International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 1221-1223

Received: 14-07-2017
Accepted: 16-08-2017

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Evaluation of different papaya genotypes for quality and biochemical changes under middle Gujarat conditions

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Abstract
An experiment was conducted at Horticulture research farm, B.A. College of Agriculture, AAU, Anand (Gujarat) to evaluate 12 genotypes, during the year 2014-15 and 2015-16. Results revealed from the pooled base that maximum fruit firmness at the time of harvest and at the time of biochemical analysis was found in genotype V_7 (GAP 7). The highest total soluble solids, reducing sugar, non-reducing sugar, total sugar, minimum PLW and maximum shelf life were recorded in genotype V_4 (Madhu Bindu).The significantly maximum total carotenoid content was measured in genotype V_1 (Pusa Nanha) while, the highest ascorbic acid content was recorded in V_8 (GAP 10).Lowest fruit cavity index was observed in genotype V_9 (GAP 12) while, minimum fiber content was detected in genotype V_6 (GAP 6) .Organoleptically the higher score for taste was observed with genotype V_4 (Madhu Bindu) while, higher score for fruit flavour was observed with V_9 (GAP 12) and colour was found in genotype V_6 (GAP 6). Overall acceptability score was observed higher with genotype V_7 (GAP 7).

Keywords: papaya, biochemical changes, quality parameters.

Introduction
Papaya (*Carica papaya* L.), belonging to the family Caricaceae, is one of the most important fruits cultivated throughout the tropical and subtropical regions of the world. It is widely believed that papaya originated in the Caribbean Coast of Central America, ranging from Argentina Chile to Southern Mexico. Recently another taxonomic revision was proposed and supported by molecular evidence that genetic distances were found between papaya and other related species (Kim *et al.*, 2002) [9]. Some species were formerly assigned to *Carica* family classified in the genus *Vasconcella* (Badillo, 2001) [2]. Accordingly, the classification of *Caricaceae* has been revised to comprise *Cylicomorpha*, *Carica*, *Jacaratia*, *Jarilla*, *Horovitzia*and*Vasconcella*, with *Carica papaya* being the only species within the genus *Carica* (Badillo, 2001) [2].

Papaya has gained more importance owing to its high palatability, fruitability throughout the year, early fruiting, highest productivity per unit area and multifarious uses like food, medicine and industrial input. Being highly remunerative and short duration fruit crop, it has a tremendous impact on economic and nutritional propitiations (Saran and Choudhary, 2013) [15]. It needs plentiful rainfall or irrigation but must have good drainage. Papayas grow and produce well in a wide variety of soils. The plant often develops a strong taproot shortly after planting. Papaya is also important for its fruit which ranks onlysecond in terms of daily consumption in South East Asia (OECD, 2005) [12] and is an excellent source of essential nutrients such as Iron, Calcium, Vitamin B and C. Besides, it is an abundant source of carotene (2020 IU/100 g) and precursor of vitamin A (USDA, 2009) [18]. Generally ripe fruit is used for table purpose, while mature fruits are being utilized in the preparation of candy or tooty fruity and jam. Ripe fruits are also used in preparation of ready to serve papaya juice, drink mixed jam and toffee.

Farmers of middle Gujarat region have shown interest in cultivation of papaya due to ease and convenience in its raising as the crop is short duration. Farmers facing serious problems to procure seeds of improved varieties of papaya for commercial cultivation and they buy seeds from private agency without any surety of their genotype. Some cultivars like Madhu Bindu and Taiwan Red Lady are under cultivation in Middle Gujarat. A number of varieties have been released by institutes and universities across the country. A need was felt to evaluate them for their performance under Middle Gujarat conditions. Keeping in view the foregoing consideration, investigation was conducted for constant two seasons.

Materials and Methods

Twelve genotypes of papaya (*Carica papaya* L.) were screened for present investigation (Table 1). at Horticultural Research Farm, Department of Horticulture, B.A. College of Agriculture,Anand Agricultural University,Anand during the years 2014-15 and 2015-16. The experiment was laid out in Randomized Block Design with three replications. The seeds of different genotypes of papaya were sown in polythene bags to raise the seedlings under control condition. Seeds were treated with carbendazim before sowing. The pits of 30 × 30 × 30 cm in dimensions were dug at the spacing of 2.5 × 2.5 metre each way. The seedlings having uniform growth of about 20 to 30 cm height was selected for transplanting. One seedling of gynodioecious genotypes while, three seedling of dioecious genotypes were transplanted in each pit at the spacing of 15 cm apart in a triangular fashion. The chemical analysis for estimating reducing, non- redicung and total sugars was done by titrametric methods of Lane and Eynon described by Ranganna (1979) [14]. TSS were determined by hand Refractometer. The various parameters for acceptability of papaya genotypes were determined by mean score procedure of organoleptic test (0-9 score). Statistical analysis was done as per procedure described by Panse and Sukhatme (1985) [13].

Table 1: Genotypes of papaya

Sr. No.	Genotype name	Sr. No.	Genotype name
1.	PusaNanha	7.	GAP 7
2.	PusaDwarf	8.	GAP 10
3.	Pune Selection 3	9.	GAP 12
4.	MadhuBindu	10.	GAP29
5.	CO 8	11.	GAP30
6.	GAP 6	12.	GAP 31

Result and Discussion

The data concerning to various quality attributes clearly indicated that the differential response obtained due to different genotypes of papaya. Pooled analysis given for biochemical characters of papaya in Table 2. The data concerning to various quality attributes clearly indicated that the differential response obtained due to different genotypes of papaya. Pooled analysis given for biochemical characters of papaya in Table 2.The highest fruit firmness at harvest (9.45 kg/cm^2) and at the time of biochemical analysis (6.51 kg/cm^2) were noticed in genotype V_7 (GAP 7).The genotype V_4 (Madhu Bindu) exhibited significantly highest TSS (12.67 ^{0}Brix), reducing sugar (8.01), non-reducing sugar (1.08) and total sugar (9.09). While, maximum carotenoid content (2.92 mg/ 100 g pulp) was found in genotype V_1 (Pusa Nanha) and ascorbic acid content (38.11 mg/ 100 g pulp) was foundwith V_8 (GAP 10).

Table 2: Effect of different papaya genotypes on biochemical parameters (Two years pooled data)

Tr. No.	Genotypes	Fruit firmness (kg/cm^2) at the time of harvest	Fruit firmness (kg/cm^2)at the time of biochemical analysis	TSS (^{0}Brix)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Total carotenoid content (mg/100g pulp)	Ascorbic acid content(mg/100 g)
V_1	PusaNanha	5.39	4.32	10.97	7.01	0.94	7.95	2.92	24.13
V_2	PusaDwarf	7.81	5.71	9.76	7.43	0.96	8.40	2.87	28.12
V_3	Pune Selection 3	7.30	6.22	9.11	6.47	0.93	7.40	1.87	28.31
V_4	MadhuBindu	6.25	4.57	12.67	8.01	1.08	9.09	1.97	30.06
V_5	CO 8	5.53	3.77	8.69	6.25	0.94	7.18	1.78	25.30
V_6	GAP 6	6.56	4.19	7.93	6.59	0.95	7.54	1.64	27.00
V_7	GAP 7	9.45	6.51	8.07	6.30	0.92	7.21	1.64	27.42
V_8	GAP 10	6.66	4.06	8.99	6.90	0.87	7.76	1.45	38.11
V_9	GAP 12	7.38	5.07	8.32	6.53	0.84	7.37	1.59	28.85
V_{10}	GAP 29	8.26	5.42	9.59	6.48	0.90	7.38	1.66	27.58
V_{11}	GAP 30	6.51	4.52	12.59	7.72	0.96	8.68	1.60	29.23
V_{12}	GAP 31	7.43	5.43	11.31	7.33	0.92	8.25	1.85	32.76
T	S.Em ±	0.09	0.11	0.11	0.17	0.02	0.17	0.06	0.53
	C. D. (P =0.05)	0.27	0.30	0.30	0.48	0.04	0.47	0.17	1.50
Y×T	S.Em ±	0.15	0.16	0.17	0.27	0.02	0.26	0.09	0.75
	C. D. (P =0.05)	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %		3.58	5.65	2.93	6.65	4.37	5.74	8.59	4.47

Table 3: Effect of different papaya genotypes on quality parameters (Two years pooled data)

Tr. No.	Genotypes	Fruit cavity index (%)	Fiber content (%)	Physiological loss in weight (%)	Shelf life (days)	Taste (Score)	Flavour (Score)	Colour (Score)	Overall acceptance (Score)
V_1	PusaNanha	22.18	12.53	8.87	5.61	5.17	5.33	6.00	5.50
V_2	PusaDwarf	26.96	13.00	9.14	5.64	5.33	5.00	5.83	5.17
V_3	Pune Selection 3	29.51	12.81	8.59	4.77	4.33	4.50	6.17	4.50
V_4	MadhuBindu	26.95	12.29	8.22	6.34	6.50	5.17	6.00	5.33
V_5	CO 8	33.80	12.39	11.51	3.71	4.00	3.83	5.17	4.00

V_6	GAP 6	26.53	11.09	10.59	4.00	6.00	5.50	6.67	5.00
V_7	GAP 7	22.93	12.63	9.80	4.33	5.33	5.33	6.00	6.00
V_8	GAP 10	28.81	12.90	8.65	5.87	5.33	5.33	5.67	5.33
V_9	GAP 12	21.48	12.96	9.70	4.38	5.83	5.83	5.83	5.83
V_{10}	GAP 29	24.74	13.90	9.36	4.14	5.67	5.83	6.33	5.83
V_{11}	GAP 30	36.95	12.98	9.40	4.09	5.33	5.00	5.67	4.83
V_{12}	GAP 31	22.88	13.20	10.39	4.99	4.83	4.67	4.83	4.83
T	S.Em ±	0.73	0.12	0.34	0.18	0.48	0.49	0.37	0.46
	C. D. (P =0.05)	2.10	0.35	0.96	0.51	1.36	NS	NS	NS
Y×T	S.Em ±	1.07	0.18	0.48	0.25	0.63	0.64	0.56	0.63
	C. D. (P =0.05)	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %		6.87	2.40	8.70	9.13	20.48	21.76	16.55	21.07

The Pooled data analysis given for quality attributes of papaya in Table 3.The lowest fruit cavity index (21.48%) was observed in genotype V_9 (GAP 12) and minimum fiber content (11.09 %)was recorded in V_6 (GAP 6). The minimum PLW (8.22%) andmaximum shelf life (6.34 days) were observed in genotype V_4 (Madhu Bindu). Thebetter taste 6.50 score was recorded with V_4 (Madhu Bindu) while in flavour, colour and overall acceptance the data were observed non-significant differences among the different genotypes. However, numerically higher value of flavour, colour and overall acceptancewas found in genotype V_9 (GAP 12), V_6 (GAP 6) and V_7 (GAP 7) respectively.

Most of the significant variations were found among the genotypes of papaya for qualitative attributes is might be based on the fact that every genotypes has its own nature in development of fruits which may be varied due to various physiological phenomenon *viz.* photosynthetic efficiency, rate of translocation of photosynthates from source to sink and photo-respiration that takes place in the plant body. Different genotypes had differential response to varied environmental factors. The results are in close conformity with the findings of Dinesh *et al.* (2000) [5], Das and Dinesh (2004) [4], Kavitha *et al.* (2005) [8], Singh *et al.* (2005) [17], Jana *et al.* (2010) [7], Meena *et al.* (2010) [10], Meena *et al.* (2012) [11], Ara *et al.* (2013) [1], Jambhale *et al.* (2014) [6], Saran *et al.* (2015) [16] and Chalak *et al.* (2016) [3].

Thus, varieties Madhu Bindu,Pusa Nanha, GAP 12, GAP 6 and GAP 7were found more convenient for quality attributing parameters and overall acceptance of papaya.

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