The Pharma Innovation Journal 2021; 10(12): 1524-1527

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 1524-1527

www.thepharmajournal.com
Received: 17-10-2021
Accepted: 29-11-2021

Gangakhedkar PS
Department of Food Microbiology and Safety, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Shinde ST
Department of Food Microbiology and Safety, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Mane RP
Department of Food Microbiology and Safety, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Gaikwad GP
Department of Food Microbiology and Safety, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
Gangakhedkar PS
Department of Food Microbiology and Safety, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Studies on Physico-chemical properties of sweet orange

Gangakhedkar PS, Shinde ST, Mane RP and Gaikwad GP

Abstract
Sweet orange is considered as most important fruit crop of citrus group with their wholesome nature multi fold nutrition and medicinal value have made them so important. Sweet oranges are manufactured on large scale all over the world and needed due to less number of seeds and are better juice quality. Fruit size in terms of length and diameter, shape and number of seeds per fruit did not change significantly. Fruit weight varies between green and ripe fruit. The nutritional value of sweet orange fruit was assessed using chemical method. Chemical properties were found to be as follows the moisture content was observed 87.6%, TSS (10 0 Brix), pH (3.9), per cent acidity (0.41%), total sugars (8.40%), reducing sugars (2.0%), non-reducing sugars (6.46%) and ascorbic acid (45.10 mg/ml). The objectives of the present study were to study the physicochemical properties of sweet orange fruit.

Keywords: Sweet orange, physical content, chemical content, mineral content

1. Introduction
Sweet Orange is considered as most significant fruit crop of citrus group with their wholesome nature multifold nutrition and medicinal value have made them so important. Sweet Orange (*Citrus sinensis* L. Osbeck) belongs to family Rutaceae. Sweet orange is native of Southern China. It is now widely distributed and naturalized in sub-tropical zone of India. It is cultivated particularly in Brazil, China, Japan, Turkey and India. Sweet orange need dry climate and arid weather with distinct summer and winter seasons with low rainfall. It is grown on wide range of soil ranging from clay to light sandy and sensitive to salt. Sweet orange is well grown on medium black, red, alluvial river bank loamy soil of Maharashtra state and Goradu soil of Gujarat.

Botanical classification of orange Kingdom: *Plantae*;
Division: *Magnoliophyta*;
Class: *Dicotyledons*;
Sub Class: *Sapindales*;
Order: *Rosidae*;
Family: *Rutaceae*;
Sub family: *Aurantoideae*;
Genera: *Citrus*;
Species: *sinensis*.
(Parle and Chaturvedi, (2012) [2].

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.
The major sweet orange producing states in India are Andhra Pradesh, Maharashtra, Tamil Nadu, Karnataka, Madhya Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Uttar Pradesh, Punjab and Haryana. In India, about 27.47 lakh ha. area is under sweet orange cultivation with production of 424.82 lakh tones of fruits with 15.5 MT productivity. Anonymous, (2016) [5].
In Maharashtra, sweet orange is grown in Jalna, Aurangabad, Parbhani, Nanded, Nagpur, Amravati and Ahmednagar districts. It is cultivated on area of 61.8 thousand ha.

With the production of 543.0 thousand MT of fruits and productivity is 8.8 MT/ha. Anonymous, (2015) [4]. Citrus is third in area and production in India after Mango and Banana. Citrus group comprises of four major types i.e. Mandarin, Sweet Orange, Acid Lime and Lemons. In India, citrus is cultivated on 846.00 thousand ha with the total production of 74.64 lakhs tones and productivity of 8.8 million tons per ha. India is 6th largest producer in Sweet orange. Maximum area under Sweet orange is in Andhra Pradesh followed by Maharashtra and Karnataka. Maharashtra is largest producer of Sweet orange in the country and contributes to about 49 per cent of the total production of Sweet orange. In Maharashtra area under Sweet orange cultivation is 107.00 thousand ha with production of 652.00 thousand MT and productivity 6.1 MT/ha. Commercially Sweet orange is grown in Khera district of Gujarat and Jalna, Aurangabad, Nanded districts of Marathwada region. Anonymous, (2014) [3].

The main citrus growing states in India are Andhra Pradesh, Maharashtra, Punjab, Haryana, Karnataka and Rajasthan. Sweet oranges are the second largest citrus fruits cultivated in the country and accounts for approximately 70 per cent of the citrus production. The total area for sweet orange production in India during 2012-13 was 164.66 million hectare, production: 1186.41 million tonnes and productivity: 7.21 million tonnes per hectare. Maharashtra stands first in area wise production of sweet oranges in India next to Andhra Pradesh, Karnataka and Punjab. Singh and Naqvi, (2001) [7].

As per the FAO (2012) report global citrus production was 115.23 million tons and highest citrus producing countries are China (22.94 milliontons), Brazil (22.70 million tons), USA (10.44 million tons) and India (7.46 million tons) (NRCC 2013). Globally sweet orange accounted for approximately 64% of citrus production, mandarin (20%), lemon and limes (10%) and others (6%). In India, Citrus (12.4%) is third most important fruit crop after banana (32.6%) and mango (22.1%). It is grown on 1.04 million ha area with 10.9 million tons production and 9.7 tons / ha productivity (NHB, 2013). Mandarins (*Citrus reticulata* Blanco) is the largest grown commercial citrus cultivar in India with 43% share, followed by sweet orange (*Citrus sinensis* L. Osbeck) with 25% area, acid lime & lemons (*Citrus aurantifolia* Swingle) with 25% area and others contribute 7% share.

2. Methods and Materials

2.1 Physical properties of fruits

2.1.1 Weight

Sweet orange fruits five each were individually weighed on electronic balance and average weight of fruit was expressed in grams (g).

2.1.2 Diameter of fruit

The diameter of sweet orange fruits was measured with the help of vernier calliper and expressed in terms of (mm).

2.1.3 Shape

Shape of the fruits was recorded by visual observations.

2.1.4 Colour

The colour of the fruits was recorded by visual observations.

2.1.5 Number of seed

The number of seeds per fruit of five fruit was measured manually then average was calculated and expressed in number.

2.1.6 Determination of Moisture

Moisture was estimated by accurately weighing the 5 g sample of sweet orange subjected to oven drying at 105°C for 4 hr. It was again weighed after cooling in desiccators until constant weight. The resultant loss in weight was calculated as moisture content (AOAC, 2000).

$$\text{Moisture \%} = \frac{\text{Initial weight} - \text{final weight}}{\text{weight of sample}} \times 100$$

2.1.7 Determination of pH

The pH value of the sweet orange juice was determined potentiometric ally by means of a digital pH meter.

2.1.8 Determination of TSS (Total Soluble Solids)

The sweet orange juice was prepared and a drop of juice was placed on the prism of hand refractometer (ERMA make) and total soluble solids was recorded as ^{0}Brix.

2.1.9 Determination of titratable acidity

The acidity of sample was calculated as per the method suggested by (Ranganna, 1986).

Reagents

1. Sodium hydroxide (0.01N)
2. Phenolphthalein indicator

5 ml of fresh sample was taken in 100 ml volumetric flask and volume made up to 100 ml with distilled water. A measured aliquot (10ml) was then titrated against 0.1 N NaOH using phenolphthalein as indicator to a light pink colour. Acidity was expressed as per cent citric acid.

$$\text{Per cent acidity} = \frac{\text{Titre x Normality of NaOH x volume made up x 64}}{\left[\begin{array}{c}\text{(As citric acid) Volume of sample}\\ \text{Taken for estimation}\end{array}\right] \text{x} \left[\begin{array}{c}\text{Weight or volume x 1000}\\ \text{of sample taken}\end{array}\right]} \text{X100}$$

2.1.10 Total sugars (%)

Total sugars were determined following the method described by (AOAC, 1965). A quantity of 50 ml lead free filtrate was taken in a 100 ml volumetric flask and to it 5 ml of concentrated HCl was added, mixed well and then kept for 24 hours at room temperature. Acid was then neutralized with NaOH using a drop of phenolphthalein as an indicator till the pink colour persisted for at least few seconds. Then volume was made up to 100 ml. Total sugars were then estimated by taking this solution in a burette and titrating it against standard Fehling's solution mixture of A and B (1:1) using methylene blue as an indicator and taking brick red colour as an end point.

2.1.11 Ascorbic acid (mg/100ml)

Ascorbic Acid was determined using the standard procedure of (AOAC, 2005).

2.2 Calculations

Using the data obtained in standardization of the dye, calculate the titer using the following formula:

Mg ascorbic acid in volume of standard solution titrated**

$$\text{Titre} = \frac{\text{Mg ascorbic acid in volume of standard solution titrated**}}{[(\text{Average ml dye used to titrate standards-(average ml dye used to titrate blank)}]}$$

*mg ascorbic acid in vol of std. sol titrated = (mg ascorbic acid/50 ml) × 2 ml

3. Proximate composition of sweet orange

3.1 Determination of Crude Protein

The crude protein was determined by weighing 0.2 g of sweet orange samples by the Kjeldhal method as described in method No. 46-10 of AACC (2000) [1]. This is based on the fact that on digestion with concentrated Sulphuric acid and catalysts, organic compounds are oxidized and the nitrogen is converted to ammonium sulphate. Upon making the reaction mixture alkaline, ammonia is liberated, removed by the steam distillation, collected and titrated.

3.1.1 Procedure

The nitrogen content of samples was determined by using micro Kjeldhal method. The sample was first digested in digestion flask with H_2SO_4 in presence of digestion mixture for 3-4 hr till the contents of digestion flask get transparent colour. The samples were then diluted with distilled water up to 250 ml in a volumetric flask. The ammonia from the samples was liberated through distillation after adding 40% NaOH solution and collected in flask containing 4% boric acid solution using methyl red as an indicator. The nitrogen content in the samples was determined by titrating against standard 0.1 N H_2SO_4 solution and the crude protein percentage was calculated by using formula.

$$\text{Percent Nitrogen (N)} = \frac{(\text{Sample-Blank}) \times \text{N of } H_2SO_4 \times 0.014 \times \text{D.F.}}{\text{Wt. of sample (g)}} \times 100$$

Percent Protein = Percent Nitrogen × 6.25

3.2 Determination of Crude Fat

The method employed was that of solvent extraction using a Soxhlet extraction as described in method No. 30-10 of AACC (2000) [1]. 2 g of sample was taken in a thimble and placed in extraction tube of Soxhlet apparatus. About 250 ml of Hexane was added in 500 ml bottom flask of the apparatus and connected to Soxhlet apparatus. The fat was extracted by running Hexane over the sample at the rate of 3-4 drops per sec for about 5 hr. The solvent was recovered and the flask was kept in hot air oven for 10 min at 40-50 ºC. The flask was cooled in desiccator and weighed. Fat percentage was calculated according to the following formula.

$$\text{Percent Crude Fat} = \frac{\text{Final weight of flask} - \text{Empty weight of flask}}{\text{Weight of sample}} \times 100$$

3.3 Total Carbohydrates

Carbohydrates were calculated by difference method as follows (AOAC, 2005).

Total Carbohydrates = 100 - % (Moisture + Fat + Protein + Ash +Crude Fiber)

3.4 Determination of Ash

The ash content was determined as a total inorganic matter by incineration of the samples at 600ºC according to method No. 08-01 of AACC (2000) [1]. Remaining inorganic materials are reduced to their most stable form, oxides or sulphates and are considered as "ash".

3.5 Procedure

Oven dried 5 g sample was taken in a pre-weighed silica crucible and charred on the burner. Then it was ignited in the muffle furnace at 550-600 ºC for 5-6 hours or till to get constant weight of greyish ash. The ash of sample was calculated with the following formula.

$$\% \text{ Ash} = \frac{\text{Weight of crucible with ash} - \text{Weight of empty crucible}}{\text{Total weight of sample}} \times 100$$

3.6. Estimation of Minerals

Minerals like calcium, magnesium, potassium, zinc, copper, sodium and iron were determined by using titration and spectrophotometric method (Atomic Absorption Spectrophotometer).

4. Result and Discussion

4.1 Physical- chemical properties of sweet orange (*Citrus sinensis*)

The understanding of physical quality attributes is critical in determining the consumer acceptability of product. The yield of ultimate product depends upon the quality of raw material which could be measured in terms of physical properties. Sweet orange fruit (*citrus sinensis*) *viz.* from local market of Parbhani was used during present investigation and results with respect to physical properties are summarized in Table 1.

Table 1: Physical properties of sweet orange Fruit

Physical parameters	Average value
Fruit colour	Greenish yellow
Fruit segment	Yellowish orange
Fruit shape	Roundish oval
Weight (g)	188.9
Horizontal Diameter (mm)	63.65
Vertical Diameter (mm)	64.05
Number of segment per fruit	10
Number of seed per fruit	15

*Each value is an average of three determinations

Data from Table 1 showed that the average fruit weight was 188.9g, whereas horizontal and vertical diameter of orange fruit was 63.65mm and 64.05 mm respectively. The shape and color were observed visually and the shape of orange was found to be roundish oval and color was greenish yellow, and fruit segment colour was yellowish orange, number of segment of fruit and number of seed per fruit was 10 and 15 respectively. The results were closely in agreement with Dhineshkumar and Siddharth (2015) [8].

Table 2: Chemical composition of sweet orange

Chemical Parameters	Orange Juice
Moisture (%)	87.6 ± 0.3
TSS (^{0}Bx)	10 ±1.0
pH	3.9 ±0.5
Titrable acidity (%)	0.41±0.4
Total Fat (%)	0.16 ± 0.1
Total carbohydrates (%)	7.59 ± 0.4
Total Protein (%)	0.95±0.2
Ash (%)	1.4 ± 0.2
Ascorbic Acid (mg/100gm)	45.10 ± 1.2
Crude Fiber (%)	1.9 ± 0.2

*Each value is an average of three determinations

From table 2 exposed that the moisture content in orange juice was 87.6 per cent and carbohydrate content was found to be 7.59 per cent. The pH and TSS content was noted 3.9 and 10 brix. The fat and protein content were very low 0.3 per cent and 0.95 per cent. The crude fibre content of orange juice was noted to be 1.9 per cent. Ash content of orange juice was found to be 1.4 per cent. These all chemical parameters were in close agreement with results reported by Etebu and Nwauzoma, (2014) [9].

4.2 Mineral composition of sweet orange

Minerals are inorganic elements needed by the body as structural component and regulators of body processes.

The data regarding iron, potassium, calcium, magnesium and zinc of orange are depicted in Table 3. The concentration of these minerals was recorded to be 0.3, 90.12, 38.20, 8.9 and 0.1 (mg/100g) respectively. The values of calcium, magnesium, phosphorus, potassium and zinc were similar with the results reported by Etebu and Nwauzoma, (2014) [9]. The concentration of Ca and K were found much higher than the other inorganic minerals. However, zinc was found very low in concentration.

Table 3: Mineral composition of sweet orange

Minerals	Average value mg/100g
Iron	0.3 ±0.20
Potassium	90.12 ± 1.29
Calcium	38.20±1.20
Magnesium	8.9 ± 0.08
Zinc	0.1 ± 0.01

*Each value is an average of three determinations

5. Conclusion

Sweet orange is also a rich source of potassium, hence they helps in curing diarrhea and dysentery. Sweet oranges are rich in vitamin C hence helps by making up for the deficiency that causes scurvy. Physico-chemical characteristics of orange were studied and revealed that the oranges are greenish yellow in colour, round in shape, the horizontal and vertical diameter were 63.65 mm and 64.05 mm respectively. Number of segment of fruit and number of seed per fruit was 10 and 15 respectively Average weight of orange was 188.9 g. The results of proximate composition revealed that orange possesses high moisture (87.6 per cent). Orange had protein (0.95 per cent) and carbohydrate (7.59 per cent). Orange contains good amount of potassium, calcium and magnesium. Orange was found to be higher in potassium (90.12 mg) and calcium (38.20 mg). Looking to the demand of natural beverages, there is great scope for the preparation of juices and other fruit-based beverages. Sweet orange juice also benefits individuals suffering from indigestion, irregular bowel movement, and other gastrointestinal problems. Sweet orange juice is an excellent thirst quencher and a good replacer for carbonated sweetened drinks. It has a cooling effect in cases of fever and jaundice. It provides relief from stomach related problems.

6. Reference

1. AACC. Approved Methods of the American Association of Cereal Chemists, 10th Ed. AACC, St. Paul, MN, USA. 2000.
2. Parle M, Chaturvedi D. Orange: range of benefits. International Research Journal of Pharmacy. 2012;3(7):59-63.
3. Anonymous. Indian Horticulture Database, National Horticulture Board, Government. of India. 2014;1(3):25-29.
4. Anonymous. Indian Statistical Database, http:/www.indiastat.com, Government. of India. 2015;2(5):51-73.
5. Anonymous. Indian Statistical Database, http:/www.indiastat.com, Government. of India. 2016;3(6):22-36.
6. AOAC. Association of Official Analytical Chemists, official methods of analysis AOAC, Washington D.C. 1965.
7. Singh S, Naqui SA. Citrus fruit. IBDCM Publication, Lucknow (UP). 2001;80(2):97-104.
8. Dhineshkumar V, Siddharth M. Studies on physical properties of orange fruit. Journal of Food Research and Technology. 2015;3(4):125-130.
9. Etebu E, Nwauzoma AB. A review on sweet orange (*Citrus Sinensis*) health, diseases, and management. American Journal of Research Communication. 2014;2(2):33-70.