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Development of Papaya squash blended with Pineapple, Pomegranate and Banana

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Abstract
The present research entitled "Development of papaya squash blended with pineapple, pomegranate and banana" was carried out during 2020-21 at Post Harvest Technology Laboratory, College of Horticulture, Rajendranagar, Hyderabad, Telangana. The experiment was laid in a Completely Randomized Design (CRD), composed of seven treatments and three replications*Viz.*,T_1-papaya 75% + pineapple 25%, T_2-papaya 50% + pineapple 50%, T_3-papaya 75% + pomegranate 25%, T_4- papaya 50% + pomegranate 50%, T_5- papaya 75% + banana 25%, T_6 - papaya 50% + banana 50% and T_7- papaya 100%. Among the different treatments papaya 50% + pineapple 50% (T_2) recorded the maximum organoleptic score *i.e.*, colour appearance (8.10), consistency (8.00), flavour (8.50), taste (8.50), mouth feel (8.32) and overall acceptability (8.11) and with preferable TSS (45.04°Brix), pH (3.20), titrable acidity (1.28%), ascorbic acid (37.30mg/100g), reducing sugars (8.26%) and total sugars (36.33%) respectively. Among the different squash blends T_2 -papaya 50% + pineapple 50% had attained the best quality and organoleptic score and it was selected as the best treatment.

Keywords: Papaya, Pineapple, Pomegranate, Banana, squash, TSS, Ascorbic Acid, Titrable acidity, Total sugars, Reducing sugars, pH

Introduction
Papaya *(Carica papaya* L.*)* is native of Tropical America and belongs to the family Caricaceae. It has now spread all over the tropical world. Papaya is popular as a common man's fruit. Papaya can provide the essential protective nutrition to the poorest section of the society. In India, papaya is grown over an area of 150.0 thousand hectares with an annual production of 6063.0 thousand MT of fruits having a productivity of 40.4 MT/ha (NHB, 2020-21). In India it is largely grown in Andhra Pradesh, Telangana, Karnataka, Maharashtra and Madhya Pradesh. In Telangana it is grown in Rangareddy, Nalgonda, Karimnagar and Khammam. In Telangana it is grown in an area of 1.18 thousand hectare and annual production of 79.27 thousand MT and productivity 66.92 MT/ha(Ministry of Agriculture and Farmers welfare, Govt. of India, Indiastat, 2018). Papaya cultivation has good economic potential especially due to its multifarious uses as fresh fruits, processed products, production of papain and pectin. Papaya contains 90.7% moisture, 0.5% protein, 0.1% fat, 8.3% carbohydrates and fair amount of vitamins A, B1, B3, B5, B7, C, E and K (Daagema, 2020) [3]. It is a rich source of three powerful antioxidants, carotenoids (Carotene, Pro vitamin A), ascorbic acid (vitamin C) & Tocopherol (Vitamin E) (Rajasekhar Pinnamaneni, 2017) [8]. Papaya is rich in fiber. Papaya is the most effective immunity booster and it has natural laxative property and it also helps in improving the metabolism. It is subjected to heavy post-harvest losses of about 40-60% (Kumar *et al.*, 2019) [7]. Developing value added products utilizing papaya would help prevent post-harvest losses and enhance its market potential. Pineapple is one of the most important tropical fruit. It is a rich source of vitamin C, vitamin A, vitamin B1, vitamin B_2 and minerals like calcium, phosphorus, and iron (Farid Hossain, 2015) [5]. The fruit also contains bromelin, a proteolytic enzyme. It provides adequate roughage to prevent constipation. It is used in processing for the preparation of squash, jam, and other beverages. The products of pomegranate such as bottled juice, syrup and jelly are appreciated due to its nutritive and dessert qualities and palatability. The arils or juice of pomegranate contains high sugar content, dietary fiber, and variable quantity of organic acids. In addition, pomegranate has been reported to be rich source of vitamins like foliate and vitamin K (USDA, 2010) [13]. Pomegranate juice is a major source of antioxidant nutrients that protect against heart diseases. The pomegranate has become popular worldwide (Syed *et al.*,

2018) [12]. Bananas have a very special place in diet, as it is low in fat and cholesterol and high in calorie, 100g of banana provides about 116 Kcal of energy. It is an excellent source of vitamin A, B6, C and D. It is rich in minerals like potassium, magnesium, phosphorus and calcium. Malic, citric and oxalic acids are the main acids of ripening banana.

Material and Methods

The present research entitled "Development of papaya squash blended with pineapple, pomegranate and banana" was carried out during 2020-21 at Post Harvest Technology Laboratory, College of Horticulture, Rajendranagar, Hyderabad, Telangana. The experiment was laid in a Completely Randomized Design (CRD), composed of seven treatments and three replications *Viz.*, T_1-papaya 75% + pineapple 25%, T_2- papaya 50% + pineapple 50%, T_3-papaya 75% + pomegranate 25%, T_4- papaya 50% + pomegranate 50%, T_5- papaya 75% + banana 25%, T_6 - papaya 50% + banana 50% and T_7- papaya 100%.

Extraction of fruit Pulp/Juice: Fruits used in the experiment were washed thoroughly twice with clean water. The outer skins were peeled with a sharp knife in case of papaya and pineapple and were cut into small pieces. In case of banana it is hand peeled and cut into small pieces and in case of pomegranate the outer skin is removed with sharp knife and cut into four halves and arils were extracted with hand. These small pieces were thoroughly homogenized in a blending machine for 10 minutes. The homogenized fruit pulp was filtered to remove any foreign material.

Papaya pulp: The well matured, firm and ripened papaya fruits were selected, washed, cleaned and hand peeled with the help of stainless steel knife and the other outer skin was removed. The fruit is cut in to two halves and seeds were removed. The fruit was chopped into small pieces and put into juice blender and obtained the pulp. The pulp was squeezed through a double layered muslin cloth and collected the juice into a stainless steel container.

Pineapple pulp: The well matured ripened fruits were selected and hand peeled with the help of stainless steel knife and the crown, rind, eyes and core was removed. Then the fruit was cut into small pieces and fed into blender for the extraction of pulp. The pulp was strained through a double layered muslin cloth in to a stainless steel container.

Pomegranate juice: The fruits were washed using tap water and were cut into four halves and arils were separated manually. The extracted arils were fed into blender for extraction of the juice. The juice was strained through double fold muslin cloth into a stainless steel container.

Banana pulp: The selected banana fruits were hand peeled and cut into small pieces and fed into a blender for extraction of the juice. The juice was strained through a double fold muslin cloth into a stainless steel container.

Preparation of papaya squash blended with pineapple, pomegranate and banana

Squash: Squash is non-alcoholic concentrated syrup that is usually fruit flavoured made from fruit juice, water and sugar or a sugar substitute. Some traditional squashes contain herbal extracts most notably elderflower and ginger. Squash must be mixed with a certain amount of water or carbonated water before drinking.It is a type of beverage commercially containing at least 25% fruit juice or pulp and 45% total soluble solid (TSS). It also contains about 1.0% acid and 350ppm sulphur dioxide or 600ppm sodium benzoate. It is diluted before serving.

Procedure for preparation of papaya blended squash: Homogenized Papaya pulp was added to the fruit pulp as per the treatments. Sugar syrup (200g/litre fruit pulp) was prepared and the syrup was strained through muslin cloth. Thereafter sugar syrup was added to the above mixture. To this blend citric acid (10g/litre fruit pulp) was added to all the treatments. The 200 ml bottles used for filling were thoroughly washed and sterilized. Further the prepared squash was filled into the bottles upto the neck portion leaving a small gap. The filled in bottles were capped and subjected to chemical and organoleptic evaluation. The process of preparation of papaya blended squash is presented in the following flow chart.

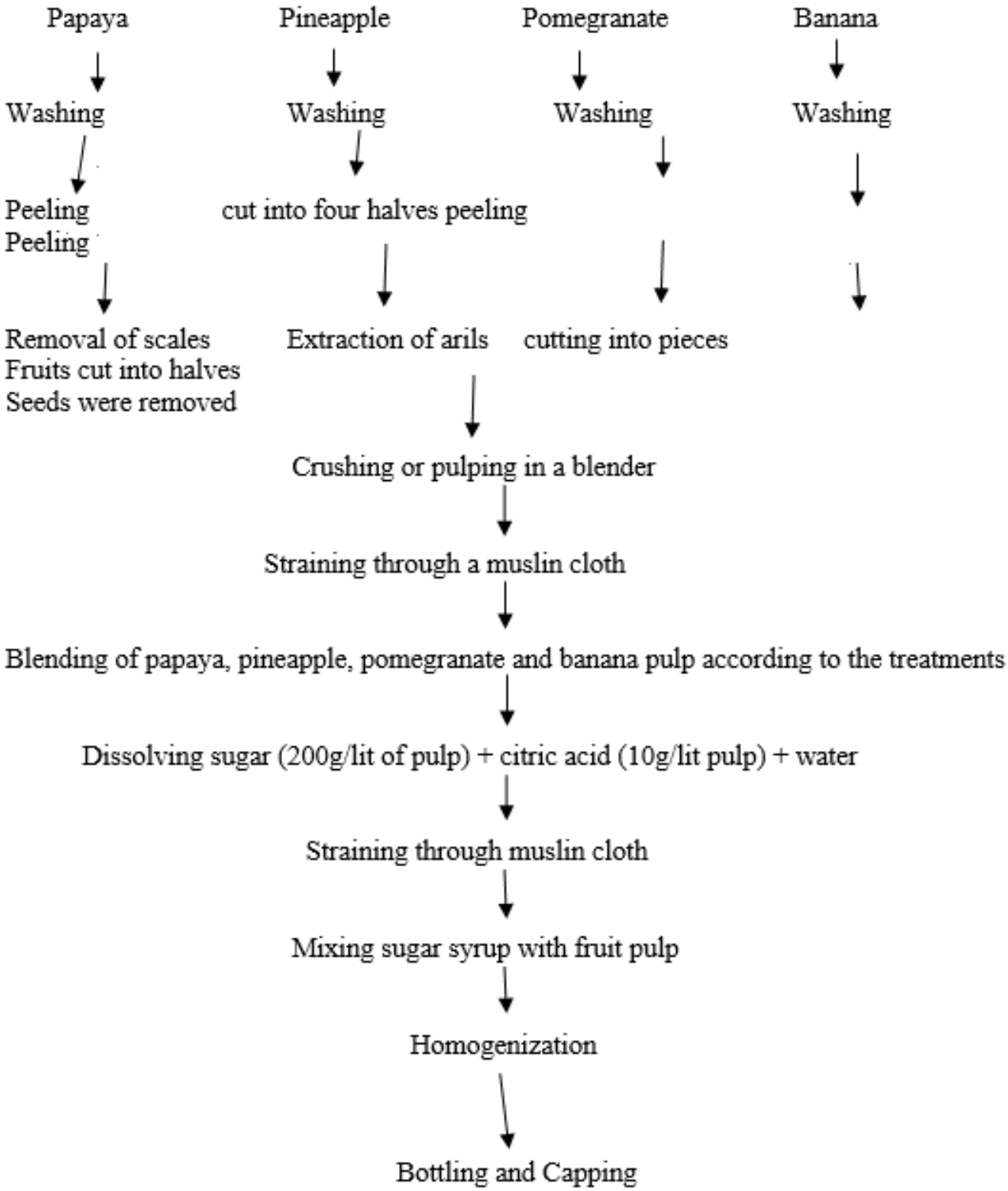

Fig 1: Flow sheet for preparation of papaya blended squash

Results and Discussion

1. Total soluble solids (°Brix)

The data recorded on Total soluble solids (ºBrix) of papaya blended squash was presented in Table 1 and depicted in Fig. 1. There were non-significant differences observed on TSS of papaya blended squash in different combinations. However, among the different blends the highest TSS (45.12°Brix) was reported in papaya 50% + banana 50 % (T_6). Whereas the lowest TSS (45.00°Brix) was recorded in papaya 100% (T_7). The variation in TSS might be due to various concentration and combination of pineapple, pomegranate and banana pulps added with papaya pulp. Similar findings were also reported by Awsi Jan and Dorcus Masih (2012) [1] in pineapple, carrot and orange blend juices were reported. Shaheel *et al*. (2015) [10] reported in karonda juice blended with guava, papaya, and pineapple juices.

2. pH

The data recorded on pH of papaya blended squash was presented in Table 1 and depicted in Fig. 1. Among the different treatments the highest pH (3.50) was recorded in papaya 75 % + pomegranate 25 % (T_3). Whereas the lowest pH (3.02) was recorded in papaya 100 % (T_7). This variation in pH of papaya blended squash might be due to variation in

papaya pulp added with pineapple, pomegranate and banana. Similarly, as reported by Awsi Jan and Dorcus Masih (2012) [1] in pineapple, carrot and orange blended juices, the acidity and pH are inversely proportional to each other and also by Shaheel *et al.* (2015) [10] in karonda juice blended with papaya, pineapple and guava.

3. Titrable Acidity (%)

The data recorded on Titrable acidity (%) of papaya blended squash was presented in Table 1 and depicted in Fig. 1. Among the different treatments the highest titrable acidity (1.28) was recorded in papaya 50% + pineapple 50% (T_2). Whereas the lowest titrable acidity (1.19) was recorded in papaya 50% + banana 50 % (T_6). This increase in titrable acidity of papaya 50% + pineapple 50% (T_2) may due to the addition of pineapple which is acidic. The same was confirmed by Deka (2000) [4] in lime-aonla, mango-pineapple and guava-mango blended juices. Shaheel *et al.* (2015) [10] reported in karonda juice blended with papaya, pineapple and guava.

4. Ascorbic acid (mg/100g)

The data recorded on Ascorbic acid (mg/100g) of papaya blended squash was presented in Table 1 and depicted in Fig. 1. There was significant difference among the treatment combinations on ascorbic acid content of papaya blended squash. Among the different treatments the highest ascorbic acid content (37.30 mg/100g) was recorded in papaya 50 % + pineapple 50 % (T_2) which was on par with (37.21mg/100g) in papaya 75 % + pineapple 25 % (T_1) and 37.10mg/100g in papaya 100% (T_7). Whereas the lowest ascorbic acid content (28.12 mg/100g) was recorded in papaya 50 % + banana 50 % (T_6).It was observed that the higher ascorbic acid content in papaya 50% + pineapple 50% (T_2). This might be due to higher ascorbic acid content of pineapple. Similar findings were also reported by Gowri *et al.,* (2015) [6] in papaya and carrot (50:50) blended squash and also by Deka (2000) [4] in mango-pineapple, lime-aonla and guava-mango blends.

5. Reducing sugars (%)

The data recorded on Reducing sugars (%) of papaya blended squash was presented in Table 1 and depicted in Fig. 1. Among all the treatments the highest reducing sugars (13.28 %) was recorded in papaya 50 % + banana 50 % (T_6) which was followed by (11.09 %) in papaya 75 % + banana 25 % (T_5). Whereas the lowest reducing sugars (8.24 %) was recorded in papaya 75% + pineapple 25% (T_1). This variation in reducing sugars might be due to variation in concentration of papaya blended with banana pulp having highest TSS.Similar findings were also reported by Sakhale (2012) [9] in mango-whey and Gowri *et al.* (2015) [6] in papaya and carrot (50:50) blended squash.

6. Total sugars (%)

The data recorded on Total sugars (%) of papaya blended squash was presented in Table 1 and depicted in Fig. 1. Among the different treatments the highest total sugars (39.25 %) was recorded in papaya 50% + banana 50% (T_6) which was followed by (38.85%) in papaya 75% + banana 25% (T_5). Whereas the lowest total sugars (35.93 %) was recorded in papaya 100 % (T_7). There was a variation in total sugars of papaya blended squash and this might be due to addition of pineapple, pomegranate and banana in different proportions. Similarly, by Bharadwaj and Mukherjee (2011) [2] in kinnow, aonla and ginger blended juices.

7. Organoleptic Evaluation of papaya blended squash

The data recorded on organoleptic evaluation of papaya blended squash was presented in Table 2 and depicted in Fig. 2.Organoleptic evaluation was conducted by the 9 members of semi trained panel and the scores were given based on 9-point hedonic scale rating by evaluating the color appearance, flavour, taste, mouth feel, aroma, consistency and overall acceptability.

7.1. Colour appearance: Among the different treatments the highest colour appearance (8.10) was recorded in papaya 50% + pineapple 50 % (T_2) which was on par with (8.00) in papaya 75 % + pineapple 25 % (T_1), 7.90 in papaya 100% (T_7) and 7.82 in papaya 75% + pomegranate 25% (T_3). Whereas the lowest colour appearance (7.43) was recorded in papaya 50% + banana 50 % (T_6).

7.2. Consistency: Among the different treatments the highest consistency (8.00) was recorded in papaya 50 % + pineapple 50 % (T_2) which was on par with papaya 75 % + pineapple 25 % (T_1) and 7.85 in papaya 50 % + pomegranate 50 % (T_4). Whereas the lowest consistency (6.50) was recorded in papaya 50 % + banana 50 % (T_6).

7.3. Flavour: Among the different treatments the highest flavour (8.50) was recorded in papaya 50 % + pineapple 50 % (T_2) which was on par with papaya 75 % + pomegranate 25 % (T_3) which recorded 8.20. Whereas the lowest flavour (7.03) was recorded in papaya 100% (T_7).

7.4. Taste: Among the different treatments the highest taste (8.50) was recorded in papaya 50 % + pineapple 50 % (T_2) which was on par with 8.19 in papaya 75 % + pineapple 25% (T_1), 7.90 in papaya 75% + pomegranate 25% (T_3) and 7.85 in papaya 50% + pomegranate 50% (T_4). Whereas the lowest taste (7.00) was recorded in papaya 100 % (T_7).

7.5. Mouth feel: Among all the treatments the highest mouth feel (8.32) was recorded in papaya 50 % + pineapple 50 % (T_2) which was followed by papaya 75 % + pineapple 25 % (T_1) which recorded 7.94. Whereas the lowest mouth feel (6.36) was recorded in papaya 100 % (T_7).

7.6. Overall acceptability: Among the different treatments the highest overall acceptability (8.11) was recorded in papaya 50 % + pineapple 50 % (T_2) which was on par with 7.97 in papaya 75 % + pomegranate 25 % (T_3), 7.93 in papaya 50% + pomegranate 50%(T_4) and 7.92 in papaya 75% + pineapple 25% (T_1). Whereas the lowest overall acceptability (7.11) was recorded in papaya 75 % + banana 25 % (T_5).Among the different blended squashes, the combination of papaya and pineapple (50:50) (T_2) showed best in physico-chemical properties and organoleptic evaluation. Hence the same treatment *viz.,* T_2- papaya 50% + pineapple 50% was selected for blending with spices and evaluation for storage stability for a period of three months at ambient storage conditions. These results are similar with findings of Awsi Jan and Dorcus Masih (2012) [1] in pineapple, carrort and orange juice blends. Sindumathi *et al.,* (2017) [11] also reported the ratio of 50:50 was reached the highest sensory scores for

overall acceptability of naturally flavoured mango and papaya blended beverage. Gowri *et.al.* (2015) [6] also reported in papaya and carrot (50:50) blended squash which had the highest organoleptic score (7.90).

Table 1: Quality Parameters of freshly prepared papaya blended squash with pineapple, pomegranate and banana

Treatment	TSS (ºBrix)	pH	Ascorbic acid (mg/100g)	Tritrable acidity (%)	Reducing sugars (%)	Total sugars (%)
T_1-Papaya 75% + Pineapple 25%	45.03	3.13	37.21	1.25	8.24	36.10
T_2-Papaya 50% +Pineapple 50%	45.04	3.20	37.30	1.28	8.26	36.33
T_3-Papaya 75% + Pomegranate 25%	45.05	3.50	30.14	1.22	9.53	37.58
T_4-Papaya 50% + Pomegranate 50%	45.07	3.39	30.01	1.20	10.78	37.10
T_5- Papaya 75% + Banana 25%	45.08	3.22	28.61	1.20	11.09	38.85
T_6- Papaya 50% + Banana 50%	45.12	3.23	28.12	1.19	13.28	39.25
T_7-Papaya 100%	45.00	3.02	37.10	1.23	10.73	35.93
SEm ±	NS	0.03	0.35	0.02	0.08	0.19
CD @5%	NS	0.10	1.05	0.05	0.24	0.57

Table 2: Organoleptic evaluation of freshly prepared papaya blended squash with pineapple, pomegranate, and banana

Treatments	Color appearance	Consistency	Flavour	Taste	Mouth feel	Overall acceptability
T_1-Papaya 75% + Pineapple 25%	8.00	7.85	8.00	8.19	7.94	7.92
T_2-Papaya 50% +Pineapple 50%	8.10	8.00	8.50	8.50	8.32	8.11
T_3-Papaya 75% + Pomegranate 25%	7.82	7.53	8.20	7.90	7.80	7.97
T_4-Papaya 50% + Pomegranate 50%	7.60	7.85	7.35	7.85	7.56	7.93
T_5- Papaya 75% + Banana 25%	7.50	6.80	7.32	7.60	7.00	7.11
T_6- Papaya 50% + Banana 50%	7.43	6.50	7.35	7.50	6.58	7.61
T_7-Papaya 100%	7.90	7.51	7.03	7.00	6.36	7.45
SEm ±	0.12	0.15	0.11	0.26	0.10	0.13
CD @ 5%	0.35	0.45	0.35	0.80	0.31	0.40

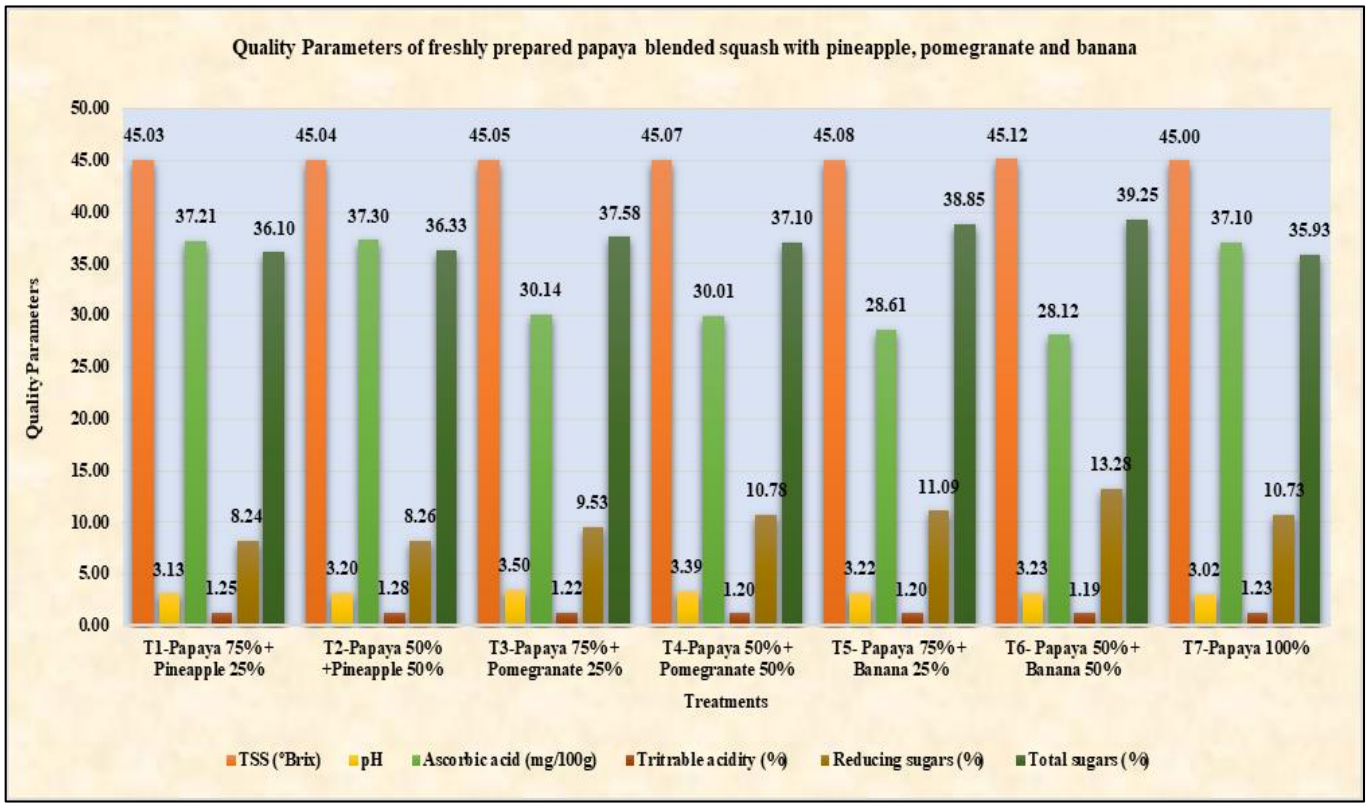

Fig 1: Quality Parameter of freshly prepared papaya blended squash with pineapple, pomegranate and banana

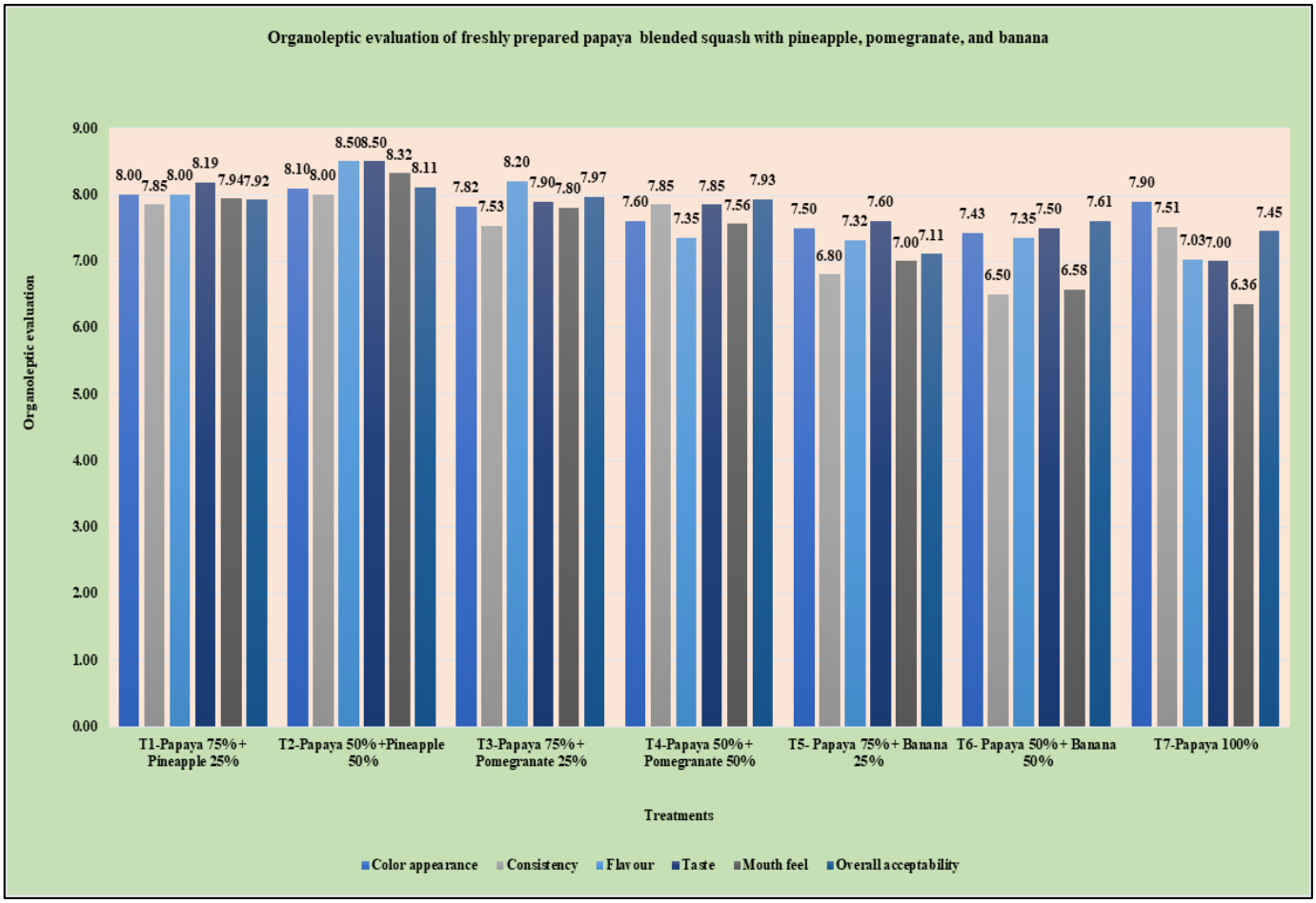

Fig 2: Organoleptic evaluation of freshly prepared papaya blended squash with pineapple, pomegranate, and banana

Conclusion

On the basis of result observed from this experiment it was concluded that papaya 50 % + banana 50 % (T_6) recorded the highest TSS (45.12ºBrix), the highest reducing sugars (13.28%) and the highest total sugars (39.25%). Whereas the highest ascorbic acid content (37.30mg/100g) and titrable acidity (1.28%) were recorded in papaya 50% + pineapple 50% (T_2). The highest pH (3.50) was recorded in papaya 75% + pomegranate 25% (T_3).In sensory evaluation, the highest colour appearance 8.10, consistency 8.0, flavour 8.50, taste 8.50, mouth feel 8.32 and overall acceptability 8.11 was recorded in papaya 50 % + pineapple 50 % (T_2), on a 9-point hedonic rating scale. Based on quality parameters and organoleptic evaluation, the ratio of 50:50 (papaya: pineapple) (T_2) reached the highest sensory scores for overall acceptability.

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