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Studies on the preparation of mixed fruit squash from guava, banana and mango

J. SELVI, P. BANUMATHI, S. KANCHANA AND M. ILAMARAN

Mixed fruit squash was prepared using guava, banana and mango in the ratio of 50: 50: 50. The prepared squash were bottled in glass bottles stored at room (R_1) and refrigerated (R_2) temperature**.** A increasing trend in the acid content of the mixed fruit squash was observed. The acid content of mixed fruit squash reduced from 1.052 to 1.465 and from 1.052 to 1.430 per cent in R_1 and R_2 samples, respectively. Mixed fruit squash had 45. 50° brix TSS and it was slightly lower in R_1 (45.28° brix) compared to R_2 (45. 35° brix) samples on storage. A gradual increase in the reducing sugar content of mixed fruit squash was observed. The reducing sugar increase was found in mixed fruit squash from 5.95 to 8.52 and 5.95 to 7.65 g per 100 ml in R_1 and R_2 samples, respectively. A gradual reduction in the ascorbic acid content was observed in all the samples during storage. The initial ascorbic acid content was 41.25 and at the end of 180 days satorage, the ascrobic acid content was 30.18 mg in R_1 and 32.82mg/100ml in R_2. The freshly prepared mixed fruit squash recorded 372 mg per 100ml (R_1 and R_2)-carotene. At the end of storage period the b-carotene content decreased as 205 and 242 mg/100 ml in R_1 and R_2, respectively. A slight increase in the microbial load was noted in the formulated value added fruit products during storage. All the formulated value added fruit products secured highly acceptable to acceptable score values during the storage. The mean overall acceptability score values noted in storage ranged from 8.35 in R_1 and R_2 of mixed fruit squash. Comparative economic analysis of value added production showed that the cost of production of mixed fruit squash per litre was Rs. 37.37.

Key Words : Fruit squash, Mixed fruit squash

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INTRODUCTION

India is the leading producer of mango in the world. Mango is one of the most perishable fruits and heavy production of mango in a country like India necessitates storage till they reach consumers or processed. Mango is called the king of all fruits because of its rich, luscious, aromatic flavor and a delicious taste in which sweetness and acidity are delightfully blended. It is the most popular and the choicest fruit and occupies a prominent place among the fruits of the world. Guava (*Psidium guajava* L.) is one of the important commercial crops of India. Guava occupies fourth place among important fruits of India after mango, banana and citrus. Guava is referred as the apple of tropics and one of the most common fruits in India. Guava is one of the richest sources of vitamin C, it also contains substantial quantities of carbohydrates (sugars, pectin) and materials like calcium, and phosphorus. Guava is consumed mainly as fresh fruit. It has an excellent digestive and nutritive value with pleasant flavor, palatability and availability in abundance at moderate cost.

Banana is the largest produced and maximum consumed amongst the fruits cultivated in India. It is known as the 'common man's fruit'. It is highly nutritive and very delicious. India ranks first amongst the banana cultivating countries of the world with an annual production share of 25 per cent of the total harvest (Surendranathan *et al.*, 2004). Banana is grown extensively throughout the tropical and sub tropical regions of the world and represents as number one fruit crop in the world in terms of both production and trade. The availability of

MEMBERS OF RESEARCH FORUM

Author for correspondence :

J. SELVI, Department of Food Science and Nutrition, Home Science College and Research Institute, (T.N.A.U.), MADURAI (T.N.) INDIA
Email: selvisathi81@gmail.com

Associate Authors' :

P. BANUMATHI S. KANCHANA AND M. ILAMARAN, Department of Food Science and Nutrition, Home Science College and Research Institute, (T.N.A.U.), MADURAI (T.N.) INDIA

banana all around the year is yet another reason for its immense popularity (Rao, 1999).

The fruit juice blended squashes such as papaya and mango, amla and lime, amla and pineapple in the ratio of 4:1 were prepared as per FPO specification by Manimegalai *et al.* (1994) and Hilda and Manimegalai (1996), respectively. The enzyme clarified muskmelon juice was used to prepare squash as per FPO specification and enriched by fortifying with 100 mg of ascorbic acid per 100 g (Teotia *et al.*, 1995). The present study was under taken in order to evaluate the guava, banana and mango blended mixed fruit squash.

METHODOLOGY

Matured, firm fruits like guava, mango, banana, lime and ginger were purchased from local market. Non-perishable items such as sugar, citric acid and potassium metabisulphite (KMS) were purchased in bulk from the local market. Glass bottles (capacity 650 ml) with caps were used for storing the prepared mixed fruit squash.

Methods :

Guava, banana and mango were used for the study. The flow chart for the preparation of mixed fruit squash is given in Fig. 1. The fruit pulp was prepared by adding equal proportion of fruit pulp in the ratio of 1:1:1.Required amount of sugar and citric acid were taken in a vessel. Sugar syrup was prepared using required amount of sugar and citric acid.The prepared syrup was filtered and allowed to cool.The fruit juice was added to the syrup and mixed thoroughly.The required amount of KMS was mixed in a small quantity of fruit juice and added to the prepared squash and mixed well. The prepared squash was poured in a sterilized bottle (capacity 650 ml) leaving headspace (2 cm) and capped airtight.

Processing of mixed fruit squash :

The mixed fruit squash was prepared by using guava, banana and mango with FPO specification *viz.,* fruit pulp –25 %, TSS 45°brix, acidity – 1.0% and potassium metabisulphite – 700 ppm.

Chemical analysis :

The acidity of the sample was estimated by the Ranganna (1995). The pH of the sample was estimated by the method described by Hart and Fischer (1971). The total soluble solids of the fruit was found out by using a hand refractometer.The total and reducing sugar content of the sample was determined by the Shaffer Somogyi micro method described by MC Donald and Foley (1960). The β-carotene content of the sample was estimated colorimetrically (Kemmeter and Fraps, 1943). Ascorbic acid was estimated following the procedure of Mahadevan and Sridhar (1982). The microbiological load of the stored sample was enumerated at regular intervals by the methods described by Istawankiss (1984).

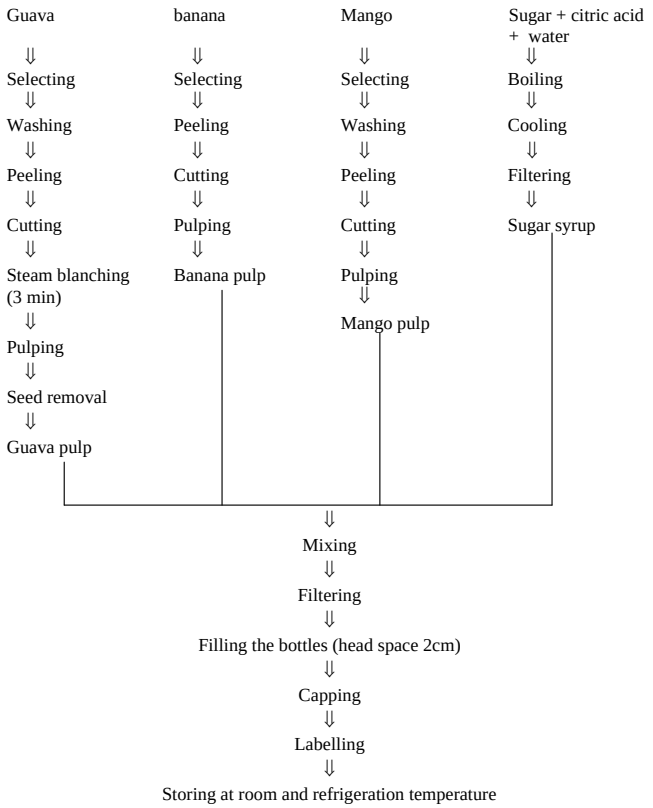

Fig. 1. Flow chart for the preparation of mixed fruit squash (guava, banana, mango)

Organoleptic evaluation :

The developed mixed fruit squash was evaluated for organoleptic characteristics namely colour, appearance, flavour, texture, taste and overall acceptability by using score card with nine point hedonic rating scale (9-1).

Economic feasibility analysis :

To analyze the economic feasibility of the processing plant project, four criteria were considered, *viz.,* internal-rate of return, benefit-cost ratio, pay-back period and break-even point (Rajan, 1984).

Statistical analysis :

The data obtained from the various experiments were subjected to statistical analysis to find out the impact of storage condition used and storage period. Factorial Completely Randomized Design (FCRD) was applied for the analysis of the study as described by Rangaswamy (1995).

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation are presented below :

Chemical composition of the selected fruit juices :

The chemical composition of the selected fruit juices were analyzed and presented in Table 1. The TSS of the selected fruit juices varied between 7.00 (lime) and 13.0°brix (mango). The acid content of the fruit juices was noted in the decreasing order of lime (3.25%), banana (0.68%), mango (0.38%) and guava (0.31%). Among the selected fruit juices mango had the highest pH (3.61) followed by guava (3.42), banana (3.24) and lime (2.07). The reducing sugar content was maximum in guava juice (8.0%) and lime juice recorded minimum value for reducing sugar content (1.02%). The highest total sugar content was noted in mango (12.61%). Presence of b-carotene was noticed only in mango juice (1884 mg/100g). The ascorbic acid content was observed in all the fruit juices with maximum content observed in guava (112.8 mg / 100g).

Changes in the chemical constituents of the mixed fruit squash (Guava, banana, mango)

Acid and pH :

An increasing trend was observed in the acid content of the mixed fruit squash throughout the storage period stored at room (R_1) and refrigeration (R_2) temperature (Table 2). From the data it could be seen that the initial acid content of the squash was 1.052 g per cent and it was increased to 1.465 g per cent in R_1 and 1.052 to 1.430 g per cent in R_2 after 180 days of storage.As the acid content of the squash increased, the pH decreased during storage. The initial pH of mixed fruit squash was 4.15 and at the end of the storage period the pH was 3.32 in R_1 and 3.44 in R_2. The statistical analysis showed a significant difference in the acid content of the squash throughout storage period and at different storage conditions. Significant difference in pH content was observed in squash with respect to storage condition and storage period. Likewise Shanmugam (2004) reported a slight reduction in pH in the mixed fruit squashes stored at room temperature during storage. The initial values of pH were 2.86 (mango base), 2.87 (pineapple base), 2.85 (papaya base) and 2.80 (lime base).

TSS :

The freshly prepared mixed fruit squash (Table 2) had 45. 5° brix of TSS and it was slightly lower in R_1 (45.28) compared to R_2 (45.35) samples at the end of 180 days of storage. The statistical analysis of the data revealed that there existed a significant difference in the squash, storage condition and storage period. Similar trend was reported by Saravanakumar and Manimegalai (2003) during the storage of mixed fruit juice RTS beverage and strawberry squash.

Total and reducing sugar :

As the storage period increased there was a reduction in total sugar content (Table 3). The initial total sugar content of the mixed fruit squash was 35.40 g per cent. At the end of

Table 1. Chemical composition of the selected fruit juices (100g)

S.No.	Name of the fruits	TSS (°Bx)	Acidity (g)	pH	Reducing sugar (g)	Total sugar (g)	β-carotene (µg)	Ascorbic acid (mg)
1.	Mango	13.00	0.38	3.61	6.06	12.61	1884	16.15
2.	Guava	11.00	0.31	3.42	8.00	11.80	-	112.80
3.	Banana	12.50	0.68	3.24	7.28	11.21	-	6.50
4.	Lime	7.00	3.25	2.07	1.02	3.42	-	52.74

Table 2. Changes in the acidity, pH and TSS (°Bx) content of the mixed fruit squash (guava, banana , mango) during storage

Storage period (S) (days)	Acidity (g/100ml)		pH		TSS (°Bx)	
	Storage condition (R)		Storage condition (R)		Storage condition (R)	
	R_1	R_2	R_1	R_2	R_1	R_2
0	1.052	1.052	4.15	4.15	45.50	45.50
30	1.120	1.098	3.90	4.00	45.50	45.50
60	1.186	1.115	3.79	3.89	45.50	45.50
90	1.201	1.168	3.62	3.72	45.45	45.48
120	1.225	1.200	3.50	3.61	45.40	45.44
150	1.348	1.325	3.43	3.54	45.33	45.40
180	1.465	1.430	3.32	3.44	45.28	45.35

	Acidity (g/100ml)			pH			TSS (°Bx)	
	SED	CD (0.05)		SED	CD (0.05)		SED	CD (0.05)
S	0.00294	0.00603**	S	0.01406	0.02880**	S	0.01406	0.02880**
R	0.00157	0.00322**	R	0.00751	0.01539**	R	0.00751	0.01539**
SR	0.00416	0.00852**	SR	0.01988	0.04072**	SR	0.01988	0.04072^{NS}

R_1- Room temperature R_2- Refrigeration temperature

**indicate of significance of value at P = 0.05 NS= Non-significance

storage period the total sugar content of R_1 was 28.50g/100ml and in R_2 it was 30.82 g /100 ml. The retention of total sugar in the refrigerated (R_2) sample was found to be better when compared to R_1 during storage.

With increase in storage period, the reducing sugar content of the squash also increased, irrespective of the storage conditions. The initial reducing sugar content of squash was 5.95 g per cent and at the end of storage period the reducing sugar content reduced to 8.52 g per cent in R_1 and 7.65g per cent in R_2. The statistical analysis of the data showed a highly significant difference in total and reducing sugar content of mixed fruit squash during storage condition and storage period.

Similar trend was reported by Sudhagar (2001). The reducing sugar content of pear and pear and pineapple juice (80:30) blended squashes contained initially 2.01 and 1.97 g per cent of reducing sugar, respectively, which had changed to 2.76 and 2.18 g per cent after storing for 180 days at room temperature.

Ascorbic acid and b-carotene :

A higher loss in ascorbic acid content was noted in the squash throughout the storage period (Table 4). Initially, the ascorbic acid content was 41.25 mg/100 ml and at the end of 180 days of storage, the ascorbic acid content was 30.18 mg in R_1 and 32.82 mg / 100 ml in R_2. Ascorbic acid content loss was higher in R_1 when compared to R_2, at the end of storage period. Significant difference in ascorbic acid content was observed in mixed fruit squash with respect to storage condition and storage period.

The freshly prepared squash recorded 372 µg/100 ml of β-carotene. At the end of storage period the β-carotene content was decreased in both R_1 and R_2 (372 to 205 and 372 to 242 µg/ 100 ml, respectively). Maximum loss in b-carotene content was observed in R_1 (372 to 205 µg/100 ml) when compared R_2 (372

Table 3. Changes in the total and reducing sugar (g/100 ml) content of the mixed fruit squash during storage

Storage period (S) (days)	Total sugar (g/100 ml)		Reducing sugar (g/100 ml)	
	Storage condition (R)		Storage condition (R)	
	R_1	R_2	R_1	R_2
0	35.40	35.40	5.95	5.95
30	35.28	34.98	6.28	6.10
60	34.97	34.80	6.95	6.55
90	33.50	33.92	7.40	6.90
120	32.15	33.20	7.98	7.10
150	30.05	32.15	8.28	7.34
180	28.50	30.82	8.52	7.65

	Total sugar (g/100 ml)			Reducing sugar (g/100 ml)	
	SED	CD (0.05)		SED	CD (0.05)
S	0.09407	0.19270**	S	0.01199	0.02455**
R	0.05028	0.10300**	R	0.00641	0.01312**
SR	0.13304	0.27252**	SR	0.01695	0.03472**

R_1 - Room temperature R_2 - Refrigeration temperature
**indicate of significance of value at P = 0.05

Table 4. Changes in the ascorbic acid (mg/100 ml) and β-carotene (µg/100 ml) content of the mixed fruit squash during storage

Storage period (S) (days)	Ascorbic acid (mg/100 ml)		β-carotene (µg/100 ml)	
	Storage condition (R)		Storage condition (R)	
	R_1	R_2	R_1	R_2
0	41.25	41.25	372	372
30	40.05	40.95	345	366
60	38.15	40.25	310	335
90	37.10	39.14	285	310
120	35.24	37.85	250	285
150	33.28	35.65	228	265
180	30.18	32.82	205	242

	Ascorbic acid (mg/100 ml)			β-carotene (µg/100 ml)	
	SED	CD (0.05)		SED	CD (0.05)
S	0.01512	0.03097**	S	1.35986	2.78561**
R	0.00808	0.01655**	R	0.72687	1.48897**
SR	0.02138	0.04380**	SR	1.92313	3.93945**

R_1 - Room temperature R_2 - Refrigeration temperature
**indicate of significance of value at P = 0.05

to 242 μg/100 ml) at the end of 180 days of storage period. Statistical analysis of the data showed a highly significant difference in β-carotene content of mixed fruit squash with respect to storage conditions and storage period.

Microbial changes of the mixed fruit squash :

An increasing trend in microbial population was noted in the mixed fruit squash during storage but was highly in an acceptable link (Table 5). Initially bacterial, fungi and yeast count was below detectable level (BDL) and at the end of storage period bacterial count of mixed fruit squash was increased from 1 to 4 x 10^5cfu/g in R_1 and 1 to 3 x 10^5cfu/g in R_2 samples, 2 to 5 x 10^4cfu/g in R_1 and 1 to 4 x 10^4cfu/g in R_2 samples in fungi and yeast count was 2 to 5 x 10^3cfu/g in R_1 and 1 to 4 x 10^3cfu/g in R_2 samples during the storage period.

Organoleptic characteristics of mixed fruit squash during storage :

The mixed fruit squash secured highly acceptable to acceptable score values during the storage (Table 6). The mean overall acceptability score values were 8.35 in R_1 and R_2 samples at the end of 180 days. Saravanakumar and Manimegalai (2003) stated that the freshly prepared strawberry squashes had reddish pink colour, strong flavour and highly acceptable taste. As the storage period increased, the score values for acceptance, colour, taste and overall acceptability showed a decreasing trend. The flavour score values decreased from 4.0 to 3.9 and 3.6 for Sujatha variety and Labella variety squashes, respectively.

Economics of mixed fruit squash production :

Economics of mixed fruit squash production at the rate of 100 litres/day production capacity and operating season of 300 days in a year revealed a fixed cost (operation and maintenance cost) of Rs. 30,050 for the processing plant. The total variable cost (production cost) was worked out to be Rs. 10.90 lakhs. It was found that annual total cost of production was Rs. 11.21 lakhs and gross return estimated to be 30 tonnes of mixed fruit squash produced was Rs. 12.00 lakhs by using prevailing product market price. In nutshell, it was found that the cost of production of mixed fruit squash /litre was Rs. 37.37. Also profit per litre of mixed fruit squash was estimated to be Rs. 2.63. (Table 7).

Economic feasibility analysis :

It could be seen from the Table 7 that the internal rate of return was 40.15 per cent which was more than current bank rate indicating that the proposal of setting a plant producing 100 litres / day for 300 days of operating capacity can be commercially viable. The benefit cost ratio was workout to be 1.07 for this processing plant. A project can be accepted, if the benefit cost ratio was more than unity. Hence, the proposal for setting up this plant was found to be economically feasible.

For determining break even point, the total fixed cost was

Table 5. Changes in the microbial population of mixed fruit squash during storage

Storage period (S) (days)	Bacteria (x10^5/g)		Fungi (x 10^4 /g)		Yeast (x 10^3 /g)	
	R_1	R_2	R_1	R_2	R_1	R_2
0	BDL	BDL	BDL	BDL	BDL	BDL
30	1	1	2	1	2	1
60	2	1	2	1	2	2
90	2	2	3	2	3	2
120	3	2	3	2	4	3
150	3	3	4	3	4	3
180	4	3	5	4	5	4

BDL – below detectable level R_1- Room temperature R_2- Refrigeration temperature

Table 6. Organoleptic characteristics of mixed fruit squash

Storage period (S) (days)	Quality attributes							
	Room temperature (R_1)				Refrigeration temperature (R_2)			
	Colour and appearance	Flavour	Taste	Overall acceptability	Colour and appearance	Flavour	Taste	Overall acceptability
0	8.6	8.6	8.6	8.60	8.6	8.6	8.6	8.60
30	8.6	8.5	8.5	8.55	8.6	8.5	8.6	8.58
60	8.6	8.5	8.5	8.55	8.6	8.5	8.6	8.58
90	8.5	8.5	8.5	8.50	8.6	8.5	8.5	8.55
120	8.5	8.4	8.5	8.48	8.5	8.4	8.4	8.45
150	8.4	8.4	8.4	8.44	8.4	8.3	8.3	8.38
180	8.4	8.3	8.3	8.35	8.4	8.3	8.2	8.35

R_1- Room temperature R_2- Refrigeration temperature

Table 7. Economic analysis of value added mixed fruit squash productions

S.No.	Analysis particulars	Mixed fruit squash production (in litres)
Economics of production		
1	Cost of production/unit (Rs/unit)	37.37
2	Production/year (litres/kgs)	30,000
3	Price /unit (Rs/unit)	40.00
4	Profit/Year (Rs)	0.78lakhs
5	Profit/unit (Rs/ litres)	2.63
Economic feasibility analysis		
1	Internal rate of return (%)	40.15
2	Benefit -cost ratio	1.07
3	Break-even point (litres/kgs/year)	8,268

found to be Rs. 30,050. The variable cost per litre was Rs. 36.37 and the unit contribution to fixed cost was analysed as Rs 3.63/ litre. The analysis showed that break even point for the above said processing plant was 8,268 litres/year. It was the minimum production required for successful operation of the plant.

The pay back period was workout to be within one year. Hence, this analysis showed that greater benefit could be accured as profit from second year onwards.

Conclusion :

It could be possible to process value added fruit product of mixed fruit squash. Storage condition and packaging the value added products in suitable packaging materials (Glass bottles- capacity 650 ml) could extend the shelf life of the product with minimum changes in the chemical composition. Value added fruit products of mixed fruit squash showed an increasing trend in acidity and reducing sugar whereas a decreasing trend in pH, TSS, total sugar, β- carotene and ascorbic acid contents were noticed during storage. A slight increase in the microbial population was observed in the product. Among the value added fruit product of mixed fruit squash had secured higher sensory score values. So that the market structure for fruits might be more competitive and the benefits could be proportionally shared by fruit growers in the study area.

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