BY: PROF. C. SIVAKKOLUNDU
DR P. LOGANATHAN

SAFFRON: THE MOST EXPENSIVE SPICE IN THE WORLD

India's contribution to global saffron production is a little over three tonnes; yet this spice plays an important and symbolic role in our cuisine—forcing the country to import from Iran.

Saffron is a spice derived from the flower of the Crocus sativus, commonly known as the saffron crocus. Crocus is a genus in the family Iridaceae. Each saffron crocus grows to 20-30 cm (8-12 in) and bears up to four flowers, each with three vivid crimson stigmas. Together with the styles, or stalks that connect the stigmas to their host plant, the dried stigmas are used in various cuisines as a seasoning and colouring agent. Saffron, among the world's most costly spices by weight, is native to Southwest Asia and was first cultivated in Greece. As a genetically monomorphic clone, it was slowly propagated throughout Eurasia and later in parts of North Africa, North America and Oceania.

Saffron flowers

Features of saffron

Saffron's bitter taste and iodoform or hay-like fragrance results from the chemicals picrocrocin and safranal. It also contains a carotenoid dye, crocin, which imparts a rich golden-yellow hue to dishes and textiles. Its recorded history is attested in a 7th century BC Assyrian botanical treatise compiled under Ashurbanipal, and it has been traded and used for over four millennia. Iran now accounts for approximately 90 per cent of the world's production of saffron. Because each flower's stigmas need to be collected by hand and there are only a few per flower, saffron is the most expensive spice in the world.

The history of saffron

The origin of the English word saffron is, like that of the cultivated saffron clone itself, somewhat uncertain. It stems from the Latin word safranum via the 12th century Old French term safran. Etymology beyond that point is conflicted.

The domesticated saffron crocus, Crocus sativus, is an autumn-flowering perennial plant unknown in other parts of the world. Its progenitors are possibly the eastern Mediterranean autumn-flowering Crocus cartwrightianus, which is also known as 'wild saffron' and originated in Central Asia.

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. They are membrane-like structures that cover and protect the crocus's 5-11 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, and either expand after the flowers have opened or do so simultaneously with their blooming. 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. 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 (0.98-1.2 in) in length.

Nutrition Value of Saffron

Saffron	Nutritional value per 100 g
Energy	1,298 kJ (310 kcal)
Carbohydrates	65.37 g
Dietary fibre	3.9 g
Fat	5.85 g
Saturated	1.586 g
Monounsaturated	0.429 g
Polyunsaturated	2.067 g
Protein	11.43 g
Water	11.90 g
Vitamin A	530 IU
Thiamine (vit. B1)	0.115 mg (10%)
Riboflavin (vit. B2)	0.267 mg (22%)
Niacin (vit. B3)	1.460 mg (10%)
Vitamin C	80.8 mg (97%)
Calcium	111 mg (11%)
Iron	11.10 mg (85%)
Magnesium	264 mg (74%)
Phosphorus	252 mg (36%)
Potassium	1724 mg (37%)
Sodium	148 mg (10%)
Zinc	1.09 mg (11%)
Selenium	5.6 μg
Folate (N1)	93 μg
Vitamin B6	1.010 mg
Ash	5.45 g

Source: USDA Nutrient Database

Areas of cultivation

Crocus sativus thrives in the Mediterranean maquis (shrubland), 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 in 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 1000-1500 mm (39-59 in). The 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. Rain immediately preceding flowering boosts saffron yields, while rainy or cold weather during flowering promotes disease and reduces yields. Persistently damp and hot conditions harm the crop, while rabbits, rats and birds cause damage by digging up corms. Nematodes, leaf rust and corm rot pose other threats.

Mother corms planted deeper yield higher-quality saffron, though they form fewer flower buds and daughter corms. Italian growers optimise thread yield by planting 15 cm (5.9 in) deep, in rows 2-3 cm (0.79-1.2 in) apart, and at a depth of 8-10 cm (3.1-3.9 in) in order to optimise flower and corm production. Greek, Moroccan and Spanish growers, all employ distinct depths and spacing to suit their locales.

The necessary conditions for cultivation

Saffron thrives on 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 the application of some 20-30 tonnes of manure per hectare. Later, 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 ne-

cessity a speedy affair: after blooming at dawn, flowers are harvested immediately—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. One freshly picked flower yields an average 30 mg (0.0011 oz) of fresh saffron or 7 mg (0.00025 oz) of dried saffron.

Grades of saffron

Saffron is graded via the laboratory measurement of crocin (which affects colour), picrocrocin (taste), and safranal (fragrance) content. Determination of non-stigma content (floral waste content) and other extraneous matter such as inorganic material (ash) is also key. Grading standards are set by the International Organisation for Standardisation, a federation of national standards bodies. ISO 3632 deals exclusively with saffron and establishes four empirical colour intensity grades: IV (the poorest), III, II and I (the finest quality). These colour grades proceed from grades with absorbance capabilities lower than 80 (for all Category IV saffron varieties) up to 190 or greater (for Category I). The world's finest samples (the select, red-maroon tips of stigmas picked from the finest flowers) receive absorbance scores in excess of 250. Market pieces for saffron types follow directly from these ISO scores. However, many growers, traders, and consumers reject such lab test numbers. They prefer a more holistic method of sampling batches of thread for taste, aroma, pliability, and other traits in a fashion similar to that practised by wine tasters.

Despite such attempts at quality control and standardisation, 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. 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.

Saffron threads

Varieties of saffron

The various saffron crocus cultivars give rise to thread types that are often regionally distributed and characteristically distinct. Varieties from Spain, including the trade names Spanish Superior and Crème, are generally mellower in colour, flavour, and aroma; they are graded by government-imposed standards. Italian varieties are slightly more potent than their Spanish counterparts, while 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, and some of them are organically grown. In the US, Pennsylvania Dutch saffron—known for its earthy notes—is marketed in small quantities.

Consumers may regard certain cultivars as premium in quality. The Aquila saffron, or the Zafferano dell' Aquila, is defined by its 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 per cent of Italian production. Kashmiri saffron is recognisable by its dark maroon-purple hue—it's among the world's darkest, which hints at a strong flavor, aroma, and colourative effect.

Trade and uses of saffron

Almost all saffron grows in a belt bounded by the Mediterranean in the west and the rugged region encompassing Iran and India in the east. The other continents, except Antarctica, produce smaller amounts. Some 300 tonnes

(300,000 kg) of dried whole threads and powder are gleaned yearly, of which 50 tonnes (50,000 kg) can be rated as top-grade 'coupe' saffron. Iran accounts for around 90-93 per cent of global production and exports much of its crop. A few of Iran's drier eastern and southeastern provinces, including Fars, Kerman, and those in the Khorasan region, harvest the bulk of today's global production. In 2005, Greece, which ranked No 2 in the world, produced 5.7 tonnes (5700 kg), while Kashmir in India produced 2.3 tonnes (2300 kg).

In recent years, Afghan cultivation has risen, while due to the unrest in parts of Kashmir, output has declined—as it has in Azerbaijan, Morocco and Italy. Prohibitively high labour costs and the easy availability of abundant Iranian imports mean that only select locales continue the tedious harvest in Austria, England, Germany and Switzerland—the Swiss village of Mund has an annual output of a few kilograms. Tasmania, China, Egypt, France, Israel, Mexico, New Zealand, Turkey, California, and certain states in Central Africa are micro-scale cultivators.

The price of saffron

To glean an amount of dry saffron weighing 450 g (1 lb) requires growers to harvest 50,000 to 75,000 flowers, from a field the size of a football pitch. 110,000-170,000 flowers or two football fields are needed to gross one kilogram. Forty hours of labour are needed to pick 150,000 flowers. Stigmas are dried quickly upon extraction and (preferably) sealed in airtight containers. Saffron prices at wholesale and retail rates range from US$ 1100 to 11,000/kg. A kilogram contains between 150,000 and 450,000 threads. Vivid crimson colouring, slight moistness, elasticity, and lack of broken-off thread debris are all traits of fresh saffron.

Uses 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 colouring to foods. Saffron is widely used in Indian, Persian and European cuisines. Sometimes, saffron is also used in Arab and Turkish cuisines. Confectioneries and liquors also include saffron. Common saffron substitutes include safflower, annatto and turmeric (Curcuma longa). Saffron has also been used as a fabric dye, particularly in China and India, and in perfumery. It is used for religious purposes in India, and is widely used in cooking in many cuisines, ranging from the Milanese risotto of Italy, the bouillabaisse of France to the biryani and various meat accompaniments in South Asia.

Saffron has a long history in traditional healing; several modern research studies have hinted that the spice has possible anti-carcinogenic (cancer-suppressing), anti-mutagenic (mutation-preventing), immunomodulating and antioxidant-like properties. Saffron stigmas, and even petals, may be helpful for depression. Saffron may protect the eyes from the direct effects of bright light and retinal stress, apart from slowing down macular degeneration and retinitis pigmentosa. Other controlled research studies have indicated that saffron may have many other potential medicinal properties.

Prof. C. Sivakkolundu is assistant professor, Department of Economics, Thiruvalluvar University, Serkkadu, Vellore, while Dr P. Loganathan is associate professor and head, Department of Economics, Kandaswamy Kandar's College, Velur, Namakkal District