

Physico-chemical characteristics of some strawberry (*Fragaria x ananassa*) genotypes under Garhwal region of Uttarakhand

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Strawberry (*Fragaria ananassa* Duch.) is one of the most attractive and acceptable soft fruits of the world. In north India, area under strawberry is increasing rapidly due to its remunerative prices. However, in Uttarakhand, its area is limited to Dehradun, Udham Singh Nagar and Nainital districts. Evaluation of the suitability of different strawberry cultivars for a specific area is of paramount importance for suggesting varieties for general cultivation in different agro-climatic conditions (Asrey and Singh 2004). Still the work on identification of suitable genotype of strawberry for agro-climatic conditions of Garhwal Himalayas remains scanty in literature. It is in high demand for table purpose as well as jam making, canning and ice cream preparations. So, it is essential to select suitable genotypes of strawberry for value addition. Therefore, studies were taken to find out variation in physicochemical characters of fruits of 17 genotypes of strawberry under mid-hill conditions of Garhwal Himalayas of Uttarakhand.

The study was carried out at Research Block of Department of Horticulture, College of Forestry and Hill Agriculture, GB Pant University of Agriculture and Technology, Ranichauri, Tehri-Garhwal, Uttarakhand, India during 2006–07. Runners of 17 genotypes of strawberry were collected from SUKAST(S), Shalimar, Srinagar (J&K). Experiment was laid out in randomized block design with 3 replications at 1 843 m above mean sea level under mid hill conditions of Central Himalaya. The runners were planted on raised (15 cm) double rowed beds during third week of October 2006 and mulched with black polyethylene. Twenty plants of each of the 17 cultivars were planted in 3 m × 1.2 m raised bed for investigation. Individual rows were spaced

at 60 cm and plant-to-plant distance was kept at 30 cm. During the course of study, uniform cultural practices were followed during the investigation. The length of 10 randomly selected fruits from each replication was measured in cm from calyx plug to the pointed end or apex of the fruit. Fruit width was measured at the broadest point from the wider side and the mean values of 10 fruits were expressed in cm. The weight of the representative fruits (10 of each replication) was recorded and average weight/fruit was worked out.

The ripe fruits of strawberry cultivars were harvested at appropriate intervals. These fruits were then analyzed for their physico-chemical properties from 10 randomly selected from each picking. TSS of ripe fruits was determined with the help of hand refractometer (0–32°B) after calibration with distilled water. The values of 10 fruits per replication were averages and expressed in ° Brix. Titratable acidity was estimated by standard method described by Ranganna (1997) and expressed as percentage and was averaged. Total sugars were worked out as per cent on fresh weight basis (Lane and Eynon 1923). Total soluble solids: acid ratio was worked out by dividing the TSS by titratable acidity in each replication. Total sugar: acid ratio was worked out by dividing the total sugar percentage by titratable acidity. For determination of moisture weighed fruit samples were kept in Petry plates and placed in hot air oven at 70±2°C temperature. The weight of the samples was recorded at regular intervals till it become constant and the moisture was calculated using the following formula.

$$\text{Moisture (\%)} = \frac{\text{Fresh weight} - \text{dry weight}}{\text{Fresh weight}} \times 100$$

The total solids were computed by subtracting the moisture content from 100 and the mean values were expressed as percentage. Statistical analysis of the data was carried out by the method of analysis of variance as outlined by (Gomez and Gomez 1984).

The data on fruit length revealed that various genotypes differed in significantly in fruit length. Genotype 'Chandler'

*Short note

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Table 1 Physico-chemical characters of fruits of strawberry genotypes grown in mid hills of Garhwal Himalayas

Genotype	Fruit length (cm)	Fruit width (cm)	Average fruit weight (g)	TSS (°Brix)	Acidity (%)	Total sugar (%)	TSS: Acid ratio	Total sugar: Acid ratio	Moisture (%)
'Senga Sengana'	3.30	2.80	14.41	8.7	0.98	5.81	8.87	5.92	90.2
'Red Coat'	2.62	1.76	8.63	11.1	1.07	8.39	10.54	7.84	87.6
'Confictura'	2.64	1.80	9.46	10.5	0.93	6.85	11.25	7.36	88.4
'Brighton'	2.60	1.64	7.31	9.7	1.01	6.96	9.57	6.89	89.2
'Gorella'	2.64	1.74	8.37	9.7	0.99	7.54	9.82	7.61	89.1
'Pajaro'	2.78	1.80	9.95	11.1	1.02	5.60	11.17	5.49	87.5
'Shasta'	2.60	1.62	7.11	9.6	1.09	6.03	8.80	5.53	89.3
'Howard'	2.92	1.80	10.76	8.8	0.96	4.83	9.16	5.03	90.1
'Catskill'	2.70	1.76	9.16	8.1	1.12	5.63	7.20	5.02	90.8
'Chandler'	3.59	2.86	15.50	11.4	0.99	6.19	11.24	6.61	87.6
'Addie'	2.80	1.80	8.93	8.7	0.89	5.97	9.85	6.78	90.2
'Osolana'	2.92	1.82	10.35	8.5	1.02	5.22	8.35	5.09	90.0
'Larson'	2.85	1.82	10.41	10.1	1.03	6.04	9.10	5.87	88.8
'Belrubi'	2.62	1.64	7.33	10.4	0.97	7.29	10.72	7.51	88.5
'Missionary'	2.95	1.68	8.80	8.5	1.29	6.08	6.63	4.71	90.4
'Seascape'	2.85	1.85	9.95	11.9	0.92	5.76	12.96	6.26	87.0
'Dana'	2.92	1.80	10.80	9.9	0.95	5.57	10.45	5.86	89.0
CD ($P=0.05$)	0.045	0.019	0.024	0.03	0.01	0.23	0.04	0.02	0.01

had the longest fruits (3.59 cm), followed by 'Senga Sengana' (3.30 cm) which were significantly higher to others, whereas 'Shasta' recorded shortest fruit length (2.60 cm) (Table 1). The maximum fruit width was recorded (2.86 cm) in 'Chandler', followed by 'Senga Sengana' (2.80 cm) which was significantly higher in comparison to other genotypes (Table 1). Genotype 'Shasta' showed significantly lower fruit width of only 1.62 cm, followed by 'Brighton' (1.64 cm) and 'Belrubi' (1.64 cm), which were similar to each other. Fruit size showed marked variations among different genotypes tested during the course of present study. Hancock and Bringham (1988) also determined sufficient variation for fruit size in different strawberry cultivars. These results are in conformity with the findings of Recupero *et al.* (1989). Moore *et al.* (1970) reported that these differences in fruit size are primarily due to plant vigour, competition among fruits in the inflorescence, number and size of developed achenes, differences in activity among the achenes in the production of growth material, climatic conditions, irrigation and plant nutrients. Fruit yield is directly related to average berry weight. Average berry weight, showed significant differences among various strawberry genotypes. The average berry weight ranged from 7.11 g ('Shasta') to 15.50 g ('Chandler'). The fruits of 'Chandler' and 'Senga Sengana' were significantly heavier having an average weight of 15.50 g and 14.41 g, respectively. Genotype 'Shasta' exhibited least fruit weight, followed by 'Brighton' (7.31 g) and 'Belrubi' (7.33 g) which were at par with each other. These results are in accordance with the finding of Hancock *et al.* (1983). Total soluble solids (TSS) content ranged from 8.07 °B ('Catskill') to 11.93 °B 'Seascape'. 'Seascape' showed significantly highest TSS contents over all other genotypes and 'Catskill'

recorded the least TSS (8.07 °B). A significant difference in titratable acidity was found among genotypes undertaken for evaluation (Table 1). 'Missionary' had the highest acidity (1.29%) and 'Addie' had the least (0.89%). The genotypes 'Gorella' and 'Chandler' had similar acidity (0.99%) which was at par with 'Senga Sengana'. Total sugar content ranged from 4.83 and 8.39%. Genotype 'Red Coat' (8.39%) showed significantly higher levels of total sugar than all other cultivars, whereas lowest total sugar (4.83%) was registered in 'Howard'. The level of sugar contents of strawberry fruits observed in the present study are in agreement with investigations of Singh *et al.* (2008). The reasons for deviation in total sugar in fruit may be ascribed due to differences in growing conditions and climatic variations as reported by Polovyanov (1985). Different cultivars showed significant variation in their TSS : acid ratio. 'Seascape' gave berries with highest TSS : acid ratio (12.96), followed by 'Confictura' (11.25) and 'Chandler' (11.24), which were at par with each other. The lowest TSS: acid ratio was observed in 'Missionary' (6.63). The total sugar: acid ratio was found to be significantly higher in 'Red Coat' (7.84) than remaining genotypes. Least total sugar: acid ratio was recorded in 'Missionary' (4.71), followed by 'Catskill' (5.02) and 'Howard' (5.03) and these were statistically at par with each other. Moisture percentage ranged from (87.0%) in 'Seascape' to (90.8%) in 'Catskill'. 'Catskill' was reported to have significantly higher moisture content. These results are in accordance with the findings of Hancock *et al.* (1983). It can be concluded that 'Chandler', 'Senga Sengana' and 'Seascape' were found superior in physico-chemical characteristics of fruits compared to other genotypes.

SUMMARY

The ripe fruits of 17 genotypes of strawberry were analyzed for their physico-chemical characters under mid-hill conditions of Garhwal Himalaya of Uttarakhand. Significant variation in fruit characters, ie fruit length, fruit width, fruit weight, TSS, acidity, total sugar, TSS : acid ratio and moisture content were recorded among various genotypes. 'Chandler', 'Senga Sengana' and 'Seascape' were found superior in physico-chemical characteristics of fruits compared to other genotypes. Based on these finding 'Chandler', 'Senga Sengana' and 'Seascape' genotypes of strawberry can be recommended for commercial cultivation in this region.

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