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## Profiling of fruit physico-chemical attributes of some promising guava (*Psidium guajava* L.) cultivars under the new alluvial zone of West Bengal

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### Abstract

An investigation was made on twenty promising guava cultivars viz. Lalit, Allahabad Safeda, Lucknow - 49, Shweta, Philippines, Kohir Safeda, Arka Amulya, Hisar Surkha, Safed Jam, Hisar Safeda, Arka Mridula, Arka Kiran, Kohir Round, Kohir Red, SRD-1, Kohir Long, Kafri, Mohammad Khaja, Baruiipur Local and Dudh Khaja on the basis of fruit morphology and physico-chemical properties at Horticultural Research Station (HRS), Mondouri, Bidhan Chandra Krishi Viswavidyalaya during 2016-17. Fruit weight was maximum Hisar Surkha, followed by Lucknow - 49, Philippines and Shweta. Fruit quality in terms of TSS (°Brix) was best in Arka Kiran followed by Lalit, Kohir Red, and SRD-1. Arka Kiran showed maximum vitamin C content and total sugar per 100 g of fruit pulp with a meagre amount of acidity. So, apart from the local varieties Hisar Surkha and Arka Kiran are recommended for cultivation under the new alluvial zone of West Bengal.

**Keywords:** *Psidium guajava* L., evaluation, fruit quality, fruit morphology, cultivars

### 1. Introduction

Guava (*Psidium guajava* L.) is one of the most common edible tree fruit found in the tropical and sub-tropical climate. It belongs to the Myrtaceae family, which comprises 150 genera and more than 5,650 species (Govaerts *et al.*, 2015) [4]. This fruit is believed to be originated in tropical America (Hayes, 1953) [5]. It is one of the hardy fruit tree adapted to a wide range of soil and climatic condition. It can grow well in a neglected condition and sometimes considered as a weed in Hawaii and Fiji Island. This is one of the common and choicest table fruit in India and often called as 'Poor man's apple' due to its easy availability at a low price, with excellent nutritional value. Guava is rich source of pectin and vitamin C. Per 100g of fruit contains considerable amount of vitamin C content (75-260 mg), thiamine (0.03-0.07 mg), riboflavin (0.02-0.04 mg), phosphorus (22.5-40.0 mg), calcium (10.0-30.0 mg) and iron (20-25 mg) and 0.5-1.8 percent pectin (Shukla *et al.*, 2009) [18]. The seed yield 3-13 % oil, which is rich in essential fatty acids (omega-3 and omega-6 polyunsaturated fatty acids) and can be used as a salad dressing (Mahour *et al.*, 2012) [9]. The seed extract contains compounds with antibacterial, antifungal and analgesic properties (Gonçalves *et al.*, 2008) [3]. The pharmacological actions and the medicinal uses of aqueous extracts of different parts of guava plant viz., fruits, leaves, roots and bark in traditional medicine include the treatment of gastroenteritis, diarrhoea, hypertension, diabetes, dysentery and also used to heal wounds (Joseph and Priya, 2011) [8]. These features of extraordinary nutritive and pharmaceutical value make guava a superfruit.

In India, it is the fifth most important fruit crop, grown in an area of 4054 thousand hectares with a total production of 265 thousand metric ton. Uttar Pradesh is the leading state in guava production, with 0.42 MT followed by Madhya Pradesh, Bihar, Andhra Pradesh and West Bengal (Horticulture Statistics Division, 2018) [6]. In West Bengal, major guava growing areas are, South and North 24 Parganas, Birbhum, Nadia, West Midnapore, and Murshidabad. In Bengali, it is called as 'Peyara' or 'Piara.' In West Bengal, about 25 cultivars are reported to grow in Nadia, 24 Parganas (North and South), Birbhum, Midnapore (West and East), Purulia, Bankura, Burdwan Where The Soils Are Fertile (Alluvial) And Having High Water Table. Many Named Cultivars are available in the research stations and university. However, growers prefer 'Allahabad Safeda,' 'Khaja (Bengal Safeda),' 'Dudh Khaja,' 'Mohammad Khaja,' 'Kafri,' 'Teli,' 'Bhagalpur' and 'Baruiipur' (Mitra *et al.*, 2008) [10].

The Above Description, Reveals the Importance of *Psidium* Sp. Especially of Common Guava (*Psidium guajava*).

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Description of guava cultivars based on morphological and chemical parameters are a useful tool for systematic breeding programs. The biochemical characterisation of guava fruits is important in trait-specific breeding programs (for red pulp colour, ascorbic acid, total soluble solids, etc.) for processing industries and pharmaceuticals. Maintenance of superior genotypes concerning fruit and other characters for further crop improvement programs is essential (Jana *et al.*, 2010) [7]. The varietal specification is considered as one of the most critical aspects of successful commercialisation of any crop under specific agro-climatic condition. Guava cultivars/genotypes have been evaluated in different states for different characters by several workers. These findings are useful to the growers for selecting suitable cultivars. During the last decade, many improved varieties have been developed by selection or hybridisation by some research institutions of the country. The suitability of these new varieties may help expand the guava cultivation both in traditional and non-traditional zones and enhance the productivity in the state. In pursuance of the above findings the present studies were undertaken to evaluate the fruit morphological and biochemical characteristics of some varieties and recent hybrids of guava under the new alluvial zone of West Bengal.

## 2. Materials and Methods

The study was carried out at Horticultural Research Station, Moundari (22.9°N latitude, 88.5°E longitude and an average altitude of 9.75 m above sea level), Bidhan Chandra Krishi Viswavidyalaya (W.B.) during 2016-17. The experimental site comes under sub-tropical humid climate, as it is situated just to the south of tropic of cancer. During the experiment, the average temperature was 29°-31°C in summer months and between 17°-26°C in winter months. The average rainfall was about 1472 mm. The data were statistically analysed by the method of analysis of variance using randomised block design (RBD) as described by Panse and Sukhatme (1978) [12]. The experiment consisted of twenty treatments, each as a cultivar. All the treatments were replicated five times, and one tree served as a unit of treatment in each replication. Ten fruits were randomly harvested from each plant for recording observations. The plants in the germplasm block were five years old and planted at a distance of 5 × 5 m distance. The varieties were Lalit, Allahabad Safeda, Lucknow-49, Shweta, Philippines, Kohir Safeda, Arka Amulya, Hisar Surkha, Safed Jam, Hisar Safeda, Arka Mridula, Arka Kiran, Kohir Round, Kohir Red, SRD-1, Kohir Long, Kafri, Mohammad Khaja, Baruipur Local and Dudh Khaja.

The mature fruits were taken randomly from all plant direction of the plants from each variety, and observation was taken for fruit characteristics. The morphological characters of fruits like fruit shape, fruit base shape, fruit shape at stalk end, fruit calyx persistence, diameter of calyx cavity in relation to the fruit, fruit surface colour, absence or presence of fruit dots, and fruit pulp colour was described with the help of Guava descriptors (Rajan *et al.*, 2011) [15]. Fruit growth parameters in term of weight (g) were taken using an electronic balance, whereas volume (ml) of the fruits was determined by the water displacement method. The fruit shape was determined visually; fruit size was recorded by measuring the length (cm) and diameter (cm) of fruits using digital Vernier callipers. For determination of pulp weight (g) the skin of freshly harvested fruits was peeled off, and pulp was separated and weighed by using electronic balance, and pulp thickness were measured with the help of Vernier calliper and expressed in millimetre (mm). Core weight (g)

was calculated after separating the core part from the fruit and weighed by using the electronic balance.

Fruit quality-related parameters were determined in terms of total soluble solids/ TSS (°Brix), titrable acidity (%), Vitamin C content (mg/100 g), total sugar content (%), reducing sugar (%), non-reducing sugar (%) and sugar to acid ratio. The total soluble solid (°Brix) of pulp was determined using a digital refractometer (Atago PAL-1). Acidity was estimated by simple acid-alkali titration method in terms of citric acid, and vitamin C content was determined by adopting standard procedure (AOAC, 2007) [11]. Total sugar was analysed as per method is given by Lane and Eynon's method reported by Ranganna, (1986) [16].

Data were expressed as the mean of all the scores. The morphological traits that could not be numerically counted were rated based on categories described in descriptors. The results were statistically analysed for analysis of variance with the help of windows based computer package OPSTAT (Sheoran *et al.*, 1998) [17].

## 3. Results and Discussion

The data showed in Table 1 showed that different cultivars differed significantly for their fruit characteristics when measured in July after five years of planting. The highest fruit weight was recorded in Hisar Surkha (168.5 g), followed by Lucknow – 49 (156.4 g), Philippines (155.2 g), Shweta (146.6 g) and it was minimum in SRD-1 (77 g). Pandey *et al.*, (2016) [11] reported an average fruit weight of 157.20 g, while Singh *et al.*, (2013) [19] reported under 144.58 g in Hisar Surkha under Uttar Pradesh condition. Fruit size is an essential parameter of yield. Data of fruit size in term of fruit length and diameter showed significant variation among different cultivars. The fruit length varied from 5.75 cm to 4.64 cm. Maximum fruit length was noticed in Philippines (5.75 cm) followed by Lucknow-49 (5.52 cm), Kohir Safeda (5.47 cm) and Allahabad Safeda (5.28 cm), while minimum fruit length was observed in Shweta (4.64 cm). The fruit diameter ranged from 6.29 cm to 4.42 cm, and the maximum fruit diameter was observed in Kafri (6.29 cm) followed by Arka Mridula (6.18 cm) and Safed Jam (6.18 cm). While Kohir Round (4.42 cm) showed a minimum fruit diameter. Fruit volume is another essential character for guava fruit. It was found that fruit volume varied from 176.72 ml to 78.06 ml Hisar Surkha (176.72 ml) showed the highest fruit volume followed by Philippines (168.39 ml) and Shweta (157.77 ml). Minimum fruit volume was recorded in Kohir Round (78.06 ml). (Patidar *et al.*, 2012) [14] reported a slightly lower fruit volume of 144.25 ml in Hisar Surkha at Vindhya region of Madhya Pradesh.

Physical composition varied significantly among different cultivars (Table 1). Pulp weight varied from 60.5 g to 137 g. Maximum pulp weight was observed in Hisar Surkha (137 g) followed by Philippines (130.5 g), Shweta (122.3 g) and Safed Jam (114.6 g) and minimum pulp weight was noticed in Kohir Round (60.5 g). The pulp thickness varied significantly from 6.11 mm to 17.45 mm among the different cultivars. The higher pulp thickness was observed in Kohir Safeda (17.45 mm) followed by Lucknow-49 (16.65 mm), Lalit (14.11 mm) and Philippines (13.77 mm). Lowest pulp thickness was recorded in SRD – 1(6.11 mm). Pandey *et al.*, (2016) [11] found pulp thickness of 14.70 mm in Lalit under north Indian condition. The core weight varied significantly from 26.95 g to 48.13 g. Lowest core weight was found in SRD-1 (26.95 g) followed by Kohir Round (29.40 g) and Baruipur Local (32.59 g), while the highest core weight was observed in

Hisar Surkha (48.13 g). The different cultivars showed a wide variation in the total number of seeds per fruit, which varied from 96 to 298.2 per fruit. The lowest number of seed per fruit is found in Kohir Long (96.0) and highest in Baruiपुर Local (298.2). Seed weight per fruit varies between 6.63 g to 2.1 g. SRD-1(2.1 g) showed the lowest seed weight per fruit while, Philippines (6.63 g) showed highest seed weight per fruit. While, Verma and Singh, (2015) [20] found maximum number of seeds per fruit in Lalit (554.3) under Uttar Pradesh condition.

The chemical analysis of fruits (Table 2) in terms of TSS ( $^{\circ}$ Brix), acidity (%), ascorbic acid (mg/100 g), total sugar (%), reducing sugar (%), non-reducing sugar (%) and sugar to acid ratio revealed that highest TSS was recorded in Arka Kiran (11.25  $^{\circ}$ Brix) followed by Lalit (10.49  $^{\circ}$ Brix), Kohir, Red (9.85  $^{\circ}$ Brix), SRD – 1(9.76  $^{\circ}$ Brix) and Hisar Safeda (9.61  $^{\circ}$ Brix) and lowest in Safed Jam (7.10  $^{\circ}$ Brix). Under the Tarai condition of Uttarakhand, Arka Kiran showed TSS of 7.54  $^{\circ}$ Brix (Dubey *et al.*, 2016) [2]. The minimum acidity was recorded in Lalit (0.24%), Arka Kiran (0.25%), Allahabad Safeda (0.25%) and Shweta (0.287%) and maximum acidity was observed in Philippines (0.60%). However, Patel *et al.*, (2011) [13] found that Lalit showed high acidity of 0.61% under mid hills of Meghalaya. The maximum total sugar is found in Arka Kiran (7.01%) followed by Shweta 6.93%), Arka Amulya (6.85%) and Lalit (6.77%) and minimum in Philippines (4.87%). While Dubey *et al.*, (2016) [2] found that Arka Kiran showed total sugar of 13.48% under Uttarakhand situation. Table 2 showed that the fruits of Allahabad Safeda (4.31%) contained the maximum amount of reducing sugar followed by Arka Mridula (3.68%), Kohir Long (3.67%) and Arka Amulya (3.63%). This result is at par with the amount of reducing sugar of Allahabad Safeda reported by (Mahour *et al.*, 2012) [9]. The higher non-reducing sugar was found in Arka Kiran (3.50%), Shweta (3.43%), Lalit (3.30%) and Arka Amulya (3.22%). According to Dubey *et al.* (2016) [2], Arka Kiran showed 5.69% non-reducing sugar under Uttarakhand. The vitamin-C content differed significantly among the

selections, and it ranged from 100.32 mg to 215.79 mg per 100 g of pulp. Arka Kiran topped the list for vitamin C content (215.79 mg/ 100g) closely followed by Hisar Safeda (194.05 mg), Shweta (187.58 mg), and SRD – 1 (182.77 mg). While the lower ascorbic acid content was recorded in Kafri (100.32 mg). Under Uttarakhand condition, Arka Kiran showed Vitamin C content of 176 mg/100 g of pulp (Dubey *et al.*, 2016) [2].

A close perusal of Table 3 shows that five genotypes viz. Arka Kiran, Kohir Round, Kohir Red, SRD-1 and Kohir Long is having pinkish pulp colour. Rest of the genotypes showed whitish and creamy whitish pulp colour. We found that among the five pink flesh varieties, only Kohir Round is pyriform in shape, while others are subglobose in shape. Arka Kiran has smooth surface with yellowish skin colour with the absence of any dots on the skin. On the other hand, Hisar Surkha is subglobose in shape with a flattened base. The small persistent calyx is present. The skin surface is smooth and yellowish skin colour. Hisar Safeda and Kafri showed warty fruit surface, while others are smooth.

#### 4. Conclusion

Based on preceding findings, it is concluded that Hisar Surkha showed highest fruit weight (168.50g) and pulp weight (136.96g). While Kohir Safeda showed the lowest number of seeds (96) per fruit. Arka Kiran topped in terms of Vitamin-C content (215.79 mg/100g), total soluble solids (11.25  $^{\circ}$ Brix) and total sugar (7.01%) among the twenty cultivars. Thus, Hisar Surkha and Arka Kiran are recommended for growing under the new alluvial zone of West Bengal.

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**Table 1:** Fruit Characteristics of different guava cultivars

Cultivar	Weight (g)	Length (cm)	Diameter (cm)	Volume (ml)	Length to Diameter ratio	Pulp weight (g)	Pulp Thickness (mm.)	Core Weight (g)	Pulp to core ratio	Number of Seeds per fruit	Seed Weight (g)
Lalit	134.39	4.95	6.02	132.29	0.83	102.52	14.11	40.58	3.08	216.67	4.80
Allahabad Safeda	120.68	5.28	6.05	124.77	0.87	96.70	12.23	38.24	2.84	123.80	2.73
Lucknow-49	156.35	5.52	5.97	130.97	0.93	101.50	16.65	44.05	3.30	203.57	4.50
Shweta	146.62	4.64	5.99	157.78	0.78	122.28	10.82	47.01	2.03	169.47	3.73
Philippines	155.22	5.75	5.90	168.39	0.98	130.50	13.77	46.54	2.60	297.67	6.63
Kohir Safeda	142.59	5.48	6.14	121.87	0.90	94.45	17.45	45.05	3.40	158.40	3.50
Arka Amulya	129.52	5.47	5.99	146.32	0.91	113.40	11.28	40.65	2.43	189.20	4.20
Hisar Surkha	168.50	5.01	6.16	176.72	0.82	136.96	12.23	48.13	2.24	238.37	5.30
Safed Jam	130.69	5.03	6.18	147.86	0.82	114.59	13.23	43.96	2.68	290.23	6.43
Hisar Safeda	125.73	5.09	6.03	113.14	0.85	87.69	9.58	39.58	2.13	280.13	6.23
Arka Mridula	111.80	5.04	6.18	117.28	0.81	90.89	8.16	38.36	1.91	102.07	2.27
Arka Kiran	137.20	4.97	6.09	129.96	0.82	100.72	13.74	41.24	2.95	172.90	3.87
Kohir Round	78.63	5.04	4.42	78.06	1.14	60.50	8.24	29.41	2.45	105.53	2.33
Kohir Red	123.97	4.97	5.90	97.21	0.85	75.34	13.01	44.77	2.55	102.60	2.27
SRD-1	77.07	4.99	5.70	115.85	0.88	89.78	6.11	26.95	2.06	96.10	2.10
Kohir Long	101.66	5.00	5.56	108.07	0.90	83.76	8.04	34.77	2.05	96.00	2.13
Kafri	113.00	5.05	6.29	123.39	0.80	95.62	11.93	34.15	3.04	153.73	3.40
Mohammad Khaja	132.04	5.05	6.06	139.85	0.84	108.39	11.84	46.39	2.21	184.97	4.07
Baruiपुर Local	97.03	5.08	5.23	114.82	0.99	88.99	8.95	32.59	2.44	298.20	6.60
Dudh Khaja	112.73	5.00	6.03	109.35	0.83	84.75	11.23	33.10	2.94	169.10	3.77

S.E.m(±)	3.32	0.11	0.11	4.59	0.02	3.56	0.42	2.21	0.16	5.93	0.13
CD at 5%	9.55	0.32	0.32	13.19	0.06	10.22	1.22	6.34	0.47	17.04	0.39

**Table 2:** Quality characters of different guava cultivars

Cultivars	TSS (%Brix)	Acidity (%)	Vitamin C (mg/100 g)	Total Sugar (%)	Reducing Sugars (%)	Non-Reducing Sugar (%)	Sugar to Acid ratio
Lalit	10.49	0.25	180.72	6.77	3.47	3.30	28.41
Allahabad Safeda	9.23	0.25	159.71	6.33	4.31	2.03	25.50
Lucknow-49	7.74	0.35	160.37	4.85	2.34	2.50	14.00
Shweta	8.60	0.29	187.58	6.93	3.50	3.43	24.51
Philippines	7.21	0.60	147.20	4.87	3.38	1.49	8.20
Kohir Safeda	9.55	0.37	138.51	5.94	3.25	2.69	16.11
Arka Amulya	9.45	0.46	166.25	6.85	3.64	3.22	14.89
Hisar Surkha	9.46	0.43	105.05	5.31	3.04	2.27	12.71
Safed Jam	7.11	0.31	143.09	6.13	3.56	2.57	20.68
Hisar Safeda	9.61	0.39	194.05	4.94	3.23	1.71	13.43
Arka Mridula	9.01	0.30	180.91	6.30	3.68	2.63	21.63
Arka Kiran	11.25	0.25	215.79	7.01	3.52	3.50	28.88
Kohir Round	9.52	0.34	123.86	6.24	3.56	2.68	18.80
Kohir Red	9.85	0.36	147.46	6.18	3.39	2.78	17.17
SRD-1	9.76	0.35	182.77	5.37	3.54	1.83	15.57
Kohir Long	8.79	0.39	171.74	4.99	3.67	1.32	13.31
Kafri	8.42	0.41	100.32	5.77	3.53	2.24	14.47
Mohammad Khaja	9.16	0.41	109.60	5.99	3.35	2.64	14.97
Baruipur Local	9.26	0.35	114.42	5.56	3.18	2.38	16.35
Dudh Khaja	9.22	0.30	143.17	5.90	3.42	2.48	19.94
S.E.m(±)	0.38	0.02	6.17	0.20	0.19	0.05	1.14
CD at 5%	1.09	0.05	17.73	0.57	0.54	0.14	3.27

**Table 3:** Morphological description of fruits in guava cultivars using guava descriptors (Rajan *et al.*, 2011) [15]

Cultivar	Shape	Base Shape	Base shape at the stalk end	Calyx	Calyx persistence	Surface	Skin colour	Colour of pulp	Dots: Present/ Absent
Lalit	Subglobose	Flattened	Broadly round	Small	Persistent	Smooth	Straw yellow	Pinkish	Absent
Allahabad Safeda	Roundish	Flattened	Rounded	Small	Persistent	Smooth	Yellowish green	Creamy white	Absent
Lucknow-49	Roundish ovate	Flattened	Rounded	Small	Persistent	Smooth	Green-yellowish	Creamy white	Absent
Shweta	Subglobose	Flattened	Rounded	Medium	Persistent	Smooth	Green-yellowish	Whitish	Absent
Philippines	Ovate	Broadly round	Broadly round	Small	Persistent	Smooth	Light-greenish	Whitish	Absent
Kohir Safeda	Subglobose	Flattened	Rounded	Medium	Persistent	Smooth	Light-greenish	Whitish	Absent
Arka Amulya	Subglobose	Flattened	Broadly round	Small	Persistent	Smooth	Yellowish	Whitish	Absent
Hisar Surkha	Subglobose	Flattened	Broadly round	Small	Persistent	Smooth	Yellowish	Whitish	Absent
Safed Jam	Subglobose	Flattened	Rounded	Small	Persistent	Smooth	Green yellowish	Whitish	Absent
Hisar Safeda	Oblong	Broadly round	Truncate	Medium	Persistent	Warty	Green-yellowish	Whitish	Absent
Arka Mridula	Subglobose	Flattened	Rounded	Medium	Persistent	Smooth	Green-yellowish	Whitish	Absent
Arka Kiran	Subglobose	Flattened	Broadly round	Big	Drooping	Smooth	Yellowish	Pinkish	Absent
Kohir Round	Pyriform	Flattened	Necked	Medium	Drooping	Smooth	Yellowish	Pinkish	Absent
Kohir Red	Subglobose	Flattened	Rounded	Medium	Persistent	Smooth	Light-greenish	Pinkish	Absent
SRD-1	Subglobose	Flattened	Broadly round	Medium	Persistent	Smooth	Green-yellowish	Pinkish	Absent
Kohir Long	Subglobose	Flattened	Rounded	Small	Persistent	Smooth	Yellowish green	Pinkish	Absent
Kafri	Subglobose	Flattened	Rounded	Small	Persistent	Warty	Yellowish green	Creamy white	Absent
Mohammad Khaja	Roundish ovate	Flattened	Rounded	Medium	Persistent	Smooth	Greenish-yellow	Creamy white	Absent
Baruipur Local	Elliptical round	Flattened	Rounded	Medium	Persistent	Smooth	Light yellow	Creamy white	Absent
Dudh Khaja	Subglobose	Flattened	Rounded	Medium	Persistent	Smooth	Straw yellow	Creamy white	Absent

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