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Physico-chemical analysis some guava genotypes during rainy and winter season under east and south east coastal plain zone of Odisha

J Sahoo, RK Tarai, SC Swain, BK Sethy and D Dash

Abstract

The physico-chemical characteristics of eight guava genotypes viz. Hisar Safeda, Pant Prabhat, Shweta, Hisar Surkha, L-49, Banaras Round, Allahabad Safeda and HRS Pride were studied at Horticultural Research Station, Orissa University of Agriculture and Technology, Bhubaneswar in both rainy and winter season during 2015-16 and 2016-17. The longest and shortest fruit were obtained in Pant Prabhat and Banaras Round respectively during both the season. Hisar Surkha produced maximum fruit diameter during both the season. The fruit weight was found maximum in Pant Prabhat (147.63 g during rainy and 150.60 g during winter season) and minimum in Banaras Round (106.73 g during rainy season and 112.37 g in Hisar Safeda). During rainy season the specific gravity of the fruit ranged between 0.93 to 0.97 while during winter season it ranged from 0.95 to 0.98 in Pant Prabhat. The TSS: acidity ratio varied significantly with a minimum of 20.60 in L-49 during rainy and 19.18 in Allahabad Safeda during winter to a maximum of 45.06 in Pant Prabhat during rainy and 46.54 in Pant Prabhat during winter season. The highest ascorbic acid was recorded in L-49 (154.67 mg/100 g pulp during rainy and 226.00 mg/100 g pulp during winter season). In respect of qualitative characteristics the varieties like Shweta, Pant Prabhat, HRS Pride were found better compared to the other varieties. The fruits harvested during winter season exhibited better quality than rainy season fruits.

Keywords: Guava, genotypes, quality, season

Introduction

Guava (*Psidium guajava* L.) belonging to family Myrtaceae, is an important commercial tropical and sub-tropical fruits of India. The fruit is rich in vitamins C, A and B₁ and minerals like phosphorus and iron. It contains about 180-300 mg of vitamin C per 100 g of pulp. The fruit has high demand for both table purpose as well as in processing industry for preparation of jam and jelly. It contains antioxidant factors and can control systolic blood pressure (Brar *et al.*, 2015) [4]. Guava is successfully grown over a wide range of climatic conditions due to its greater adaptability. It has been reported that in guava fruit the level of TSS ranged from 9.6 to 11.14 ° Brix, Titratable acidity from 0.28 to 0.38%, ascorbic acid from 167.50 to 210.00 mg / 100 g edible portion, total sugar from 7.93 to 8.90%, reducing sugar from 5.04 to 5.49% (Archana and Siddiqui, 2004 and Aulakh, 2004) [2]. Guava bears twice in a year i.e. during summer and winter season in a year but the best quality fruit is obtained in winter (Bal and Dhaliwal, 2004) [3]. The variations in the climatic conditions of both the season also leads to the significant differences in the quality characteristics of guava fruit. At present very little information is available about the physico-chemical quality profile of guava during rainy and winter season under Bhubaneswar condition of Odisha. Hence, the present experiment is carried out to study the comparative fruit quality performance of some commercial guava cultivars under east and south east coastal plain zone of Odisha.

Materials and Methods

The experiment on " Quality studies of some guava genotypes during rainy and winter season under east and south east coastal plain zone of Odisha " was carried out during 2015-16 and 2016-2017 at the Horticultural Research Station, Odisha University of Agriculture and Technology, Bhubaneswar. The experiment was conducted in Randomized block design (RBD) with 8 treatments (cultivars) and 3 replications. There were eight varieties consisting of elite guava selections and hybrids viz. T₁-Hissar Safeda, T₂- Pant Prabhat, T₃-Shweta, T₄-Hissar Surkha, T₅-L-49, T₆- Banaras Round, T₇- Allahabad Safeda and T₈- HRS Pride.

The observations on physico-chemical characteristics were recorded from fruits harvested during two seasons i.e. for ambe bahar (rainy season) and mrig bahar (winter season) crop of guava. Physico-chemical analysis of fruits was taken on ten randomly selected mature fruits from each plant during both seasons.

The fruit length was measured from the stalk end to calyx end using vernier callipers and expressed in cm. The fruit width was measured at the widest cheeks of fruit using vernier callipers and expressed in cm. Immediately after harvesting, weight of fruit was taken at mature stages of each replication. A total of ten mature fruits were sampled by using electronic balance and expressed in grams. The volume of fruit was measured by the conventional water displacement method and expressed in ml. Specific gravity was calculated by dividing fruit weight with fruit volume. The skin of freshly harvested fruits was peeled and pulp was separated and weighed by using electronic balance and the mean weight was recorded and expressed in grams. The pulp of the fruit was made into pieces and boiled in hot water for 15 minutes. Later the seeds were separated by using ordinary sieve (< 20 mm) and were weighed and expressed in grams. The percentage of pulp was calculated by dividing the weight of seed from the total weight of fruit. The TSS was determined by using a hand refractometer and was expressed in ° Brix. Titratable acidity was determined and expressed as per cent citric acid as described by Ranganna (1977) [13]. The ascorbic acid content was determined by the standard method as per A.O.A.C.(1990). The total and reducing sugars were estimated by following Shaffer Shomogi method as described by Ranganna (1977) [13] and expressed as per cent. The analysis and interpretation of data were done using the method of Panse and Sukhatme (1989) [11] in randomized block design

Results and Discussion

Fruit characters

Different fruiting characters under the study were found statistically significant. The observations on the fruit characters are presented in the Table 1 and mostly rounded type of fruit were recorded in most of the varieties. The skin colour of the fruit was found to be pale yellow green in the varieties Hisar Safeda, Hisar Surkha, Allahabad Safeda, Banaras Round whereas pale yellow skin colour was observed in the varieties Pant Prabhat, Shweta and HRS Pride. The pale yellow to primrose yellow colour of the skin was found in the variety L-49. The pulp colour was recorded creamy white in the varieties Pant Prabhat, Hisar Surkha, Banaras Round and HRS Pride. Snow white colour of the fruit was found in the variety Shweta whereas white colour of the pulp was recorded in the varieties Allahabad Safeda, Hisar Safeda and Lucknow-49. Most of the fruits surface was found smooth except in the variety Banaras Round.

Physical Characteristics of fruits

In respect of physico-chemical characters of fruits like fruit length, fruit breadth, fruit weight, fruit volume, pulp weight, seed weight, TSS, acidity, total sugar, reducing sugar and non-reducing sugar etc. the guava varieties Pant Prabhat, Shweta and Hisar Surkha showed better performance during rainy season. Similarly, during winter season the varieties Shweta, Pant Prabhat, Hisar Surkha and HRS Pride performed better as compared to other varieties studied (Table 2, Table 3 and Table 4). The fruit size varied significantly among different guava genotypes during study. From the data presented in the Table 2, it is obvious that during rainy season

longest fruit was observed in Pant Prabhat (6.60 cm) followed by Hisar Safeda (6.39 cm) and Hisar Surkha (6.32 cm) whereas the shortest fruit was produced by Banaras Round (5.38 cm). Similarly during winter season the maximum fruit length (6.32 cm) was recorded in Pant Prabhat followed by Hisar Safeda (6.24 cm) and Shweta (6.23 cm) and it was found minimum in Banaras Round (5.29 cm). The variation in fruit length can be attributed to genetic constitution of the seedlings. Significant variations during changes in fruit diameter of guava were also recorded among the genotypes. The fruit breadth ranged from a minimum of 5.11 cm in Banaras Round to a maximum of 6.66 cm in Hisar Surkha (during rainy season) where as it ranged from 5.50 cm in Allahabad Safeda to 6.72 cm in Hisar Surkha (during winter season). This variation may be due to phenotypic and genotypic interactions among the selections. The ratio of fruit length to breadth of different guava cultivars showed significant difference among themselves and they varied from a minimum of 0.89 in HRS pride to a maximum of 1.14 in Allahabad Safeda during rainy season and 1.10 in Allahabad Safeda to 0.91 in Hisar Surkha. Similarly, during winter season it was found maximum in Allahabad Safeda (1.10) followed by Pant Prabhat (0.98) and minimum in HRS Pride (0.88) followed by Hisar Surkha (0.91).

The maximum fruit volume was recorded in Pant Prabhat (153.55 ml) and minimum in Banaras round (112.39 ml) during rainy season while during winter season it was found highest in Pant Prabhat (154.18 ml) and lowest in Hisar Safeda (116.96 ml). During rainy season the specific gravity of the fruit ranged from a minimum of 0.93 in Hisar Surkha to a maximum of 0.97 in Shweta. During winter season there was not much significant difference with respect to specific gravity of the fruits and it ranged from a minimum of 0.95 in Banaras Round to a maximum of 0.98 in Pant Prabhat (Table 2). Man and Suryanarayan (2011) [10] also observed variation among fourteen genotypes studied with respect to fruit weight, fruit length and fruit diameter. The specific gravity in most of the cultivar was slightly higher because of the quality standards viz., total soluble solids, total sugar were found higher in fruits and these characters influenced the specific gravity of fruits. Kumar *et al.* (2006) [8] also reported variation in specific gravity among the different cultivars of Ber.

The guava varieties, which were under study showed significant variations among themselves with regards to the weight of the fruit during both rainy and winter season (Table 2). During rainy season the varieties Pant Prabhat, Hisar Surkha and Shweta were found significantly superior over the check variety Allahabad Safeda and found statistically significant over other varieties with respect to fruit weight. It was recorded maximum in Pant Prabhat (147.63 g) followed by Shweta (129.17 g) and Hisar Surkha (123.00 g) while minimum fruit weight was observed in Banaras Round (106.73 g) during rainy season. Similarly, during winter season maximum fruit weight was recorded in Pant Prabhat (150.60 g) which was found statistically at par with Shweta (145.77 g) and significantly different from other treatments. It has also been noticed that minimum fruit weight of 112.37 g was observed in Hisar Safeda. The fruit that matured during winter season attained more weight than that harvested during rainy summer season. The probable cause may be that the winter season fruit set occurs during August when plenty of food material is available in comparison to fruit set in April. Apart from food materials, climatic factors such as temperature and humidity prevailing during winter season are

also favourable for development of fruits. In winter season, the increased fruit weight was might be due to increase in sucrose accumulation in the pulp tissues of guava fruits. In rainy season crop the fruit weight might be decreased due to attack and damage of fruit fly. It is clear from the Table 3, that the pulp weight of the fruits varied significantly among each other during both rainy and winter season cultivars of guava. During rainy season, the pulp weight ranged from a minimum of 100.49 g in Banaras Round to a maximum of 140.40 g in Pant Prabhat. During winter season the highest pulp weight of the fruits varied from a minimum of 105.81 g in Hisar Safeda to maximum of 146.02 g in Pant Prabhat. Pant Prabhat was found statistically at par with Shweta while statistically significant to the remaining varieties during winter season. There were not much significant differences observed with respect to the seed weight of the fruits during both rainy and winter season crop of guava cultivars as it was indicated in the Table 3. The maximum pulp: seed ratio was found in case of winter crop. It may be due to the fact that the low temperature during ripening period of winter season crop in guava retards the excessive loss of respiratory substrates and also increase translocation of photosynthates from leaves to fruits. The seed weight was found maximum in L-49 during rainy season and in Allahabad Safeda during winter season indicating these varieties as seeded, while minimum seed weight was found in HRS Pride and Banaras Round during rainy and winter season respectively. The variation in seed weight was also recorded earlier by Rahman *et al.* (2003) [12] and Lakade *et al.* (2011) [9].

Chemical Characteristics of the fruit

It is quite apparent from the data presented in the Table 4, that with respect to TSS content of fruits the variety Pant Prabhat was found statistically at par with Shweta while significantly different from rest of the genotypes during both the rainy and winter season. The TSS of the fruit during rainy season was maximum in Pant Prabhat (12.27 °Brix) followed by Shweta (12.05 °Brix) while during winter season, it was recorded maximum in Pant Prabhat (12.38 °Brix) followed by Shweta (12.23 °Brix) and Hisar Surkha (11.37 °Brix). The varieties viz. Hisar Surkha, Hisar Safeda, Shweta and Pant Prabhat were found significantly superior over the check variety Allahabad Safeda with respect to the TSS content of the fruits. From the data depicted in the Table 4, it was obvious that during rainy season the acidity of the fruit varied significantly with highest acidity observed in L-49 (0.48%) and lowest in Pant Prabhat (0.27%). During winter season, it was found maximum in Allahabad Safeda (0.56%) and minimum in Pant Prabhat (0.27%). With regards to acidity, L-49 was found most acidic and significantly different from other varieties except Hisar Surkha with which it was statistically at par during rainy season. During winter season highest acidity was recorded in Allahabad Safeda which was found statistically significant from all the varieties. The TSS: acidity ratio varied significantly during rainy season with a minimum of 20.60 in L-49 to a maximum of 45.06 in Pant Prabhat. The variety Pant Prabhat was found statistically significant from most of the varieties. Similarly, during winter season significant variation with respect to TSS : acidity ratio was found among the varieties studied with a minimum of 19.18 in Allahabad Safeda to a maximum of 46.54 in Pant Prabhat.

An increase in TSS was recorded during winter season over that of rainy season. The TSS was low during rainy season and high during winter season. This may be due to low water

content and high soluble solids in the fruits during winter season. Kumar *et al.* (2006) [8] reported that cv. Chittidar had highest TSS (10 °Brix) followed by Apple Colour (9.8 °Brix). They also reported that acidity ranged between 0.38 (L-49) to 1.53 (Apple Colour) and maximum sugar was found in cv. L-49 (7.06%) followed by Chittidar (6.97%). As it was implied from data presented in the Table 4, that during rainy season highest total sugars content was obtained in Pant Prabhat (9.33%) followed by Shweta (9.03%), L-49 (8.78%) and Hisar Surkha (8.20%) while it was observed lowest in Banaras Round (6.36%). During winter season highest total sugar was recorded in Shweta (9.35%) followed by Pant Prabhat (9.29%), L-49 (8.90%), and Hisar Safeda (8.42%), while it was recorded lowest in Banaras Round (7.10%). During both the season the variety Shweta was found statistically at par with the variety Pant Prabhat and significantly different from other treatments. During rainy season the reducing sugar was recorded higher in the variety Pant Prabhat (5.54%) followed by Shweta (5.35%) and L-49 (4.72%) where as lowest reducing sugar content was observed in Banaras Round (3.55%). The guava varieties which were under study during the winter season clearly indicates that maximum reducing sugar was found in Shweta (5.55%) followed by Pant Prabhat (5.46%) and L-49 (3.73%) where as the minimum reducing sugar was obtained in Banaras Round (3.70%). During both the season the variety Shweta and Pant Prabhat were found statistically at par and significantly different from rest of the varieties. During rainy season the non-reducing sugar% varied within the range of 2.68 to 3.88%. The highest non-reducing sugar content was observed in Hisar Surkha (3.88%) and lowest in Banaras Round (2.68%). Similarly, during winter season crop of the guava the non-reducing sugar ranged from a maximum of 3.96% in L-49 to a minimum of 3.23% in Banaras Round.

The data presented in the Table 4, showed that there was significant differences with respect to the ascorbic acid content of fruits of different varieties during rainy season and winter season fruits of guava. During rainy season the highest ascorbic acid was recorded in L-49 (154.67 mg/100 g pulp) followed by Shweta (147.17 mg/100 g pulp) and Pant Prabhat (125.00 mg/100 g pulp) whereas it was recorded minimum in Banaras Round (93.00 mg/100 g pulp). During winter season the variety L-49 was found significantly different and superior from other varieties. It was observed highest in L-49 (226.00 mg/100 g pulp) followed by Shweta (207.83 mg/100 g pulp) and Hisar Surkha (146.50 mg/100 g pulp) while the minimum ascorbic acid was recorded in Banaras Round (110.33 mg/100 g pulp). So with respect to ascorbic acid content L-49 was found statistically at par with Shweta and significantly different from rest of the varieties during both the rainy season and winter season. Both L-49 and Shweta were found significantly superior over the check Allahabad Safeda.

Ascorbic acid content was found maximum in the winter season. High ascorbic acid content in the winter season under the present study, is probably due to genotype x season interactions. Rainy season fruit contains less vitamin C, TSS and sugar. This might be due to cloudy weather and presence of relatively more moisture in soil which must have moved in to the fruit and diluted the organic metabolites particularly sugars. Furthermore, it seems that temperature play an important role which governs the enzymatic systems involved in biogenesis and catabolism of ascorbic acid. Rathore (1972) [14] stated that in addition to increasing the availability of metabolites, the lower temperature during winter season also helps in the accumulation of more metabolites which is

responsible for improving fruit quality. The present findings are also in agreement with the finding of Kahlon *et al.* (1997); Chundawat *et al.* (1976) [5] and Ghosh *et al.* (2013) [6], who found superior fruits in winter season to that of rainy season

in respect of different biochemical parameters. The fruits harvested during winter season exhibited better quality than rainy season fruits.

Table 1: Fruit characters of different varieties of guava

Varieties	Skin colour	Shape	Surface smoothness of the fruit	Pulp colour
Hisar Safeda	Pale yellow green	Roundish	Smooth	White
Pant Prabhat	Pale yellow	Roundish	Smooth	Cream white
Shweta	Pale yellow	Roundish	Smooth	Snow white
Hisar Surkha	Smooth	Roundish	Smooth	Creamy white
L-49	Pale yellow	Roundish	Smooth	White
Banaras Round	Pale yellow green	Roundish	Rough	Cream white
Allahabad Safeda	Pale yellow green	Roundish	Smooth	White
HRS Pride	Pale yellow	Broadly rounded	Smooth	Cream white

Table 2: Fruit size, fruit weight and specific gravity of different guava cultivars during Rainy and winter season

Varieties	Fruit length (cm)		Fruit breadth (cm)		Ratio of fruit length/breadth		Fruit weight (g)		Fruit volume (ml)		Specific gravity	
	RS	WS	RS	WS	RS	WS	RS	WS	RS	WS	RS	WS
Hisar Safeda	6.39	6.24	6.59	6.53	0.97	0.96	112.97	112.37	118.31	116.96	0.96	0.96
Pant Prabhat	6.60	6.32	6.62	6.49	0.99	0.98	147.63	150.60	153.55	154.18	0.96	0.98
Shweta	5.73	6.23	5.44	6.61	1.05	0.95	129.17	145.77	133.00	150.36	0.97	0.97
Hisar Surkha	6.32	6.13	6.66	6.72	0.95	0.91	123.00	119.80	131.73	125.26	0.93	0.96
L-49	6.17	5.80	6.43	6.17	0.96	0.94	116.63	134.60	123.18	140.67	0.95	0.96
Banaras Round	5.38	5.29	5.11	5.72	1.05	0.92	106.73	112.63	112.39	118.44	0.95	0.95
Allahabad Safeda	5.92	6.04	5.24	5.50	1.14	1.10	107.93	124.93	112.70	129.68	0.96	0.96
HRS Pride	5.61	5.61	6.31	6.39	0.89	0.88	120.50	126.83	126.85	132.25	0.95	0.96
S.E (m) ±	0.20	0.21	0.25	0.23	0.03	0.03	4.57	2.68	4.71	2.79	0.01	0.01
CD at (5%)	0.58	0.63	0.72	0.68	0.09	0.09	13.37	7.84	13.79	8.16	NS	NS

Table 3: Pulp and seed content of guava cultivars during rainy and winter season

Varieties	Pulp weight (g)		Seed weight (g)		Pulp (%)		Seed (%)	
	RS	WS	RS	WS	RS	WS	RS	WS
Hisar Safeda	107.14	105.81	5.83	6.55	94.86	94.12	5.14	5.88
Pant Prabhat	140.40	146.02	7.24	4.58	95.03	96.94	4.97	3.06
Shweta	122.29	140.00	6.88	5.77	94.67	96.06	5.33	3.94
Hisar Surkha	117.33	114.00	5.67	5.80	95.39	95.13	4.61	4.87
L-49	109.00	128.33	7.63	6.27	93.49	95.34	6.51	4.66
Banaras Round	100.49	108.73	6.24	3.90	94.13	96.56	5.87	3.44
Allahabad Safeda	101.17	117.67	6.77	7.27	93.76	94.20	6.24	5.80
HRS Pride	115.13	120.33	5.37	6.50	95.51	94.86	4.49	5.14
S.E (m) ±	4.50	3.13	0.98	1.33	0.83	1.13	0.83	1.13
CD at (5%)	13.15	9.16	NS	NS	NS	NS	NS	NS

Table 4: Chemical parameters of guava cultivars during rainy and winter season

Varieties	TSS (°Brix)		Acidity (%)		TSS : acid ratio		Ascorbic acid (mg/100g edible portion)		Total sugar (%)		Reducing Sugar (%)		Non-reducing Sugar (%)	
	RS	WS	RS	WS	RS	WS	RS	WS	RS	WS	RS	WS	RS	WS
Hisar Safeda	10.77	11.35	0.30	0.42	36.47	27.35	103.00	119.83	8.23	8.42	4.41	4.43	3.63	3.79
Pant Prabhat	12.27	12.38	0.27	0.27	45.06	46.54	125.00	158.40	9.33	9.29	5.54	5.46	3.60	3.64
Shweta	12.05	12.23	0.33	0.32	35.99	38.19	147.17	207.83	9.03	9.35	5.35	5.55	3.50	3.61
Hisar Surkha	10.98	11.37	0.42	0.33	26.88	34.92	117.83	146.50	8.20	8.27	4.11	4.14	3.88	3.92
L-49	9.88	10.52	0.48	0.43	20.60	24.61	154.67	226.00	8.78	8.90	4.72	4.73	3.86	3.96
Banaras Round	10.78	10.88	0.32	0.37	33.72	29.56	93.00	110.33	6.36	7.10	3.55	3.70	2.68	3.23
Allahabad Safeda	10.23	10.72	0.36	0.56	28.07	19.18	116.33	138.83	8.10	8.17	4.11	4.20	3.79	3.77
HRS Pride	10.43	10.62	0.29	0.28	36.54	37.55	96.67	114.67	7.12	7.17	3.69	3.74	3.26	3.26
S.E (m) ±	0.18	0.15	0.01	0.01	1.29	1.32	10.74	13.12	0.03	0.03	0.16	0.14	0.14	0.12
CD at (5%)	0.53	0.43	0.04	0.04	3.77	3.86	31.42	38.39	0.09	0.10	0.48	0.40	0.42	0.35

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