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Review

Saffron chemicals and medicine usage

Mohammad Sharrif Moghaddasi

Islamic Azad University, Saveh branch, Felestin esq.39187/366, Saveh, Iran. E-mail: memo1340@yahoo.com.

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The reputation of growing saffron is about 2500 years. Apparently saffron originally comes from Greece and Mediterranean region. There are some researchers who believe that origin of this plant comes from Iran. Iran is considered to be one of the greatest producers of saffron and nearly 90% of production of saffron is produced in Iran. There are varieties of chemical components present in the stigma of the saffron plant. These chemical components include carbohydrates, minerals, mucilage, vitamins such as riboflavin and thiamine, color pigments such as crocin, anthocyanin, carotene, lycopene, Zeaxanthin and aromatic terpenic essence called "safranal" and flavoring substances such as picrocrocin. Crocin (C_{44} H_{64} O_{24}) is the most influential chemical in the coloring of saffron. Other than crocin, saffron is also made up of free aglycone crocin and a small number of anthocyanin pigments. The oil soluble color pigments include lycopene, alpha carotene, beta carotene and Zeaxanthin. Today, based on growing and effective applications of saffron in medical fields and in alternative medicine, it has attracted the attention of many researchers. Saffron may substitute chemical medicines. Some medical properties of saffron are as follows: helps digestion, strengthens the stomach and is anti-tympanites, activates the sexual desire, is analgesic, especially for colicky pains gingivitis, fights tumors and collection of free radicals (thus reacting against cancerous cells), is euphoriant and alleviates neuralgia, is a tranquilizer, cures insomnia, strengthens memory power, improve concentration, reacts against spasm, fights depression, the Alzheimer's and Parkinson's diseases, controls blood pressure disorders, lowers high cholesterol levels, cures iron deficiency (anemia) in girls, reduces chances of such heart diseases as arteriosclerosis, and helps improve heart conditions (due to the presence of thiamin, riboflavin and mineral components), cures respiratory disorders such as asthma, cough, influenza and cold, helps blood circulation in the retina, cures macula lutea and retinopathy ischemic caused by old age. Cures rheumatism and bruises when used externally, cures amebic dysentery, measles, and inflammation of the liver, splenomegaly and urogenital infections. The application of saffron in cancer-treatment experiments performed on laboratory animals has proved successful.

Key words: Saffron, crocin, picrocrocin, carotene, iycopene, antitympanit, analgesic, fights tumor, antidepression.

THE HISTORY OF SAFFRON

Saffron which is one of the most valuable herbs of Iran has attracted the world's attention to itself for its charming fragrance and delightful taste. Due to its valuable properties along with the beauty and gentleness that it grants to skin, it grows to conquer all hearts. There have been several assumptions about the origin of saffron (*Corcus sativus* L.) some of which belong to legends. According to one such legend, saffron was first brought to India with Adam's descent in to this world (Abrishami, 1997).

There are different theories about the origin of saffron. Some research documents have proved that Iran as the native land of saffron which originally grew wild at the foot of Zagros Mountains and surrounding areas of Alvand. The wild growing saffron called "Jo Ghasem" which was first referred to as "Karkomiseh" in Farsi, closely resembles the ordinary saffron. For example corn, leaves, stamen and style in *Crocus* is quite similar to Gouishi. However, because of its short style and low odor Gouishi has no economic value (Abrishami, 1997).

ECONOMIC IMPORTANCE

Saffron as the world most valuable industrial medical product is an important export commodity and is of great significance in Iran's agriculture economy.

At present Iran with production of 90% of the world

Table 1. Analytical results of main components of saffron (Mohammadi, 1997).

Type of component	Size (w/w %)
Moisture	10
Carbohydrates 9based on invert sugar)	14
Tannines	10
Pentosanes	8
Pectin	6
Starch	6
Crocine	2
Other carotenoids	1
Proteins	12
Mineral elements	6
Non-soluble in acid as	0.5
Non-volatile oil	6
Volatile oil	1
Crude fibers	5

saffron is ranked as the largest producer. In 2002 the net income from exporting 121 tons of saffron exceeded 51 million US$ (Sabzevari, 1996).

USES

The three branch style of *C. sativus* flowers is the most important economic part of the plant and known as saffron. This part of the flower contains fats, minerals, and mucilage. Saffron odor is related to colorless trepan essential oil as well as an oxigenous compound of cineole. The bitter test of saffron is due to picrocrocin and picrocrozioide which are soluble in water and alcohol and hardly in chloroform. The origin of saffron color is crocin and produces glucose and crocetin ($C_{20}H_{24}O_4$) after hydrolysis (Kafi, 2002).

Use in food industries

Saffron has a long history about use as a spice and for its wonderful color, odor and test. During the recent years public interest towards using natural additives instead of synthetic chemicals has led to a breakthrough in using saffron as a natural flavoring in food industries (Valizadeh, 1988).

After separation of colorful styles the remaining parts of harvested flowers of saffron are usually considered as waste with no special use. Recent studies have shown that these materials contain considerable amount of antocyanine, a red plant pigment. This pigment together with other felavenoides of cell sap provides beautiful violet color of saffron petioles. After extraction this natural dye will change to red color in acidic conditions.

Production of large amounts of saffron petioles after harvesting could be considered as a potential source of edible food color with antocyanine bases which is a proper substitute for synthetic red coloring agents (Valizadeh, 1988).

Table 2. Different kind of carbohydrates and pigments of dry saffron stigma (Habibi and Bagheri, 1989).

Tape	Sample 1 (%)	Sample 2 (%)
Total reductive sugars	26.70	26.30
Free reductive sugars	14.30	13.80
Sugar after inversion	14.80	14.30
Tannins and dexterine	9.40	10.30
Starch	6.00	6.40
Pentosane	6.40	6.90
Free crocine	0.60	0.50
Croctine	8.40	8.80
Non measurable materials	6.70	6.40
Gentibioside	2.79	2.31
Glucose	7.59	7.88
Fructose	1.85	1.91

Saffron toxicity

At a high dose, saffron has narcotic and ecstasy effect and excessive delight which finally lead to temporary paralysis. Abortion at overdosing with high risk of maternal death is reported (Zargari, 1993; Baker and Negbi, 1983).

CHEMICAL COMPOSITION OF SAFFRON

The type and amount of saffron components is shown in Table 1. Saffron carbohydrates are mostly from reductive sugars, which consist of around 20% of saffron dry weight. Among these carbohydrates the presence of glucose, fructose, gentibose and small quantity of xylose and ramnose were fixed. Table 2 shows all types of saffron carbohydrates and pigments.

International standard organization reported that the total weight of different elements in 100 g of dried saffron as: calcium 111 mg, phosphorous 525 mg, potassium 1724 mg, sodium 148 mg, zinc and magnesium in small quantities (24). Saffron is one of the richest sources of riboflavin. The amount of thiamine and riboflavin in four samples of saffron is shown in Table 3. In one study with mouse treated with 150 mg of saffron and the effect was similar to treating the same mouse with 40 mg of synthetic riboflavin (Habibi and Bagheri, 1989).

SPECIFIC COMPOSITION OF SAFFRON

Pigments of saffron are mainly from carotenoids groups

Table 3. Riboflavin and thiamine of four sample of saffron (Habibi and Bagheri, 1989).

Number of sample	Riboflavin (ug/g)	Thiamine (ug/g)
1	138.0	4.0
2	93.0	3.8
3	78.70	0.72
4	56.40	0.88

with carboxyl. These pigments are present as free crocetin 8,8 diaparorotene 8,8 dicarbixilic acid and other forms along with glucose gentibiose as glycosyl esters. The main coloring property of saffron comes from crocetin. Many investigations revealed that 94% of total crocetin of saffron is present in the form of glycosides compounds in crocetin and the remaining 6% is in the form of free crocetin (Habibi and Bagheri, 1989).

The color of saffron

Crocin (C_{44} H_{64} O_{24}) is the most influential chemical in the coloring power of saffron. It is a rare carotenoid found in nature which can easily dissolve in water. In comparison to other carotenoids, crocin has a wider application as a colorant in food and medicine, mainly because of its high solubility. This substance was first discovered by Solomon and Carrar in crystal form. These scientists have done a number a researcher on the structure of crocin and identified it as follows: Other than crocin, saffron is also made up of free aglycone crocin and a small number of anthocyanin pigments. The oil soluble color pigments include lycopene, alpha carotene, beta carotene and Zeaxanthin. The main parameter in deciding the quality of saffron is its coloring potential which can be measured by the quantity of its colorant components with a spectrophotometer at the wave length of 443 nanometers (Habibi and Bagheri, 1989; International organization for standardization (ISO) 3632-1 1993).

The taste of saffron

A glucose known as picrocrocin (C_{16} H_{26} O_7) is the major factor for the bitter taste of saffron. This bitter substance can undergo crystallization, through acid hydrolysis, producing safranal (a glucose and aldehyde) (27, 28).

Medical and pharmaceutical applications

Saffron is considered to have a great number of medical properties. Today, based on growing and effective applications of saffron in medical fields and in alternative medicine, it has attracted the attention of many researchers.

In traditional medication saffron has several properties such as relaxant, expectorant, exhilarating agent, digestion stimulant, spasm calmative, menstruation and fetus abortion. Saffron was also used against blood diarrhea, fever, measles, hepatitis, liver and spleen syrose, urine infection, cholera, diabetes, and dermal diseases. In English pharmaceutical codex saffron syrup, saffron glycerin and saffron tincture are discussed. Saffron is appetitive and facilitates digestion. Its essential oil is relaxant and could be useful in insomnia of nervous origin. Saffron for its effects on bronchus is used in chronic bronchitis and lung diseases. In South Asia saffron is widely used for kidney, liver, vesica disease and for medication of cholera. External application of saffron tincture is useful for dermal disease such as impetigo. Traditional knowledge of medicinal properties of saffron attracted scientific interest towards this spice and during the last decade several medicine research centers are investigating the biological and medicinal potential of saffron. Reduction of blood bilirubin level and decrease in blood cholesterol and triglycerides after using crocin and crocetin are examples of new findings about saffron properties. Recently anticancer and antitumor effects of saffron have been reported by many researchers. Saffron may substitute chemical medicines (Duke, 1987; Neghi, 1999; Niar et al., 1991).

Some medical properties of saffron are as follows:

i. Helps digestion, strengthens the stomach and is anti-tympanites.
ii. Activates the sexual desire.
iii. Is analgesic, especially for colicky pains gingivitis.
iv. Fights tumors and collection of free radicals (thus reacting against cancerous cells).
v. Is euphoriant and alleviates neuralgia, is a tranquilizer, cures insomnia, strengthens memory power, improve concentration, reacts against spasm, fights depression, the Alzheimer's and Parkinson's diseases.
vi. Controls blood pressure disorders, lowers high cholesterol levels, cures iron deficiency (anemia) in girls, reduces chances of such heart diseases as arteriosclerosis, helps improve heart conditions (due to the presence of thiamin, riboflavin and mineral components).
vii. Cures respiratory disorders such as asthma, cough, influenza and cold.
viii. Helps blood circulation in the retina, cures macula lutea and retinopathy ischemic caused by old age.
ix. Cures rheumatism and bruises when used externally.
x. Cures amebic dysentery, the measles, inflammation of the liver, splenomegaly and urogenital infections.

The application of saffron in cancer-treatment experiments performed on laboratory animals has proved successful (Baker and Neghi, 1983; Zargari, 1993).

In summary, due to saffron's unique properties, it can be used in various industries such as food and medical industries.

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