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Review Article

ORANGE: RANGE OF BENEFITS

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ABSTRACT
No wonder that oranges are one of the most popular fruits in the world. Orange *(citrus sinensis*) is well known for its nutritional and medicinal properties throughout the world. From times immemorial, whole Orange plant including ripe and unripe fruits, juice, orange peels, leaves and flowers are used as a traditional medicine. *Citrus sinensis* belongs to the family Rutaceae. The fruit is a fleshy, indehiscent, berry that ranges widely in size from 4 cm to 12 cm. The major medicinal properties of orange include anti-bacterial, anti-fungal, anti- diabetic, cardio- protective, anti-cancer, anti-arthritic, anti-inflammatory, anti-oxidant, anti-Tubercular, anti-asthmatic and anti-hypertensive. Phytochemically, whole plant contains limonene, citral, neohesperidin, naringin, rutin, rhamnose, eriocitrin, and vitamin-C. In the present review article, a humble attempt is made to compile all the strange facts available about this tasty fruit.
KEY WORDS: *Citrus sinensis*, Orange, Anti-oxidant

INTRODUCTION

Plants have anchored to the mother earth long before man set his feet on earth. God has endowed mankind with materials for survival much before his arrival on earth. The world health organization (WHO) estimates that about 80% of the population still depends upon herbal medicines for the treatment of various diseases due to easy availability, economic reasons and less side effects. Herbal remedies have formed the basis of traditional systems of medicine for ages and have formed the foundation of modern pharmacology. Herbal medicines have long history of popularity, better patient tolerance as well as acceptance. Availability of medicinal plants is not a problem especially in developing countries like India, which is having rich agroclimatic, cultural and ethnic biodiversity. Orange, the tasty, juicy fruit, belonging to the family Rutaceae is botanically known as *citrus sinensis. Citrus sinensis* is one of the most important and widely grown fruit crop, with total global production reported to be around 120 million tons. Orange trees are widely cultivated in tropical and subtropical climates for its tasty juice and medicinal value. In worldwide trades citrus fruits generate about 105 billion dollars per year all over the world. Orange fruit is cultivated in more than 130 countries including India, UK, France, Germany, Holland, Brazil, China, USA and Spain. Oranges are generally available from winter through summer with seasonal variations depending on the variety.

Table 1: Botanical classification of Orange

Kingdom	Plantae
Division	Magnoliophyta
Class	Dicotyledons
Sub Class	Sapindales
Order	Rosidae
Family	Rutaceae
Sub family	Aurantoideae
Genera	Citrus
Sub genera	Papeda
Species	Sinensis

HISTORY

Orange tree is mostly cultivated and rarely found in the forests. It was first cultivated in Southern China and Northeastern India. The Persian orange, grown widely in southern Europe after its introduction to Italy in the 11th century, was bitter. It was primarily grown for its medicinal purposes. Italian traders might have introduced it to the Mediterranean area after 1450 AD. Christopher Columbus took the seeds of oranges, lemons and citrons to Haiti and the Caribbean on his second journey of Sea in 1493 AD,. Portuguese navigators have also been credited with bringing orange trees to the Mediterranean region around 1500 AD. After identification of the orange fruit, it was quickly adopted as an edible fruit. It was so highly regarded that wealthy persons grew oranges in private conservatories, called orangeries. Spaniards introduced the sweet orange into South America and Mexico in the mid-1500s. In 1646, orange was well-known in Europe. They were introduced in Florida by Spanish explorer Juan Ponce de León, in 1753 and were introduced to Hawaii in 1792. The first record of citrus, Citrus Medica L, was done by Theophrastus, in 350 BC, and was introduced as a fruit by Alexander. In early European history, writers wrote about Persian citrus, that it had a wonderful fragrance and was thought to be a remedy for poisoning, a breath sweetener, and a repellant to moths. The citron was the first of the citruses to be known in Europe. Alexander the Great used orange fruit as a perfume first and then as a food. Orange trees had existed on American soil, years before the declaration of independence, and commercial cultivation in Florida (in 1820s) and California (in 1870s). Orange consumption in the US before 1880s, however, remained insufficient by way of transforming the industry into a full-scale citrus bonanza. Americans did not include oranges in their normal diet until around 1880s, when refrigeration and mass transport system via rail/roads was developed after which there was nation-wide recognition [1].

GEOGRAPHICAL DISTRIBUTION

The main production regions of oranges are found in United States of America (led by Brazil, Mexico, and Argentina), the Mediterranean basin (led by Spain, Italy, Egypt, and Turkey), and the South and East Asian regions (led by China, India, and Japan).

Table 2: Indian synonyms of *Citrus sinensis*

Language	Region	Name
Hindi	Delhi, Haryana	Orange
Bengali	West Bengal	Kamla, nembu, Musambi
Tamil	Tamilnadu	Nagarukam
Malayalam	Kerala	Nagaranga
Punjabi	Punjab	Malta
Marathi	Maharashtra	Mosambi
Telugu	Andhra Pradesh	Sathgudi, mosambi
Gujarathi	Gujarat	Naringi, santra,
Oriya	Orissa	Naranga
Kannada	Karnataka	Kittalu, naranga

Table 3: International synonyms of *Citrus sinensis*

Country	Name
U.K.	Narineh, narindz, narinjh
Holland	Appelsien
France	Oranger, orangedouce, sanguine
China	Tian, cheng
Italy	Arancia, aranciodolce
Germany	Apfelsine, orangenbaum
Japan	Orenji, orenzi
Spain	Naranja, naranjodulce
India	Mosambi, narangi, santra

Table 4: Different species of orange

Citrus sinensis	*Citrus aurantium*
Citrus grandis	*Citrus macropera*
Citrus aurantifolia	*Citrus reticulate*
Citrus tangerine	*Citrus climentina*
Citrus trifoliate	*Citrus macrophylla*
Citrus paradise	*Citrus bergamia*
Citrus myrtifolia	*Citrus australasica*
Citrus bergamia	*Citrus glaberrima*
Citrus junos	*Citrus mitis*
Citrus medica	*Citrus unshi*
Citrus micrantha	*Citrus mexima*

Table 5: Different varieties of Orange

Sr.	Variety	Characteristics
1.	**Mosambi**	Fruits are light yellowish orange in color, surface rough with prominent streaks on the rind, oblate to spherical, apex broad, rind thick, well-defined segments numbering 9 to 12, peeling difficult, pulp light yellow; juice sweet.
2.	**Malta (common)**	Fruits are orange-yellow, surface smooth; shape spherical; medium to large in size; thickness of the rind medium, segments 10, well-defined; pulp orange, abundant juice, good flavour
3.	**Malta (Blood Red)**	Fruit skin is yellow with scarlet blush. Rind is relatively thin, tight and glossy. Pulp corn coloured and red streaked, early ripening; pulp sweet, abundant juice, red coloured, pleasant flavour
4.	**Sathgudi**	Fruits are smooth and have attractive orange colour, shape spherical, size variable, rind medium thick, segments 10 to 12, pulp orange coloured abundant juice, good flavour.

BOTANICAL DESCRIPTION

Orange is an evergreen flowering tree. Height of orange tree is generally 9–10 m (although very old specimens have reached 15 m). The leaves 4-10 cm long arranged alternately, are ovate in shape with crenulate margins. Trees have thin smooth, and gray-brown to greenish bark. Most species are single-trunked with very hard wood. Canopy widths range from slender to broad, depending on species [2].

Fruit

The orange fruit is a hesperidium. It is a type of berry that ranges widely in size, color, shape, and juice quality. Fruits are globose to ovoid in shape. Wild orange fruit has a smooth skin, and the petiole wings are entire. The petioles of sour orange leaves are much larger than that of sweet orange. The word "orange" is derived from Sanskrit term narang. Mainly 11 individual pieces are present in a typical fruit. Oranges are round citrus fruits with finely-textured skins that are of course, orange in color just like their pulpy flesh. Oranges usually range from approximately two to three inches in diameter.

Fig1: Slices of Orange fruit

Seeds

Seeds are greenish to pale whitish, flattened, and angular. The seed is generally poly embryonic. The embryos are either “zygotic” or “nuclear.” The zygotic embryos are derived from pollination of the ovary, i.e., sexual reproduction, and therefore are not always similar in horticultural qualities to the parent tree. The nuclear embryos are derived wholly from the mother plant and show very similar characteristics to the parent plant.

Fig 2: Orange seeds

Flowers

Diameter of orange flowers is 2–4 cm (0.8–1.6 in). Flowers are axillary, fragrant, single, few or cymose, and often perfect (having both functional stamens and pistils) or staminate. The calyx is 4–5 lobed and there are generally five petals and contain some oil glands. Number of stamens range from 20 to 40. The sub globose ovary is superior, with 8–18 locules (cavities), with 4–8 ovules per locule in two rows. Flowers are small, waxy greenish-white [3].

Fig 3: Flowers of Orange tree

Leaves

Leaves are smooth, oval, 5-15cm x 2-8 cm, dark green, and glossy possessing a distinctive smell often similar to the fruit. Petioles are generally winged. Leaves are unifoliate, ovate, ovular elliptical, with acute to obtuse tips, and contain some oil glands, which are released when crushed. Young twigs are green and angled in cross-section, and axillary single spine, while older twigs and branches are spineless and circular in cross section.

Fig 4: Leaves of Orange plant

POLLINATION

Orange blossoms yield very little pollen and orange growers do not practice artificial pollination. However, there is evidence of self-incompatibility and need for cross-pollination in the TANGOR and TANGELO. Self-pollination is facilitated by citrus flowers having both sexes present on the same blossom. Cross-pollination is used only by some cultivars, occurs in tangerines and tangerine hybrids, mandarins. Honeybees are mostly used for cross pollination. The most important period for pollination was the morning in the studied crops. The beginning of fructification in sweet orange flowers depends on the number of honeybee visits. Honey bee pollination influenced quantity and quality of fruit production. The flowers frequently visited by bees produced heavier, less acid fruit, with fewer seeds per bud [4].

PHYTOCONSTITUENTS

Orange fruit contains 1.5% essential oil. The main phytoconstituents present in orange fruit are D-limonene (amount: 90 %), citral, citronellal, nootkaton, sinesal, n-nonanal, n-decanal, n-dodecanal, linalyl acetate, geranyl acetate, citronelyl acetate and anthranil acid methyl ester. Lipophilic flavonoids and furanocumarines are reported in pressed oils. There is some evidence that active ingredients of orange stimulate the secretion of gastric juice. Orange also contains several bitter flavone glycosides like neohesperidin and naringin, whose sugar component is neohesperidose, and rutin whose sugar component is rutinose. Both sugars are disaccharide of glucose and rhamnose (6-desoxymannose) [5].

Table 6: Phytoconstituents of Orange

Sr.	PHYTOCONSTITUENTS	PLANT PART
1.	Flavone glycosides; Neohesperidin, Naringin, Hesperidin, Narirutin, Triterpene; Limonene, citrol Pigment; Anthocyanin, Beta-cryptoxanthin, Crytpoxanthin, Zeaxanthin and Rutin, Eriocitrin, Homocysteine Polymethoxylated flavones; Tangeretin and Nobiletin Flavonoids; Citacridone, Citbrasine and Noradrenaline	**Fruit Peel**
2.	Terpenoids; Linalool, β elemene	**Leaves**
3.	Triterpenes; Limonene	**Flowers**
4.	Vitamins; B1, B2, B3, B5, B6, and Vitamin C Minerals; Calcium, Iron, Magnesium, Zinc, Phosphorus, Potassium	**Fruits**

PHARMACOLOGICAL PROFILE

Anti-oxidant property

Oranges form a rich source of vitamin C, flavonoids, phenolic compounds and pectins. The main flavonoids found in citrus species are hesperidine, narirutin, naringin and eriocitrin. [6,7]. Just one orange provides 116% of the daily requirement for vitamin C. Vitamin C is the primary water-soluble antioxidant, which prevents free radical generation in the body and damage to the tissues in the aqueous environment both inside and outside cells. Drinking of orange juice without salt and sugar is associated with reduced severity of inflammatory conditions, like asthma, osteo-arthritis, and rheumatoid arthritis. Vitamin C is also necessary for the proper functioning of immune system. Vitamin C is good for preventing cold, cough and recurrent ear infections.

Protection against Cardiovascular Diseases

According to World Health Organization's recent report, citrus fruits offer protection against cardiovascular diseases by reducing levels of homocysteine. Orange fruit contains vitamin C, carotenoids and flavonoids, which are cardio protective. Cholesterol lowering effect of orange is produced by Limonene. Polymethoxylated flavones (PMFs) are present in citrus fruit peel, which can lower cholesterol more effectively than some prescription drugs, without showing any side effect. Although, a variety of citrus fruits contain PMFs, the most common PMFs are tangeretin and nobiletin, which are found in the peels of oranges. PMFs work like statin drugs that inhibit the synthesis of cholesterol and triglycerides inside the liver. However, grating a tablespoon or so of the peel of orange each day and using it to flavor tea, salads, yogurt, soups, snacks or rice may be a practical way of achieving some cholesterol-lowering benefits [8].

Anti-carcinogenic property

Limonene, one of the main constituents of orange, reduces the risk of mouth, skin, lung, breast, stomach and colon cancer. Another constituent of orange is hesperidin, and its flavone analogue, diosmin, has also exhibited anti-carcinogenic activities in various in vivo studies. Anti-carcinogenic activity mainly depends on antioxidant properties of the molecules, as well as their ability to modulate the activity of detoxifying hepatic enzymes. The polymethoxylated flavones have shown strong anti-proliferative action against cancer cells and antigen activated T-lymphocytes. Beta-cryptoxanthin (an orange-red carotenoid) is present in highest amounts in oranges. It may significantly lower one's risk of developing lung cancer. [9,10].

Reduced risk of kidney stones

A study published in the British Journal of Nutrition found that when women drank 1/2 liter of orange juice daily, their urinary pH value and citric acid excretion increased therby diminishing the risk of forming calcium oxalate stones significantly [11].

Anti-ulcer property

Intake of orange juice on regular basis reduced the infection incidence with Helicobacter pylori (H. pylori) thus preventing development of ulcers [12].

Anti-anxiety effect

Aroma-therapists use orange oil as a tranquilizer. Researchers have found evidence that sweet orange oil is an anxiolytic agent[13,14].

Anti-typhoid activity

Typhoid fever (TF) caused by Salmonella typhi, is a major public health problem, particularly in developing countries. Constituents of orange fruit responsible for anti-typhoid

activity include flavonoids like citacridone, citbrasine and saponins [15].

Anti-bacterial activity

Oranges are eaten to allay fever. The roasted pulp is prepared as a poultice for skin diseases. The fresh peel is rubbed on acne. A decoction of the dried leaves and flowers is taken in Italy and France as an antispasmodic, cardio-protective and anti-emetic agent. A decoction of husked orange seeds is prescribed for urinary ailments in China. Orange peel oil produces lethal effect on fleas, fire ants, and houseflies due to its 90-95% limonene. Orange peel is medicinally used against fungi [16].

Larvicidal activity

The saponins present in the peel possess larvicidal activity [17].

Anti-diabetic activity

Anti-diabetic activity of orange is due to bioflavonoids such as hesperidin and naringin present in citrus fruit peels. These peels play an anti-diabetic role in C57BL/Ks J-db/db mice via regulation of glucose regulatory enzymes. They decrease the activity of glucose-6-phosphatase and phosphoenol pyruvate. The anti-diabetic potential of orange peel and juice appear to be mediated via anti peroxidation, inhibition of α-amylase enzyme activity that is responsible for the conversion of complex carbohydrates to glucose, increased hepatic glycogen content, stimulation of insulin secretion, and repair of secretory defects of pancreatic β-cells [18,19].

Anti-fungal activity

Citrus sinensis essential oil is an effective inhibitor of biodegrading and storage-contaminating fungus *A. Niger*. Major antifungal constituents of orange are limonene (84.2%), linalol (4.4%) and myrcene (4.1%) [20].

Anti-inflammatory, Healing and Anti-arthritic activity

Anti-inflammatory activity of *Citrus Sinensis* is due to the presence of polymethoxyflavones. The polymethoxy flavone content, especially nobiletin, appears to be responsible for the anti-inflammatory activities of certain citrus peel extracts [21]. Wounds are generally defined as physical injuries that result in an opening or breaking of the skin. The healing property of orange depends on wide variety of phytonutrients such as citrus flavones (hesperidin and naringenin), anthocyanins, hydroxycinnamic acids, and a variety of polyphenols. The most important flavone in orange is hesperidin that has been shown to reduce high blood pressure as well as cholesterol in animal studies. Importantly, most of this phytonutrient is found in the peel and inner white pulp of the orange, rather than in its liquid orange center. This beneficial compound is too often removed during processing of oranges into juice [22]. Carotenoids, zeaxanthin and beta-cryptoxanthin, are the phytonutrients, which reduce remarkably the risk of rheumatoid arthritis. Those persons consuming high amount of zeaxanthin and cryptoxanthin showed 52% less chances of developing rheumatoid arthritis. *Citrus sinensis* (orange) peel extracts contain bioflavonoids, including polymethoxylated flavones (PMFs), which have anti-inflammatory, antioxidant and hypolipidemic effects [23].

MEDICINAL USES OF ORANGE : Oranges are effective in the management of : –

- Arthritis
- Asthma
- Alzheimer's disease
- Parkinson's disease
- Macular degeneration
- Diabetes mellitus
- Gallstones
- Multiple sclerosis
- Cholera
- Gingivitis
- Optimal lung function
- Cataracts
- Ulcerative colitis
- Crohn's disease

ORANGE AS A FOLKLORE MEDICINE

From the times immemorial, the whole orange plant including fruits, leaves, flowers, peels and the juice are used as traditional medicine. Orange is a good source of Vitamins (B1, B2, B3, B5, A, B6, C), flavonoids, terpenes, potassium and calcium.

TRADITIONAL USES

- Orange juice helps to eliminate toxins from the body.
- Orange juice helps to maintain hydration.
- It is used as a general tonic.
- Orange juice is useful in cases of anxiety disorder and stress.
- It is used as a Mexican traditional medicine for the treatment of tuberculosis.
- It is used in stomach upsets; it improves appetite and prevents constipation.
- The humble Orange has a long history in Chinese Medicine as a cooling agent for coughs, colds and respiratory disorder.
- It is a traditional Chinese symbol of good luck and prosperity.
- It is used in the treatment of obesity.
- Orange symbolizes innocence and fertility.
- In France, it is used for the treatment of angina, hypertension, constipation, diarrhea, menstrual disorder and Palpitation.

NUTRITIONAL VALUE

A single orange provides 12.5% of the daily need for fiber, which has been shown to reduce high cholesterol levels thereby helping to prevent atherosclerosis. Fibers also help in keeping blood sugar levels under control, which may explain why oranges can be a very healthy snack for people with diabetes. In addition, the natural fruit sugar present in oranges, viz; fructose, can help to prevent blood sugar levels from rising too high after eating. The fiber in oranges can grab cancer-causing chemicals and keep them away from cells of the colon, providing yet another line of protection from colon cancer. Furthermore, the oranges may be helpful in reducing the constipation or diarrhea in those suffering from irritable bowel syndrome [24].

SAFETY PROFILE

The available literature does not reveal any adverse effect upon consumption of orange juice. However, allergy syndrome is reported in sensitive persons. The common symptoms include yellowing of the skin of limbs and sleepiness.

DISHES CONTAINING ORANGE

- Orange fruits
- Orange juice
- Orange blossom water
- Orange custard
- Jellies
- Orange cake
- Orange sweets
- Orange salad
- Orange curd
- Orange chicken

- Orange chocolate
- Orange ice-cream
- Orange biscuits

STRANGE FACTS

- Oranges are popular among patients for their nutritional and anti-emetic properties.
- Orange is a major source of vitamin C.
- The recent clinical experiments had shown that subjects, who drank a glass of orange juice daily for four weeks had a significant increase in their HDL-Cholesterol levels (good cholesterol). Besides that, hesperidins significantly increase folate levels. Folate has been shown to reduce the levels of homocysteine.
- The orange juice stimulates the secretion of gastric acid; and improves appetite.
- To select a good orange, check for a blemish-free orange, which is brightly colored and heavy in weight.
- Oranges can be stored at room temperatures for 2-3 days comfortably. If refrigerated, they can be stored for up to 14 days.
- Use straw while drinking orange juice, because the acids in the juice can cause the enamel of the tooth to erode.

CONCLUSION

Vitamin C supplements do not provide as much protective benefits as drinking a glass of orange juice. Orange is well known for its medicinal and nutritional properties all over the world. Its plant parts like peel, flower, fruit and juice are used as a traditional medicine. The available literature does not reveal any adverse or side effect. Clinical trials need to be carried out to exploit the therapeutic utility of orange in combating various diseases. No wonder that oranges are one of the most popular fruits in the world.

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Table 7: Nutritional value of Orange

Elements	Amount (100g)
Energy	192kj
Carbohydrate	11.54g
Sugar	9.14g
Fat	210mg
Protein	700mg
Dietary fiber	2.4g
Thiamine	100µg
Riboflavin	40µg
Niacin	400µg
Pantothenic acid	250µg
Vitamin B6	5µg
Folate	17µg
Vitamin C	45mg
Calcium	43mg
Iron	90µg
Magnesium	10mg
Phosphorus	12mg
Potassium	16.9mg
Zinc	80µg