Review: Bioactivities of Saffron as an Active Ingredient in Cosmetics

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Abstract
Saffron (Crocus sativus) is a plant that has been widely used in Asia, especially in the health sector. This can be related to other than that saffron is also known for its use as a cosmetic because Saffron has various kinds of pharmacological activities beneficial to human skin. Today's cosmetic users prefer cosmetics with herbal or natural ingredients, especially in Indonesia. This happens because it is considered that herbal cosmetics are safer and harmless in long-term use. Therefore, it is necessary to do related activity of saffron as a cosmetic ingredient. The aim of this review to provide information regarding the active substances in saffron that can be used as cosmetics. This is narrative research where the data is obtained from PubMed, Science Direct, and Google Scholar with keywords Saffron, Saffron for cosmetics, and others. There were eight references, with inclusion criteria being national and international journals and national websites published in 2011-2021, especially regarding the study of saffron activity as an ingredient for cosmetics. It was found that Saffron (Crocus sativus) contains compounds that have a cosmetic activity such as safranal which can be used as a perfume, crocin as an antioxidant and as anti-dark spot, crocin, safranal, and crocetin as anti-UV, crocin, and crocetin as an anti-inflammatory and as coloring pigment in cosmetics, vitamin C, flavonoids and zinc as a face toner, kaempferol, crocin and crocetin as anti-wrinkle, zeaxanthin, lycopene, carotene, crocin, picrocrocin, kaempferol, and crocin as anti-aging. Saffron (Crocus sativus) has various beneficial activities for the skin, so it can be used as an ingredient in making cosmetics.

Keywords: Cosmetics, Herbal, Saffron, Herbal Cosmetics, Active Ingredient

1. Introduction
In Indonesia, cosmetics is one of primary needs for women. Even now it has been produced for men and children. (1). It makes the cosmetic industry has a very rapid economic growth from year to year. According to data from the Ministry of Industry of the Republic of Indonesia, the national cosmetic industry experienced an increase in the economic growth of 20% compared to economic growth in 2017.

The high demand for cosmetics has made many irresponsible people using harmful elements in the manufacture of cosmetics, such as lead (Pb), arsenic (As), and mercury (Hg) (2). Lead (Pb) in cosmetics will be absorbed in the body, causing organ damage and cancer. Meanwhile, arsenic in cosmetics can cause skin lesions, respiratory problems, and cancer (3). The active ingredient that used in cosmetics should be safe, effective, and the dose should be avoided from long-term effects and side effects such as dermatitis and allergies (4,5).

Increased production and distribution of harmful cosmetics, causing cosmetic users to become worried and afraid in using cosmetics. So that users start switching to herbal or natural cosmetics because they are considered safer.
These herbal ingredients are obtained from plant parts of leaves, seeds, fruit, roots, stems, flowers, rhizomes, and other plant parts. Both are used in the whole form or have been made into powdered extracts. There are various kinds of herbal cosmetic products such as herbal soap, herbal shampoo, herbal face wash, and others. In addition, some products function to protect the skin from the harmful effects of free radicals, maintain the keratin structure in good condition, and make the skin healthier and cleaner. This proves that herbal cosmetics have properties comparable to synthetic materials but are safer, lighter, and healthier to use. Therefore, herbal cosmetics are increasingly popular and favored by users. One of the herbal cosmetics that is widely used by users in Indonesia is cosmetics made from Saffron. Saffron in the market is sold in the form of a cream joint which is efficacious as an anti-wrinkle and also in the form of a face toner.

Saffron (Crocus sativus) is a plant originating from the genus Iridaceous, which has been widely used in Asia, especially in the health sector, which can be related to its use as a cosmetic because Saffron has a wide range of pharmacological activities beneficial for human skin. Saffron contains many chemical compounds, including crocin, safranal, crocetin, picrocrocin. Crocin compounds contain high glycosyl compounds so that they dissolve in water and give a red or orange color to Saffron, safranal compounds are volatile compounds that produce aroma, and picrocrocin compounds are compounds that give saffron taste and aroma. These compounds have effects such as antioxidant, anti-UV, anti-inflammatory, anti-aging, anti-wrinkle, anti-dark spot, face toner, and can produce color and aroma pigments (perfume) so that Saffron can be used as an astringent active in herbal cosmetics.

2. Method

The method used when writing this article is narrative research. The library sources used are as many as 49 libraries, both from books, official websites, national or international journals. The search for library sources was carried out through databases at PubMed, Science Direct, and Google Scholar with Saffron, Crocus sativus, Cosmetic, Saffron for cosmetics, Saffron Cosmetics, and so on. Next, selecting the library sources that will be used is carried out by reviewing the title and abstract. The libraries used include libraries published in the last ten years.

3. Result

There are 536 journals obtained from PubMed, Science Direct, and Google Scholar using keywords. Choose from every journal found through titles and abstracts taken with Saffron benefits for cosmetics. The results of the selection were obtained from 8 journals which are then analyzed narratively.

4. Discussion

a. Antioxidant

In Saffron, high antioxidant activity is provided by crocin as a carotenoid. Crocin showed high radical scavenging activity (50% and 65% for 500 and 1000 ppm solutions in methanol, respectively), followed by safranal (34% for solutions of 500 ppm). This compound's high radical scavenging activity may be due to its ability to donate hydrogen atoms to DPPH radicals.

b. Anti-Inflammation
Saffron activity is an anti-inflammatory derived from crocetin and crocins compounds (21). Both of these compounds have strong antioxidants shown through their inhibition in producing pro-inflammatory cytokines such as IL-1 production by suppressing NF-B activity through inhibition of phosphorylation I kappa B kinase-a (IKK-a) and prevention of nuclear translocation of NF-B, p65 subunit (22). Crocin at a dose of 20 mg/kg can inhibit several pro-inflammatory cytokines (IL-1β, IL-6, and TNF-α) and inflammatory mediators (prostaglandin E-2 (PGE-2) and COX-2) production (21). In addition, crocin and safranal also suppress the inflammatory pain response and reduce the number of neutrophils (28).

**Table 1.** Activity of saffron and its compounds.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Compound</th>
<th>Activity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfume</td>
<td>Safranal</td>
<td>Main components of saffron essential oil.</td>
<td>[18]</td>
</tr>
<tr>
<td>Antioxidant</td>
<td>Crocin</td>
<td>High radical scavenging activity</td>
<td>[19]</td>
</tr>
<tr>
<td>Anti-UV</td>
<td>Crocin, Safranal, and Crocetin</td>
<td>As an antioxidant that can counteract and damage UV radiation on the skin</td>
<td>[20]</td>
</tr>
<tr>
<td>Anti-Inflammation</td>
<td>Crocin and crocetins</td>
<td>Inhibits that some pro-inflammatory cytokines</td>
<td>[21][22]</td>
</tr>
<tr>
<td>Face Toner</td>
<td>Vitamin C, Flavonoid and Zinc</td>
<td>Vit. C: treat hyperpigmentation, Flavonoid: brighten the face, Zinc: retinol protein binder</td>
<td>[23]</td>
</tr>
<tr>
<td>Anti-Wrinkle</td>
<td>kaempferol, crocin and crocetin zeaxanthin, lycopene, karoten, crocetin, picrocroc, kaempferol, and crocin</td>
<td>Antioxidant</td>
<td>[24]</td>
</tr>
<tr>
<td>Anti-Aging</td>
<td>Crocin</td>
<td>Antioxidant</td>
<td>[25][26]</td>
</tr>
<tr>
<td>Anti-Dark Spot</td>
<td>Crocin</td>
<td>Inhibits the enzyme tyrosinase</td>
<td>[27]</td>
</tr>
<tr>
<td>Coloring Pigments in Cosmetics</td>
<td>Crocin and crocetins</td>
<td>It gives red or orange</td>
<td>[14]</td>
</tr>
</tbody>
</table>

**c. Anti-UV**

Saffron flowers (Crocus sativus) contain main compounds such as crocin, safranal, and crocetin which have various activities, for example, as antioxidants (20). Safranal is an aldehyde monoterpenes that is included in the main volatile compounds in Saffron Flowers. Safranal can act as an anti-UV due to its activity as an antioxidant that can counteract free radicals from ultraviolet (UV) rays. This is because the impact of UV rays on the skin can cause dry skin, wrinkles, and even sagging (29).

Anti-UV, commonly called Sunscreen, is included in photoprotection, which can prevent and even damage UV radiation that harms the skin, such as aging (30). In addition, UV radiation can cause sunburn to skin cancer (31).

**d. Face Toner**

According to Salvi and Prima's 2021 study, the pistil of Saffron (Crocus sativus) can be used as a face toner because it contains Vitamin C, Flavonoids, and Zinc which can traditionally treat facial skin. Vitamin C contained in the pistil of the Saffron flower is 1.41%. Vitamin C serves to treat hyperpigmentation (32). Zinc functions as a component of the retinol-binding protein so that Vitamin A can flow in the blood. Flavonoids function to depigmentation or are often referred to as brightening agents to inhibit
tyrosinase activity when the melanogenesis process occurs (23).

Face toner can function as a cleanser after making facial repairs with facial cleansers to remove excess sebum on facial skin so that this face toner has anti-sebum activity (33, 34). In addition, facial toner is also useful for hydrating the skin to maintain its moisture (35).

e. Anti-wrinkle

Anti-wrinkle reduces or eliminates wrinkles due to age, stress, smoking, or exposure to free radicals or UV. So that in anti-wrinkle activity, compounds containing antioxidants are needed (36) (37) (38). In the research of Zeka and Mashmoul, it was found that the petals of Saffron (Crocus sativus L.) (24) (19) have antioxidant effects derived from kaempferol, crocin, and crocetin compounds, and there are safranal compounds that have antioxidant activity (39).

f. Anti-aging

Like anti-wrinkle, anti-aging can work well if it contains antioxidants (40). Saffron (Crocus sativus) contains zeaxanthin, lycopene, carotene, crocetin, picrocrocin, kaempferol, and crocin compounds that act as antioxidants (25, 26).

One of the factors that cause skin aging is exposure to UV radiation. So, the use of anti-aging is usually accompanied by anti-UV (41). Exposure to UV radiation, especially UV A light, can increase the number of reactive oxygen species and enzymes that act as protective antioxidants such as catalase. Catalase enzymes are commonly used as biomarkers or important indicators of oxidative stress. If in large quantities, it can cause damage to the skin, such as skin aging (42, 43).

g. Anti-dark spot

Saffron is known to reduce melamine in which dark spots are formed from the process of melanogenesis by the occurrence of an oxidative reaction that is controlled and accelerated by the tyrosinase enzyme, which will form melanin from a mixture of the pigments eumelanin (dark brown) and phaeomelanin (yellowish-red) which causes the formation of dark spots on the skin (44) (11). Increased melanin, especially the pigment eumelanin, can be caused by ultraviolet radiation (45). Saffron contains crocin compounds that can inhibit the activity of the tyrosinase enzyme by damaging the hydrogen bonds in the tyrosinase, which causes rearrangement and conformational changes in the enzyme and based on silicon docking studies, crocin forms extensive hydrophobic interactions with amino acid residues of the tyrosinase enzyme and crocin is an inhibitor. Mixed competitive type (27). So that Saffron can be used as an anti-dark spot and significant depigmentation in reducing skin melanin (11).

h. Perfume

In the era of Ancient Greece, Saffron was often used as a perfume by the royals because it had a sensual fragrance and was admired by the Greeks (11). Saffron has more than 150 volatile and aroma-producing compounds. Safranal is one of the main components of saffron essential oil. It is formed by hydrolysis of picrocrocin when it’s drying and storage (18). Studies have shown that a higher temperature of around 80°C and a less processing time of up to 30 minutes will result in a larger amount of safranal. Saffron, with good quality, has 2.5% volatile compounds such as safranal (46).

i. Coloring Pigments in Cosmetics

Saffron has been used as a natural color for the manufacture of cosmetics since ancient times. Reddish gold, orange, and orange-red colors are produced by Saffron (47;23). these colors have resulted from crocetin and crocin compounds of Saffron(48), which have the carotenoid glycoside structure (48).

5. Conclusion

Saffron has various activities, as an antioxidant, anti-UV, anti-inflammatory, perfume, face toner, anti-wrinkle, anti-aging, anti-dark spot, and can provide color pigments.
So that Saffron has the potential to be used in the manufacture of cosmetics.

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