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CHANGES IN FRUIT QUALITY OF LOW CHILLING PEACH (*PRUNUS PERSICA* L. BATSCH.) DURING MATURITY

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ABSTRACT

Studies were conducted under subtropical conditions to observe changes in fruit quality of different low chilling peach cultivars during maturity to find appropriate days after fruit set to harvest the fruit so that the shelf-life of peach may be enhanced. Results of the study revealed that peach cultivar Florida Prince was ready to harvest on 69 days after fruit set which was earliest among the three cultivars studied. ¹Optimum values in cultivar Early Grande for fruit length (5.71cm), axial and radial diameter (6.02cm and 5.76cm), fruit weight (107.95g), fruit firmness (6.80 kg/cm²), TSS (11.53°B) and total sugars (5.75%) reached on 74 days after fruit set. Similarly, in case of cultivar Tropic Beauty the optimum fruit length (5.31cm), axial and radial fruit diameter (5.72cm and 5.65cm), fruit weight (101.05g), fruit firmness (5.45 kg/cm²), TSS (11.27°B) and total sugars (6.03%) were recorded on 87 days after fruit set.

Key words : Peach, Low chilling, Harvesting, Maturity, TSS, Fruit firmness.

Introduction

Peach [*Prunus persica* (L.) Batsch] belonging to the family Rosaceae occupies third important position next to apple and pear in temperate regions, however, both area and production under peach in India is insignificant in comparison to other major peach growing countries of the world. Peach requires the warmest climate of all the temperate fruits and is generally grown in lower and mid-hills at an altitude between 1000-2000m above mean sea level, however, peach is one of the most susceptible temperate fruit crop towards spring frost. Though peach is considered as fruit of temperate region, but with the release of low chilling cultivars, its cultivation has been extended to the sub-tropical regions also. High chilling peach cultivar requiring 600–1000 chilling hours cannot be cultivated in sub-tropical climate, however, introduction of low chilling and early maturing cultivars requiring 250-300 chilling hours has brought miraculous change in peach cultivation under subtropical conditions

of North India particularly Punjab, Himachal Pradesh, Uttarakhand and Jammu and Kashmir. Thus, in recent years, the sub-tropical peach cultivars have recorded a fast expansion and there is a great demand for the planting material by the growers. Fruit of low chilling peach cultivars reach the market very early in season as their chilling requirement is fulfilled in comparatively less span. This is particularly true when they are grown in warmer regions. Besides, they start bearing from third year onwards as the gestation period of peach is lesser than other fruit crop. Moreover, peach is probably the most adopted temperate fruit to the warm climate and grown in Himachal Pradesh, Jammu and Kashmir, Uttarakhand and North-Eastern hills as well as in North Indian plains. Peach being highly perishable fruit, needs immediate harvesting at appropriate maturity. Harvesting of either under ripe or over ripe fruits adversely affects its market value, both fresh as well as in processing. The inadequacy of knowledge on correct picking maturity, particularly on

low chill peach cultivars, is evidenced by great variability of fruit quality and the market price. Environment influences physical and chemical characters of fruits hence studies are essential on regional basis. Sometimes farmers are forced to pick its fruits before they attain maturity to get early returns, but, returns from immature fruits are quite low. The prediction of appropriate time of maturity becomes essential from the point of view of harvesting as its fruits do not improve in quality after picking. Sub-tropical peach cultivars viz. Florida Prince, Early Grande, Shan-e-Punjab, Flordagold, Flordasun, Floradared, Valley Grande, Pratap (TA-170), Saharanpur Prabhat, Pant Peach-1, Tropic Beauty, Tropic Snow, Tropic Sweet, Gujarati and Sharbati differ in fruit characteristics, therefore a separate standard for their maturity has to be fixed. In the present studies, the different fruit quality parameters of the developing fruits in the third developmental phase of maturing fruits have been recorded so as to find out various physical indices directly related to the harvest maturity of the fruit.

Materials and Methods

Physico-chemical changes in fruit quality of subtropical peach during maturity were studied on three important sub-tropical peach cultivars viz. Florida Prince, Early Grande and Tropic Beauty at Udheywalla campus of Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu which is located at 70°-50' East longitude and 32°-39' North latitude at an altitude of approximately 300m above mean sea level. Three trees of each cultivar viz.; Florida Prince, Early Grande and Tropic Beauty) with uniform vigor and flowering were marked and were given uniform cultural treatments and the different dates of observations served as treatment units. Chemical analysis of fruits was done at 7 different dates i.e.; 3 dates before and 3 dates after anticipated/expected harvest date including the harvest on anticipated date. Each sample comprised of ten fruits collected from the selected plants. These samples were immediately brought to the laboratory for physical analysis. The length of ten fruits collected from each replication was measured with the help of Vernier caliper and was expressed on average basis. For fruit diameter, ten fruits collected from each replication, axial wise and radial wise was measured with the help of Vernier Caliper and expressed on average basis. Specific gravity of the fruit was calculated by dividing the fruit weight in air by the volume of water displaced. The colour of the fruit and freeness of the stone was estimated on the visual basis. Pulp weight was obtained by subtracting the stone weight from the total fruit weight and was expressed in grams. Fruit firmness

was measured with the help of a portable fruit pressure meter and was expressed in kg/cm². Total soluble solids, titratable acidity and total sugars were estimated as per the method suggested by AOAC (1990). Organoleptic rating was done by following Hedonic scale (1-9) points by the panel of five judges, on the basis of colour, texture, taste and aroma of the fruits. The Hedonic scale follows as 9: like extremely, 8: like very much, 7: like moderately, 6: like slightly and 5: Neither like nor dislike 4: dislike slightly, 3: dislike moderately, 2: dislike very much and 1: dislike extremely. The data recorded was analyzed statistically for interpretation of results using analysis of variance technique for RBD (Gomez and Gomez, 1986).

Results and Discussion

Fruit size (length and diameter) : The data recorded with respect to fruit length and diameter is presented in Table 1. In case of Florida Prince, maximum fruit length (5.52cm) was recorded on 75 days after fruit set. In Early Grande, data reveals rapid increase in fruit length up to 74 days after fruits set with highest value of 5.71cm recorded on 74 days after fruit set. The fruit length of Tropic Beauty showed an ascending trend from 4.84cm on 78 days after fruit set to 5.37cm on 93 days after fruit set. The fruit of all three cultivars had higher axial diameters value as compared to radial diameter and this trend continued till maturity. Like fruit length, axial and radial diameter of Florida Prince showed rapid increase from 5.16cm and 5.12cm on 60 days after fruit set to 5.75cm and 5.49cm on 69 days after fruit set i.e. till maturity. At last observation the length and diameter of the fruit declined slightly. The axial and radial diameter of Early Grande also followed the increasing trend with maturity. The maximum values of axial and radial diameters of Early Grande were 6.04cm and 5.78cm respectively on 80 days after fruit set. The axial and radial fruit diameters of Early Grande increased rapidly from 5.32cm and 5.12cm on 78 days after fruit set to 5.72cm and 5.65cm on 87 days after fruit set. The maximum values 5.77cm and 5.68cm were recorded on 93 days after fruit set. Thereafter, a slight decrease in diameter was observed on last observation. The results obtained reveal that there was rapid increase in fruit length and diameter till maturity and there after slow rate of increase in all the three cultivars with slight decline on last observation was recorded. Similar findings has also been reported by Chander *et al.* (2004) in peach.

Fruit weight, pulp weight, specific gravity and fruit firmness : Results pertaining to fruit weight, pulp weight, specific gravity and fruit firmness presented in Table 2 reveal that in cultivar Florida Prince, maximum

Table 1 : Changes in fruit length and fruit diameter of different low chilling peach cultivars during fruit maturity.

Days after fruit set	Fruit length (cm)			Fruit diameter (cm)					
	Florda Prince	Early Grande	Tropic Beauty	Axial			Radial		
				Florda Prince	Early Grande	Tropic Beauty	Florda Prince	Early Grande	Tropic Beauty
60	4.95	5.21	4.84	5.16	5.50	5.32	5.12	5.21	5.12
63	5.08	5.38	5.12	5.31	5.85	5.54	5.23	5.59	5.43
66	5.31	5.58	5.29	5.56	5.94	5.64	5.41	5.70	5.57
69	5.48	5.71	5.31	5.75	6.02	5.72	5.49	5.76	5.65
72	5.49	5.71	5.34	5.77	6.03	5.75	5.51	5.77	5.67
75	5.52	5.68	5.37	5.78	6.04	5.77	5.52	5.78	5.68
78	5.48	5.63	5.35	5.72	6.01	5.73	5.50	5.74	5.66
CD _{0.05}	0.21	0.27	0.10	0.15	0.26	0.29	0.28	0.27	0.23

fruit weight of 94.16g was recorded on 75 days after fruit set. In Early Grande, minimum fruit weight (82.53g) was recorded on 65 days after fruit set which increased rapidly to 107.95g till maturity *i.e.*; 74 days after fruit set, thereafter, a slight increase at ripening was observed with slight decrease on last observation. The maximum fruit weight (108.73g) of Early Grande was recorded on 80 days after fruit set which was statically at par with 108.57g and 107.95g on 77 and 74 days after fruit set. A sharp increase in fruit weight was recorded from 72.64g on 78 days after fruit set to 101.05g on 87 days after fruit set in cultivar Tropic Beauty and maximum fruit weight of 101.10g was recorded on 93 days after fruit set. The pattern of increase in fruit weight during the period of investigation in all the cultivars, showed almost similar trend. There has been a marked increase in fruit weight till the maturity and thereafter, a slow rate of increase was noted. These results are in line with the findings of Singh *et al.* (2005). The pulp weight (Table 2) of cultivar Florda Prince increased rapidly from 54.45g on 60 days after fruit set to 80.26g on 69 days after fruit set, thereafter, there was slight increase in pulp weight from 86.12g to 87.75g up to 75 days after fruit set. In cultivar Early Grande, pulp weight increased up to 74 days after fruit set. The pulp weight of cultivar Tropic Beauty increased from 67.10g on 78 days after fruit set to 95.24g on 87 days after fruit set, thereafter, a slight increase was observed and on 96 days after fruit set. The pattern of increase of pulp weight was identical to that of fruit weight. Similarly, the continuous increase in pulp weight was observed by Sud and Kar, (1985) in plum cultivar Beauty. The increase in pulp weight towards maturity might be due to increase in size of the fruit by increasing the cell size and more accumulation of moisture in the enlarged cell (Singh *et al.*, 2005).

Specific gravity followed the downward trend with

the advancement of maturity. In cultivar Florda Prince, specific gravity was highest (1.00) on 60 days after fruit set which decreased gradually to (0.95) on 78 days after fruit set. Specific gravity of cultivar Early Grande also followed the decreasing trend with advancement of maturity where the maximum value of specific gravity was observed as 1.01 on 65 days after fruit set. In cultivar Tropic Beauty, specific gravity was highest (1.02) on 78 days after fruit set which slowed down gradually with the advancement of maturity and least value 0.95 was recorded on 96 days after fruit set. Since specific gravity is a function of fruit weight and volume, the decrease is a result of comparatively more increase in the fruit volume than fruit weight. Similarly, Chander and Khajuria (1983) also observed similar trend in specific gravity in Flordasan peach during fruit maturity. Data on fruit firmness presented in Table 2, reveal a gradual downward trend with the advancement in fruit maturity and thereafter pressure fell sharply making the fruit difficult to handle. The fruits of cultivar Florda Prince sustained a pressure of 9.88 kg/cm² on 60 days after fruit set which followed a significant decrease in pressure up to maturity *i.e.* 7.08 kg/cm² on 69 days after fruit set. In cultivar Early Grande, fruit sustained pressure of 9.50 kg/cm² on 65 days after fruit set which recorded gradual decline with the advancement of maturity to 6.80 kg/cm² on 74 days after fruit set. Fruits of cultivar Tropic Beauty sustained a maximum pressure of 10.26 kg/cm² on 78 days after fruit set. These findings substantiate the earlier reports of Dhillon and Singh (2005).

TSS, titratable acidity and total sugars : The data pertaining to TSS, acidity and total sugars is presented in Table 3. In cultivar Florda Prince, maximum value of TSS content (12.43%) was recorded on 72 days. The total soluble solids in cultivar Early Grande maximum value of TSS (11.63%) was recorded on 80 days after fruit set

Table 2 : Changes in fruit weight, pulp weight, specific gravity and fruit firmness of different low chilling peach cultivars during fruit maturity.

Days after fruit set	Fruit weight (gm)			Pulp weight (gm)			Specific gravity			Fruit firmness (kg/cm ²)		
	Florda Prince	Early Grande	Tropic Beauty	Florda Prince	Early Grande	Tropic Beauty	Florda Prince	Early Grande	Tropic Beauty	Florda Prince	Early Grande	Tropic Beauty
60	60.17	82.53	72.64	54.45	74.97	67.10	1.00	1.01	1.02	9.88	9.50	10.26
63	69.67	94.71	87.53	63.84	87.24	81.91	0.99	0.99	1.01	8.84	8.22	9.03
66	78.87	103.69	96.93	72.94	95.96	91.26	0.98	0.98	0.98	8.01	7.78	7.19
69	86.39	107.95	101.05	80.26	100.37	95.24	0.97	0.97	0.97	7.08	6.80	5.45
72	92.37	108.57	101.09	86.12	100.40	95.24	0.96	0.97	0.96	5.99	5.76	4.17
75	94.16	108.73	101.10	87.75	100.58	94.88	0.95	0.96	0.95	4.42	4.32	3.53
78	93.94	107.24	101.08	87.39	99.22	94.81	0.95	0.95	0.95	2.91	2.65	2.90
CD _{0.05}	12.63	6.58	12.90	12.65	6.48	12.97	0.02	0.02	0.03	0.63	1.91	1.46

and in case of cultivar Tropic Beauty, TSS ranged from 9.90% to 11.27% from 78 to 87 days after fruit set, thereafter, a slight increase in TSS was recorded up to 93 days after fruit set. These results are in conformity with the results obtained by Singh *et al.* (2005) in case of peach and plum. In cultivar Florda Prince, maximum value of acidity (1.05%) was observed on 60 days after fruit set which slowed down gradually to (0.78%) on 78 days after fruit set. Similarly titratable acidity in cultivar Early Grande, acidity decreased sharply at ripening and the lowest acidity of 0.71% was recorded on 83 days after fruit set. In cultivar Tropic Beauty, maximum value of acidity (1.12%) was recorded on 78 days after fruit set and then it declined continuously to 0.68% up to 96 days after fruit set. The titratable acidity was high in the beginning in all the cultivars and it decreased as the fruit approached harvest maturity. Similar trend of changes have been reported by Sud (2004) in plum.

Total sugars (Table 3) in cultivar Florda, highest total sugars content (5.70%) was recorded on 75 days after fruit set which was at par with 5.68% and 5.64% on 72 and 69 days after fruit set. Similarly in cultivar Early Grande, total sugars increased significantly from 3.80% on 65 days after fruit set to 5.75% on 74 days after fruit set and thereafter, a slight increase in sugars was recorded up to 80 days after fruit set. In cultivar Tropic Beauty, maximum total sugar content (6.07%) was observed on 93 days after fruit set. Present findings reveal that the total sugars in all the cultivars recorded a significant increasing trend, however, rapid increase was observed up to maturity and slightly increased thereafter. Similar findings have also been reported by Chander *et al.* (2004).

Fruit colour and freeness of pit/stone : The observations on change in fruit colour and freeness of stone during fruit maturity are presented in Table 4. The change in the fruit surface colour was recorded in all the cultivars, although to the differential extents depending on the cultivars. In general, the change in surface colour was more pronounced in Florda Prince followed by Tropic Beauty and least in Early Grande. The first colour break was recorded on 60 days after fruit set in Florda Prince. In cultivar Early Grande, first colour break was recorded on 68 days after fruit set, thereafter, fruit colour developed with the advancement of maturity and on 74 days after fruit set near about half of the fruit surface was reddish pink with yellowish background. In case of cultivar Tropic Beauty, initially colour was green with partial a red tinge which is its varietal characteristic of cultivar Tropic Beauty. Subsequently the fruit surface colour changed from light green to yellowish green and finally almost whole of the surface became red and first

Table 3 : Changes in TSS, titratable acidity and total sugar of different low chilling peach cultivars during fruit maturity.

Days after fruit set	TSS (°B)			Titratable acidity (%)			Total sugars (%)		
	Florida Prince	Early Grande	Tropic Beauty	Florida Prince	Early Grande	Tropic Beauty	Florida Prince	Early Grande	Tropic Beauty
60	8.40	8.03	9.90	1.05	0.93	1.12	4.26	3.80	4.07
63	9.57	9.67	10.77	0.95	0.87	1.05	4.79	3.97	4.64
66	11.33	11.33	11.03	0.94	0.85	0.98	5.32	4.51	5.22
69	12.33	11.53	11.27	0.89	0.82	0.87	5.64	5.75	6.03
72	12.43	11.60	11.33	0.83	0.77	0.79	5.68	5.93	6.05
75	12.43	11.63	11.37	0.79	0.74	0.72	5.70	5.97	6.07
78	12.17	11.53	11.27	0.78	0.71	0.68	5.67	5.76	6.04
CD _{0.05}	1.30	0.95	0.24	0.16	0.23	0.14	0.17	0.38	0.32

Table 4 : Changes in fruit colour and freeness of pit/stone of different low chilling peach cultivars during fruit maturity.

Days after fruit set	Fruit colour			Freeness of pit/stone		
	Florida Prince	Early Grande	Tropic Beauty	Florida Prince	Early Grande	Tropic Beauty
60	Light green with pink tinges at base.	Light green	Light green with dull red tinges.	Cling	Cling	Cling
63	Light yellowish green with pink tinges at base	Light yellowish green with pink tinges at base.	Light yellowish green with red tinges at base.	Cling	Cling	Cling
66	Red blush at bottom and on cheeks of the fruit with yellowish green back ground.	Pink blush at bottom with yellowish green background.	Yellowish pink with red tinges at base and cheeks of fruit.	Cling	Cling	Cling
69	More than 50% surface of the fruit turned red with pinkish yellow background.	Near about 50% of the fruit surface reddish pink with yellowish green background.	More than 50% of the fruit surface pink with reddish tinges.	Cling	Semi-cling	Semi-cling
72	75% red with pinkish yellow background.	Major red with pinkish yellow background.	75% pinkish red with yellowish background.	Cling	Semi-cling	Semi-cling
75	Major red with pinkish background.	Major red with pinkish yellow background.	Major red with pinkish background.	Cling	Free	Free
78	Major red with pinkish background.	Major red with pinkish yellow background.	Major red with pinkish background.	Cling	Free	Free

colour break was recorded on 78 days after fruit set in cultivar Tropic Beauty. More or less similar results were reported by Josan and Chohan (1982) in case of Flordasun peach, however slight variations may be due to different climatic conditions of study. The change in fruit colour is mainly due to the accumulation of carotenoid pigments accompanied by a simultaneous loss of chlorophyll during the stage of fruit development leading to maturity. The stones in cultivar Early Grande remained clinged from 65 days after fruit set to 71 days after fruit set and on optimum maturity little bit freeness of stone was recorded on 74 days after fruit set, thereafter, 80 days after fruit

set the stone became free from pulp. In cultivar Tropic Beauty, stone of the fruit remained attached to the pulp in the initial stages and it remained clinged up to 84 days after fruit set and thereafter, it became little bit free from the pulp with advancement of maturity. At ripening stage the stone became free from 93 days after fruit set onwards. Results reveal that Florida Prince was only the cultivar which was clingstone throughout the course of study, while other two cultivars viz. Early Grand and Tropic Beauty were free stone after maturity. These findings are in line with that of Bisla and Chitkara (1980) in different cultivars of peach.

Table 5 : Organoleptic evaluation of different low chilling peach cultivars as per hedonic scale.

Cultivar	Colour	Texture	Flavour		Overall	Remarks*
			Taste	Aroma		
Florda Prince	9	8	9	8	8.5(9)	Like extremely
Early Grande	7	8	8	7	7.5(8)	Like very much
Tropic Beauty	8	6	7	7	7	Like moderately

*9 = Like extremely, 8 = Like very much, 7 = Like moderately, 6 = Like slightly, 5 = Neither like nor dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2 = Dislike very much, 1 = Dislike extremely.

Organoleptic evaluation : The evaluation of fruits as per hedonic scale (Table 5), Florda Prince scored maximum points on the basis of colour, texture, taste and aroma than other two cultivars. Cultivar Early Grande scored higher points in texture and taste than the cultivar Tropic Beauty, however, Tropic Beauty scored higher points only in case of colour than Early Grande and in rest of the parameters it scored minimum points as compared to other two cultivars. The maximum overall points (9) were in case of Florda Prince followed by Early Grande (8) and minimum in Tropic Beauty (7).

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