



A REVIEW: PHYTOCHEMICAL CONSTITUENTS, MEDICINAL USES AND ECONOMICAL VALUE OF ORANGE PEELS (*Citrus sinensis* L Osbeck)

Sheetal N. Khandla, Milan S. Vala, Bharat B. Maitreya

Department of Botany, Bioinformatics and Climate Change Impact Management

University School of Sciences

Gujarat University

Ahmedabad-380009, India.

Abstract: The present review showed the Indian and international synonyms of *Citrus sinensis*, origin of oranges, taxonomical description, phytoconstituents, pharmacological profile, nutritive value of *Citrus sinensis*, commercial production and uses, nutrient composition of sweet orange, commercial importance of *Citrus sinensis*. Sweet orange is a small evergreen tree 7.5 m high and in some cases up to 15 m. *Citrus sinensis* is from Rutaceae family. Plants of Rutaceae are herbs, shrubs and trees with glandular punctate, commonly strongly smelling herbage comprising about 150 genera and 1,500 species. These are further characterized by the common occurrence of winged petioles and spines. Orange's genus is *Citrus* and its species is *sinensis*. Probably Oranges are originated from South East Asia, and were cultivated in China 2500 BC. It is scientifically proven that oranges being rich in vitamins and minerals have many health benefits. Moreover, it is appreciated that other biologically active, non-nutrient compound found in *Citrus* fruits such as phytochemical antioxidant, soluble and insoluble dietary fibers are known to be helpful in reducing the risk of cancers, many chronic diseases like arthritis, obesity and coronary heart diseases. In the last few years, on the industrial wastes an increased attention has been focused, especially those containing residual phenols from the used plant raw material. Orange peels are one of the important dietary sources of antioxidant phenolic. 1.5% essential oil is present in the orange fruit. D-limonene (90%), citral, sinesal, n-nonanal, n-decanal, n-dodecanal, geranyl acetate, anthranil acid, citronellal, linalyl acetate, methyl ester are present. *Citrus sinensis* is effective in the management of arthritis, asthma, Alzheimer's disease, Parkinson's disease, macular degeneration, diabetes mellitus, gallstones, multiple sclerosis, cholera, gingivitis, optional lung function, cataracts, ulcerative colitis, crohn's disease. 12.5% of the daily need for fiber is provided by a single orange. Orange (*Citrus sinensis*) is one of the world's major fruit crops with global availability and

popularity in human diets. The largest producer of orange juice in the world is Brazil, followed by the U.S.A., India, China and Spain. *Citrus sinensis* has a world production of 49.6 million metric tons for the year 2016-2017.

Key Words: Anti-oxidant, *Citrus sinensis*, fiber, nutritive value, orange, phenolic, phytochemical, production.

Introduction: Plant is a living thing that grows in earth, in water, or on other plants, usually has a stem, leaves, roots, and flowers, and produces seeds (<https://dictionary.cambridge.org/dictionary/english/plant>). Around 480-360 million years ago, in the middle of Paleozoic era, plants were originated and evolved (Kenrick P. and Crane P. R., (1997)). Probably Oranges are originated from South East Asia, and were cultivated in China 2500 BC (Nicolosi *et al.*, (2008)), where it was referred as Chinese Apple (Ehler, (2011)). Most *Citrus* cultivars' center of origin is perhaps unknown, but the ancient relative of *Citrus* is native to China, the Southeast Asia, New Caledonia, Australia and the Malay Archipelago (Atta *et al.*, (2012)). The clearance of genetic origin is not available, although it is believed that the genetic origin occurred due to the interspecific hybridization of some primitive *Citrus* species (Xu *et al.*, (2013)).

Because of its high a values, source of vitamins and other uses, it is grown all over the world today. In terms of volume in production, with more than 108 million tons (FAO statistics 2006) *Citrus* ranks after banana as the world second fruit crop. Oranges are economically important fruit crops (Etebu, *et al.*, (2014)). With white flowers, it grows as a tree. For fruit to grow from seed it takes about six years (Valentina P., (2016-17)). The human diet contains important micronutrients namely vitamins C and E, carotenoids and flavonoids, essential for maintenance of human health. Virtually, multiple dietary sources of these compounds are present in all plant material (Di Majo *et al.*, (2005)). *Citrus* fruits are main source of important phytochemical nutrients and for long have been valued for their wholesome nutritious and antioxidant properties (Etebu, *et al.*, (2014)).

It is scientifically proven that oranges being rich in vitamins and minerals have many health benefits. Moreover, it is appreciated that other biologically active, non-nutrient compound found in *Citrus* fruits such as phytochemical antioxidant, soluble and insoluble dietary fibers are known to be helpful in reducing the risk of cancers, many chronic diseases like arthritis, obesity and coronary heart diseases (Crowell, (1999)).

Citrus flavonoids can prevent cancer through selective cytotoxicity, anti-proliferative actions and apoptosis (Elangovan *et al.*, (1994); Hirano *et al.*, (1994)). Flavonoids are anti-mutagenic, thus protect the DNA from damage by their ability to absorb ultraviolet light (Stapleton and Walbot, (1994)). The inhibitory effects of *Citrus* flavonoids on tumoral development and cell proliferation by rat malignant cells, in cardiac and hepatic tissue of syngenetic rats have been reported (Bracke *et al.*, (1989)). Flavonoids can also protect the DNA by interacting directly with the tumoral agents, as in the induced chromosomal by bleomycin (Heo *et al.*, (1994)).

Oranges are also rich in iron, chlorine, manganese, zinc, sodium, phosphorous, iodine, calcium, folic acid, potassium, beta-carotene, amino acids, pectin and fiber. A single orange have about 170 phytonutrients and over 60 flavonoids with anti-tumor, anti-inflammatory, blood clot inhibiting and antioxidant properties. All these properties promote overall health (Cha *et al.*, (2001)). Sweet orange (*Citrus sinensis* L) are very useful in human health. They used in the treatment of arteriosclerosis, prevention of cancer, stomach ulcers, reduction in

cholesterol level, kidney stones, strengthening of the immune system, high blood pressure. These health benefits are because of vitamins, especially vitamin C, Phytochemical compound like synephrine, limonoids, hesperidin flavonoid, polyphenols, pectin etc. (Etebu E. and Nwauzoma A. B., (2014)). Helping you looks young and keeps the skin glowing and fresh, orange protect the skin from damage (Tsuda *et al*, (2004)). *Citrus* fruits are mainly used in industries but the peels generally wasted. To utilize orange peel and pulp for the conversion into value-added product, suitable methods have to be adopted. Environmental pollution can also be reduced (Arora M. and Kaur P., (2013)).

In the last few years, on the industrial wastes an increased attention has been focused, especially those containing residual phenols from the used plant raw material. Orange peels are one of the important dietary sources of antioxidant phenolic (Hegazy A. E. and Ibrahim M. I., (2012)).

During the processing of fruit, orange peel is the by product. Studies show that they are good source of bioactive compounds. Every year large amount of oranges byproduct wastes are formed such as peels. India produces 25 lakh of orange every year. Main orange producing states of India are Punjab, Madhya Pradesh, Andhra Pradesh, Maharashtra, Rajasthan, Assam and Karnataka. The orange peels are rich in nutrients. It contains many phytochemical. That's why they are useful. They can be useful in many drugs and food items. It is essential to find the application for these peels. During the production of orange juice and other orange products, the orange peel accumulates in the bulk and will produce environmental problems. That's why using the byproduct of fruits are good thing. Tannins, terpanoids, flavonoids and saponins are present in the orange peel (Gotmare S. and Gade J., (2018)).

There is no doubt that oranges (*Citrus sinensis*) are the most demanded fruit around world and however, the orange peel is an often overlooked facet of this nutritious fruit. Orange peels had high value and people could extract essential oils from them in a number of remedies and medicines as well, in the old times. *Citrus sinensis* peels are in regular consumption as a part of the Mediterranean diet, even today. Orange fruit is considered as a fruit full of benefits but some unclear doubts regarding orange peels are still there. So, we should first accept this fact that the orange peels contain nearly three to four times more fiber of the actual fruit and flavonoids. They are good for healthy heart. Flavonoid called hesperidin are present the in orange peels and possess anti-inflammatory properties. A recent survey concludes that, a diet containing *Citrus* fruits, such as oranges, offers protection against cardiovascular tissues, due to the presence of folate in *Citrus sinensis* peels. For lowering the level of cardiovascular risk factor, it is necessary. Orange peels have anti-cancer characteristics. The flavonoids present in the orange peel can impede RLIP76 protein. RLIP76 protein is interrelated to obesity and cancer. Orange peel offers anti-allergic and anti-inflammatory benefits. Histamines are the chemicals, which causes allergic reactions and it can be prevented due to the compounds present in the *Citrus sinensis* peels and making them a highly anti-allergic food. They support natural weight loss. An additional benefits to diabetics and for those who are up to reducing weight can be provided by orange peels and orange peel extract. This is owing to the fact that *Citrus sinensis* peels are natural source of pectin, which is a natural fiber decreases the post-meal rise in blood sugar. They clear the way for kidney stones. Orange peels have the biochemical, D-limonene which is helpful in

dissolving kidney stones. It helps lightening dark spots on the skin by applying orange peel extract with milk. As skin toner, it can also be used. They improved digestion and metabolism. According to Ayurveda orange peel helps improve digestion and gears metabolism. It can be used as mouth freshener and chewing orange peels or rubbing them inside teeth helps whitening as well as deals with their sensitivity. The biochemical, D-limonene, present in the *Citrus sinensis* peels neutralized gastric acid and supports normal peristalsis (<https://insightscare.com/orange-peels-benefits-offer/>).

Classification of *Citrus sinensis* (According to Bentham and Hooker):

Domain	: Eukarya
Kingdom	: Plantae
Subkingdom	: Tracheobiontas
Division	: Magnoliophyta
Class	: Magnoliopsida
Subclass	: Rosidae
Order	: Sapindales
Family	: Rutaceae
Genus	: <i>Citrus</i>
Species	: <i>sinensis</i>
Genetic group	: <i>Citrus</i> Fruit
Scientific name	: <i>Citrus sinensis</i> L Osbeck
Local name	: Sweet orange

Indian synonyms of *Citrus sinensis*:

Table 1: Indian synonyms of *Citrus sinensis*

LANGUAGE	REGION	NAME
Hindi	Delhi, Haryana	Orange
Bengali	West Bengal	Kamla, nembu, musambi
Tamil	Tamilnadu	Nagarukan
Malayalam	Kerala	Nagaranga
Punjabi	Punjab	Malta
Marathi	Maharashtra	Mosambi
Telugu	Andhra Pradesh	Sathgudi, mosambi
Gujarati	Gujarat	Naringi, santara
Oriya	Orissa	Naranga
Kannada	Karnataka	Kittalu, naranga

(Source: Milind P. and Dev C., (2012))

International synonyms of *Citrus sinensis*:

Table 2: International synonyms of *Citrus sinensis*

COUNTRY	NAME
U.K.	Narineh, narindz, narinjh
Holland	Appelsien
France	Oranger, orangdouce, anguine
China	Tian, cheng
Italy	Arancia, aranciodolce
Germany	Apfelsine, orangenbaum
Japan	Orenji, orenzi
Spain	Naranja, naranjodulce
India	Mosambi, narangi, santra

(Source: Milind P. and Dev C., (2012))

Plant description:

Citrus sinensis is from Rutaceae family. Rutaceae are herbs, shrubs and trees with glandular punctate, commonly strongly smelling herbage comprising about 150 genera and 1,500 species. These are further characterized by the common occurrence of winged petioles and spines (Valentina Perea, (2016-17)). Sweet orange (*Citrus sinensis* L. Osbeck) (to distinguish it from closely related species like sour orange, *C. aurantium* *C. reticulata* and mandarin orange), is a small evergreen tree 7.5 m high and in some cases up to 15 m (Etebu, *et al.*, (2014)).



Figure 1: *Citrus sinensis*

Geographical distribution:

➤ Fossil Record:

In 1753 Carl Linneaus referred *Citrus* as the genera of the orange species. Chloroplast DNA analyses revealed that the chloroplast genome of sweet orange was derived from pummelo. Pummelo is the maternal parent of orange. The closest paternal parent is mandarian (Valentina Perea, (2016-17)).

➤ Origin:

In 314 B. C., the join up between the Pomelo and the Mandarin create two different types of *Citrus*: (1) Bitter orange (2) Sweet orange. 7,000 years ago both of this is native to southern Asia and spread through the Silk Road until reaching west Asia and finally ending in Europe. Their main purpose was to help there with medicine during the 15th century. Spanish explorers start popularizing them by the 16th century and brought them to the “New World” (America) where many orange trees are planted by missionaries in Florida and then on California which presently are known for their orange plantations. *Citrus sinensis* were already prestigious and popular before the 20th century. Then, they were only used in important holidays as thanksgiving of Christmas. Nowadays oranges are really popular all around the world. They are very popular only not because of its nutrients, but because it has large number of vitamins, which are helpful to human in defenses (Valentina Perea, (2016-17)).

➤ Present Distribution

In United States of America (led by Argentina, Brazil and Mexico), the main production regions of oranges are found, the South and East Asian regions (led by China, India and Japan), the Mediterranean basin (led by Spain, Italy, Turkey and Egypt) (Milind P. and Dev C., (2012)). Present world production of *Citrus* is about 98.7 million tons of fresh fruit, of which 62 percent is orange (FAOSTAT, (2001)), (Valentina Perea, (2016-17)).

Taxonomy description:

➤ Leaves

Orange (*Citrus sinensis*) produces leathery and evergreen leaves of different shapes, ranging from elliptical to oblong to oval, 6.5-15 cm long and 2.5-9.5 cm wide, often bearing narrow wings on the petioles.

➤ Flower

Fragrant white flower either singly or in whorls of 6, about 5 cm wide, with 5 petals and 20-25 yellow stamens. Flowers are small and greenish-white. Flowers are waxy.

➤ Seeds

Seeds are greenish to pale whitish colored. They are flattened and angular. The seeds are generally poly embryonic and the embryos are either zygotic or nuclear. From pollination of ovary zygotic embryos are derived and the nuclear embryo is derived wholly from the mother plant and show mostly similar characteristics to the parent plant.

➤ Fruit

The fruit may be globose to oval. Fruit is 6.5-9.5 cm wide and ripens to orange yellow. Anatomically, the fruit consist of two distinct regions: pericarp and endocarp. The pericarp is also known as the peel, skin or rind, and the endocarp is also called as pulp or juice sacs. Epidermis of epicuticular wax with numerous small aromatic oil glands is present on the skin. This oil gland gives the particular smell. The quality of wax is depending on the variety, climatic conditions and growth rate. The pericarp consist of the over flavedo, or epicarp largely made of parenchymatous cells and cuticle. Embedded oil glands create terpenoid aromatic compound such as valencene, and alpha/beta sinsenal. Beneath the epidermis is the flavedo, with its characteristics green, yellow or orange color. The flavedo is generally a colorless, spongy inner layer of mesophyll that changes character and thickness throughout fruit development, properties that determine ease of peeling (webber, (1989)). The flavedo is very fine and fragile containing oliferous vesicles on the inside which can be collected by scarping on the flavedo layer. The albedo, or mesocarp lying beneath the flavedo consists of tubular-like cells joined together to constitute the tissue mass compressed into the intercellular area. The albedo is rich in flavonoids, which if transferred to the juice imparts a bitter taste. The pulp is typically sweet and juicy. The flesh or pulp is divided into 10-14 segments. The ripe fruit is classified as a hesperidium which is a type of berry with multiple seeds and is fleshy. Flashy juice sacs accumulate sugars, organic acids and large amount of water. It is causing difficulties in the extraction of nucleic acids and proteins (Etebu, *et al.*, (2014)), Milind P. and Dev C., (2012)).

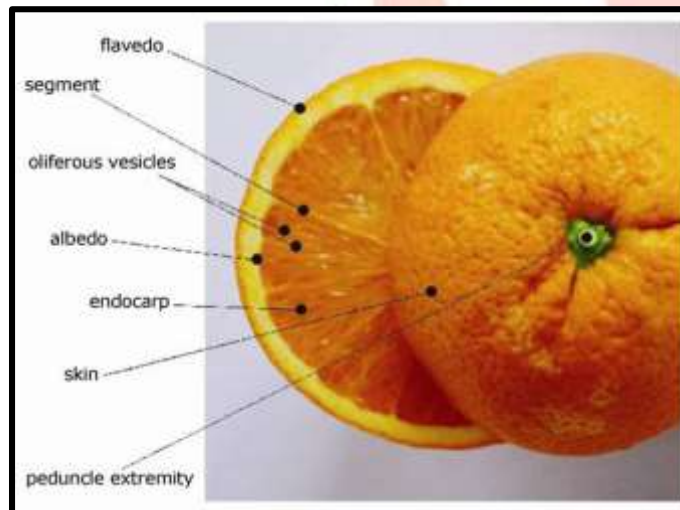


Figure 2: Structure of *Citrus sinensis* fruit (Etebu, *et al.*, (2014))

Pollination:

Heavy, sticky and not wind-blown pollen is produced by *Citrus sinensis*. Honeybees are required for cross pollination. Typically honeybees are important insect pollinators for cross pollination of *Citrus sinensis* (Valentina Perea, (2016-17)). By *Citrus* flowers having both Saxes present on the same blossom self-pollination is facilitated. Only by some cultivars, occur in tangerines and tangerine hybrids cross-pollination is used. The most suitable period for pollination is the morning. In sweet orange flowers the beginning of fructification depends on the numbers of honeybee visit. Quality and quantity of fruit production is influenced by honeybee pollination. The

flowers which are frequently visited by honeybees will produce heavier, less acid fruit, with fewer seeds per bud (Milind P. and Dev C., (2012)).

Phytoconstituents:

1.5% essential oil is present in the orange fruit. D-limonene (90%), citral, sinesal, n-nonanal, n-decanal, n-dodecanal, geranyl acetate, anthranil acid, citronellal, linalyl acetate, methyl ester are present (Milind P. and Dev C., (2012)).

Table 3: Phytoconstituents present in various plant part

Sr.	PHYTOCONSTITUENTS	PLANT PART
1	Flavone glycosides; Neohesperidin, Naringin, Hesperidin, Narirutin Triterpene; Limonene, Citrol Pigment; Anthocyanin, Beta-cryptoxanthin, Cryptoxanthin, Zeaxanthin and Rutin, Eriocitrin, Homocysteine Polymethoxylated flavones; Tangeritin and Nobiletin Flavonoids; Citacridone, Citabrsine and Noradrenaline	Fruit peel
2	Terpanoids, 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

(Source: Milind P. and Dev C., (2012))

Pharmacological profile:

It has anti-carcinogenic property. Limonene which is present in the orange, reduce the risk of breast, colon, lung, skin, mouth cancer. It gives protection against cardiovascular diseases. Cardio protective substances like vitamin C, flavonoids, and carotenoids are present in the orange fruit. Oranges have good anti-oxidant property. Oranges are full of phenolic compounds, pectin, vitamin C and flavonoids. It is the good source for prevention of cold, cough and ear infections. According to the 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 citic acid excretion increased thereby diminishing the risk of forming calcium oxalate stones significantly. They reduced risk of kidney stones.

Particularly in developing countries, typhoid is a major public health problem. Because of flavonoids like citracridone, citbrasine and saponins of orange fruit it shows anti-typhoid activity. It has anti-typhoid activity. To allay fever oranges are eaten. For skin diseases the roasted pulp is prepared as a poultice. For the treatment of acne, the fresh peel is rubbed on the skin. In Italy and France as an antispasmodic a decoction of dried leaves and flowers is taken. In China a decoction of husked orange seeds is prescribed for urinary ailments. Hence it has anti-bacterial activity. On regular basis consumption of orange juice reduced the infection incidence with *Helicobacter pylori* (*H. pylori*) thus preventing development of ulcers. It contains anti-ulcer property. *Citrus sinensis* oil as a tranquilizer used by aroma-therapists. Some researchers found that sweet orange oil is an anxiolytic agent. It obtains anti-anxiety effect. It contains larvicidal activity because of the presence of saponins. Due to bioflavonoids such as hesperidin and narangin present in *Citrus* fruit peels it has anti-diabetic activity. Limonene (84.2%), linalool (4.4%) and myrcene (4.1 %) are major antifungal constituents of *Citrus sinensis*. An effective inhibitor of biodegrading and storage containing fungus is orange essential oil. Hence it has anti-fungal property. Because of the presence of polymethoxyflavones *Citrus sinensis* have anti-inflammatory activity. The healing property of *Citrus sinensis* is depends on the wide variety of phytonutrients such as *Citrus* flavones, hydroxycinnamic acids, anthocyanin and a variety of polyphenols. Hesperidine is the most important flavone in the orange that has been shown to reduce high blood pressure as well as cholesterol in in animal studies. Rather than in its liquid orange center, in the peel and inner white pulp most of this phytonutrients is found. During processing of oranges into juice this beneficial compound is too often removed. Due to the presence of carotenoids, zeaxanthin and beta-cryptoxanthin phytonutrients reduce remarkably the risk of rheumatoid arthritis. Consuming high amount of zeaxanthin and cryptoxanthin showed 52% less chances of developing rheumatoid arthritis. Hence it has healing and anti-arthritis property (Milind P. and Dev C., (2012)).

Commercial production and uses of *citrus sinensis*:

➤ Food uses: -

Due to its refreshing flavor oranges had become famous in warm places.

Fruit: For example, *Citrus sinensis* are sliced, dried and pulverized, and the powder is added to baked goods as flavoring.

Skin: Peels are used for making perfume and soaps. Fragrance is oranges' biggest quality. To clear, detoxify, and tone the skin orange peels are used and have found wide use in skin care products.

Juice: Oranges are commonly utilized in fruit cups, salads, gelatins and numerous other desserts, and as garnishes on cakes, meat and poultry dishes, at home. For preparing fresh juice pulp is used. Juice is rich in protein content. In 1963, dehydrated orange juice developed and it is sold for use in food manufacturing, adding flavor, color and nutritive elements to bakery goods and many other products. To control ulcers and sores, the juice extracted from sweet orange leaves is commonly used additionally. The juice extracted from the leaves work as a remedy.

➤ **Medical uses: -**

Citrus sinensis is effective in the management of arthritis, asthma, alzheimer's disease, parkinson's disease, macular degeneration, diabetes mellitus, gallstones, multiple sclerosis, cholera, gingivitis, optional lung function, cataracts, ulcerative colitis, crohn's disease.

Nutrients: Orange fruit is low in calories and it contains no saturated fats or cholesterol, but it is rich in dietary fiber and pectin. Pectin helps to protect the mucosa of the colon by its virtue as a bilk laxative. Oranges, especially juice contains a very good amount of vitamin C (Provide 48.5 mg/100 g, about 81% of DRI) which helps in the antioxidant protection and immune support because helps the body develop resistance infectious agents that come from the blood. Orange peel contains the compounds which can lower the cholesterol and act as a cleaner of the interior of the human body. Some minerals as potassium and calcium are also present in orange fruit. Potassium is an important component of cell and body fluids that helps control heart rate and blood pressure through countering pressing effect of sodium.

Skin: To increase appetite, reduce phlegm and treat coughs, colds, intestinal gas, acid indigestion and cancerous breast sores, the skin of the *Citrus sinensis* is used.

Juice/Nectar: One orange can provide about 7% of the daily requirement of potassium needed of the body. To remove phlegm and clear the congestion in the nasal and chest passages, *Citrus sinensis* juice is best.

Diseases: A reduced risk of colon cancer is associated with the intake of vitamin C. Vitamin C helps us in prevent asthma, osteoarthritis and rheumatoid. Limonoids are present in the orange which are proven to help fight a number of cancers like skin, lung, breast, stomach and colon.

➤ **Traditional uses: -**

Japanese believed that *Citrus* blossoms symbolize chastity. It is used by Arab women to color gray hair. Blossoms and the pulp of oranges were used to create cosmetics in other places. In cases of anxiety disorder and stress, orange juice is very helpful. To maintain hydration orange juice is useful. It is used as general tonic. For the treatment of tuberculosis it is used as a Mexican traditional medicine. For the treatment of angina, constipation, menstrual disorder, hypertension, it is used in France. It is used to prevent constipation. In Chinese medicine the humble orange has a long history as a cooling agent for coughs, colds and respiratory disorder. It is used as traditional symbol of good luck in China.

Magic/Ritual significance:

It is said that high-energy scent of *Citrus sinensis* communicates the joy of angels to human beings.

For embodying the sun in a mixture, whether pot pourri, tea, sachet and charm, *Citrus sinensis* is great.

Citrus sinensis peel lifts those who are down, like the Sun, helps the confused find direction and gives new life to spiritual yearnings.

(Valentina Perea, (2016-17), Milind P. and Dev C., (2012))

Nutritive value:

12.5% of the daily need for fiber is provided by a single orange. To reduce high cholesterol levels it has been shown thereby helping to prevent atherosclerosis. In keeping blood sugar levels under control fibers also help. It may explain why oranges can be very healthy snack for people with diabetes. To prevent blood sugar levels from rising too high after eating, the natural fruit sugar present in oranges, viz; fructose can help. The fibers in oranges keep cancer causing chemicals away from cells of the colon. In reducing the constipation or diarrhea in those suffering from irritable bowel syndrome *Citrus sinensis* may be helpful (Milind P. and Dev C., (2012)).

Nutrient composition of sweet orange:

Table 4: Nutrient composition of sweet orange

Composition	Amount
Energy	197 kJ (47 kcal)
Sugars	9.35 g
Dietary fiber	2.4 g
Fat	0.12 g
Protein	0.94 g
Water	86.75 g
Vitamin A equiv.	11 µg (1%)
Thiamine (Vitamin B1)	0.087 mg (8%)
Riboflavin (Vitamin B2)	0.04 mg (3%)
Niacin (Vitamin B3)	0.282 mg (2%)
Pantothenic acid (Vitamin B5)	0.25 mg (5%)
Vitamin B6	0.06 mg (%)
Folate (Vitamin B9)	30 µg (8%)
Choline	8.4 mg (2%)
Vitamin C	53.2 mg (64%)
Vitamin E	0.18 mg (1%)
Calcium	40 mg (4%)
Iron	0.1 mg (1%)
Magnesium	10 mg (3%)
Manganese	0.025 mg (1%)
Phosphorus	14 mg (2%)
Potassium	181 mg (4%)
Zinc	0.07 mg (1%)

(Source: USDA Nutrient Database (2014))

Commercial importance of *Citrus sinensis*:

➤ Exporting and importing of the product: -

These are the 15 major countries that exported highest dollar value of oranges in 2015.

Table 5: 15 major countries that exported highest dollar value of oranges in 2015

Sr.no.	Country	Cost
1	Spain	US\$1.3 billion
2	South Africa	\$589.6 million
3	United States	\$568.6 million
4	Egypt	\$492.7 million
5	Netherlands	\$198.4 million
6	Turkey	\$167.3 million
7	Australia	\$143.6 million
8	Greece	\$120.8 million
9	Italy	\$99.6 million
10	Portugal	\$94.6 million
11	Morocco	\$86.4 million
12	China	\$82 million
13	Hong Kong	\$66.9 million
14	Chile	\$62.3 million
15	Israel	\$47.7 million

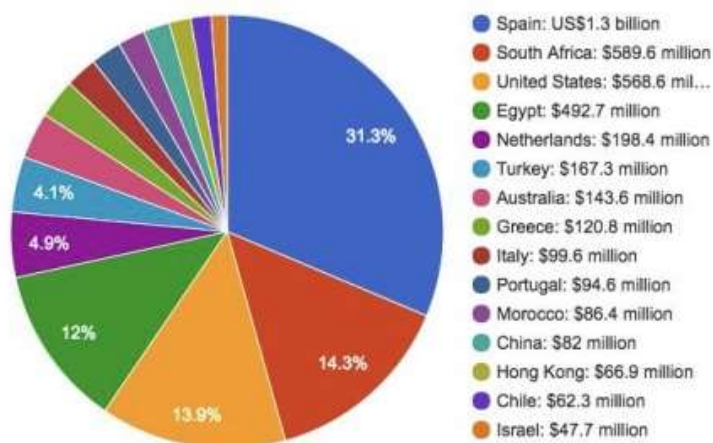


Figure 3: 15 major countries that exported highest dollar value of oranges in 2015

(Source: Valentina Perea, (2016-17))

➤ **Importance in the economy: -**

Orange (*Citrus sinensis*) is one of the world's major fruit crops with global availability and popularity in human diets. Albert Lasker invented orange juice as the solution for the solution for orange overproduction, years later people start invented orange juice as a commercial product and start to sell it. The largest producer of orange juice in the world is Brazil, followed by the U.S.A., India, China and Spain. *Citrus sinensis* has a world production of 49.6 million metric tons for the year 2016-2017 (USDA, 2017).

➤ **Top 10 world's leading orange producers: -**

Rank	Area	Production (Int 1000)	Production (MT)
1	Brazil	3481071	18012560
2	USA	1578237	8166480
3	China, mainland	1256177	65000000
4	India	966290	50000000
5	Mexico	708636	3666790
6	Spain	566980	2933800
7	Egypt	538493	2786397
8	Italy	342163	1770503
9	Turkey	321194	1662000
10	South Africa	311691	1612828

Table 6: Showing top 10 leading orange's producers

(Source: <http://www.mapsofworld.com/world-top-ten/orange-producing-countries.html>)

Conclusion: Based on review its concluded that oranges are also rich in iron, chlorine, manganese, zinc, sodium, phosphorous, iodine, calcium, folic acid, potassium, beta-carotene, amino acids, pectin and fiber. A single orange have about 170 phytonutrients and over 60 flavonoids with anti-tumor, anti-inflammatory, blood clot inhibiting and antioxidant properties. All these properties promote overall health. 12.5% of the daily need for fiber is provided by a single orange. *Citrus sinensis* is effective in the management of arthritis, asthma, alzheimer's disease, parkinson's disease, macular degeneration, diabetes mellitus, gallstones, multiple sclerosis, cholera, gingivitis, optional lung function, cataracts, ulcerative colitis, crohn's disease. These health benefits are because of vitamins, especially vitamin C, Phytochemical compound like synephrine, liminoids, hesperidin flavonoid, polyphenols, pectin etc. Because of its high a values, source of vitamins and other uses, it is grown all over the world today. In terms of volume in production, with more than 108 million tons (FAO statistics 2006) *Citrus* ranks after banana as the world second fruit crop. Oranges are economically important fruit crops.

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