International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 22-02-2026, Accepted: 25-03-2026, Published: 09-04-2026
Volume 11, Issue 2, 2026, Page No. 35-39

Saffron as a biochemical treasure: Applications in skin health and disease

Attamohammad Khorajiya[1*], Salma Fatema musamji[2], Khadija Ambaliyasana[2], Shabbirali Jangrala[1], Kalpna Patel[1]
[1] Assistant Professor, Maktabah Jafariyah College of Science and Technology, Gujarat, India
[2] Research Scholar, Maktabah Jafariyah College of Science and Technology, Gujarat, India

Abstract
Saffron (*Crocus sativus* L.), revered as the "golden spice," is a botanically and pharmacologically rich substance long valued in traditional medicine systems across cultures. This review delves into the multifaceted biochemical profile of saffron particularly its key constituents such as crocin, crocetin, safranal, and picrocrocin and highlights their significant dermatological and pharmacological potential. In cosmetology, saffron exhibits potent antioxidant, anti-inflammatory, photoprotective, anti-aging, and skin-brightening properties, making it a promising agent in natural skincare formulations. Simultaneously, its pharmacological actions span antidepressant, neuroprotective, anticancer, anticonvulsant, and cognitive-enhancing effects, with mounting evidence from preclinical and clinical studies supporting its therapeutic relevance. The review further contextualizes saffron's cultural history, chemical composition, and the mechanisms underlying its biological activities. Through an integrative analysis of traditional applications and emerging scientific insights, this paper underscores saffron's potential as a powerful cosmeceutical and biomedical compound, while also identifying key knowledge gaps for future exploration.

Keywords: *Crocus sativus* L., crocin, crocetin; safranal, skin health, traditional medicine

Introduction

Saffron (*Crocus sativus* L.), often referred to as the "golden spice," is a sterile triploid plant belonging to the Iridaceae family. Primarily cultivated in Iran, India (notably Kashmir), Greece, and Morocco, saffron is derived from the dried stigmas of its flowers, which are meticulously hand-harvested. Renowned for its culinary and coloring properties, saffron also holds significant value in traditional medicine systems—such as Ayurveda, Unani, and Persian medicine—where it has been utilized for over 3,000 years to treat ailments ranging from respiratory disorders to mood disturbances and gastrointestinal conditions [1]. This rich historical legacy underscores its enduring therapeutic relevance.

The pharmacological efficacy of saffron stems from its principal bioactive compounds: crocin, crocetin, picrocrocin, and safranal. Crocin, responsible for saffron's vibrant red hue, exhibits potent antioxidant and neuroprotective effects. Crocetin, a carotenoid, enhances oxygen diffusion and offers cardioprotective benefits. Picrocrocin contributes the characteristic bitter taste, while safranal, a volatile compound, imparts saffron's distinct aroma and is associated with antidepressant and anticonvulsant properties [2, 3]. Collectively, these constituents confer a broad spectrum of biological activities, including anti-inflammatory, anticancer, antidiabetic, antidepressant, and neuroprotective effects, positioning saffron as a promising candidate in biomedical research [4]. Preclinical studies have demonstrated that saffron and its derivatives modulate oxidative stress pathways, cytokine production, neurotransmitter activity, and gene expression, suggesting therapeutic potential in neurodegenerative diseases, cardiovascular disorders, and cancer.

Beyond its medicinal applications, saffron has garnered attention in cosmetology for its antioxidant, anti-inflammatory, skin-brightening, and anti-aging properties. Its bioactive molecules, particularly crocin and safranal, protect skin cells from oxidative damage caused by environmental stressors such as ultraviolet (UV) radiation, pollution, and free radicals [5]. These benefits, supported by both traditional knowledge and emerging clinical evidence, highlight saffron's role as a multifunctional agent in natural skincare and dermo cosmetic innovation.

This review aims to synthesize the pharmacological and cosmetological benefits of saffron, with a focus on its bioactive constituents, mechanisms of action, clinical applications, and potential as a cosmeceutical agent. Additionally, it will explore current research trends and identify knowledge gaps to guide future investigations and product development.

Origin and History

Saffron (*Crocus sativus* L.), a spice native to the Mediterranean region, likely traces its origins to Greece, Asia Minor, and Persia [6, 8]. Its cultivation spans the eastern Mediterranean and beyond, with evidence of widespread use dating back to the Late Bronze Age [9]. For over 3,500 years, saffron has been harvested as a prized spice in Egypt and the Middle East [10]. The domesticated *C. sativus* emerged from its wild progenitor, *C. cartwrightianus*, through human selection for elongated stigmas, resulting in a sterile mutant that appeared during the Late Bronze Age [9]. The Romans later introduced saffron to Great Britain, while Arab traders carried it to Spain, facilitating its spread across Europe [11].

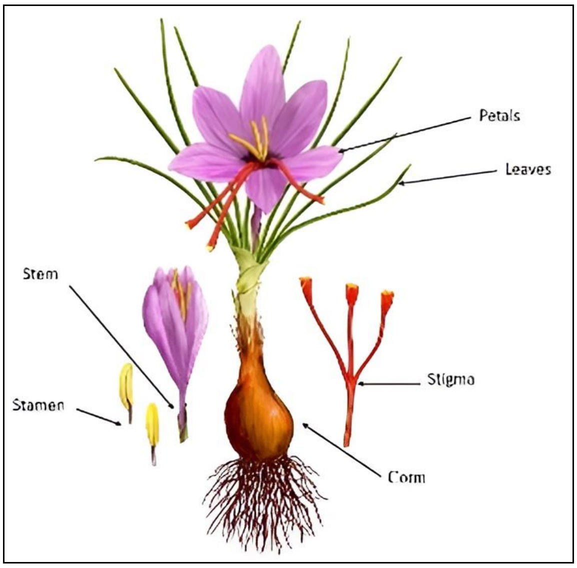
In India, particularly Kashmir—the country's sole commercial saffron-producing region—the timeline of cultivation remains less certain. Historical records suggest saffron farming in Kashmir began around 550 AD, though its introduction is often attributed to Persian influence. Some scholars propose that Persian rulers, seeking to enrich their gardens and parks, transplanted saffron cultivars across their empire, including into India [12]. An alternative theory posits that following Persia's conquest of Kashmir, saffron corms were sown in local soil, yielding a harvest as early as

500 BC [13]. This Persian connection is widely accepted as the foundation of Kashmir's saffron legacy [14]. Local legends further claim that cultivation began in Padampore (now Pampore), approximately 13 km from Srinagar, later expanding to alluvial plateaus in Budgam, Tsrar, and southern Kashmir.

The term "saffron" derives from the French "safran," rooted in the Latin "safranum," which is linked to the Italian "zafferano" and Spanish "azafrán." This etymology traces back to the Arabic "asfar," meaning "yellow," through "zafran," the spice's Arabic name [15]. This nomenclature has permeated most European languages and several non-European ones. The genus name "Crocus" originates from "Corycus," a Greek term tied to a region in Cilicia in the eastern Mediterranean [16]. Together, these linguistic and historical threads underscore saffron's deep cultural and botanical significance.

Chemical Composition of Saffron

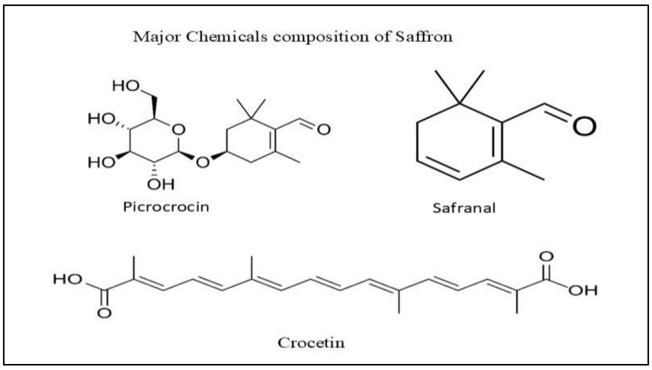
Saffron contains over 150 volatile and aroma-yielding compounds, along with numerous non-volatile bioactive compounds, primarily carotenoids. Its key constituents include crocetin (α-crocetin) and its glycosidic derivatives such as crocin, gentiobioside, and glucoside. Other carotenoids present are β-crocetin, γ-crocetin, α-carotene, β-carotene, lycopene, zeaxanthin, and mangiocrocin. The glycosyl esters of crocetin, particularly crocin ($C_{44}H_{64}O_{24}$), contribute to saffron's strong coloring properties. Additionally, monoterpene aldehydes like picrocrocin ($C_{16}H_{26}O_7$) and its derivative safranal ($C_{10}H_{14}O$) are responsible for saffron's bitter taste and characteristic aroma. These bioactive components are concentrated in the red stigmatic lobes of the saffron flower. Saffron also contains anthocyanins, flavonoids, vitamins (riboflavin and thiamine), amino acids, proteins, starch, minerals, and gums. [16]



Botanical Information of Saffron (*Crocus sativus L.*)
Kingdom: Plantae
Division: Magnoliophyta (Angiosperms)
Class: Liliopsida (Monocots)
Order: Asparagales
Family: Iridaceae
Genus: *Crocus*
Species: *Crocus sativus* L.

Table 1: Chemical Constituents of Saffron

Category	Compounds	Function/Role
Volatile Compounds	Safranal ($C_{10}H_{14}O$)	Responsible for saffron's aroma
Monoterpene Aldehydes	Picrocrocin ($C_{16}H_{26}O_7$)	Contributes to saffron's bitter taste
Carotenoids	Crocetin (α-crocetin)	Precursor of crocin, contributes to pigmentation
	β-Crocetin (monoethyl ester)	Colorant and antioxidant
	γ-Crocetin (dimethyl ester)	Colorant and antioxidant
	α-Carotene, β-Carotene, Lycopene, Zeaxanthin, Mangiocrocin	Color pigments and bioactive compounds
Glycosidic Derivatives	Crocin ($C_{44}H_{64}O_{24}$), Digentiobioside, Gentiobioside, Glucoside, Gentioglucoside, Diglucoside	Strong coloring capacity, water-soluble carotenoids
Other Bioactive Compounds	Anthocyanins, Flavonoids, Vitamins (Riboflavin, Thiamine), Amino acids, Proteins, Starch, Minerals, Gums	Various health benefits and physiological functions



Cosmetology and Perfumery Applications of *Crocus sativus* (Saffron)

Saffron (*Crocus sativus L.*) has a rich legacy of use in traditional medicinal and cosmetic systems across diverse cultures. In traditional Iranian medicine, saffron was applied to improve complexion and treat bacterial skin infections such as erysipelas. Ancient Greek texts describe its use for revitalizing facial skin, alleviating acne, and treating skin wounds. Furthermore, Hindu traditions used saffron as a natural pigment to create the bindi. These applications highlight saffron's enduring value in skincare and beauty rituals.

1. Anti-aging and Treatment of Skin Disorders

Saffron's utility in herbal cosmetics stems from its rich antioxidant profile and traditional use in treating skin imperfections. A blend of saffron strands soaked with basil leaves and mixed with virgin coconut oil, olive oil, or raw milk has been used as a facial exfoliant to enhance blood circulation and address blemishes such as acne. Moreover, saffron's antioxidant content helps alleviate erythema (a condition characterized by skin redness and inflammation) by inhibiting the expression of pro-inflammatory markers like tumor necrosis factor-alpha (TNF-α) and interleukins.

Notably, topical formulations containing 3% *C. sativus* extract have shown potential in the management of melanoma [17].

2. Photoprotective (Anti-UV) Properties

Saffron is recognized for its ability to protect the skin against ultraviolet (UV) radiation damage. Studies indicate that saffron-based lotions may outperform conventional sunscreen agents such as homosalate [17]. The active constituents, crocin and crocetin, exhibit photoprotective activities by preventing UVB-induced cellular damage. Crocetin's efficacy has been specifically validated in *in vitro* studies using human skin-derived fibroblasts [18].

3. Skin Lightening and Pigment Reduction

Saffron contributes to skin lightening by inhibiting melanin synthesis. This process, known as melanogenesis, is regulated by oxidative enzymes, particularly tyrosinase. Antioxidant compounds such as crocin, quercetin, kaempferol, and other monoterpenoids within saffron suppress tyrosinase activity, reducing melanin levels and hyperpigmentation. Clinical use of saffron-infused creams combined with avocado oil has demonstrated improvements in skin elasticity, reduction of wrinkles, and minimization of transepidermal water loss [17].

4. Natural Coloring Agent

The reddish-golden hue of saffron, attributed to its crocin and crocetin content, is utilized as a natural pigment in cosmetics. In Indian culture, saffron is traditionally used to make bindi or sindoor. It is also incorporated as a natural dye in herbal lipsticks and other cosmetic formulations.

5. Perfumery and Aromatic Use

Saffron is a valued fragrance agent due to its complex composition of over 150 volatile aromatic compounds. The key contributor, safranal, forms from the hydrolysis of picrocrocin during drying and storage. This compound imparts saffron's distinctive aroma, making it a prized ingredient in perfumery [17].

6. Face Toner Formulation

Saffron-based facial toners benefit from the synergistic effects of vitamin C, zinc, and flavonoids. Vitamin C acts as a potent antioxidant, zinc regulates sebum production and mitigates acne scars, and flavonoids inhibit melanogenesis, thereby contributing to skin brightness and even tone [18].

Pharmacological Properties of *Crocus sativus*

Saffron has held a revered position in ancient systems of medicine including Ayurveda, Chinese, Greek, Mongolian, and Arabic traditions. Its pharmacological actions span neurological, oncological, antioxidant, and dermatological domains, largely attributed to bioactive compounds like crocin, crocetin, and safranal.

1. Antidepressant Effects

Saffron demonstrates antidepressant efficacy through modulation of neurotransmitters such as serotonin, dopamine, and norepinephrine. The active components crocin and safranal inhibit the reuptake of these neurotransmitters, yielding effects comparable to pharmaceutical antidepressants like imipramine and fluoxetine, yet with fewer side effects [19].

2. Neuroprotection in Parkinson's Disease

Preclinical studies suggest that crocetin enhances the activity of antioxidant enzymes and protects against 6-hydroxy dopamine-induced neurotoxicity, a model of Parkinson's disease. This neuroprotection is vital given the role of oxidative stress in dopaminergic neuronal loss [19].

3. Memory and Cognitive Function

Crocin, a major constituent of saffron, has shown promise in enhancing learning and memory in animal models. Its neuroprotective effects are linked to inhibition of apoptotic pathways, particularly those induced by TNF-α, suggesting therapeutic potential for Alzheimer's and related cognitive disorders [19].

4. Anticancer Activity

Saffron's constituents, especially crocin and crocetin, exhibit antitumor properties by reducing lipid peroxidation and improving antioxidant enzyme function. Studies report that saffron can mitigate histopathological changes in chemically induced lung and hepatic cancers, demonstrating tumor-suppressive effects [19].

5. Antioxidant Potential

Crocin and crocetin, carotenoid compounds found in saffron, scavenge free radicals and mitigate oxidative stress. These properties help preserve cellular integrity and combat age-related and chronic diseases [17].

6. Anticonvulsant Activity

Safranal has shown dose-dependent protection against seizures in PTZ-induced convulsion models. Its activity may involve GABA_A-benzodiazepine receptor modulation, as suggested by antagonism with flumazenil and naloxone. In contrast, crocin does not appear to possess anticonvulsant effects [20].

Table 2 : Application of Saffron in Cosmetic

Application Area	Description	Active Compounds
Anti-Aging & Skin Diseases	Treats acne, blemishes, and erythema; enhances skin tone and circulation; may aid in melanoma management.	Crocin, Safranal, Flavonoids, Vitamin C
Anti-UV Agent	Protects against UVB damage; more effective than some commercial sunscreens.	Crocin, Crocetin
Skin Lightening & Spot Reduction	Inhibits melanin formation by suppressing tyrosinase; rejuvenates and brightens skin.	Crocin, Quercetin, Kaempferol, Monoterpenoids
Natural Coloring Agent	Provides saffron's reddish-gold tint; used in bindi, sindoor, and herbal lipsticks.	Crocin, Crocetin
Perfume/Fragrance	Contains over 150 aroma-producing compounds; safranal is the key fragrant molecule.	Safranal, Picrocrocin-derived volatiles
Face Toner Preparation	Vitamin C acts as antioxidant, zinc controls oil, and flavonoids brighten by inhibiting melanin.	Vitamin C, Zinc, Flavonoids

Table 3: Application of Saffron in Pharmacology

Application Area	Description	Active Compounds
Anti-Depressant	Acts on serotonin, dopamine, and norepinephrine; comparable to fluoxetine without side effects.	Safranal, Crocin
Anti-Parkinson's	Crocetin enhances antioxidant defenses and protects neurons from oxidative stress.	Crocetin
Memory & Learning	Crocin enhances memory, prevents neuron death, and counters neurodegeneration.	Crocin
Anti-Carcinogenic	Crocetin suppresses tumor formation and protects against liver and skin carcinogens.	Crocetin, Crocin
Anti-Oxidant	Crocin and crocetin neutralize reactive oxygen species and protect tissues.	Crocin, Crocetin (Carotenoids)
Anti-Convulsant	Safranal reduces seizures via GABA-A receptor pathways; crocin shows no effect in seizure models.	Safranal

Conclusion

Saffron (*Crocus sativus L.*) emerges as a multifaceted botanical agent with profound implications in both dermatological and biomedical sciences. Its unique phytochemical profile—dominated by crocin, crocetin, picrocrocin, and safranal—offers potent antioxidant, anti-inflammatory, photoprotective, and skin-lightening effects that position it as a valuable component in natural skincare and cosmeceuticals. Additionally, saffron's pharmacological benefits extend into neurology, oncology, and psychiatry, where it demonstrates antidepressant, neuroprotective, and anticancer properties. Traditional knowledge, supported by modern clinical and preclinical evidence, affirms saffron's role not only as a cosmetic enhancer but also as a therapeutic agent. Continued research into its mechanisms and clinical applications will further unlock its potential in integrative dermatology and personalized medicine.

Acknowledgment

We would like to express our sincere gratitude to Maktabah Jafariyah College of Science and Technology for providing us with the necessary academic environment, encouragement, and resources to carry out this review work. We are especially thankful to the Head of the Science Department for their continuous support, motivation, and valuable guidance throughout the preparation of this manuscript. Their constructive suggestions and insightful feedback have been instrumental in enhancing the quality of this review paper.

We also extend our heartfelt appreciation to Mansiya Mohsin Ali for her dedicated assistance with typing and layout, and to Imran Makrani for his valuable insights that contributed meaningfully to the development of this work. lastly, we thank all faculty members and peers for their cooperation and encouragement throughout the course of this work.

References

1. Srivastava R, Ahmed H, Dixit RK, Saraf SA. Crocus sativus L.: a comprehensive review. Pharmacognosy reviews,2010:4(8):200.
2. Mahmoud FF, Al-Awadhi R, Haines DD, Dashti A, Dashti H, Al-Ozairi E, et al. Sour cherry seed kernel extract increases heme oxygenase-1 expression and decreases representation of CD3+ TNF-α+ and CD3+ IL-8+ subpopulations in peripheral blood leukocyte cultures from type 2 diabetes patients. Phytotherapy Research,2013:27(5):767-774.
3. Khazdair MR, Boskabady MH, Hosseini M, Rezaee R, Tsatsakis AM. The effects of *Crocus sativus* (saffron) and its constituents on nervous system: A review. Avicenna journal of phytomedicine,2015:5(5):376.
4. Bathaie SZ, Mousavi SZ. New applications and mechanisms of action of saffron and its important ingredients. Critical reviews in food science and nutrition,2010:50(8):761-786.
5. Nam KN, Park YM, Jung HJ, Lee JY, Min BD, Park SU, et al. Anti-inflammatory effects of crocin and crocetin in rat brain microglial cells. European journal of pharmacology,2010:648(1-3):110-116.
6. Vavilov NI, Ed. The origin, variation, immunity and breeding of cultivated plants, Translated from Russian by Chester KS; The Ronald Press Company: New York, 1951, 364.
7. Bowels EA, Ed. A handbook of Crocus and Colchicum for gardeners; Bodley Head, London, 1952, 222.
8. Skrubis B. In The cultivation in Greece of *Crocus sativus* L, Proceedings of the international conference on saffron (*Crocus sativus* L.) L' Aquila, Italy, 27–29 October, 1989; Tammaro F; Marra L; Eds.; Universita Degil Studi L' Aquila e Academia Italians della Cucina, L' Aquila: Italy, 1990,171–182.
9. Negbi M. Saffron cultivation: past, present and future prospects. In Saffron: *Crocus sativus* L.; Negbi M; Ed.; Harwood Academic Publishers: Amsterdam, The Netherlands, 1999, 1–18.
10. Fernandez JA. Biology, biotechnology and biomedicine of saffron. Recent Res. Dev. Pl. Sci.,2004, 2, 127–159.
11. The Royal Horticultural Society. Plants of current interest, 2003. http://212.78.71.150/gardens/wisley/archive/wisleypcisept.asp. (accessed 6 December 2006).
12. Dalby A, Ed. Dangerous Tastes: The Story of Spices; University of California Press: Berkely, CA;2002; 256.
13. McGee HJ, Ed. On Food and Cooking: The Science and Lore of the Kitchen; Press Scribner: New York, NY, 2004, 896.
14. Singh GC, Dhar U. Origin of Kashmir saffron- a possible clue from weeds. Science and Culture,1976:42:485–487.
15. In Wikipedia. http://en.wikipedia.org/wiki/saffron (accessed 15 November 2006).
16. Kumar R, Singh V, Devi K, Sharma M, Singh MK, Ahuja PS. State of art of saffron (*Crocus sativus* L.) agronomy: A comprehensive review. Food Reviews International,2008:25(1):44-85.
17. Mzabri I, Addi M, Berrichi A. Traditional and modern uses of saffron (*Crocus sativus*). Cosmetics,2019, 6, 63.
18. Damayanti GS, Riyanto P. Literature Review: The Role of Saffron (*Crocus sativus* L) in Cosmetic

Dermatology. Jurnal Kedokteran Diponegoro (Diponegoro Medical Journal),2023:12(6):375-382.

19. Bhargava V. Medicinal uses and pharmacological properties of *Crocus sativus* Linn (Saffron). Int. J. Pharm. Pharm. Sci,2011:3(3):22-26.
20. Rajabian A, Hosseini A, Hosseini M, Sadeghnia HR. A review of potential efficacy of Saffron (*Crocus sativus* L.) in cognitive dysfunction and seizures. Preventive Nutrition and Food Science,2019:24(4):363.