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EVALUATION OF DIFFERENT GUAVA STRAINS FOR YIELD AND PHYSICO-CHEMICAL CHARACTERISTICS

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ABSTRACT

A study was conducted at Horticultural Research Institute, AARI, Faisalabad, Pakistan for selection of guava germplasm with elite characteristics of commercial importance. For collection of guava germplasm, different areas of Punjab were surveyed during the year 2014-2017. Ten strains of guava marked as GS-1 to GS-10 were analyzed for their yield and physio-chemical characteristics. Data were analyzed statistically in RCBD. The highest productivity in terms of yield was obtained in GS-3(75.50 kg/tree) followed by GS-7 (66.75 kg/tree) and GS-2 (65.50 kg/tree). Fruit width (83.67 mm), fruit size (7606.7 mm^2), fruit weight (258.75 g), core length (47.13 mm) were found maximum in GS-3 as compared to other selections. Seediness was least pronounced in GS-3 (95.00) while maximum seeds were observed in GS-5 (236.75). Seed core to pulp ratio was found minimum in GS-9 while GS-8 scored maximum seed core: pulp. Maximum TSS (15.8 °Brix) was found in GS-5 followed by GS-8 (14.5 °Brix).GS-3 excelled other selections in terms of higher yield and better fruit quality i.e. maximum fruit weight, size and less number of seeds. However, these selections must be untapped for their hidden potential for further study and breeding purpose.

KEYWORDS: guava; selections; fruit yield; physiochemical characterization; Pakistan.

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INTRODUCTION

Guava is a popular fruit crop of tropics and sub-tropics, originated from Mexico and Peru. Guava belongs to family Myrtaceae and its edible species is *Psidium guajava*. It is known as the apple of tropics and is blend of important vitamins, minerals and nutrients (Adrees *et al.,* 2010). It is rich source of vitamin C having 3-6 times more than oranges. Fruit is consumed fresh as well as in processed form such as juices sweets, jams and jellies. Guava plant requires a range of temperature from 15-30°C for its best growth and optimum annual plant temperature of 18°C. This type of climate allows guava to grow well in subtropical conditions (Salazar *et al.,* 2006). Guava fruit of best quality is obtained from winter crop.

Globally main producers of guava are India, China and Thailand. Pakistan ranks 4th in the world guava production. Its acreage has reached to an area of 64938 hectares with production of 586070 tonnes during the year 2017-18 in Pakistan. In commercial production, Punjab is a leading province with production of 491670 tonnes (GoP, 2017-18). It can adapt to wide range of soil and pH (4.5-8.5), so its cultivation is increasing with the passage of time. Besides having advanced cultural practices, availability of varieties with improved characteristics of commercial importance is need of the time. In Pakistan, cultivars of commercial importance are Gola and Surahi mainly grown in areas of Sheikhupura, Nankana Sahib, Okara, Kasur, Sahiwal, Multan, Bahawalpur and Faisalabad. Guava is although self-pollinated crop but also affected by cross pollination, so there is always variability in fruit characteristics of seedlings (Iyer and Subramanian, 1987). In fruit crops, this variability can be a blessing in the selection and evaluation of new varieties that can enrich gene pool. In order to increase the market of guava, there is a need to increase its varieties of commercial importance that can compete and improve the guava productivity. It is prerequisite to find new strains that can have better fruit quality of not only domestic but also of export potential. New selections could bring a momentum in guava industry. Developed countries have a lot contribution in collection and evaluation of guava gene pool for commercialization. Padilla-Ramírez *et al.* (2007) selected 12 strains and determined their yield and quality for the enhancement of guava germplasm in Mexico. Similar work has been conducted in India, where several promising cultivars of guava were developed and evaluated for their growth and quality under climatic conditions of north India (Pandey *et al.,* 2007). Du Preez and Welgemoed (1990) studied the performance of selected seedlings of guava and compared their quality to only one existing cultivar Fan Retief in Nelspruit (South Africa). Moreover, in India Shiva *et al.* (2017) studied the important correlation among different vegetative and

fruit quality parameters of 22 genotypes of guava that would be desirable in evaluation of new varieties.

The objective of this research was the selection of new guava germplasm with elite characteristics that can compete with the upcoming challanges in guava industry.

MATERIAL AND METHODS

The site of experiment is progeny orchard of Horticultural Research Institute, AARI, Faisalabad. For germplasm collection, survey was made during winter season of the year 2014-2017 in Faisalabad, Jhang, Kasur, Sheikhupura, Nankana Sahib and other districts of Punjab. Ten guava selections (GS) viz. GS-1, GS-2, GS-3, GS-4, GS-5, GS-6, GS-7, GS-8, GS-9 and GS-10 were selected. Plants with uniform and desired fruit characteristics were tagged for further study. During Sept-Oct (2014-2017), cuttings were taken from tagged plants for further multiplication to get true to type plants. During winter season, fruits were randomly picked from the selected and tagged plants and brought to laboratory of the Institute (Latitude 31.42°N, Longitude 73.09°E, Elevation 189 m) for physiochemical analysis.

The treatments were replicated five times. The treatments and collection site for each variety are given as under;

Table. 1. Name of strains and collection site of different guava selections

S. No.	Name of strain	Collection site
1.	Guava selection-1	MauzaQiam, Ali Shah, Bhawana, District Chiniot
2.	Guava selection-2	MauzaQiam, Ali Shah, Bhawana, District Chiniot
3.	Guava selection-3	Majhi Sultan, District Jhang
4.	Guava selection-4	Chak No. 245 R B, Abbas Pur, Faisalabad
5.	Guava selection-5	Chak No. 113/RB, 6 KM North, Sangla Hills
6.	Guava selection-6	Chak No. 245 R B, Abbas pur, Faisalabad
7.	Guava selection-7	Chak No. 463 G.B. District Toba Tek Singh
8.	Guava selection-8	Khan Fruit Farm, Sham Kot, KanganPur, Kasur
9.	Guava selection-9	Haveeli Bahadur Shah, Mulwana More, Jhang
10	Guava selection-10	Mirza Pur, Nankana Sahib

Sensory evaluation was carried out by using Hedonic scale (1-9) to rate the selections for colour, flavour, taste and texture (Peryam and Pilgrim, 1957). Fruits were arranged according to replication for analysis. A panel of ten judges evaluated sensory assessment using the Hedonic scales as given below. For each replication, average score was recorded.

Hedonic scale rating

Product: _____
Variety: _____
Date: _____
Name of Judge: _____
Signature: _____

Instructions: *(Please read the instructions carefully before filling blanks*

1. This is an organoleptic analysis form for the evaluation of Guava fruit.
2. Please follow the numerical system for scoring the samples.
3. Please do not disturb the sequence of the samples provided.
4. Please wash the tongue before testing next sample with water provided.

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

Fruit weight of individual fruit was recorded using digital weighing balance (SF-400A, China) and average was calculated. Fruit length and breadth was measured with the help of Vernier calipers (mm) and fruit size (mm^2) was calculated afterwards. Fruit length was taken from base to calyx of fruit while breadth was measured from the most rounded portion of guava fruit. Similarly, core length and width were measured with Vernier caliper in mm. Seeds were counted and seed core to pulp ratio was then calculated. A total soluble solid (TSS) was measured by digital refractometer ATAGO, RS-5000 (Atago, Japan).

Experiment was laid out according to RCBD with four replications. Analysis of variance technique was employed to test the significance of data, while the least significant difference (LSD) ($P \leq 0.05$) test was used for the comparison of treatments (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Yield

The results (Fig.1) indicated that all selections differed statistically in yield potential from each other. Maximum fruit yield was obtained in GS-3(75.50 kg/tree) followed by GS-7 (66.75 kg/tree) and GS-2 (65.5 kg/tree) which are at par with each other. GS-10 gave minimum fruit yield (31.50 kg/tree) among all selections. These results corroborate the study of Babu *et al.* (2007) from north eastern region of India who reported yield variation among different strains of guava.

Morphological characteristics of 10 guava strains were depicted in Table 2. These characters have impact during selection of any strain. GS-1 is oblate, GS-2 is pyriform and GS-8 is obvate and these shapes are most pronounced in all strains with some differcences. Flesh colour in GS-3, GS-5 and GS-9 has red pigmentaiton that might be industry orinted. These characters can fetch good market value.

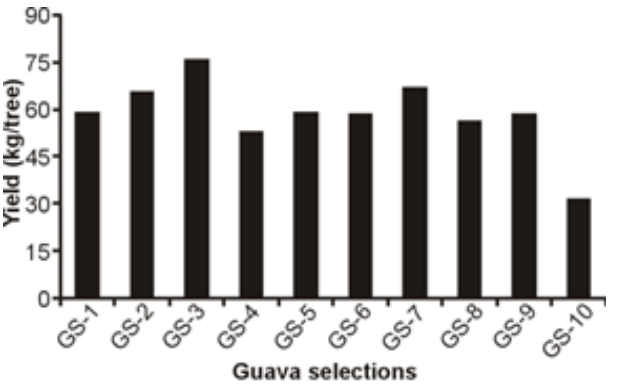

Fig. 1. Yield of different guava selections

Table 2. Shape, colour of fruit and flesh of different selections guava

Name of variety	Colour of fruit	Colour of flesh	Shape of fruit
Guava selection-1	Yellowish	Whitish	Oblate
Guava selection-2	Yellowish	Whitish	Pyriform
Guava selection-3	Yellowish with red tints	Yellowish	Pyriform with broader bottom
Guava selection-4	Greenish yellow	Reddish	Oblate to round
Guava selection-5	Reddish Yellow	Whitish	Oblate to round
Guava selection-6	Yellowish to off white	Whitish	Narrow obovate
Guava selection-7	Yellowish	Whitish	Pyriform
Guava selection-8	Greenish yellow	Reddish	Obovate with ridges
Guava selection-9	Yellow with Red blush	Whitish	Pyriform with unclear neck
Guava selection-10	Yellowish to off white	Whitish	Oblate

Pictorial presentation of guava strains

Sensory evaluation

Sensory evaluation is an important assessment of fruit quality conducted to evaluate consumer's preference or market trend.

Fruit colour: The data (Table 3) of sensory evaluation, indicate that maximum score (8.50) for fruit colour was exhibited by GS-5 which was at par with GS-3 (8.00). Minimum rating (4.25) for fruit colour was observed in GS-8 and GS-4 that are at par with each other. Fruit colour is the main criteria considered by consumer before purchase and it results in degradation of chlorophyll and increase in the concentration of carotenoids (Abreu *et al.,* 2012).

Taste: Regarding taste, maximum score (9.00) was obtained by GS-1 followed by GS-3 (8.75) while GS-6 had minimum score (5.50) among all selections (Table 3). As GS-1 got higher rating, this might be new introduction in guava industry and its demand may be increased if accepted by consumers.

Flavour: Guava has strong aroma that contributes to flavor. GS-3 scored highest rating (9.00) for flavour followed by GS-5 (8.75) and GS-8 (8.00) (Table 3). Flavour of any fruit depends upon the sugar, carbohydrates, aromatic compounds, polysaccharides and phenolic compounds (Saleem *et al.,* 2008). Thus it was observed that GS-3, 5 and 8 showed better flavour as compared to other guava selections (Table 3).

Texture: Related to fruit texture, all selections exhibited significant difference at 5% level of significance. Maximum rating (8.75) was attained by GS-3 followed by GS-1 (7.75) and minimum value (5.00) was obtained by GS-6 (Table 3). Thus GS-3 was better in respect to texture of guava fruits showing better quality as compared to other guava selections.

Table 3. Sensory evaluation of guava selections

Treatments	Colour (Score)	Taste (Score)	Flavour (Score)	Texture (Score)
GS-1	5.25cd	9.00a	7.50bcd	7.75ab
GS-2	6.25bc	7.25bc	6.25de	7.00bcd
GS-3	8.00a	8.75a	9.00a	8.75a
GS-4	4.25d	7.00bc	7.75abc	6.25cd
GS-5	8.50a	7.75ab	8.75ab	7.25bc
GS-6	5.25cd	5.50d	6.25de	5.00e
GS-7	6.00bc	8.00ab	6.25de	6.00de
GS-8	4.25d	7.00bc	8.00abc	6.00de
GS-9	7.00ab	6.25cd	5.00e	7.00bcd
GS-10	6.00bc	7.75ab	7.00cd	7.25bc

Any two means not sharing a common letter are significant at 5% level of probability

Physiochemical parameters

Fruit Length: Data presented in Table 4 indicate that fruit length ranged from 94.38 to 53.78 mm. Selection GS-7 have maximum fruit length (95.37 mm) followed by GS-2 (94.38 mm) and GS-3 (90.95 mm). These results are in line with those of Singh *et al.,* (2016) who reported fruit length of different guava selections ranging from 52.6 mm in MPUAT to 72.1 mm in Sarbati.

Fruit width: Fruit width exhibited significant differences, where maximum fruit width was observed in GS-3 (83.67 mm) and minimum (54.73 mm) in GS-5 (Table 4). In earlier study, best reported guava genotype had 73.6 mm fruit diameter (Mahmoud and Peter, 2014).

Fruit size: Fruit size also exhibited significant differences where maximum fruit size was observed in GS-3 (7606.7 mm^2) (Table. 4). Minimum fruit size (3094.9 mm^2) was found in GS-10. Fruit size is varietal characteristic mainly controlled by genetics that can be helpful in evaluating new varieties. Fruit of different sizes can have different markets according to their usage.

Fruit weight: Fruit weight also exhibited significant differences among all selections at 5% level of significance (Table 4). The values reflected a range of fruit weight from 258.75 to 101 g. Maximum fruit weight was observed in GS-3 (258.75 g) followed by GS-2 (170 g) and GS-6 (152.25 g) both of which are at par with each other. GS-10 showed minimum fruit weight and falls under the category of small size. These results are in line with findings of Jana *et al.* (2009) who reported maximum fruit weight in Chittidar (174.33 g) and Allahbad Safeda (242.4 g) during rainy and winter season. However, Padilla-Ramírez *et al.* (2007) studied 12 selections having a range of fruit weight 37.4 to 76.1 g/fruit from the Calvillo-Cañones Region, México.

Core length and width: From statistical analysis, it was observed that core length and width was significantly different for different selections. Maximum core length (47.13 mm) was found in GS-3 followed by GS-6 (46.51 mm) and GS-7 (46.42 mm). Minimum core length (26.51 mm) was observed in GS-10.In case of core width, GS-7 had maximum value (46.26 mm) followed by GS-8 (39.94 mm) and GS-6 (33.48 mm) (Table 4).

Table 4. Physiochemical characteristics of guava selections

Treatments	Fruit Length (mm)	Fruit width (mm)	Fruit size (mm^2)	Fruit weight (g)	Core length (mm)	Core width (mm)	Core size (mm^2)	Number of Seed	Seed core: pulp
GS-1	60.14f	57.41d	3452.2fg	112.75de	30.792d	27.88d	859.1f	177.50c	25.05c
GS-2	94.38ab	60.35cd	5690.2c	170.00b	29.41d	23.10e	587.3g	102.00e	10.33e
GS-3	90.95bc	83.67a	7606.7a	258.75a	47.13a	34.03 c	1605.2b	95.00e	21.30cd
GS-4	70.16e	57.05d	4003.6e	109.25de	43.28b	28.12d	1215.4d	178.25c	21.30cd
GS-5	60.79f	54.73d	3324.8g	114.75cde	33.70c	29.83d	1005.6e	236.75a	30.49ab
GS-6	89.02c	59.93cd	3324.8g	152.25b	46.15a	33.48c	1546.0b	136.00d	28.98b
GS-7	95.37a	67.19b	6410.5b	134.75bcde	43.42b	46.26a	2009.2a	199.00c	28.98b
GS-8	61.34f	64.20bc	3939.6ef	146.50bcd	33.48c	39.94b	1336.8c	127.75d	33.98a
GS-9	83.48d	58.03d	4844.0d	151.65bc	34.95c	15.25g	532.9g	230.25b	11.03e
GS-10	53.78g	57.38d	3094.9g	101.00e	26.51e	23.107e	612.3g	250.00b	19.96d

Any two means not sharing a common letter are significant at 5% level of probability

Core size: Core size was found maximum in GS-7 (2009.2 mm^2) followed by GS-3 (1605 mm^2) while GS-9 showed minimum (532.9 mm^2) core size.

Seed number: The analyzed data showed statistically highly significant difference among various selections. GS-5 excelled in seed number (236.75) while GS-3 was found to be low seeded (95.00) (Table 4). Similarly, Singh *et al.* (2016) found a range of seeds i.e. 128-194/100 g fruit in seven varieties of guava where Shweta was documented as low seeded and Sarbati as high seeded varieties.

Seed core to pulp ratio: Seed core to pulp ratio is an important parameter in determination of fruit usage. All selected varieties found significantly different from each other regarding seed core to pulp ratio (Table 4). Pertaining to seed core to pulp ratio, guava selection 2 (GS-2) showed minimum value (10.33) which was at par with GS-9 (11.03). However, GS-8 had maximum value for seed core to pulp ratio (33.98) followed by GS-5 (30.49). For processing industry, varieties having small seed core are desirable as compared to those having seed core. In earlier studies of Singh *et al.,* 2016 and Allahbad Safeda accounted for maximum pulp thickness followed by L-49 and red fleshed.

Total soluble solids (TSS): Total soluble solids are an important parameter that not only determines fruit quality by influencing its taste but also one of the important maturity indices. Data presented in Fig.2 revealed that TSS is highly significant for various guava selections. Among all selections, maximum TSS (15.8 °Brix) was observed in GS-5 followed by GS-8 and GS-10 having 14.5 °Brix and 14.1 °Brix TSS respectively. Similarly, Pandey *et al.* (2007**)** found 15.67 °Brix TSS in Hisarsurkha, newly developed hybrid.

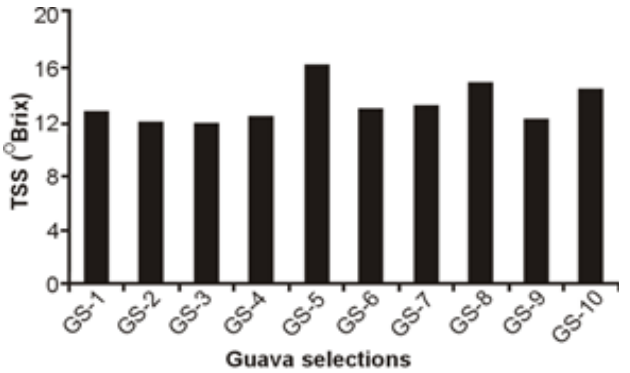

Fig. 2. Total soluble solids of different guava selection

CONCLUSION

The study concludes that among all selections, GS-3 gave maximum yield, fruit weight, fruit size with maximum rating for flavor and texture. This strain also remained low seeded as compared to other strains while maximum TSS was found in GS-5. In future, it is possible that GS-3 strain would be desirable for processing industry as it is low seeded. As GS-5 has highest value of TSS, it might become more likeable for fresh consumption. It is suggested to conduct further studies on these strains to cultivate them on commercial basis.

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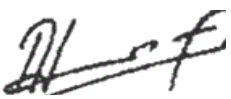
2.	Nida Mahreen	Reviewed the literature and wrote-up manuscript	
3.	Muhammad Ashfaq	Provided guidance during research	
4.	Muhammad Maaz Aziz	Analyzed the data	
5.	Javed Iqbal Gill	Conducted survey for selection and maintenance of strains.