Saffron (Crocus sativus Iridaceae), a low ornamental plant with grass-like leaves and large lily-shaped flowers, produces orange-red stigmas, which constitute the saffron of commerce. The saffron flowers in autumn and is dormant during the summer months. Flowers are lilac to mauve, but the outstanding feature of the flower is its three bright red stigmas 25-30 mm long, which droop over the petals. A white-flowered form of saffron is known, but the stigmas are not as large. It inhabits the European continent, and is frequently cultivated for the sake of the yellow stigmas, which are used in medicinal preparations, colouring and flavouring food items 1.

With its strong, exotic and bitter taste, saffron is named among the sweet-smelling herbs, as the Song of Solomon. The plant was also known to the ancient Greeks and Romans. In spite of being the most expensive spice, it is still within the reach of every home 2.

The plant is a native of south Europe and is cultivated in Spain, France, Italy, Greece, Turkey, Persia, India and China. Spain and Iran are the largest producers accounting for more than 80% of the world’s production. In recent years, yield has enormously increased and Iran now produces more saffron than Spain and has become the world’s number one producer and accounts for 95% of world’s production. France, Switzerland, Italy, Germany, Taiwan and Kuwait, each importing one to five tonnes of saffron worth 4,35,000 to 1.9 million dollars are the major importers of Iranian saffron 3. Considerable quantities of saffron are imported into India, principally from Spain and France. India exports a small quantity of saffron to Arabia, Bahrain Islands, Burma, Hong Kong and other
neighbouring countries. Exports of saffron declined sharply from 1942-43 onwards and completely ceased from 1944-45, but it gained the pace during the year 1990 and onwards. Spain accounted for 60 to 98 % of India's exports over the years. During the year 1994-95, India exported more than 4 tonnes of saffron (in the form of stigma and stamen) valued at Rs 13 million to various countries.

In Kashmir, saffron is grown over an area of 3,000 hectare, producing 9,000 kg of dry saffron (stigma + style). The productivity, however, remains low (2-2.5 kg/ha) as compared to 4-5 kg/ha in Spain. The quality of the final product varies with the method of extraction of floral parts and their subsequent treatment. The final product as sold in the bazaar is a loosely matted mass of dark, reddish brown flattened stigmas with a characteristic aromatic odour and bitter taste. They are glossy and unctuous to the touch when fresh, but after keeping they become dull and brittle.

Saffron is used principally for its colouring and flavouring properties. It is used for colouring butter, cheese, puddings, pastry and confectionery. Saffron is rather unique among spices in that its main aroma and colour components are water-soluble; therefore, the stigmas may be soaked overnight in water, filtered and then water is added, which gives a pure and homogeneous colour. In another method preferred in Persia and India, the powdered spice is extracted with a little milk, and kept for half an hour, the milk gets the deep colour of egg yolk and is useful for colouring biriyani or sweets. Using the dry spice (whether ground or as a whole) directly for cooking is not favourable. In middle east countries, saffron is used to prepare an oil based perfume called ‘Zaafaran Attar’, which is a mixture of saffron and sandalwood.

Saffron pigments are used as natural colours in the manufacture of certain cosmetics. A saffron yellow pigment is used to stabilize light sensitive insoluble drugs. A hair tonic containing minoxidil and a saffron extract has synergistic effect on promoting hair growth. A natural antioxidant, 3,8-dihydroxy-1-methyl-anthraquinone-2-carboxylic acid, isolated from stem callus, has a better antioxidant activity than vitamin E in the inhibition of oxidation of linoleic acid. A novel xanthone-carotenoid glycosidic conjugate, mangicrocin isolated from saffron showed significant adaptogenic activity.

Saffron has various medicinal properties. It is used as a nerve sedative and emmenagogue. It is used occasionally in exanthemata diseases to promote eruptions. Saffron is used in fevers, melancholia and enlargement of the liver. It has also stimulant and stomachic properties and is considered to be a remedy for catarrhal affections of children. In modern pharmacopoeias, it is employed only to colour other medicines or as a cordial adjunct. It has been employed as an abortifacient and several fatal cases have been recorded. Saffron bulbs are toxic to young animals, and stigmas in overdoses are narcotic. In high dosage, saffron exhibits toxic qualities; allegedly, it has even been tried as an abortifacient. Due to its high price, saffron poisoning occurs very rarely.
Traditionally, it is also being used for the treatment of ailments of bladder, kidney and liver and also for cholera. It is applied locally in case of freckles, ascitis, and naevi. Saffron is used as a memory enhancer and for the treatment of ulcer, headache and myopia. Mixed with rose water, it is used as eye drops, mixed with ghee and sugar, it is given for migraine and, mixed with milk, it acts as a tonic for skin and brain. In Unani medicine, saffron is used to reduce inflammation, for treatment of enlarged liver and in infection of the bladder and kidneys. As an ingredient in recipes, saffron is useful in menstruation disorders and painful labour, and for strengthening the heart and as a refrigerant for the brain. In winters, mixed with milk, it is given to children to prevent them from cold. Its paste is applied on the forehead. Extracts of saffron, *Nigella sativa*, *Ixora javanica* and *Saraca asoca* are principal constituents of a preparation used for the treatment of cancer in the Indian system of medicine\(^2\).

Saffron is frequently adulterated with styles, anthers and parts of corolla of saffron.

**Data and Methodology**

To analyse the patenting activity in saffron, different patent databases were used, namely, US patent database\(^5\), WIPO database on PCT applications\(^6\), Europe network of patent databases including JPO and the worldwide patent databases\(^7\). The search on US patent database was made in the full text of all US patents issued since 1790 up to March 2002 using the Boolean search on the title or abstract using the following search query:

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ttl/“saffron” or ttl/“crocus sativus” or ttl/“keshra” or ttl/“zaffer” or ttl/“kum kuma” abst/“saffron” or abst/“crocus sativus”) or abst/“keshra” or abst/“zaffer”or abst/“kum kuma”
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The query resulted in a list of 8 patents. Of these, only one patent that did not relate to saffron was removed leading to a set of only 7 patents. The search query was further refined in the US patent database by searching in the patent claims as below:

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aclm/“saffron” or aclm/“crocus sativus” or aclm/“keshra” or aclm/“zaffer” or aclm/ “kum kuma”
```

The searches led to 23 patents. After removing the patents that did not relate to saffron or those obtained in the earlier search, a set of 9 patents was obtained. Thus, in all 16 patents were taken for analysis from the US patent database that were relating to technological innovations in saffron.

A search in the PCT electronic database of World Intellectual Property Organization (WIPO) was made using the query “saffron” in the title or the abstract. The search gave only one international patent application published under the PCT on the process for obtaining an extract of saffron. The search in the worldwide patent database maintained by the European Patent Office gave 173 patent applications published worldwide in over 50 countries. Of these, after removing overlaps or such patents that did not relate to saffron, a set of 138 patent applications was obtained.
Similarly, the search in the title or abstract of the Japanese patent database resulted in 69 patent applications. A search was also made in the INPADOC database available on the National Informatics Centre (NIC), New Delhi site. The search resulted in a total of 33 patents on saffron. The search in Ekaswa-B database of patent applications notified for opposition by Indian patent office, and maintained by TIFAC, New Delhi, did not contain any patent application on saffron. However, Ekaswa-A database of patent applications filed in India since 1995 till March 2001 showed that only two patent applications were filed by the same person from Switzerland for saffron essence and saffron spirit.

Thus, in all, 259 patents were taken for analysis that exclusively related to the patenting activity on saffron. The analysis of the patenting activity was made at two levels. First, the data were examined with respect to the trends in the growth of the patenting activity along with the identification of countries active in R&D and patenting on saffron. Secondly, the patent data were examined by looking into the title, abstract or patent claims to ascertain the novelty and usefulness of technological innovations. The data for the inventor’s country was also used to find the countries active in R&D.

**Trends in Patenting**

The analysis of the data for 259 patents indicated that maximum patenting activity relating to saffron was in China followed by Japan, Germany, Spain, Canada, Russia and Europe. The data further indicated that during 1950, only UK granted patents for inventions relating to saffron. In all, there were only 6 patents during 1920-57. Major patent activity in saffron started from the year 1990. During 1990-2001, maximum number of patents were granted by China (100) followed by Japan (48), US (8), EPO (6), Germany (5), UK (4), Spain (4), Canada (3), France (1), Russia (2), Australia (1), Taiwan (1) and Italy (1) (Table 1). Indian inventors received none of the patents in saffron. Most of the patents are for the process of culturing of selected stigmas of saffron plant to get another good quality of the plant. Some of the patents relate to the preparation of saffron beverage. A few of them deal with the process for obtaining an extract of saffron that can be used as a substitute for saffron and artificial dyes. Technology and R&D focus of some selected countries is discussed below:

**China**

In China, patent activity started during the year 1992 and was maximum in the year 2000. Patent data analysis found that the maximum patents were for the use of saffron as an ingredient for the preparation of medicines for treatment of various ailments, also for the preparation of ointment for bone healing, fracture settlement, bone growth, blood cleaning pills, curing diabetes, curing burns, curing of senile cataract, osteoporosis, leukemia and other forms of cancer. Patents were also for making saffron flavoured beverage, saffron extract, medicated wines for curing rheumatic arthritis and leukemia, for preparing sunscreen agents,
medicinal pills for treating lung diseases, bone setting powder for fractures, paste for treating leukoderma, leuoplakia valve especially coronary, ointment for relaxation of muscles and joints.

**Japan**

Maximum patent activity in Japan has been during the years 1989 to 2000. Patenting activity started from the year 1982 and was maximum in 1989 and has continued till today. The main focus of the patenting activity has been the utilization of saffron as a colouring agent, essence, beverage and cosmetics. Several patents have been granted for the use of saffron as a colouring agent for food. It is also being used as an anti-oxidant in cosmetics.

In UK, the patent analysis shows that patents are mainly for the use of saffron in making savory rice dishes, new glucose extract of meadow saffron and process for preparing the same, as an ingredient for preparing the medicine for relaxation of muscles and joints and for face packs.

**Spain**

Patent analysis shows that saffron patents are for its use an ingredient in the

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*Date for one patent is not available
preparation of medicinal creams for burns and bruises, skin treatment, for producing stigma like tissues, also for preparing extract of saffron, saffron flavoured beverage and saffron liquor.

**Germany**

According to the patents filed in Germany, patent activity is mainly on the use of saffron for making dessert rice dish, for preparing a tonic wine, which promotes blood circulation, relaxes muscles and joints.

**Conclusion**

The patenting activity on saffron indicates a spurt in R&D activity in countries other than India. They have exploited these vast traditional bioresources for commercial gain leading to innovative products, processes and applications. The analysis of the patenting activity on saffron brings out the emerging technological directions covering a wide range of its applications. The overall thrust of the technological applications is to make use of the properties of saffron or its extract as an ingredient. The unique characteristics that have been exploited commercially relate to its use as a colouring agent in food products, in medicine, beverages and as an ingredient in cosmetics. It is observed that countries like China and Japan have carried out research work mainly in the area of its use as a colouring agent, as an ingredient in medicines and beverages. India in spite of its being a resource rich country has not made any attempt in this direction.

**Acknowledgement**

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