sun Protection Factor (SPF) value. UV-Vis spectrophotometry can determine SPF values in vitro (Permana *et al*., 2022).

Sunscreens can be classified into two types, namely chemical sunscreens and physical sunscreens. Chemical sunscreen protects the skin by absorbing UV rays, while physical sunscreen protects the skin by reflecting UV rays (Uchale *et al*., 2024). Examples of widely used physical sunscreens are titanium dioxide and zinc oxide, while chemical sunscreens are oxybenzone, avobenzone, octisalate, etc. (Ma *et al*., 2021). The sunscreen comes from synthetic compounds that can cause harmful side effects on the skin if used continuously. Sunscreen from natural ingredients is one solution to reduce these side effects (Mandal *et al*., 2022).

Basil (*Ocimum basilicum* L.) is a plant traditionally used to treat headaches, coughs, diarrhoea, impaired kidney function, diabetes, and cardiovascular diseases. Basil contains about 20 compounds with methyl eugenol as its active compound (Balakrishnan *et al*., 2018). Basil leaf extract is rich in phenolic compounds such as flavonoids and anthocyanins, and it has sunscreen activity because it can absorb UV rays (Ismail *et al*., 2014 & Komić *et al*., 2023). Flavonoids can absorb UV radiation due to double bonds in their structure. In addition, flavonoids can also reduce oxidative stress reactive oxygen species (ROS) because they have hydroxyl groups connected to aromatic rings (Messias *et al*., 2023).

Jicama (*Pachyrhizus erosus* L.) is a food crop that is not widely used but has a high nutrient content and various biological activities. Jicama contains secondary metabolic compounds such as flavonoids and saponins with natural sunscreen activity (Chandra *et al*., 2023). Jicama starch, made with small particle sizes, can be used as a physical sunscreen. In addition, the opaque amylum property, which is impermeable to light but can reflect rays, is very beneficial in preventing the absorption of UV rays on the skin (Zulkarnain *et al*., 2013).

Research on the formulation and activity of sunscreen preparations from natural ingredients, especially basil extract and jicama starch, still needs to be widely developed. The sunscreen activity of several natural ingredients has been widely studied. Still, no study has compared the strength of the sunscreen activity based on its SPF value in the form of preparations. Based on the background description, this study was conducted to determine the comparison of sunscreen activity of basil leaf extract (*Ocimum basilicum* L) with jicama tuber starch (*Pachyrhizus erosus* L) based on SPF value in vitro using UV-Vis spectrophotometry and to determine the concentration of basil leaf extract (*Ocimum basilicum* L) or jicama root starch (*Pachyrhizus erosus* L) which has the highest SPF value.

MATERIALS AND METHOD

TOOLS AND MATERIALS

The tools used in this study were analytical balance (Fujitsu), UV-Vis Spectrophotometer (Biobase), pH meter (HI), Rotary Evaporator, Blender (Phillips), Maserator, Oven, and glassware. The ingredients used were basil leaves (*Ocimum basilicum* L.), jicama tubers (*Pachyrhizus erosus* L.), 96% alcohol, stearic acid, glycerin, cetyl alcohol, triethanolamine, propylparaben, methylparaben, aquadest, Mg powder, and concentrated HCl.

DETERMINATION OF BASIL (*Ocimum basilicum* L.) AND JICAMA (*Pachyrhizus erosus* L.) PLANT

The first stage of this study was to determine the truth related to morphological characteristics in basil (*Ocimum basilicum* L.) and jicama (*Pachyrhizus erosus* L.) plant samples macroscopic at the Botany Laboratory, Faculty of Pharmacy, Yayasan Pendidikan Imam Bonjol (YPIB) Majalengka.

SAMPLE COLLECTION

The raw materials for this study were basil leaves (*Ocimum basilicum* L), which were obtained as much as 5 kg from Cirebon Regency, West Java, and jicama tubers (*Pachyrhizus erosus*), which were obtained as much as 7 kilograms from Cirebon Regency, West Java.

MAKING BASIL (*Ocimum basilicum* L.) LEAF SIMPLICIA

Five kg of basil leaves were sorted wet and washed with running water. Next, the basil leaves were dried under sunlight with a cloth. The dried sample was crushed into simplicia powder and stored in a tightly closed container. Moisture content testing was carried out using moisture balance to test the quality of simplicity.

MAKING BASIL (*Ocimum basilicum* L.) LEAF EXTRACT

300 grams of simplicia were put into a macerator container, and 2 L of 96% ethanol solvent was added. Then, the solvent was tightly closed and left for 2 days while stirring occasionally. Next, filtration was carried out, and filtrate 1 was obtained. Maceration was repeated for the residue with 96% ethanol as much as 1 L for 1 day. Then, the maceration results were filtered again to produce filtrate 2. Filtrate 1 and 2 were combined and then concentrated using a rotary evaporator at a temperature of 50 °C until a thick extract was formed.

MAKING JICAMA (*Pachyrhizus erosus* L.) STARCH

Jicama tubers weighing 7 kg were cut and then mashed using a blender. The results were filtered and squeezed. The filtrate was put into a container for 24 hours until a starch deposit was formed. The starch was separated and then dried using the oven. The dry starch was ground using a blender and then sieved until a fine starch powder was obtained. Moisture content was tested using moisture balance to test the starch quality produced.

PHYTOCHEMICAL SCREENING OF BASIL (*Ocimum basilicum* L.) LEAF EXTRACT AND JICAMA (*Pachyrhizus erosus* L.) STARCH

Phytochemical screening was carried out only for flavonoid compounds because these compounds have sunscreen activity through the absorption of UV rays (Messias *et al*., 2023).

One gram of basil leaf extract and jicama starch were added to 10 mL of hot water, boiled for 5 minutes, and filtered. A 5 mL filtrate was put into the test tube, then 0.05 mg Mg powder and 1 mL concentrated HCl were added, and strong shaking was carried out. The presence of flavonoid compounds is indicated by red, yellow, or orange colors (Larasati & Putri, 2023).

MAKING SUNSCREEN CREAM WITH BASIL (*Ocimum basilicum* L.) LEAF EXTRACT AND JICAMA (*Pachyrhizus erosus* L.) STARCH

Table 1: Formulation of Sunscreen Cream of Basil Leaf Extract and Jicama Starch

Material	Function	Composition (%)		
		Basil Leaf Extract Formula (X1, X2, X3)	Jicama Starch Formula (X4, X5, X6)	Negative Control Formula (K-)
Basil leaf extract	Active substances	15, 20, 25	-	-
Jicama starch	Active substances	-	15, 20, 25	-
Triethanolamine	Emulsion Stabilizer	4	4	4
Stearic acid	Thickening agent, emollient, and emulsifier	6	6	6
Cetyl alcohol	Emulsion Stabilizer	2	2	2
Glycerine	Humectans and emollients	8	8	8
Methylparaben	Preservatives	0.2	0.2	0.2
Propylparaben	Preservatives	0.02	0.02	0.02
Aqudest	Solvent	Ad 100	Ad 100	Ad 100

Sunscreen creams were formulated according to the Table 1. The procedure started by weighing all the ingredients, then mixing and melting the oil phase (stearic acid, propylparaben, and cetyl alcohol) in a water bath. Then, the water phase (triethanolamine, methylparaben, glycerin, and aquadest) was heated over the bath. The oil phase was mixed into the water phase, stirred until homogeneous at 60-70°C, and then cooled. After the cream base was ready, the active substance was put into the base and stirred until homogeneous. The cream is placed in a tightly closed container.

EVALUATION OF BASIL (*Ocimum basilicum* L.) LEAF EXTRACT AND JICAMA (*Pachyrhizus erosus* L.) STARCH SUNSCREEN CREAM PREPARATIONS

The evaluations for this sunscreen cream preparation were organoleptic, homogeneity, pH, dispersion, adhesion, and stability tests. The organoleptic test was carried out by observing the cream preparation in terms of the cream's shape, smell, and color. The homogeneity test was carried out by placing cream between two glass objects and then observing the presence of coarse or non-homogeneous particles under light. The pH test was carried out using a pH meter; the pH of an excellent topical preparation was adjusted to the pH of the skin, which was 4.5-6, so as not to irritate (Saryanti *et al*., 2019).

For the spreadability test, 1 gram of cream was placed in the middle of a round glass and then covered with another round glass. One hundred grams weight was placed on it for 1 minute. The diameter of the cream was measured by taking the average length of several sides. The diameter requirement for the spreadability test was 5 to 7 cm. For the adhesion test, 1 gram of cream was placed on two glass objects, then pressed with a 100 g weight for 5 minutes. The release time from the glass object was recorded. Good adhesion for cream preparation was >4 seconds (Tungadi *et al*., 2023).

The cycling test was carried out by storing the sample in the refrigerator at 4°C for 24 hours and then transferring it to an oven at 40°C for 24 hours. This test was repeated for six cycles. Then, the organoleptic, homogeneity, pH, dispersion, and adhesion tests were repeated. The cream is stable if there were no significant changes.

SUNSCREEN ACTIVITY TEST OF BASIL (*Ocimum basilicum L*) LEAF EXTRACT AND JICAMA (*Pachyrhizus erosus* L) STARCH CREAM

In vitro sunscreen activity tests to determine the values of erythema transmission percentage (%Te), pigmentation transmission percentage (%Tp), and Sun Protection Factor (SPF) were carried out using a UV-Vis spectrophotometer (Rahmiyani *et al*., 2022).

The stock solution was made at 1000 ppm by weighing 0.1 grams of cream and then dissolved with 96% ethanol to 100 mL. Absorption values were measured every 5 nm in the wavelength range of 292-372 nm for erythema, 322-372 nm for pigmentation, and 290-320 nm for SPF. The absorption value was converted into a transmitant value for erythema and pigmentation.

%Eritema Transmission (%Te) was calculated using the following formula:

$\%Te = \frac{\Sigma TxFe}{\Sigma Fe}$ where %Te is the % of erythema transmission, ΣT is the total energy of transmission, Fe is the energy of erythema, and ΣFe is the total energy of erythema.

%Pigmentation Transmittance (%Tp) was calculated using the following formula:

$\%Tp = \frac{\Sigma TxFp}{\Sigma Fp}$ where %Tp is the % of pigmentation transmission, ΣT is the total transmission energy, Fp is the pigmentation energy, and ΣFp is the total pigmentation energy.

A compound or preparation has activity as a sunscreen if it meets the requirements of %Te < 1% and %Tp in the range of 3-40% (Gunarti & Fikayuniar, 2020).

The SPF value was calculated using the following formula:

$$SPF = CF + \sum_{290}^{320} EE\ (\lambda) x\ I\ (\lambda) x\ Abs\ (\lambda)$$

where CF is the correlation factor with a value of 10, EE is the erythema efficiency, I is the intensity of the ray spectrum, and Abs is absorbance.

Furthermore, the SPF value was classified to determine the ability of sunscreen. According to *The Food and Drug Administration* (FDA), the classification of sunscreen ability levels is as follows (Juanita & Juliadi, 2020):

1. Minimum: SPF 2-4
2. Moderate: SPF 4-6
3. Extra: SPF 6-8
4. Maximum: SPF 8-15
5. Ultra: SPF >15

RESULTS

DETERMINATION RESULTS OF BASIL (*Ocimum basilicum* L.) AND JICAMA (*Pachyrhizus erosus* L.) PLANTS

The results of the determination carried out at the Botanical Laboratory of the Faculty of Pharmacy, YPIB Majalengka University, showed that the basil plants examined belonged to the Labiatae family with the species *Ocimum basilicum* L, and the jicama tuber plants belonged to the Fabaceae family with the species *Pachyrhizus erosus* L.

RESULTS OF MAKING BASIL (*Ocimum basilicum* L.) LEAF SIMPLICIA AND JICAMA (*Pachyrhizus erosus* L.) STARCH

Basil leaf simplicia powder obtained was 300 mg from the initial weight of 5000 g, and the starch of jicama tubers produced was 132 g from the initial weight of 7000 g. The results of the moisture content test of basil leaf simplicia and jicama tuber starch were 2.2% and 2.85%.

RESULTS OF MAKING BASIL LEAF EXTRACT (*Ocimum basilicum* L.)

The results of basil leaf extract obtained using the maceration method with ethanol solvent were 53.51 g with a yield of 17.83%.

RESULTS OF PHYTOCHEMICAL SCREENING OF BASIL LEAF EXTRACT (*Ocimum basilicum* L.) AND JICAMA STARCH (*Pachyrhizus erosus* L.)

The screening results for flavonoid content in basil leaf extract showed an orange solution, while jicama starch showed a dull yellow color. Thus, it can be concluded that basil leaf extract and jicama starch positively contain flavonoids.

RESULTS OF EVALUATION OF SUNSCREEN CREAM PREPARATION OF BASIL LEAF EXTRACT (*Ocimum basilicum* L.) AND THE TUBER STARCH OF JICAMA (*Pachyrhizus erosus* L.)

The sunscreen cream, basil leaf extract, and jicama tuber starch were evaluated on the first day after making the cream. The evaluations include organoleptic, pH, homogeneity, dispersion, and adhesion tests. The stability test was carried out using the cycling test method for six cycles at storage temperatures of 4°C and 40°C for 24 hours. The test results are shown in Table 2. All test results met the requirements.

Table 2: Results of Evaluation of Cream Preparations of Basil (*Ocimum basilicum* L) Leaf Extract and Jicama (*Pachyrhizus erosus* L) Starch

Formulation	Organoleptic			pH	Homogeneity	Dispersion (cm)	Adhesion (sec)	Stability
	Shape	Color	Smell					
X1	Semi Solid	Deep green	Distinctive	6.32	Homogeneous	6.7	32.40	Stable
X2	Semi Solid	Green Concentrated	Distinctive	6.31	Homogeneous	6.4	29.58	Stable
X3	Semi Solid	Green Concentrated	Distinctive	6.32	Homogeneous	6.3	30.16	Stable
X4	Semi Solid	White	Distinctive	6.29	Homogeneous	7	30.84	Stable
X5	Semi Solid	White	Distinctive	6.37	Homogeneous	7	29.40	Stable
X6	Semi Solid	White	Distinctive	6.38	Homogeneous	7	30.94	Stable

Information:

X1: Basil Leaf Extract Cream 15%
X2: Basil Leaf Extract Cream 20%
X3: Basil Leaf Extract Cream 25%

X4: Jicama Tuber Starch Cream 15%
X5: Jicama Tuber Starch Cream 20%
X6: Jicama Tuber Starch Cream 25%

RESULTS OF SUNSCREEN ACTIVITY TEST OF BASIL (*Ocimum basilicum L*) LEAF EXTRACT AND JICAMA (*Pachyrhizus erosus* L) TUBER

Table 3 shows the sunscreen activity test results, including the %erythema transmittance (%Te), % pigmentation transmittance (%Tp), and % *Sun-Protecting Factor* (SPF) values.

Table 3: Values of %Te, %Tp, and SPF

Formulation	Sunscreen Activities			
	%Te	%Tp	SPF	Sunscreen Categories
X1	11,246	16,839	9,406	Maximum
X2	8,391	13,845	10,662	Maximum
X3	2,840	8,017	15,413	Ultra
X4	92,932	96,370	0,298	None
X5	93,388	96,500	0,303	None
X6	89,192	93,007	0,460	None
K+	0,054	0,049	36,120	Ultra

Information:

X1: Basil Leaf Extract Cream Concentration 15%
X2: Basil Leaf Extract Cream Concentration 20%
X3: Basil Leaf Extract Cream Concentration 25%
X4: Jicama Tuber Starch Cream Concentration 15%
X5: Jicama Tuber Starch Cream Concentration 20%
X6: Jicama Tuber Starch Cream Concentration 25%
K+: Wardah® Sunscreen Gel SPF 35

DISCUSSIONS

Basil leaves (*Ocimum basilicum* L.) for the extract in this study came from fresh leaves because they could have a higher flavonoid content. Flavonoid compounds have chromophore groups in the form of conjugated double bonds that can absorb UV rays as sunscreen. Hydroxyl groups connected to aromatic rings on flavonoids can reduce the oxidative stress of ROS (Messias *et al*., 2023). Jicama (*Pachyrhizus erosus* L.) tubers also contain flavonoid compounds for sunscreen use. In addition, jicama starch, made with a small particle size, can serve as a physical sunscreen. The property of opaque amylum, impermeable to light but can reflect light, is very beneficial for preventing the absorption of ultraviolet radiation on the skin (Zulkarnain *et al*., 2013). Jicama tubers also contain other phenolic compounds that can inhibit the melanin formation process to prevent and reduce pigmentation on the skin (Chandra *et al*., 2023).

Basil leaves were made simplicia by drying in the sun covered with a cloth because this method produces higher levels of phenolic compounds than other drying methods (Ningsih *et al*., 2022). Basil leaf simplicia was ground into powder to enlarge the particle's surface area and increase the simplicia's contact with the solvent to extract more polyphenol compounds (Jovanović *et al*., 2017). Jicama starch was made by grounding jicama tubers and then precipitating the filtrate to obtain the starch. The moisture content test used the Moisture Balance tool to determine the quality of basil leaf simplicia and jicama tuber starch. The moisture content of basil leaf simplicia powder was 2.2%, and jicama starch powder was 2.85%. These results show that basil leaf simplicia powder and jicama starch met the moisture content requirements in simplicia, which is ≤ 10% (Ministry of Health of the Republic of Indonesia, 2017).

Basil leaf simplicia powder was extracted by the maceration method because it is simple, easy to do, does not require expensive tools, and can extract thermoplastic compounds (Gori *et al*., 2021). The solvent used was ethanol because ethanol can extract phenolic compounds and flavonoids well from basil leaves (Ngunyen *et al*., 2021). The maceration process was carried out 2 times with a duration of 48 hours and 24 hours to optimize the amount of compounds extracted. The extract solvent from the maceration was evaporated using a rotary evaporator to produce a viscous extract. Based on the Indonesian Herbal Pharmacopoeia 2nd Edition, the yield of basil extract is at least 5.6%. The yield of basil leaf thick extract in this study of 17.83% has met the requirements.

Thick extracts of basil leaves and starch powder of jicama were tested for flavonoids using metal reagents magnesium (Mg) and concentrated hydrochloric acid (HCl). The addition of magnesium (Mg) and concentrated hydrochloric acid (HCl) metal powder to this test reduced the benzopyrone nuclei contained in the flavonoid structure so that the color changed to orange or red (Hassan & Laily, 2014). The results showed that basil leaf extract and jicama tubers positively contained flavonoids.

A thick extract of basil leaves and jicama starch powder was made into a cream preparation with concentrations of 15%, 20%, and 25% to determine the most optimal concentration for UV protection. All formulas were tested for evaluation of preparations, including organoleptic, homogeneity, pH, adhesion, dispersion, and stability.

The homogeneity test aimed to see whether the preparation has been made homogeneous by applying cream to a transparent glass and then observing whether the cream is homogeneous. The absence of coarse granules indicates homogeneity, so the cream feels soft when applied to the skin. Based on the homogeneity test results, all creams met the requirements according to the literature; the cream was declared homogeneous if it had a homogeneous color, free from coarse or fine grains clumped together (Azkiya *et al*., 2017).

The pH test aimed to determine the level of acidity or alkalinity in a preparation. The preparation's pH must be according to the skin's pH of 4.5-6.5. A cream that is too acidic will irritate the skin, while a cream that is too alkaline will cause the skin to become scaly (Saryanti *et al*., 2019). Based on the pH test results, all creams met the pH requirements for topical preparations.

The spreadability test of the preparation was carried out to determine the quality of the cream base that can spread when the cream is used. Good dispersion can ensure the maximum release of active substances; the more comprehensive the spreading power of the cream, the better the spread so that the cream releases the active ingredients more quickly. The addition of load can cause the diameter of the spread to be larger so that the spread area is also larger. A good cream takes less time to spread and will have a high spreading power. Good cream spread is 5-7 cm (Tungadi *et al*., 2023). Based on the results of the spreadability test, all creams met the spreadability requirements.

The adhesion test determined the cream's ability to adhere to the skin. The longer the adhesion, the longer the contact between the cream and the skin, so the release of active substances was better. The adhesion requirement of a good cream was >4 seconds (Tungadi *et al*., 2023). Based on the adhesion test results, all creams met the requirements of the adhesion test.

Based on the stability test results using the cycling test, all formulations of cream preparations met the requirements of organoleptic, pH, homogeneity, dispersion, and adhesion tests for six cycles at storage temperatures of 4°C and 40°C for 24 hours.

There are two methods for determining the potential of sunscreen, namely by selecting the characteristics of sunscreen using spectrophotometric analysis and measuring UV absorption or transmission through the sunscreen product layer on a quartz plate or biomembrane. Testing the potential of sunscreen cream of basil leaf extract and jicama starch was carried out by calculating the erythema transmittance value (%Te), pigmentation transmittance (%Tp), and SPF value using UV-Vis spectrophotometry.

Based on the test results, the erythema transmission values (%Te) of sunscreen cream with basil leaf extract concentrations of 15%, 20%, and 25% were 11.246%, 8.391%, and 2.840%. Meanwhile, the erythema transmission value (%Te) of jicama starch sunscreen cream with concentrations of 15%, 20%, and 25% were 92.932%, 93.388%, and 89.192%. These sunscreen cream formulations did not meet the percentage value of erythema transmission <1%. Positive control showed that the %Te result met the requirement of 0.054%.

The pigmentation transmittance value (%Tp) of basil leaf extract sunscreen cream with concentrations of 15%, 20%, and 25% were 16.839%, 13.845%, and 8.017%. Meanwhile, the pigmentation transmittance value (%Tp) of jicama starch sunscreen cream with concentrations of 15%, 20%, and 25% were 96.370%, 96.500%, and 93.007%. The requirement for %Tp was 3 - 40%. The basil leaf extract sunscreen cream formulation met the %Tp requirement for all concentrations. In contrast, the jicama starch sunscreen cream formulation does not meet the %Tp requirement for all concentrations. Positive control showed that the %Tp result met the requirement of 0.049%.

The determination of the SPF value of sunscreen cream using UV-Vis spectrophotometry was validated by performing a positive control measurement of SPF 35 sunscreen, which gave a measurement result of 36.120. The results of the SPF values of sunscreen cream with basil leaf extract concentrations of 15%, 20%, and 25% were 9.406, 10.662, and 15.413. In creams with a concentration of 15% and 20% basil leaf extract, the sunscreen's ability was at its maximum level with SPF 8-15. While in creams with a concentration of 25% basil extract, sunscreen's ability was at an ultra level with SPF >15. The higher the concentration of basil leaf extract in the cream, the higher the SPF value. The results of the value of the jicama starch sunscreen cream with concentrations of 15%, 20%, and 25% were 0.298, 0,303, and 0.460. The formulation of jicama starch cream did not meet sunscreen requirements because it was below the minimum limit of SPF 2-4.

CONCLUSION

Based on the results of the study, the SPF values of basil leaf extract sunscreen cream with concentrations of 15%, 20%, and 25% were 9.40 (maximum), 10.66

(maximum), and 15.41 (ultra). The results of measuring the SPF value of jicama tuber starch sunscreen cream with concentrations of 15%, 20%, and 25% were <2, so it is ineffective as a sunscreen. Basil leaf extract sunscreen cream with a concentration of 25% showed the best SPF value with an ultra sunscreen ability level.

REFERENCES

- Azkiya, Z., Ariyani, H., & Nugraha, S. T. (2017). Evaluation of Physical Properties Cream from Red Ginger Extract *(Zingiber officinale* Rosc Var Rubrum*)* as Anti Pain. *Journal of Current Pharmaceutica Sciences*, *1*(1), 12–18.
- Balakrishnan, P., Ramalingam, P. S., Nagarasan, S., Ranganathan, B., Gimbun, J., & Shanmugam, K. (2018). A Comprehensive Review on Ocimum basilicum. *Journal of Natural Remedies*. *18*(3). 71–85.
- Chandra, B., Wijaya, J., Yetti, R. D., & Azizah, Z. (2023). Identifikasi Metabolit Sekunder dan Pengujian Aktivitas Antioksidan pada Umbi Bengkuang (*Pachyrhizus erosus* (L.) Urb.). *Jurnal Farmasi Higeia*, *15*(2), 206–214, https://doi.org/10.52689/higea.v15i2.554.
- Gori, A., Boucherle, B., Rey, A., Rome, M., Fuzzati, N., & Peuchmaur, M. (2021). Development of An Innovative Maceration Technique to Optimize Extraction and Phase Partition of Natural Products. *Fitoterapia*, *148*, 104798, https://doi.org/10.1016/j.fitote.2020.104798.
- Gunarti, N., & Fikayuniar, L. (2020). Formulasi dan Uji Aktivitas Gel Tabir Surya dari Ekstrak Buah Blackberry (Rubus fruticosus) Secara In Vitro dengan Spektrofotometri UV-Visibel. *Kartika: Jurnal Ilmiah Farmasi*, *7*(2), 66–72.
- Hassan, M. N. & Laily, N. A., (2014). Uji Kandungan Flavonoid dan Perbandingan Aktivitas Antioksidan pada Ekstrak Etanol Simplisia Bunga Pepaya Gantung Saat Kuncup dan Mekar. *J. Skrining Bioaktif*, *1*(1), 1–15.
- Ismail, I., Handayany, N., Wahyuni, D., & Juliandri, J. (2014). Formulasi dan Penentuan Nilai SPF (Sun Protecting Factor) Sediaan Krim Tabir Surya Ekstrak Etanol Daun Kemangi (*Ocimum sanctum* L.). *Jurnal Farmasi*, *2*(1), 6–11.
- Jovanović, A. A., Đorđević, V. B., Zdunić, G. M., Pljevljakušić, D. S., Šavikin, K. P., Gođevac, D. M., & Bugarski, B. M. (2017). Optimization of The Extraction Process of Polyphenols from *Thymus serpyllum* L. Herb Using Maceration, Heat- and Ultrasound-Assisted Techniques. *Separation and Purification Technology*, *179*, 369–380, https://doi.org/10.1016/j.seppur.2017.01.055.
- Juanita, R. A., & Juliadi, D. (2020). Penetapan Potensi Tabir Surya Krim Ekstrak Etanol Daun Ceremai (*Phyllanthus acidus* L.) dengan Spektrofotometri UV-Vis. *Jurnal Farmagazine*, *7*(1), 51–57, https://doi.org/10.47653/farm.v7i1.154.
- Komić, M. S., Živanović, B., Dumanović, J., Kolarž, P., Sedlarević, Z. A., Morina, F., Vidović, M., & Veljović, J. S. Differential Antioxidant Response to Supplemental UV-B Irradiation and Sunlight in Three Basil Varieties. *International Journal of Molecular Sciences*, *24*(20), 15350, https://doi.org/10.3390/ijms242015350.
- Larasati, D., & Putri, F. M. S. (2023). Skrining Fitokimia dan Penentuan Kadar Flavonoid Ekstrak Etanol Limbah Kulit Pisang (*Musa acuminata* Colla). *Jurnal Mandala Pharmacon Indonesia*, *9*(1), 125–131, https://doi.org/10.35311/jmpi.v9i1.330.
- Ma, Y., & Yoo, J. (2021). History of Sunscreen: An Updated View. *Journal of Cosmetic Dermatology*, *20*(4), 1044–1049.
- Mandal, S., Kundu, S., Uddin, M. R., Das, P., Paul, P., Roy, P., Tribedi, P., & Sahoo, P. (2022). Identification of A Novel Quinoline-Based UV-Protective Pigment from A Psychrotrophic Arctic Bacterium. *J Appl Microbiol*, *133*(5), 3059–3068.
- Messias, M. A., Ferreira, S. M., Tavares, L., & Santos, L. (2023). A Comparative Study between Onion Peel Extracts, Free and Complexed with β-Cyclodextrin, as a Natural UV Filter to Cosmetic Formulations. *International Journal of Molecular Sciences*, *24*(21), 15854. https://doi.org/10.3390/ijms242115854.
- Ministry of Health of the Republic of Indonesia. (2017). Indonesian Herbal Pharmacopoeia 2nd Edition. Jakarta: Ministry of Health of the Republic of Indonesia.
- Nguyen, V. T., Nguyen, Q., Thi, N., Thi, C., Tran, T. T., & Nghi, P. (2021). Studies on Chemical, Polyphenol Content, Flavonoid Content, and Antioxidant Activity of Sweet Basil Leaves (*Ocimum basilicum* L.). *IOP Conference Series: Materials Science and Engineering*, *1092*(1), 012083.
- Nikafshar, S., Zabihi, O., Ahmadi, M., Mirmohseni, A., Taseidifar, M., & Naebe, M. (2017). The Effects of UV Light on the Chemical and Mechanical Properties of A Transparent Epoxy-Diamine System in The Presence of An Organic UV Absorber. *Materials*, *10*(2), 180, https://doi.org/10.3390/ma10020180.
- Ningsih, A. W., Sukardiman, S., Syahrani, A., Charisma, A. M., & Wahyuni, K.I. (2022) Study of Drying Methods and Extraction Methods on Phenolic Content. *International Conference on Government Education Management and Tourism*, *1*(1), 1–9.
- Permana, A., Damayanti, T. A., & Yuniarsih, N. (2022). Potensi Tumbuhan dan Tanaman Herbal Indonesia Sebagai Anti SPF. *Jurnal Health Sains*, *3*(6), 312–318. https://doi.org/10.46799/jhs.v3i6.525.
- Rahmiyani, I., Dewi, W., Pratita, A., & Shaleh, R. (2022). Formulasi Krim Ekstrak Biji Kupa (Syzygium polycephalum) dan Penentuan Nilai SPF

(Sun Protection Factor) secara In Vitro. *Jurnal Ilmiah Ibnu Sina (JIIS): Ilmu Farmasi dan Kesehatan*, *7*(2). 328–339.

- Sari, M., & Yuniarti, Ei. (2023). The Effect of Sun Exposure on The Effectiveness of The Serotonin Hormone: Literature Review. *Jurnal Biologi Tropis*, *23*(4), 91–97, https://doi.org/10.29303/jbt.v23i4.5532.
- Saryanti, D., Setiawan, I., & Safitri, R. (2019). Optimasi Asam Stearat dan TEA pada Formula Sediaan Krim Ekstrak Kulit Pisang Kepok (*Musa paradisiaca* L.). *Jurnal Riset Kefarmasian Indonesia*, *1*(3), 225–237.
- Smaoui, S., Ben, H. H., Ben, C. I., & Kadri, A. (2017). Development and Stability Studies of Sunscreen Cream Formulations Containing Three Photo-Protective Filters. *Arabian Journal of Chemistry*, *10*(1), 1216–1222, https://doi.org/10.1016/j.arabjc.2013.02.020.
- Sopyan, I., Gozali, D., & Tiassetiana, S. (2017). Formulation of Tomato Extracts (*Solanum lycopersicum* L.) As A Sunscreen Lotion. *National Journal of Physiology, Pharmacy, and Pharmacology*, *8*(3), 453–458.
- Tungadi, R., Pakaya, M., & As'ali, P. W. (2023). Formulasi dan Evaluasi Stabilitas Fisik Sediaan Krim Senyawa Astaxanthin. *Indonesian Journal of Pharmaceutical Education*, *3*(1), 117–124, https://doi.org/10.37311/ijpe.v3i1.14612.
- Uchale, A. K., Kandalkar, P. S., & Pansare, S. S. (2024). Formulation and Development of Herbal Sunscreen Cream. *International Journal of Creative Research Thoughts*, *12*(7), 659–677.
- Zulkarnain, A., Ernawati, N., & Sukardani, N. (2013). Activities of Yam Starch (*Pachyrrizus erosus* (L.) Urban) As Sunscreen in Mouse and The Effect of Its Concentration to Viscosity Level. *Traditional Medicine Journal*, *18*(1), 1–8.

