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THE BEST FORMULATION OF COMPOUNDS CONTAINED IN HERBAL PLANTS AS SUNSCREEN: A REVIEW

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Abstract: The harmful effects of exposure to light (UV) can be prevented by using sunscreen. This study aims to determine the best formulation contained in various herbal plants to be used as a manufacturing material sunscreen. The method in this study is the study of literature from the research journal database on the internet, namely through google scholar and the Proquest University of Mataram. Sunscreens are assessed in terms of light protection factor expressed by the SPF value (Sun Protection Factor) to determine the effectiveness of sunscreen preparations or the ability to withstand UV rays. Several types of herbal plants that grow in various regions in Indonesia contain photoprotective bioactive compounds. Aromatic ginger (*Kaempferia galanga L.*) is a herbal plant widely used as an ingredient in sunscreens with a high protection category. Cinnamic derivatives, namely ethyl para-methoxycinnamate (EPMS), are one of the compounds contained in aromatic ginger and can be used as a manufacturing material sunscreen that is good and safe for the skin.

Keywords: *Herbal Plant, Sunscreen, Kaempferia galanga L.*

INTRODUCTION

Indonesia is known as a tropical country with most of the population working outside, so it is exposed to direct sunlight containing Ultraviolet (UV) rays. UV that reaches the surface of the earth is divided into UV A (320-400 nm) and UV B (290-320 nm) [1]. UV rays are only a small part of the spectrum of sunlight, but these rays are most harmful to the skin [2]. Naturally, the skin has protection against UV rays by thickening the stratum corneum and forming melanin in the epidermis. Excessive contact with exposure to UV light causes the skin's natural systems to not function properly, causing harmful effects, such as redness (erythema), dark spots (pigmentation), premature aging, dry skin, wrinkles, and skin cancer [3].

Prevention of the harmful effects of exposure to UV light can be done by using sunscreen. Sunscreen is a cosmetic preparation used to protect the skin from sun exposure that reflects or absorbs sunlight effectively, especially in the emission area of ultraviolet waves, to prevent skin disorders due to exposure to sunlight [2]. Antioxidant-active substances in sunscreen preparations can avert skin disorders caused by (UV) radiation. Among the various active antioxidant compounds, flavonoids can counteract ultraviolet (UV)-induced radicals, thus providing a protective effect against UV radiation by absorbing UV rays [4]. Flavonoid compounds have the potential as sunscreens due to the presence of chromophores (conjugated double bonds) that can absorb UV A and UV B rays, thereby reducing their intensity on the skin [5].

The mechanism for preparing sunscreen is divided into two groups: the chemical sunscreen group that works to absorb UV light and the physical blocking group (sunscreen that works physically). Physical blocking sunscreens work by reflecting or deflecting UV radiation [6]. Sunscreen ingredients can be obtained synthetically or naturally.

Titanium dioxide can reflect UV rays as a physics sunscreen used as an ingredient in various cosmetics [7, 8]. EPMS is the main component derived from cinnamic compounds, which have activity as sunscreen agents. EPMS levels in aromatic ginger rhizome simplicia can reach 2.5% [9]. The high levels of EPMS cause aromatic ginger to have good prospects of being used as a basic material for synthesizing sunscreen compounds with higher working power [10].

The ability of sunscreen compounds to protect the skin from UV exposure is identical to the wavelength of maximum absorption. That matter depends on the structure and electronics of each compound [11]. Most potential sunscreen compounds are organic compounds with chromophore groups that can absorb UV light. This ability is due to electronic transitions in the sunscreen molecule, where the transition energy is equivalent to the energy of UV light.

RESEARCH METHOD

This research reviews the utilization of secondary metabolites from various plant extracts in the environment around the residence. The method used is a literature study using descriptive analysis. Data was obtained from articles in research journal databases. The database is sourced from the internet through Google Scholar and the Proquest University of Mataram, with the keywords "sunscreen and herbal plants" in

searching for references to articles from several relevant studies.

Data findings from various researchers are combined and described as the main source of information in the article. The community can use the findings as a medicinal ingredient or reference in developing natural sunscreen products. Natural products in various cosmetic products are in great demand among Indonesians.

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RESULTS AND DISCUSSION

Several herbal plants are found in the surrounding environment, grow in various regions in Indonesia, and can be used as ingredients for manufacturing sunscreen. These various plants contain different active compounds to be used as formulations to manufacture sunscreens. Sunscreens are assessed in light protection factor expressed by the value of SPF (Sun Protection Factor) to determine the effectiveness of sunscreen preparations or the ability to withstand UV rays. The sun protection factor is a universal indicator that explains the effectiveness of a product or substance that is a UV protector; the higher the SPF value of a product or active sunscreen agent, the more effective it is at protecting the skin from the adverse effects of UV rays [12].

Basil leave (*Ocimum Sanctum L.*)

Based on research (Ismail et al., 2014), positive basil leaves contain chemical compounds of flavonoids, alkaloids, saponins, and tannins. These compounds are reported to be able to protect against UV rays [13]. In this study, the SPF value contained in basil leaves was tested using the in vitro method. Extractbasil was tested with three variations, namely 0.03%, 0.06%, and 0.12%. SPF values of basil extract at concentrations of 0.03% and 0.06% were 5.21 and 5.94. Both values are included in the medium protection category. As for the extract with a concentration of 0.12%, it produces a high SPF value of 8.97.

Soursop Juice (*Annona muricata L.*)

Soursop juice is taken from the fruit soursop ripe fruit because it contains a lot of vitamin C, which is useful as an antioxidant [14]. Variations of the tested extracts were at concentrations of 1%, 3%, and 5% and were analyzed using a UV spectrophotometer at 290-320 nm. Soursop juice (*Annona muricata L.)* The measurement of the SPF value was carried out using the Mansur method; the SPF values were obtained at concentrations of 1%, 3%, and 5%, namely 5.188, 12.242, and 17.247.

The SPF value is classified as follows, the value of 2-4 is minimal protection, SPF 4-6 is moderate protection, SPF 6-8 is extra protection, SPF 8-15 is maximum protection, and SPF ≥ 15 includes ultra protection [15].

Blackberry Fruit Extract

Blackberry fruit can be used as preparation material, making sunscreen in gel form [16]. The gel texture was chosen because it looks attractive, does not clog pores, and is not sticky. Blackberry is a plant that contains flavonoids and carotenoids, which have aromatic rings that can absorb UV rays, especially UV A and UV B.

The concentration of ethanol extract blackberry is made in five variations, namely 0.25, 0.5, 0.75, 1.0, and 1.25%. Sunscreen activity contained in blackberry extract was tested using a UV-Vis spectrophotometer with parameters SPF value, percent erythema, and pigmentation based on the absorption of the wavelengths, namely 292.5 nm and 372.5 nm.

The measurement of the SPF value on FI (2.25% extract) is 4.16, which is included in the low category. The SPF value on FII (extract 0.5%), namely 13.2, is included in the medium category. Each SPF value for FIII, FIV, and FV (0.75%, 1.0%, and 1.25%), namely 14.68, 31.2, and 245, 18, is included in the category sunblock. The results of this study indicated that the best quality gel extract preparation was FIV with an SPF value of 31.2 which was included in the ultra category.

Binahong leaves (*Anredera cordifolia*)

The various concentrations of binahong leaf extract were analyzed using a UV spectrophotometer at 290-400 nm. Moderate protection extract concentrations were obtained at 300 ppm and 350 ppm of 4.36 and 5.82, extract protection at 400 ppm was 7.44, and maximum protection at 450 ppm was 10.45 [17].

In this study, binahong leaves were used, rich in vitamin C and have high antioxidants with an IC50 value of 40.27 ppm. Usage of these antioxidants can be photoprotective to protect the skin, such as phenolic compounds and compounds are antioxidants [18].

Cempedak leaves (*Artocarpus champeden spreng*)

The SPF test value contained in cempedak leaves was in vitro using a UV Vis spectrometer with %Te and % Tp measurements [19]. The ethyl acetate fraction from the crude extract of chempedak leaves in the range of 200-300 ppm has an ultra-sunscreen ability to protect UV A.

Moringa Leaves (*Moringa oleifera*)

One of the biggest flavonoids in Moringa leaves is quercetin, which has antioxidant power 4-5 times higher than vitamin C and vitamin E. Moringa leaves contain quercetin of 409.06 mg/100 g dry sample. The results of calculations with nanoemulsion extract concentration of 10,000 ppm have an SPF value of 5.5, concentrated extract 20,000 ppm and 30,000 ppm have SPF

values of 5.6 and 5.8, respectively. According to the FDA category, it is included in the moderate protection value. Skin that does not use sunscreen under exposure to sunlight can only last 10 minutes; if using sunscreen, the skin's resistance is extended ten times [20].

Bittervine (Mikania micrantha Kunth)

Based on the results, the ethanol of the vines has high antioxidants and good sunscreen activity [21]. The results of calculating the %Te of the bittervine plant extract using a UV Vis spectrophotometer in vitro in a concentration range of 100-250 ppm (100,150,200,250 ppm) are grouped into three categories, namely standard, protection additional, and *sunblock*. %Te is a value that indicates the ability of a chemical compound to protect the skin from ultraviolet rays (UVB) 290-320 nm, which can cause erythema (redness) [22].

The %Te value at a concentration of 100 ppm of bittervine extract, namely 11.3024, is included in the standard suntan category. Standard suntan is category 3 in categorizing sunscreen protection by value percentage erythema (%Te). Standard suntan protects by absorbing UV B radiation, protecting the skin from redness but does not cause skin darkening (pigmentation) [23]. Concentrations of 150 and 200 ppm extract vineyards have a %Te of 3.5238 and 1.3864, categorized as extra protection. At the highest concentration, 250 ppm, bittervine creeper extract has a %Te of 0.3838 which is in the sunblock category. Sunblock is the best sunscreen activity because it protects the skin from ultraviolet rays (UVA and UV B).

The SPF value calculated at a concentration of 250 ppm shows an SPF value of 42.8810, included in the high category. Theoretically, the ethanol extract of bittervine at a concentration of 250 ppm could be used as a cosmetic sunscreen.

Seaweed Formulation (*Turbinaria Sp.)* and aromatic ginger (*Kaempferia Galanga L.*)

Seaweed and aromatic ginger are known to contain good ultraviolet light-blocking compounds. But research on cream formulations phrase solar energy from these two materials has never been done [24]. The treatment in the study was the ratio between seaweed and aromatic ginger with a ratio of 1:1 (Cream A), 1:2 (Cream B), 2:1 (Cream C), and control (Cream D). To determine the effectiveness of sunscreen using a UV Vis spectrophotometer. The highest SPF value is obtained from cream B with a ratio of seaweed and aromatic ginger 1:2. Cream A, C, and control have an SPF value of 14.89, 10.41, and 4.39. The SPF value indicates that the higher the aromatic ginger content is given, the more sunscreen activity will increase (Primary*et al*., 2019). aromatic ginger contains ethyl para-methoxycinnamate (EPMS), which can block UV B rays.

Aromatic ginger (Kaempferia Galanga L.)

Research utilizing the terms compound in aromatic ginger as a bioreactor in forming AgNPs (silver nanoparticles) by the method *of green synthesis* [25]. AgNPs which are conjugated with EPMS compounds in aromatic ginger can be used as formulations in the manufacture of sunscreens. They tested sunscreen activity in this study by calculating the %Te, %Tp, and SPF values using a UV Vis spectrophotometer. The EPMS-conjugated AgNPs sample tested was 200 ppm at a wavelength of 292-372 nm, while the EPMS sunscreen activity test without AgNPs was also carried out with a concentration of 1000 ppm.

Based on the calculation data, EPMS-conjugated AgNPs can be categorized as sunblock with an SPF value of 36.4. Meanwhile, EPMS without AgNPs has an SPF value of 38.4. So sunscreen preparations with AgNPs conjugated with EPMS with a concentration of 200 ppm and EPMS with a concentration of 1000 ppm are included in the ultra protection category.

Various kinds of herbs and plants in the surrounding environment have sunscreen activity which can be used as components in the manufacture of sunscreen. The bioactive compounds contained in these various kinds of plants each have different protective abilities as sunscreens. One of the bioactive compounds, phenolics, can act as a natural sunscreen because of its antioxidants and photoprotective [26]. Antioxidant compounds are inhibitors to inhibit auto-oxidation [27]. The antioxidant effect of phenolic compounds is due to their oxidizing properties to neutralize free radicals. Phenolic compounds are proven to protect skin damage from UV radiation.

Forty-nine bioactive phytochemicals, including esters, terpenoids, flavonoids, diarylheptanoids, polysaccharides, thiourea derivatives, lipodepsi peptide cyclic, and other phenolic compounds, have been reported [28]. The most purified bioactive phytochemical is ethyl methoxycinnamate (EPMS), kaempferol, kaempferide, kaemgalangol A, asam kaempsulfonic, cystargamide B, 3-caren-5-one dan xylose.

The aromatic ginger plant is one of the plants that have the potential as a source of sunscreen (*sunscreen*) organic. The EPMS content in the rhizomes of this plant can act as a natural shield against UV B rays. Plants belonging to the Spermatophyta division, Angiospermae subdivision, monocot class, Scitamineae order, ginger tribe (Zingiberaceae), the genus Kaempferia and the species Kaempferia Galanga This L in the field of traditional cosmetics is used as a mixture of ingredients for aromatic ginger rice cold powder [29].

Research on EPMS compounds as ingredients for organic sunscreen compounds contained in aromatic ginger has been carried out a lot. The SPF value from the results of testing the EPMS compounds in several studies is included in the high protection category. Innovations carried out in research make formulations containing bioactive compounds in seaweed and aromatic gingers components of sunscreens, producing sunscreens that have ultra protection in formulations with a higher ratio of aromatic ginger content [30-32]. The higher the aromatic ginger content, the more sunscreen activity will increase [33].

Based on the results of the analysis and review of the journals, the EPMS compounds contained in aromatic ginger can be used as an alternative manufactured sunscreen that has high protection and is safe for the skin.

CONCLUSION

Various kinds of herbal plants that grow in various regions in Indonesia contain bioactive compounds that are photoprotective. Many bioactive compounds contained in various types of plants can be used as components in the manufacture of organic sunscreen that is safe for the skin. Phenolic compounds such as flavonoids, tannins, antioxidants, and other compounds are found in many herbal plants. Aromatic ginger (*Kaempferia galanga L.*) is one of the herbal plants containing many bioactive compounds. Cinnamic derivatives, namely ethyl para-methoxycinnamate (EPMS), one of the compounds in aromatic ginger, can be used as a manufacturing material for good quality sunscreen and high protection.

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