The Journal of Phytopharmacology 2017; 6(6): 356-358
Online at:www.phytopharmajournal.com

Review Article

ISSN 2320-480X
JPHYTO 2016; 6(6): 356-358
November- December
Received: 16-10-2017
Accepted: 22-11-2017

Refaz Ahmad Dar
Division of Microbial Biotechnology, Indian Institute of Integrative Medicine (CSIR), Sanatnagar, Srinagar, Jammu & Kashmir-190005, India

Mohd Shahnawaz
a) Division of Plant Biotechnology, Indian Institute of Integrative Medicine (CSIR), Jammu - Tawi -180001, India
b) Department of Botany, Savitribai Phule Pune University, Pune, Maharashtra-411007, India

Sumera Banoo Malik
Division of Cancer Pharmacology, Indian Institute of Integrative Medicine (CSIR), Jammu & Kashmir-180001, India

Manisha K. Sangale
Department of Botany, Savitribai Phule Pune University, Pune, Maharashtra-411007, India

Avinash B. Ade
Department of Botany, Savitribai Phule Pune University, Pune, Maharashtra-411007, India

Parvaiz Hassan Qazi
Division of Microbial Biotechnology, Indian Institute of Integrative Medicine (CSIR), Sanatnagar, Srinagar, Jammu & Kashmir-190005, India

Correspondence:
Parvaiz Hassan Qazi
Division of Microbial Biotechnology, Indian Institute of Integrative Medicine (CSIR), Sanatnagar, Srinagar, Jammu & Kashmir-190005, India
Email: refazahmad[at]gmail.com

Cultivation, distribution, taxonomy, chemical composition and medical importance of *Crocus sativus*

Refaz Ahmad Dar*, Mohd. Shahnawaz, Sumera Banoo Malik, Manisha K. Sangale, Avinash B. Ade, Parvaiz Hassan Qazi

ABSTRACT

Crocus sativus L. is one of the most important plant belongs to family Iridaceae. It is having various medicinal potential, and is widely being used in food industries. In Jammu and Kashmir State, its cultivation is restricted to two districts only (Pulwama and Kishtwar). In the present review an attempt was made to highlight the cultivation practices of saffron, to discuss its distribution around the globe, to specify its taxonomic status, to enlist its chemical constituents, and to discuss its various beneficial usages.

Keywords: Saffron, Cultivation, Iran, Pulwama, Kishtwar, *Crocus sativus*.

INTRODUCTION

Crocus sativus L. is small perennial plant, considered as king of the spice world. It belongs to Iridaceae. The genus Crocus consists of about 90 species and some are being cultivated for flower. The flowers (three stigmas-distal end of the carpel) of the *C. sativus* contain three key components, known as crocin, picrocrocin and safaranal [1]. These three components are reported to be responsible for the colour, taste and aroma of the saffron. The flowering time in case of *C. sativus* during autumn [2]. The tradition methods of saffron cultivation and flower harvesting are very tedious and labour extensive and leads to increase the cost of the saffron. Due to its high demand and low production, it is the most expensive spice and is called as red gold in the present scenario. Negbi [3] reported total saffron production (50 million tons) annually around the globe and estimated its costs worth about $50 million.

As the saffron is one of the most import cash crops in the world, in the present review we attempted to understand the Cultivation practices, distribution pattern, taxonomic status, chemical composition and medicinal importance of *Crocus sativus* based on the published literature.

Cultivation:

Crocus sativus is a triploid sterile plant, propagated through rhizomes. The rate of natural propagation is very low and is widely being cultivated in different parts of the world [1]. As per reports [4]; [5]; [6] the traditional cultivation practice of the *C. sativus* has significantly entered in lagging phase and it is about to diminish in some countries where it was cultivated at large scale. At the flowering stage, the flowers are being hand-picked and allowed to dry under shade conditions. This method is very traditional and is reported as poor method, because it leads to reduction of saffron production, which is considered as responsible for its high economic value. In India, cultivation of *C. sativus* is restricted to Jammu and Kashmir State only and is reported from its both Provinces. The glittering saffron of Pampore is very famous in Kashmir Province but the saffron cultivated in Kishtwar vale also maintained its charm in Jammu Province. Overall the Jammu and Kashmir based saffron is world famous due to its quality. The annual consumption of saffron in India from all sources is reported to be 5 to 6 tons. But due to receding cultivating land of the saffron and utilizing conventional cultivation practices, the production of the world famous saffron is in danger [7]. At *in vivo* level the efficiency of daughter corms generation was reported very low [8]; [9]. So, it is believed that to propagate the saffron bulbs is not an easy job that is why, its propagation rate is receding [8], [9], [1].

Some people suggested *in vitro* techniques to generate the propagating material at large scale, but at practical level no efficient protocol is available to achieve this target [10]. Utilizing various tissues of the saffron as an *ex-plant*, shoot generation of saffron plant was also reported but with very low frequency [11]; [12]; [13]; [10]; [14]; [15]; [16]; [17]; [18]; [19]. To enhance the potential capabilities to cultivate saffron to get the maximum yield, various biotechnological approaches (considered as most feasible techniques) were employed. To address this issue, national mission on saffron (with total research grant of 3.76 billion rupees) was initiated by the Indian Government in the state of Jammu and Kashmir state in the year 2010 by collaborating two research institutions (Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUST-K) and Central Institute of Temperate Horticulture, Srinagar). In India many institutions (ICAR, DBT, CSIR) are involved to develop methods to enhance the production of saffron at both *in vitro* and *in vivo* level. The biotechnological tools lead to the establishment of protocol for mass multiplication of disease free clones and also provide the insights via rDNA technology to get the transgenic lines [20]. So, the major constraints for the production of the saffron at the *in vitro* level were reported as, poor production of the plantlets, low frequency of cormlet formation [15]. Wani and Mohiddin [21] documented that out of many *in vitro* reports (20) only Milyaeva *et al.* [15] and Sheibani *et al.* [22] reported *in vivo* generation of saffron after passing *in vitro* stage.

To lower down the price of the saffron, people have tried to identify the new lands for cultivation in different parts of the world. In past, we also attempted to cultivate the saffron in Pune (Western Maharashtra, India) but unfortunately we had not witnessed its flowering stage [1].

In Iran and India, collectively about 95,000 families are dependent on the cultivation and farming of saffron. So, it is necessary to enhance the interest of saffron farmers by identifying some more advanced methods with commercial applicability to generate saffron in good quality at large scale.

To enhance the saffron quality and quantity, all the possible barriers should be removed with great care and the best elite cultivar should be used for the cultivation [7].

Botany and Taxonomic Position of *C. sativus*:

The *C. sativus* is a perennial plant and attains maximum height of 30 cm, with erect, ciliate margined leaves. It flowers during the month of the November and December. The flowers of the *C. sativus* reported to have two bracts at the base, pale-violent veined calyx, yellow and white coloured anthers and filament with color and filament with white colour. Although *C. sativus* don't bear any fruit but its shade dried red-stigma is the most important and highly consumed part [23]. Among the 85 reported species of the genus *Crocus*, *C. sativus* is the only species which attract the special attention because of its medicinal potential, colouring property and spice usage [24]. The most expensive spice which has been valuable since ancient times for its odoriferous, coloring, and medicinal properties was composed from dried stigmas of saffron flowers [10] systematic position of *Crocus sativus* L. [25] is as follows:

Kingdom: Plantae

Division: Spermatophyta

Sub-division: Angiospermae

Class: Monocotyledonae

Sub-class: Liliidae

Order: Liliales

Family: Iridaceae

Genus: *Crocus*

Species: *C. sativus*

Geographical distribution of *Crocus sativus*:

The origins of *C. sativus* is not clearly known, some suggest eastern Mediterranean as its endemic place [26] and some consider its Iranian origin. As per the archaeological and historical data, the domestication of *C. sativus* is very old (2,000 to 1,500 years BC) [27]. The *C. sativus* is reported to be cultivated in Afghanistan, Azerbaijan, China, Egypt, France, Greece, India, Iran, Iraq, Israel, Italy, Japan, Pakistan, Morocco, Spain, Switzerland, Turkey, United Arab Emirates since ancient times [28]; [29], and recently Australia also have started its cultivation [30].

Chemical composition of saffron:

Abdullaev [31] studied the phytochemical composition of the saffron and reported various volatile (>150), non-volatile (carotenoids, lycopene, and α and β carotenes), and aromatic compounds. Three key components in saffron were reported as crocins, picrocrocin and safranal (expressed mostly in stigma), followed by the presence of vitamins (riboflavin and thiamine) in traces [32]; [33]; [34]. The red colour of the stigma is due to Crocin (long chain of highly unsaturated and conjugated tetraterpenes). In *C. sativus* and in its other species five different kinds of crocins (crocin-1 to crocin-5) were documented [35]. The adour and bitterness of the saffron is due to picrocrocin, and is being used as a flavoring agent [4]; [36]; [37].

Medicinal Potential of saffron:

As per reports, since the pre-historic times, the medicinal potential of the *C. sativus* are well documented [32]; [38]. In the present scenario, saffron water extract (carotenoid) have proven with medicinal potential to treat cancer, cerebrovascular and cardiovascular complications [32]. [39]; [40]; [41]; It is also reported to have various other activities in different parts of the world e.g. in Middle East, it is reported to be used as antispasmodic, aphrodisiac, carminative, cognition enhancer, emmenagogue and thymoleptic in traditional Chinese system of medicine, saffron was used to treat amenorrhea, high-risk deliveries, menorrhagia and postpartum lochiostasis [32]. In Indian system of medicines, saffron was used to treat the disease of bronchitis, fever, headache, sore throat and vomiting [42]. Various pharmacological activities are also reported in saffron viz. antihypertensive activity [43], anticonvulsant activity [44], antitussive activity [44], anti-inflammatory action of saffron [24], antioxidant activity of saffron [45]; [44]. Besides the medicinal importance, saffron is being used as a spice (regarded as all-time king of spice world) [38], as a dye [46], as perfume [35], in food industry [47].

CONCLUSION

Based on the literature overview, it could be concluded that, due to urbanization, saffron land is reducing day by day. So, it is needed to find new land for its cultivation. Further the biotechnological tools need to be utilized to generate elite clone of the saffron with high yielding and diseases resistant potential.

Acknowledgment

First author is thankful to CSIR for the financial assistance, MS is highly indebted to DST-SERB for National Post-doctoral Fellowship, SBM is thankful to UGC for JRF award, MKS dully acknowledges the financial assistance of UGC-BSR.

REFERENCES

1. Shahnawaz M, Sangale MK, Qazi HA, Dar RA , et al., An attempt of in vivo cultivation of Crocus sativus L. in Western Maharashtra, India. International Journal of Advanced Research 2017, 5, 1403-1407.
2. Goldblatt, P., Phylogeny and classification of Iridaceae. Annals of the Missouri Botanical Garden 1990, 77, 607-627.
3. Negbi, M., Saffron: Crocus Sativus L, CRC Press 2003.
4. Visvanath, S., Ravishankar, G. A., Venkataraman, L. V., Induction of crocin, crocetin, picrocrocin, and safranal synthesis in callus cultures of saffron: Crocus sativus L. Biotechnology and applied biochemistry (USA) 1990.
5. Chen, S.-a., Zhao, B., Wang, X., Yuan, X., Wang, Y., Promotion of the growth of Crocus sativus cells and the production of crocin by rare earth elements. Biotechnology letters 2004, 26, 27-30.
6. Molina, R. V., Valero, M., Navarro, Y., Guardiola, J. L., Garcia-Luis, A., Temperature effects on flower formation in saffron (Crocus sativus L.). Scientia Horticulturae 2005, 103, 361-379.
7. Ahmad, M., Zaffar, G., Habib, M., Arshid, A., et al., Saffron (Crocus sativus L.) in the light of biotechnological approaches: A review. Scientific Research and Essays 2013, 9, 13-18.
8. Jirage, D. B., Ravishankar, G. A., Suvarnalatha, G., Venkataraman, L. V., Profile of polyamines during sprouting and growth of saffron (Crocus sativus L.) corms. Journal of plant growth regulation 1994, 13, 69-72.
9. Chahota, R. K., Dhiman, K. C., Rana, S. S., Mohar, S., Efficacy of different propagating methods for higher daughter corm production in saffron (Crocus sativus L.). Indian Perfumer 2003, 47, 155-158.
10. Plessner, O., Ziv, M., Negbi, M., In vitro corm production in the saffron crocus (Crocus sativus L.). Plant cell, tissue and organ culture 1990, 20, 89-94.
11. Ting, P. T., Pai, S. H., Wu, I., Wang, P. K., Preliminary report on tissue culture of corm of Crocus sativus L. Chih wu Hsueh pao.= Acta botanica sinica 1979.
12. Ding, B. Z., Bai, S. H., Wu, Y., Fan, X. P., Induction of callus and regeneration of plantlets from corm of Crocus sativus L. Chih wu Hsueh pao= Acta botanica sinica 1981.
13. Isa, T., Ogasawara, T., Efficient regeneration from the callus of saffron (Croccus sativus). Japanese Journal of Breeding 1988, 38, 371-374.
14. Aguero, C., Tizio, R., In vitro mass bulbification as a preliminary contribution to saffron (Crocus sativus L.) micropropagation. BIOCELL-MENDOZA- 1994, 18, 55-55.
15. Milyaeva, E. L., Azizbekova, N. S., Komarova, E. N., Akhundova, D. D., In-vitro formation of regenerant corms of saffron Crocus (Crocus-sativus L). Russian Journal of Plant Physiology 1995, 42, 112-119.
16. Piqueras, A., Han, B. H., Escribano, J., Rubio, C. n., et al., Development of cormogenic nodules and microcorms by tissue culture, a new tool for the multiplication and genetic improvement of saffron. Agronomie 1999, 19, 603-610.
17. Bhagyalakshmi, N., Factors influencing direct shoot regeneration from ovary explants of saffron. Plant cell, tissue and organ culture 1999, 58, 205-211.
18. Karamian, R., I International Symposium on Saffron Biology and Biotechnology 650 2003, pp. 253-259.
19. Blazquez, S., Olmos, E., Hernandez, J. A., Hellen, E., et al., I International Symposium on Saffron Biology and Biotechnology 650 2003, pp. 261-267.
20. Yasmin, S., Nehvi, F. A., Saffron as a valuable spice: A comprehensive review. African Journal of Agricultural Research 2013, 8, 234-242.
21. Wani, B. A., Mohiddin, F. A., Micropropagation of genus Crocus-a review. African Journal of Agricultural Research 2009, 4, 1545-1548.
22. Sheibani, M., Nemati, S. H., Davarinejad, G. H., Azghandi, A. V., Habashi, A. A., II International Symposium on Saffron Biology and Technology 739 2006, pp. 259-267.
23. Fleming, T., PDR for herbal medicines, Montvale, NJ: Medical Economics Company. vi 2000.
24. Fernandez, J.-A., Biology, biotechnology and biomedicine of saffron. Recent Research Developments in Plant Science 2004, 127-159.
25. Saxena, R. B., Botany, Taxonomy and Cytology of Crocus sativus series. Ayu 2010, 31, 374.
26. Winterhalter, P., Straubinger, M., Saffron-renewed interest in an ancient spice. Food Reviews International 2000, 16, 39-59.
27. Grilli Caiola, M., I International Symposium on Saffron Biology and Biotechnology 650 2003, pp. 25-37.
28. Vinning, G., Saffron: issues in international marketing. August. Paper deposited on SNV MAP. August 2005.
29. Singla, R. K., Bhat, V. G., Crocin: an overview. Indo Global Journal of Pharmaceutical Sciences 2011, 1, 281-286.
30. Nehvi, F. A., Wani, S. A., Dar, S. A., Makhdoomi, M. I., et al., II International Symposium on Saffron Biology and Technology 739 2006, pp. 375-381.
31. Abdullaev, F. I., Cancer chemopreventive and tumoricidal properties of saffron (Crocus sativus L.). Experimental Biology and Medicine 2002, 227, 20-25.
32. Rios, J. L., Recio, M. C., Giner, R. M., Manez, S., An update review of saffron and its active constituents. Phytotherapy Research 1996, 10, 189-193.
33. Bouvier, F., Suire, C., Mutterer, J. r. m., Camara, B., Oxidative remodeling of chromoplast carotenoids identification of the carotenoid dioxygenase CsCCD and CsZCD genes involved in crocus secondary metabolite biogenesis. The Plant Cell 2003, 15, 47-62.
34. Rubio-Moraga, A., Castillo-Lapez, R., Gamez-Gamez, L., Ahrazem, O., Saffron is a monomorphic species as revealed by RAPD, ISSR and microsatellite analyses. BMC Research Notes 2009, 2, 189.
35. Tarantilis, P. A., Tsoupras, G., Polissiou, M., Determination of saffron (Crocus sativus L.) components in crude plant extract using high-performance liquid chromatography-UV-visible photodiode-array detection-mass spectrometry. Journal of Chromatography A 1995, 699, 107-118.
36. Zarghami, N. S., Heinz, D. E., Monoterpene aldehydes and isophorone-related compounds of saffron. Phytochemistry 1971, 10, 2755-2761.
37. D'Auria, M., Mauriello, G., Racioppi, R., Rana, G. L., Use of SPME-GC-MS in the study of time evolution of the constituents of saffron aroma: modifications of the composition during storage. Journal of chromatographic science 2006, 44, 18-21.
38. Ferrence, S. C., Bendersky, G., Therapy with saffron and the goddess at Thera. Perspectives in biology and medicine 2004, 47, 199-226.
39. Nair, S. C., Pannikar, B., Panikkar, K. R., Antitumour activity of saffron (Crocus sativus). Cancer Letters 1991, 57, 109-114.
40. Abdullaev, F. I., Frenkel, G. D., The effect of saffron on intracellular DNA, RNA and protein synthesis in malignant and non-malignant human cells. BioFactors (Oxford, England) 1992, 4, 43-45.
41. Abdullaev, F. I., Biological effects of saffron. BioFactors (Oxford, England) 1993, 4, 83-86.
42. Fleming, T., Inc 1998.
43. Shahdadi, H., Barati, F., Bahador, R. S., Eteghadi, A., Clinical Applications of Saffron (Crocus sativus) and its Constituents: A literature review. 2016.
44. Hosseinzadeh, H., Shamsaie, F., Mehri, S., Antioxidant activity of aqueous and ethanolic extracts of Crocus sativus L. stigma and its bioactive constituents, crocin and safranal. Pharmacognosy Magazine 2009, 5, 419.
45. Chatterjee, S., Poduval, T. B., Tilak, J. C., Devasagayam, T. P. A., A modified, economic, sensitive method for measuring total antioxidant capacities of human plasma and natural compounds using Indian saffron (Crocus sativus). Clinica Chimica Acta 2005, 352, 155-163.
46. Basker, D., Negbi, M., Uses of saffron. Economic Botany 1983, 37, 228-236.
47. Aberoumand, A., A review article on edible pigments properties and sources as natural biocolorants in foodstuff and food industry. World J Dairy Food Sci 2011, 6, 71-78.

HOW TO CITE THIS ARTICLE

Dar RA, Shahnawaz M, Malik SB, Sangale MK, Ade AB, Qazi PH. Cultivation, distribution, taxonomy, chemical composition and medical importance of *Crocus sativus*. J Phytopharmacol 2017;6(6):256-358.