



## Quality Evaluation and Optimization of Squash from low Chill Peach (*Prunus persica* L.) Cultivars

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**Abstract:** Physico-chemical evaluation of three low chill peach cultivars namely Florda Prince, Early Grande and Shan-e-Punjab and optimization of squash prepared from the fruits of these cultivars were done to select suitable cultivars for preparation of squash. Six different combinations of recipes for preparation of squash beverage from the fruits of each cultivar i.e., three levels of pulp @ 25, 30, and 35 per cent and two of sugar concentrations @ 40 and 45 per cent were examined for optimizing their levels to find an acceptable peach squash. Formulation of squash prepared by using 35 per cent pulp and 40 per cent sugar scored maximum for their sensory attributes and overall acceptability, irrespective of cultivar. Among the cultivars, squash prepared from cv. Florda Prince was found organoleptically best with overall acceptability and good sensory scores.

**Keywords:** Peach, cultivars, squash, physico-chemical, quality, sensory quality.

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### 1. Introduction

Among the stone fruits peach (*Prunus persica* L.) is the third most important temperate fruit crop of India. Its cultivation has attended a significant position during the past few years and still there is great scope. The crop has become popular in sub-tropical plains of north India with the introduction of low chilling cultivars. In India, the most produced high chilling varieties are commonly cultivated in Jammu and Kashmir, Uttarakhand, Himachal Pradesh and hilly tracts of the Punjab. Whereas low chill peaches are mostly grown in Punjab, Haryana, Western Uttar Pradesh, Himachal Pradesh and

Uttarakhand (Bal, 2014) and are economically very important for a variety of reasons. Production of low chill fruits provides an alternative in sub-tropical regions of the world to supply fresh fruits for local markets and the potential to transport the fruit to distant markets not producing peach at the same time. Fruit develops rapidly in the warm environments and harvests two months earlier than the cultivars grown in the cooler temperate regions. The price of the fruit is very high at that time. Peaches contains fairly good amounts of vitamins, proteins, carbohydrates, ascorbic acid and minerals as compared to most other common fruits that are used for table purpose (Salunkhe and Kadam, 1995 and Sharma *et al.* 2002). The demand for stone fruits and their processed products has increased day by day because of high nutritional value, rise in health concerns and nutritional awareness. Peach fruit is also a potential source of bioactive compounds (cancer, heart disease), offering medicinal benefits such as potential protection from various chronic diseases (Kim *et al.* 2014). It is also a good source of minerals like phosphorus, potassium, and iron and vitamins and low calorific diet (Gopalan *et al.* 1996). Peaches are also rich source of potassium which is good for the purification of the blood and helps in maintaining blood pressure and health of heart. Prunacin is the main glycoside present in the pulp (Byrne *et al.*, 1991). Peach fruits are the most appreciated fruit by the consumers both in terms of processed and fresh forms due to their special characteristics in terms of taste, flavour, appearance, sweetness and juiciness. It has colour appeal, appetite and is most refreshing (Ismail *et al.* 2009). Some work has been done on squash and canning of peaches (Aggarwal *et al.* 1992, Srivastava and Arora, 1994) but only meager studies are available on the processing suitability of these cultivars into squash, canned and pulp based products. Due to its perishable nature farmers are unable to get their products higher returns. Therefore, by preserving and utilizing fresh fruits into various value-added products will be a viable option to get additional returns. Ready-to-serve, squash and diluted beverages are one of the best and commonly acceptable drinks now-a-days all over the world. Fruit based beverages preferred over the non-fruit based beverages all over the world due to retention of medicinal, nutritional and calorific properties. Fruit quality characteristics of individual cultivar are considered to be one of the most important factors influencing quality of squash and beverages. Hence, the investigation was carried out to assess the suitability of three low chill peach cultivars viz., Florada Prince, Early Grand and Shan-e-Punjab grown under *Tarai* condition of Uttarakhand for their suitability to “squash” drink to optimize the suitable combination of ingredients for preparation of peach squash through physico-chemical and sensory attributes.

## 2. Materials and Methods

Freshly harvested firm, ripen, healthy and uniform fruits of peach cvs. Florida Prince, Early Grande and Shan-e-Punjab were procured from the orchard of Horticultural Research Centre, Patharchatta, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand during last week of April to first week of May, 2020. Fruits were collected in carton boxes cushioned with a thick layer of newspaper and were brought to the postharvest laboratory of department of horticulture. Fruits were washed thoroughly to remove any adhere dust and foreign materials. Physico-chemical attributes of all three cultivars viz., weight, volume, specific gravity, length and diameter of peach fruit were calculated as per standard procedures. Pulp was obtained from peach fruits and bio-chemical analysis was conducted for TSS, acidity, pH, ascorbic acid, reducing and total sugars by adopting standard procedures (Ranganna, 1986). TSS was recorded by using digital hand refractometer (Model-MSW503) at room temperature and expressed in terms of degree brix. Titratable acidity (expressed as malic acid %) was determined by titrating the juice with 0.1 N NaOH using phenolphthalein as an indicator. Ascorbic acid was measured in prepared aliquot sample titrated against standard 2, 6 dichlorophenol – indophenols dye to a pink end point and then titre is used to calculate the ascorbic acid in the sample. Modified Lane and Eynon method as described by Ranganna (1986) was used to determine total sugar content in the fruits.

Fruits of all three varieties were weighed separately, peeled and cut into small slices with stainless steel knife and put them in 0.05% KMS treated water to avoid browning. Fruit slices were boiled in 20% water till the pieces get softened. Pulp was extracted by transferring softened fruit pieces to pulper machine. Squash was prepared as per specifications of FSSAI from pulp of peach fruits. Six different combinations i.e. three levels of pulp @ 25, 30, and 35 per cent and two of sugar concentrations @ 40 and 45 per cent were used to prepare squash from the pulp of each cultivar. The concentration of acid (as citric acid) was kept constant @ 1.0% in all combinations.

The squash was filled in previously sterilized plastics bottles of 500 ml capacity leaving adequate head space and sealed immediately. Filled squash bottles were pasteurized at 85 °C for 15 minutes and then cooled rapidly to ambient condition and stored in refrigerator. Organoleptic evaluation of squash was done by a panel of 8 semi-trained judges using 9-point hedonic scale (Amerine *et al.* 1965). Different sensory quality attributes viz., appearance/ colour, consistency, flavor, taste and overall acceptability was determined. The experimental design was complete randomized design with factorial

concept for organoleptic evaluation of squash prepared from three cultivars with 18 treatment combinations and physico-chemical evaluation of cultivars were analyzed statistically using randomized block design (RBD) to test the significance of results using critical difference (C.D.) at 5% level of significance (Panse and Sukhatme, 1967).

### 3. Results and Discussion

#### 3.1. Physico-chemical Characteristics of Peach Cultivars

Significant differences in terms of their physical characteristics were observed among cultivars and presented in Table 1 and 2. Fruits of Shan-e-Punjab achieved highest mean weight (109.594 g) and volume (111.536 ml) among all three cultivars while fruits of Florida Prince recorded lowest mean weight (75.871 g) and volume (77.453 ml). The wide range of fruit weight (75.871 to 109.594 g) was observed among cultivars under study. Specific gravity was observed maximum in cv. Shan-e Punjab which was *at par* with other two cultivars. Different variation in fruit weight (45.29 g to 112 g) was also reported by Ahmed *et al.* (2002). Bhatnagar and Kaul, (2002) reported fruit weight in a range of 93.32 g to 122.33 g. Kanwar *et al.* (2002) also observed wide range of fruit weight (67.3 g to 88.8 g) in low chill peach cultivars. Under Ranchi condition of India, Jana, (2015) reported that Shan-e-Punjab bears largest fruit weight (39.93 g). Saran *et al.* (2010) observed that fruit weight range of 25.33 g to 74.48 g was observed in low chill peach cultivars under Dehradun (Uttarakhand) condition.

Significantly higher fruit length and diameter was also obtained in cv. Shan-e-Punjab followed by Early Grande while these were observed minimum in Florida Prince. The mean value for the fruit length in different peach cultivars varied from 5.181 cm to 5.954 cm. The mean values of fruit diameter were found in a range of 5.119 cm to 5.831 cm. The maximum fruit diameter was recorded in cultivar of Shan-e-Punjab (5.831 cm) followed by Early Grande (5.603 cm) and Florida Prince (5.119 cm). Similar findings were reported by Bhatnagar and Kaul (2002) under growth and development studies on peach in Sri Ganganagar (Rajasthan) condition. Kanwar *et al.* (2002) highlighted the range of fruit diameter from 4.73 cm to 5.57 cm in low chill peach cultivars.

The other physical attributes viz., flesh weight, stone weight, flesh: stone ratio, peel weight, flesh content, stone content and peel content of different cultivars are presented in the Table 2. Flesh weight was found maximum in the cultivar Shan-e-Punjab (84.823 g) while it was recorded minimum in Florida Prince (59.019 g). Stone weight was observed lowest in cv. Early Grande (6.724

**Table 1: Physical characteristics of fruits of peach cultivars**

Cultivars	Fruit weight (g)	Fruit volume (ml)	Specific gravity	Fruit length (cm)	Fruit diameter (cm)	Flesh weight (g)	Stone weight (g)	Peel weight (g)	Flesh: stone ratio	Flesh content (%)	Stone content (%)
Florda Prince	75.871	77.453	0.979	5.181	5.119	59.019	7.449	9.177	7.921	77.837	9.836
Early Grande	87.234	88.929	0.981	5.430	5.603	63.106	6.724	11.704	9.393	72.361	7.716
Shan-e-Punjab	109.594	111.536	0.982	5.954	5.831	84.823	7.207	11.961	11.776	77.389	6.573
C.D. at 5%	4.401	4.120	NS	0.127	0.142	3.391	0.282	0.534	0.477	2.447	0.429
C.V. (%)	4.112	3.777	1.306	1.951	2.180	4.175	3.357	4.139	4.180	2.739	4.527
SEm±	1.413	1.322	0.005	0.041	0.045	1.089	0.090	0.171	0.153	0.785	0.138

**Table 2: Chemical characteristics of fruits of peach cultivars**

Cultivars	pH	TSS (%)	Acidity (%)	TSS: acid ratio	Ascorbic acid (mg/100g)	Sugars (%)		
						Reducing sugars	Total sugars	Non-reducing sugars
Florda Prince	4.343	14.579	0.974	14.980	9.890	9.537	11.240	1.703
Early Grande	4.563	12.400	1.309	9.477	12.163	9.869	11.023	1.140
Shan-e-Punjab	4.617	13.143	1.186	11.081	14.620	5.654	9.786	4.131
C.D. at 5%	0.126	0.376	0.033	0.553	0.484	0.112	0.105	0.059
C.V. (%)	2.367	2.388	2.447	3.965	3.360	1.135	0.835	2.172
SEm±	0.040	0.121	0.011	0.178	0.155	0.036	0.034	0.019

g) while it was highest in Florda Prince (7.449 g). Mean weight of peel was found maximum in Shan-e-Punjab which was *at par* with Early Grande while it was found minimum in Florda Prince due to less fruit size. Flesh content was observed to be maximum in the cultivar Florda Prince (77.837 g) which was also *at par* with Shan-e-Punjab (77.389 g). Stone content was observed lowest in the cv. Shan-e-Punjab (6.573%) followed by Early Grande (7.716) while it was observed highest in Florda Prince (9.836%).

Flesh: stone ratio was observed maximum in Shan-e-Punjab (11.776) while it was found minimum in Florda Prince (7.921). Inherent genetic attributes and climatic conditions of the region are the main reason for variation in physical

attributes of cultivars. Under the climatic conditions of Punjab, peach cv. Valle Grande exhibited the highest fruit weight (88.8 g) and diameter (5.6cm) followed by Early Grande (87.2 g and 5.4cm) as reported by Kanwar *et al* (2002) while Jana (2015) observed that Shan-e-Punjab bears largest fruit (39.93g) under Ranchi condition of India.

The data regarding the chemical characteristics of fruits from all three cultivars have been presented in Table 3 and were found to be significantly different among all the peach cultivars. Studies revealed that pH value of peach cultivars ranged from 4.343 to 4.617 with highest pH (4.617) was found in cv.

**Table 3: Effect of pulp and sugar levels on different sensory attributes of squash in peach cultivars**

Treatments	Combinations	Appearance/ colour	Consistency	Flavour	Taste	Overall accept- ability	Mean
T <sub>1</sub>	C <sub>1</sub> P <sub>1</sub> S <sub>1</sub>	7.00	6.62	7.00	7.12	7.25	6.998
T <sub>2</sub>	C <sub>1</sub> P <sub>1</sub> S <sub>2</sub>	7.12	7.12	7.25	7.25	7.00	7.148
T <sub>3</sub>	C <sub>1</sub> P <sub>2</sub> S <sub>1</sub>	7.62	7.25	7.50	7.50	7.50	7.474
T <sub>4</sub>	C <sub>1</sub> P <sub>2</sub> S <sub>2</sub>	7.37	7.50	7.37	7.25	7.37	7.372
T <sub>5</sub>	C <sub>1</sub> P <sub>3</sub> S <sub>1</sub>	7.75	7.87	7.75	8.00	7.87	7.848
T <sub>6</sub>	C <sub>1</sub> P <sub>3</sub> S <sub>2</sub>	7.50	7.50	7.50	7.25	7.25	7.400
T <sub>7</sub>	C <sub>2</sub> P <sub>1</sub> S <sub>1</sub>	6.00	6.25	6.00	6.25	6.75	6.250
T <sub>8</sub>	C <sub>2</sub> P <sub>1</sub> S <sub>2</sub>	6.25	6.75	6.25	6.50	6.50	6.450
T <sub>9</sub>	C <sub>2</sub> P <sub>2</sub> S <sub>1</sub>	6.50	7.00	6.50	6.62	7.00	6.724
T <sub>10</sub>	C <sub>2</sub> P <sub>2</sub> S <sub>2</sub>	6.50	7.25	6.75	6.75	6.50	6.750
T <sub>11</sub>	C <sub>2</sub> P <sub>3</sub> S <sub>1</sub>	7.00	7.25	7.25	7.00	7.25	7.150
T <sub>12</sub>	C <sub>2</sub> P <sub>3</sub> S <sub>2</sub>	7.00	7.50	7.25	6.62	6.75	7.024
T <sub>13</sub>	C <sub>3</sub> P <sub>1</sub> S <sub>1</sub>	7.00	6.50	6.75	7.00	7.25	6.900
T <sub>14</sub>	C <sub>3</sub> P <sub>1</sub> S <sub>2</sub>	7.25	6.75	7.00	7.25	7.00	7.050
T <sub>15</sub>	C <sub>3</sub> P <sub>2</sub> S <sub>1</sub>	7.37	7.00	7.25	7.25	7.37	7.248
T <sub>16</sub>	C <sub>3</sub> P <sub>2</sub> S <sub>2</sub>	7.50	7.25	7.25	7.00	7.00	7.200
T <sub>17</sub>	C <sub>3</sub> P <sub>3</sub> S <sub>1</sub>	7.50	7.50	7.50	7.50	7.62	7.524
T <sub>18</sub>	C <sub>3</sub> P <sub>3</sub> S <sub>2</sub>	7.37	7.50	7.50	7.12	7.00	7.298
C.D. at 5%		0.490	0.484	0.462	0.483	0.428	
C.V. (%)		6.982	6.856	6.574	6.902	6.061	
SEm±		0.175	0.173	0.165	0.173	0.153	
Where, C <sub>1</sub> = Florida Prince; C <sub>2</sub> = Early Grande; C <sub>3</sub> = Shan-e-Punjab P <sub>1</sub> = 25% Pulp; P <sub>2</sub> = 30% Pulp; P <sub>3</sub> = 35% Pulp and S <sub>1</sub> = 40% TSS; S <sub>2</sub> = 45% TSS							

Shan-e-Punjab and lowest pH (4.343) value in Florida Prince. Significantly higher TSS was observed in Florida prince (14.579) while it was lowest in cv. Early Grande (12.400). Similarly, Bhatnagar and Kaul, (2002) highlighted that TSS content ranged from 13.40 °B to 13.80 °B in low chill peach cultivars. Ahmed *et al.* (2002) and Fathi *et al.* (2012) also reported variation of TSS in low chill peach cultivars. Hajilou and Fakhimrezaei (2011) reported that the TSS in eight peach cultivars ranged from 11.50 °B to 17.33 °B at Agriculture University of Tabriz, Iran.

The data presented in Table 3 clearly shows that the titratable acidity was significantly different among all the cultivars under study. Maximum titratable acidity was observed in Early Grande (1.309%) and it was found minimum in cv. Florida Prince (0.974%). It is a well known fact that acidity of fruit decreases and total soluble solids increases during maturity and ripening stage of fruit (Padda *et al.* 2011). Bhatnagar and Kaul, (2002) reported that the titratable acidity was less (i.e. 0.58) in cv. Florida Sun and more acidity (0.61%) was recorded in cv. Partap. Kanwar *et al.* (2002) reported titratable acidity with range of 0.55 – 0.74% in low chill peach cultivars. The variation in the acidity in different cultivars of peach is due to their varietal characters. Variable values of acidity due to different cultivars of peach were also reported by Babu *et al.* (2011).

The data presented in a Table 3 clearly showed presence of significantly different variation in ascorbic acid content among all peach cultivars. Vitamin C content was ranged from 9.89 to 14.62 mg/100g in all three cultivars with maximum in cv. Shan-e-Punjab (14.62 mg/100g) and minimum in Florida Prince (9.89 mg/100g). High amount of vitamin C is preferable and it is one of the important characters that determine the nutritive value of the fruit. Singh *et al.* (2016) also reported wide variations in vitamin C content (8.40- 21.33 mg/100g) with maximum in cv. Sharbati (21.33 mg/100g) and minimum in Florida Prince (8.40 mg/100g) while Hajilou and Fakhimrezaei, (2011) reported variation of ascorbic acid content from 8.14 mg/100 g to 12.3 mg/100 g.

Total sugar was observed maximum in cv. Florida Prince (11.24%) while it was recorded minimum in Shan-e-Punjab (9.786%). Reducing sugar was observed highest in Early Grande (9.869%) while it was found lowest in Florida Prince. Non-reducing sugar was observed maximum in Shan-e-Punjab (4.131%) while it was observed lowest in fruits of Early Grande. Therefore, fruit quality characteristics significantly varied with the cultivars. Singh *et al.* (2016), Jana, (2015), Kanwar *et al.* (2002), Nautiyal and Misra (1982) and Bisla and Chitkara (1980) also observed similar type of variation among the peach cultivars studied in different climatic conditions.

### 3.2. Sensory Evaluation of Peach Squash

Physico-chemical attributes of fruits of cultivar may only not be considered merely suitable for preparation of any beverage but organoleptic characteristics of product also plays a vital role. So, the suitability of peach squash prepared from fruits of three different cultivars with different combinations of pulp and sugar concentration was determined by evaluation of organoleptic quality attributes in terms of terms of appearance/colour, consistency, flavor and taste by a team of 8 semi-trained judges (Table 3).

It is evident from the data that sensory score for appearance/colour of squash made from pulp of Florida Prince, Early Grande and Shan-E-Punjab varied from 6.00 to 7.75. Squash formulated by using 35 per cent pulp and 40 per cent sugar ( $C_1P_3S_{1'}$ ,  $C_2P_3S_{1'}$  and  $C_3P_3S_{1'}$ ) scored maximum for colour, irrespective of cultivar while combination of 25 per cent pulp and 40 per cent sugar ( $C_1P_1S_{1'}$ ,  $C_2P_1S_{1'}$ ,  $C_3P_1S_{1'}$ ) scored least for appearance/colour of squash in all the cultivars. Squash prepared from the fruits of cultivar Florida prince ( $C_1$ ) scored maximum (7.75) while it was *at par* with Shan-e-Punjab ( $C_3$ ). Sensory score for the appearance/colour of squash made from the pulp of Florida Prince, Early Grande and Shan-e-Punjab varied from 7.0 to 7.75, 6.0 to 7.0 and 7.0 to 7.5, respectively.

It is evident from the data regarding consistency of peach squash that sensory score for consistency of squash made from pulp of Florida Prince, Early Grande and Shan-E-Punjab varied from 6.25 to 7.87. Squash formulated by using 35 per cent pulp and 40 per cent sugar ( $C_1P_3S_{1'}$ ,  $C_2P_3S_{1'}$ ,  $C_3P_3S_{1'}$ ) scored maximum for consistency, irrespective of cultivar. Combination of 25 per cent pulp and 40 per cent sugar ( $C_1P_1S_{1'}$ ,  $C_2P_1S_{1'}$ ,  $C_3P_1S_{1'}$ ) scored least for consistency of squash among all the cultivars. Squash prepared from the fruits of cultivar Florida Prince ( $C_1$ ) scored maximum (7.87) while Early Grande ( $C_2$ ) and Shan-e-Punjab ( $C_3$ ) scored similar (7.50).

Sensory score for flavour of squash made from pulp of Florida Prince, Early Grande and Shan-E-Punjab varied from 6.00 to 7.75. Squash formulated by using 35 per cent pulp and 40 per cent sugar ( $C_1P_3S_{1'}$ ,  $C_2P_3S_{1'}$ ,  $C_3P_3S_{1'}$ ) scored maximum for flavour, irrespective of cultivar. Combination of 25 per cent pulp and 40 per cent sugar ( $C_1P_1S_{1'}$ ,  $C_2P_1S_{1'}$ ,  $C_3P_1S_{1'}$ ) scored least for flavour of squash in all the cultivars. Squash prepared from the fruits of cultivar Florida prince ( $C_1$ ) found superior and scored maximum (7.75) while it was *at par* with Shan-e-Punjab ( $C_3$ ).

Sensory score for taste of squash made from pulp of Florida Prince, Early Grand and Shan-e-Punjab varied from 6.25 to 8.00. Squash formulated by using



35 per cent pulp and 40 per cent sugar ( $C_1P_3S_1$ ,  $C_2P_3S_1$ ,  $C_3P_3S_1$ ) scored maximum for taste, irrespective of cultivar which may be due to better compatibility of juice and TSS levels arriving at suitable sugar acid ratio in the product. Combination of 25 per cent pulp and 40 per cent sugar ( $C_1P_1S_1$ ,  $C_2P_1S_1$ ,  $C_3P_1S_1$ ) scored least for taste of squash in all the cultivars. Squash prepared from the fruits of cultivar Florida prince found superior and scored maximum (8.00) maximum.

It is evident from the data that sensory score for overall acceptability of squash made from pulp of Florida Prince, Early Grande and Shan-E-Punjab varied from 6.75 to 7.87. Squash formulated by using 35 per cent pulp and 40 per cent sugar ( $C_1P_3S_1$ ,  $C_2P_3S_1$ ,  $C_3P_3S_1$ ) scored maximum for overall acceptability, irrespective of cultivar. This might be due to better colour, consistency and acceptable sugar acid ratio of the product. Combination of 25 per cent pulp and 40 per cent sugar ( $C_1P_1S_1$ ,  $C_2P_1S_1$ ,  $C_3P_1S_1$ ) scored least for overall acceptability of squash in all the cultivars. Squash prepared from the fruits of cultivar Florida prince ( $C_1$ ) found superior and scored maximum (7.87) while it was *at par* with Shan-e-Punjab ( $C_3$ ).

Sensory score for the overall acceptability of squash made from the pulp of Florida Prince, Early Grande and Shan-e-Punjab varied from 7.25 to 7.87, 6.75 to 7.25 and 7.25 to 7.62, respectively. Data also revealed that scores of all sensory attributes and overall acceptability of squash was improved with increasing concentration of pulp in squash. Similar findings were reported by Singh *et al.* (2016) and revealed that maximum score in terms of colour,

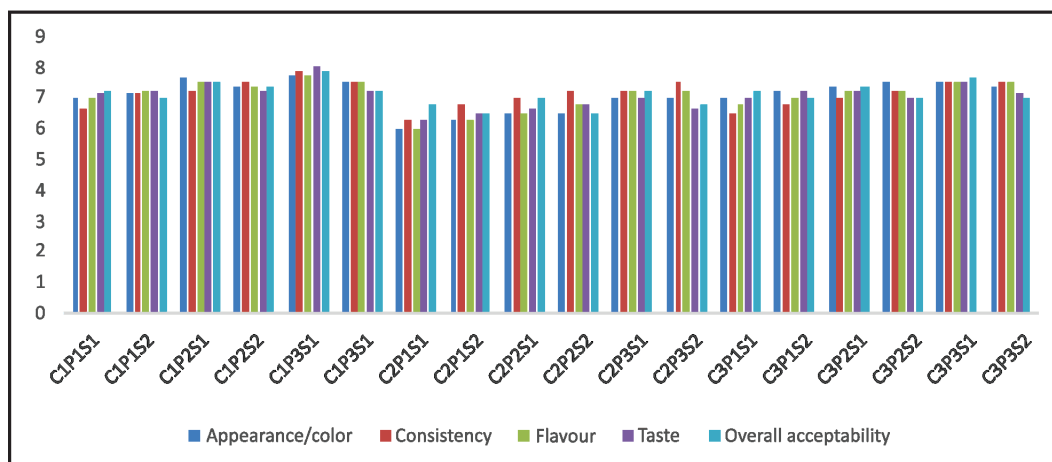


Figure 1: Effect of pulp and sugar levels on different sensory attributes of squash in peach cultivars



**Plate 1: Peach squash and their diluted drink**

flavour, consistency and taste of 'Peach Nectar' were recorded in Florida Prince cultivar. Overall acceptability of 'Peach Nectar' was attained highest prepared by the fruits of cultivar Florida Prince. Srinivas *et al.* (2007) reported that squash prepared from CV Ganesh with 25 per cent juice, 50°Brix TSS and 1.5 per cent acidity and in CV Mridula with 25 per cent juice, 45° Brix TSS and 1.5 per cent acidity was found to be the best recipe with overall acceptability and good organoleptic scores.

#### **4. Conclusion**

Organoleptic studies revealed that squash made from the recipe incorporated with 35 per cent pulp, 40 per cent sugar and 1 per cent acid were found to be most acceptable irrespective of cultivars. Fruits of Florida Prince cultivar were found most suitable for the preparation of squash on account of its high rated sensory attributes.

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