

# STUDIES ON PHYSICO-CHEMICAL CHANGES DURING FRUIT GROWTH AND DEVELOPMENT IN DIFFERENT VARIETIES OF GUAVA (*PSIDIUM GUAJAVA* L.)

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## KEYWORDS

Guava  
Growth  
Development  
Physical parameters  
Chemical parameters  
Best variety

Received on :  
03.09.2015

Accepted on :  
25.03.2016

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## ABSTRACT

An investigation on physico-chemical changes in fruits of three varieties of guava viz., Allahabad Safeda, L-49 and Red Guava during growth and development was observed. At maturity there was an increase in physical characters like length, diameter, weight, moisture content except fruit firmness which decreased. Allahabad Safeda recorded significantly highest fruit length (6.90 cm) and diameter (7.32 cm) at maturity. The moisture at maturity ranges between 71.08 to 75.42%. Quality parameters such as TSS (13.58° Brix) and total sugar (12.37%), ascorbic acid (282.3 mg/ 100 gm) was found highest in Allahabad Safeda. L-49 had significantly low acidity (0.35%) as compared to Red Guava (0.46%) and Allahabad Safeda (0.39%), respectively. Allahabad Safeda ranked first and performed better in most of the growth and physical parameters as well as chemical composition.

## INTRODUCTION

Guava (*Psidium guajava* L.) the apple of the tropics is one of the most common fruit in India. It claims to be the fourth most important fruit in terms of area and production after mango, banana and citrus. It is believed to have been introduced in India during the early 17<sup>th</sup> century, and it occupies nearly 234.05 thousand ha producing 2660.76 thousand MT (Anon. 2012-13). It is a rich source of vitamin C (260 mg/100g of fruit pulp). Plant growth, yield and physico-chemical attributes are important parameters to study the variability among the different fruit crops (Pandey *et al.*, 2007). The information on physico-chemical changes during growth and development of guava fruits are scanty and it is an essential factor to evaluate the different varieties and also as stated by Mattiuz *et al.*, 1997 that the knowledge of guava fruiting cycle will assist us in obtaining relevant datum for the application of cultural practices the following study was undertaken.

## MATERIALS AND METHODS

The study was carried out at Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand during April, 2013 on six year old trees of Allahabad Safeda, L-49 and Red Guava. Six healthy and uniform trees of each variety were selected and tagged. Flower buds which opened simultaneously were tagged during the mrig flowering season.

The first sampling was done 20 days after fruit set. Subsequent samples were collected at an interval of 20 days interval upto 140 days after fruit set in all the three varieties. Completely randomized block design was used and there were six replications for each variety and from each variety five fruits were selected and evaluated for physical and chemical parameters on each sampling.

### Physical changes

The sampled fruits were washed and weighed and their volume was measured by water displacement method. The length and diameter of the fruit was measured by vernier calliper. Change in colour was noted visually, specific gravity was calculated from fruit volume and weight values and fruit firmness was measured using penetrometer. The sample fruits were dried in oven at 90°C temperature for 24 hrs and moisture percentage was measured from the dry weight and fresh weight.

The moisture percentage was calculated by using the following formula.

$$\text{Moisture(\%)} = \frac{\text{Fresh fruit wt(g)} - \text{Dry fruit wt}}{\text{Fresh fruit wt(g)}} \times 100$$

### Biochemical changes

The total soluble solids were determined using hand refractometer. The acidity, sugars and ascorbic acid content in the sample were determined using method described by

Ranganna (1979).

## RESULTS AND DISCUSSION

### Physical Parameters

Physical parameters like weight, volume, specific gravity, length, diameter and colour of fruit were significantly influenced by the varieties of guava and increased with advancement of growth period. At maturity Allahabad Safeda recorded significantly the highest fruit length (6.90 cm) followed by Red Guava (6.40 cm) and minimum in variety L-49(5.93 cm). The data on fruit diameter was significantly maximum in Allahabad Safeda (7.32 cm) followed by Red Guava (6.71 cm) and L-49(6.31 cm) (Table 1). However the increment in the length and diameter of fruit in all the varieties was similar so ratio of fruit length: diameter was non significant

and ranged 0.98- 1.07 up to 80 DAFS. It decreased to 0.92-0.96 after 80 DAFS indicating greater increase in fruit diameter than length. The variety Allahabad Safeda recorded the highest fruit weight (151.3 g) followed by the Red Guava (127g), and minimum in L-49 (115 g) Table 1. Similar trend was also noted for fruit volume, where the variety Allahabad Safeda had the highest fruit volume (152.7 ml) followed by Red Guava (129.5 ml) and minimum in L-49 (118.8 ml) Table 1. The increase in volume may be due to an increment in intercellular space with advancement of fruit growth as stated by Baker and Davis (1951). The specific gravity was not significantly influenced by the varieties but it showed a decreasing trend with the advancement of maturity. In stage 1 and stage 2 *i.e.* till 100 DAFS, the specific gravity ranged between 1.14- 1.00. After 100 DAFS *i.e.* at 120 and 140 DAFS it decreased and ranged between 0.98- 0.97 (Table 1).

**Table 1: The periodical weight, volume, specific gravity, length, diameter and fruit firmness of guava fruit as influenced by different varieties during their growth and development**

DAFS	Weight(g)			Volume (ml)			Specific gravity			C.D		
	A.S	L-49	R.G	(0.05)	A.S	L-49	R.G	(0.05)	A.S	L-49	R.G	(0.05)
20	6.31	4.41	5.95	0.28	5.93	4.06	5.60	0.29	1.14	1.14	1.14	N.S
40	26.25	21.00	26.00	1.82	25.13	19.93	24.96	1.94	1.06	1.08	1.06	N.S
60	35.32	29.15	34.38	2.88	33.81	27.12	33.01	2.76	1.10	1.04	1.05	N.S
80	46.67	35.27	41.46	6.33	44.98	33.46	40.30	5.02	1.06	1.04	1.07	N.S
100	79.18	57.95	77.85	1.50	80.28	61.73	78.04	6.81	1.00	1.01	1.00	N.S
120	118.6	98.83	112.7	5.81	119.9	100.7	113.5	2.88	0.98	0.97	0.99	N.S
140	151.3	115.0	127.0	7.29	152.7	113.5	129.5	3.03	0.98	0.97	0.98	N.S

DAFS	Lenght (cm)			C.D (0.05)	Diameter (cm)			C.D (0.05)	Fruit firmness kg/ cm <sup>2</sup>			C.D (0.05)
	A.S	L-49	R.G		A.S	L-49	R.G		A.S	L-49	R.G	
20	1.11	1.13	1.04	N.S	1.09	1.12	1.01	N.S	-	-	-	-
40	2.43	2.18	2.04	0.27	2.35	2.16	2.03	0.22	-	-	-	-
60	2.80	2.33	2.67	0.21	2.75	2.35	2.61	0.20	-	-	-	-
80	3.24	2.86	2.95	0.25	3.28	2.84	2.99	0.26	-	-	-	-
100	4.95	3.90	4.67	0.44	5.23	4.31	4.97	0.45	13.31	13.34	13.23	N.S
120	6.20	5.40	5.88	0.51	6.60	5.68	6.11	0.39	8.80	7.93	7.98	N.S
140	6.90	5.93	6.48	0.41	7.32	6.31	6.71	0.44	1.52	1.51	1.52	N.S

A.S: Allahabad Safeda, R.G: Red Guava, C.D: Critical difference, DAFS : days after fruit set, NS : non significant

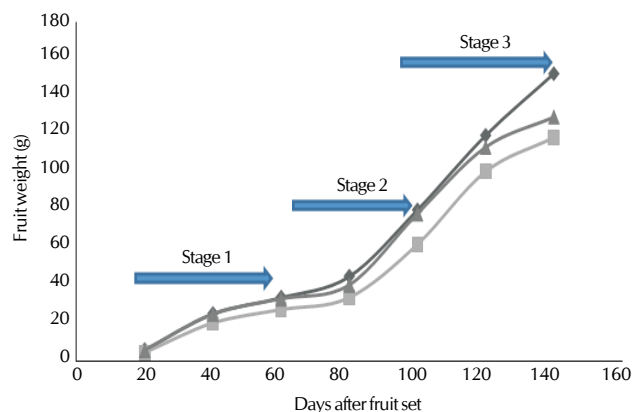
**Table 2: The periodical moisture content, TSS, ascorbic acid, total sugars, reducing sugars and non-reducing sugar (%) of guava fruit as influenced by different varieties during their growth and development stages**

DAFS	Moisture (%)			C.D(0.05)	TSS (%)			C.D(0.05)	Ascorbic acid (%)			C.D(0.05)
	A.S	L-49	R.G		A.S	L-49	R.G		A.S	L-49	R.G	
20	19.01	18.32	19.09	N.S	6.03	5.90	5.98	N.S	25	22.16	19.50	1.28
40	26.76	24.86	23.58	1.51'	6.03	6.18	6.03	N.S	48.58	46.43	41.43	2.00
60	34.60	32.05	31.24	2.18	7.18	6.95	6.70	0.22	96.95	81.03	78.47	7.42
80	53.38	50.19	48.51	3.10	7.70	7.51	7.45	0.18	133.4	122.8	119.7	7.94
100	64.43	61.42	60.44	2.10	9.45	9.30	9.11	0.17	190.0	177.5	158.2	7.42
120	69.61	67.36	66.26	1.81	10.54	10.05	9.42	0.52	253.0	235.3	218.8	12.56
140	75.42	72.96	71.08	1.80	13.58	13.38	11.66	1.22	282.3	261.5	227.0	18.94

DAFS	Total sugar(%)			C.D (0.05)	Reducing sugar(%)			C.D (0.05)	Acidity (%)			C.D (0.05)
	A.S	L-49	R.G		A.S	L-49	R.G		A.S	L-49	R.G	
20	6.65	0.65	0.61	N.S	-	-	-	-	0.38	0.30	0.39	0.03
40	1.04	1.02	1.01	N.S	0.68	0.66	0.54	0.02	0.39	0.31	0.41	0.03
60	2.00	1.82	1.19	0.21	1.52	1.43	0.82	0.09	0.40	0.36	0.46	0.04
80	5.37	4.92	3.83	0.37	3.53	3.13	2.92	0.21	0.46	0.39	0.52	0.05
100	6.43	5.96	5.25	0.36	3.90	3.72	3.11	0.16	0.49	0.42	0.56	0.05
120	9.20	8.88	7.76	0.25	5.33	5.10	4.89	0.20	0.43	0.39	0.49	0.04
140	12.3	11.69	10.31	1.10	7.99	7.58	6.96	0.24	0.39	0.35	0.46	0.04

A.S: Allahabad Safeda, R.G: Red Guava, C.D: Critical difference, DAFS: days after fruit set, NS : non significant



**Figure 1: The periodical weight (g) of guava fruit in different varieties during their growth and development stages**

The first visible signs of change in colour were observed when the fruit attained 100 days old, the skin became perceptibly lighter in colour. The light green colour of the skin then changed to greenish yellow followed by pale greenish yellow at maturity in varieties Allahabad Safeda and L-49 as compared to Red Guava. This change is attributed to the disappearance and unmasking of chlorophyll and appearance of carotenoid pigments with maturity.

Fruit firmness decreased at maturity. The immature fruit had very high texture and so readings could not be recorded with the available pressure tester. Therefore reading was possible after 100 DAFS. Fruit showed declining values with progressive ripening but all the varieties exhibited non significant values in fruit firmness. Bulk *et al.* (1995) suggested that cellulose, in addition to pectin enzymes may contribute to the softening of fruit.

The moisture content in fruit increased with the development of fruit in all the varieties and at maturity it was significantly highest in the variety Allahabad Safeda (75.42%) followed by Red Guava (72.96%) and L-49 (71.08%) (Table 1). The high percentage of moisture in the fruit during maturity indicates there was greater accumulation of water, which increased the cell turgidity and cell size.

### Biochemical parameters

#### Total soluble solids

The TSS at initial stage of fruit growth was less but with the advancement of growth period, there was gradual increase in TSS. At maturity Allahabad Safeda recorded significantly the highest TSS (13.58°Brix) followed by L-49 (13.18°Brix) and Red Guava (11.66°Brix) (Table2). The increase in TSS could be attributed to the fact that the reserved food stored in the form of poly-saccharides is depolymerised and starch is converted to simple sugars by various hydrolysing enzymes. Similarly rise in TSS was also observed in guava by Bulk (1995), Dubey *et al.* (2009).

#### Total sugars

The total sugars content showed an increasing trend with the development of the fruit. At maturity total sugars was higher in Allahabad Safeda (12.37 %) which was at par with L-49 (11.69 %) and the lowest in Red Guava (10.31 %) (Table2). Similar results reported by Dhillon (2007) in pear fruit, in mango by

Wongmetha *et al.* (2015). There was an increase in reducing sugar content in fruit during its growth and development. At maturity stage significantly the maximum reducing sugar was recorded by the variety Allahabad Safeda (7.99%) followed by L-49 (7.58%) and Red Guava (6.96 %) (Table2). Increase in reducing sugar can be attributed to enzymatic conversion of starch into sugar (Kumar *et al.*, 2015). The non reducing sugar also followed a similar trend.

#### Titrateable acidity

The titrateable acidity was increased gradually upto 100 DAFS and then it exhibited a declining trend till the maturity (Fig 2). Significantly the maximum acidity was observed in Red Guava (0.46%) followed by Allahabad Safeda (0.39%) and L-49 (0.35%) which were at par (Table2). Similar behavior for acidity was recorded by Nag *et al.* (2011).

#### Ascorbic acid

Ascorbic acid increased with an advancement of fruit maturity and ripening due to active synthesis of ascorbic acid during development and early ripening which might be attributed to inactivation of ascorbic acid oxidase due to high content of phenols (Hedge and Charria, 2004). At maturity, significantly the maximum ascorbic acid content was recorded by the variety Allahabad Safeda (282.3 mg/ 100 gm) followed by L-49 (261.5mg/100 gm) and Red Guava (227.0 mg/100 gm) (Table 2).

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