Effect of Blending and Storage on the Physicochemical Composition of the Papaya and Mango Squash

Arun Prabha, Rajni Modgil and Anupama Sandal

Abstract
Papaya and mango pulp was blended in different ratios, i.e., 100:0, 85:15, 70:30 and 55:45, respectively, to prepare squash. Prepared squash was analyzed for various nutritional and physicochemical characteristics. Parameters studied were pH, acidity, TSS, Beta carotene total sugars reducing and non-reducing sugars. Squash was packaged in glass bottles and stored for six months to assess the shelf life after storage at ambient temperature. The samples were analyzed at an interval of one month. The results revealed that good quality squash can be prepared by blending papaya and mango. With the increase in storage period, the pH (2.96–3.03) and reducing the sugar content of the squash increased, from 20.34–22.83 whereas the acidity, TSS, ascorbic acid, β carotene content, total and non-reducing sugars decreased significantly. Initial TSS in the control sample was 44.12, which decreased to 43.91% after 6-month storage. Papaya pulp can be blended with mango pulp for developing squash.

Keywords: Acidity, Mango, Papaya, Squash, Storage period, Total sugars, TSS.

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Introduction
India has got a wide range of soil and climatic conditions, due to which a large variety of fruits and vegetables (both indigenous and introduced) are grown here. Today, India is the most important fruit-producing country in the world. About 10.4 percent of all the fruits and 40 percent of the tropical fruits of the world are produced in India.

Papaya (Carica papaya), popularly known as wonder fruit of tropics, belongs to family Caricaceae. The papaya tree is a large, quick growing, soft-stemmed plant. The fruits can be harvested within a year. At the time of harvest, there is a glut in the market and being highly perishable and fast ripening, and it can not be stored for a longer time. Lack of proper storage and transportation facilities ultimately leads to low economic returns to the growers Papaya is a very wholesome fruit ranks second only to mango as a source of beta carotene. It is a good source of natural sugars, vitamin C and also contains fair amounts of calcium and phosphorus (Saravanan et al., 2004) but is low in calories and has got medicinal value. It has been used a laxative since ancient times. It is used for the treatment of various digestive disorders, diabetes mellitus, and is also effective in lowering blood cholesterol level (Cherian and Cheriyan, 2003). Though papaya is a nutritious fruit, it is not widely used in the product preparation because of its odd flavor (Aruna et al., 1999) which is not acceptable to many peoples. Blending of papaya with mango, which is juicy stone fruit (drupe) can be helpful in improving the flavor of the developed product. Mango from numerous species of tropical trees belonging to the flowering plant genus Mangifera is cultivated mostly for their edible fruit. The king of the fruits, “mango fruit is one of the most popular, nutritionally rich fruits with unique flavor, fragrance, taste, and health-promoting qualities and is often labeled as “super fruit”. In the present study, an attempt has been made to develop and analyze the squash prepared by blending papaya pulp with it with mango pulp to increase its acceptability and nutritional quality.

Materials and methods
The papaya, mango fruits, and sugar were procured from the local market and were sorted for the uniformity in color and size. Healthy and disease free fruits were selected for the study. The fruits were washed thoroughly, peeled and deseeded for the extraction of the pulp. The pulp so extracted was homogenized in a mixer blender. The papaya and mango pulp was blended in the different blending proportion, i.e., 100:0 (SQ1), 85:15 (SQ2), 70:30 (SQ3) and 55:45 (SQ4), respectively to prepare squash (ingredients fruit pulp 1000 g, sugar 1800 g, citric acid 20 g, and water 1000 mL). The flow sheet for the preparation of the squash is given in Flowchart 1. The prepared sample was analyzed at the
initial day of the storage and further kept for storage under the ambient condition for six months and was analyzed at an interval of one month for the assessment of various physicochemical and nutritional parameters. Acidity, ascorbic acid, reducing, non-reducing and total sugars of the squash were assessed by the method prescribed by Ranganna, (2007), whereas the pH was determined by using pH meter and the TSS was analyzed with the help of hand refractometer. The β carotene content was estimated by the method suggested by Roy, (1973). The experiments were carried out in triplicate and the data so obtained were subjected to Analysis of Variance (ANOVA) using statistical package WINDOWSTAT 8.0. Data was analyzed statistical package WINDOWSTAT 8.0

The obtained data were interpreted following Sendecor and Cochran (1994) and compared at 5 percent level of significance ($p \leq 0.05$).

**Results and Discussion**

As reflected in Table 1, the pH of the squash increased continuously with the increment in the storage duration. The values obtained for the pH from the first day to six months of storage for the SQ1 treatment were 2.96, 2.97, 2.98, 2.99, 3.00, 3.01, and 3.03. The mean values for the SQ2 treatment were 2.86, 2.87, 2.88, 2.91, 2.92, 2.93; for the SQ3 treatment 2.81, 2.83, 2.84, 2.88, 2.89 and 2.90 whereas, the values in case of SQ4 treatment were 2.71, 2.72, 2.74, 2.76, 2.78, 2.80 and 2.81, respectively in the squash. As is clear from the data a significant ($p \leq 0.05$) difference was there in the pH of the squash prepared by utilizing a different blend of the papaya and mango. The observations of the present investigation were in conformation with those reported by earlier authors Kumari (2007). The increase in the pH might have also been associated with a decrease in the acidity of the squash.

**Total Soluble Solids**

As is evident from the Table the TSS of the SQ1 was 45.01°Brix for SQ2; 44.19° Brix for SQ3 and 44.12°B for the SQ4 treatment in the squash, respectively at the initial day of storage. A slight decline was observed in the total soluble solids with the advancement of the storage period. A similar declining trend was followed in all the treatments, until the end of the storage period of six months. The maximum value (44.75°B) was observed for the SQ1 treatment, followed by (44.31°B) for SQ3 and 44.05°B for the SQ2 treatment. The minimum value of 43.91°B was observed in case of the SQ1 treatment in the seeded papaya squash. The decrease in the TSS of the squash might have been due to the conversion of the sugars to acid. Sirohi et al., (2005) and Kumari (2007) reported a decline in the TSS in mango pudina beverage supplemented with whey and mango whey beverages.

**Acidity**

Table 3 reveals that the acidity of the squash was higher in the SQ1 (1.52) treatment followed by SQ2 (1.49), SQ3 (1.44)
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and SQ4 (1.41) treatment at the initial day of storage in the squash, but it decreased with the increase in the storage period. After six months of storage, the values were 1.30, 1.28, 1.20, and 1.17 percent, respectively for the SQ1, SQ2, SQ3, and SQ4 treatments. As depicted in the table the blending of the papaya with mango resulted in significant ($p \leq 0.05$) decrease in the value of acidity of the squash. Sethi (1993) and Prasad (2000) observed an increase in the acidity of the litchi and pomegranate squash during storage for 12 months. The decrease in the acidity might have been due to fermentation of the organic acids or by the degradation of the ascorbic acid.

### Ascorbic Acid

Graph 1 depicts the effect of different blending proportion on the ascorbic acid content of the papaya squash. It can be seen from the figure that the highest value (14.39 mg/100 g) for the ascorbic acid content was recorded in SQ1 treatment, while the lowest value 9.87 mg/100g was analyzed in case of the SQ4 treatment in the squash. After six months of storage maximum ascorbic acid content was observed in the SQ1 treatment (12.37 mg/100g), followed by SQ2 (6.36 mg/100g) and SQ3 (8.46 mg/100g) treatment. The minimum value for the ascorbic acid was observed for the SQ4 treatment (7.02 mg/100g) in the squash after six months of storage. The decrease in the ascorbic acid might have been due to the reason that the ascorbic acid is a heat sensitive vitamin and get converted to dehydroascorbic acid. The decrease in the ascorbic acid might have been due to the reason that the storage has resulted in the more degradation of the ascorbic acid. Saravanan et al., (2004) reported a decline in the ascorbic acid content of the papaya squash.

### β carotene/total carotenoids

As depicted in Table 4 the β carotene content of the papaya squash. The β carotene content of the squash increased significantly ($p \leq 0.05$) with the increase in the mango proportions. The β carotene content at the initial day of the storage was highest (0.36 mg/100 mL) for the SQ4 treatment. The lowest value, i.e., 0.17 mg/100g, was observed in case of the SQ1 treatment at the initial day of the storage. Thereafter, a decline in the values of the β carotene was observed in all the treatments. After six months of storage, the highest value 0.18 mg/100 g was recorded for the SQ4 treatment, followed by 0.12 and 0.10 mg/100g respectively in case of the SQ3, SQ2 treatments. The lowest value 0.01 mg/100g was recorded for

### Table 3: Effect of blending and storage on the acidity (%) of the squash

| Treatments | Storage period (in months) |
|------------|---------------------------|
|            | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| SQ1        | 1.52 | 1.49 | 1.46 | 1.42 | 1.39 | 1.36 | 1.30 |
| SQ2        | 1.49 | 1.47 | 1.45 | 1.41 | 1.38 | 1.33 | 1.28 |
| SQ3        | 1.44 | 1.40 | 1.36 | 1.32 | 1.26 | 1.23 | 1.20 |
| SQ4        | 1.41 | 1.37 | 1.33 | 1.30 | 1.25 | 1.21 | 1.17 |

CD ($p \leq 0.05$)
- Treatments (T): 0.008
- Storage Period(S): 0.01
- TXS: NS

Graph 1: Effect of blending and storage on the ascorbic acid (mg/100g) content of squash
the SQ1 treatment after six months of storage in the squash. The decrease in the β carotene with the storage period might have been due to the reason that the β carotene gets oxidized with storage and also by the biochemical degradation of the pigment. Similar observations were also recorded by Kumari (2007) in the whey mango squash.

**Total Sugar**

The data pertaining to the total sugar content of the squash is given in Table 5 as is clear from the Table that the total sugar increased with the blending of mango, but a slight decrease was observed in the value of the total sugars with an increase in the storage period. The total sugar content of squash SQ1, SQ2, SQ3, and SQ4 treatments was 43.11, 44.63, 45.95, and 46.30 percent, respectively at the initial day of the storage. The values for the total sugars decreased significantly (p ≤0.05) in all the treatments. The maximum value (45.95 %) for the total sugars was observed for the SQ4 treatment, whereas the minimum value (42.68 %) was recorded for the SQ1 treatment. The loss in the total sugar content might have been due to the Maillard reaction or chemical reaction of the sugar in the presence of acid. The findings of the present investigation are at par with those reported by Kannan and Thirumaran (2004) in case of the jamun squash after six months of storage period.

**Reducing Sugars**

Table 6 shows the reducing sugar content of the squash. Initially, the reducing sugar content for the SQ1, SQ2, SQ3, and SQ4 treatments was 20.34, 20.97, 21.39, and 21.94 percent, respectively. The values for the reducing sugar content increased significantly (p ≤ 0.05) in all the treatments with the increase in the storage duration. At the end of six months of storage, the reducing sugars were 24.72, 24.13, 23.69, and 23.32 percent, respectively, for the SQ1, SQ2, SQ3, and SQ4 treatments. Barwal et al. (2002) observed an increase in the reducing sugar content of the plum squash. Sethi (1993) also observed an increase in the percent reducing sugar in the litchi squash during storage of six months. An increase in the reducing sugars might be due to acid hydrolysis and also due to the biochemical changes taking place during the storage due to which nonreducing sugars are hydrolyzed to form the reducing sugars.

**Nonreducing Sugars**

Table 7 illustrates the nonreducing sugar content of the squash. An increase in the values of the nonreducing sugar was obtained in all the treatments with an increase in the mango proportion. The maximum value 23.32 percent was observed for the SQ3 treatment whereas the least value 21.62 percent was obtained in case of the SQ1 treatment. With the increase in storage period, the nonreducing sugars decreased. The lowest value (18.39 %) for the nonreducing sugars was recorded in SQ1 treatment and the highest value (20.19 %) was observed for the SQ4 treatment after six months of storage. The decrease in the nonreducing sugar content during storage might have been due to the biochemical changes occurring during the storage, conversion of the non reducing sugars to the reducing sugars and therefore

| Treatments | Storage period (in months) |
|------------|---------------------------|
|            | 0  | 1  | 2  | 3  | 4  | 5  | 6  |
| SQ1        | 20.34 | 20.75 | 21.33 | 21.98 | 22.39 | 22.83 | 23.32 |
| SQ2        | 20.97 | 21.49 | 21.91 | 22.22 | 22.87 | 22.98 | 23.69 |
| SQ3        | 21.39 | 21.96 | 22.35 | 22.93 | 23.22 | 23.93 | 24.13 |
| SQ4        | 21.94 | 22.54 | 22.86 | 23.27 | 23.75 | 24.08 | 24.72 |

CD (p ≤0.05)  
Treatments (T) : 0.07  
Storage Period(S) : 0.09  
TXS : NS

| Treatments | Storage period (in months) |
|------------|---------------------------|
|            | 0  | 1  | 2  | 3  | 4  | 5  | 6  |
| SQ1        | 21.62 | 21.16 | 20.56 | 19.83 | 19.39 | 18.77 | 18.39 |
| SQ2        | 22.47 | 21.93 | 21.46 | 21.06 | 20.32 | 19.93 | 19.32 |
| SQ3        | 23.32 | 22.73 | 22.27 | 21.67 | 21.33 | 20.52 | 20.19 |
| SQ4        | 23.15 | 22.52 | 22.15 | 21.69 | 21.21 | 20.82 | 20.17 |

CD (p ≤0.05)  
Treatments (T) : 0.05  
Storage Period(S) : 0.07  
TXS : 0.01
decrease in the nonreducing sugars. Kumari (2007) also reported a decrease in the percent non reducing sugars after six months of storage.

**Conclusion**

Papaya fruit can be utilized for making the squash by blending pulp with mango pulp. Blending of papaya pulp with mango pulp resulted in an increase in β carotene and total sugar content and decrease in acidity content of squash. Papaya and mango pulp can be blended for the development of squash. The prepared squash can be stored for a longer period of time. This will be helpful in increasing the utilization of this nutritionally rich fruit.

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