ETHNO MEDICINAL, PHYTOCHEMICAL AND PHARMACOLOGICAL PROPERTIES OF *CROCUS SATIVUS* (SAFFRON)

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Saffron is cultivated in the less confined limited geographical area in the Jammu and Kashmir. It is used in treating various diseases due to many medicinal values. Saffron is linked with the Kashmiri cuisine that is traditionally being used and embodies the rich cultural heritage of the region. In Kashmir saffron cultivation is peculiar and it is a legenary crop of the well-drained fields of Pampore, Jammu and Kashmir. It is famous for production of the very high quality saffron. It also interests both scientists and consumers due to its immense value in both spices and medicinal properties. Although, in the recent trends, India ranks second only after Iran in terms of both area and production, but also ranks fifth in terms of productivity among all the top seven saffron producing countries of the world. However, Saffron production is currently suffering on several counts, falling productivity and unscientific post-harvest management are the major concerns. Some other factors that are responsible for the decline of saffron industry in Kashmir are, lack of availability of good-quality corms as seed material, poor soil fertility, lack of assured irrigation, infestation by rodents and diseases, poor post-harvest management, improper marketing facilities and increased urbanization on saffron lands. This legendary crop is under threat of extinction and warrants collective attention of researchers, farmers and policy makers. So, the aim of the present review paper is to collect complete report of the status, distribution, and uses of saffron from different region of Jammu and Kashmir.

Keywords: *Crocus sativus*, Ethnobotany, Iridaceae, J&K, India

India is one of the richest ethnobotanical hub in the world. Its rich diversity is yet have to be fully documented, utilized and conserved different medicinal plant species. Saffron has been a significant constit Quent formula of our prehistoric physicians and homoeopaths in the field of Indian systems of medicine. More than 86 species of saffron are distributed around the Mediterranean region to Indian subcontinent. The Jammu and Kashmir are one of the top saffron (*Crocus sativus*) growing regions of the world. History of Saffron in Kashmir valley was first mentioned in 'Rajatarangini', written by Kalhana, a 12th century poet even before the reign of King Lalitaditya in 750 AD.

It is commonly known as Kesar, Kumkum in Sanskrit and in Kashmiri language it is commonly known as 'Koung'. Saffron is grown uparound an altitude of 1585 to 1677 m above mean sea level under temperate climatic conditions in Kashmir. In Kashmir, soil is heavy textured consists of silty clay loam as the predominant texture in upper horizons and silty clay in lower horizons. The soils are calcareous in nature with average organic carbon and calcium carbonate contents of 0.36 and 4.5%, respectively. The soil is slightly alkaline with pH ranging from 6.2 to 8.0 and with electrical conductivity between 0.08dsm⁻¹ and 0.32dsm⁻¹. Higher yields coincide with higher pH values. Saffron is the most valuable and most expensive plant species in the world. Its filaments are infact the dried stigmas of the saffron flower. The qualities of saffron are all dependent on its colouring power (crocin concentration), odour (safranal) and taste (picrocrocin). The high safranal content are responsible for best quality of saffron. Essential oils are responsible for its all therapeutic properties (Sujata et al. 1992). This plant species shows an active growth from autumn season to late spring season and also survives the summer drought. Saffron is bulbous in nature, autumn flowering and perennial characteristics belong to Iris family (Dhar et al. 1988). Flowers of the Saffron have three bright, orange-red stigmas which are mainly considered as true saffron. Saffron
contains about 0.4 to 1.0 percent of essential oils in which the principal component is picrocrocin. Saffron is commercially cultivated in a very short confined area of Kashmir valley, mainly in Pampore district on the right banks of the river Vitasta (also called as river Jhelum) about a distance of 12 km from Srinagar. Apart from the Pampore district, the saffron is also grown in large area at Kishwara district of Jammu region (Nauriyal and George 1977). Saffron has a variety of medicinal and therapeutic properties and various studies has reported its role to cure diseases in traditional prescriptions including in different Chinese, Unani and Ayurveda medicines (Kamalipour et al. 2011). Gohari et al. (2013) also reported some vital medicinal role of saffron such as sedative, anti-asthma, expectorant, emmenagogue and apoptogenic agent. Husaini et al. (2013) reported the major saffron producing regions of the world as Iran, Spain and Kashmir. In the Kashmir valley total cultivated region covers nearly 4% and approximately 16% of aggregate agricultural income is generated by saffron (Anonymous, 2008). Contributing greatly to agricultural economy. It is one of the best quality saffron in the whole world due to its rich flavour and colour and has been normally used in the well-known Kashmiri Cuisine and has been in good demand since long (Chand 2005). In Economy of the India, agriculture has a key role and always has been occupied a place of pride and honour (Dhar et al. 1997, Escribano et al. 2000). This plant is the one of the most expensive cultivated herb in the world (Saeidnia 2012). The word saffron is firstly originated from the French term “Safran”, which has been derived one from the Latin word “safranum” and comes secondly from the Arabic word “Zafaran” that means yellow (Evans 1997, Harper 2006, Mozaffarian 1997). Botanists have been documented that in Achemenian Imperial court that saffron was used in food or as spicy plant product for cooking purposes (Abrishami 1997). The plant has underground parts called corms or bulbs; this plant has no seed production and can be used for vegetative saffron propagation. The wonderful characteristic of the coloured

![Figure 1: Map showing geographical location of Saffron cultivation, Map Source: J&K ENVIS Newsletter](image-url)
flowers of saffron is three stigmas (approximately 25-30 mm long), over the petals. Each bulb can produce one to seven flowers. It has been reported that the cultivated species has originated basically as a natural hybrid so that it can be selected for its long stigmas and maintained. The flower of saffron is a light purple, but it has present the thread like reddish-coloured stigmas that is valued both as a spice and as well as natural colorant. It takes almost 35,000 flowers to yield just 1 pound of stigmas having the key overall medicinal value (Leffingwell 2002, Rechinger 1975, Wani et al. 2011)

**Systematic Position:** Crocus consists of 9 species viz. *Crocus cartwrightianus* and its derivatives, *C. sativus*, *C.moabiticus*, *C. oreocreticus*, *C. pallasii*, *C. thomasii*, *C. badriaticus*, *C. asumaniae* and *C.mathewii*.

**Classification:**
- **Kingdom:** Plantae
- **Division:** Spermatophyta
- **Sub-division:** Angiospermae
- **Class:** Liliopsida (Monocotyledonae)
- **Sub-class:** Liliidae
- **Order:** Iridaceae
- **Genus:** Crocus
- **Species:** *C. sativus*

**Botanical Description:** Saffron is a perennial herbaceous plant attaining a height of 25 to 40cm. Corm, foliar structure and floral organs all constitute major parts of saffron plants. These corms are generally 3 to 5cm in diameter and are covered by tunics (Farooq and Meraj, 2016). The common cultivated saffron is perennial flowering plant mainly absent in the wild. It has been reported by many that it probably descends from the Mediterranean autumn-flowering *Crocus cartwrightianus* which is known as wild saffron. It is a sterile triploid form (Kafi et al. 2006). The purple flowers of *saffron* fail to produce viable seeds as it is sterile; so, reproduction is hindered. The propagation of the plant is done by clusters of corms which is underground bulb-like, starch-storing organ.
Vegetative division produces normally ten "cormlets" that can be capable to be grown into new plants in the next season because corm survives for only single season. The brown globular compact corms are small, measure as large as 5 cm in diameter, with a flat base, and are covered in a dense mat of parallel fibres called the "corm tunic". These also bear thin, net-like vertical fibres, that grow up to 5 cm above the neck of plant (Kafi et al. 2006).

**Cultivation of Saffron:** The cultivated common saffron is totally unknown in the wild, descended from *Crocus cartwrightianus*, the Iranian wild species. It is a triploid which is "self-incompatible" and male sterile, hence incapable of independent sexual reproduction, so all propagation is done by vegetative propagation (Negbi 1999). It can even survive cold winters, tolerating as low as −10 °C (14 °F) and short periods of snow cover. Saffron grows well in cold regions with warm or sub-tropical climate. Sandy or loamy soil is required which is rich, very well drained, and free from clay and decaying humus. Corms are used in vegetative propagation of the plant. The corms are fleshy storage structure and are covered externally by the film of inter-woven fibre which protects the starchy fleshy part and can be observed only after removing these films of the corm. For the better cultivations, raised beds are prepared in the water-logged areas, with a suitable slope with all round drains of proper depth and width giving it the shape of a good vegetable nursery. Thorough preparation of soil is required firstly. The small area of plots is raised and squared which are surrounded by drains of 22 cm wide; 15 cm deep, set up in well pulverized soil, and is quite appropriate for transplantation. The corms are planted at the 8-10 cm depth and 15-20 cm apart in straight rows with usually a distance of 18 cm between the rows. The soil is to be broken gently 2 to 3 times before the flower appears and the plots are hoed and weeded. Once the plants are established then there is no need of manuring and irrigation. The new corms being produced annually and the old ones rooted away then the corms once established continue to live for 10-15 years, these are usually transplanted during August to September. It is reported that the corms
sown in July generally succumb to various diseases and due to often decay of the soil. It has been reported that about 20 quintals of corms are required to plant almost one acre of plant (Fotidar 1987). Recently, beyond the traditional saffron yielding lands of Jammu and Kashmir, it is reported that Agronomists had been dreaming for long want to grow saffron, highly valued all over the world. As so far, the presence of crop has been confirmed only to Pampore in Kashmir valley and even adjoining fields area in the valley were found totally infertile for saffron cultivation. There is a great breakthrough in saffron cultivation and was found that Kishtwar district of Jammu & Kashmir supports saffron cultivation. A recent report also reveals that they have not only succeeded in increasing the yield of Saffron in the above-mentioned area but also extended cultivation of it to new lands. Now the researchers are very much confident that Saffron can also be successfully cultivated wherever certain necessary agro-climatic conditions are available. The facts above mentioned have experimentally been proved by Srivastava et al. (1974). They carried out the experimental cultivation of saffron in lower altitude of 300 meter in Jammu and succeeded. A total of 100 corms were introduced, all of them germinated, leaves appeared and 60 had come in flower. Remaining would have also flowered, but due to frequent rainfall no flowers appeared. On conclusion that rains adversely affect flowering of this plant. The above observation proved that, climatic conditions play a vital role in Saffron cultivation. It basically needs plenty of moisture content during spring, moderate showers in later summer and bright cool and dry flowering season in autumn. Apart from India other notable cultivators of saffron are France, Italy, and Spain (Srivastava et al. 1974). It takes about 35,000 flowers to yield just one pound of stigmas. Over 200,000 dried stigmas (obtained from about 70,000 flowers) yield 500 g of pure saffron (Leffingwell 2002, Rechinger 1975, Wani et al. 2011).

**Phytochemistry:** Saffron is a significant medicinal and spicy plant because of its strong odour and concentrated natural yellow colour. It has been reported from various photochemical researches that the colour is mainly due to the crocin, which is a degraded carotenoids compounds, and crocetin. The flavor comes from mainly safranal, which is the carotenoid oxidation products and the bitter taste comes from picrocrocin, which is a glucoside. Pfander and Schurtenberger (1982) reported that an active compound which may be derived by bio-oxidative cleavage of zeaxanthin was responsible for the colour and odour. Saffron has present safranal a major principle which is the carboxaldehyde volatile compound constituting 70% of total volatile constituents, which is easily formed from picrocrocin by de-glucosylation (Himeno et al. 1987).

Saffron is a very rich source of proteins, vitamins (riboflavin and thiamine), potassium, iron, copper, zinc, sodium and manganese. Saffron is greatly valued for its significant colour, taste and aroma. The photochemical compound that gives it photochemical properties generally defines its quality. Besides the above mentioned carotenoids, Crocin glycosyl esters give its characteristic color. These photochemical compounds are found in extremely important proportion in stigmas. Among minority compounds are alpha and beta carotene, lycopene and zeaxanthin as well as a conjugated xanthocarotenoid. Saffron contains flavonoidss and is responsible for bitterness. Around the first quarter of the 20th century with the isolation and identification of safranal, which is the major aromatic compound reported for the first time by (Winterstein and Teleczky (1922) to be produced by the alkaline or acid hydrolysis of
picrocrocin. It was concluded the Carotenoid degradation either by thermal treatment or enzyme activity gives rise to chemical compounds that contribute to aroma and flavor (Farooq and Meraj 2016)

**Pharmacology:** Saffron contains many chemical compounds that are known to have been anti-oxidant, disease preventing as well as curing and medicinal properties. It is traditionally used as a fragrant, stimulant, tonic, stomachic, aphrodisiac, anodyne, antispasmodic, diuretic, anticancer, laxative, galactogogue and is useful in bronchitis, pharyngopathy, cephalgia, vomiting, fever, melancholia, hepatomegaly, vitiating conditions of Kapha, epilepsy, inflammations, and skin diseases. Recent scientific findings have been encouraging, uniformly showing that saffron and its derivatives can affect carcinogenesis.

In a variety of *in vivo* and *in vitro* models particularly crocin and crocetin show anticancereous activity in pancreatic, breast, lung, and leukemic cells. The flower pistils contain several essential volatile oils, but the most important all of them is safranal which gives saffron its pleasant flavour. Other significant volatile oils in saffron are cineole, phenethenol, pinene, borneol, geraniol, limonene, p-cymene, linalool, terpinen-4-oil, etc.

It has many non-volatile active components viz; the most important of them is α-crocin, a carotenoid compound, which gives pistils their characteristic golden-yellow color. It also contains other carotenoids, including zeaxanthin, lycopene, α- and β-carotenes. These are important antioxidants that protect the human body from oxidant-induced stress, cancers, infections and acts as immune modulators. The active components in saffron have many therapeutic applications in many traditional medicines as antiseptic, antidepressant, anti-oxidant, digestive, anti-convulsant. This novel spice is good source of minerals like copper, potassium, calcium, manganese, iron, selenium, zinc and magnesium. Potassium helps to control heart rate and blood pressure is an important component of cell and body fluids. Manganese and copper are used by the human body as co-factors for the antioxidant enzyme, superoxide dismutase. Red blood cell production and as a co-factor for cytochrome oxidases enzymes. Iron is needed. Also, it is rich source of many vital vitamins, including vitamin A, folic acid, riboflavin, niacin, vitamin-C that are essential for optimum health. The therapeutic applications in many traditional medicines since long time are only due to the presence of active components present. Various Research studies have reported that, safranal, has antioxidant, cytotoxic effect on cancer cells, anticonvulsant and antidepressant properties. A carotenoid compound, Alfa-crocin, which gives the spice its characteristic golden-yellow colour, is anti-oxidant, anti-depressant, and anti-cancerous.

**Adulteration:** Saffron is frequently adulterated with differenced styles and stamens of *Crocus sativus*, stigmas of *Zea mays*, *Calendula spp.*, Outer skin of red onion, petals of *Papaver somniferum*, flakes of *Areca catechu* and *Cuscuta* stems, and in the markets paper cuttings coated with glycerine is adulterated to increase weight (Srivastava *et al*. 1985).

**Purity Tests:**
1. In sulphuric acid, the saffron stigmas immediately become blue, gradually changing to deep violet or purple and finally purplish-red.
2. It basically imparts a yellow colour to water, alcohol, methanol, ether, chloroform, but it does not show colour to xylene and benzene.

**Ethnobotanical and Medicinal Uses:** The saffron has been a chief constituent of the
recipes of Susruta (700 – 600 B.C.), Vagbhath (500 – 100 B.C.), and Charaka (3000 – 500 B.C.) who had practiced medicine for longer times in the past. In Ayurvedic system of medicine, the uses of saffron as medicine is available in the ancient codex of Ayurvedic classics. It is normally used as a condiment for its aromatic odour and significant colouring and flavouring matter. In action, it is a good stimulant to heart, brain, liver and sex. Saffron is aphrodisiac, astringent, cordial, diuretic, stimulant, emmenagogue, and stomachic. It is also used medicinally in small doses in rheumatism, loss of appetite, dyspepsia, diarrhoea and dysentery, vomiting, enlargement of liver and spleen in spasmodic cough, asthma and Catarrhal affections of children, epilepsy, fevers and general tonic. It is given to relieve flatulent colic, amenorrhoea, dysmenorrhoea and leucorrhoea. Passaries of saffron are used in painful affections of the uterus. It gives warmth in snowy areas. Externally saffron is used in headache in the form of paste, also applied to bruises and superficial sores rheumatic and neuralgic pains and congestion of chest. It is given in anaemia, chlorosis and seminal debility. It is given in a dose of 1.5 to 3.00 grains. In large doses it is abortificient. It is highly useful as a remedy for infection of urinary bladder and kidney and cures cholera. Dry boiled corms are administered for sciatica and other rheumatic pains. It is good in scabies. Bulb of the Saffron for vathasonita / Amavata (Rheumatoid arthritis) preparation of the medicine. Bulbs of Saffron are to be boiled in Cow’s milk and prepared in the form of paste. The paste is to be applied locally when the inflammation appeared in the joints of Vathasonita / Amavata(Rheumatoid arthritis) patients. Saffron for colour complexion. 120 mg of Saffron if taken every day with one cup of milk by the pregnant women, it is said that the same will give good colour complexion to the new born baby (Singh et al. 2005).

**Indigenous Knowledge Gathered from Local Peoples:** Indians peoples are generally used the exotic spices having great medicinal value. In India, the dishes are served laced with saffronis regarded as mark of honour to the guest. Indigenous uses of saffron in different parts of world are mentioned here first by people of Kashmir then other parts of India and in the last brief account of some other countries, which also consume saffron since long time (Sharma, 1999). Basically, the use of saffron is grouped into two categories i.e. local medicine, and the other used in the preparation of different dishes, which are made on special events. A few of them are listed here:

**Indigenous Uses** (Singh et al. 2005): Use of saffron in kashmiri local medicine and other uses: As a facial cream for decolouring of skin Colouring agent. To cure skin disease, fever, Used in rituals and religious functions, Carminative and diaphoretic, To prepare stimulant and tonic, Useful in bronchitis, cold and cough, Saffron is sprinkled on the various occasions,

Above ground vegetative part is used as fodder.

**Use of Saffron in Different Indian Dishes** (Singh et al. 2005, Mehta et al. 2002): This spice is also widely used in sweet recipes like kheer, rasmalai, Indian yoghurt drink (lassi), butter lassie (makhania lassi), milky rice or vermicelli puddings and sweet custard-like desserts from India. It is an essential commodity in high quality milk cream-based confectioneries and Mughlai dishes in India wherein it imparts a rich colour and distinct flavour. It flavors baked goods and is one of the ingredients in the liqueur, Chartreuse. It is used in sedatives, as an antispasmodic and for flatulence. It is also used in perfumes and dyes (Mehta et al. 2002). In Kashmir it is widely used for preparation of Kehawa: A drink prepared for stimulant, in which saffron is one of the major constituents; Tea: Saffron is also a chief ingredient of tea of high esteems;
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Wajwan: A group of non-vegetarian dish prepared to serve during the marriage party in Kashmir, in which saffron is one of the major spices; Sewai: A sweet preparation in which saffron is also used prepared during 'Id' festival; Biryani: A non-vegetarian dish in which saffron is principal constituent of spices.

**Ethnobotanical Uses:** Due to the large number of experienced users in India and the frequency of use also being very high, the consumer in India is very discerning. Saffron finds a variety of uses in India and abroad. In India, it is used as herb in Ayurvedic Medicines, which heal a variety of diseases ranging from Arthritis to Impotence and Infertility. Here is the list (Table 1) of a few uses where saffron is put to medicine as a cure and as a preventive. The list is just to give an idea of the usefulness of this exotic herb (Maheswari, 1996; Sharma, 1999).


**Saffron in Ayurveda:**
- Curing asthma and cough
- Useful in colds
- To treat alcoholism
- To treat acne and skin Diseases
- To prepare Chyawanprash

**Saffron in Unani Medicine:**
- Used in medicines that reduce inflammation
- For treatment of enlarged liver and infection of urinary bladder and kidneys
- As an ingredient in recipes useful in menstrual disorders
- For strengthening the heart and as nervine tonic
- As a diuretic if soaked overnight in water and administered with honey Pounded with clarified butter (ghee) is used for treating diabetic patients.

More uses and biological activities have been reported by Rehmani *et al.* (2007).

**Documented Properties and Actions:** There is a long history of the use of saffron in the Indigenous medicines of many cultures. As a result of a variety of recent scientific investigations, there is now convincing evidence for the biological activity of saffron and its constituents (Table 1). One of the activities of saffron, which has the greatest potential in medical applicability, is its ability to inhibit carcinogenesis. A number of recent studies have shown that saffron extract possesses antitumor activity against transplanted tumors and anticarcinogenic activity against chemically induced carcinogenesis *in vivo*, and cytotoxic effects on tumor-derived cells *in vitro* (Singh *et al.* 2005, Nair *et al.* 1996). These findings have raised the possibility that natural saffron and/or some of its constituents might be used as alternative antitumor or anticarcinogenic agents, either alone or in combination with synthetic substances having anticancer activity (Nair *et al.* 1996 and Nair *et al.* 1992). The recent scientific findings on the biological activities of saffron, for its therapeutic activity against a number of diseases, provide strong indications that saffron and/or its components may be useful agents in modern medicine. In Ayurvedic health system and in folk medicine saffron has been used from the long-time past as a mild sedative, expectorant, anti-asthma, emmenagogue, and adaptogenic agent and also it was used in various opioid preparations for pain reliefs (Schmidt *et al.* 2007). The E-Monographs German Commission has not approved this plant for use in cramps or asthma (Blumenthal 1998). Some experimental finding from different scientists also confirmed that ethanolic fraction of stigma revealed that due to high content of phenolics and flavonoids there is highest antioxidant activity (Baba *et al.* 2015) and other studies reported that crocin has
role in inhibition of edema formation (Zhong et al. 2009). Other experimental data showed that saffron can inhibit the cyclooxygenase enzyme activity which ultimately helps in reduction of inflammation. Saffron relieves neuropathic pain by reduction of many pro-inflammatory cytokines, antioxidant activity and apoptotic pathways (Amin et al. 2014) and in vitro study has shown that crocin possess dual inhibitory activity against COX-1 and COX-2 enzymes. Saffron also shows a very important role in the tumour prevention and some findings resulted that saffron and its constituents induce apoptosis or change the ratio of bcl2/bax and finally inhibit the development and progression of tumour (Guang et al. 2009).

CONCLUSION

Saffron and its vital constituents have a great role in disease prevention and medicinal value. These days in this developing world the recognition of alternative medicines-based treatment is gaining much significance in the health practice. The role of saffron due to presence of its phytochemical compounds crocin and crocetin in the curing of numerous diseases has been successfully proven by modulation of various physiological and biochemical pathways. Many researchers also reported that Saffron has also exhibited an anti-tumour effect through inactivation or activation of different molecular cascades.'

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