

Pemanfaatan Limbah Kulit Buah Nagasebagai Kosmetik : Sebuah Tinjauan

Dragon Fruit Peels Waste as Cosmetic: An Overview

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Abstrak

Kulit buah naga (*Hylocereus polyrhizus*) memiliki berbagai potensi sebagai bahan dasar produk kosmetik ramah lingkungan. Penelitian ini berfokus pada evaluasi sifat bioaktif kulit buah naga, menemukan bahwa senyawa yang terkandung di dalamnya lebih efektif dalam menangkal radikal bebas dibandingkan daging buahnya. Teknik pengumpulan data dilakukan dengan studi pustaka dan penelusuran informasi digital dengan sasaran berupa studi pustaka [literature review] mencari informasi dari sumber literatur yang relevan selama dua minggu pada bulan November - Desember 2024 dengan mencari >30 referensi dari Google Scholar, ResearchgateNet dan Scienedirect, Sinta, MDPI, Pubmed. Selain itu, situs web resmi yang digunakan dalam rentang tahun 2014-2024. Studi pustaka dilakukan dengan mengidentifikasi masalah mengenai kandungan berbagai formulasi. Metode yang digunakan melalui pendekatan kualitatif, yaitu penelitian deskriptif dan cenderung menggunakan analisis. Ekstrak kulit buah naga menunjukkan aktivitas yang signifikan dalam mencegah kerusakan kulit yang disebabkan oleh sinar UV dan polusi. Inovasi ini tidak hanya memberikan solusi pengurangan limbah agroindustri, tetapi juga menciptakan produk kosmetik berkelanjutan dengan nilai ekonomi tinggi. Pemanfaatan limbah ini mendukung tren konsumen terhadap produk berbahan alami dan ramah lingkungan. Penjabaran ini menunjukkan bahwa kulit buah naga berpeluang besar untuk digunakan sebagai bahan aktif dalam berbagai jenis produk kosmetik, seperti pelembab, serum, krim, dan masker wajah, yang berdampak positif bagi kesehatan kulit dan lingkungan.

Kata kunci: Anti-penuaan; Antioksidan; Antimikroba; Kosmetik; Kulit buah naga.

Abstract

Background : Dragon fruit peels (*Hylocereus polyrhizus*) have various potential as a base ingredient in eco-friendly cosmetic products. This study focused on evaluating the bioactive properties of dragon fruit peels, finding that the compounds contained therein are more effective in counteracting free radicals than the flesh of the fruit. **Method :** Data collection techniques were carried out by literature study and digital information search with the target objectives in the form of literature study [literature review] searching for information from relevant literature sources for two week in November - December 2024 by searching >30 references from Google Scholar, ResearchgateNet and Scienedirect, Sinta, MDPI, Pubmed. As well as, official websites in the range of 2014-2024. Literature study was conducted by identifying problems regarding the content of different formulations. The method was through a qualitative approach, which is descriptive research and tends to use analysis. Dragon fruit peel extract showed significant activity in preventing skin damage caused by UV rays and pollution. This innovation not only provides a solution for agro-industrial waste reduction, but also creates sustainable cosmetic products with high economic value. This waste utilization supports the consumer trend towards products based on natural and environmentally friendly ingredients From this review, dragon fruit peels have a great opportunity to be used as an active ingredient in various types of cosmetic products, such as moisturizers, serums, creams, and face masks, with a positive impact on skin health and the environment.

Keywords: Anti-aging; Antioxidant; Antimicrobial; Cosmetic; Dragon fruit peel

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1. INTRODUCTION

Dragon Fruit Peel Waste and Unaddressed Waste Cases

Dragon fruit is highly favored by a wide range of people in the world including Indonesia. Dragon fruit (*Hylocereus polyrhizus*) is generally consumed on its pulp, the skin on dragon fruit tends to be discarded because the general public considers the taste of dragon fruit skin bitter, sour, tasteless and not worth eating. Meanwhile, red dragon fruit occupies the highest percentage of consumers in Kalimantan specifically in Palangkaraya. The highest dragon fruit production reached the target of 22,736 quintals with a cultivation land area of 97.061 ha area. Dragon fruit skin is no less useful than dragon fruit meat, the content of dragon fruit skin consists of 3.2% protein, 72.1% carbohydrates, 46.7% dietary fiber, and the content of dragon fruit skin advantages namely alkaloids, flavonoids, tannins, steroids, saponins, and polyphenols[3]. Utilization of dragon fruit skin is beneficial for skin health in cosmetic topical preparations, many problems about dry skin are often found in the surrounding community. The cause of dry skin is due to the presence of free radicals sourced from external factors such as ultraviolet rays, air pollution, and unhealthy lifestyles. The skin is vulnerable to free radicals because the skin layer is the outermost layer of humans that functions to protect the body [3].

Trend of Cosmetic Products and Cosmetic Market Demand

In recent years, the trend in the cosmetics industry has been toward products based on natural and environmentally friendly ingredients. Cosmetic products with natural ingredients that have natural antioxidant, anti-inflammatory, and anti-aging properties have become a favorite among consumers. These cosmetic products have become very popular, especially products that are able to protect the skin from the effects of free radicals caused by pollution and Ultraviolet exposure, whose exposure is always increasing every year. Free radicals caused by pollution and Ultraviolet exposure can cause skin damage such as premature aging, dry skin, and the appearance of various other skin problems. the popularity of these cosmetic products is also driven by increasing awareness of health and the long-term effects of the products used. this is also driven by awareness of the side effects of synthetic products that they use both to themselves and to the environment. Products based on natural ingredients and environmentally friendly.

Research Innovation Objectives

The advantage of using natural ingredients is that they have fewer side effects and even side effects are rare. [7]The purpose of the research innovation on dragon fruit peel waste for cosmetics is to contribute to the reduction of dragon fruit peel waste and provide high waste value for cosmetic ingredients. This is developed and promoted through the provision of alternative environmentally friendly cosmetic products from dragon fruit peels in order to have the value of new economic opportunities for farmers and local industries. This can be in line with the increasing market demand for high-quality natural products that have properties such as antioxidants, anti-aging, moisturizers, and anti-free radicals that are beneficial in skincare.

2. METHODS

Procedure

The strategy for data collection techniques is carried out by literature studies and digital information searches with the target targets in the form of literature studies [literature review] seeking information from relevant literature sources for one week in September - October 2024 by searching >30 references from Google Scholar, ResearchgateNet and Sciencedirect, Shinta, MDPI, Pubmed. As well as, official websites in the range of 2014-2024. Literature study was conducted by identifying problems regarding the content of various formulations. The writing method is through a qualitative approach, which is descriptive research and tends to use analysis. The main focus in this qualitative research is on the process of analyzing the literature review search through related **keywords**: Antiaging; Antioksidan; Antimicrobial; Cosmetics; Dragon fruit peel.

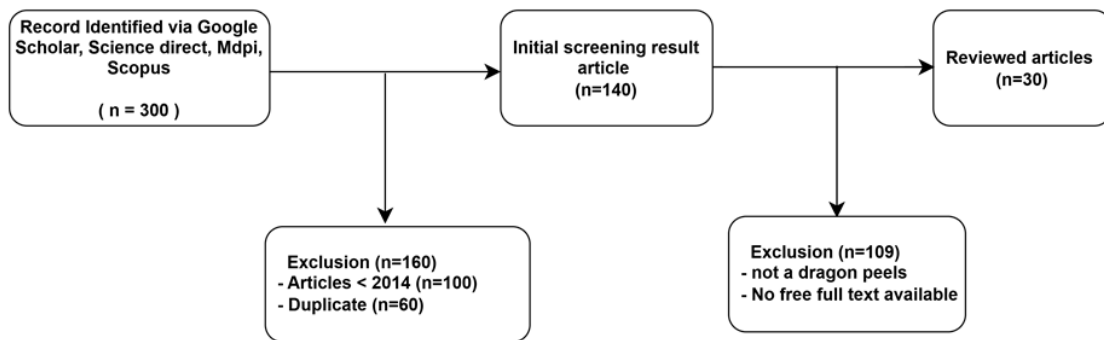


Figure 1. Literature Review Flowcharts

3. RESULTS

Based on the results of research conducted by searching for scientific article journals, several scientific article journals were obtained in accordance with the keywords the researchers were looking for. After screening those that fall within the inclusion criteria of the keywords of the scientific article journals searched, several scientific article journals were obtained which are reviewed in the following table 1.

Table 1. Summary of the Use of Dragon Fruit Peels as Cosmetic

Source	Types of extraction methods	concentration of Dragon fruit peels	Content	Benefit	Activity
[1]	Blending	90% +10% yellow pumpkin	Anthocyanins	Antioxidant and Antiaging	43.16%
[6]	Disc-diffusion	100 mg/mL	Flavonoid, Polyphenols, alkaloid	Anti-acne	10.05 [Antibacterial]
[7]	Partially Fermented Process	2,5 jam	Flavonoid	Antioxidant and Antiaging	19.00 Antioxidant DPPH]
[8]	Maceration	0,0625; 0,125; 0,25; 0,5; 1 gram/ 100 ml	Vitamin A, B1, B3, B6, C, dan E, Alkaloids, Terpenoid, Flavonoid, Cobalamin, Phenolic, Carotene, Protein, Iron, and phytoalbumin	Antioxidant	6,468%; 9,738%; 12,286%;13,141 %; 20,867%
[9]	Maceration	4,71%	Betasianin, Flavonoid, saponin.	Antioxidant, Anti-inflammation, and Antiaging	9,837 mg/mL [Antioxidant]
[5]	Maceration	1; 3; 5 gram/100 ml	Flavonoid, Polyphenol, Alkaloid	Moisturizer	21%; 27%; 29,4% [Moisturizer]
[10]	Maceration	0,5; 1; 2 gram/100ml	Alkaloid, Saponin,	Antioxidant and Anti-	0,8; 0,5; 0,4 [Antioxidant]

			Flavonoid, Terpenoid, dan Steroid	inflammation	Activity Index]
[11]	Infundation	40%	Betasianin and Lignin.	<i>Moisturizer</i> kulit	30% [<i>Moisturizer</i>]
[12]	Maceration	26,1 gram	Antosianin	Antiproliferatif dan Antioxi-dan	0,144 [Rf Antosianin]
[13]	Maceration	0,3; 0,6; 0,9 gram/100ml	Betalain	Antioxi-dan	163,19±0,24; 127,14±12,08; 111,43±3,53 [<i>IC</i> ₅₀]
[14]	Maceration	30%	Antosianin	Anthocyanin	30% [yield]
[6]	Maceration; Fractionation	503,68 [maceration]; 8, 1 [fractionation] [gram]	Flavonoid, carotenoid, and antocianin	Antioxi-dan	1,654 %; 53,333% [yield]
[15]	Reflux	99,94; 99,776; 99,96; 99,52 [gr]	Polifenol, alkaloid, flavonoid, tannin, vitamin c, betasianin, antosianin, serat	Antioxi-dan	4,9; 0,6; 30,2; 8,8 [% yield]
[2]	Maceration	500 gram ekstrak; 1500 ml air	Anthocyanins, polifenol	Antioxi-dan	24,27; 24,85; 25,51; 26,17; 26,87 [%]
[15]	Maceration	26,4587 mg/ml	Anthocyanins	Antioxi-dan and natural dye	46,7%
[16]	Soxhlet	3%; 5%; 7%	Flavonoids, Antioxi-dan, and Vitamins.	<i>Skin Moisturizer</i>	40±7; 45±8; 50±9
[16]	Slow extraction	95/ 105 gram	Betacyanin pigment	<i>Antioxi-dan</i> and Anti- inflammation	2%
[17]	Maceration	10 gram	Phenol, Antioxi-dan	<i>Antioxi-dan</i>	91.911; 90.508; 93.207
[18]	Microwave assisted extraction	100 gram	Pectin	<i>Natural dye</i>	21.68%
[19]	SCWE [Subcritical Water Extraction Method] and AE [Hot Acid Extraction]	11.27%-15.28%	Pectin	Antioxi-dan and <i>Skin Moisturizer</i>	18.88%
[20]	Ultrasonic	55.85	Betasianin	Antimicrobial,	823.580 ±

	Method	mgBE/100 g		Antioxidant, Anti-inflammation	13.250 [Antioxidant DPPH IC ₅₀ µg/mL]
[21]	Maceration	144.60 mg/mL	Polifenol	Antiaging Antioxidant	0,88 AAI [Antioxidant Activity]
[22]	Maceration	20 µg/mL.	flavonoids, Phenol, Vitamin C, Vitamin E, Terpenoid, Thiamin, Niacin, Pyridoxine, Cobalamin, Carotene and Phytoalbumine	<i>Natural dye</i> Antioxidant Antimicrobial	Streptococcus aureus ATCC 29213 [67,5, 67,0, 85,1, 83,1 %] ; Bacillus subtilis ATCC 11774 [73,4, 98,6, 97,1, 100 %] ; gram negatif bacteria escheria coli ATCC 35218[70,0, 73,1, 74,2, 94,9 %]. Final concentration 20 µg/mL.
[23]	Maceration	74.27%	Flavonoids, Phenol, Vitamin C, Vitamin E, Terpenoid, Thiamin, Niacin, Pyridoxine, Cobalamin, Carotene and Phytoalbumin	Antimicrobial	34,38 mg EAG/g & 28,62 mg q/g [Antibacterial]
[24]	Ethanol Extraction; Hexane And Ethyl Acetate Extraction	100 gram	Vitamin B, Vitamin c, Flavonoid	Antioxidant	140,12 ± 5,76 [Antioxidant] 2,52 ± 0,52 [vitamin c]
[25]	Maceration	4,22%	Flavonoid, Phenol, Alkaloid, Tannin.	Antiacne	10.52 ± 0.89 GAE mg/ gram extract, 3.41 ± 0.27 TAE mg/ gram extract, and 1.37 ± 0.07 QE mg/ gram extract.

[26]	Enzym Asisted Extracted [EZX] Ultrasonic Assisted Extraction [US] Hot Water Extraction [HW] Cold Water Extraction [CW]	[EZX] 47.74% [US] 15.17% [HW] 15.03% [CW] 10.93%	Pectin	Antioxidant	EZX [27.05- 74.29%] [Highest Antioxidant]
[27]	Refractance Window Drying [RWD]	20 mg/100g	Vitamin C Betasianin	Natural dye	37.39 [Fresh sample]; 19,02 [dry sample]
[28]	Maceration	50.97%	Antosianin	Antioxidant	2,964mg/100g
[29]	Solvent Extraction; Water Extraction; Super Critical Fluid Extraction; Enzym Assisted Extraction; Microwave And Ultrasonic Assisted Extraction	100 gram	Phenolic	Antioxidant	566 mg GAE/100 g dm ; 5,7 mg GAE/100 g dm ; 2728 mg GAE/100 g dm ; 400 mg GAE/100 g dm ;514 mg GAE/100 g dm ;880 mg GAE/100 g dm ;6013 mg GAE/100 g dm ;2723 mg GAE/100 g dm ; 2011 mg GAE/100 g dm ;

4. DISCUSSION

4.1 Types of Cosmetics Used from Dragon Fruit Peel Waste

Cosmetics is a mixture of materials used to beautify, clean the body, and as an aesthetic beauty value. Skin health is very important for everyone. Human skin is an organ that is susceptible to various diseases, one of which is acne. Acne is a skin problem that is very disturbing to appearance. [30] Cosmetics with dragon fruit skin innovation is the most interesting innovation in the world of beauty. Treatment cosmetics focus on skincare properties such as anti-aging, anti-aging, moisturizers designed to nourish the skin, and therapeutic cosmetics focus on treating acne or eczema and have medical claims attached to them upon use.

4.2 Extraction Method of Dragon Fruit Peel Used

Some secondary metabolites of plants, many active role of phenolic content and flavonoids. In taking dragon fruit peel extracts, various extraction methods were carried out. The blender extraction method was carried out by blending all dragon fruit peel waste for 2 minutes and heating at 70-80 for 25 minutes while stirring continuously. The advantages of this method were chosen because it is simple, fast, low cost, and high effectiveness for the extraction of soft materials [1]. The diffusion method is used to analyze antibacterial activity. in research conducted by Wahdaningsih and Utari [6], the disc diffusion method was used to measure antiacne activity. The advantage of the disc diffusion method is that it can test antibacterial activity in bulk with more than one sample obtained to detect anti-acne content. besides this method has a short processing time. the disadvantage of diffusion itself is that it requires manual labor [31]. Partially Fermented Process consists of

withering, rolling, and cell wall lysis to initiate enzymatic oxidation, as well as final drying to reduce moisture content to 3-5%.

Fermentation is a metabolic process that occurs under anaerobic conditions [without oxygen] in which microorganisms such as bacteria, fungi, or yeast convert organic compounds for a short period of time to prevent full oxidation of the antioxidants. With partial fermentation, only a fraction of the phenols are oxidized so that the antioxidant activity is maintained [7]. Maceration is an extraction that is done without heating. This method focuses on extracting compounds by selecting the appropriate solvent. The advantage of this method is that it is easy to do, but maceration requires a long processing time because it is done without heating. This method is commonly used for compounds that are not heat resistant. From the extraction results, the yield will be obtained. The yield shows the ratio between the secondary metabolites obtained and the number of samples extracted [3]. Infundation is done by heating the sample at 90 degrees Celsius for 15 minutes. infundation uses a simple tool and is cheap to operate, but the infundation results can settle back if it cools. The disadvantage of this method is that the results of this extract are unstable and easily contaminated with germs and molds. So that the results of the extract should not be used or stored for more than 24 hours. active compounds in dragon fruit peel will be attracted by the liquid extractor until dissolved in the liquid extractor. Extraction will be better if the surface area of the sample is expanded so that contact with the solvent is higher [32].

Sokletation is very good for extracting a compound because the compound will contact the solvent repeatedly and continuously. continuous contact will ensure a thorough extraction of the compounds to be isolated. After extraction the ethanol solvent will be removed with a rotary evaporator. this process will evaporate the solvent and produce a concentrated extract [33]. The Microwave Assisted Extraction [MAE] method is used because this method enhances the extraction of pectin by producing higher yields in a short time. in a study conducted by Taharuddin [18] obtained a pectin extraction yield of 21.68%. This finding indicates that the level of pectin extraction with microwave assistance increased significantly. The study also showed that the results of dragon fruit skin extraction at wave power of 300, 450, 600, 800 W were 11.8; 14.9; 17.2; 18.5% respectively [18]. The Ultrasonic Assisted Extraction extraction method is the most popular extraction method used because it is an environmentally friendly method with the use of acoustic cavitation that damages plant tissue or samples to be extracted until high mass transfer occurs. The UAE extraction method has a shorter extraction time, the power consumption used by the UAE method is less than conventional extraction techniques such as maceration [28]. The UAE method has a better mass transfer rate than other methods, the extraction results obtained can be drastically increased, the use of a small volume of solvent and increased penetration of liquid into the cell wall which is very fast and the extraction results are more concentrated [33]. The UAE extraction process has disadvantages if it is carried out at a temperature that exceeds the optimum limit, it will cause the extracted sample compound to oxidize, and the extract content obtained is less than optimal [34]. Acid Extract is a method used to extract an acidic compound including neutralizing the basic properties of a sample to be extracted. The advantage of acid extraction is that it can produce high extraction results, especially if you want to get maximum pectin results [19]. Supercritical Fluid Extraction SFE is an extraction that involves a little organic solvent and the final result of the SFE method tends to have no solvent residue left behind. The SFE method can preserve compounds that are less stable at temperature, the advantage of the SFE method is that it is cheap in operational costs. However, the cost of maintaining the equipment tends to be more expensive [36].

In chemistry, reflux is a laboratory technique used to heat an environment for a long time without losing its solvent. This process is done by heating the reaction mixture in a closed container equipped with a cooling condenser, so that the vapor formed will condense and return to the reaction solution. . Reflux extraction is a method that is carried out using a solvent according to its temperature. The reflux method is often used as an extract by evaporating the solvent until condensation occurs in the condenser, and goes back down to the reaction vessel so that the solvent remains in the condenser and the reaction continues, until the filtrate is obtained [37]. The advantages of this method are that it can be done in a shorter time and is effective in obtaining higher extract results. The disadvantage of the reflux method is that it can cause compound degradation that is difficult to control because of the temperature used. The fractionation method is a

development method of liquid-liquid extraction, solid-liquid extraction, soxhlet, and column chromatography. Of the several extractions, the fractionation method has the same principle. The fractionation method generally separates various compound mixtures based on differences in polarity. The advantage of the fractionation extraction method is that it can simplify the steps to remove compounds through chromatography analysis. The disadvantage of the fractionation extraction method is the risk of losing a compound during the summary process.

4.3 The role of active compounds in dragon fruit skin.

Antioxidants in cosmetics are needed as inhibitors of free radicals and oxidative stress on human skin. Free radicals are electron molecules in the body that cause damage due to the reactive sources produced and damage important molecules in the body. The important role obtained from the presence of antioxidants in cosmetic preparations is that they can be used as a quality defense, prevent rotting/rancidity of a preparation, prevent changes in aroma color and physical damage caused by oxidation reactions [34]. Dragon fruit skin has great potential as an anti-acne and anti-aging because its antioxidant compounds are able to ward off free radicals. Oxidative stress occurs when there is an imbalance between the production of reactive oxygen species (ROS). When the skin is exposed to UV, ROS will be produced in large quantities, triggering damage to proteins, lipids, and DNA which results in damage to collagen and elastin, which triggers the formation of acne and wrinkles. This aging and acne mechanism is exacerbated by ROS which results in the Mitogen-Activated-Protein-Kinase (MAPK) pathway which increases the excretion of Matrix Metalloproteinases (MMP) which are responsible for collagen degradation and weakening the skin structure. The antioxidant content in dragon fruit skin can reduce the formation of ROS and suppress the activity of MMP by neutralizing free radicals. The Betacyanin content of dragon fruit skin also has anti-inflammatory activity which can help inflammation caused by free radicals. Antioxidants in dragon fruit skin will neutralize reactive oxygen so that oxidative stress is reduced and acne inflammation is also reduced. In addition, vitamin C from dragon fruit skin which is known to stimulate collagen production can also help repair cell damage and accelerate skin healing. Vitamin C also helps brighten the skin and reduce black spots from acne scars. Acne is generally caused by *Cutibacterium acnes* Polyphenol and flavonoid compounds in dragon fruit skin which have antimicrobial and anti-inflammatory activities can inhibit bacterial growth and suppress inflammatory reactions thereby preventing inflammation. [37].

The prevalence rate of acne in Indonesia for individuals aged 35-44 years is 3%, aged 25 years and above is 12%, and aged 15-18 years is 80% to 85%. According to the Global Burden of Disease (GBD) study, acne vulgaris affects 85% of young adults [39]. In cosmetic preparations from dragon fruit skin waste, it also functions as an antimicrobial and maintains skin health. Skin antimicrobials in dragon fruit skin can prevent *Cutibacterium acnes* from colonizing. *Cutibacterium acnes* is a gram-positive, anaerobic, aerotolerant bacteria and bacteria that are normally found on the skin. *Cutibacterium acnes* play a role in the formation of acne, this involves the mechanism of breaking down free fatty acids from skin lipids which causes inflammation from the results of lipase. The resulting inflammation produces bacteria that successfully colonize and proliferate so that there is an increased risk of severe pro-inflammatory cytokine production. This is related to the antiproliferative content of dragon fruit skin which contains compounds that have the potential to inhibit the growth of excessive skin cells, helping to remove dead skin cells so that the skin looks smoother and brighter [38].

5. CONCLUSION

Dragon fruit peel has great potential as a basic ingredient for cosmetics because of its rich content of bioactive compounds such as; antioxidants, flavonoids, pectin, and betacyanin. The use of dragon fruit skin extract innovation in cosmetic products not only provides functional antioxidant benefits but can also be used as an anti-inflammatory, anti-aging, and moisturizer. This innovation can support the reduction of agro-industrial waste and organic waste which are considered to have no aesthetic value before, cosmetics from dragon fruit skin can be processed into various environmentally friendly cosmetic products and can provide added value to the national economy.

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