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Studies on preparation and storage of tamarind squash[#]

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Abstract

An attempt was made to standardize the protocol for the preparation of tamarind squash. The chemical composition of tamarind squash and changes in chemical constituents during storage at ambient temperature were studied. Results showed that higher amount of mean TSS (54.13%), reducing sugar (9.51%) and total sugar (30.25%) were noticed in recipe having 30% juice + 50% TSS + 1% acidity, whereas higher retention of ascorbic acid (3.68 mg 100 g^{-1}) was observed in recipe having 30% juice + 40% TSS + 1% acidity. However, minimum TSS (40.48%), reducing sugar (8.82%) and total sugar (22.77%) were noticed in recipe having 25% juice + 40% TSS + 1% acidity and titrable acidity in the recipe having 30% juice + 50% TSS + 1% acidity. Among the recipes the tamarind squash prepared from 30% juice + 50% TSS + 1% acidity was found superior to other recipes. The beverage retained its characteristic colour, aroma and taste up to 3 months of storage at room temperature.

Keywords: acidity, squash, storage, sugar, tamarind

Introduction

Tamarind is an underutilized crop grown in arid and semi-arid regions of India. Tamarind contains high amount of tartaric acid which makes it unfit for fresh consumption. It is an important crop of dry land horticulture. The fruit is a good source of calcium, phosphorus, iron and vitamins. It also contains small amount of vitamin A and C. (Siddig *et al*. 2006).

The pulp is the main source for souring food products like chutneys, sambar, curries and sauces. Tamarind pulp is also the fruit base in preparations of jams, jellies, ice-creams, canned tamarind juice and syrup. Tamarind fruit is also reported to be used as a raw material for the preparation of wine- like beverages. It is also enjoyed in the form of refreshing drinks and beverages. Fruit are commonly processed into juices, nectars, fruit punch, concentrates, glazed and crystallized fruit. The pulp can withstand thermal processing without affecting the original flavor profile (Siddig *et al*. 2006).

Post harvest loss of fresh tamarind is the most pressing problem of the processing industries

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in the country. Further, it is not possible to enjoy the taste throughout the year because of their perishable nature. So, value addition and product diversification is one of the main concerns in future for solving these problems. Due to perishable nature of the fruits, they require immediate processing to avoid post harvest losses (Ramakumar *et al.* 1997) and changes in colour from brown to black due to phenolics and non-enzymatic browning during storage (Siddig *et al*. 2006). About 90% of tamarind fruits are used as fresh and are hardly used for processing. Therefore, the present investigation was carried out to develop a technology for preparation of value added product (squash) from tamarind pulp.

Materials and methods

Tamarind fruits of var. DTS-1 were procured from Department of Plantation and Spices Crops, Kittur Rani Channamma College of Horticulture, Arabhavi (Karnataka) during the year 2011-2012. The fully ripe fruits were harvested during April and the shells were removed manually and then the pulp was separated from the seeds. Ginger and mango ginger were procured from the local market for the study. The experiment with seven treatments and three replications was laid out in completely randomized block design (Table 1). All the treatments had similar acidity (1%), salt (0.5%) and KMS (0.25g L^{-1}).

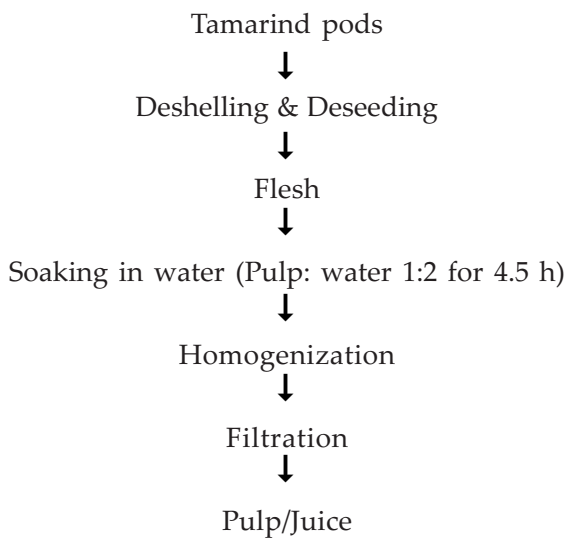

Fig. 1. Flow diagram for extraction of tamarind pulp

Table 1. Treatment details

Treatments	Juice (%)	TSS (%)
T_1	25 (9:1) Tamarind: Ginger	40
T_2	30 (9:1) Tamarind: Ginger	40
T_3	25 (9:1) Tamarind: Ginger	45
T_4	30 (9:1) Tamarind: Ginger	45
T_5	25 (9:1) Tamarind: Ginger	50
T_6	30 (9:1) Tamarind: Ginger	50
T_7	30 (9:1) Tamarind: Mango ginger	40

For the preparation of tamarind squash, juice was mixed with sugar and water was added as per recipes mentioned in the treatment details. The beverage was preserved by addition of potassium meta bisulphate @ 0.25 g L^{-1} and salt 0.5%, respectively. The beverages were filled in clean, sterile bottles of 200 mL capacity and sealed with caps and stored at room temperature (28°C) for upto 3 months.

TSS was measured by using digital refractometer (Make Erma). Titratable acidity was estimated as per the modified procedure of AOAC (Anon. 1984). Ascorbic acid content was determined by using 2,6-dichlorophenol indophenol dye titrimetrically as per the modified procedure of AOAC (Anon. 1984). Sugars were estimated as per the dinitro salicylic acid (DNSA) method (Miller 1972). Organoleptic evaluation of tamarind squash was done at 30 days interval i.e., at 30, 60 and 90 days after storage (DAS). It was diluted with water in the ratio of 1:.3 before serving to judges. The organoleptic characters like colour and appearance, aroma and flavour, taste and overall acceptability were evaluated by a panel of semi-trained judges consisting of 10 panelists of Kittur Rani Channamma College of Horticulture, Arabhavi consisting of five point Hedonic scale.

Results and discussion

Changes in chemical composition during storage

An increasing trend was observed in total soluble solids (TSS) content of tamarind blended ginger squash during storage (Table 2). The mean TSS varied between 40.48% and 54.13%. It is evident from the results that

Table 2. Changes in TSS and pH of tamarind squash blended with ginger at different days of storage

Treatment	TSS (%)					pH				
	Initial	30 DAS	60 DAS	90 DAS	Mean	Initial	30 DAS	60 DAS	90 DAS	Mean
T_1- 25% juice* + 40% TSS	40	40.16	40.33	40.96	40.48	2.0	2.74	2.75	2.79	2.76
T_2- 30% juice* + 40% TSS	40	40.33	40.70	41.70	40.91	2.0	2.70	2.70	2.76	2.72
T_3- 25% juice* + 45% TSS	45	45.16	45.76	46.40	45.77	2.0	2.32	2.45	2.47	2.41
T_4- 30% juice* + 45% TSS	45	47.10	47.53	48.20	47.61	2.0	2.24	2.26	2.32	2.27
T_5- 25% juice* + 50% TSS	50	53.23	53.40	54.40	53.67	2.0	2.16	2.21	2.41	2.26
T_6- 30% juice* + 50% TSS	50	53.70	54.03	54.66	54.13	2.0	2.13	2.16	2.16	2.15
T_7- 30% juice** + 40% TSS	40	41.20	41.33	41.70	41.41	2.0	2.62	2.64	2.75	2.67
Mean	44.28	45.84	46.15	46.86	46.28	2.0	2.41	2.45	2.79	2.46
S.Em ±	1.496	0.062	0.041	0.280		0.227	0.062	0.066	0.085	
CD (P<0.01)	6.298	0.265	0.175	1.178		NS	0.263	0.280	0.360	

*Tamarind: Ginger (9:1); **Tamarind : Mango ginger (9:1); #Acidity (1%) and salt (0.5%); DAS=Days after storage

treatment T_6 (53.70%, 54.03% and 54.66%) recorded maximum TSS compared to other treatments during storage. This increase might be due to hydrolysis of polysaccharides like starch and pectic substances into simpler substances. Similar observations were recorded by Kotecha & Kadam (2003) in tamarind syrup and Nath *et al.* (2005) in ginger blended kinnow mandarin squash. The pH of the prepared products showed an increasing trend at different days of storage (DAS) (Table 2). The mean pH varied between 2.15-2.76. Among the treatments T_6 (2.13, 2.16 and 2.16) & T_5 (2.16, 2.21 and 2.41) recorded lowest pH at 30, 60 and 90 DAS, respectively compared to all other treatments. This was mainly due to corresponding decrease in acidity. Similar observation was observed by Nath *et al*. (2005) in kinnow mandarin-ginger squash. Acidity of the prepared products gradually declined during storage (Table 3). The mean acidity varied between 0.88-0.95%. Among the different treatments maximum acidity was noticed in T_1 (0.97, 0.95 and 0.93) which was on par with T_2 (0.96, 0.94 and 0.92 at 30, 60 and 90 DAS, respectively). This decrease might be due to acid hydrolysis of polysaccharides and non-reducing sugars to their simpler components where the acid is utilized for converting them to hexose sugars or complexes in the presence of metal ions. Analogous result was reported by Gajanana (2002) in amla juice. Reduction in acidity during the storage period of the beverages was observed by Lakshmi *et al*. (2005) in flavoured tamarind RTS beverages and Nidhi *et al.* (2008) in RTS bael-guava beverage.

Gradual decrease in ascorbic acid content in tamarind squash blended with ginger was observed during storage (Table 3). The mean ascorbic acid content varied between 3.29-3.68 mg 100 g^{-1}. Among the treatments T_2 (3.75, 3.70 and 3.62 mg 100 g^{-1}), which was on par with T_1 (3.73, 3.64, 3.60 mg 100 g^{-1}) and T_6 (3.67, 3.64, 3.51 mg 100 g^{-1}) recorded maximum ascorbic acid retention during 30, 60 and 90 DAS, respectively compared to other treatments during storage. Gradual decrease of ascorbic acid content may be due to oxidative destruction of ascorbic acid in the presence of

Table 3. Changes in titratable acidity and ascorbic acid of tamarind squash blended with ginger at different days of storage

Treatment	Titratable acidity (%)					Ascorbic acid (mg 100 g^{-1})				
	Initial	30 DAS	60 DAS	90 DAS	Mean	Initial	30 DAS	60 DAS	90 DAS	Mean
T_1- 25% juice* + 40% TSS	1.0	0.97	0.95	0.93	0.95	3.75	3.73	3.64	3.60	3.64
T_2- 30% juice* + 40% TSS	1.0	0.96	0.94	0.92	0.94	3.75	3.75	3.70	3.62	3.68
T_3- 25% juice* + 45% TSS	1.0	0.93	0.92	0.89	0.91	3.75	3.71	3.61	3.56	3.62
T_4- 30% juice* + 45% TSS	1.0	0.92	0.91	0.88	0.90	3.75	3.58	3.56	3.54	3.58
T_5- 25% juice* + 50% TSS	1.0	0.91	0.89	0.86	0.88	3.75	3.40	3.28	3.20	3.29
T_6- 30% juice* + 50% TSS	1.0	0.90	0.87	0.84	0.87	3.75	3.67	3.64	3.51	3.60
T_7- 30% juice** + 40% TSS	1.0	0.95	0.94	0.91	0.93	3.75	3.71	3.62	3.58	3.63
Mean	1.0	0.93	0.91	0.89	0.91	3.75	3.65	3.57	3.51	3.57
S.Em ±	0.079	0.005	0.005	0.006		0.112	0.024	0.015	0.062	
CD (P<0.01)	NS	0.024	0.022	0.028		NS	0.102	0.067	0.264	

*Tamarind: Ginger (9:1); **Tamarind : Mango ginger (9:1); #Acidity (1%) and salt (0.5%); DAS=Days after storage

molecular O_2 by enzymes (Seung & Adel 2000). Comparatively higher ascorbic acid content was observed at the end of storage period in case of samples having higher percentage of juice content. Analogous observations for decline in ascorbic acid content was observed in aonla juice by Gajanana (2002), in rose apple-aonla squash by Basavaraja (2005) and in bael-guava RTS by Nidhi *et al*. (2008). Increase in reducing and total sugars and decrease in non-reducing sugars is a general phenomenon noticed by many workers. Among the treatments, the maximum reducing sugars, non-reducing sugars and total sugars, were noticed in T_6 consisting of 30% juice + 50% TSS (Table 4). Significantly highest reducing sugar was recorded in T6 (9.22%, 9.51% and 9.81%) at 30, 60 and 90 DAS, respectively. Significantly highest non- reducing sugars was recorded in T_6 (20.53%), which was, however, non significant at 60 and 90 DAS. Total sugar content of tamarind blended ginger squash increased slightly during storage. It could be attributed to the acid hydrolysis of polysaccharides which resulted in increase in soluble sugars content. Similar findings were observed by Kotecha & Kadam (2003) in tamarind syrup and Sahu *et al*. (2006) in mango-lemongrass beverage observed an increase in total and reducing sugars and decrease in non-reducing sugars during storage.

Organoleptic evaluation (Scores out of 5.00)

At 30, 60 and 90 DAS significantly maximum score for colour, aroma & overall acceptability was observed in treatment T_6, whereas for taste, maximum score was found in treatment T_5 (Table 5 & Fig. 2). This might be due to better consistency, acceptable color and sugar acid blend. Similar result has been reported in tamarind RTS (Kotecha & Kadam 2003). A proper sugar acid blend improves the taste of the juice. Therefore, in the present investigation, different levels of tamarind juice, TSS and acid were tried in order to produce good quality squash. The recipe containing 30% juice + 50% TSS + acidity (1%) + salt (0.5%) + KMS (0.25 g L^{-1}) was found superior with respect to overall acceptability.

Table 4. Changes in sugars of tamarind squash blended with ginger at different stages of storage

Treatment	Reducing sugars (%)					Non Reducing sugars (%)					Total sugars (%)				
	Initial	30 DAS	60 DAS	90 DAS	Mean	Initial	30 DAS	60 DAS	90 DAS	Mean	Initial	30 DAS	60 DAS	90 DAS	Mean
T_1- 25% juice* + 40% TSS	8.25	8.53	8.82	9.12	8.82	13.40	13.74	13.95	14.15	13.94	21.65	22.27	22.77	23.27	22.77
T_2- 30% juice* + 40% TSS	8.25	8.63	8.96	9.25	8.94	13.40	17.67	17.84	18.05	17.85	21.65	26.30	26.80	27.30	26.80
T_3- 25% juice* + 45% TSS	8.25	8.80	9.10	9.40	9.10	13.40	19.50	19.70	19.97	19.72	21.65	28.30	28.80	29.30	28.80
T_4- 30% juice* + 45% TSS	8.25	8.94	9.23	9.53	9.23	13.40	18.39	18.60	18.80	18.59	21.65	27.33	27.83	28.33	27.83
T_5- 25% juice* + 50% TSS	8.25	9.08	9.37	9.67	9.37	13.40	14.32	14.53	14.73	14.52	21.65	23.40	23.90	24.40	23.90
T_6- 30% juice* + 50% TSS	8.25	9.22	9.51	9.81	9.51	13.40	20.53	20.74	20.94	20.73	21.65	29.75	30.25	30.75	30.25
T_7- 30% juice** + 40% TSS	8.25	8.62	8.93	9.22	8.92	13.40	16.61	16.80	17.01	16.80	21.65	25.23	25.73	26.23	25.73
Mean	8.25	8.83	9.13	9.42	9.12	13.40	17.25	17.45	17.66	17.45	21.65	26.08	26.58	27.08	26.58
S.Em ±	0.322	0.008	0.005	0.074		1.009	0.045	0.184	0.225		0.891	1.401	2.452	1.656	
CD (P<0.01)	NS	0.037	0.024	0.312		NS	0.191	NS	NS		NS	NS	NS	NS	

*Tamarind: Ginger (9:1); **Tamarind : Mango ginger (9:1); #Acidity (1%) and salt (0.5%); DAS=Days after storage

Table 5. Organoleptic scores (out of 5.00) for colour, aroma and taste of tamarind squash as influenced by treatments

Treatment	Colour (out of 5.00)				Aroma (out of 5.00)				Taste (out of 5.00)			
	30 DAS	60 DAS	90 DAS	Mean	30DAS	60 DAS	90 DAS	Mean	30DAS	60 DAS	90 DAS	Mean
T_1- 25% juice* + 40% TSS	3.30	3.20	3.18	3.22	3.00	2.41	2.21	2.54	3.25	3.35	3.46	3.35
T_2- 30% juice* + 40% TSS	3.50	3.40	3.38	3.42	3.51	2.83	2.68	3.00	3.54	3.61	3.75	3.63
T_3- 25% juice* + 45% TSS	3.40	3.30	3.28	3.32	3.16	3.08	2.86	3.03	3.38	3.41	3.55	3.44
T_4- 30% juice* + 45% TSS	3.80	3.78	3.76	3.78	3.78	3.58	3.25	3.53	3.85	3.91	4.05	3.93
T_5- 25% juice* + 50% TSS	3.70	3.68	3.66	3.68	3.68	2.98	2.51	3.06	3.93	4.18	4.48	4.188
T_6- 30% juice* + 50% TSS	3.90	3.80	3.78	3.82	3.83	3.75	3.48	3.68	3.90	4.13	4.26	4.11
T_7- 30% juice** + 40% TSS	3.60	3.50	3.45	3.51	3.26	3.08	2.66	3.00	3.18	3.21	3.35	3.24
Mean	3.60	3.52	3.49	3.53	3.46	3.10	2.80	3.12	3.57	3.69	3.84	3.70
S.Em ±	0.057	0.051	0.05		0.137	0.201	0.152		0.114	0.103	0.119	
CD (P<0.01)	0.24	0.184	0.210		0.551	0.879	0.644		0.426	0.487	0.483	

*Tamarind: Ginger (9:1); **Tamarind : Mango ginger (9:1); #Acidity (1%) and salt (0.5%); DAS=Days after storage

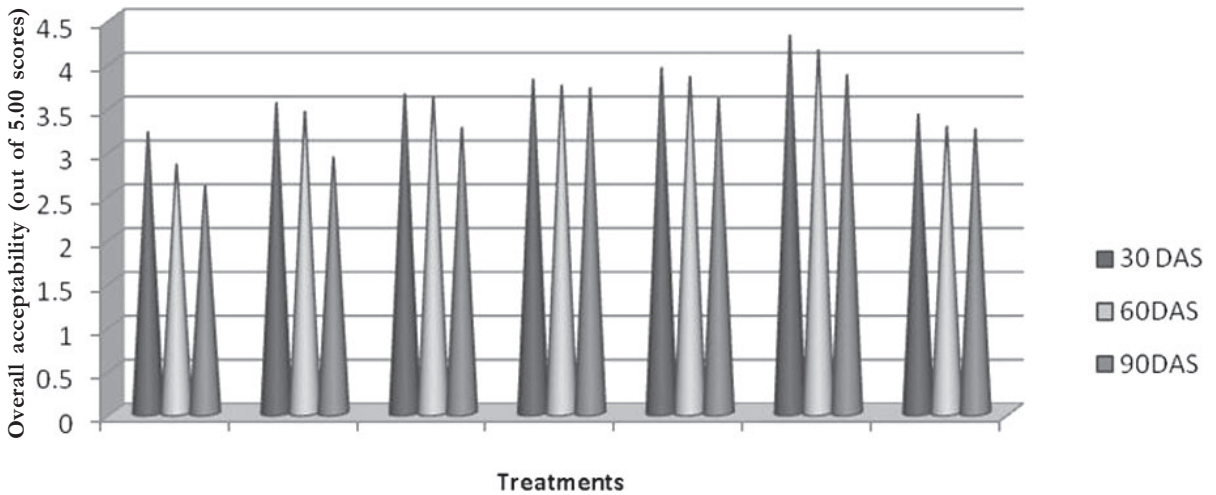

Fig. 2. Changes in overall acceptability of tamarind squash blended with ginger during storage
T_1-25% juice + 40% TSS; T_2-30% juice + 40% TSS; T_3-25% juice + 45% TSS; T_4-30% juice + 45% TSS; T_5-25% juice + 50% TSS; T_6-30% juice + 50% TSS; T_7-30% juice + 40% TSS

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