Pharmacogn. Res., 2025; 17(4):1163-1170.
https://www.phcogres.com

Review Article

A Comprehensive Review of *Crocus sativus* L.: Botanical Characteristics, Phytochemical Composition, and Therapeutic Applications

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ABSTRACT

Known as saffron (syn. Kesar), *Crocus sativus* L., a member of the Iridaceae family, is mostly grown in Iran, though it is also grown in India and Greece. It is made from the dried red stigmas of the flower. Terpenes, terpene alcohols, and their esters make up the majority of the more than 150 volatile and aromatic substances that this plant produces. Picrocrocin and safranal are responsible for the characteristic bitter taste and hay-like or iodoform-like scent of saffron, respectively. Anti-hypertensive, anti-convulsant, anti-tussive, anti-genotoxic, cytotoxic, anxiolytic, aphrodisiac, antioxidant, anti-depressant, anti-nociceptive, anti-inflammatory, and smooth muscle relaxant properties are only a few of the many pharmacological activity that *Crocus sativus* demonstrated. Additionally, it has been demonstrated to improve cognitive abilities including memory and learning as well as ocular perfusion by boosting blood flow to the retina and choroid. The historical use, phytochemical profile, pharmacodynamic characteristics, medicinal uses, possible adulterants and replacements, and toxicity data related to *Crocus sativus* L. are all extensively examined in this extensive review. In addition, it covers the qualitative chemical tests, pharmaceutical formulations, and analytical assessment that are relevant to its standardization and quality control.

Keywords: Anticonvulsant, Antinociceptive, Aphrodisiac, Crocin,*Crocus sativus*, Safranal.

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Received: 09-05-2025;
Revised: 14-07-2025;
Accepted: 22-09-2025.

INTRODUCTION

Saffron, or *Crocus sativus* L. (family Iridaceae), is a perennial, stemless geophyte that is widely grown in Iran and other places including India and Greece.[1] The dried crimson stigmas, which frequently retain a tiny amount of the golden style, are the plant's commercially valuable part. According to historical records, saffron cultivation began around 2300 BCE. The oldest documented mention of it is ascribed to the Akkadian monarch Sargon, who was said to have been born in the settlement of Azupirano, which translates to "Saffron Town," on the banks of the Euphrates.[2] Frescoes found in the Palace of Knossos on the island of Crete provide a more certain identification of the saffron crocus, which dates back to the Minoan culture (c. 1700-1600 BCE).[3]

It is thought that Crocus Cartwrightian us is the wild ancestor of cultivated *C. sativus*. Most people agree that the earliest official record of saffron was found in an Assyrian botanical compendium that King Ashurbanipal created in the 7th century BCE. Historical and archaeobotanical documents indicate that it was used medicinally for more than 90 different conditions during a period of around 4,000 years.[4]

According to botany, *Crocus sativus* L. flowers in October and produces leaves from October to May. Three stigmas, or the terminal parts of the carpels, are present in the plant's hermaphrodite blooms, which are pollinated by bees and butterflies.[5] These stigmas, together with the style, are gathered and dried for use in food and medicine. Certain edaphic and climatic conditions are necessary for saffron cultivation, which thrives in light to medium-drained soils, especially those with low nutrient content.[6] Significantly adding to its economic importance is the fact that saffron blossoms just once a year and can only be harvested within a limited window of three to four weeks in October to November.[7]

Since *Crocus sativus* L. is a sterile triploid that cannot reproduce sexually or produce viable seeds, it is propagated vegetatively by corms. When feasible, seed germination takes place over a long

DOI: 10.5530/pres.20252301

length of time (1-6 months) at around 18ºC, and it takes about three years for seeds to blossom.[8]

The presence of picrocrocin and safranal gives saffron its distinctive bitter taste and hay- or iodoform-like aroma, which are attributed to its organoleptic properties. The concentration of three main secondary metabolites-crocin, which gives it its color-picrocrocin, which gives it its taste, and safranal, which gives it its aroma-largely determines its pharmacological and commercial value.[9,10]

Saffron is used as an antidepressant in traditional Persian medicine. Similar to this, stigmas (pistils) are used in Ayurvedic and other traditional Indian medicinal systems for their analgesic, cardioprotective, and neurotherapeutic qualities, which include treating mental illnesses.[11] Crude extracts of saffron stigmas have been shown in experiments to increase learning and memory in animal models and to aid cognitive recovery in ischemia/reperfusion models. Furthermore, many traditional medical systems have traditionally valued saffron as an aphrodisiac.[12]

Scientific Classification

Kingdom: Plantae.

Division: Magnoliophyta.

Class: Liliopsida.

Order: Asparagales.

Family: Iridaceae.

Genus: Crocus.

Species: *C. sativus*.[12]

Synonyms

Hindi - kesar, zaffran;[13] Sanskrit - avarakta, saurab, mangalya, agnishikha, kumkuma, mangal, kusrunam; English- saffron; Arab and Persian - zafrah, zipharana; Ben - jafran; Bom - safran, kessar; Mah - kecara; Guj - keshar; Tel - kunkuma-purva, kunkumma-purru; Tam. and Mal. - kunkumappu; Can. and Kon. - kunkuma-kesara; Fr.and Ger. - safran.

Macroscopy

Crocus sativus L. has a deep-colored stigma that ranges from dark red to reddish-brown, and a style that has colors that range from yellowish-brown to yellowish-orange.[14] *Crocus sativus* L.'s dried stigmas have a powerful, distinctive, and fragrant smell. The flavor is distinctive and somewhat bitter.[15] In terms of morphology, the styles are around 10 mm long and the stigmas are about 25 mm long. The style has a cylindrical form, while the stigma has a trifid structure.[16]

Microscopy

The stigmas can be seen as distinct structures or grouped in groups of three at the apex of the yellowish styles when the soaking medication is seen under a microscope or magnifying lens. Each stigma is around 25 mm long and has the appearance of a thin, funnel-shaped structure with a distinctively dentate or fimbricate rim.[17]

Chemical Constituents

A wide range of physiologically active components have been isolated and characterized as a result of the many phytochemical and biochemical studies conducted on *Crocus sativus* L. (saffron) due to its many therapeutic uses (Tables 1 and 2).[18] Crocin, which gives saffron its vibrant color; picrocrocin, which gives it its characteristic bitter taste; and safranal, which gives it its distinct scent and smell, are the main characteristic constituents of saffron (Figure 1).[19]

In addition to a range of non-volatile bioactive components, many of which are members of the carotenoid family, such as zeaxanthin, lycopene, and different forms of α- and β-carotene, saffron has more than 150 volatile and aroma-contributing ingredients.[20] Terpenes, terpene alcohols, and their esters make up the majority of the volatile fraction's more than 34 constituents, which are distinguished by their powerful, pervasive smell.[21]

Crocins, which are hydrophilic carotenoids, are an essential component of the non-volatile components and give the stigmas their crimson to reddish-brown coloration. Other carotenoids including carotenes and crocetin accompany them.[22] Safranal is the main organoleptic ingredient that gives saffron its distinctive scent, whereas picrocrocin, a glycosidic precursor of safranal, is largely responsible for the spice's bitterness.

Chemically known as the trans-crocetin di-(β-D-gentiobiosyl) ester, α-crocin is primarily responsible for the golden yellow-orange hue of saffron. Its systematic (IUPAC) name is 8,8-diapo-8,8-carotenoic acid. α-Crocin is a digentiobiose ester of crocetin, an oil-soluble, hydrophobic conjugated polyene dicarboxylic acid.[23] The resultant crocin is water-soluble after being esterified with two water-soluble gentiobiose molecules, which makes it perfect for coloring aqueous food matrices like rice-based foods. Interestingly, α-crocin can make well over 10% of saffron's dry weight.[24]

One molecule of crocin and two molecules of picrocrocin are produced when protocrocin, a hypothesized precursor molecule, breaks down during the fresh plant's drying process.[25] While picrocrocin breaks down into glucose and safranal, crocin hydrolyzes to yield gentiobiose and crocetin.[26]

Picrocrocin ($C_{16}H_{26}O_7$), with the systematic name *4-(β-D-glucopyranosyloxy)-2,6,6-trimethylcyclohex-1-ene-1-carboxaldehyde*, is a conjugate of an aldehydic moiety (safranal) and

a carbohydrate unit.[27] Besides imparting bitterness, picrocrocin exhibits insecticidal and pesticidal activities and may comprise up to 4% of dry saffron by weight. Safranal, comparatively less bitter than picrocrocin, may account for as much as 70% of saffron's volatile fraction in certain samples.[28] Another compound contributing to saffron's complex scent profile is *2-hydroxy-4,4,6-trimethyl-2,5-cyclohexadien-1-one*, often described as imparting a "saffron- or dried hay-like" aroma.[29]

Research using callus cultures fed with uridine-diphosphoglucose and maintained at pH values between 7.0 and 7.6 has shown that all-trans-crocetin bio transforms into its equivalent glycosides.[30] Furthermore, the callus stem tissue of *Crocus sativus* L. has yielded 3,8-dihydroxy-1-methylanthraquinone-2-carboxylic acid, a strong antioxidant that inhibits linoleic acid oxidation more well than vitamin E. Saffron must be stored in sealed containers to prevent deterioration caused by atmospheric oxygen since exposure to changing pH, light, and oxidative conditions compromises its chemical stability.[31]

Pharmacologically, *Crocus sativus* L. has shown antidepressant qualities, which are mainly ascribed to the effects of safranal and crocin. Additionally, preliminary phytochemical screens indicate that the high levels of flavonoids, tannins, and anthocyanins in saffron flower extracts may influence their antinociceptive and anti-inflammatory properties. Numerous bioactive flavonoids, such as rutin, quercetin, luteolin, hesperidin, and other bioflavonoids, have been found in saffron, according to additional research.[32]

Pharmacological Actions

Antihypertensive properties

The cardiovascular effects of *Crocus sativus* L. petal extracts were examined by Fatehi and associates. They assessed the extracts' effects on blood pressure in anesthetized rats and on neuromuscular responses in the guinea pig ileum and isolated rat vas deferens under Electrical Field Stimulation (EFS).[33] It was discovered that *Crocus sativus* L. petal extracts, both aqueous and ethanolic, reduced systemic blood pressure in a dose-dependent manner. In particular, when 50 mg/kg of the aqueous extract was administered, the mean arterial pressure significantly decreased from 133.5±3.9 mmHg to 117±2.1 mmHg. Although peripheral vascular effects seem to prevail, it is speculated that this hypotensive effect results from a direct impact on heart function, a decrease in total peripheral resistance, or a mix of the two.[34]

The petal extracts considerably reduced the contractile responses brought on by EFS in isolated rat vas deferens preparations. ATP and noradrenaline, which function as co-transmitters from sympathetic nerve terminals, are the main mediators of these contractions. Furthermore, compared to the aqueous extract, the ethanolic extract produced a more noticeable inhibitory effect on EFS-induced contractions in the guinea pig ileum and rat vas deferens, indicating that ethanol may extract more potent or bioavailable active constituents from *Crocus sativus* L. petals.[35]

Anticonvulsant properties

In a mouse model of seizures brought on by Pentylenetetrazol (PTZ), the anticonvulsant qualities of safranal and crocin, the two main components of *Crocus sativus* L. stigmas, were assessed. Safranal administered intraperitoneally at dosages of 0.15 and 0.35 mL/kg considerably decreased seizure duration, postponed the beginning of tonic convulsions, and protected mice against seizure-induced death. Conversely, in the identical experimental circumstances, crocin given intraperitoneally at a dosage of 22 mg/kg did not show any discernible anticonvulsant action.[36]

Antitussive properties

A 20% citric acid aerosol-induced cough model in guinea pigs was used to evaluate the antitussive properties of *Crocus sativus* L. stigma and petal extracts, as well as its main components safranal and crocin. The frequency of coughing episodes was considerably decreased by administering safranal (at dosages of 0.25 to 0.75 mL/kg) and the ethanolic extract of *Crocus sativus* L. stigmas (at doses ranging from 100 to 800 mg/kg). Conversely, under the same experimental circumstances, neither crocin nor the ethanolic or aqueous extracts of *Crocus sativus* L. petals showed any discernible antitussive effect.[37]

Saffron's cytotoxic and antigen-ototoxic properties

Using the Ames/Salmonella assay, two well-known mutagens, Benzo[a]Pyrene (BP) and 2-Aminoanthracene (2-AA), and the *in vitro* colony-forming assay, the antimutagenic, comutagenic, and cytotoxic characteristics of *Crocus sativus* L. were assessed in four different human cell lines: one normal (CCD-18LU) and three malignant (HeLa, A-204, and HepG2). Saffron showed no mutagenic or antimutagenic efficacy against BP-induced mutagenesis using the TA98 strain in the Ames test.[38] However, in the setting of 2-AA-induced mutagenicity, it showed a dose-dependent co-mutagenic impact, which is mainly ascribed to the presence of safranal.[39] Saffron preferentially inhibited malignant cell types in the *in vitro* colony-forming experiment, sparing healthy cells in the process. Additionally, saffron's separated carotenoid components had lethal effects on tumor cells; crocin derivatives in particular showed a strong suppression of the development of tumor cell colonies.[40] All of these results point to the possible chemo preventive effects of saffron and its carotenoid constituents against cancer.

Impact on sexual conduct

Male rats were used to test the aphrodisiac effects of *Crocus sativus* L. stigma aqueous extract and its main ingredients, crocin and safranal. Safranal (0.1, 0.2, and 0.4 mL/kg body weight), sildenafil (60 mg/kg body weight; positive control), crocin (100, 200, and 400 mg/kg body weight), aqueous extract (80, 160, and

320 mg/kg body weight), or saline (vehicle control) were all given intraperitoneally to the animals. Quantitative evaluations were conducted on sexual behavior measures, including Ejaculation Latency (EL), Mount Latency (ML), Intromission Latency (IL), and Mounting Frequency (MF). At all tested dosages, crocin and the aqueous extract at 160 and 320 mg/kg resulted in a substantial increase in MF, IF, and EF while simultaneously decreasing ML, IL, and EL. Conversely, there was no discernible aphrodisiac effect from safranal. These results support the aphrodisiac properties of crocin and *Crocus sativus* L. aqueous extract, indicating its potential use in treating sexual dysfunction.[41]

Anxiolytic activity

This study aimed to evaluate the potential anxiolytic effects of crocins in rodents. To this end, the light/dark test paradigm was employed. Rats were administered crocins (50 mg/kg), a dose shown not to affect motor activity, or diazepam (1.5 mg/kg) as a positive control.[42] Both crocins and diazepam significantly increased the latency to enter the dark compartment and extended the time spent in the lit chamber, indicative of anxiolytic activity. In contrast, lower doses of crocins (15-30 mg/kg) did not produce any substantial alterations in behavior. These findings suggest that crocins, active constituents of *Crocus sativus* L., exhibit anxiolytic-like effects in the rat model.[43]

Calm property

The β-adrenergic activity of aqueous-ethanolic extracts of *Crocus sativus* L. (Iridaceae) and its component, safranal, was evaluated in guinea pig tracheal chains in order to clarify the processes behind the relaxing effects of the plant. By creating cumulative concentration-response curves of isoprenaline-induced relaxation in pre-contracted isolated tracheal chains, the β2-adrenergic stimulatory effects were assessed.[44] Two quantities of *Crocus sativus* L. aqueous-ethanolic extract (0.1 and 0.2 g%), safranal (1.25 and 2.5 µg), 10 nM propranolol, and saline were all included in the experimental solutions. Two conditions were used for the study: tissues that were not incubated (group 1, n=9) and tissues that were treated with 1 µM chlorpheniramine (group 2, n=6). In comparison to saline controls, the results showed notable changes to the left in the isoprenaline curves when the greater extract concentration was employed in group 1 and with both concentrations in group 2. When both extract concentrations (0.17±0.06 and 0.12±0.02) and safranal concentrations (0.22±0.05 and 0.22±0.05) were present in group 1, as well as the extract concentrations in group 2 (1.16±0.31 and 0.68±0.21), the EC_{50} values (the concentration of isoprenaline needed to induce 50% of the maximum response) were significantly lower than those found in tissues treated with saline. Furthermore, group 1's maximal reactions were substantially less than those of saline when both extract concentrations and safranal were present. These results imply that safranal contributes to the strong stimulatory impact of *Crocus sativus* L. extract on β2-adrenoreceptors. Additionally, the information suggests that the plant may have an inhibitory impact on Histamine (H1) receptors.[45]

Impact on depression

In a 6-week, double-blind, placebo-controlled, randomized study, the effectiveness of *Crocus sativus* petal extract as a therapy for mild-to-moderate depression was assessed. The study included forty adult outpatients who were diagnosed with serious depression as defined by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). For the course of the experiment, participants were randomized to receive either a placebo (Group 2) or 30 mg/day of *Crocus sativus* L. petal extract (Group 1).[46] *Crocus sativus* L. petal extract outperformed the placebo on the Hamilton Depression Rating Scale at the 6-week endpoint by a substantial margin (d.f.=1, F=16.87, p<0.001). There were no appreciable variations in the frequency of adverse effects between the two groups. According to these results, mild-to-moderate depression can be effectively managed with *Crocus sativus* L. petal extract. Subsequent first studies revealed that *Crocus sativus* L. has antidepressant properties similar to fluoxetine's in the treatment of depression. The antidepressant activity of *Crocus sativus* L. petals, a less expensive substitute for saffron made from the stigma, has also been emphasized by recent preclinical research, indicating its clinical significance for economical treatment methods.[47]

Effect on learning behaviour and long-term potentiation

In animal models with ethanol-induced learning and memory deficits, the treatment of saffron extract and its main bioactive components, crocin and crocetin, has been demonstrated to improve memory and cognitive function. Therefore, saffron taken orally may present a viable therapeutic strategy for the treatment of neurodegenerative diseases and related cognitive impairments.[48]

Impacts on retinal function and ocular blood flow

It has been shown that crocin analogues derived from *Crocus sativus* considerably improve blood flow in the retina and choroid, aiding in the restoration of retinal function. These

Table 1: Chemical composition of saffron.[18]

Component	Mass percentage
H20	19.0-14.0
Polypeptides	11.0-14.0
Cellulose	4.0-7.0
Lipids	3.0-8.0
Minerals	1.0-1.5
Miscellaneous Non-nitrogenous	40.0
Carbohydrates	12.0-15.0

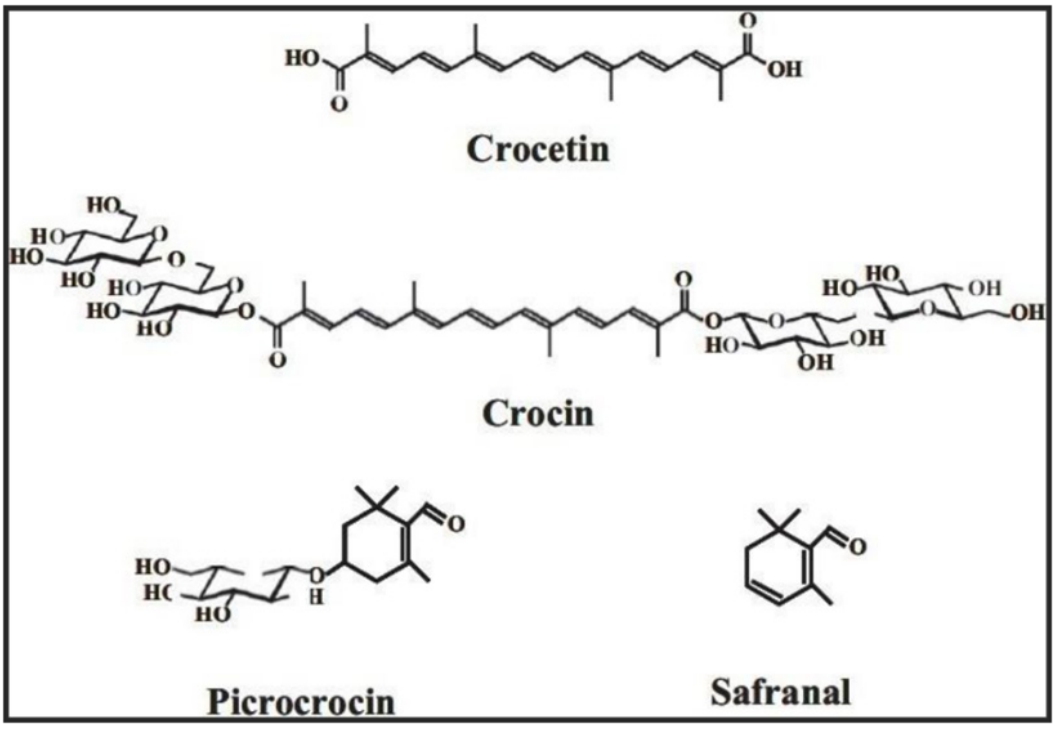

Figure 1: Structures of the chemical constituents.[19]

findings imply that crocin analogs may have therapeutic value in the management of age-related macular degeneration and ischemic retinopathy.[49]

Implication for coronary heart disease

When administered twice daily to human subjects, 50 mg of saffron dissolved in 100 mL of milk significantly decreased the susceptibility of lipoproteins to oxidation in individuals suffering from Coronary Artery Disease (CAD). These results highlight saffron's potential as a strong antioxidant in the treatment of heart disease.[49]

Antinociceptive and anti-inflammatory properties

In chemically generated pain models, extracts from *Crocus sativus's* stigma and petals showed strong antinociceptive effects in addition to acute and/or long-term anti-inflammatory action. The presence of bioactive substances such flavonoids, tannins, anthocyanins, alkaloids, and saponins is probably what causes these pharmacological effects.[50]

Uses

Saffron in medicine

Around 1550 B.C.,[51] the Ebers Papyrus mentions using saffron to heal renal problems. It was advised to be added to meals as a "cheering cardiac medicament," but because of its appetite-suppressant properties, excessive use was discouraged. Saffron has been shown to increase appetite and reduce headaches and hangovers when taken in moderation. Saffron is used nowadays as a nerve relaxant, carminative, diaphoretic, emmenagogue, and treatment for liver enlargement, melancholia, and catarrhal infections. Following instances of deaths, when death occurred after ingesting 1.5 g of saffron, its usage as an abortifacient decreased. According to recent studies, saffron contains over 100 μg/g of riboflavin, making it one of the richest known sources of the vitamin. Furthermore, by lowering blood cholesterol levels by half and counteracting the decreased oxygen diffusivity brought on by high plasma protein and cholesterol levels, saffron may lessen the severity of atherosclerosis. It has been demonstrated that adding crocetin to a nutrient fermentation broth increases the production of antibiotics and other beneficial compounds. The antidepressant, anti-inflammatory, anti-tumor, radical-scavenging, and cognitive-enhancing qualities of saffron and its components have been confirmed by pharmacological research. Additionally, saffron extract has chemoprotective qualities that protect mice from oxidative stress brought on by genotoxin. In mouse models of Maximum Electroshock (MES) and Pentylenetetrazol (PTZ), anticonvulsant effects have also been reported.

Saffron as dye

Saffron has historically been used for a variety of purposes, such as dyeing fabrics and clothing. It is best known for its unique pigment, α-crocin, which is a water-soluble carotenoid. Since ancient times, saffron's deep yellow-orange color has been used to dye textiles. Additionally, because of its vibrant and consistent coloring, saffron has been used as a histology stain, especially for connective tissue. Such applications of saffron demonstrate its

Table 2: Proximate analysis of saffron.[18]

Component	Mass percentage
Water soluble components	53.0
Gums	10.0
Pentosans	8.0
Pectins	6.0
Starch	6.0
a- Crocin	2.0
Carotenoids	1.0
Lipids	12.0
Non-volatile oils	6.0
Volatile oils	1.0
Protein	12.0
Inorganic matter ("ash")	6.0
HCI soluble ash	0.5
Water	10.0
Fiber (crude)	5.0

importance not only in medical and culinary contexts but also in scientific research and the textile industry.[52]

Saffron as a fragrance

When saffron is dried, safranal, a delightfully scented chemical, is created. Picrocrocin, the bitter substance found in the fresh stigma, is probably what caused this change through enzymatic or thermal dissociation. The distinctive scent of saffron, which contributes to its distinct sensory profile, is caused by the formation of safranal. Saffron is frequently used in cooking because of its vivid color, unique scent, and delicate flavor. In many different cuisines, but especially in Indian, Middle Eastern, and Mediterranean dishes, it is a highly valued spice.[52] Rice dishes, soups, stews, sauces, and desserts frequently use saffron, which adds color and a delicious flavor. Its use in cuisine is linked to luxury and sophisticated cooking, and it also adds to a rich cultural legacy.[53]

Chemical Tests

A number of tests are required by the United States Pharmacopeia (U.S.P.) to determine the quality of saffron. It states that the yellow styles must not be present in saffron. Saffron should leave no greasy trace when squeezed between filtering paper. It should give the saliva a rich orange-yellow hue when chewed.[54] Saffron should not leave behind any mineral or pulverulent material when soaked in water, nor should it show any organic materials that don't take on the proper form. The liquid should turn a clear yellow when one part saffron is mixed with 100,000 parts water.[55] Furthermore, benzine agitated with saffron should not acquire any color, signifying the lack of picric acid and other coal-tar products. Saffron should not lose more than 14% of its weight when dried at 100°C (212°F), indicating that no additional moisture was introduced. Additionally, no more than 7.5% ash should be left over after burning dried saffron with unrestricted airflow, guaranteeing that no foreign inorganic materials are present.[56]

CONCLUSION

Saffron (*Crocus sativus* L.) is a historically and pharmacologically significant plant prized for its unique organoleptic and therapeutic properties. Cultivated for over four millennia, saffron is not only one of the most valuable spices but also a potent source of bioactive compounds with a wide array of medicinal benefits. Its pharmacological effects—ranging from antidepressant, anxiolytic, anticonvulsant, and antitussive activities to cardiovascular, cognitive, and reproductive health support—are largely attributed to its primary constituents: crocin, picrocrocin, and safranin. These compounds impart Safran's distinct colour, taste, and aroma while contributing to its therapeutic efficacy. Scientific investigations support its use in traditional medicine and suggest its promise as a complementary or alternative treatment for various conditions including depression, neurodegenerative disorders, and cardiovascular diseases. Given its rich phytochemical profile and multifaceted pharmacological actions, saffron stands as a valuable natural product warranting further clinical research and integration into modern therapeutic regimes.

ABBREVIATIONS

IUPAC: International Union of Pure and Applied Chemistry; **H_2O:** Water; **HCl:** Hydrochloric Acid; **EFS:** Electrical Field Stimulation; **EL:** Ejaculation Latency; **ML:** Mount Latency; **IL:** Intromission Latency; **MF:** Mounting Frequency; **DSM:** Diagnostic and Statistical Manual; **CAD:** Coronary Artery Disease; **MES:** Maximum Electroshock; **PTZ:** Pentylenetetrazol; **USP:** United States Pharmacopeia.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

SUMMARY

Saffron, derived from the dried stigmas of *Crocus sativus* L., is a highly valued spice known for its medicinal, culinary, and economic significance. Indigenous to regions like Iran, India, and Greece, saffron has been cultivated since at least 2300 BCE. As a sterile triploid plant, *C. sativus* is propagated vegetatively by corms and flowers once annually, requiring specific soil and climatic conditions. Its pharmacological value lies in three key compounds: crocin (color), picrocrocin (taste), and safranal (aroma), which also contribute to its therapeutic potential. Extensive studies highlight saffron's diverse pharmacological actions, including antidepressant, anticonvulsant, anxiolytic, antitussive, antihypertensive, and aphrodisiac effects. Saffron

also exhibits anti-inflammatory, antioxidant, and anticancer properties. Crocin and safranal, its primary active constituents, have been shown to improve memory, reduce anxiety, support cardiovascular health, and inhibit tumor cell growth. Additionally, saffron's volatile and non-volatile constituents include over 150 bioactive compounds, many of which belong to the carotenoid family. Clinical trials confirm saffron's efficacy in treating mild-to-moderate depression, showing results comparable to fluoxetine. Traditional medicine systems, including Persian and Ayurvedic, have long used saffron for mental, sexual, and neurological health. Due to its complex chemical profile and therapeutic properties, saffron continues to garner attention in modern pharmacological research.

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Cite this article: Sharma M, Brahmbhatt HK, Sen AK. A Comprehensive Review of *Crocus sativus* L.: Botanical Characteristics, Phytochemical Composition, and Therapeutic Applications. Pharmacog Res. 2025;17(4):1163-70.