Saffron and its Farming, Economic Importance, Export, Medicinal characteristics and Various Uses in South Khorasan Province - East of Iran

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ABSTRACT: One of the most valuable and irreplaceable ones all over the world is Saffron. It is such an expensive product which is weighted in Mesghals (=5 grams) or grams. Saffron as the most expensive agricultural and medicinal plant has a unique status among industrial and export products. Today, with %60 of the universal production, Iran is considered the main producer of Saffron in the world. Saffron’s numerous qualities and uses together with the role it plays in the economy of Iranian farmers call for a particular attention to eradicate problems regarding its production, export and merchandising. In Iran it is specially an exceptional product, because it require little water and low care. It can provide jobs for villagers and prevent their emigration from country to cities. Compared to the other kinds of products, it can bring about a remarkable income both for the farmers and for the country. Thus, if enough consideration is exercised, the government may decrease its oil export dependency by relying on a good plan to improve Saffron production. Among exporting items, Saffron has a high exporting value in Khorasan, since it constituted %92 of the whole export items and %98 of the cultivated land in 2001. The high quality of Saffron produced in Iran has persuaded some European countries like Spain to buy Iran’s Saffron in bulk. Later on they pack them under Spanish titles and present them to International markets. It goes without saying that they cannot produce Saffron with such Quality, since those country lack the climatic and ecological conditions necessary to grow such a valuable product. So the Khorasanian scholars and writers should try to introduce this precious native product to the other nations based on the findings and information they have. Saffron is important from aspects of economy, medicine, producing employment opportunities and as food stuff. This article tries to describe a brief history of Saffron, explain its qualities and introduce the ecosystem of medicinal plants in Southern Khorasan. It also attempt to introduce the problems and difficulties with regard to Saffron and its export.

Keywords: Saffron, Farming, Economic, medicinal plants, South Khorasan Province, Iran

INTRODUCTION

“He is light of heart because he had slept in a bed of saffron.”—Author Unknown

Saffron, an exotic and elaborately extracted spice, has for centuries been in global demand. Highly coveted for its beauty, aroma, healing powers, and overall appeal, “Red Gold” is known to be “the most expensive spice in the world.”

Saffron or Crocus Sativus, accentuates myth, magic, medicine, and meals all over, with legendary "roots" that can be traced back through history and into story. From the cradle of civilization to Cleopatra’s courts, from Sumerian and Persian kingdoms to Greek and Biblical divinity, from the Near and Far East to the European and American West, saffron appears everywhere, both in trade and in tale.
The domesticated saffron crocus, Crocus sativus, is an autumn-flowering perennial plant unknown in the wild. Its progenitors are possibly the eastern Mediterranean autumn-flowering Crocus cartwrightianus, which is also known as "wild saffron" and originated in Greece. The saffron crocus probably resulted when C. cartwrightianus was subjected to extensive artificial selection by growers seeking longer stigmas. C. thomasi and C. pallasii are other possible sources.

It is a sterile triploid form, which means that three homologous sets of chromosomes compose each specimen's genetic complement; C. sativus bears eight chromosomal bodies per set, making for 24 in total. Being sterile, the purple flowers of C. sativus fail to produce viable seeds; reproduction hinges on human assistance: clusters of corms, underground, bulb-like, starch-storing organs, must be dug up, divided, and replanted. A corm survives for one season, producing via this vegetative division up to ten "cormlets" that can grow into new plants in the next season. The compact corms are small, brown globules that can measure as large as 5 cm (2.0 in) in diameter, have a flat base, and are shrouded in a dense mat of parallel fibers; this coat is referred to as the "corm tunic". Corms also bear vertical fibers, thin and net-like, that grow up to 5 cm above the plant's neck (Golmohammadi, 2012).

The plant grows to a height of 20–30 cm (8–12 in), and sprouts 5–11 white and non-photosynthetic leaves known as cataphylls. These membrane-like structures cover and protect the crocus's 5 to 11 true leaves as they bud and develop. The latter are thin, straight, and blade-like green foliage leaves, which are 1–3 mm in diameter, either expand after the flowers have opened ("hysteranthous") or do so simultaneously with their blooming ("synanthous"). C. sativus cataphylls are suspected by some to manifest prior to blooming when the plant is irrigated relatively early in the growing season. Its floral axes, or flower-bearing structures, bear bracteoles, or specialised leaves that sprout from the flower stems; the latter are known as pedicels. After aestivating in spring, the plant sends up its true leaves, each up to 40 cm (16 in) in length. In autumn, purple buds appear. Only in October, after most other flowering plants have released their seeds, do its brilliantly hued flowers develop; they range from a light pastel shade of lilac to a darker and more striated mauve. The flowers possess a sweet, honey-like fragrance. Upon flowering, plants average less than 30 cm (12 in) in height. A three-pronged style emerges from each flower. Each prong terminates with a vivid crimson stigma 25–30 mm (0.98–1.18 in) in length.

Saffron is a cash crop that most of researchers believe it is indigenous crop of Iran. Saffron (Crocus sativus L.) is a valuable medicinal plant which has many therapeutic applications since long time ago as anti-spasmodic, carminative, and diaphoretic (Golmohammadi, 2012).

One of the most valuable and irreplaceable medicinal plants all over the world is Saffron. Saffron is originated from iridaceae. According to some European sources, It is produced locally in Mediterranean and west Asian climate. It can be seen in arid areas of Iran with cold winter and hot summer, that is in Southern, and Razavi Khorasan. While other wild types of saffron are also used because of their beautiful decorative flowers, the common agricultural type has a particular economical value. In Southern Khorasan the ecological condition is that of a desert. Low precipitation, high evaporation causes very low humidity. Large Temperature fluctuations occur during days and nights. In some higher areas conditions are

Saffron in the Islamic Republic of Iran is planted as a perennial crop and its yield varies in consecutive years as do fruit trees (Azizi-Zohan, 2006). The crop production function for water (water application/yield response function) is dependent on the year of production. This is due to the fact that the amount of corm per unit area (corm intensity) varies in consecutive years. Therefore, the crop production function of saffron for water is dependent not only on the amount of applied water but also on the amount of corm in unit area. For perennial crops such as saffron, the economical analysis of deficit irrigation is dependent on the amount of corm in unit area. This is similar to the case for orchards where the yield depends on the tree age (Sepasghah, 2008).

Saffron is originated from iridaceae. According to some European sources, It is produced locally in Mediterranean and west Asian climate (latitude of 30-50 northern degrees, longitudinal of 10 Western up to 80 Eastern degrees). It can be seen in arid areas of Iran with cold winter and hot summer, that is in Southern, and Razavi Khorasan (located in the East part of the country). While other wild types of saffron are also used because of their beautiful decorative flowers, the common agricultural type has a particular economical value. In Southern Khorasan the ecological condition is that of a desert. Low precipitation, high evaporation causes very low humidity. Large Temperature fluctuations occur during days and nights. In some higher areas conditions are
ecologically more favorable for plant growth, but they are not so distinct from those of the deserts. Some of the most important elements in Saffron are Crocin Glucosid, Crocetin, Beta & Gama Saffronol, carotene, Lycopen and Pirocin. Saffron is anodyne and it is useful for stomach. It is used to cure menses irregularities and it is useful for women’s bleeding resulted from delivery. It is exhilarating and good for strengthening humans’ senses and mental abilities. It is also good for Liver, spleen, headache, sleeplessness, etc. Renal stone can also be cured if used by honey.

Saffron is grown in arid and semi-arid regions in Iran in late autumn, winter and late spring with rainy season. It should be irrigated by supplemental basin irrigation. Since rainfall is usually delayed in autumn, therefore, a pre-flowering irrigation of about 100 mm is needed. In areas with a seasonal rainfall of 600 mm a post-flowering irrigation of about 50 mm is adequate for economical yield. In areas with seasonal rainfall of 400 and 200 mm continuous supplemental irrigation is needed with intervals of 24 and 15 days or irrigation regimes of 50% ETp and 75% ETp, respectively. In these areas, irrigation regimes can be planned based on crop water stress index (CWSI) of 0.60 and 0.27, respectively (Golmohammadi, 2012).

Traditional agriculture in Iran is based on development of cropping systems with low water requiring crops such as saffron (Crocus sativus L.). However, not much research has been conducted on this crop to improve technology for its production. Saffron belongs to Iridaceae family and it is mostly distributed in Irano-Touranian region and west of Asia with low annual rainfall, cold winters and hot summers. At present, saffron is cultivated in Iran and a few countries with old civilization.
Figures. 1 & 2 & 3 & 4 & 5 & 6. Preparing land, getting animal fertilizer and sowing bulbs of saffron by farmers in the Ghandab (Khoonik Olia) village in Nehbandan city in South Khorasan province-East of Iran (pictures by author. Sep and Oct, 2013)

Figures. 7 & 8. Resistant of saffron shrub to snow and very cold air temperature (-15°C) during winter in the Ghandab (Khoonik Olia) village in Nehbandan city in South Khorasan province-East of Iran (pictures by author. Jan 14, 2014)
Iran is leading country in saffron production with 47200 ha cultivated area and 160 ton annual production (3.4 kg ha⁻¹ yield) (Kafi, 2006). The main saffron production areas in Iran are located in Khorasan, Fars and Kerman provinces. Its cultivation area increased by an annual rate of about 22% in last decade (Anonymous, 2002), however, its annual production increased by about 14%. This indicates that the saffron yield (kg ha⁻¹) decreased about 50% that may be due to occurrence of drought and newly cultivated fields with low yield (Alipour Eskandani, 2013).

The three-branch style of saffron flowers is the most important economic part of the plant. Saffron is used as a spice and a natural food color. In traditional medication, saffron has several properties. Further, its petals are a food color and its leaves are used as animal feed.

There are distinct differences between eco-physiological behavior of saffron and other crops. Flowers appear before development of other plant organs. Occurrence of flowers coincides with cold temperature in fall. In contradiction of the economic yield of most conventional crops, saffron yield is style/stigma that is a small part of its flower. Harvest index of saffron is less than 0.5% compared with 30 to 60% for other crops (Golmohammadi, 2012).

Most of the conventional crops positively respond to irrigation in summer, while summer irrigation is avoided for saffron. Therefore, saffron irrigation is considered as supplemental irrigation. These indicate that the eco-physiological criteria of saffron are quite different from other crops. These differences have been reviewed by Kafi (2006). However, as he indicated, there is a great deal of controversy related to ecological, physiological and phonological characteristics of saffron that should be examined. Traditionally, saffron is irrigated four times during October to May, however, to achieve high yield, appropriate irrigation scheduling should be used (Alipour Eskandani, 2013).
**Saffron bulbs for vegetative reproduction**

*Crocus sativus* thrives in the Mediterranean marquee, an ecotype superficially resembling the North American chaparral, and similar climates where hot and dry summer breezes sweep semi-arid lands. It can nonetheless survive cold winters, tolerating frosts as low as −10 °C (14 °F) and short periods of snow cover. Irrigation is required if grown outside of moist environments such as Kashmir, where annual rainfall averages 1,000–1,500 mm (39–59 in); saffron-growing regions in Greece (500 mm or 20 in annually) and Spain (400 mm or 16 in) are far drier than the main cultivating Iranian regions. What makes this possible is the timing of the local wet seasons; generous spring rains and drier summers are optimal. Rain immediately preceding flowering boosts saffron yields; rainy or cold weather during flowering promotes disease and reduces yields. Persistently damp and hot conditions harm the crops, and rabbits, rats, and birds cause damage by digging up corms. Nematodes, leaf rusts, and corm rot pose other threats. Yet *Bacillus subtilis* inoculation may provide some benefit to growers by speeding corm growth and increasing stigma biomass yield (Golmohammadi, 2012).

The plants fare poorly in shady conditions; they grow best in full sunlight. Fields that slope towards the sunlight are optimal (i.e., south-sloping in the Northern Hemisphere). Planting is mostly done in June in the Northern Hemisphere, where corms are lodged 7–15 cm (2.8–5.9 in) deep; its roots, stems, and leaves can develop between October and February. Planting depth and corm spacing, in concert with climate, are critical factors in determining yields. Mother corms planted deeper yield higher-quality saffron, though form fewer flower buds and daughter corms. Italian growers optimize thread yield by planting 15 cm (5.9 in) deep and in rows 2–3 cm (0.79–1.18 in) apart; depths of 8–10 cm (3.1–3.9 in) optimize flower and corm production. Greek, Moroccan, and Spanish growers employ distinct depths and spacing that suit their locales (Alipour Eskandani, 2013).

*C. sativus* prefers friable, loose, low-density, well-watered, and well-drained clay-calcareous soils with high organic content. Traditional raised beds promote good drainage. Soil organic content was historically boosted via application of some 20–30 tones of manure per hectare. Afterwards, and with no further manure application, corms were planted. After a period of dormancy through the summer, the corms send up their narrow leaves and begin to bud in early autumn. Only in mid-autumn do they flower. Harvests are by necessity a speedy affair: after blossoming at dawn, flowers quickly wilt as the day passes. All plants bloom within a window of one or two weeks. Roughly 150 flowers together yield but 1 g (0.035 oz) of dry saffron threads; to produce 12 g (0.42 oz) of dried saffron (or 72 g (2.5 oz) moist and freshly harvested), 1 kg (2.2 lb) of flowers are needed; 1 lb (0.45 kg) yields 0.2 oz (5.7 g) of dried saffron. One freshly picked flower yields an average 30 mg (0.0011 oz) of fresh saffron or 7 mg (0.00025 oz) dried (Golmohammadi, 2012).
Chemistry of Saffron

Saffron contains more than 150 volatile and aroma-yielding compounds. It also has many nonvolatile active components,[29] many of which are carotenoids, including zeaxanthin, lycopene, and various α- and β-carotenes. However, saffron's golden yellow-orange colour is primarily the result of α-crocin. This crocin is trans-crocetin di-(β-D-gentiobiosyl) ester; it bears the systematic (IUPAC) name 8,8-diapo-8,8-carotenoic acid. This means that the crocin underlying saffron's aroma is a digentiobiose ester of the carotenoid crocetin. Crocins themselves are a series of hydrophilic carotenoids that are either monoglycosyl or diglycosyl polyene esters of crocetin (Alipour Eskandani, 2013).

Crocetin is a conjugated polyene dicarboxylic acid that is hydrophobic, and thus oil-soluble. When crocetin is esterified with two water-soluble gentiobioses, which are sugars, a product results that is itself water-soluble. The resultant α-crocin is a carotenoid pigment that may comprise more than 10% of dry saffron's mass. The two esterified gentiobioses make α-crocin ideal for colouring water-based and non-fatty foods such as rice dishes.

The bitter glucoside picrocrocin is responsible for saffron's flavour. Picrocrocin (chemical formula: C₁₆H₂₆O₇; systematic name: 4-(β-D-glucopyranosyloxy)-2,6,6-trimethylcyclohexa-1,3-diene-1-carboxaldehyde) is a union of an aldehyde sub-element known as safranal (systematic name: 2,6,6-trimethylcyclohexa-1,3-diene-1-carboxaldehyde) and a carbohydrate. It has insecticidal and pesticidal properties, and may comprise up to 4% of dry saffron. Picrocrocin is a truncated version of the carotenoid zeaxanthin that is produced via oxidative cleavage, and is the glycoside of the terpene aldehyde safranal. The reddish-coloured zeaxanthin is, incidentally, one of the carotenoids naturally present within the retina of the human eye (Alipour Eskandani, 2013).

When saffron is dried after its harvest, the heat, combined with enzymatic action, splits picrocrocin to yield D-glucose and a free safranal molecule. Safranal, a volatile oil, gives saffron much of its distinctive aroma. Safranal is less bitter than picrocrocin and may comprise up to 70% of dry saffron's volatile fraction in some samples. A second element underlying saffron's aroma is 2-hydroxy-4,4,6-trimethyl-2,5-cyclohexadien-1-one, which produces a scent described as saffron, dried hay-like. Chemists find this is the most powerful contributor to saffron's fragrance, despite its presence in a lesser quantity than safranal. Dry saffron is highly sensitive to fluctuating pH levels, and rapidly breaks down chemically in the presence of light and oxidizing agents. It must, therefore, be stored away in air-tight containers to minimize contact with atmospheric oxygen. Saffron is somewhat more resistant to heat (Golmohammadi, 2012).

Grades and ISO 3632 categories of Saffron

The International Organization for Standardization (ISO) writes saffron's testing standards. Saffron contains several chemical compounds, which cause its strength to vary between 190-250. This number refers to the amount of CROCIN, saffron's principal chemical compound, present in a laboratory reading.

Saffron is not all of the same quality and strength. Strength is related to several factors including the amount of style picked along with the red stigma. Age of the saffron is also a factor. More style included means the saffron is less strong gram for gram, because the color and flavor are concentrated in the red stigmas. Saffron from Iran, Spain and Kashmir is classified into various grades according to a the relative amounts of red stigma and
yellow styles it contains. Grades of Iranian saffron are: “sargol” (red stigma tips only, strongest grade), “pushal” or “pushali” (red stigmas plus some yellow style, lower strength), “bunch” saffron (red stigmas plus large amount of yellow style, presented in a tiny bundle like a miniature wheatsheaf) and “konge” (yellow style only, claimed to have aroma but with very little, if any, colouring potential). Grades of Spanish saffron are “coupé” (the strongest grade, like Iranian sargol), “mancha” (like Iranian pushal), and in order of further decreasing strength “rio”, “standard” and “sierra” saffron. The word “mancha” in the Spanish classification can have two meanings: a general grade of saffron or a very high quality Spanish-grown saffron from a specific geographical origin. Real Spanish-grown La Mancha saffron has PDO protected status and this is displayed on the product packaging. Spanish growers fought hard for Protected Status because they felt that imports of Iranian saffron re-packaged in Spain and sold as “Spanish Mancha saffron” were undermining the genuine La Mancha brand.

Countries producing less saffron do not have specialized words for different grades and may only produce one grade. Artisan producers in Europe and New Zealand have offset their higher labor charges for saffron harvesting by targeting quality, only offering extremely high grade saffron.

In addition to descriptions based on how the saffron is picked, saffron may be categorized under the international standard ISO 3632 after laboratory measurement of crocin (responsible for saffron's colour), picrocrocin (taste), and safranal (fragrance or aroma) content. However, often there is no clear grading information on the product packaging and little of the saffron readily available in UK is labeled with ISO category. This lack of information makes it hard for customers to make informed choices when comparing prices and buying saffron (Alipour Eskandani, 2013).

Under ISO 3632, determination of non-stigma content (“floral waste content”) and other extraneous matter such as inorganic material (“ash”) are also key. Grading standards are set by the International Organization for Standardization, a federation of national standards bodies. ISO 3632 deals exclusively with saffron and establishes three categories: III (poorest quality), II, and I (finest quality). Formerly there was also category IV, which was below category III. Samples are assigned categories by gauging the spice’s crocin and picrocrocin content, revealed by measurements of specific spectrophotometric absorbance. Safranal is treated slightly differently and rather than there being threshold levels for each category, samples must give a reading of 20-50 for all categories.

These data are measured through spectrophotometry reports at certified testing laboratories worldwide. Higher absorbances imply greater levels of crocin, picrocrocin and safranal, and thus a greater coloring potential and therefore strength per gram. The absorbance reading of crocin is known as the "coloring strength" of that saffron. Saffron's colouring strength can range from lower than 80 (for all category IV saffron) up to 200 or greater (for category I). The world's finest samples (the selected, most red-maroon, tips of stigmas picked from the finest flowers) receive coloring strengths in excess of 250, making such saffron over three times more powerful than category IV saffron. Market prices for saffron types follow directly from these ISO categories. Sargol and coupé saffron would typically fall into ISO 3632 category I. Pushal and mancha would probably be assigned to category II. On many saffron packaging labels, neither the ISO 3632 category nor the coloring strength (the measurement of crocin content) is displayed (Golmohammadi, 2012).

However, many growers, traders, and consumers reject such lab test numbers. Some people prefer a more holistic method of sampling batches of threads for taste, aroma, pliability, and other traits in a fashion similar to that practiced by practiced wine tasters.[34] However, ISO 3632 grade and coloring strength information allow consumers to make instant comparisons between the quality of different saffron brands, without needing to purchase and sample the saffron. In particular, consumers can work out value for money based on price per unit of coloring strength rather than price per gram, given the wide possible range of coloring strengths that different kinds of saffron can have.

Despite attempts at quality control and standardization, an extensive history of saffron adulteration, particularly among the cheapest grades, continues into modern times. Adulteration was first documented in Europe’s Middle Ages, when those found selling adulterated saffron were executed under the Safranschou code. Typical methods include mixing in extraneous substances like beets, pomegranate fibers, red-dyed silk fibers, or the saffron crocus's tasteless and odorless yellow stamens. Other methods included dousing saffron fibers with viscid substances like honey or vegetable oil to increase their weight. However, powdered saffron is more prone to adulteration, with turmeric, paprika, and other powders used as diluting fillers. Adulteration can also consist of selling mislabeled mixes of different saffron grades. Thus, in India, high-grade Kashmiri saffron is often sold and mixed with cheaper Iranian imports; these mixes are then marketed as pure Kashmiri saffron, a development that has cost Kashmiri growers much of their income (Golmohammadi, 2012).

As saffron is "worth its weight in gold," for years, scandalous merchants have either "cut" the product with various additives, added water weight, or simply tried to pass off cheap imitations as the real saffron. In all cases, it
is next to impossible to imitate the real thing, and though offenders are not treated as harshly these days, a brief look at history sheds light on the once-thought severity of the crime—punishments were once extreme for such fakery. Powder and thread form are both found and are equal in potency and quality, however, the powder is often cheaper, because it is easier to imitate (Alipour Eskandani, 2013).

**Farming conditions and Environmental requirements**

Saffron growth in temperate and dry climate is favored. However, vegetative growth of saffron coincides with cold air temperature with freezing conditions in winter. The mean monthly maximum, minimum and absolute minimum air temperatures in the saffron production areas, *i.e.*, Khorasan and Fars provinces for cold months of growing season are shown in Table 1. The mean monthly maximum and minimum air temperatures in October to December in southern parts of Khorasan are 20 and 0.0°C, and for Fars province are 15.0 and -8.9°C, respectively (Kafi, 2006). According to this reference, absolute minimum temperature of -22°C occurred in Torbate-Hydarieh (saffron production area) in northern part of Khorasan province while this value is -20.0°C for Fars province. Monthly air and soil temperature at different depths is shown in Figure 1. These data obtained in a soil texture similar to that in a saffron field in Bajgah (Fars province, Iran). In summer, soil temperature at depth of 5.0 cm (about 40.0°C) is higher than air temperature that is measured at a height of 2.0 m and may inhibit corm physiological activity planted at this depth in furrow irrigation. However, soil temperature at depth of 30.0 cm (30.0°C) is lower than air temperature that enhances the corm physiological activity planted at this depth in basin irrigation. In winter, soil temperature in 30.0 cm depth (5.0°C) is higher than that in 10.0 cm (2.0°C) depth may enhance saffron corm growth planted at this depth.

Although saffron is planted in arid and semi-arid regions in Iran and is adapted to these conditions, however, according to the research findings in Greece, saffron should not be under water stress in some of the growth stages. In Greece, saffron corms grow in March and April, and September it is the time of flower initiation, therefore, saffron should not be under water stress in these periods. In Morocco, saffron is irrigated by basin irrigation. In these fields, 30-50 mm of irrigation water is used weekly in September to November and the amount of applied irrigation water is 35-50 mm during December to March that is applied with 2-week interval. Furthermore, saffron is not irrigated during April to August. By this irrigation regime, saffron yield of these fields reported to be 2-2.5 kg ha-1 and it is much lower than those reported in Italy (10-16 kg ha-1) and Spain (10-12 kg ha-1). Almost similar irrigation schedule is practiced in saffron plantation in Iran that results in low saffron yield (3.4 kg ha-1) as reported by Kafi, (2006). Therefore, it hypothesized that other irrigation methods, *i.e.*, furrow and appropriate irrigation interval may improve saffron yield (Golmohammadi, 2012).
Figures. 22 & 23 & 24 & 25 & 26 & 27 & 28 & 29. multi-cropping of saffron with other trees and plants such as wheat, barberry, walnut and etc. in the Tagheski plain and Gol and Freeze villages – 48 & 55 km distance to Birjand city center of South Khorasan province-East of Iran (pictures by author. Oct 21, 2013 & Nov 4, 2013).

Water quality is an important factor in plant growth and yield specially yield of saffron. Saffron growing season coincides with late autumn, winter and early spring with cold to moderate temperatures. However, during the summer where water shortage is a limiting factor for growth of many crops, saffron is in its dormant stage with no water requirement. High yield of saffron depends on a strong vegetative growth that requires enough water after flowering in late autumn to early spring. Therefore, for irrigated saffron or supplementary irrigated saffron for rain-fed conditions, proper planning for irrigation regimes is necessary.

Saffron in Iran is planted as a perennial crop and its yield varies in successive years (Sepaskhah, 2008). The crop production function for water is dependent on the year of production. This is due to the fact that the amount of corm per unit area (corm intensity) varies in successive years. Therefore, the crop production function of saffron for water is dependent not only on the amount of applied water but also it depends on the amount of corm per unit area. Sepaskhah, (2008) derived equations for determination of required water at variable seasonal rainfall and different prices of water and corm leading to maximum crop yield or profit with limited water conditions for saffron.

Saffron is grown in arid and semi-arid regions in Iran. Its flower appears in mid autumn and coincides with cold temperature. It shows positive response to irrigation in autumn, and winter with rainy season, but summer irrigation should be avoided. Therefore, saffron irrigation is supplemental irrigation especially in semi-arid region. In contradiction to most other crops, basin irrigation should be used for saffron with a pre-flowering irrigation for economical production. Even for rain-fed saffron with seasonal rainfall of about 600 mm, pre-flowering irrigation is required in area that rainfall delayed until late in autumn. The most appropriate time for pre-flowering irrigation is mid October in saffron plantation areas in Iran. In rain-fed saffron with occasional seasonal rainfall of about 600 mm, pre-flowering irrigation of about 150 mm is needed, while continuous supplemental irrigation is needed for regions with seasonal rainfall of about 400 mm or lesser (A.R. Sepaskhah, A.A. Kamgar-Haghighi. January 2009).

Approach to use of medicinal plants and plant products become more prominent its role in the global economic cycle, so increasing use of them is not limited only to growing developing countries, but in the developed countries have a lot of development. Saffron has a long history in Iranian agriculture, and its production is based on indigenous knowledge, particularly in central and southern khorasan and as the most expensive agricultural and medicinal crop worldwide, has a special position among Iranian industrial and export products. At the present, Iran is the largest producer and exporter of saffron, with more Than go percent of the global production of this precious crop is dedicated to Iran. Numerous and widespread usages of saffron, the special properties of this valuable medicinal plant, it’s given role in the livelihoods of farmers in some provinces, as well as its high value added, all
high light the need for more attention to issues related to saffron. Definitely, world’s expectations from a country that considers itself as the master of saffron is very high, and of course, any claim in this regard is defensible only based on research approaches. Among the important challenges ahead are the problem of low yields per unit area and the discriminate increase in saffron cultivation area, instability of saffron price in production sector, lack of attention to the required investment and planning of generate saffron science and specialized, scientific research centers.

Ecological zoning and yield monitoring of saffron in central and southern khorasan showed that age of saffron farms, time of flowering, length of flowering period, corn size, irrigation interval, and amount of manure applied have a positive linear with yield. In addition, results showed if notice to environmental and the nutritional actual needs of saffron, can be achieved to increase performance in per unit area. Saffron is planted in special climate conditions and has a unique growth process. The results showed that precipitation was most effective on the yield during the month of Dec., Jan., Feb., Mar. and Apr. compared with the other months. Regarding minimum and average temperature, the month of Oct., Nov., Dec. and Jan. were the most effective months on the yield. It is hoped that in the future and with additional works, we see the more expansion of the frontiers of sciences, knowledge and technology about saffron (Behdani, 2013).

Saffron as an important Medicinal plant

Medicinal plants are the most natural remedy for man’s disease and sicknesses which has been bestowed on human by nature. Though man has made a great improvements in the field of pharmacology, yet the great and remarkable role of medicinal plants in healing and relieving the pain cannot be ignored. The effectual raw material existing in medicinal plants has been used by man for a long time and they do not seem to be replaced by man made products.

Saffron (Crocus sativus L.) is a plant of the iridaceae family. The dried intact stigmas of saffron are widely used as a condiment, medicinal plant and food additive in the different countries. Recently, saffron extract was found to have anti-cancer activities against different carcinoma cells. Many of these medicinal properties of saffron can be attributed to a number of its compounds such as crocins, phenolic, flavonoid and other substances having strong antioxidant and radical scavenger properties. The importance of antioxidants in maintaining health and protection from cancer is of great interest in revealing the antioxidant compounds of spice or herb plants.

Crocus sativus L. (family Iridaceae) is an important crop cultivated for its red stigmatic lobes that constitute the high valued saffron of commercial use. Saffron is a perennial autotriploid vegetatively propagated plant where breeding is generally difficult. In recent years application of tissue culture for the large scale propagation and genetic improvement of saffron has been emphasized. Compared with the traditional method, plant tissue culture offers a great potential for callus induction.

Saffron (Crocus sativus L.) is a triploid, sterile, monocot plant belongs to the family Iridaceae, sub family Crocoideae. C.sativus only bloom once a year and should be collected within a very short duration, the stigmas of Saffron flowers are harvested manually and subjected to desiccation then have been used as a spice. It has been also used as a drug to treat tumor, cancer, chronic uterine hemorrhage, insomnia, scarlet fever, small pox, colds and cardiovascular disorders. It has been shown that saffron is a protective agent against chromosomal damage. Saffron has been vegetative propagated by corn, each mother corn produce 7-8 cormlet each year. The main colors of saffron, crocetin and crocetin glycosides, and the main flavors, picrocrocin, Safranal is the main component of aroma and it's bitter taste is related to Glycoside picrocrocin that are derived from the oxidative cleavage of the carotenoid zeaxanthin which cleavage by zeaxanthin cleavage dioxygenase (ZCD).

Saffron (Crocus sativus L.) is a valuable medicinal plant whose product is varied under different types of stresses.

Several studies demonstrated the antimicrobial effects of red stigmas of saffron flowers but because of the high expense of the stigma the use of this part of the plant as antimicrobial agent is not economical. Therefore, in this study the antibacterial activity of the total methanol extract of the petals and stamens of Saffron flowers against five foods borne strains were evaluated.

Saffron (Crocus sativus L.) belongs to the Iridaceae family. Its valuable dried spice that accumulates in the stigmas is widely used for coloring and flavoring many foods. it has a long medicinal history as part of traditional healing; several modern research studies have hinted that the spice has possible anticarcinogenic (cancer-suppressing), anti-mutagenic (mutation preventing), immunomodulating, and antioxidant-like properties.

Saffron is dried stigmas of Crocus sativus L. and member of Iridaceae family which is propagated with means of corms, because it is a sterile plant and can’t produce seeds. Each mother corm produces 8-9 cormlet every year. Corms are faced with much stress, such as water deficiency, during its development. Biochemical investigations are playing the predominant role in improving the quality of yield such as saffron.
Crocus sativus L. (Iridaceae) commonly known as saffron is a perennial stem less herb widely cultivated in Iran and Greece. Among the elements important for plant growth and development iron plays an important role because of its peculiar physic-chemical properties. It is essential for the functional number of redox protein and free iron act as a catalyst in the fenton reaction. Leaching derived from vermicomposting called worm tea. Vermicompost leachate might contribute to plant development because it contains Nutrients, Hormones, humic acid and beneficial Microorganisms.

As Saffron has natural antimicrobial properties and is growing in many regions in Iran increasingly, thus, the extract of some parts of this plant is applicable in food products. On the other hand, the importance of Staphylococcus aureus in meat products as hamburger has been proven previously due to manual handling or post-processing contamination. With regard to the above mentioned, usage of Saffron is considered essential in meat products as a natural antimicrobial agent to prevent food poisoning and spoilage. Perhaps, saffron extract has a strong antimicrobial influence against many known pathogens in food products, but it needs to be performed in researches about the effect of this extract on sensory properties and total acceptance in near future.

Pain is the toughest human experience and herbal medicines have been used to reduce the pain from long time ago. Saffron, is a plant food flavor which had been established to have many health benefits. Saffron has been used to reduce pain and believes to reduce the tooth pain. Therefore in this study the effect of saffron on the dental pain control after the root canal treatment was clinically examined (Golmohammadi, 2012).

Types of Saffron

Saffron from different producer countries, picked and dried in different ways gives rise to different end qualities. The various saffron crocus cultivars give rise to thread types that are often regionally distributed and characteristically distinct. Varieties (not varieties in the botanical sense) from Spain, including the trade names "Spanish Superior" and "Creme", are generally mellower in color, flavor, and aroma; they are graded by government-imposed standards. Italian varieties are slightly more potent than Spanish. The most intense varieties tend to be Iranian. Various "boutique" crops are available from New Zealand, France, Switzerland, England, the United States, and other countries, some of them organically grown. In the U.S., Pennsylvania Dutch saffron—known for its "earthy" notes—is marketed in small quantities.

Consumers may regard certain cultivars as "premium" quality. The "Aquila" saffron, or zafferano dell'Aquila, is defined by high safranal and crocin content, distinctive thread shape, unusually pungent aroma, and intense colour; it is grown exclusively on eight hectares in the Navelli Valley of Italy's Abruzzo region, near L'Aquila. It was first introduced to Italy by a Dominican monk from Inquisition-era Spain. But the biggest saffron cultivation in Italy is in San Gavino Monreale, Sardinia, where it is grown on 40 hectares, representing 60% of Italian production; it too has unusually high crocin, picrocrocin, and safranal content. Another is the "Mongra" or "Lacha" saffron of Kashmir (Crocus sativus 'Cashmirianus'), which is among the most difficult for consumers to obtain. Repeated droughts, blights, and crop failures in the Indian-controlled areas of Kashmir combine with an Indian export ban to contribute to its prohibitive overseas prices. Kashmiri saffron is recognizable by its dark maroon-purple hue; it is among the world's darkest, which hints at strong flavor, aroma, and coloring effect.

Saffron was detailed in a 7th-century BC Assyrian botanical reference compiled under Ashurbanipal. Documentation of saffron's use over the span of 4,000 years in the treatment of some 90 illnesses has been uncovered. Saffron-based pigments have indeed been found in 50,000 year-old depictions of prehistoric places in northwest Iran. The Sumerians later used wild-growing saffron in their remedies and magical potions. Saffron was an article of long-distance trade before the Minoan palace culture's 2nd millennium BC peak. Ancient Persians cultivated Persian saffron (Crocus sativus 'Hausknechtii') in Derbena, Isfahan, and Khorasan by the 10th century BC. At such sites, saffron threads were woven into textiles, ritually offered to divinities, and used in dyes, perfumes, medicines, and body washes. Saffron threads would thus be scattered across beds and mixed into hot teas as a curative for bouts of melancholy. Non-Persians also feared the Persians' usage of saffron as a drugging agent and aphrodisiac. During his Asian campaigns, Alexander the Great used Persian saffron in his infusions, rice, and baths as a curative for battle wounds. Alexander's troops imitated the practice from the Persians and brought saffron-bathing to Greece.

Conflicting theories explain saffron's arrival in South Asia. Kashmiri and Chinese accounts date its arrival anywhere between 2500–900 years ago. Historians studying ancient Persian records date the arrival to sometime prior to 500 BC, attributing it to a Persian transplantation of saffron corms to stock new gardens and parks. Phoenicians then marketed Kashmiri saffron as a dye and a treatment for melancholy. Its use in foods and dyes subsequently spread throughout South Asia. Buddhist monks wear saffron-colored robes; however, the robes are not dyed with costly saffron but turmeric, a less expensive dye, or jackfruit. Monks' robes are dyed the same
color to show equality with each other, and turmeric or ochre were the cheapest, most readily available dyes. Gamboge is now used to dye the robes.

Some historians believe that saffron came to China with Mongol invaders from Persia. Yet saffron is mentioned in ancient Chinese medical texts, including the forty-volume pharmacopoeia titled *Shennong Bencaojing* ("Shennong's Great Herbal", also known as *Pen Ts'ao* or *Pun Tsao*), a tome dating from 300–200 BC. Traditionally credited to the fabled Yan ("Fire") Emperor Shennong, it discusses 252 photochemical-based medical treatments for various disorders. Nevertheless, around the 3rd century AD, the Chinese were referring to saffron as having a Kashmiri provenance. According to Chinese herbalist Wan Zhen, "[t]he habitat of saffron is in Kashmir, where people grow it principally to offer it to the Buddha." Wan also reflected on how it was used in his time: "The flower withers after a few days, and then the saffron is obtained. It is valued for its uniform yellow color. It also can be used to aromatize wine" (Golmohammadi, 2012).

**Saffron in Wider Near East, Western Europe and the USA**

The Minoans portrayed saffron in their palace frescoes by 1600–1500 BC; they hint at its possible use as a therapeutic drug. Ancient Greek legends told of sea voyages to Cilicia, where adventurers sought what they believed were the world's most valuable threads. Another legend tells of Crocus and Smilax, whereby Crocus is bewitched and transformed into the first saffron crocus. Ancient perfumers in Egypt, physicians in Gaza, townspeople in Rhodes, and the Greek *hetaira* courtesans used saffron in their scented waters, perfumes and potpourris, mascaras and ointments, divine offerings, and medical treatments.

In late Hellenistic Egypt, Cleopatra used saffron in her baths so that lovemaking would be more pleasurable. Egyptian healers used saffron as a treatment for all varieties of gastrointestinal ailments. Saffron was also used as a fabric dye in such Levantine cities as Sidon and Tyre. Aulus Cornelius Celsus prescribes saffron in medicines for wounds, cough, colic, and scabies, and in the mithridatium.

Such was the Romans’ love of saffron that Roman colonists took it with them when they settled in southern Gaul, where it was extensively cultivated until Rome's fall. Competing theories state that saffron only returned to France with 8th-century AD Moors or with the Avignon papacy in the 14th century AD.

European saffron cultivation plummeted after the Roman Empire went into eclipse. As with France, the spread of Islamic civilization may have helped reintroduce the crop to Spain and Italy. The 14th-century Black Death caused demand for saffron-based medicaments to peak, and Europe imported large quantities of threads via Venetian and Genoan ships from southern and Mediterranean lands such as Rhodes. The theft of one such shipment by noblemen sparked the fourteen-week long *Saffron War*.

The conflict and resulting fear of rampant saffron piracy spurred corm cultivation in Basel; it thereby grew prosperous. The crop then spread to Nuremberg, where endemic and insalubrious adulteration brought on the *Satranschou* code whereby culprits were variously fined, imprisoned, and executed.

Saffron cultivation was introduced into England in around 1350, the story being that corms were smuggled from the Levant in a special hollow compartment of a pilgrim's staff. The crop seems to have been initially grown in monastic gardens for medicinal use, only being planted in the less kind conditions of open fields many decades later. Soil and climatic conditions meant that by the sixteenth century, saffron cultivation had centered on Eastern England. The Essex town of Saffron Walden, named for its new specialty crop, emerged as a prime saffron growing and trading centre. However, an important omission in a botanical book published in the 1790s meant that the true extent of saffron growing in the eastern counties has been long overlooked. North Norfolk (especially the area around Walsingham), southern Cambridge shire and a small area of west Suffolk also produced saffron. Some was also grown in Gloucestershire and other "Westerlie Parts" according to one source. The evidence for this comes from several angles including tithe records, estate records and field names. In Norfolk, customs records show locally grown saffron was exported to the Low Countries. (The crop has recently been re-introduced to Norfolk and award-winning ISO 3632 category I saffron is grown at Burnham Norton.).

However, an influx of more exotic spices—chocolate, coffee, tea, and vanilla—from newly contacted Eastern and overseas countries caused European cultivation and usage of saffron to decline. The last grower in England appears to have been John Knott of Duxford in Cambridge shire, who delivered his crop to London apothecaries until around 1818. It would be more than two centuries before saffron was commercially grown in England again. Only in southern France, Italy, and Spain did the clone significantly endure.

Europeans introduced saffron to the Americas when immigrant members of the Schwenkfelder Church left Europe with a trunk containing its corms. Church members had grown it widely in Europe. By 1730, the Pennsylvania Dutch cultivated saffron throughout eastern Pennsylvania. Spanish colonies in the Caribbean bought large amounts of this new American saffron, and high demand ensured that saffron's list price on the Philadelphia commodities exchange was equal to gold. Trade with the Caribbean later collapsed in the aftermath of
the War of 1812, when many saffron-bearing merchant vessels were destroyed. Yet the Pennsylvania Dutch continued to grow lesser amounts of saffron for local trade and use in their cakes, noodles, and chicken or trout dishes. American saffron cultivation survives into modern times, mainly in Lancaster County, Pennsylvania (Golmohammadi, 2012).

<table>
<thead>
<tr>
<th>Table 1. global situation of Iran in producing of Saffron (2013)</th>
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<tr>
<td>producing of Saffron in the world (tons)</td>
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<tr>
<td>170</td>
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(Government of Iran, Ministry of Jihad Agriculture, Agronomy statistics of South Khorasan province. 2013. Table extracted by: golmohammadi, F. 2014)

<table>
<thead>
<tr>
<th>Table 2. acreage of planting and amount of producing Saffron in South Khorasan province during 2009-2012</th>
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<tr>
<td>year</td>
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<td>2010</td>
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<td>2011</td>
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<td>2012</td>
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(Government of Iran, Ministry of Jihad Agriculture, Agronomy statistics of South Khorasan province. 2013. Table extracted by: golmohammadi, F. 2014)

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<tr>
<th>Table 3. Nutritional value of Saffron</th>
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<td>Saffron (Crocus sativus L.) Nutritional value per 100 g (3.5 oz)</td>
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<tr>
<td>Energy</td>
</tr>
<tr>
<td>Carbohydrates</td>
</tr>
<tr>
<td>Dietary fiber</td>
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<tr>
<td>Fat</td>
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<tr>
<td>saturated</td>
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<tr>
<td>- monounsaturated</td>
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<td>- polyunsaturated</td>
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<td>Protein</td>
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<tr>
<td>Water</td>
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<tr>
<td>Vitamin A</td>
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<td>Thiamine (vit. B₁)</td>
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<td>Riboflavin (vit. B₂)</td>
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<td>Niacin (vit. B₃)</td>
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<td>Vitamin C</td>
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<td>Folate</td>
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<tr>
<td>Vitamin B₆</td>
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<td>Ash</td>
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(Golmohammadi, 2012).

**Trade of Saffron in the world**

Almost all saffron grows in a belt bounded by the Mediterranean in the west, and the rugged region encompassing Iran and Kashmir in the east. The other continents, except Antarctica, produce smaller amounts. Some 300 t (300,000 kg) of dried whole threads and powder are gleaned yearly, of which 50 t (50,000 kg) is top-grade "coupe" saffron. Iran answers for around 90–93% of global production and exports much of it.[16] A few of Iran's drier eastern and southeastern provinces, including Fars, Kerman, and those in the Khorasan region, glean the bulk of modern global production. In 2005, the second-ranked Greece produced 5.7 t (5,700.0 kg), while Morocco and Kashmir, tied for third rank, each produced 2.3 t (2,300.0 kg).

In recent years, Afghan cultivation has risen; in restive Kashmir it has declined. Azerbaijan, Morocco, and Italy are, in decreasing order, lesser producers. Prohibitively high labour costs and abundant Iranian imports mean that
only select locales continue the tedious harvest in Austria, England, Germany, and Switzerland—among them the Swiss village of Mund, whose annual output is a few kilograms. Tasmania, China, Egypt, England (at a tiny village in the county of Norfolk) France, Israel, Mexico, New Zealand, Turkey (mainly around the town of Safranbolu), California, and Central Africa are micro scale cultivators.

To glean 1 lb (450 g) of dry saffron requires the harvest of 50,000–75,000 flowers; a kilogram requires 110,000–170,000 flowers.[80][81] Forty hours of labor are needed to pick 150,000 flowers.[82] Stigmas are dried quickly upon extraction and (preferably) sealed in airtight containers.[83] Saffron prices at wholesale and retail rates range from US$500 to US$5,000 per pound, or US$1,100–11,000/kg, equivalent to £2,500/€3,500 per pound or £5,500/€7,500 per kilogram. The price in Canada recently rose to CA$18,000 per kilogram. In Western countries, the average retail price in 1974 was $1,000/£500/€700 per pound, or US$2,200/£1,100/€1,550 per kilogram.[84] In February, 2013, a retail bottle containing 0.06 ounces could be purchased for $16.26 or the equivalent of $4,336 per pound or as little as about $2,000/pound in larger quantities. A pound contains between 70,000 and 200,000 threads. Vivid crimson coloring, slight moistness, elasticity, and lack of broken-off thread debris are all traits of fresh saffron. Saffron is the most expensive spice in the world.

Use of Saffron

Saffron's aroma is often described by connoisseurs as reminiscent of metallic honey with grassy or hay-like notes, while its taste has also been noted as hay-like and sweet. Saffron also contributes a luminous yellow-orange coloring to foods. Saffron is widely used in Indian, Persian, European, Arab, and Turkish cuisines. Confectioneries and liquors also often include saffron. Common saffron substitutes include safflower (Carthamus tinctorius, which is often sold as "Portuguese saffron" or "açafraão"), annatto, and turmeric (Curcuma longa). Saffron has also been used as a fabric dye, particularly in China and India, and in perfumery.[84] It is used for religious purposes in India, and is widely used in cooking in many cuisines, ranging from the Milanese risotto of Italy to the bouillabaisse of France to the biryani with various meat accompaniments in South Asia (Alipour Eskandani, 2013).

Saffron has a long medicinal history as part of traditional healing; several modern research studies have hinted that the spice has possible anticarcinogenic (cancer-suppressing), anti-mutagenic (mutation-preventing), immunomodulating, and antioxidant-like properties. Saffron stigmas, and even petals, may be helpful for depression. Early studies show that saffron may protect the eyes from the direct effects of bright light and retinal stress apart from slowing down macular degeneration and retinitis pigmentosa. (Most saffron-related research refers to the stigmas, but this is often not made explicit in research papers.) Other controlled research studies have indicated that saffron may have many potential medicinal properties (Golmohammadi, 2012).

harvesting of saffron

As indicated in legend, saffron itself is derived from the long reddish-orange stigma of the low ornamental saffron crocus plant's large lily-shaped purple flower. Handpicked and harvested on early autumn morning of warm nights, anywhere from 70,000 to 250,000 of them are actually needed in order to collect just one pound of pure saffron. In Central Otago trials it took 45-55 minutes to pick 1000 flowers and 100-130 minutes to remove stigmas for drying. This means it takes around 370-470 hours of work to produce 1 kg of dried saffron.

Thus, this labor-intensive but highly cherished yellow-hued wonder has established itself worldwide as "a spice to be reckoned with." Luckily, a little bit of saffron goes a long way, as only one pinch is needed in order to flavor and color a culinary creation. In fact, more than a pinch could be not only bitter, but also ultimately toxic: “The use of it ought to be moderate and reasonable, for when the dose is too large, it produces a heaviness of the head and sleepiness. Some have fallen into an immoderate convulsive laughter which ended in death.” Culpeper’s The Complete Herbal, 1649 (Alipour Eskandani, 2013).

The harvest of saffron crop begins with picking of the blossoms and separating the stigmas from them. The harvest period is traditionally from late September to the late December. The process begins early in the morning before sunrise. The stigmas collected are placed in shade in a warm and dried room for five to seven days to dry. In some cases the drying is done in a ritual of roasting. And finally, after the stigmas are dry, they are variously packed and stored away from light and humidity. A survey of the regions where saffron is grown will provide testimony to the fact that the knowledge of cultivation was transferred from Iran to other regions (Alipour Eskandani, 2013).
Figures. 30 - 44. using all of the family members of farmers namely old men and women, girls and children in various stages in cropping of saffron specially in stage of gathering in the Tagheski plain and Gol and Freez villages – 48 & 55 km distance to Birjand city center of South Khorasan province-East of Iran (pictures by author. Oct 21, 2013 & Nov 4, 2013)

**Trade of Saffron of Iran with EU and WTO**

**EU**

With respect to saffron, the European Union’s Common Agricultural Policy (CAP) of 2001 deems saffron as a “protected designation of origin” (PDO) product, meaning that under intellectual property laws, the EU recognizes “Azafran de La Mancha” as an item whose exclusive intellectual property rights belong to Spain, the “geographic indication” (GI) region thus ascribed to the good. The EU’s GI proposals in general have been highly criticized,
described by various scholars and economists as “a protectionist tool” used to “disallow products names after a region or associated with a particular region unless they were produced there.”

Another criticism of the EU’s GI international registry stems from the practical concern of policing. The registry would require nations to recognize, enforce, and police their companies and prevent them from using those indications marked in the registry. In order to do so, a “new regulatory bureaucracy would need to be created in each country.” The EU is already monitoring a steadily growing 2,100+ of such GIs, and this would have to be extended to the international registry.

Despite these contentious complexities, the TRIPS agreement, through the WTO, seeks to protect such “regional rights,” as described below.

**WTO**

Under the 1995 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS agreement) of the WTO, saffron could potentially gain protection under Article 22. Article 22 states, “geographical indications are, for the purposes of this Agreement, indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin.”

Despite saffron’s often-noted Iranian origin and reputation, there is enough “buzz” surrounding saffron’s Spanish “roots” to warrant such possible identification. As of yet, no final decisions have been reached regarding Spain’s “Azafran de la Mancha” GI protection, and thus, its effects upon the future of Iran and Spain’s bilateral trade agreements are even more uncertain.

As for cases of specific dispute, there are none with respect to Iran and Spain’s intellectual property concerns. However, previously, when the US Patent Office granted the University of Mississippi in Jackson exclusive rights to medicinal use of saffron, the Indian Council for Scientific Research fought American courts and proved via ancient Sanskrit texts that the knowledge lies in the heart of Indian heart and tradition. The U.S. research monopoly took two years to undo, and is one of the few success stories regarding intellectual property claims (Golmohammadi, 2012).

**Iranian Saffron in its Environment**

Iranian saffron’s primary commercial cultivation is in the eastern and southeastern parts of the country, where the extreme climate and flat, treeless landscapes are best suited for the Sativus Crocus flower’s proliferation. The saffron flower, which flourishes best in hot and dry weather in the summer, and cold weather in the winter, grows well in the regions’ sandy or clay-laden soils.

Saffron cultivation works on a cyclical basis, not only with each year, but also among seven-to-nine-year intervals, at which time studies show production begins to decline. At that time, the land is used to sow other crops instead, such as grains, in order to replenish the soil’s lost nutrients. Thus, the younger bulbs, two to three years old, according to the locals, are ideal, as they produce the best quality saffron yields.

Within the year itself, the sowing season is between June and July, where the bulbs are placed in 20-centimeter-deep ridges, about 10 centimeters apart from one another. The bulbs must be sown by hand, a very labor-intensive process yielding only a 1% return. In other words, for every 1,000 grams of the flower, only 10 grams of saffron is actually obtained. Again, this means that 70,000 to 250,000 actual flowers are needed in order to collect just one pound of pure saffron.

Nevertheless, the bulbs are both painstakingly planted and handpicked and harvested in 100% organic conditions—as of now, sources say, no chemical means are used to enhance or facilitate saffron growth. The handpicking of blossoms, and the manual separation of the stigmas—the part of the flower that is dried, from which usable saffron is actually derived—takes place from late September to late December, when the blossoms are from 15 to 20 days old. During this time, the harvesting hours begin very early in the morning before sunrise, and continue until close to lunchtime (Golmohammadi, 2012).

After harvest, the stigmas are taken to dry—a process whose execution is especially crucial due to the stigmas’ natural moisture, essential in maintaining active chemicals’ properties. Traditionally placed in a warm, dry, shady room for just under a week, saffron stigmas have even sometimes been known to be roasted. Once dried, they are “packed away far from light and humidity,” often employing the latest and most sophisticated technological methods to ensure preservation of this highly coveted, low-return treasure of labor. Standards are then calculated from lab analyses, conducted based on the ISO 3632 standard (Golmohammadi, 2012).
Quantitatively, the Khorassan Province is by far Iran’s most impressive region of saffron activity, weighing in at nearly 90% of all Iranian cultivation and production. The Qayen Province, in spite of its more meager production figures, still fares very high on the quality scale, and thus is a proud source of saffron for world trade. Though many other regions in Iran, such as the Fars Province’s Estahbanat, as well as part of the Kerman Province, have histories of cultivation, production in these areas have been primarily focused on domestic consumption rather than on production for exportation purposes. Production is, however, reported to be on the rise in these regions.

**Tarvand Saffron Company - An Iranian Saffron Success Story**

Tarvand Saffron Company began 150 years ago, when Mohsen Ehtesham’s grandfather, Mr. G. Fathi, started growing saffron in a region of Iran called Gibra, 25 kilometers away from Ghaen, the “City of Saffron” an area with the perfect climate for cultivation. As it caught on in Mr. Fathi’s family, generation after generation, it progressively grew, eventually making its way to Mr. Ehtesham, current Chairman of the Board and Managing Director of Tizpak, Inc., of which Tarvand Saffron Company is a part.

One of the greatest current proponents of technological innovation in saffron production—a recent movement geared toward increasing Iran’s competitive edge— it seems that Mr. Ehtesham’s family has always valued the pursuit of proper scientific methods of saffron production. Mr. H. Fathi, another of his ancestors, graduated from Tehran University 105 years ago, becoming one of the first agricultural engineers in south Khorassan, applying his skills also toward producing the highest-quality saffron possible.

The following generation, Mr. Ehtesham’s parents, also became fanatic fans of saffron, devoting their lives to the cause of cultivation as well. However, they were the first generation to move beyond pure production into the realm of “honest trading.”

In 1962, Mohsen Ehtesham was born into the same region, and thus, the same business, continuing his education to receive his MBA, writing his Thesis on the effect of investment in technical units of sorting, processing, and packaging saffron (Golmohammadi, 2012).
He has since inaugurated his first systematic plant with modern facilities, and also began a tradition, hosting the First Festival of Saffron in November 2002, at which the Vice President/Secretary of Ministry of Agriculture, members of parliament, University instructors, and inter- and intra-national saffron traders were in attendance. Today, the mission continues to grow, as does Mr. Ehtesham’s profitability and corporate enterprise, having expanded into producing not only saffron, but also beauty and home products as well.

CONCLUSION

Globally, Saffron is currently grown and produced in, and imported from, Egypt, Southern Europe, Spain, Morocco, Turkey, India, and Iran. In Iran, the most significant quantity and quality of saffron comes from southern Khorasan, an Iranian province that, according to its Governor General, produced 173 of the world’s 210-ton output in 2002. Qayen and Torbat are also major cultivation areas in Iran. Because exports of saffron brought in revenues of $51 million to Iran in 2001, Director of National Saffron Festival Akhlaqipour and President Mohammad Khatami began encouraging further economic development, raising media publicity of Iranian saffron, as well as calling for upgraded and technologically innovative production means, in an effort to raise the quality of their product to “a level at par with international standards.” As it stands, Iran, along with Spain, is recognized as producing the highest quality of the spice, as measured by International Standardization Organization (ISO) guidelines.

Due to the long experience with its cultivation, and the transfer of methods of growing and harvesting from person to person, or generation to generation, Iranian saffron has managed to keep its distinctive qualities in comparison with those produced in other regions of the world. That might also explain why Iranian saffron enjoys such an exceptional recognition for its fragrance, flavor and color at international markets. Iran uses 10-15 t in its domestic market and the rest is exported to Spain. Spain re-exports this product together with its own. Trade statistics, therefore, give an inflated impression of the size of the Spanish industry. Overall, Spanish production is in decline, due mainly to increasing labor costs and the unwillingness of young people to enter the industry. Spain is NOT the biggest producer, nor is ALL of its saffron production excellent quality.

Saffron is widely cultivated in Iran and is one of the natural edible dyes with high economical and biological value which is used to increase acceptability of foods in society. It is known as a spice and obtained from the dried stigma of saffron flower (Crocus sativus). Many compounds and properties of stigma have been considered as volatile agents (safranal), bitter principles (picrocrocin), dye materials (crocetin and its glycosidic, crocin) and pharmacologically actives so far. Color must have high quality and safety and its addition to foods have relation with food nutrition value. Saffron stigma includes Crocin, Picrocrocin, Safranal which are related to its color, flavor and odor, respectively. Up to now many scientists make pharmacological extract, but the aim of this research is production of saffron extract with increasing its quality factors. This product is extracted with polar solvent and produced as a ready to use solution which can be diluted in water and include saffron color, odor and flavor.

Throughout saffron’s global journeys, Iran has long been a significant, but often overlooked, source of high-quality saffron production and export. Recent trade data from several sources indicates that Iran’s ancient tradition is still alive, with the nation reigning in many surveys as the number one exporter of saffron worldwide, consistently producing as much as 85% of world output. However, many regional importers are thought to also be exporters of the Iranian saffron, in other words, re-exporting Iranian saffron, usually under a different name and for as much as three times the profit margin. How and why does this happen? Can Iran seek protection? Due to the Islamic Republic’s inability to gain membership status to the World Trade Organization (WTO), it currently runs the risk of sacrificing its saffron rights to Spain, despite—or perhaps partly as a result of—their recent bilateral trading
agreements with one another. While it is clear that Iran is economically engaged with Spain via saffron and other products and industries, what does this development mean for the Iranian saffron industry within the world saffron trade? In other words, whose saffron is it, anyway, and is there any dispute among the contenders? This case study attempts to better understand this question, along with the cultural and environmental impacts of such trade patterns.

Saffron as the most expensive agricultural and medicinal plant has a unique status among industrial and export products. Today, with %60 of the universal production, Iran is considered the main producer of Saffron in the world. Saffron's numerous qualities and uses together with the role it plays in the economy of Iranian farmers call for a particular attention to eradicate problems regarding its production, export and merchandising. Among exporting items, Saffron has a high exporting value in Khorasan, since it constituted %92 of the whole export items and %98 of the cultivated land in 2001. The high quality of Saffron produced in Iran has persuaded some European countries like Spain to buy Iran's Saffron in bulk. Later on they pack them under Spanish titles and present them to International markets. It goes without saying that they cannot produce Saffron with such Quality, since those countries lack the climatic and ecological conditions necessary to grow such a valuable product. So the Khorasanian scholars and writers should try to introduce this precious native product to the other nations based on the findings and information they have. Saffron is important from aspects of economy, medicine, producing employment opportunities and as food stuff. This article tries to describe a brief history of Saffron, explain its qualities and introduce the ecosystem of medicinal plants in Southern Khorasan. It also attempts to introduce the problems and difficulties with regard to Saffron and its export.

Saffron is a herbal and chromic plant. Saffron is one of the major items of export at present that only 20 percent of it used as domestic consumption and the remainder is exported to other countries in the world. Saffron is one of the most valuable spices and also it is very valuable as a drug.

Saffron (Crocus sativus L.) is a cash crop acclimatized to hillsides and plateaus of arid and semi-arid regions [1] although majority cultivated in east of Iran annually around 55000 hectares with production more than 180 tones. Saffron is one of crops that have competition with other field crops in Khorasan Razavi province compared by benefit to cost ratio. Modelling of production helped us to understand how it goes up area of cultivation every year and what points are more important to manage increasing of saffron to have a balance between market demand and resources use efficiency. Cropping pattern programming showed the most important factors of saffron competition are water requirement, non overlapping of water requirement with few crops, history of good minimum price in market and excellent reflects to enhance of farm management. In addition it is fitted to small holder farmers conditions. In an overview results showed there are potential of increasing saffron cultivation in some cities area like Torbat-Heydarieh, Khaf, Kashmar and Nishabour. But in other areas saffron competition for taking resources not overcomes by other major field crops. When model runs for more efficiency in water uptake individually, saffron comes in the higher level of cultivation pattern table. But in a goal programming with multi objective frameworks it is recommended only for 32 percent of khorasan province farms. This type of research is an economic and biologic analysis for saffron production that can be used for other new comer plants, like medicinal plants, to cultivation pattern of any region.

Saffron is dried stigmas of crocus sativus L. and member of Iridaceae family which is propagated with means of corms, because it is a sterile plant and can't produce seeds. Each mother corm produces 8-9 cormlet every year. Corms are faced with much stress, such as water deficiency, during its development.

Iran is one of rich centers of saffron germ plasm in the world. Moreover, the populations belonged to one species which has been grown in different ecological conditions usually varies genetically. The high level of genetic diversity led to increasing selection chance of the proper genotypes for plant domestication and breeding.

Iran is considered as one of the major centers of plant species variation including medicinal herb saffron. However, the medicinal species have been prone to extinction in recent years. Therefore, It is essential to make conservation and collection of the species by different ways e.g. to establish gene bank and evaluating the populations in order to identify the medicinal valuable genotypes.

Saffron (Crocus sativus L.) is a geophytic plant which is one of the most commonly known medicinal and aromatic plant species in the world. The stigma of saffron is used for dye, food or beverages additive and in the pharmacology industries. Little information is available on the saffron nutrition and hormonal properties. Saffron (Crocus sativus L.) is one of the highest priced spices of world and its quality depends on the concentration of three major metabolites: crocin, safranal and picrocrocin which are responsible for color, aroma and bitter taste of saffron, respectively. The use of saffron as a medicinal plant has a long history and it has been used as a sedative and analgesic in traditional medicinal preparations.
Saffron (*Crocus sativus* L.), an herbaceous sterile triploid plant, is used mainly as a source of secondary metabolites having aromatic and medicinal value. The major secondary metabolites of saffron are crocin (which is glycoside derivatives of trans-crocetin), picrocrocin, and safranal.

Saffron stigma, contain some chemical substances such as crocin that shows the beneficial effects against some diseases. Crocin is unusual, in that it is water soluble carotenoid as a consequence of their glycosylated state, so it is easy to administer. Thus it appears to be an appropriate component of saffron for evaluation as potential anticancer agents. On the other hand breast cancer is the second leading cause of cancer related death among women and about 70% of these cancers are estrogen-dependent for growth.

Saffron, *Crocus sativus*, is the most expensive spice in the world. Saffron though cultivated in different parts of the world, is mainly cultivated in Iran. It has wide range of medical uses such as antitumor, antifungal and anti-inflammatory activities.

Saffron (*Crocus sativus* L.) is a Native plant of Iran including various medical and food properties. Saffron has an important place and great background in terms of economical issues in Iran. There is a growing concern and demand for healthy food on behalf of both policy makers and the public. Traditional saffron production systems which, in both technical and social terms are forms of ecological production are still operated in many parts of Iran. A return to more sustainable production systems in a country like Iran with a long history of ecological agriculture could be one effective method to protect the fragile local environments. Agronomic practices such as application of organic fertilizers, non-chemical methods for pests and weed control, complete family labour work for production and processing, share-cropping and socio-cultural environment surrounding the whole process of saffron is in compliance with organic farming principles. Alternative treatments in which application of chemical pesticides is at its lowest level have been under increasing consideration. There are various references showing that application of bottom mushroom bed residue compost bring different benefits such as weed reduction, water capacity and soil structure improvements (Janpoor, & Soltanian, 2013).

Nowadays, the world business is based on the competition. In this regard, the use of more efficient methods and tools has been the center of attraction. Packing is one of the effective measures in the process of selling products to count. Iran enjoys favorable climate conditions; therefore, it can produce many crops such as saffron and it also is the biggest producer of it in the world. But due to lack of proper facilities for packaging, the license of direct exports of the product is lost.

Today, trade is a global issue that definitely needs to follow world trade rules. Saffron trade in the us countries can be studied as a model in the process of global trade. Iran as the world's largest producer and exporter of saffron a significant proportion of the production, cultivation and the export value is allocated to this product. The process of strategic and targeted development of sustainable agriculture in the context of WTO agricultural trade can be optimized. Increasing production efficiency, knowledge transfer, and R&D spillovers depends on the expansion of agricultural trade, in addition to providing goal the WTO; the international competitiveness of products for export development will be possible. If the causes, problems and constraints affecting the export demand and supply will be identified, and then eliminate or reduce the export of actions take place, the possibility of optimizing the export market will be in the international arena. Given the name of plants such as saffron is identified with Iran so Thinkers and writers on this land is and relevant information to make it available to interested. And to learn those actual and potential characteristics of this valuable plant and also its various aspects of economic, employment, medication, etc. In this paper, it has been introduced to the saffron and its properties and saffron to the historical background and its economic importance is also discussed. It also posed challenges and effective strategies for maintaining and developing world markets offered.

Due to the post-Islamic Revolution era’s political tensions, the modern-day Islamic Republic of Iran suffers long-standing trade sanctions from much of the Western world. Iran’s continual attempts to join the World Trade Organization (WTO) have persistently failed from the early 1990s well into the new millennium. In April 2004, Iran's Expediency Council Chairman Akbar Hashemi Rafsanjani cites Iran’s “peaceful nuclear programs” as one such obstacle to WTO membership. Washington, holding firm, refuses to budge, as the United States, backed by Israel, has continually blocked the Islamic Republic's WTO entry based upon its status as a “rogue state.”

Thus, Iran has drifted away from multilateral trading, and instead, toward establishing bilateral trade agreements with several key nations. Among these nations stands another leading world exporter of—and simultaneously a major importer of—Iranian saffron: Spain. Spain, with a similar climate to Iran and a flourishing saffron trade history and industry of its own, is a WTO member who does not form bilateral trading relations with any developed country. It seeks to claim the exclusive rights to “Azafran de la Mancha”—or Saffron of La Mancha—under European Union (EU) geographic indication (GI) protection. Spain, if successful, may obtain the official rights to the Iranian strands of the spice for good.
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