

Comparative analysis of physio-chemical parameters and effect of different juice extraction techniques on the pulp yield of nectarine cultivars

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ABSTRACT

Fruits supplement human diet by providing various nutrients. Fruit cultivation in India, grows most fruitful in the areas of the Himalayas, with abundance from every angle. Nectarine fruit is a hybrid of peach and plum. The major commercial varieties of nectarine grown in Himachal Pradesh are May Fire, Snow Queen and Silver King. The study was aimed to determine the difference in nutritional parameters of selected cultivars of nectarine and to study the effect of different juice extraction techniques on the yield of pulp. Results revealed that there was a non-significant difference in terms of physical parameters in all the varieties. In case of proximate composition significant difference was observed in ash and carbohydrate content among all the varieties. pH, ascorbic acid, brix-acid ratio and sugars had significant difference with highest ascorbic acid was noted in May Fire (8.52mg/100gm) while Snow Queen variety had highest pH (3.30) and total sugars (8.33 %) when compared with each other. Mineral composition showed that the fruit had highest content of potassium with maximum value reported for Snow Queen (202.00 mg/100g). A significant difference was also observed in all the varieties when analyzed for phosphorous, magnesium and sodium content. Data related to juice extraction techniques showed that highest pulp recovery was observed in blanching treatment with pulp recovery noted as 70, 69 and 68 per cent for Snow Queen, May Fire and Silver King while lowest pulp recovery was noted in manual method.

Key Words: nectarine, cultivars, physico-chemical parameters, extraction techniques

INTRODUCTION

Deciduous fruits, covering pome and stone fruits contribute importantly to the horticultural economy of India. Since long back, India has served as a country dependent on agriculture. A large number of fruit and vegetable are grown in different parts of the country. Nature has been abundantly generous to Himachal Pradesh in endowing it with conditions conducive for growing of large variety of fruits that is why Himachal Pradesh is known as 'Fruit bowl of India'. Nectarine fruit is a hybrid of peach and plum. In India, Himachal Pradesh is a state which has made efforts for growing nectarine fruit by Horticulture Department in Palampur area of Kangra district. About 28 thousand ha area is covered under peach, plum, apricot, almond and cherry and estimated yield of peach and nectarine is 0.50 t/ha in Himachal Pradesh (Ghosh, 2010). The major commercial varieties of nectarine grown in Himachal Pradesh

are May Fire, Snow Queen and Silver King. Fruit quality is a fundamental determinant for the acceptance of nectarine cultivars by consumers, because of the high competition of new released cultivars in the market (Crisosto and Crisosto 2005). Nectarines are characterized by yellow or white flesh, freestones, round shape, red peel, resistance to handling and shipping and high soluble solid content (Sortino *et al.*, 2013).

Nectarines (*Prunus persica*) belong to the Rosaceae family and are thought to have originated in China. Nectarine fruit is having a fuzzless skin. Nectarine fruit look more like plums than peaches because of the smooth and shiny skin that's why nectarine is also known as "Peach with a plum skin". The major difference between the nectarine and peach is that the nectarine has smooth skin and the peach has needle-like, hairy or fuzzy skin. In the present scenario, everybody is acquainted with the term 'Superfruits', which provide the significant value of nutrients beyond basic nutrition, as having high antioxidants, nutrient density and with potential health benefits such as the ability to lower certain risk of diseases (Palmer, 2009). Nectarines have a lower calorie count and are a good source of carotenes, flavonoids, potassium, phosphorus, dietary fiber,

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and vitamins A, C, lycopene and lutein. By considering nectarine as super fruit, the study was planned to find the difference in selected cultivars in terms of nutritional composition and to determine the effect of different juice extraction techniques on the percent juice/pulp yield of selected nectarine cultivars.

MATERIALS AND METHODS

The study was carried out in the year 2009-2011 at CSKHPKV, Palampur (H.P) in the Department of Food Science, Nutrition and Technology, CSKHPKV, Palampur (Himachal Pradesh), India. Three varieties of nectarine fruit viz. Snow Queen, May Fire and Silver King were procured from the Horticulture Department, CSKHPKV, Palampur (H.P), India. The fruits were washed under running tap water to remove adhering dirt etc. The three varieties of fruits were assessed for physical, chemical, proximate composition, mineral estimation and juice extraction techniques.

Physical parameters:

Fruit colour and shape: It was assessed by visual appearance while length and breadth of the fruits were assessed by vernier caliper.

Fruit volume: It was recorded by water displacement method in which 500 ml of measuring cylinder was taken and filled with 200 ml of water. 50g of fruit was put into the cylinder. The raise in water level was noted and recorded in ml.

Specific gravity: It was calculated by dividing the weight of ten randomly selected fruits by volume of ten randomly selected fruits.

$$\text{Specific gravity (g/ml)} = \frac{\text{Weight of fruits (g)}}{\text{Volume of fruits (ml)}} \times 100$$

Weight : The fruit weight was assessed by electronic weighing balance.

Chemical parameters:

TSS and pH content : TSS and pH content was measured by hand refractometer and pH meter, respectively.

Moisture, protein, fat, ash and fibre: These parameters were estimated by the method (AOAC, 1990).

Carbohydrates : Carbohydrates were determined by the method NIN, 1983.

Total carbohydrates (%) = 100- (moisture % + protein % + fat % + fibre % + ash %)

Acidity, ascorbic acid, pectin, sugars and minerals: These parameters were estimated by the approved methods of Ranganna (2007).

β -carotene (Srivastava and Kumar, 2003)

β -carotene was extracted from the sample by crushing 5 g of sample with 10-15 ml acetone, adding crystals of anhydrous sodium sulphate. The supernatant was decanted and collected in a beaker. The process was repeated twice. 10-15 ml petroleum ether was added and mixed thoroughly. The content was transferred in to the separating funnel, two layers were separated out on standing solution. Lower layer was discarded and upper layer was collected and volume was made upto 100 ml with petroleum ether. The optical density was recorded at 452 nm using petroleum ether as blank.

$$\text{O.D} \times 13.9 \times 10^4 \times 100$$

$$\beta\text{-carotene} = \frac{\text{O.D} \times 13.9 \times 10^4 \times 100}{\text{Wt. of sample (g)} \times 560 \times 1000}$$

Anthocyanin (Srivastava and Kumar, 2003)

Anthocyanin was extracted from the sample by blending 10 g of sample with 10 ml of ethanolic HCL and transferred to 100 ml volumetric flask. The volume was made up and the solution was stored in refrigerator at 4°C, and then filtered through Whatman No.1 filter paper. Optical density of filtrate was recorded at 535 nm.

$$\text{O.D} \times \text{Volume made up} \times 100$$

$$\text{Total O.D} / 100 \text{ g} = \frac{\text{O.D} \times \text{Volume made up} \times 100}{\text{Weight of sample (g)}}$$

$$\text{Total O.D} / 100 \text{ g}$$

$$\text{Total anthocyanin} = \frac{\text{Total O.D} / 100 \text{ g}}{98.2}$$

Standardization of juice extraction techniques:

Different techniques for peeling and softening of fruit tissues were done for the maximum recovery of pulp/ juice. Peeling techniques were standardized in the laboratory with 100g of fruits/ treatment. The peel, pulp and stone percentage were recorded. The methods for different extraction techniques were illustrated as:

Manual peeling

Fruits of three varieties of nectarine were sorted and washed properly. The peel and pulp were extracted manually and recorded its percentage.

Blanching

The fruits were blanched in boiling water for 3 to 5 minutes and immediately transferred to cold water. Peel the skin and pulp was extracted. The recovery of pulp was noted.

Hot lye peeling

The fruits were tied in a muslin cloth and treated with different concentration of lye solution i.e. 1, 2, 3 and 4 % lye solution (NaOH) at 80°C for appropriate time to remove the peel properly. 4 % lye solution at 80°C for 120 seconds was found to be the best treatment. After treatment the fruits were dipped in cold water followed by dipping in 1 % citric acid solution to remove excess of lye and finally the fruits were rinsed in water. Pulp was extracted, homogenized and measured the peel, stone and pulp recovery.

Cold lye peeling

Fruits were tied in a muslin cloth and treated with different concentration of lye solution i.e. 1, 2, 3 and 4 % lye solution (NaOH) for appropriate time to remove the peel properly. 4 % lye solution for 8 to 10 minutes was found to be best. After treatment the fruits were dipped in cold water followed by dipping in 1 % citric acid solution to remove excess of lye and finally the fruits were rinsed in water. Pulp was extracted and quantity was measured.

Steaming

The fruits were subjected to steaming for 5, 7, 9 and 11 minutes in autoclave by adding known amount of water. Steaming for 7 minutes in autoclave was found to be best for peel removal and pulp extraction. Pulp was extracted and recovery was noted.

RESULTS AND DISCUSSION

Physical characteristics

Table 1 shows data related to physical parameters. Figure 1 represents fruit colour as reddish yellow with round shape. The mean values for length, breadth and weight for all the cultivars were ranged from (3.97- 4.07cm), (4.16-4.30cm) and (40.10-41.40 gm). Studies by (Milosenic *et al.*, 2012; Kishore *et al.*, 2017) reported weight for Mayfire cultivar and Red Nectarine as 66.77 g and 147.56g which is higher than the cultivar selected. While the results for length and diameter is also on the higher side (Milosenic *et al.*, 2012; Kishor *et al.*, 2017). The results for the values for fruit volume (ml) and specific gravity (g/ml) ranged from 40.00-41.04 (g/ml) and 1.-1.02 (ml), respectively. All the cultivars varied non-significantly with respect to physical parameters. The results for specific gravity are in close agreement with the findings (Kishor *et al.*, 2017).

Proximate composition

The mean values for moisture and protein content were ranged from 85.75 to 85.93 and 1.22 to 1.32 %, respectively (Table 2). A non-significant difference ($P \leq 0.05$) was observed when all the cultivars were

compared with each other. The per cent moisture and protein content present in four varieties of nectarine varied from 86.20 to 88.40 and 0.80 to 1.10 %, respectively (Wills *et al.*, 1983). The values are in close agreement with the present results. This variation would be due to genetic variation of the varieties. The values for crude fat ranged from 0.44 to 0.50 per cent. (Wills *et al.*, 1983) reported the value of % fat present in four varieties of nectarine was 0.10 %. The values for ash were calculated as 0.73, 0.67 and 0.80 per cent for Snow Queen, May Fire and Silver King, respectively. The % ash present in four varieties of nectarine varied from 0.30 to 0.40 per cent (Wills *et al.*, 1983). As per the data, the values for crude fibre varied non-significantly within the varieties. The values of crude fibre for Snow Queen, May Fire and Silver King were calculated as 2.05, 1.98 and 2.00 %, respectively. Data regarding carbohydrate content reveals that all the three varieties of nectarine fruit differed significantly ($P \leq 0.05$) and the values ranged from 11.64 to 11.91 per cent. This variation in the values might be due to the varietal difference and the stage of maturity.

Chemical Composition and functional constituents

Table 3 illustrates data pertaining to total soluble solids, pH, acidity, ascorbic acid, brix-acid ratio, sugars, pectin, β -carotene and total anthocyanin of three varieties of nectarine fruit. The values for TSS differed non-significantly with the varieties as the recorded values ranged from 10.5 to 10.7 °B. The results of the present study are in agreement with the findings of (Wills *et al.*, 1983; Kishore *et al.*, 2017; Farina *et al.*, 2019). The pH values of three varieties of nectarine varied significantly ($P \leq 0.05$). The pH values of three varieties of nectarine were calculated as 3.30, 3.23 and 3.20. The variation may be due to varietal difference and stage of maturity and harvesting. The results obtained are in close agreement with (Srivastava and Arora 1996 and Joshi *et al.*, 1991). The values for acidity in three varieties were calculated as 0.85, 0.76 and 0.89 % as malic acid. The storage behavior of Sunred nectarine fruit recorded the titrable acidity as 0.84 per cent (Dhillon *et al.*, 1981). According to (Srivastava and Arora 1994; Kumar 1991; 1995), the titrable acidity values varied from 0.37 to 1.01, 0.78 to 0.91 and 0.36 to 0.98 %, respectively. The values for acidity are in agreement to the cited ones. The value of ascorbic acid content of three varieties of nectarine fruit viz. Snow Queen, May Fire and Silver King were 7.56, 8.52 and 8.03 mg/100g, respectively. The results for ascorbic acid are in line with the investigation of (Barwal and Sharma 2001; Sharma 2002; Kishore *et al.*, 2017). Brix-acid ratio is an important parameter to determine the optimum

fruit maturity. As per the data the values varied significantly among the varieties. Almost similar observations were recorded by (Sharma and Lal 1999; Kher and Dorjay, 2001). The values of reducing sugars varied non-significantly with respect to varieties, as the highest value was observed in Silver King (5.98 %) followed by Silver King (5.97 %) and May Fire (5.97 %). Values of present study are in close agreement with the finding (Mohapatra and Sharma, 1997). The values for non-reducing sugars varied significantly with the varieties. Maximum value of non-reducing sugars was recorded in Snow Queen (2.37 %) followed by May Fire (2.11 %) and Silver King (1.93 %). Total sugars varied significantly with respect to varieties and the values for total sugars were calculated as 8.33, 8.19 and 8.02 % for three varieties of nectarine. The difference in values may be due to varietal difference. The present results are in line with the findings (Srivastava and Arora 1994; Mohapatra and Sharma 1997; Gothwal *et al.*, 1998; Sharma and Lal, 1999). The data regarding the pectin content of three varieties of nectarine fruit varied non-significantly among the varieties. Maximum value for pectin was observed in Silver King (0.91 %) followed by May Fire (0.88 %) and Snow Queen (0.85 %) as calcium pectate. The present findings are in close agreement with the findings (Wani and Saini, 1990). The values for β -carotene were differed non-significantly with the varieties and the values calculated for β -carotene for three varieties of nectarine fruit were 1.16, 1.15 and 1.29 mg/100g. The present results are in accordance with the results (Mariaa *et al.*, 2002). The values for total anthocyanin content of three varieties of nectarine fruit varied non-significantly.

Mineral Composition

The data in Table 4 shows mineral composition. Calcium, phosphorus, magnesium, sodium, potassium, iron and copper were analyzed in three varieties of nectarine fruit. The values for calcium varied non-significantly with the varieties viz. Snow Queen (6.00), May Fire (5.80) and Silver King (6.00) mg/100g. However, phosphorus content varied significantly among the varieties. Magnesium content of three varieties of nectarine varied significantly with the varieties viz. Snow Queen (8.87), May Fire (9.00) and Silver King (8.50) mg/100g. Sodium content differed significantly among the varieties and it was estimated as 0.22, 0.18 and 0.25 mg/100g in three varieties. Potassium content of three varieties of nectarine fruit varied significantly with the varieties and the highest value was recorded in Snow Queen (202.00), followed by Silver King (200.89) and May Fire (200.80) mg/100g. However, the values for iron and copper varied non-

significantly ($P \leq 0.05$) within the varieties. The estimated values for iron and copper ranged from 0.25 to 0.29 and 0.06 to 0.09 mg/100g, respectively. The difference in the mean values could be due to varietal and agro-climatic reasons. (Wills *et al.*, 1983) scrutinized the values of different minerals viz. K, Na, Ca, Mg, Fe and Zn and the values ranged between 220 to 240, 0 to 1, 6 to 11, 6 to 8, 0.1 to 0.2 and 0.1 mg/100g, respectively. The slight difference could be due to varietal difference and agro-climatic reasons.

Standardization of peel and pulp extraction techniques:

Data pertaining to effect of different pulp extraction techniques on the pulp, peel and stone recovery of nectarine fruit are presented in Table 5. Highest pulp recovery was observed in 'Blanching treatment' as the values for per cent pulp recovery were observed as 70, 69 and 68 % for Snow Queen, May Fire and Silver King, respectively. After Blanching, the highest pulp recovery was observed in 'Steaming' as the values of pulp recovery in three varieties of nectarine fruit was recorded as 69, 68 and 68 % after these extraction techniques, highest per cent pulp recovery was observed in 'Hot lye peeling', 'Cold lye peeling' and 'Manual' techniques as the values ranged from 66 to 67, 63 to 64 and 55 to 56 %, respectively. Maximum pulp recovery was observed in 'Snow Queen' followed by 'May Fire' and 'Silver King'. The minimum and maximum value for peel recovery was observed in 'Blanching' and 'Manual' techniques of extraction. As far as stone recovery is concerned, the maximum value was observed in 'Manual' and the minimum value was observed in 'Blanching'.

(Gothwal *et al.*, 1998) extracted pulp from three varieties of plum revealed that the plums yielded 75.10, 75.20 and 75.50 % pulp in three varieties of plum viz. Santa rosa, Meriposa and Early transparent gage, respectively. The peel comprised of 10.70, 10.90 and 10.5 per cent while, stone contributed to 14.30, 14.40 and 14.0 %, respectively. (Waskar and Garande, 1999) employed different methods of extraction as blanching, cold extraction and enzymatic methods for getting the highest recovery of raw and clarified ber juices. Per cent raw juice yield as affected by different extraction methods ranged from 53.0 to 75.2.

CONCLUSION

A large number of fruit and vegetable are grown in different parts of the country including major and minor fruits. Nature has been abundantly generous to Himachal Pradesh in endowing it with conditions

conducive for growing of large variety of fruits that is why Himachal Pradesh is known as 'Fruit bowl of India'. Considering major and minor fruits, Himachal Pradesh state has made efforts to grow different cultivars of nectarine (May Fire, Snow Queen and Silver King). All the cultivars were almost same in terms of physical parameters while significant difference was seen in ash, carbohydrate, pH, ascorbic acid, brix-acid ratio and sugars among all the cultivars with highest ascorbic acid was noted in May Fire. The fruit is a rich source of potassium, phosphorous, magnesium and sodium content. Blanching treatment was the best treatment for

maximum recovery of than other treatments (steaming, hot lye peeling, cold lye peeling and manual method). Hence, it can be concluded from the study that the fruit had good amount of nutrients and can be grown in other areas of the state for proper utilization of fruit in the form of value-added products with enhanced shelf life and nutrient profile.

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Table 1: Variability in physical characteristics of nectarine cultivars

Parameters	Varieties			CD ($P \leq 0.05$)
	Snow Queen	May Fire	Silver King	
Length (cm)	3.97	3.95	4.07	NS
Width (cm)	4.26	4.16	4.30	NS
Weight (g)	40.90	40.10	41.40	NS
Fruit volume (ml)	40.00	40.10	41.04	NS
Specific gravity (g/ml)	1.02	1.00	1.01	NS
Colour	Reddish yellow	Reddish yellow	Reddish yellow	-
Shape	Round	Round	Round	-
Defects (if any)	-	-	-	-

* Data presented are average of triplicate determinations

* NS= Non-significant

Table 2: Variability in proximate composition of nectarine cultivars

Parameters	Varieties			CD ($P \leq 0.05$)
	Snow Queen	May Fire	Silver King	
Moisture (%)	85.80	85.93	85.75	NS
Ash (%)	0.73a	0.67 a	0.80 a	0.05
Crude Protein (%)	1.22	1.32	1.26	NS
Crude Fat (%)	0.50	0.47	0.44	NS
Crude Fibre (%)	2.05	1.98	2.00	NS
Total Carbohydrates (%)	11.91 a	11.64 a	11.81 a	0.02

*Letters with superscript shows significant difference ($P \leq 0.05$)

Table 3: Variability in chemical and functional characteristics of nectarine cultivars

Parameters	Varieties			CD ($P \leq 0.05$)
	Snow Queen	May Fire	Silver King	
Total soluble solids(?B)	10.6	10.7	10.5	NS
pH	3.30 a	3.23 a	3.20 a	0.02
Acidity (%)	0.85	0.76	0.89	NS
Ascorbic acid (mg/100g)	7.56 a	8.52 a	8.03 a	0.22
Brix-acid ratio	12.54 a	14.23 a	11.93 a	0.37
Reducing sugars (%)	5.97	5.97	5.98	NS
Non-reducing sugars (%)	2.37 a	2.11 a	1.93 a	0.07
Total sugars (%)	8.33 a	8.19 a	8.02 a	0.24
Pectin(% as Calcium pectate)	0.85	0.88	0.91	NS
?-Carotene (mg/100g)	1.16	1.15	1.29	NS
Total anthocyanin (mg/100g)	0.20	0.19	0.18	NS

*Letters with different superscript shows significant difference ($P \leq 0.05$)

Table 4: Variability in mineral composition of nectarine cultivars

Parameters	Varieties			CD ($P \leq 0.05$)
	Snow Queen	May Fire	Silver King	
Calcium (mg/100g)	6.00	5.80	6.00	NS
Phosphorus (mg/100g)	25.35 a	26.07 a	26.06 a	0.05
Magnesium (mg/100g)	8.87 a	9.00 a	8.50 a	0.15
Sodium (mg/100g)	0.22 a	0.18 a	0.25 a	0.02
Potassium (mg/100g)	202.00 a	200.80 a	200.89	1.16
Iron (mg/100g)	0.28	0.29	0.25	NS
Copper (mg/100g)	0.07	0.09	0.06	NS

*Letters with different superscript shows significant difference ($P \leq 0.05$)

Table 5 : Effect of pulp extraction techniques on the percent pulp, peel and stone recovery of nectarine cultivars

Variety / Treatment	Pulp (%)	Stone (%)	Peel (%)
Snow Queen			
Manual	55	19	26
Blanching	70	16	14
Cold lye peeling	64	16	20
Hot lye peeling	67	17	16
Steaming	69	16	15
Range	55-70	16-19	14-26
May Fire			
Manual	56	19	25
Blanching	69	16	15
Cold lye peeling	64	18	18
Hot lye peeling	67	16	17
Steaming	68	17	15
Range	56-69	16-19	15-25
Silver King			
Manual	56	20	24
Blanching	68	16	16
Cold lye peeling	63	19	18
Hot lye peeling	66	17	17
Steaming	68	17	15
Range	56-68	16-20	15-24

*Data presented are average of triplicate determinations.

Nectarine Cultivars



Figure 1 : Physical appearance of nectarine cultivars

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