



ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2026): 4.97
IJAFA 2026; 8(2): 107-110
www.agriculturaljournals.com
Received: 09-11-2025
Accepted: 13-01-2026

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Orange: Application in food industry

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DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i2b.1175>

Abstract

Orange (*Citrus sinensis*) is one of the most widely cultivated citrus fruits and plays a significant role in the global food industry due to its nutritional value, sensory appeal, and functional properties. Oranges are rich sources of vitamin C, dietary fiber, flavonoids, carotenoids, and natural antioxidants, making them valuable ingredients in health-oriented food products. In the food industry, oranges are extensively used in the production of juices, concentrates, nectars, jams, marmalades, candies, bakery items, dairy products, and beverages. Orange peel and by-products are increasingly utilized for the extraction of essential oils, pectin, dietary fiber, and bioactive compounds, promoting waste valorization and sustainability. Additionally, orange-derived compounds are employed as natural flavoring agents, preservatives, and color enhancers in processed foods. The versatility, functional benefits, and consumer acceptance of orange-based ingredients highlight their growing importance in food formulation, product development, and the advancement of nutraceutical and functional food sectors.

Keywords: Orange, *Citrus sinensis*, food industry, functional foods, by-products, bioactive compounds

Introduction

Citrus sinensis is the botanical name for the delicious, juicy orange fruit, which is a member of the Rutaceae family (Milind and Dev, 2012) [13]. *Citrus sinensis* is one of the most significant and extensively cultivated fruit crops, with an estimated 120 million tonnes produced worldwide. Because of their delicious juice and therapeutic benefits, oranges are widely grown in tropical and subtropical regions; about one-third of the fruit is processed into juice, with the other portion being eaten whole (Marshall, 2017) [12]. Depending on the variety, oranges are typically accessible from winter to summer (Milind and Dev, 2012) [13]. Considering the status of orange cultivation in India, Mandarin holds the first position in terms of production (5.10 MMT) followed by sweet orange (Mosambi) 3.26 MMT in 2017-18 with a productivity of 11.9 MT/Ha in 428300 Ha area (NHB, 2018). Export of oranges (fresh/dried) from India is 15840.48 MT. Varieties of orange grown in India are Pusa sharad, Malta, Jaffa & Satgudi (NHB, 2018).

Orange's chemical constitution and physico-chemical characteristics

Berries of the orange variety vary greatly in size, colour, shape, and juice quality. An average fruit consists of about 11 separate pieces. Oranges are spherical citrus fruits with pulpy flesh and a finely textured skin that is naturally orange in colour. According to Milind and Dev (2012) [13], oranges typically have a diameter of two to three inches.

An orange is made up of juice vesicles encased in a peel, which is a waxy skin. The peel is made up of a thicker, fibrous inner layer known as the albedo and a thinner, coloured outer layer known as the flavedo. The endocarp, the edible portion of the fruit, contains a central fibrous core and separate segments housing the juice sacs (Marshall, 2017) [12].

Orange provides many nutrient supplies which are beneficial for human health and well-being. Orange fruit is high in pectin and dietary fibre yet low in calories, cholesterol, and saturated fats. According to Ogoloma *et al.* (2013) [16], a ripe orange has about 88.8% moisture, 0.63% ash, 0.65% fat, 0.44% protein, 9.30% carbs, and 0.18% fibre. Iron, manganese, zinc, salt, phosphorus, iodine, calcium, potassium, folic acid, beta-carotene, and amino acids are also abundant in oranges (Cha *et al.*, 2001) [5]. Orange is well-known for its high vitamin C content, just like other citrus fruits. Freshly extracted juice typically contains 450-600 mg of vitamin C per litre (Marshall and Laws, 2017) [12].

Orange's functional qualities and health advantages

Cardiovascular disease prevention

Citrus fruits lower homocysteine levels, which protects against cardiovascular illnesses. It has cardioprotective flavonoids, carotenoids, and vitamin C. Limonene has the ability to reduce cholesterol. Poly Methoxylated Flavones (PMFs) have anti-cardiovascular and cholesterol-lowering properties. One useful method of decreasing cholesterol may be to consume one tablespoon of orange peel daily and use it to flavour tea, salads, yoghurt, soups, snacks or rice (Kurowska and Manthey, 2004)^[10].

Anti-ulcer and anti-cancer characteristics

Limonene, which is found in oranges, lowers the risk of lung, oral, skin, breast, stomach and colon cancer. Additionally, it includes flavone and hesperidin, which have demonstrated anti-carcinogenic properties in a number of *in vivo* investigations (Shimoi *et al.*, 1994)^[21]. Orange's anti-carcinogenic action is mostly dependent on its antioxidant qualities and capacity to regulate the activity of liver enzymes that aid in detoxification (Tanaka *et al.*, 1997)^[23]. Regular consumption of orange juice prevented the formation of ulcers by lowering the incidence of *Helicobacter pylori* infection (Cha *et al.*, 2001)^[5].

Decreased chance of kidney stones

According to Simon *et al.* (2003)^[22], consuming 500 ml of orange juice every day considerably reduces the chance of developing calcium oxalate stones.

Anti-anxiety effect

Aroma-therapists use orange oil as a tranquilizer which helps to reduce the anxiety. Sweet orange oil as an anxiolytic agent (Faturi *et al.*, 2010)^[6].

Anti-typhoid action

Citricidone, citrasiene, and saponins are flavonoids present in oranges that have been shown to be effective against typhoid fever (Vivek *et al.*, 2010)^[24]. The peel's saponins have larvicidal properties that lessen typhoid larva invasion (Wiesman *et al.*, 2005)^[26].

Anti-diabetic action

Bioflavonoids with anti-diabetic properties, such as hesperidin and naringin, are found in orange fruits and peels. (Kumar *et al.*, 2010; Parmar *et al.*, 2008)^[9, 17].

Antifungal properties

Essential oil found in orange peel is an effective inhibitor of biodegrading and storage-contaminating fungus *Aspergillus niger*. According to Sharma and Tripathi (2008)^[20], limonene, linalol, and myrcene are the main antifungal components in oranges.

Healing, anti-inflammatory and anti-arthritis properties

Certain citrus peel extracts appear to have anti-inflammatory properties due to their polymethoxy flavone concentration, particularly nobiletin (Yu *et al.*, 2004)^[27]. Orange contains a variety of flavones, such as naringin and hesperidin, anthocyanins, and hydroxyl cinnamic acids, which have been shown to be useful against cholesterol and high blood pressure. Zeaxanthin and beta-cryptoxanthin are examples of carotenoids that lower the incidence of rheumatoid arthritis (Oben *et al.*, 2009)^[15].

Preventing obesity

The alkaloid synephrine found in orange peels inhibits the liver's synthesis of cholesterol. Oranges' antioxidant components fight oxidative stress, which oxidises the blood's low-density lipoprotein (LDL) (Acham *et al.*, 2018)^[1].

Orange processing

A. Pasteurization

Orange juice is pasteurized to inactivate PME. It is pasteurised for 10-30 seconds at 95-98 °C. This can be carried out separately or as the initial stage of the evaporation process. (Marshall and Laws, 2017)^[12].

B. Winterization

There are traces of dissolved wax from the fruit peel in the polished oil. The wax completely dissolves at temperatures higher than 15 or 20 °C. At lower temperatures, though, the product could become hazy. The polished oil is "winterised," or dewaxed, to prevent this issue (Marshall and Laws, 2017)^[12].

Primary and secondary products of orange

(a) Primary products

Natural fruit

Fruit meant for the fresh fruit market is picked, then sent to packing stations where it is often assessed visually, cleaned, waxed and packaged.

Juice

This product is produced in two alternative ways:

1. As a single-strength (natural strength) product in frozen form.
2. As bulk concentrate normally in frozen form.

(b) Secondary products of orange

Enhanced orange juices like juice with added floating pulp, vitamin enriched, calcium enriched, fiber enriched, reduced acid etc. Orange nectar, orange juice drinks, orange flavour drinks, candied citrus peels are not be called orange juice. Other products include pulp, pulp wash, peel oil (cold-pressed oil), essence, D-limonene, citrus molasses and pectin (Marshall, 2017)^[12]. Foods like jams, jellies, and marmalades are created by boiling fruits and sugar to produce a high Brix product with a gel-like semisolid consistency (Bourne, 1999)^[4].

Application of orange juice in dairy and food products

Jain (2002)^[8] developed whey orange juice concentrate utilizing cheese whey and orange juice, different proportions of cheese whey, orange juice, cane sugar and other ingredients were used to formulate the concentrate. Whey orange beverage containing orange juice 25%, whey 65%, sugar 9.8%, stabiliser (CMC) 0.2% and pH 4.0 was most acceptable. The whey orange juice concentrate had a shelf life of 18 days at 30 °C.

Wadatar (2017)^[25] prepared paneer whey beverage incorporating orange juice at different rates *i.e.* 10, 15, 20, 25 and 30% with 8% sugar. The overall acceptability of paneer whey beverage prepared with 25% orange juice was significantly superior.

Golande (2007)^[7] prepared orange *burfi* by using sweet orange juice at different levels *i.e.* 5, 10, 15%. Orange juice was blended with concentrated buffalo milk at pasty

consistency followed by sugar addition at the rate of 40%. Burfi with 10% orange juice was found optimum in terms of sensory attributes.

Sarjerao (2013) ^[19] prepared orange flavoured *lassi* by incorporating orange juice at levels of 3, 6, 9, 12 and 15%. *Lassi* containing 12% orange juice obtained highest sensory score.

Application of orange peel and orange peel powder

Magada (2008) ^[11] incorporated the orange and mandarin peel powder in the biscuit preparation. Powder was used at three levels 5, 10 and 15%. In sensory evaluation 5 and 10% were found acceptable. Addition of peel powder inhibits the peroxidation of the lipids, so the peel powder could be used instead of synthetic antioxidants. The peroxide values after 6 months of storage were significantly lower than the control.

Patel (2017) ^[18] prepared *Bhapa dahi* by addition of candied orange peel (6%) and orange peel powder (2%) along with mango pulp (18.0%) & orange crush (20%) as a flavoring. The resultant product had higher amount of beta-carotene, vitamin C and fiber with good textural properties compared to control.

Babiker (2013) ^[3] incorporated orange peels at 5, 7.5 and 10% levels in the preparation of bread. Dilution of the functional gluten proteins and/or the interaction between fibrous materials and gluten were found responsible for poor baking quality.

Ananthakumar *et al.* (2018) ^[2] analysed physicochemical properties and shelf life of ghee residue candy incorporated with orange peel powder and aqueous extract at the levels of 5, 10, 15% (1:1 proportion). On sensory evaluation candy with 10% orange components was found to be the best among the others. Texture analysis showed increased hardness and stickiness after 30 days of storage at refrigerated temperature which might be due to loss of moisture during storage.

Zaker (2017) ^[28] studied exploration of orange components in weaning food. Both orange peel powder and pomace powder was blended in 1:1 proportion and added at different rates *i.e.* 5, 10, 15%. Results showed that 10% was found optimum in terms of sensory attributes. Fat, protein, carbohydrates and ash were found to be increased with increase in rate of addition of orange peel and pomace powder.

Conclusion

Oranges are known for their unique flavour, high content of carbohydrates, dietary fibre, vitamins, minerals, and biologically active phytochemicals like flavonoids and carotenoids, which have antioxidant and provitamin A properties. It has low-fat, low-sodium profile and its association with prevention of chronic diseases promotes orange consumption for improved human health. These medicinal and nutritional properties of orange have increased its potential as a suitable ingredient in various food products.

References

1. Acham IO, Ahemen S, Ukeyima MT, Girgih AT. Tropical fruits: bioactive properties and health promoting benefits in chronic disease prevention and management. *Asian Food Sci J.* 2018;5(4):1-13.
2. Ananthakumar KV, Dhanalakshmi B, Karunakaran R. Shelf life analysis of ghee residue candy incorporated with orange peel. *Int J Chem Stud.* 2018;6(1):476-479.
3. Babiker WA, Sulieman AME, Elhardallou SB, Khalifa EA. Physicochemical properties of wheat bread supplemented with orange peel by-products. *Int J Food Sci Nutr.* 2013;2(1):1-4.
4. Bourne MC. The science and technology of making preserves. New York State Food Venture Center Newsletter (Cornell University). 1999;2(6):4-5.
5. Cha JY, Cho YS, Kim I, Anno T, Rahman SM, Yanagita T. Effect of hesperetin, a citrus flavonoid, on liver triacylglycerol content and phosphatidate phosphohydrolase activity in orotic acid-fed rats. *Plant Foods Hum Nutr.* 2001;56(4):349-358.
6. Faturi CB, Leite JR, Alves PB, Canton AC, Teixeira-Silva F. Anxiolytic-like effect of sweet orange aroma in Wistar rats. *Prog Neuropsychopharmacol Biol Psychiatry.* 2010;34(4):605-609.
7. Golande SS. Preparation of sweet orange burfi. Doctoral thesis. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani; 2007.
8. Jain D. Development of whey orange juice concentrate. Master's thesis. National Dairy Research Institute, Karnal; 2002.
9. Kumar S, Vinod KR, Banji D, Kumar K. Plants as potent antidiabetic and wound healing agents: a review. *Hygeia J Drugs Med.* 2010;3(1):11-19.
10. Kurowska EM, Manthey JA. Hypolipidemic effects and absorption of citrus polymethoxylated flavones in hamsters with diet-induced hypercholesterolemia. *J Agric Food Chem.* 2004;52(10):2879-2886.
11. Magda RA, Awad AM, Selim KA. Evaluation of mandarin and navel orange peels as natural sources of antioxidants in biscuits. *Alex J Food Sci Technol.* 2008;32(5):75-82.
12. Marshall P, Laws D. The Orange Book: Reclaiming Liberalism. London: Profile Books; 2017.
13. Milind P, Dev C. Orange: range of benefits. *Int Res J Pharm.* 2012;3(7):59-63.
14. National Horticulture Board. Ministry of Agriculture and Farmers Welfare, Government of India; 2018.
15. Oben J, Enonchong E, Kothari S, Chambliss W, Garrison R, Dolnick D. Phellodendron and citrus extracts benefit joint health in osteoarthritis patients: a pilot double-blind placebo-controlled study. *Nutr J.* 2009;8(1):38.
16. Ogoloma MU, Nkpaa MK, Akaninwor JO, Uwakwe AA. Proximate, phytochemical and mineral composition of some edible fruits grown in oil-producing communities of Rivers State, Nigeria. *J Environ Sci Toxicol Food Technol.* 2013;5(3):38-46.
17. Parmar HS, Kar A. Medicinal values of fruit peels from *Citrus sinensis*, *Punica granatum*, and *Musa paradisiaca*. *J Med Food.* 2008;11(2):376-381.
18. Patel HM. Incorporation of orange peel fiber for value addition to bhapa dahi. Doctoral thesis. Anand Agricultural University, Anand; 2017.
19. Sarjerao JD. Studies on preparation of orange juice (*Citrus sinensis*) flavoured lassi. Doctoral thesis. Mahatma Phule Krishi Vidyapeeth, Rahuri; 2013.
20. Sharma N, Tripathi A. Effects of *Citrus sinensis* (L.) Osbeck epicarp essential oil on growth and

- morphogenesis of *Aspergillus niger*. Microbiol Res. 2008;163(3):337-344.
21. Shimoi K, Masuda S, Furugori M, Esaki S, Kinae N. Radioprotective effect of antioxidative flavonoids in γ -ray irradiated mice. Carcinogenesis. 1994;15(11):2669-2672.
 22. Simon JA, Hudes ES, Perez-Perez GI. Relation of serum ascorbic acid to *Helicobacter pylori* serology in US adults. J Am Coll Nutr. 2003;22(4):283-289.
 23. Tanaka T, Makita H, Kawabata K, Mori H, Kakumoto M, Satoh K, Ogawa H. Chemoprevention of azoxymethane-induced rat colon carcinogenesis by flavonoids diosmin and hesperidin. Carcinogenesis. 1997;18(5):957-965.
 24. Vivek KR, Nandini SS, Anitha S. Anti-typhoid activity of aqueous extract of fruit peel *Citrus sinensis* (L.). Int J Pharm Res Dev. 2010;2(9):31-36.
 25. Wadatkar HV. Studies on preparation of paneer whey beverage using orange (*Citrus reticulata*) juice. Doctoral thesis. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola; 2017.
 26. Wiesman Z, Chapagain B. Larvicidal effects of aqueous extracts of *Balanites aegyptiaca* against larvae of *Culex pipiens*. Afr J Biotechnol. 2005;4(11):1207-1211.
 27. Yu H, Robert RT, Ho CT. Anti-inflammatory activity of polymethoxyflavones in sweet orange (*Citrus sinensis*) peel and metabolites of nobiletin. Abstr Pap Am Chem Soc. 2004;227:31-32.
 28. Zaker A. Isolation and characterization of nutraceutical components from orange waste and their application in weaning food. Doctoral thesis. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani; 2017.