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Development and Quality Evaluation of Tamarind Plum Blended Squash During Storage

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Abstract

The achievement was done to study the combination of tamarind plum blended squash for 90 days' interval at room temperature. Tamarind and plum was added at a combination of 750: 0, 650: 100, 550: 200, 450: 300, 350:400, 250:500, 150:600 and 50:700 represent each treatment. The prepared tamarind plum blended squash was analyzed physio-chemically for TSS, Ascorbic acid, acidity, sugar acid ration, pH, reducing and non-reducing sugar, organoleptically for taste, color, texture and overall acceptability for a total period of 90 days. The result of the statistical analysis showed that treatment and storage interval shows a significant ($P<0.05$) effect both physio-chemical and organoleptic evaluation. Results also revealed that the decrease occurred in ascorbic acid content from (39.49 mg/100 gm to 27.40 mg/100 gm), titratable acidity (1.09% to 0.98%),non-reducing sugar (44.36% to 21.97%), and sensory evaluation included taste (6.85 to 5.83), color (6.33 to 5.36), flavor (7.54 to 5.75) and overall acceptability (8.03 to 6.14) while increased was found in total soluble solid (48.98°brix to 49.61°brix), sugar-acid ratio (44.94 to 50.79), pH (2.77 to 2.84), reducing sugar (17.21% to 31.23%) during storage. The maximum mean values were observed for TSS is TPS_7 (51.64°brix), ascorbic acid TPS_7 (37.87 mg/ 100 gm), titratable acidityTPS_1 (2.31%), sugar acid ratio TPS_0 (50.55), pH TPS_7 (2.93), reducing sugar TPS_0 (25.32%), non-reducing sugar TPS_4 (37.64%), color TPS_5 (6.70), flavourTPS_5 (7.54), taste TPS_5 (7.00) and overall acceptability TPS_5 (7.76). Among all the treatment TPS_5 was found to be the best. The result revealed that significant ($P<0.05$) decreased was found in physio-chemical and organoleptic parameter of treatment TPS_5.

Keywords: Plum; Tamarind; Vitamin C; Sodium benzoate; Acidity

Introduction

Tamarind (*Tamarind indica L.*) belongs to *Caesalpiniaceae* family. It is mostly grow in tropical Africa but has become naturalized in North and South America from Florida to Brazil, also grown in subtropical China, India, Pakistan, China, Thailand, Philippines, Indonesia and Spain. Tamarind fruit can be used for many purposes such is digestive, carminative, laxative, expectorant and tonic blood [1]. Tamarind pulp has medicinal purposes also and continues to be used by many people in Africa, Asia and America [2]. Tamarind juice have certain disadvantages such as unappetizing color, loss of fresh taste and spoiled easily [3] and hypoglycemic activity [4]. Tamarind pulp is mainly used for souring food products like chutneys, sambar, curries and sauces. Tamarind pulp is also used in preparations of jams, jellies, ice-creams, wine like beverages, canned tamarind juice and syrup. 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 be used with original flavor after thermal processing [2]. Tamarind fruit contain low water content and is difficult to extract pulp from the fruit. With the advancing of technologies pulp of tamarind can be extracted by conventional processing techniques like soaking, maceration and straining. With the use of such techniques we can easily extract pulp [5]. The pulp of tamarind contains tartaric acid, reducing sugars, pectin, proteins, fiber, and cellulosic materials. The acid and sugar contents differ from sample to sample; for example, tartaric acid: 8%-18%, reducing sugars 25% to 45%, pectin 2% to 3.5% and proteins 2% to 3% [6]. Tamarind pulp has rich aroma and pleasant acidic taste which is widely used as a chief souring agent for curries, sauces, and certain beverages. The pulp also used as a raw material for the preparation of wine like beverages [7].

Plum (*Prunus domestica* L.) is highly perishable climacteric stone fruit and has short shelf-life at optimal temperatures. Decay of plum fruit may be due to mold growth and rapid ripening during storage. Shelf life of plum can be extend through proper handling, transportation and marketing chain and also to kept in low temperature storage to extent postharvest quality of the fruit [8]. Plum also called as stones fruits consist of a solid covering with seed enclosed. The enclosed seed of plum is richest in proteins, lipids thus, they maybe a cheap source of different substances that could be useful for food, cosmetic, and pharmaceutical industries. The lipid content of plum seeds has already been explored. Plums contain red flesh and peel and are very exciting fruit due to their high content on bioactive compounds, such as the anthocyanins and other polyphenolic compounds with a high antioxidant capacity [9]. These natural substances found in plum acts to prevent diseases such as diabetes and cancer [10]. Concentrated soft drinks are used for refreshing purpose and are very popular drink contains certain proportion of juice. The summer season of Pakistan is long there for mostly people uses such type of beverages. Such type of activities like production, preservation and sale of these beverages provide commercial importance to our country [11]. Fruit beverages are a combination of products containing pulp, juice and water as well as sweetener, coloring, flavoring, and preservatives. Although fruit ingredient present in beverages has a dominant role of providing flavor and overall character, such types of products differ from fruit

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Treatments	Tamarind juice (ml)	Plum juice (ml)	CMC (g)	Sugar (kg)	Water (ml)	potassium meta-bi-sulphite (%)
TPS_0	750	_	2	1	250	0.1
TPS_1	650	100	2	1	250	0.1
TPS_2	550	200	2	1	250	0.1
TPS_3	450	300	2	1	250	0.1
TPS_4	350	400	2	1	250	0.1
TPS_5	250	500	2	1	250	0.1
TPS_6	150	600	2	1	250	0.1
TPS_7	50	700	2	1	250	0.1

Table 1: Proposed plan of study for research.

juices and are labeled accordingly [12]. Keeping in view the importance of tamarind plum fruit; the plum and tamarind blended squash is developed.

Objectives

a. To produce value added beverage from blends of tamarind plum.

b. To develop suitable combination of tamarind plum blended squash.

c. To analyze tamarind plum blended squash for physicochemical and sensory characteristic during storage.

Materials and Methods

Selection of fruits

Tamarind and Plum fruit at optimum maturity were purchased from the local market of Peshawar and was brought to the laboratory of Food Technology section, ARI Tarnab, Peshawar, for preparation of tamarind plum blended squash.

Pretreatment of blended squash

Tamarind and Plum fruit were carefully sorted to discard diseased, damaged, bruised and immature fruits. Then sorted fruits were thoroughly washed with tap water and the water was drained off. The unwanted portion was removed by trimming. The pulp was extracted by using pulping machine (Model.35027, Rochdale England).

Preparation of blended Squash

Tamarind and plum fruit blended squash were prepared following the method of Archana and Laxman [13], showed in (Table 1). The materials were added following the ratio 4:3:1 of sugar, pulp and water respectively.

Packaging and storage

The prepared squash was packed in PET bottles and was stored at room temperature for 3 months and was study for phsico-chemical characteristics and sensory attributes at 15 days of intervals.

Physicochemical analysis

The prepared squash was examining for pH, TSS, Titratable acidity, Vit C, reducing and non-reducing sugar, sugar acid ratio was calculated from the data of TSS and titratable acidity and was measured by method of AOAC [14].

Total soluble solids

TSS (°brix) were find out by the standard method of AOAC [14], method no, 932.14 and 932.12. TSS (°brix) of the blended squash was finding out using hand refractometer. The instrument was calibrated and takes the reading accurately by putting a minute quantity of tamarind plum blended squash.

Titratable acidity

Preparations of standard solution 0.1 N NaOH: Take 6.30 g of oxalic acid and 4.5 g of NaOH in a volumetric flask and add distilled water in it to make a volume of 1 liter separately. Take 10 ml of 0.1 N solution of NaOH and titrate against 0.1 N solution of oxalic acid. Add 3 drops of phenolphthalein (indicator). Repeat the experiment for three times. Taken the reading till pink color is appears.

Titration of sample: Take 10 ml of squash sample, dissolved in distilled water to make a volume of 100 ml. Then take 10 ml of sample solution and add two drops of phenolphthalein and titrate along 0.1N NaOH solution. Repeat the experiment for 3 times to reduce error. Take the reading when pink color is appears.

$$\text{Acidity}(\%) = \frac{CF \times N \times T \times D \times 100}{V \times S}$$

Where:

C.F = Correction Factor for acidity.

N = Normality of sodium hydroxide used.

T = ml of sodium hydroxide used.

D = Dilution Factor for sample.

V = Sample taken for dilution.

S = Sample taken for titration.

Sugar acid ratio

Sugar acid ratio for tamarind plum blended squash was calculated using the formula.

$$\text{Sugar acid ratio} = \frac{\text{Total Soluble Solids}(\text{TSS})}{\text{Titratble acidity}(\%)}$$

pH

The pH;is hydrogen ion concentration and it ranges from 1 to 14 that shows acidity and alkalinity of the sample, while the pH with 7 is neutral that is pure water indication. To find out pH of the sample, proper method of AOAC [14], 2005.02 was applied. Switch on the pH meter and standardized with the buffer solution of pH 4 and pH 7, respectively. Take10 ml of tamarind plum sample in a beaker and put the electrode in it and note the result.

Reducing sugar

To analyze/ reducing sugar of tamarind plum blended squash standard method' of AOAC [14], 920.183 was' applied.

Reagents

Fehling A: Dissolved. 34.65g of $CuSO_4.5H_2O$ in 500 ml of distilled, water.

Fehling B: Take 173 g of potassium/ titrate and 50gg of NaOH in beaker, dissolve it in 10 ml of water. The prepared solution was; taken and put into 500 ml conical flask and volume was prepared up to the mark by means of distillation water.

Methylene blue: Methylene blue is an indicator. Take 0.2 g of methylene; blue in 100 ml of volumetric flask and dissolve it in 150 ml of distillated water and the level was]made up to the spot, through further addition distilled water.

Procedure: Take 10 ml of tamarind plum blended squash sample and add distilled water to make the exact volume of 100 ml. Then take 5 ml of Fehling A and 5 ml of Fehling B, with 10 ml of distilled water was taken in conical flask. Heat was given to the flask till boiling start. Add the solution from the burette drop by drop till color becomes bricks red. 2 drops of methylene blue was added in a boiling solution. If color changes from red to blue the reaction needed to add extra tamarind plum solution till brick red color persists.

Calculation: Amount of Fehling A is 5 ml + % ml of Fehling B = X ml of the 10% of sample solution is equal of 0.05 g of reducing sugar × 100 ml of 10 % sample solution will contain.

$$\text{100 ml of10 \% solution will contain} = \frac{0.05 \times 100}{\text{X ml}} = \text{ Y g of reducing sugar}$$

$$\text{Reducing sugar}(\%) = \frac{\text{Y} \times 100}{10}$$

Non-reducing sugars

To investigate non-reducing sugar of tamarind plum blended squash standard method of AOAC [14], 920.184 was applied.

Procedure: 10 ml of sample was taken in volumetric flask and volume was made 100 ml with distill water. 20 ml of solution was taken and dilute with 10 ml of 1 N HCl. Mixture was heated till boiling, 10 ml of 1 N of NaOH was added after cooling and volume was made 250 ml. Take 5 ml Fehling A and B solution and dilute with 10 ml distilled water. Heat the solution to boiling and add tamarind plum blended diluted solution drop by drop till red brick color appears. Add 2 drops of methylene blue to check either the reaction is completed or not. For determination of non-reducing sugar the following formula was applied.

Calculations: Solution is equal to X ml = 0.05 g of reducing sugars

250 ml of sample contains = 259 × 0.05 / ml = Y g of reducing sugars

This 250 ml of sample solution was prepared from 20 ml of 10%.

Sample solution contains Y × 100 / 20 = P g reducing sugar.

10 ml of sample solution contain = P g of reducing sugar.

100 ml of sample solution contain = P × 100/10 = Q g of total reducing sugar.

Q g of reducing sugar = inverted sugar + free reducing sugar.

Formula for non-reducing sugar is = total reducing sugar – free reducing sugar.

Ascorbic acid

Preparation of standard solutions: 42 mg of sodium bicarbonates ($NaHCO_3$) and 50 mg of 2,6 dichlorophenol indophenols dye to make the volume of 250 ml with distilled water. To prepare standard solution of Vitamin C take 50 mg of ascorbic acid and poured in 50 ml 0.4% of oxalic acid solution. Keep the solution for 24 hours. Take 5 ml of ascorbic acid solution and titrate along dye till pink color appears and persists for one minute. Formula used to find out dye factor.

$$\text{Dye factor}(\text{F}) = \frac{\text{vitamin C solution taken in ml}}{\text{Volume of used dye}}$$

Titration of sample: Take 10 ml of tamarind plum blended squash and make a volume of 100 ml with 0.4% oxalic acid solution. 10 ml of sample solution were taken in a flask and titrate along dye to appear pink color and persist for 15 sec. Formula for Vitamin C content is:

$$\text{Ascorbic acid (mg/100 g)} = \frac{\text{F} \times \text{T} \times 100}{\text{S} \times \text{D}}$$

Where,

F = Standardization factor = ml of ascorbic acid / ml of pigment used.

T = ml of pigment used for sample.

S = ml of diluted sample taken for titration.

D = ml of sample taken for dilution.

Sensory evaluation

The samples of tamarind plum blended squash were sensory evaluated for color, texture, flavor and overall acceptability by 10 trained judge's panel. Organoleptic study was carried out for about 3 month. The evaluations were done using 9 points hedonic scale of Larmand [15].

Statistical analysis

All the data concerning treatments and storage interval were statistically analyzed by means of complete Randomized Design (CRD) 2 Factorial as recommended by Hicks [12] and the means were find out using least significant difference (LSD) Test at 5% possibility level.

Result and Discussion

Total soluble solids (°brix)

According to Table 2 the sample of tamarind plum blended squash were studied for TSS (°brix). The data of the samples shows significant ($P<0.05$) increase during keeping time of storage. The sample of the tamarind plum blended squash were in the range of 47.45 (TPS_2) to 51.35 (TPS_7). The TSS of all the samples was gradually rises from 48.29 (TPS_0) to 51.94 (TPS_7) during 90 days of storage. Table 2 also showed that minimum mean TSS value was recorded for TPS_2 (47.78) while TPS_7 had maximum mean value of (51.64). Similarly, this is also observed from the data that maximum percent increase in TSS was found in TPS_2 (1.76), while a sample TPS_5 (1.05) had a minimum percent increase. The data showed a significant change in blended squash of tamarind plum during storage. Similar observations were recorded by Kotecha and Kadam [16] in tamarind syrup and Nath et al. [17] in ginger blended with mandarin squash that because of hydrolysis of polysaccharides like starch and pectic substances into simpler substances during processing increases in TSS. Gillani [18] investigated increase in TSS in different mango cultivar. With the use of chemical preservative TSS of apple pulp increases Kinh et al. [19]. It is concluded that TSS of tamarind plum blended squash increased with storage and treatment.

Ascorbic acid (Vitamin C)

The data from Table 3 shows significant ($p < 0.05$) effect on

Treatment	Storage interval							% Inc	Means
	Initial day	15	30	45	60	75	90		
TPS_o	47.55	47.69	47.78	47.88	47.92	48.12	48.29	1.53	47.89g
TPS_1	47.65	47.74	47.84	47.96	48.11	48.23	48.33	1.41	47.98f
TPS_2	47.45	47.54	47.65	47.74	47.84	47.93	48.03	1.76	47.78h
TPS_3	48.35	48.44	48.56	48.63	48.72	48.81	48.92	1.17	48.63e
TPS_4	49.25	49.34	49.43	49.52	49.62	49.73	49.82	1.14	49.53d
TPS_5	49.95	50.04	50.11	50.2	50.29	50.39	50.48	1.05	50.21c
TPS_6	50.25	50.34	50.43	50.54	50.62	50.73	50.81	1.10	50.53b
TPS_7	51.35	51.45	51.54	51.63	51.74	51.85	51.94	1.14	51.64a
Mean	48.98g	49.07f	49.17e	49.26d	49.36c	49.47b	49.61a	--	--

[a-g] Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 2: TSS (°brix) of squash prepared from blending of tamarind and plum juice at different levels.

Treatments	Storage interval							% Dec	Means
	Initial day	15	30	45	60	75	90		
TPS_o	35.79	33.35	31.09	29.78	27.87	25.35	23.76	33.61	29.69g
TPS_1	36.23	35.98	33.98	31.09	26.98	25.18	23.93	33.95	30.60f
TPS_2	37.98	36.01	34.98	31.35	28.64	26.98	25.75	32.20	31.68e
TPS_3	38.09	37.98	33.09	32.29	30.01	28.87	26.75	31.23	32.68d
TPS_4	39.91	37.45	35.67	33.91	31.25	29.65	27.85	30.22	33.67c
TPS_5	41.25	39.28	38.01	36.61	34.44	32.11	30.01	27.03	35.98b
TPS_6	41.99	39.24	37.35	36.12	33.42	31.81	29.19	30.48	35.59b
TPS_7	43.86	41.23	39.09	37.54	36.15	34.54	31.87	27.34	37.87a
Mean	39.49a	37.58b	35.72c	33.69d	31.11e	29.31f	27.40g	--	--

[a-g] Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 3: Ascorbic acid of squash prepared from blending of tamarind and plum juice at different levels.

Treatments	Storage interval							% Dec	Mean
	Initial day	15	30	45	60	75	90		
TPS_o	1.00	0.98	0.96	0.95	0.93	0.92	0.90	10.00	2.08h
TPS_1	1.03	1.01	0.99	0.97	0.95	0.93	0.91	11.65	2.31g
TPS_2	1.05	1.03	1.01	0.99	0.97	0.95	0.93	11.43	2.29f
TPS_3	1.08	1.06	1.04	1.03	1.01	0.99	0.97	10.19	2.17e
TPS_4	1.11	1.09	1.07	1.05	1.03	1.02	1.00	9.91	2.16d
TPS_5	1.15	1.13	1.11	1.09	1.08	1.06	1.04	9.57	2.15b
TPS_6	1.13	1.11	1.09	1.07	1.05	1.04	1.02	9.73	2.16c
TPS_7	1.18	1.16	1.15	1.13	1.11	1.08	1.06	10.17	2.25a
Mean	1.09a	1.07b	1.05c	1.04d	1.02e	1.00f	0.98g	--	--

[a-g] Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 4: Titratable acidity of squash prepared from blending of tamarind and plum juice at different levels.

storage and treatment of blended squash of tamarind plum. There shows a significant ($p < 0.05$) decrease in vitamin C. The ascorbic acid of tamarind plum squash was in the zero days from 35.79 (TPS_0) to 43.86 (TPS_7) which is then gradually decrease from 23.76 (TPS_0) to 31.87 (TPS_0) during storage period of 90 days. Mean value of ascorbic acid was recorded 39.49 at zero-day interval, while 27.40 at for the period of 90 days. According to Table 3, TPS_7 had a highest mean value (37.87), while TPS_0 had minimum (29.69) mean value. Sample TPS_1 (33.95) shows highest percent decrease, while sample TPS_5 (27.03) has lowest. The above results are in agreement with Kinh et al. [19], studied lower percent of ascorbic acid found in apple pulp affected by both temperature and light. Saleem et al. [20] studied that time interval also decreases ascorbic acid value. Bezman et al. [21] also concluded that ascorbic acid of grape juice also decreased during time of storage in room temperature. Storage interval, oxygen, light and heat treatment decrease the effect of ascorbic acid by both enzymatic and non-enzymatic catalyst [22]. In most liable nutrients, Vitamin C is very important because its degradation is used as an indicator of quality.

Titratable acidity

In Table 4 samples of tamarind plum squash shows significant (P<0.05) difference during time period of storage. The % acidity of the squash samples was in the range of 1 (TPS_o) to 1.18 (TPS_7) at initial day, while showed a decreasing trend of 0.9 (TPS_o) to 1.06 (TPS_7) correspondingly during 90 days of interval. Mean value at initial day was 1.09, decreases to 0.98 at 90 days intervals. The sample TPS_1 (2.31) shows high value of mean while sample TPS_5 (2.15) shows minimum TPS_1 (11.65) had a maximum % decrease in acidity, while TPS_5 (9.57) showed the minimum decrease in percent acidity. Increase of acidity is because of storage condition and pectic substance break down [23]. Hye et al. [24] found increasing trend in acidity, while pH decrease of fruit juices during processing and storage time. Analogous result was reported by Gajanana [25] that hydrolysis of polysaccharides and non-reducing sugars reduces acid of amla juice, where the acid is converting to hexose sugars or complexes in the presence of metal ions. Lakshmi et al. [26] and Nidhi et al. [27] also observed reduction in acidity during the storage period of the tamarind RTS and RTS bael-guava beverages

Treatment	Storage interval							% Inc	Mean
	Initial day	15	30	45	60	75	90		
TPS_o	47.55	48.66	49.77	50.40	51.53	52.30	53.66	11.38	50.55a
TPS_1	46.26	47.27	48.32	49.44	50.64	51.86	53.11	12.89	49.56b
TPS_2	45.19	46.16	47.18	48.22	49.32	50.45	51.94	12.99	48.35c
TPS_3	44.77	45.70	46.69	47.21	48.24	49.30	50.43	11.23	47.48d
TPS_4	44.37	45.27	46.20	47.16	48.17	48.75	49.82	10.94	47.11e
TPS_5	43.70	44.55	45.43	46.37	46.87	47.86	48.86	10.56	46.23f
TPS_6	44.20	45.08	45.97	46.92	47.90	48.45	49.49	10.68	46.86e
TPS_7	43.52	44.35	44.82	45.69	46.61	48.01	49.00	11.19	46.00f
Mean	44.94g	45.88f	46.80e	47.68d	48.66c	49.62b	50.79a	--	--

a-g Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 5: Sugar acid ratio of squash prepared from blending of tamarind and plum juice at different levels.

Treatment	Storage interval							% Dec	Means
	Initial day	15	30	45	60	75	90		
TPS_o	2.68	2.69	2.71	2.72	2.73	2.74	2.76	2.90	2.72h
TPS_1	2.69	2.07	2.72	2.73	2.75	2.76	2.77	2.89	2.73g
TPS_2	2.72	2.73	2.74	2.75	2.76	2.78	2.79	2.51	2.75f
TPS_3	2.72	2.74	2.75	2.76	2.78	2.79	2.08	2.86	2.76e
TPS_4	2.75	2.76	2.77	2.79	2.81	2.82	2.83	2.83	2.79d
TPS_5	2.86	2.88	2.89	2.91	2.92	2.92	2.93	2.39	2.90b
TPS_6	2.81	2.83	2.84	2.85	2.86	2.87	2.88	2.43	2.85c
TPS_7	2.89	2.9	2.92	2.93	2.94	2.95	2.97	2.69	2.93a
Mean	2.77g	2.78f	2.79e	2.81d	2.82c	2.83b	2.84a	--	--

a-g Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 6: pH of squash prepared from blending of tamarind and plum juice at different levels.

respectively. It's released from the data that the titratable acidity decreases with storage and treatment.

Sugar acid ratio

Table 5 shows a significant (P<0.05) effect on both the treatment effect and storage effect on blended squash of tamarind plum. The ratio sugar acid of squash samples was in the range of 43.52 (TPS_7) to 47.55 (TPS_o) at initial day, while showed an increasing trend of 48.86 (TPS_6) to 53.66 (TPS_1) correspondingly during 90 days storage interval. Initial day storage mean was 44.94, which increase to 50.79. Sample TPS_o (50.55) show high mean value while the sample TPS_7 (46.00) with lowest value of mean. Sample TPS_o showed % increase of maximum (11.38), while TPS_5 (10.56) showed the minimum increase in percent sugar acid ratio. According to Chyau et al. [28] substances like pectin, reducing sugar, total sugar and acidity of guava fruit decreases at ripe stage while the sugar/acid ratio of the fruit guava increased. It is concluded from the data that sugar acid ratio increased with time by storage and treatment.

pH

The data of tamarind plum blended squash shows a decreasing trend during the period of storage intervals. Tamarind plum squash pH was in between 2.68 (TPS_o) to 2.89 (TPS_7) at zero days of interval which gradually increases from 2.76 (TPS_o) to 2.97 (TPS_7) during 90 days of storage time. Mean of the data at 1st day was 2.77, and then decreased to 3.73 during keeping time of storage. Sample TPS_7 of tamarind plum squash shows high mean 2.93, while sample TPS_o of tamarind plum has a lowest mean 2.72. Sample TPS_o has high percent decrease of (2.90) in case of pH. However, squash sample TPS_5 (2.39) of the minimum pH with percent decrease found. There found a significant (P<0.05) effect of tamarind plum blended squash in case of time and treatment. Nath et al. [17] investigate same results for kinnow (mandarin) ginger squash. According to Jitareerat et al. [29] pH of fruits and vegetables changes because of heat treatment on biochemical substances, decrease of respiration and metabolic process. Cecilia and Maia [30] studied a decreasing trend in pH of apple juice during keeping time. With the increase of acidity and pectin hydrolysis pH of the juice decline [31]. Thus, concluded that pH increases with treatment and storage effects on tamarind plum blended squash.

Reducing sugar

Table 6 shows effect of time interval and treatment on blended squash of tamarind plum. Reducing sugars of tamarind plum squash was in between 17.10 (TPS_7) to 17.32 (TPS_1) at initial day. There shows an increasing trend of 28.10 (TPS_o) to 33.23 (TPS_3) during 90 days of storage time period. Initial day mean of tamarind plum was 17.21, which shows gradual increase of 31.23 during the storage time period. Tamarind plum sample TPS_o (25.32) showed the maximum mean value, however sample TPS_5 (23.08) had minimum mean value. Squash sample TPS_3 (48.18) found with maximum percent increase, while the sample TPS_5 (39.07) with lowest percent increase in reducing sugar. There found a significant (P<0.05) effect on tamarind plum blended squash during treatments and storage intervals of times. The above results show similarity with the report of Kotecha and Kadam [16] and Sahu et al. [32] on tamarind syrup and mango lemongrass beverage respectively reported an increase trend in total and reducing sugars. Both acidity and temperature has caused positive effect on reducing sugar (convert sucrose to glucose and fructose) [33]. Reducing sugar of fruits increases because of sucrose reduction. It is concluded that the reducing sugars of the treatment increases with time interval.

Non-reducing sugar

In the Table 7 tamarind plum blended squash data are significantly (P<0.05) reduced during storage and treatment intervals. The data of squash samples was in the range of 40.20 (TPS_o) to 47.1 (TPS_4) at initial day. While during storage period the non-reducing sugar content decrease gradually from 19.35 (TPS_o) to 25.76 (TPS_5) at 90 days of interval. Initial mean data was 44.36, which shows a reducing trend of 21.97. Tamarind plum blended sample TPS_4 (37.64) with maximum mean, while squash sample TPS_7 (30.87) with minimum mean. High percent decrease (54.95), for sample TPS_2. However, TPS_5 (44.54) showed the minimum % decrease. Kotecha and Kadam [17] and Sahu et al. [32] reported same results of increasing total sugar as well as reducing sugar, while decreasing of non-reducing sugar for tamarind syrup and mango lemongrass beverage respectively, during storage. Main cause of reducing sugar conversion to non-reducing sugar is glycogenesis, also change of vitamins, sugar and organic acid change during storage intervals in carrot pulp. Thus, concluded that the non-reducing sugar decreases with treatment and storage condition.

Taste

According to the data of Table 8, statistically shows a reducing trend significantly (P<0.05) of tamarind plum blended squash during treatment and storage condition. The sensory score for taste of tamarind plum blended squash were in the range of 6.6 ($TPS_{o,}$ TPS_7) to 7.4 (TPS_5) at zero days of interval, there found a gradual decrease of 5.5 ($TPS_{1,}$ TPS_7) to 6.5 (TPS_5) during the storage period of 90 days. Mean data for initial day was 6.85, which gradually down to 5.83. The squash of tamarind plum sample TPS_5 (7.00) shows highest mean, while with lowest score of sample TPS_7 (6.04). Sample (TPS_1) with maximum decrease of 17.91%, while minimum decrease of 12.16% was observed by TPS_5. The data above had a significant effect on taste of tamarind plum blended squash during storage and treatment time intervals. During RTS beverages light effects acids and ascorbic acid (Vitamin C) present in orange squashes [34]. The RTS of tamarind shows same results according to Kotecha and Kadam [17]. The depletion of taste is effected by acid, pH fluctuation [35].

Color

There shows a decreasing effect significantly (P<0.05) on color of tamarind plum squash during period of time interval. At zero day interval, the sensory score for color of tamarind plum squash samples

Treatment	Storage interval							% Inc	Mean
	Initial day	15	30	45	60	75	90		
TPS_o	17.25	20.25	23.76	25.48	28.15	30.35	31.98	46.06	25.32a
TPS_1	17.32	19.01	21.24	25.31	28.54	30.35	32.31	46.39	24.88ab
TPS_2	17.28	18.09	21.29	24.32	26.45	28.54	31.46	45.07	24.03bc
TPS_3	17.22	20.02	22.25	25.32	28.45	30.21	33.23	48.18	25.27a
TPS_4	17.24	19.25	22.87	24.54	26.93	28.54	30.65	43.75	24.29bc
TPS_5	17.12	20.21	22.23	23.35	24.43	26.15	28.01	39.07	23.08d
TPS_6	17.15	19.01	22.98	24.84	26.89	29.45	31.98	46.37	24.63abc
TPS_7	17.01	19.19	21.09	23.65	26.98	28.09	30.15	43.28	23.98c
Mean	17.21g	19.53f	22.32e	24.60d	27.10c	29.06b	31.23a	--	--

$^{a-g}$ Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 7: Reducing sugar of squash prepared from blending of tamarind and plum juice at different levels.

Treatment	Storage interval							% Dec	Mean
	Initial day	15	30	45	60	75	90		
TPS_o	40.02	39.56	35.43	31.87	27.85	22.96	19.35	51.87	31.03d
TPS_1	42.35	40.12	35.24	31.01	27.43	24.45	20.25	52.18	31.55d
TPS_2	44.95	42.01	38.65	34.21	30.24	23.46	20.25	54.95	33.41c
TPS_3	45.98	43.25	40.13	35.65	31.35	25.78	21.98	52.20	34.87b
TPS_4	47.01	45.24	41.21	39.19	34.99	30.01	25.65	45.54	37.64a
TPS_5	46.45	43.87	40.24	35.87	30.87	28.31	25.76	44.54	35.91b
TPS_6	46.01	45.01	40.95	37.45	30.14	25.09	22.45	51.30	35.44b
TPS_7	41.76	39.35	34.76	30.12	27.09	22.12	20.01	51.87	30.87d
Mean	44.36a	42.32b	38.33c	34.42d	30.10e	25.39f	21.97g	--	--

$^{a-g}$ Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 8: Non-reducing sugar of squash prepared from blending of tamarind and plum juice at different levels.

Treatment	Storage interval							% Dec	Mean
	Initial day	15	30	45	60	75	90		
TPS_o	6.6	6.4	6.3	6.2	6.0	5.8	5.7	13.64	6.14de
TPS_1	6.7	6.6	6.4	6.1	6.0	5.8	5.5	17.91	6.16cd
TPS_2	6.8	6.6	6.5	6.2	6.0	5.9	5.7	16.18	6.24cd
TPS_3	6.9	6.7	6.5	6.4	6.3	6.2	6.0	13.04	6.43b
TPS_4	7.0	6.9	6.7	6.5	6.3	6.1	6.0	14.29	6.50b
TPS_5	7.4	7.3	7.2	7.0	6.9	6.7	6.5	12.16	7.00a
TPS_6	6.8	6.6	6.5	6.2	6.1	5.9	5.7	16.18	6.26c
TPS_7	6.6	6.3	6.2	6.0	5.9	5.8	5.5	16.67	6.04e
Mean	6.85a	6.68b	6.54c	6.33d	6.19e	6.03f	5.83g	--	--

$^{a-g}$ Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 9: Taste of squash prepared from blending of tamarind and plum juice at different levels.

Treatment	Storage interval							% Dec	Mean
	0	15	30	45	60	75	90		
TPS_0	6.5	6.4	6.2	6.1	5.9	5.6	5.5	15.38	6.03b
TPS_1	6.3	6.2	6.0	5.9	5.6	5.5	5.3	15.87	5.83c
TPS_2	6.1	6.0	5.8	5.6	5.5	5.3	5.1	16.39	5.63e
TPS_3	6.0	5.9	5.7	5.4	5.3	5.2	5.0	16.67	5.50f
TPS_4	6.2	6.0	5.9	5.8	5.7	5.4	5.3	14.52	5.76d
TPS_5	7.1	7.0	6.9	6.7	6.6	6.4	6.2	12.68	6.70a
TPS_6	6.2	6.0	5.9	5.6	5.4	5.3	5.2	16.13	5.66e
TPS_7	6.2	6.0	5.9	5.7	5.6	5.5	5.3	14.52	5.74d
Mean	6.33a	6.19b	6.04c	5.85d	5.70e	5.53f	5.36g	--	--

$^{a-g}$ Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 10: Color of squash prepared from blending of tamarind and plum juice at different levels.

Treatment	Storage interval							% Dec	Mean
	Initial day	15	30	45	60	75	90		
TPS_0	7.1	6.6	6.0	5.4	4.4	3.3	2.3	67.61	5.01c
TPS_1	7.8	7.5	7.1	6.7	6.2	5.6	4.9	37.18	6.54b
TPS_2	7.6	7.5	7.3	7.2	7.0	6.6	6.3	17.11	7.07ab
TPS_3	7.5	7.4	7.2	7.0	6.9	6.8	6.7	10.67	7.07ab
TPS_4	7.7	7.4	7.2	6.8	6.6	6.3	6.0	22.08	6.86b
TPS_5	7.9	7.8	7.7	7.6	7.4	7.3	7.1	10.13	7.54a
TPS_6	7.4	7.3	7.1	7.0	6.8	6.7	6.3	14.86	6.94b
TPS_7	7.3	7.2	7.1	7.0	6.9	6.8	6.4	12.33	6.96b
Mean	7.54a	7.34ab	7.09ab	6.84bc	6.53cd	6.18de	5.75e	--	--

$^{a-g}$ Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 11: Flavor of squash prepared from blending of tamarind and plum juice at different levels.

Treatment	Storage interval							% Dec	Mean
	Initial day	15	30	45	60	75	90		
TPS_0	7.8	7.3	6.8	6.1	5.3	4.1	3.6	53.85	5.86d
TPS_1	8.0	7.7	7.4	7.0	6.4	5.8	5.0	37.5	6.76c
TPS_2	8.2	7.9	7.5	7.1	6.6	6.0	5.4	34.15	6.96bc
TPS_3	8.0	7.8	7.6	7.5	7.4	7.1	6.9	13.75	7.47ab
TPS_4	8.1	8.0	7.8	7.5	7.4	7.1	7.0	13.58	7.56a
TPS_5	8.2	8.0	7.9	7.8	7.7	7.4	7.3	10.98	7.76a
TPS_6	8.0	7.9	7.5	7.4	7.3	7.1	6.9	13.75	7.44ab
TPS_7	7.9	7.7	7.6	7.5	7.3	7.1	7.0	11.39	7.44ab
Mean	8.03a	7.79ab	7.51bc	7.24cd	6.93de	6.46ef	6.14f	--	--

$^{a-g}$ Values of different alphabetic letter shows significant (P<0.05) difference from each other.

Table 12: Overall acceptability of squash prepared from blending of tamarind and plum juice at different levels.

from 6 (TPS_3) to 7.1 (TPS_5) which decreased gradually from 5 (TPS_3) to 6.3 (TPS_5) through 90 days of intervals. Initial day mean was 6.33, which decreases to 5.36. The sample TPS_5 with maximum mean of 6.70 were found, while there found lowest mean of 5.50 for sample TPS_3. Decrease of 16.67 % was observed at sample TPS_3 while the minimum % decrease was noted at TPS_5 (12.68). There found a significant (P<0.05) effect on color of tamarind plum blended squash during storage interval. The result was in favor of Jain et al. [36], reported a decreasing trend in color during 90 days storage of squash. Color of the beverages decreases because of presence of 2 Methyl 3 furanthiol and methanol gives rotten flavors in stored orange juices [21]. Brennder et al. [37] studied that presence of SO_2 decreases fruits and vegetables browning.

Flavor

Table 9 shows data of tamarind plum blended squash. The mean sensory scores for flavor of squash decreased significantly (P<0.05) on both treatments and storage time intervals. The judges panel scores for flavor of tamarind plum blended squash from 7.1 (TPS_0) to 7.9 (TPS_5) during zero days of intervals. However, during storage interval of 90 days' flavor of the squash samples decreased gradually from 2.3 (TPS_0) to 7.1 (TPS_5). Mean flavor was found 7.54, which decreased to 5.75 throughout the storage period of time intervals. TPS_5 was found to be high mean (7.54), while the low score mean (5.01) was obtained for TPS_0. The maximum percent decrease in flavor of the squash was recorded in TPS_0 (67.61), while minimum decrease of 10.13% was observed at TPS_5. The tamarind plum squash was significantly (P<0.05) differ in case of treatment and time interval. Results of physiochemical, sensory properties of orange drink shows similarity were reported by Jain et al. [35]. According to Martin [38] results on pasteurized orange juice shows depletion of organoleptic quality kept in glass bottles. Similar with these results of Paracha [39], that loss of flavor of guava squashes during storage of 3 months of storage interval. A slight difference in flavor may be due to storage conditions and storage time.

Overall acceptability

Table 10 shows the effect of both the treatments and storage interval on overall quality of tamarind plum blended squash. The acceptability of overall quality of the blended squash reduces considerably ($P<0.05$) on both treatments and storage time interval. The overall acceptance score of tamarind plum squash at initial days ranges from 7.8 (TPS_0) to 8.2 (TPS_5, TPS_2), which fall gradually from 3.6 (TPS_0) to 7.3 (TPS_5) during the 90 days of storage period of time. Mean value for over-all acceptance was 8.03, which decrease down to 6.14 during the storage period. The highest score of mean (7.76) was observed at TPS_5, while minimum score of mean (5.86) was observed at TPS_0. The highest percent decrease of 53.85 was recorded at TPS_0, while minimum percent decrease of 10.98 was observed at TPS_5. The overall acceptability of tamarind plum blended squash is significantly ($P<0.05$) influenced by treatments and storage interval (Tables 11 and 12). Rosario [34] observed that with the increasing of days' storage overall quality of acceptance decreases. Loss of overall quality were affected by processing like, temperature and storage time [24].

Conclusion and Recommendations

Conclusion

Present work of tamarind plum blended squash was carried out with different proportions. Chemical preservatives were used to inhibit the growth of microbial activity in tamarind plum blended squash. Prepared squash was packed in plastic bottles and stored at room temperature for 90 days of storage. Prepared squash was then evaluated for physicochemical and sensory properties during 90 days of storage. Some physicochemical and sensory analysis was examined to be changed but not affected overall quality of the squash. On the basis of above results it was concluded that sample TPS_5 show best in keeping quality during storage time intervals. Hence, the results of sample TPS_5 of tamarind plum blended squash is more recommended in terms of commercial use and for large scale industrial production. Squash prepared from tamarind and plum are more acceptable to consumers because of sour test, need commercialization.

Recommendations

1. Different proportion of tamarind pulp can also be used with other fruit pulp.

2. It is suggested to study the influence of storage condition and packaging materials on tamarind plum blended squash.

3. This is recommended to carry a research on non-caloric tamarind plum blended squash.

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