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T Meenakshi Sundari
Vellalar College of Pharmacy
Maruthi Nagar, Thindal,
Erode, Tamil Nadu, India

A Saravana Kumar
Vellalar College of Pharmacy
Maruthi Nagar, Thindal,
Erode, Tamil Nadu, India

S Irfan
Vellalar College of Pharmacy
Maruthi Nagar, Thindal,
Erode, Tamil Nadu, India

B Abishek
Vellalar College of Pharmacy
Maruthi Nagar, Thindal,
Erode, Tamil Nadu, India

J Neteesh
Vellalar College of Pharmacy
Maruthi Nagar, Thindal,
Erode, Tamil Nadu, India

Corresponding Author:
T Meenakshi Sundari
Vellalar College of Pharmacy
Maruthi Nagar, Thindal,
Erode, Tamil Nadu, India

Saffron's golden glow: Unveiling its skincare potential: A review

T Meenakshi Sundari, A Saravana Kumar, S Irfan, B Abishek and J Neteesh

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Abstract
For generations, people have valued saffron medicinal and culinary properties. Saffron (*Crocus sativus*) obtained from the flowers stigmas saffron flowers were used for their considerable cosmetic potential which was demonstrated by recent studies. It is a useful component of skincare and hair care solutions saffron chemical makeup pharmacological characteristics and cosmetic uses are examined. Our review article with particular attention to the herbs, anti-inflammatory and antioxidant qualities, improvement of skin tone and reduction of hyperpigmentation wrinkle-reducing and anti-aging qualities promotes the regeneration of skin and healing during second-degree burns and minor injuries. Some main chemical constituents present in saffron like picrocrocin also show a good action on cancer patients. We address the effectiveness of extracts of crocin in saffron and other active ingredients in a range of cosmetic formulations such as serums, shampoos, conditioners, and face creams as a natural substitute for synthetic compounds in cosmetic products. Saffron's effectiveness and versatility are highlighted by our thorough review.

Keywords: Saffron, *Crocus sativus*, skincare, cosmetics, anti-inflammatory

Introduction

The skin serves as the most prevalent sensory organ, with its condition often mirroring the overall health of the body. It is a protective barrier for the more delicate and complex internal organs. The term "saffron" is derived from the Arabic word "Zaffran," which translates to "yellow," and its historical significance can be traced back to at least 1500 B.C. in various classical texts. Notably, Ancient Egypt provides one of the earliest references to saffron, where it was utilized by Cleopatra and other pharaohs for its aromatic and alluring properties, as well as for ritualistic cleansing in temples and sacred sites. Saffron is obtained from the fall-blooming plant *Crocus sativus*, which belongs to the Iris family and is indigenous to Asia Minor, where it has been cultivated for millennia for use in medicine, perfumes, dyes, and as a flavourful addition to culinary dishes and beverages. The Arabs recognized saffron anesthetic qualities and were instrumental in introducing its cultivation to Spain during the 10th century. Historical evidence indicates that saffron was an essential component of Hispanic-Arabic cuisine during that era. The earliest documented reference to saffron appears in the B.C. Assyrian botanical text compiled under King Ashurbanipal, and subsequent research has revealed its application in the treatment of approximately 90 ailments over 4,000 years. In the Middle Ages, saffron gained prominence in Great Britain, with a legend suggesting that during the reign of Edward III, a pilgrim smuggled a saffron bulb from the Middle East in a hollowed stick to the town of Walden, where it flourished and contributed to the town's prosperity. During the Renaissance, Venice emerged as the principal commercial hub for saffron, which was valued at its weight in gold, and it remains the most expensive spice globally to this day [1]. The stamens and corolla strips of the saffron crocus, along with the ligulate corollas of marigold florets, which are frequently dyed with methyl orange and sometimes referred to as femininely or Chinese safflower, are noteworthy. Additionally, the ligulate florets of safflower are commonly found in commercial saffron products. Other components include the slender stems and roots of certain monocotyledons, such as Cortex, which may be artificially colored, as well as the stigmas of *Zea mays* (corn silk). Due to its high cost, saffron is vulnerable to various forms of fraud perpetrated by dealers. Food adulteration typically involves the incorporation of inexpensive materials into valuable products, resulting in items that maximize profit while minimizing costs. A prevalent form of fraud in saffron production is the mixing of similar products, including safflower, red-dyed silk fibers, beet, marigold, and pomegranate with authentic saffron stigmas. Numerous studies have focused on identifying methods to detect various forms of saffron adulteration. It developed and evaluated techniques such as laser-induced breakdown spectroscopy (LIBS), attenuated total reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy, and Raman spectroscopy, employing Principal Component Analysis (PCA) to identify and quantify adulterants like safflower, turmeric, and others. Their findings indicated that the LIBS technique, along with Partial Least Squares (PLS) analysis, could effectively detect plant adulterants in saffron at levels below 10%, which are challenging to identify using traditional UV-Vis spectroscopy. Furthermore, Petrakis and Polissiou (2017) utilized different reflectance infrared Fourier transform spectroscopy (DRIFTS) and chemometric methods to investigate saffron contamination with six distinct plant adulterants, including turmeric, gardenia, *C. sativus* stamens, and calendula. They concluded that DRIFTS, combined with chemometric analysis, offers a rapid, safe, and cost-effective alternative for assessing saffron adulteration with plant derivatives. The research utilized ^1H NMR metabolite fingerprinting to investigate the adulteration of saffron with various plant products, applying both OPLS-DA and 2PLS-DA models to the ^1H NMR data [2]. The results demonstrated that NMR metabolite fingerprinting is more effective than the ISO 3632 method for identifying saffron adulteration, particularly in powdered forms. Among the related species of saffron are *Crocus cartwrightianus* (Cartwright's crocus), *Crocus thomasii* (Thomas' crocus), *Crocus hadriaticus* (Hadrian's crocus), *Crocus moesiacus* (Moesian crocus), *Crocus tommasinianus* (Tommasini's crocus), *Crocus flavus* (yellow crocus), *Crocus albiflorus* (white crocus), *Crocus minimus* (least crocus), *Crocus speciosus* (showy crocus), and *Crocus vernus* (spring crocus). These species share similarities in flowering traits, such as cup-shaped flowers and similar colors, as well as growth patterns, being perennial and bulbous, and their geographical distribution in the Mediterranean region and temperate climates.

Fig 1: Saffron [*Crocus sativus*]

Geographical distribution

Saffron cultivation is thought to have commenced approximately 3,500 years ago in Egypt. During the Middle Ages, the cultivation of saffron expanded from the Middle East into Europe, ultimately reaching Great Britain in the 14th century. Grilli Caiola has conducted a comprehensive review of the archaeological and historical documentation regarding the occurrence and dissemination of saffron and its related species. The Middle East is the primary center of origin for *Crocus sativus*, while other scholars propose that Asia Minor or the southwestern Greek Islands may also be potential areas of origin. posits that *Crocus sativus* was likely selected and domesticated in Crete during the late Bronze Age, from which it subsequently spread to India, China, and various Middle Eastern nations. The Arabs are credited with introducing saffron to the entirety of Mediterranean Europe Several scholars suggest that its origins can be traced back to Iran and Kashmir, from which it disseminated into the Greek and Roman realms. While the exact timeline for saffron's introduction to Kashmir remains uncertain, a 12th-century text titled "Rajatarangini," authored by the Kashmiri poet Kalhana, provides evidence of its presence in the region before the reign of King Lalitaditya in 750 AD. The genetic origins of *Crocus sativus* are thought to have arisen through auto-triploids from a wild Crocus, potentially resulting from the fertilization of a diploid unreduced egg cell by a haploid sperm cell, or through the fertilization of a haploid egg cell by two haploid sperm cells. Alternatively, allopolyploid may have occurred via the hybridization of Crocus cartwrightianus and Crocus hadriaticus [3]. In a karyological investigation conducted by Brighton in 1977, supported by the AELP analysis by Zubor *et al*, it was proposed that the most likely ancestor of *C. sativus* is C. cartwrightianus. Currently, saffron is cultivated with varying degrees of intensity in several countries, including Iran, India, Greece, Spain, Italy, Turkey, France, Switzerland, Israel, Pakistan, Azerbaijan, China, Egypt, Japan, Afghanistan, Iraq, and more recently, Australia. The global annual production of saffron is estimated to be around 205 tons, with Iran accounting for approximately 80% of this total, producing 160 tons from over 47,000 hectares of cultivated land. Specifically, the Khorasan province in Iran contributes significantly, with 46,000 hectares yielding 137 tons of saffron. In India, saffron is exclusively grown in the Kashmir division of Jammu and Kashmir, where it is locally referred to as "Koung." This crop occupies about 4% of the total cultivated area in the Kashmir valley and yields approximately 5-6 tons annually. However, saffron exports from India decreased from 9.7 tons in 1998-99 to 8.7 tons in 2000-01, coinciding with a drop in the spot price from Rs. 32,936 per kilogram (approximately $866) in 1997-98 to Rs. 17,500 (around $374) in 2004-05. Over the past decade, the area under saffron cultivation and its annual production in the state have exhibited a declining trend. There has been an 83% reduction in area, a 215% decrease in production, and a 72% decline in productivity. The primary factors contributing to the decrease in saffron cultivation and production constraints, both globally and in the Jammu and Kashmir state of India, include high labor costs, a lack of variability in key economic traits, low corm yields, susceptibility to diseases, low yields of important biochemical compounds such as safranin, picrocrocin, and crocin, and Husaini *et al.* conducted a review of the cultivation methods employed for saffron in Kashmir, as well as the various factors contributing to the decrease in saffron production [4].

Fig 2: Geographical Distribution

Cultivation

The fundamental requirement for the successful cultivation of commercial saffron is the presence of fertile soil at a suitable elevation. The climate represents the second critical factor, necessitating a prolonged photoperiod alongside dry, moist soil conditions. Saffron is predominantly cultivated in low-lying, arid regions situated at elevations between 1500 and 2500 meters above sea level. A photoperiod of approximately 12 hours is essential, offering various benefits while simultaneously delaying the flowering process. In India, saffron corms are typically planted during June and July, with some regions also planting in August and September. Flowering commences in October. The plant requires intense heat and dryness during the summer months, while it thrives in extremely cold conditions during winter. The winters experienced in regions such as Karnataka, Himachal Pradesh, and Jammu & Kashmir provide optimal conditions for saffron development [5]. Soil quality is a crucial element in saffron cultivation; the plant flourishes in loamy, sandy, and calcareous soils. Although gravelly soil is also conducive to saffron farming, heavy clay soils are unsuitable. Saffron prefers acidic soil, with an optimal pH range of 5.5 to 8.5 for optimal growth. Saffron is characterized by its lower water requirements compared to other spices. The soil should maintain a slightly moist condition without becoming completely dry. Irrigation is typically administered on a weekly schedule, necessitating the application of 283 cubic meters of water per acre throughout the growing season. The cultivation of saffron is achieved through the use of corms, which are specialized underground stems. In India, particularly in the Kashmir region, three distinct varieties of saffron are cultivated: Aquilla saffron, Creme saffron, and Lacha saffron. Before sowing saffron seeds, it is essential to prepare the soil by thoroughly plowing it to achieve a brittle texture. It is recommended to incorporate 20 tonnes of cow dung, along with 90 kg of nitrogen, 60 kg of phosphorus, and 60 kg of potassium per hectare into the soil before the final plowing, ensuring thorough mixing. This practice will enhance soil fertility and structure, leading to a superior saffron yield [6]. Trenches measuring 12-15 cm in depth are excavated, with an approximate spacing of 10 cm between plants. The saffron corms are then placed directly into these trenches, after which the soil is loosely spread over the top. Care should be taken not to compact the soil excessively, as this may hinder air circulation. Following the planting of the corms, irrigation is generally unnecessary; however, supplemental watering may be required in the event of prolonged dry conditions or severe drought during the warmer months. The timing of crop planting is crucial for achieving optimal yields. Failure to plant seeds at the appropriate time can lead to disappointing harvests. Therefore, it is essential to adhere to the designated planting schedule. For saffron, the ideal months for harvesting are July and August, with mid-July being particularly favorable. When planting saffron corms, it is recommended to create a pit measuring 6-7 centimeters deep and to maintain a spacing of approximately 10 centimeters between each corm. This practice promotes healthy growth and enhances pollen production. If light rain occurs shortly after planting, additional watering is unnecessary. However, in the absence of rain, irrigation may be required two to three times within 15 days. It is critical to ensure that no water accumulates in the fields during irrigation; if such deposits occur, prompt drainage measures must be implemented to prevent damage to the crops. The labor-intensive harvesting process contributes to saffron's high market value, as the flowers begin to bloom three to four months post-planting, provided they are planted by October. Harvesting should take place at dawn, before sunrise, and ideally between sunrise and 10 AM. For those utilizing solar dryers, a drying period of 7-8 hours is necessary [6, 7].

Collection

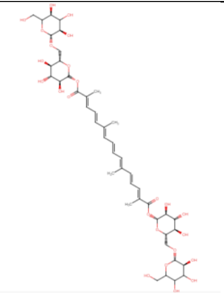
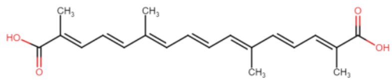
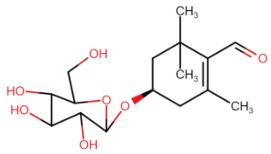
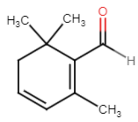
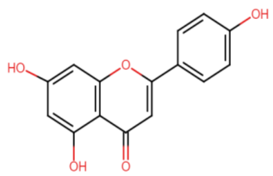
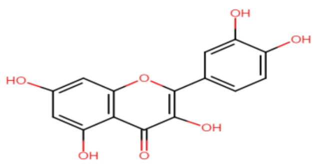
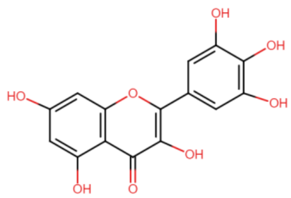
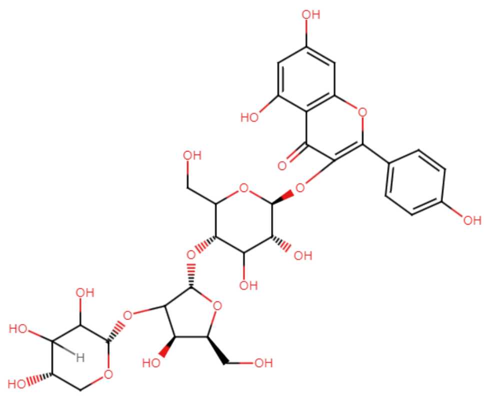
Saffron originated from the flower of *Crocus sativus*, sometimes referred to as the saffron crocus. The vivid red stigma and styles which are also referred to as threads are picked and dried principally for use as food flavoring and coloring. Iran is thought to be the origin of saffron, however, the precise location is still unclear. Although; it has also been argued that this plant might have its origins in Greece and Mesopotamia. Before being introduced to parts of North Africa, North America, and Oceania, the saffron crocus gradually expanded across much of Eurasia. Everywhere it grows in the world, saffron is collected in autumn. In some places, it is typically harvested in October and February after the wine harvest and just before the olive harvest occurs after planting the corms mostly in June the stem leaves and roots develop between October and February bright colored flowers appear only in October and after most other flowering plants have released their seeds they range from a light Pestle shade of lilac to a darker mauve purple. The flowers have a pleasant scent the plants can grow up to 30 cm tall and bear up to four flowers when they flower. The viability of harvested saffron flowers is limited to a period of 3 to 4 days, extending to a maximum of 2 weeks in certain locales, which necessitates timely and proper harvesting to prevent loss. Typically, the flowers remain in bloom for an average of 20 to 35 days [4]. It is essential to harvest the flowers either before noon or after sunset, as they bloom with the dawn; any delay in this process can lead to wilting due to sunlight exposure, making the flowers unsuitable for collection. Saffron is cultivated in some of the most fertile regions, where traditional farmers, equipped with skills passed down through generations, engage in the harvesting process. Predominantly, women are seen gathering the blooms, often remaining in these roles longer than men due to their genetic advantages in adapting to such challenging environments and their heightened stress resilience. Additionally, the limited window for flower collection, which occurs only over a few days each year, coupled with the fragility of the saffron flower, presents considerable difficulties. As a result, approximately 90% of the workforce in this sector, particularly during the harvesting stage, is comprised of women.

Fig 3: Collection of saffron

Phytoconstituents

Carotenoids are natural pigments that impart yellow and orange hues to plants and vegetables, playing a crucial role in the process of photosynthesis. These compounds possess antioxidant properties due to their ability to interact with radical species. In a study examining saffron flower extracts, the total carotenoid content was assessed across various parts of the flower, revealing that the stigmas contained the highest concentration of carotenoids and exhibited superior antioxidant activity compared to other parts. Crocin, a water-soluble pigment found in saffron stigmas, is a diester derived from a carotenoid dicarboxylic acid and is synthesized from zeaxanthin through a series of reactions involving cleavage enzymes. The antioxidant properties of crocin are associated with its capacity to scavenge reactive oxygen species (ROS), thereby playing a significant role in the inhibition of ROS formation. Isoprenoids, or terpenoids, are compounds derived from isoprene, an unsaturated hydrocarbon. The classification of terpenoids is determined by the number of isoprene units, leading to a diverse array of categories, including monoterpenoids, sesquiterpenes, diterpenes, triterpenes, and polyterpenes [2]. Monoterpenes, which are prevalent among secondary metabolites in aromatic plants, have been shown to have beneficial effects on cardiovascular health. Additionally, picrocrocin has been identified in saffron stigmas at a concentration of 4%. Picrocrocin is the primary compound that imparts the characteristic bitter flavor to saffron. The minimum concentration of picrocrocin required to elicit a discernible bitter taste sensation in food is 10 mg/l. This compound is widely regarded as a quality indicator for saffron, as determined by various quantification techniques, including High-Performance Liquid Chromatography (HPLC), as specified in ISO 3632 [8]. During the drying process, picrocrocin undergoes a thermal transformation into volatile and aromatic molecules known as safranal. The saffron stigmas are noted for their pronounced aroma, which is largely attributed to the concentration of these volatile compounds. A total of thirty-seven distinct compounds have been identified in saffron, with safranal being the most prevalent. Safranal is classified as a cyclic monoterpenoid and is chemically identified as 2,6,6-trimethyl-1,3-cyclohexadiene-1-carboxaldehyde. In addition to its aromatic properties, safranal possesses significant antioxidant, antifungal, and antibacterial properties, and plays a crucial role in agriculture as a biochemical biostimulant. Another category of secondary metabolites found in saffron plants includes flavonoids, which are characterized by a structure comprising three rings: two benzene rings A and B connected by a heterocyclic pyran ring (C). The categorization of flavonoids can be approached through various criteria, including their biosynthetic origins, variations in the heterocyclic ring structure, or the oxidation state of the central pyran ring. Flavonoids play a crucial role in scavenging free radicals, primarily due to the presence of hydroxyl groups, which confer significant antioxidant properties. One of the predominant antioxidant compounds found in saffron stigmas and its by-products, such as petals and leaves, is kaempferol glycoside. This natural secondary metabolite of plants is recognized for its potential in cancer prevention. Additionally, other phenolic compounds are acknowledged for their pigmentary roles [9]. Anthocyanins, in particular, contribute to the diverse coloration observed in various fruits, vegetables, and flowers. The anthocyanins present in saffron tepals predominantly consist of delphinidin, petunidin, and malvidin glycoside

Fig 4: Saffron flower Extract oil

S. No	Chemical compound	Molecular formula	Saffron part	Activity	Effect
01	CAROTENOIDS: Crocin Crocetin	 	Stigmas, petals, stamens Stigmas, petals	Inhibits the enzyme tyrosinase, high radical scavenging activity	Anti-inflammation, anti-dark spots, coloring pigments red and orange
02	MONOTERPENOIDS: Picrocrocin Safranal	 	Stigmas Stigmas	As an anti-oxidant, the main components of saffron essential oil, counteract UV radiation.	Anti-aging, anti UV, perfumes.
03	FLAVANOIDS: Kaempferol Quercetin Myricetin Primflasine	   	Petal, stamens, leaves Stigmas, petal, stamens Petals Petals	Brightens the face, as an anti-oxidant to counteract and damage UV radiation on the skin	Anti-oxidant, skin protective, for treating cancer
04	Vitamin C, Karoten, zinc		Stigmas, petals	Retinol protein binder, to treat hyperpigmentation, anti-oxidant	Face toner, anti-wrinkle,

Cosmetic uses

Fig 5: cosmetic products

Anti-wrinkle
Research has demonstrated that the petals of saffron exhibit antioxidant properties attributed to the presence of kaempferol, crocin, and crocetin compounds, alongside safranal compounds that also contribute to antioxidant activity.

Anti-aging
The effectiveness of anti-aging interventions is notably improved when they include antioxidants. Saffron is a source of several antioxidant compounds, such as zeaxanthin, lycopene, carotene, crocetin, picrocrocin, kaempferol, and crocin. A significant factor contributing to skin aging is exposure to ultraviolet radiation, which often necessitates the integration of anti-aging formulations with anti-UV properties. Notably, exposure to UV radiation, particularly UVA light, can lead to an increase in reactive oxygen species and stimulate the activity of protective antioxidant enzymes like catalase. Catalase is commonly recognized as a biomarker for oxidative stress, and when present in excessive amounts, reactive oxygen species can inflict damage on the skin, thereby accelerating the aging process [9].

Anti-dark spot
Saffron has been identified as a substance that can diminish melanin production, which is responsible for the formation of dark spots through the process of melanogenesis. This process is influenced by an oxidative reaction that is both regulated and expedited by the enzyme tyrosinase, leading to the synthesis of melanin from the combination of eumelanin (dark brown) and phaeomelanin (yellowish-red). The presence of melanin, particularly eumelanin, can be exacerbated by exposure to ultraviolet radiation. Notably, saffron contains crocin compounds that have the potential to inhibit tyrosinase activity by disrupting the hydrogen bonds within the enzyme. This disruption results in rearrangements and conformational alterations of the enzyme, as evidenced by silicon docking studies.

Perfumes
Saffron has historically been favored by royalty as a perfume due to its alluring scent, which garnered admiration from the ancient Greeks. This spice contains over 150 volatile and aromatic compounds, with safranal being a primary constituent of saffron essential oil. Safranal is produced through the hydrolysis of picrocrocin during drying and storage. High-quality saffron typically comprises approximately 2.5% volatile compounds, including safranal [12].

Colouring pigments in cosmetics
Saffron has served as a natural dye in cosmetic production since antiquity. The hues produced by saffron include reddish gold, orange, and orange-red, which arise from the presence of the compounds crocetin and crocin, both of which belong to the carotenoid family.

Saffron against skin acne
Due to the glucoside content found in saffron stigmas, the results indicated that after a 14-day application of the specified masks, 90% of acne cases were resolved. Additionally, saffron was incorporated into the formulation of an herbal soap product designed to eliminate skin acne. In a similar vein, saffron was included in an herbal and essential oil mask, which demonstrated a positive impact on acne. The saffron-based soap, containing significant levels of alkaloids and ginsenosides (35% and 4%, respectively), exhibited restorative, Moisturizing, Anti-inflammatory, and anti-aging properties for the skin. Furthermore, the saffron amino acid soap proved to be highly effective in addressing spots, acne, and pigmentation issues resulting from qi stagnation, blood stasis, and endocrine imbalances.

Saffron against UV radiation
Extracts derived from saffron by-products exhibit significant efficacy as agents against ultraviolet radiation, making them suitable for incorporation into sunscreen formulations. The by-products of saffron flowers are rich in various compounds that facilitate the rapid healing of skin injuries and the treatment of diverse dermatological conditions. These extracts have been shown to enhance wound healing, as evidenced by increased cellular proliferation. In addition to the saffron tepals, Deris has developed a cosmetic cream that utilizes extracts from the saffron pistil (ranging from 0.1% to 1%) combined with Pistacia oil. This cosmetic formulation offers protective benefits for the skin, potentially slowing the aging process due to its antioxidant and free radical-scavenging properties [11].

Healing of second-degree burns
A research investigation was conducted to assess the efficacy of saffron extract cream in treating heat-induced burns, comparing its outcomes with those of silver sulfadiazine (SSD) in a rat model. The results indicated that the wound size in the saffron-treated group was notably reduced in comparison to the other groups. Furthermore, histological analysis revealed that saffron extract significantly enhanced the re-epithelialization process of burn wounds relative to the alternative treatments.

Effect on the eyes
Saffron has a long-standing history of use across various cultures for the treatment of numerous ocular conditions, including corneal disorders, conjunctivitis, cataracts, and purulent eye infections. The kohl pencil, utilized in ancient Egyptian civilization, continues to be employed today to darken the eyes. Historically, women in the Orient applied kohl as a protective measure against environmental elements such as sunlight, wind, and sand, as well as to guard against ocular infections. This kohl was composed of a finely milled

powder derived from a combination of cloves, rosewood, saffron, and antimony. Recent research indicates that saffron extract may play a beneficial role in alleviating eye diseases, including cataracts and retinal degeneration, while also enhancing blood circulation and retinal functionality.

Culinary uses

Throughout history and across various cultures, saffron has predominantly served as a culinary ingredient. Chefs and saffron connoisseurs often describe its fragrance as akin to honey, albeit with metallic undertones. In countries such as India, Iran, and Spain, saffron is commonly utilized as a seasoning for rice dishes. In Spanish gastronomy, it is prominently in recipes like Paella Valenciana, a rice-based specialty, and zarzuela, a fish dish. Additionally, saffron is integral to French bouillabaisse, a spiced fish soup, as well as Italian Milanese risotto and saffron-infused cake. In Iran, saffron is a key component of the national dish, Chellow kabab. Indian cuisine incorporates saffron into biryanis, which are traditional rice dishes, and it is also found in sweets like Gulab jamun and kulfi. In Morocco, saffron replaces mint in tea and is employed as a spice in various traditional recipes, including koftas (meatballs with tomatoes) and mrouzia, a sweet and Savory dish made with mutton or dill. Furthermore, saffron plays a vital role in the chermoula herb blend that enhances the flavor of numerous Moroccan dishes [10].

Home remedies

Saffron has been used in folk medicine and the Ayurvedic health system as a sedative, experiment, anti-asthma, emmenagogue, and adaptogenic agent. Saffron was used in various opioid preparations for pain relief [16th -19th centuries]. The complete German Commission E monograph has not approved this plant for use in cramps or asthma [13].

Fig 06: Ayurvedic preparation of saffron

Adverse effects

Skin irritation: The application of saffron may lead to skin irritation characterized by symptoms such as redness, itching, and rashes, particularly in individuals with sensitive skin. Allergic contact dermatitis: Certain individuals may exhibit an allergic response to saffron, resulting in allergic contact dermatitis when utilizing saffron-based cosmetic products. Yellow discoloration: The active component of saffron, known as crocin, has the potential to induce yellow discoloration of the skin, especially with extended use or when applied in high concentrations. Skin dryness: Saffron may contribute to skin dryness, particularly when utilized in elevated concentrations or the absence of hydrating agents [13]. Interaction with other ingredients: Saffron has the potential to interact with various cosmetic components, including essential oils and fragrances, which may heighten the likelihood of adverse reactions. Individuals who should exercise caution include: - Pregnant or breastfeeding women - Those with sensitive skin or known allergies - Individuals suffering from skin disorders such as eczema, psoriasis, or rosacea - Persons on medications that heighten sensitivity to sunlight, as saffron may exacerbate this effect.

Toxicity

Saffron is non-toxic in animals [LD50-20.7 g/kg] and non-cytotoxic *in vitro* studies [[LD50-200 m kg/ml]. The tubers are poisonous to young animals. In terms of LD50 values and maximum non-lethal dose, the stigma extracts were more toxic than the petal extract and were administered at 1.6 g/kg i.p. specified. and 3.38 g/kg, i.p. in mice. According to a toxicity classification, stigma, and petal extracts are "relatively toxic" and "low toxic," respectively. Treatment with the *C. sativus* extracts also significantly extended the lifespan of cisplatin-treated mice almost threefold. Toxicity studies showed that hematological and biochemical parameters were within normal limits with saffron extract [14]

Marketed formulation

Saffron Extract: Extract derived from *Crocus sativus*, abundant in crocin, crocetin, and safranal, Emollients: - Sweet almond Oil (Prunus Amygdalus) - Coconut Oil (Cocos nucifera) - Shea Butter (Butyrospermum parkii), Humectants: - Honey (Mel) - Glycerin, Emulsifier: - Cetearyl Olivate (and) Sorbitan Olivate, Preservative: - Phenoxyethanol (and) Ethylhexylglycerin, pH Adjuster: - Citric Acid (as required). Benefits of the saffron cream Provides nourishment and hydration to the skin. - Assists in evening out skin tone and diminishing hyperpigmentation. - Offers anti-aging effects and antioxidant benefits. - Calms and soothes irritated skin.

Saffron medicinal soap

Saffron Extract: Extract derived from *Crocus sativus*, containing significant amounts of crocin, crocetin, and safranal, Soap Base: - Olive Oil (*Olea europaea*) - Coconut Oil (*Cocos nucifera*) - Palm Oil (*Elaeis guineensis*) - Castor Oil (*Ricinus communis*), Medicinal Herbs:- Calendula Officinalis (Pot Marigold) - Chamomilla Recutita (German Chamomile) - Lavandula Angustifolia (Lavender), Essential Oils: - Tea Tree Oil (Melaleuca Alternifolia) - Lavender Oil (Lavandula Angustifolia), Preservative:- Sodium Benzoate, pH Adjuster: - Citric Acid (as required) Benefits of the soap. Alleviates and soothes irritated skin. - Exhibits anti-inflammatory and antioxidant effects. - Aids in the reduction of acne and enhances skin clarity. - Provides moisture and nourishment to the skin. - Contains antimicrobial properties attributed to tea tree oil [14].

Saffron health product

Saffron Extract (300mg per capsule): - Extract derived from *Crocus sativus*, standardized to contain crocin, crocetin, and safranal., Vitamin C (50mg per capsule): - Ascorbic acid included to enhance absorption and provide antioxidant properties, Bioavailability Enhancer (10mg per capsule): - Piperine, an extract from black pepper, utilized to improve the bioavailability of saffron's active compounds, Vegetable Capsule: - Composed of hypromellose (HPMC) or pullulan, serving as the encapsulating medium for the formulation. Benefits of health products Promotes mood enhancement and cognitive performance. - Exhibits antioxidant and anti-inflammatory properties. - Potentially alleviates stress and anxiety levels. - Contributes to ocular health and visual acuity. - May enhance the quality of sleep.

Conclusion

"To sum up, saffron has become a highly valued and adaptable component in makeup, providing several advantages for skin and hair health. While its hair growth stimulation and scalp-soothing qualities make it a potential component in haircare formulations, its antioxidant, anti-inflammatory, and skin-brightening capabilities make it a great addition to skincare products. The safety and effectiveness of saffron in cosmetic applications are supported by a body of research encompassing traditional usage, *in vitro*, *in vivo*, and clinical investigations. Its bioactive ingredients, such as crocin, work well in a range of cosmetic formulas, which makes it a viable substitute for artificial ingredients. Saffron has the potential to be a key component in the creation of novel, potent, and environmentally friendly cosmetics as the market for sustainable and natural goods grows. Additionally

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