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Shravan R

Department of Food Process
Technology, College of Food
Technology, Vasant Rao Naik
Marathwada Krishi Vidyapeeth,
Parbhani, Maharashtra, India

DM Shere

Department of Food Process
Technology, College of Food
Technology, Vasant Rao Naik
Marathwada Krishi Vidyapeeth,
Parbhani, Maharashtra, India

Joshi Monali M

Department of Food Process
Technology, College of Food
Technology, Vasant Rao Naik
Marathwada Krishi Vidyapeeth,
Parbhani, Maharashtra, India

Study of physico-chemical characteristics of sweet orange (*Citrus sinensis*) fruit

Shravan R, DM Shere and Joshi Monali M

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 Orange (*Citrus sinensis*) belongs to family Rutaceae. The present investigation was undertaken to find out physico-chemical characteristics of sweet orange fruit. The result show that the physical and chemical properties of sweet orange (*Citrus sinensis*) fruit. 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 88.5% TSS (11° Brix), pH (3.8), per cent acidity (0.51%), total sugars (8.36 %), reducing sugars (1.8%), non reducing sugars (6.56%) and ascorbic acid (46.5mg/ml). The objectives of the present study were to study the physicochemical properties of sweet orange fruit

Keywords: Sweet orange, *Citrus × sinensis*, physical property, nutritional value

Introduction

Sweet Orange is considered as most important fruit crop of citrus group with their wholesome nature multifold nutrition and medicinal value have made them so important. Sweet Orange (*Citrus sinensis*) 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 dev, 2012) [6]. 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) [2].

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) [1].

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. Just one orange provides 116 per cent 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.

Correspondence**Shravan R**

Department of Food Process
Technology, College of Food
Technology, Vasant Rao Naik
Marathwada Krishi Vidyapeeth,
Parbhani, Maharashtra, India

Vitamin C is also necessary for the proper functioning of immune system. Vitamin C is good for preventing cold, and cough. (Parle and Chaturvedi, 2012) [6]. The beneficial effect of citrus fruit consumption on human health due to presence of antioxidant and anti-radicle properties (betoret *et al.* 2009) [5].

Materials and Methods

Plant material

Matured ripe Sweet orange fruits having greenish yellow colour, fully ripe sweet orange fruit were collected from local area of Parbhani (Maharashtra) for experimental purpose.

Physical properties of sweet orange fruit

The physical characteristics of sweet orange fruit were studied. Matured green and ripe, healthy fruits with uniform size, colour, and maturity were selected. The length, width, diameter, and average weight were measured. The flesh was removed with the help of knife or the spoon manually and separated rind and seeds and their weights were recorded separately. All linear measurements were taken by using Vernier calliper. Where quality attributes like colour, appearance, shape, uniformity and defects were recorded visually.

1. Average weight

The weight of randomly selected five fruits was taken individually on an electronic weighing balance. Then average weight of fruit was calculated and expressed in grams.

2. Average length

The length of five fruits measured with help of Vernier Caliper and average calculated and expressed in cm.

3. Average diameter

The diameter of five fruits was measured and then average was calculated and expressed in mm.

4. Number of seeds per fruit

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

5. Thickness of rind

Thickness of rind of five fruits was measured by Vernier Caliper and then average was calculated and expressed in mm.

6. Weight of pomace

The weight of sweet orange pomace was taken individually on an electronic weighing balance.

3. Chemical properties of sweet orange fruit

Analysing chemical properties of the fruit, the fruit were broken and pulp, seed and pericarp of fruit were separated. Moisture, titrable acidity, crude fibre, crude fat, crude protein and ash content were estimated by employing the standard methods of analysis. pH was measured by control dynamic digital pH meter. Total sugar content was estimated by the phenol-sulfuric acid analysis using glucose as standard. The nature of the carbohydrate was confirmed by Molisch tests, Felhing's test and Iodine test. The total carbohydrate content was determined by anthrone method.

1. Moisture

Moisture refers to the amount of free water and volatile substances that are lost by drying the food under controlled

temperature in Hot air oven. It is expressed in g per 100 g sample.

2. Crude fat

5 g sample was weighed accurately in thimble and defatted with petroleum ether in Soxhlet apparatus for 6-8 hrs. at 70 °C. The resultant ether extract was evaporated and crude fat content was calculated (A.O.A.C. 1990) [3].

3. Total ash

Total ash was determined according to A.O.A.C. (1990) [3]. 5gm sample was weighed into crucible and ignited at low flame till all the material was completely charred. Then it was kept in muffle furnace for 6 hrs. at 550 °C and further cooled in desiccators and weighed. This was repeated till two consecutive weights were constant and percent ash was calculated.

4. Acidity as percent citric acid

The acidity of sample was calculated by standard A.O.A.C. method (1990) [1]. Acidity was expressed as percent citric acid.

$$\text{Percent acidity as citric acid} = \frac{\text{Titer} \times \text{Normality of NaOH} \times \text{Volume made up} \times 64 \times 100}{\text{Volume taken for estimation} \times \text{Wt. / volume of sample taken} \times 1000}$$

5. Ascorbic acid

The ascorbic acid was determined by method of Ranganna (1986) [6].

$$\text{Ascorbic acid mg/100 ml} = \frac{\text{Aliquot of extract taken for estimation} \times \text{Weight or volume of sample taken for estimation}}{\text{Titer} \times \text{Dye factor} \times \text{Volume made up} \times 100}$$

Dye factor = 0.5 Titer value

6. Dietary Fiber

Total dietary fiber were analysed according to standard AOAC methods (AOAC, 1995) [4].

7. Total Sugars

Total sugars was determined by using Phenol Sulphuric Acid Method.

8. Reducing Sugars

Reducing sugars was estimated using Nelson Somogyi method.

9. Non reducing sugars

The value of non reducing sugars was obtained by subtracting the reducing sugars from total sugars.

Result and Discussion

The physical characteristics of fruit play a very important role in development of processing technology and on the quality of final products. Quality of any fruit can be judge by the physical parameter. The data on physical characteristics of ripened sweet orange fruits are presented in Table 1. The colour of sweet orange fruit changes from greenish yellow to yellowish orange, during the ripening change in colour may be due to degradation of chlorophyll content and formation of carotenoid pigments. Fruit shape is roundish oval. Fruit weight varies between green and ripe fruit. The average

number of segment observed 10 per fruits. The values for fruit length observed 7.5 cm. The horizontal Diameter of sweet orange was found to be 66.66 mm and vertical diameter 67.05 mm the average weight of five fruits was noted to be 198.5 grams. Thickness of peel found 1.8 mm. And number of seed per fruits varies between 15 to 23 it depending upon genetic and environmental factor.

Sweet orange fruit were analysed for TSS, pH, total acidity, reducing sugar, moisture content, fat, protein, and ash. The results are presented in table 2. Fat was negligible in sweet orange fruit. During riping colour of the fruits change and moisture content, sugar content of fruits increased, while acid content decrease during ripening and flesh softening and textural changes, formation of aroma volatiles and accumulation of organic acid with associated with development of flavour. The taste of juice was significantly affected by the stage of ripening of the fruit.

Table 1: Physical parameter of sweet orange fruit

S. No.	Parameter	Value
1	Fruit colour	Greenish yellow
2	Fruit segment	Yellowish orange
3	Fruit shape	Roundish oval
4	Average weight (g)	198.5
5	Average number of segment	10
6	Average length (cm)	7.5
7	Average weight of peel (g)	48.10
8	Horizontal diameter (mm)	66.66
9	Vertical diameter (mm)	67.05
10	Thickness of rind (mm)	1.8
11	Weight of pomace (g)	66.00
12	Number of seeds per fruit	16

Table 2: Chemical composition of sweet orange fruit

S. No.	Parameter	Observation
1	pH	3.8
2	TSS	11
3	Total acidity percent	0.51
4	Moisture percent	88.5
4	Protein percent	0.7
5	Fat percent	0.05
6	Carbohydrate percent	10.3
7	Fibre percent	0.11
8	Ash percent	0.3
9	Reducing sugar percent	1.8
10	Non reducing sugar percent	6.56
11	Total sugar percent	8.36
12	Ascorbic acid (mg/100ml)	46.5

Conclusion

In the present investigation efforts were made for analysis of physicochemical characteristics of sweet orange fruit. Chemical properties were found to be as follows: sweet orange fruit contain (88.5 %) moisture, (0.05 %)fat, (0.7 %) crude protein, (0.3%) ash, TSS (11° Brix), pH (3.8), per cent acidity (0.51%), total sugars (8.36%), reducing sugars (1.8%), non reducing sugars (6.56%) and ascorbic acid (46.5mg/ml). The physical characteristics of fruit play a very important role in development of processing technology and on the quality of final products and chemical composition which is assess the nutritional value.

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