Oxidative and pharmaceutical properties of saffron (Crocus Sativus)

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***Abstract*- Crocus sativas Linn (Iridaceae) used widely in tropical and subtropical countries for a variety of purposes in both household and for medicinal purposes. the stigmas of the plant are used for they contain a variety of chemical constituents like the crocetin, crocin and other Flavanoids which make them suitable to possess diversified medicinal properties for treating various ailments. In countries like India and other Asian countries Saffron is being used in their traditional medicines from the pre-historic ages. Chemical constituents were studied for their diversified properties and this review focus on the detailed chemical constituents along with the pharmacological properties tested with the plant. Cultivation in Kashmir valley has its historical roots from Iran where world's largest amount (70 percent) of saffron is cultivated in the country. Jammu & Kashmir having monopoly in the saffron cultivation in India nearly 7.3 percent of world saffron is produced in the State puts India on the third rank in world saffron production. Pampore area of Pulwama district produces almost 75 percent of total share of state. But during recently the area under cultivation, production productivity is on decline with the result the saffron cultivation is under threat in the state due to presence of lot of problems in the sector; on the other influence this sector is means of likelihood of large no of people. Government of India and state government have introduced National Saffron Mission for the rejuvenation and promotion of saffron cultivation in the state. The paper analyses the trends in saffron cultivation in terms of area production and productivity. Through light problems and the threats exists in the cultivation of the saffron in the valley. The information is basically primarily in nature it is collected from the saffron cultivators and mostly qualitative in nature.**

***Index Terms*- Crocus Sativas, crocetin. Saffron Cultivation, Under Extinction, Decaling Production.**

I. INTRODUCTION

The Kashmir valley represents one of the major saffron (*Crocus sativus kashmirianus*) growing areas of the world. The time at which saffron was introduced to Kashmir is not precisely known, although evidence from '*Rajatarangini*', written by a 12th century poet and historian Kalhana, indicates its presence in Kashmir even before the reign of King *Lalitaditya* in 750 AD. Saffron (*Crocus sativus*; Iridaceae), originating from the Arabic word '*zafaran*' meaning yellow, is a fascinating spice steeped in rich history. This "golden" spice is known as '*Kum Kum*' and '*Kesar*' in Sanskrit, and '*Koung*' in Kashmiri language. Even though successful attempts to grow saffron in other areas of India such as Uttar Pradesh and Himachal Pradesh have been reported as well as in other parts of J&K state like Kargil, almost all saffron production is actually limited to Kashmir. In Kashmir, saffron is grown on uplands (termed in the local dialect as 'Karewas'), which are lacustrine deposits located at an altitude of 1585 to 1677 m above mean sea level (amsl), under temperate climatic conditions. The soils are heavy textured with silty clay loam as the predominant texture in upper horizons and silty clay in lower horizons. These soils are alfisols and are well drained. The soils are calcareous in nature with average organic carbon and calcium carbonate contents of 0.35 and 4.61%, respectively. The soil is slightly alkaline with pH ranging from 6.3 to 8.3 and with electrical conductivity between 0.09dsm-1 and 0.30dsm-1. Higher yields coincide with higher pH values.

Kingdom	Plantae
Phylum	Magnoliophyta (Angiosperm)
Class	Liliopsida (Monocot)
Order	Asparagales
Family	Iridaceae
Genus	Crocus
Species	C. sativus
Sub-species	kashmirianus

II. SAFFRON AS A CULTIVATED PLANT GROWS

Saffron as a cultivated plant grows from altitude of sea level to almost 2000 m, although it is more acclimatized to hill sides, plateaus and mountain valleys ranging in altitudes between 600 and 1700 m. The advantage with this crop is that this plant can be cultivated in arid or semi-arid areas where the water deficit is extreme in summer. There are different accounts on the origin of saffron from the mountainous regions of Asia Minor to Greece, Western Asia, Egypt or Kashmir. Saffron was known by the Sumerian civilization (6th millennium BC) and Greece was the physical bridge for its entry in Europe. Polien, the Greek historian at 2 BC, has recorded all the spices from the metal column erected in front of the King's palace.

Around 2400 BC, there were evidences of its use in colouring tunics in Castile-la-Mancha region of Spain. Saffron became more renowned in Mesopotamia with the development of Babylonian culture. Several texts speak of its use as a condiment during the reign of Hammurabi (1800 to 1700 BC) and also of the fact that dyes and paints constituted other uses to which it was put. It was also reported to be important in Acadia culture around 2350 BC. Iranian historians have different theories about the origin of saffron. According to the Iranian history, saffron originated from Zagross and Alvand Mountains. Its oldest evidence dates back to "Achaemenian", an ancient Persian dynasty. Saffron finds its name in the oldest text of Kashmir. Also, in the much celebrated ancient cluster of Kashmir, "Rajtarangini and Kalhana" includes Kashmiri saffron among those special attributes of Kashmir. Saffron is mentioned in the 5th century BC in Kashmiri records. Iran, Spain and Kashmir are the major saffron producing regions of the world. In Iran, saffron is cultivated in Sourthern Khorasan province located at an altitude of around 1000m (amsl) Birjand, Ghaen, Gon-Abad, Torbathadariah, Firdous, Istahban, Kerman, Isfahan, Kashan and Shahrkord are major saffron producing areas of Iran. Castile-La-Mancha region located at an altitude of 600 m with pluviosity of 300 to 400 mm is famous for Mancha saffron produced in the regions which are Albacete, Cidadreal, Cuenca, Toledo and Teruel. Greece, Azerbaijan, Turkey,

Morrocco, Italy and France are other saffron producing countries, contributing about 2% to the total global saffron production. In Greece, Krokos Kozani region is dedicated to saffron cultivation. Sub mountainous areas between 650 and 1100 m of

Aquila, Cerdena and Emilia-Romagna and San Gimigiano are famous in Italy for saffron cultivation. In Azerbaijan, it is cultivated on the peninsula of Apsheron near Baku in a region of reduced precipitation 223 mm. In Turkey, Hivan Hapier village, Viran village of Urfa and saffron bolu, are famous for saffron cultivation since ages. In Morocco, saffron is cultivated in several areas around Taliouine located at an altitude between 1200 to 1400 m near the Atlas Mountain with extremely low precipitation between 100 to 200 mm. Saffron is mentioned in the 5th century B.C in Kashmiri records (Nauriyal et al., 1997). It is said to have originated from the Takshak spring located in Zewan village, 10 km. towards the east of Srinagar city and that its cultivation has spread in its neighbourhood. Veghbhata and Sushtra used saffron as an important ingredient in Auyrvedic medicines. However, according to the Kashmiri legends, saffron was brought to the region by two sufi ascetics, Khawja Masood wali (r.a) and Sheikh Sharif-u-din wali (r.a) According to Abul Fazl there was twelve thousand bighas under Saffron cultivation at Pampore and Saffron fields extended about a Kos at Andarki. According to Jehangir the yearly produce of Saffron was about 500 Hindustani maunds, saying that, "it is not known whether such a huge quantity is grown anywhere in the world." Kashmir is the second largest contributor of saffron to the global market. Pampore Tehsil of Kashmir (India) is the the main hub of saffron activity in Kashmir and is located at 34° 1' N, 74° 56' E, with an average alleviation of 1574 m.a.m.s.l. Khunmoh, Zewan, Balhama, Sampora, Ladhoo, Chandhara, Woyan, Khrew, Shar Konibal, Dussu, Namblabal, Kadlabal, Hatiwara, Samboora and Lethpora are prominent saffron villages of Tehsil Pampore .

Saffron (Crocus sativusL.) is known as one of the earliest cultivated plants. This plant is an important crop cultivated as the source of its spice for at least 3,500 years. Saffron is a perennial spice and has been spread out in Mediterranean and west Asia. It has been proposed that saffron is effectual against arteriosclerosis, while reducing cholesterol levels in the blood. Many in vivo tests on tumors in rats, as well as in vitro trials on established cellular lines, have been carried out. It is highly valued as a culinary spice for its flavouring and colouring properties. Interest in the impact of saffron carotenoids on human health is growing due to their high antioxidant capacity. The major components of saffron are crocins, picrocrocin and safranal. Crocin is responsible for the color of saffron, whereas picrocrocin and safranal are responsible for its bitter taste and aroma. In other words Saffron's quality depends on its three major metabolites providing the unique colour and flavour to the stigmas. Picrocrocin ($C_{16}H_{26}O_7$) is considered to be the main bitter principle of saffron. It is a monoterpene glycoside precursor of safranal ($C_{10}H_{14}O$). b-Glucosidase action on picrocrocin liberates the aglycone, 4-hydroxy-2,6,6- trimethyl-1-cyclohexene-1-carboxaldehyde (HTCC, $C_{10}H_{16}O_2$) which is transformed to safranal by dehydration during the drying process of the plant material. Lower moisture about 12% according to ISO 3632-2 (2015) preserves quality characteristics of product during longer storage periods. Here method validation and effects of drying methods (Shade-drying and microwave drying) on safranal content of saffron (Crocus sativusL.) is presented.

III. CHEMISTRY OF C. SATIVUS

Chemical analysis of C. sativus stigmas has shown the presence of about 150 volatile and non-volatile compounds. Fewer than 50 constituents, however, have been identified so far. The volatiles consist of more than 34 components that are terpenes, terpene alcohols and their esters among which safranal is the main component. Non-volatile compounds comprise crocins, crocetin, picrocrocin and flavonoids (quercetin and kaempferol) [5].

In particular, crocins, glucosyl esters of crocetin, are water-soluble carotenoids and are responsible for saffron's characteristic colour. Picrocrocin, glycoside of safranal, is responsible for the bitter taste of the spice and is the precursor of safranal. Safranal, the main component of the distilled essential oil, is a monoterpene aldehyde, responsible for its characteristic aroma [6,7]. In Figure 1 the molecular structure of C. sativus components crocin and saffranal is illustrated In particular, crocins, glucosyl esters of crocetin, are water-soluble carotenoids and are responsible for saffron's characteristic colour. Picrocrocin, glycoside of safranal, is responsible for the bitter taste of the spice and is the precursor of safranal. Safranal, the main component of the distilled essential oil, is a monoterpene aldehyde,

responsible for its characteristic aroma [6,7]. In 1 the molecular structure of C. *sativus* components crocin and saffranal is illustrated.

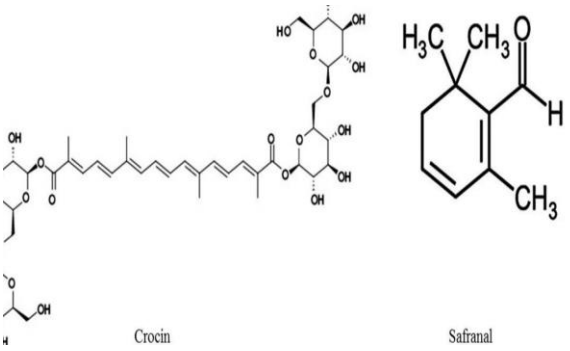

Figure1. Molecular structures of C. sativus components crocin and safranal.

IV. SAFETY EVALUATION OF C. SATIVUS AND ITS CONSTITUENTS

Toxicity studies have demonstrated that the hematological and the biochemical parameters were within a normal range in mice treated with saffron extracts. It has also been reported that the oral LD50 of saffron was 20.7 g/kg administered as a decoction in mice . Further, arecent work investigated either the acute (up to 3 g, both orally (p.o.) and intraperitoneally (i.p.)) or the sub-chronic effects of crocin (15–180 mg/kg, i.p.) in different biochemical, hematological andpathological parameters in rodents. The results of this study demonstrated that chronic treatment with crocin did not alter the weight of heart, lung, liver, kidney and spleen. Crocin, at the highest dose (180 mg/kg), increased platelets and creatinine levels, and reduced food intake and body weight. A decline in alveolar size in lungs was observed following the highest dose of crocin (180 mg/kg). The authors concluded that crocin, at pharmacological doses, was not shown to markedly damage any of the major organs of the body. Interestingly, the findings of clinical studies suggest that both C. sativus extracts and crocin display a relatively safe and normal pharmacological profile. Specifically, in a double-blind, placebo-controlled trial conducted among healthy volunteers, a one-week treatment with saffron (200–400 mg/day) did not evidence particular alterations. The results of another double-blind, placebo-controlled study performed in healthy volunteers also showed that administration for one month of crocin (20 mg/day) did not elicit significant alterations of different hematological, biochemical, hormonal and urinary parameters recorded.

V. CONCLUSION

Cultivation in Kashmir valley has its historical roots from Iran where world's largest amount (70 percent) of saffron is cultivated in the country. Jammu & Kashmir having monopoly in the saffron cultivation in India nearly 7.3 percent of world saffron is produced in the State puts India on the third rank in world saffron production. Pampore area of Pulwama district produces almost 75 percent of total share of state. Saffron (Crocus sativusL.) is known as one of the earliest cultivated plants. This plant is an important crop cultivated as the source of its spice for at least 3,500 years. Saffron is a perennial spice and has been spread out in Mediterranean and west Asia. It has been proposed that saffron is effectual against arteriosclerosis, while reducing cholesterol levels in the blood. Many in vivo tests on tumors in rats, as well as in vitro trials on established cellular lines, have been carried out. It is highly valued as a culinary spice for its flavouring and colouring properties. The results of this study demonstrated that chronic treatment with crocin did not alter the weight of heart, lung, liver, kidney and spleen. Crocin, at the highest dose (180 mg/kg), increased platelets and creatinine levels, and reduced food intake and body weight.

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