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UTILIZATION OF FRUIT EXTRACTS FOR SUNSCREEN

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ABSTRACT
Indonesia is one of the countries with high exposure to sunlight, and most of its population works outdoors, making skin protection necessary. While sunlight provides benefits, it also has harmful effects on the skin if exposed excessively. Ultraviolet rays, UVB and UVA, work synergistically to damage the skin, thus requiring prevention or protection to reduce the negative impacts of radiation. Excessive sun exposure is the main exogenous mediator of skin damage. The negative effects of sun exposure on the skin lead to various skin problems such as darkening, wrinkles, dullness, and the appearance of dark brown spots, and it can even cause skin cancer. Therefore, using sunscreen is crucial as it can prevent UV rays from penetrating the skin. This study uses a literature review design, where relevant scientific articles are analyzed to explore the potential of natural ingredients as sunscreen agents. A total of 9 articles were collected from various databases, including PubMed, ScienceDirect, and Google Scholar, using specific keywords related to UV protection, natural sunscreen, and bioactive compounds in plants. The selection of articles was based on inclusion and exclusion criteria, ensuring that only recent and relevant studies were considered. Natural ingredients have not yet been widely utilized in the sunscreen industry. Plants contain substances that can be extracted and serve as a potential source of sunscreen due to their photoprotective properties. This provides insight into the ability of plants to protect the skin through the compounds they contain, such as bioactive compounds like phenolic substances and antioxidants.

Keywords: fruit extracts; sunscreen; skin

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INTRODUCTION

Indonesia is one of the countries with high exposure to sunlight and most of its population works outdoors so that skin protection is needed. Sunlight, in addition to providing benefits, also has a negative impact on the skin if exposed to it excessively. Ultraviolet UVB and UVA rays work synergistically in damaging the skin so that prevention or protection is needed to reduce the negative impact on the skin due to this radiation (Tahar et al., 2019). Excessive exposure to sunlight is the main exogenous mediator of skin damage. The negative impact caused by exposure to sunlight on the skin causes many skin problems such as dark skin, wrinkles, dullness and the appearance of blackish brown spots and can even cause skin cancer so that the use of sunscreen is very important because it can inhibit the penetration of UV rays into the skin (Sari et al., 2019).

If exposure to sunlight is excessive, the skin's epidermis tissue is unable to fully fight the negative effects so that protection is needed, one of which is with sunscreen. Sunscreen is a skin protector from sun exposure because sunscreen compounds have conjugated bonds so that these bonds resonate when exposed to UV rays and will reduce energy to protect the skin. Sunscreen has two working mechanisms, namely physically by reflecting and refracting UV rays that hit the skin and chemically by absorbing UV rays emitted by the sun (Y. D. Putri et al., 2019; Tahar et al., 2019).Sunscreens currently on the market are generally made from synthetic chemicals. The chemicals contained in sunscreens are aromatic compounds with

carbonyl groups that can irritate the skin. Examples of undesirable events due to the use of chemical sunscreens are irritant contact dermatitis, allergic contact dermatitis, phototoxic reactions, photoallergic reactions and scomedogenicity (Ratnapuri et al., 2020). Natural materials have not been widely utilized in the sunscreen product industry. In plants there are substances that can be extracted and become potential sources of sunscreens because they are photoprotective. This provides a little insight into the ability of plants to protect the skin through compounds contained in plants in the form of bioactive compounds such as phenolic compounds and compounds that are antioxidants. The use of natural sunscreens is being further researched to reduce the side effects of sunscreens with chemicals (Prasanth et al., 2020). Sunscreens can be sourced from natural materials and chemical synthesis. Compounds that have the potential to be sunscreens are phenolic compounds, especially the flavonoid group which has a chromophore group that can reduce the intensity of UV exposure to the skin (Sari et al., 2019).

Natural sunscreens have advantages over synthetic ones because they have fewer side effects, provide better protection, and are readily available. A variety of natural ingredients derived from plants, algae, and propolis have shown potential photoprotective effects. Natural compounds including flavonoids, cinnamon, polyphenols, carotenoids, anthocyanins, triterpenoid saponins have shown desirable Sun Protection Factor (SPF) in addition to anti-inflammatory and antioxidant properties. To be able to use natural sunscreens, knowledge is needed about natural ingredients that can be used as sunscreens and their mechanisms of action (Prasanth et al., 2020; Pratama et al., 2020; Tahar et al., 2019). The aim of this study is to analyze and summarize the potential of natural ingredients as sunscreen agents, focusing on their bioactive compounds, photoprotective mechanisms, and effectiveness in providing protection against UV radiation. This research also aims to compare the advantages of natural sunscreens over synthetic ones and to explore their possible applications in the skincare industry.

METHOD

Review of relevant articles obtained through search engine databases sourced from published articles from International Journals or National Journals. Search for articles through pages such as Google Scholar and PubMed. Literature searches are carried out using keywords, namely "fruit extract" and "sunscreen". The articles obtained are then selected manually. The selection process uses two criteria in the form of exclusion and inclusion criteria, exclusion criteria in the form of articles published less than 2019 (the latest within 5 years counted back from 2024). While the inclusion criteria are in the form of articles according to the topic being studied, namely regarding the potential of various fruit extracts as sunscreen ingredients with in vitro or in vivo research in the 2019-2024 publication year.

Furthermore, the articles are selected according to the research topic and the information is taken and then a report on the results of the literature study is made in order to obtain the final result in the form of an article review. A total of 9 articles were collected from various databases, including PubMed, ScienceDirect, and Google Scholar, using specific keywords related to UV protection, natural sunscreen, and bioactive compounds in plants. The selection of articles was based on inclusion and exclusion criteria, ensuring that only recent and relevant studies were considered. Natural ingredients have not yet been widely utilized in the sunscreen industry. Plants contain substances that can be extracted and serve as a potential source of sunscreen due to their photoprotective properties. This provides insight into the ability of plants to protect the skin through the compounds they contain, such as bioactive compounds like phenolic substances and antioxidants.

RESULT

Potential of Rambutan Fruit Peel Extract as Sunscreen

Rambutan (*Nephelium lappaceum L*) is a tropical plant belonging to the soapberry or Sapindaceae family which is generally found in Northeast Brazil and Southeast Asia. Rambutan fruit skin contains phenolic and flavonoid compounds which have high antioxidant activity and have the potential to be photoprotective.

Figure 1. Rambutan skin (*Nephelium lappaceum L.)*

Table 1.
Rambutan Peel Extract as Sunscreen

Contents	Method	Working Mechanism	Reference
Flavonoid	In-vitro UV spectrophotometer	Rambutan fruit skin (*Nephelium lappaceum L*) is known to contain active flavonoid compounds. Some flavonoids from plants are known to have antioxidant activity and have the ability to protect the skin from exposure to ultraviolet (UV) rays.	Vifta, RL, Pratiwi, KA, & Agustina, RC (2020). Utilization of Rambutan Fruit Peel (*Nephelium lappaceum L.*) as a Sunscreen Cosmetic Agent. Semarang Regency Research Information Media, 2(2), 181-190.
Polyphenols	In-vitro UV spectrophotometer	The high SPF value of the extract may be due to the polyphenolic content. This compound is known as a cytoprotective agent against UV damage. during the process of photosynthesis in plants. Working mechanism UV filter from polyphenols by absorbing UV B radiation.	(Aji et al., 2020). Utilization of Rambutan Fruit Peel Waste as Sunscreen Gel and Antibacterial Against Sthaphylococcus aureus. Journal of Pharmacopolium, 3(2).
Tannin	In-vitro UV spectrophotometer	Tannin contained in rambutan seeds can act as an antimicrobial, besides that it can also increase SPF levels. SPF increased by 135% (from 11.2 to 26.3).	(Y. D. Putri et al., 2019). Antioxidant Activity Test and Determination of SPF Value In Vitro of Rambutan (*Nephelium lappaceum*), Mangosteen (*Garcinia mangostana*) and Durian (*Durio zibethinus*) Peel Extract. Borneo Journal of Pharmascientech, 3(2), 169-177.

Potential of Grape Seed Extract as Sunscreen

Grape seeds are taxonomically in the kingdom Plantae, division Tracheophyta, class Magnoliopsida, order Vitales, family Vitaceae, genus Vitis and species *Vitis vinifera L.* The main polyphenolic compounds contained in grape seed extract are flavonoids, including flavan-3-ol monomers such as catechin, epicatechin and polymerized oligomers (proanthocyanidins). Catechins are recognized as the most powerful natural antioxidants that show. The bioactivity results are promising and provide added value to cosmetics so that they can be used to prevent skin damage due to UV which provides long-term protection against premature skin aging (Yarovaya et al., 2021).

Figure 2. Grape seed extract (*Vitis vinifera L.*) as a sunscreen

Table 2.
Grape Seed Extract as Sunscreen

Contents	Method	Working Mechanism	Reference
Tocopherol	In-vitro UV spectrophotometer	Tocopherol can protect the skin from pollutants and ultraviolet radiation that can cause damage to the skin. The natural properties of tocopherol which are easily soluble in fat make tocopherol easily absorbed when used topically on the skin.	Wahyuni, P. (2019). Determination of SPF Value of Sunscreen Cream Based on Grape Seed Oil Extract. Herbal Medicine Journal, 1(1), 16-20.
Polyphenols	In-vitro UV spectrophotometer	Polyphenols from grape seeds are powerful free radical scavengers and are effective against inflammation, deoxyribonucleic acid (DNA) damage, suppression of immune responses, and degradation of skin collagen caused by UV radiation.	Yarovaya, L., Waranuch, N., Wisuitiprot, W., & Khunkitti, W. (2021). Effect of grape seed extract on skin fibroblasts exposed to UVA light and its photostability in sunscreen formulation. *Journal of Cosmetic Dermatology*, 20(4), 1271-1282.
Tannin	In-vitro UV spectrophotometer	Tannin contained in grape seeds can act as an antioxidant, there is a synergistic effect in the formulation consisting of UV filters and grape seed extract on antioxidant activity and protection against UVB rays.	Hübner, AA, Sarruf, FD, Oliveira, CA, Neto, AV, Fischer, DC, Kato, E. T & Bacchi, EM (2020). Safety and photoprotective efficacy of a sunscreen system based on grape pomace (*Vitis vinifera L.*) phenolics from winemaking. Pharmaceutics, 12(12), 1148.

Potential of Avocado Seed Extract as Sunscreen

Avocado seeds (*Persea americana Mill.)* are rich in chemical compounds. Phytochemical analysis revealed the presence of flavonoids, anthocyanins, condensed tannins, alkaloids and triterpenes in the methanol extract of avocado seeds. The content of flavonoid compounds in avocado seeds is 1.90 mg in 100 g of avocado seeds. These chemical compounds play an important role in health effects, including as sunscreen (Suhaenah et al., 2019).

*Figure 3.*Avocado seed extract (*Persea americana Mill.)* as a sunscreen.

Table 3.
Avocado Seed Extract as Sunscreen

Contents	Method	Working Mechanism	Reference
Ethanol	In-vitro UV spectrophotometer	Ethanol extract of avocado seeds is able to ward off free radicals (1,1-Diphenyl-2-picryl-hydrazyl) with an IC value of 5068.0 ± 4.0 µg/ml and is able to ward off free radicals (2,2-Azinobis-3-ethyl benzothiazoline-6-sulfonic acid) with an IC value of 5075.0 ± 5.0 µg/ml. In addition, ethanol extract of avocado seeds has a protective effect against DNA damage due to H2O2 induction.	(Vo et al., 2019). Free radical scavenging and anti-proliferative activities of avocado (*Persea americana Mill*.) seed extract. Asian Pacific Journal of Tropical Biomedicine, 9(3), 91-97.
Acetone	In-vitro UV spectrophotometer	Acetone is a semi-polar solvent that is widely used for the extraction of semi-polar compounds. Extraction of avocado seeds with 100% acetone solvent has been proven to produce extracts with the highest total antioxidant activity, namely 265.75 mg ascorbic acid equivalents (AAE)/100 g compared to 100% ethyl acetate solvent (229.65 mg AAE/100 g).	(Suradnyana et al., 2023). Formulation and antioxidant and sunscreen activity test of avocado seed acetone extract cream. Scientific Journal of Medicamento, 9(1), 42-51.
Phenol	In-vitro UV spectrophotometer	The antioxidant activity of avocado seed extract depends on the extraction solvent used, with the order of activity from largest to smallest respectively being 100% acetone, 100% ethyl acetate, 100% ethanol, 70% acetone, 100% water, 70% ethyl acetate, and 70% ethanol. Avocado seeds (*Persea americana Mill Hass variety*) are an excellent source of phenolic compounds that have high antioxidant activity.	(Pacheco-Coello & Seijas-Perdomo, 2020). Evaluation of the antioxidant activity of the aqueous and methanolic extracts of seeds of *Persea Americana Mill*, variety Hass, from the state of Aragua in Venezuela. Revista Boliviana de Química, 37(3), 142-147.

Potential of Strawberry Fruit Extract

Strawberries (*Fragaria X ananassa)* are fruits that have high nutritional content and have phytochemical compounds that are beneficial for health, including anthocyanins, ellagic acid, catechins, quercetin and kaempferol which are antioxidant compounds. Flavonoids contained

in strawberries are secondary metabolites that have pharmacological effects. The use of flavonoids as antioxidants to prevent diseases caused by free radicals (Yulistina, 2022).

Figure 4. Strawberry fruit extract (*Fragaria X ananassa*) as a sunscreen

Table 4.
Strawberry Fruit Extract as Sunscreen

Contents	Method	Working Mechanism	Reference
Phenolic	In-vitro UV spectrophotometer	At a concentration of 1 mg/mL the extract contains a total of phenolic compounds of 1755mg GAE/100 g of extract with an antioxidant capacity of 6.23%. Sunscreen activity testing obtained %Te and %Tp at an extract concentration of 200 µg/mL of 0.5039 and 0.5365 respectively and decreased with increasing extract concentration, included in the sunblock classification. The SPF value of the extract at a concentration of 200 µg/mL of 13.85 is included in the maximum protection category.	Widyastuti, W., Kusuma, AE, Nurlaili, N., & Sukmawati, F. (2016). Antioxidant and sunscreen activity of strawberry (*Fragaria x ananassa AN Duchesne*) ethanol extract. JSFK (Journal of Pharmaceutical & Clinical Sciences), 3(1), 19-24.
Flavonoid	In-vitro UV spectrophotometer	Strawberry water extract with a concentration of 0.81 mg/mL has an antioxidant capacity of 50%. The flavonoid content found in strawberries is one of the compounds that has an antioxidant effect.	(Primagara & others, 2021). Ethanol Extract of Strawberry Fruit (*Fragaria x ananassa Duchesne ex Rozier*) as a Tyrosinase Inhibitor. Phytopharmaca: Scientific Journal of Pharmacy, 11(1), 35-42.
Phenolic	In-vivo UV spectrophotometer	Phenolic compounds have conjugated bonds in the benzene core where when exposed to UV light there will be resonance by transferring electrons. The similarity of the conjugation system in phenolic compounds and chemical compounds that are usually contained in sunscreens causes this compound to have the potential to be photoprotective. Phenolic compounds such as flavonoids are one of the powerful antioxidants that can bind metal ions that are thought to be able to prevent the harmful effects of UV rays or at least reduce skin damage.	(M. A. D. Putri et al., 2023) Activity Test of Strawberry Ethanol Extract Cream Preparation (*Fragaria xananassa var duchesne*) In Vitro and In Vivo as Sunscreen. Intan Husada: Nursing Scientific Journal, 11(02), 196-210.

DISCUSSION

Several studies in various countries including Indonesia have proven that rambutan fruit skin extract can be used as sunscreen (Sekar et al., 2017). Various studies are currently being conducted in vitro to identify, evaluate and develop sunscreens from rambutan fruit skin extract as natural ingredients in cosmetic products. Research conducted by Mota et al., reported that rambutan fruit skin extract is able to absorb UV radiation in the UVB range between 290-320 nm and produces a significant increase in SPF value even at the lowest concentration. This increase is the effect of phenolic substances in rambutan fruit skin (Limsuwan & Amnuikit, 2017; Mota et al., 2020). Phenolic substances such as tannins and flavonoids are directly related to photoprotective action against UV radiation (Mota et al., 2020; Sunaryo, 2021).Several in vitro studies have shown that polyphenols from grape seeds are powerful free radical scavengers and are effective against inflammation, deoxyribonucleic acid (DNA) damage, suppressing immune responses, and skin collagen degradation caused by UV radiation. Shariff et al. also found that water-in-oil emulsions containing grape seed extract were effective in reducing skin pigmentation and increasing its elasticity after 8 weeks of use. Research conducted by Hubner et al., grape seed extract is rich in polyphenols that are useful for the skin from UV rays (Sunaryo, 2021; Yarovaya et al., 2021).

Research conducted by Hubner et al (Brazil, 2020) to determine the efficacy and clinical safety of sunscreen containing grape seed extract. The study was conducted by comparing formulations consisting of UV filters (butylmethoxydibenzoyl methane, ethylhexyl methoxycinnamate and ethylhexyl dimethyl PABA) with UV filter formulations added with grape seed extract. Antioxidant activity and SPF values were assessed in both formulations. The results showed a synergistic effect in the formulation consisting of UV filters and grape seed extract on antioxidant activity and protection against UVB rays (Hübner et al., 2020; Syafriana et al., 2020). Several studies have been conducted in vitro on avocado seed extract as sunscreen. The study conducted by Suhainah A, et al. to determine the Sun Protection Factor (SPF) value of avocado seed ethanol extract. The seed simplicia was extracted by maceration method using 96% ethanol solution, then sample solutions were made with concentration series of 200, 400, 600, 800 and 1000 ppm. Furthermore, the absorbance of the sample solution was measured at a wavelength of 290-320 nm with an interval of 5 nm. The results showed that 1000 ppm avocado seed ethanol extract had the highest SPF value of 8.02, which is categorized as maximum protection (Mota et al., 2020).

Research has been conducted by (Zakiah F et al, 2021) on the antioxidant formulation test of avocado seed extract gel. Antioxidant testing was carried out using the DPPH method using a UV-Vis spectrophotometer. Avocado seeds were extracted by maceration using 70% ethanol. The results of the study showed that avocado seed extract had an IC50 value of 26.46 ppm (strong antioxidant strength level) (Adnyani et al., 2017).Various studies have been conducted both in vitro to evaluate strawberry fruit extract as sunscreen. Widyastuti et al., (2020) tested the antioxidant activity and sunscreen levels in strawberries. Extracts from strawberries were made into lotion preparations by varying VCO and olive oil as emoll ients. From the study, the extract contained phenolic compounds, flavonoids and saponins. At a concentration of 1 mg/mL, the extract contained a total of phenolic compounds of 1755 mg GAE/100 g of extract with an antioxidant capacity of 6.23%. Sunscreen activity testing obtained %Te and %Tp at an extract concentration of 200 µg/mL of 0.5039 and 0.5365 respectively and decreased with increasing extract concentration, included in the sunblock classification. The SPF value of the extract at a concentration of 200 µg/mL of 13.85 was included in the maximum protection category (Berkey et al., 2019). All lotion formulas met the physical evaluation requirements. It can be concluded that strawberry fruit ethanol extract has

antioxidant and sunscreen activity and can be made into a lotion preparation (Widyastuti et al., 2016).

Gasparrini M, et al (Mexico, 2017) conducted a study to test the efficacy of strawberry formulation (50 μg / mL) supplemented with Coenzyme Q10 (100 μg / mL) and SPF 10 into human skin fibroblasts irradiated with UVA. Evaluation of the apoptosis rate, the amount of intracellular reactive oxygen species production, the expression of proteins involved in the antioxidant and inflammatory responses, and mitochondrial function was carried out. The results showed that topical use of strawberries and Coenzyme Q10 simultaneously provided a significant photoprotective effect ($p < 0.05$), reduced cell death, increased antioxidant defense, decreased inflammatory reactions, and improved mitochondrial function. The results obtained suggest the use of strawberry-based formulations as an innovative, natural, and useful tool for the prevention of skin diseases due to UVA exposure to reduce or replace synthetic sunscreen agents (Gasparrini et al., 2017).

CONCLUSION

Sunscreen is one of the skin protectors from sun exposure because in sunscreen compounds there are bonds that can conjugate each other so that the bonds resonate when exposed to UV rays and will reduce energy and protect the skin. Sunscreen can be sourced from natural ingredients and chemical synthesis. Sunscreens on the market are generally made from synthetic chemicals. The use of sunscreen creams from synthetic chemicals can cause irritation and can cause allergic contact dermatitis. In plants there are natural substances that can be extracted and can act as potential sources of sunscreen. Some natural ingredients that are often associated with sunscreen are rambutan fruit skin extract, grape seed extract, avocado seed extract, strawberry fruit extract. These natural ingredients can be used as sunscreen because they contain antioxidant compounds that are photoprotective.

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