Environment and Ecology 36 (4A) : 1100—1105, October—December 2018
Website : environmentandecology.com ISSN 0970-0420

Standardization and Nutritional Evaluation of Tamarind Juice with Stabilizers

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Received 25 May 2018; Accepted 28 June 2018; Published on 18 July 2018

Abstract Tamarind, *Tamarindus indica* L., is a multipurpose tropical fruit tree used primarily for its fruits, which are eaten fresh or processed, used as a seasoning or spice or the fruits and seeds are processed for non-food uses. In the present work, we have attempted to prepare and standardize tamarind juice using stabilizer. Juices were prepared with different variations in sugar content (T_1,T_2 and T_3) and stabilizers (TS_1 and TS_2). Statistical analysis was done to find the significant difference in sensory parameters in different treatments. The results show that there is a significant difference at ($p>0.05$) between tamarind juice with and without stabilizer i. e. T_1, TS_1 and TS_2 for quality attributes of color /appearance, texture and taste. According nutritional analysis TSS content varied from 11.7 ± 0.2 to 12.3 ± 0.05. Titrable acidity of the products varied from 0.36 ±0.01 to 0.42 ± 0.01. The ascorbic acid content was 1.8 ± 0.03 mg in TS_1 and 2.2 ± 0.10 mg in TS_2 product. Total sugar content of developed products varied from 12.13 ± 0.11 to 12.16 ± 0.09. The results showed that the developed tamarind juice of different combinations with respect to sugar and stabilizer is found to be acceptable by consumers with regard to overall acceptability.

Keywords Standardization, Nutritional evaluation, Tamarind juice, Stabilizers, Sugar content.

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Introduction

Tamarind, *Tamarindus indica* L., is a multipurpose tropical fruit tree used primarily for its fruits, which are eaten fresh or processed , used as a seasoning or spice, or the fruits and seeds are processed for non-food uses. The species has a wide geographical distribution in the subtropics and semiarid tropics and

is cultivated in numerous regions. Tamarind belongs to the dicotyledonous family leguminosae which is the third largest family of flowering plants with a total of 727 genera recognized and the number of species is estimated at 19,327 (Lewis et al. 2005). The pulp of the fruit has been used as a spice in Asian cuisine, especially in the southern part of India, for a long time. Almost all parts of the tree find a use in the food, chemical, pharmaceutical or textile industries, or as fodder, timber and fuel (Dagar et al. 1995, Pugalenthi et al. 2004).

The tamarind fruit consists mainly of pulp and seeds. The fruit, both ripe and dry, contains mainly tartaric acid, reducing sugars, pectin, tannin, fiber and cellulose. The whole seeds also contain protein, fat, sugars and carbohydrates. Both pulp and seeds are good sources of potassium, calcium and phosphorus and contain other minerals like sodium, zinc and iron (Cornel 1991, Pino et al. 2004, Soong and Barlow 2004).

Tamarind is valued highly for its fruits, especially the pulp which is used for a wide variety of domestic and industrial purposes, especially for food and beverages (Ajayi et al. 2006). The pulp constitutes 30—50% of the ripe fruit, the shell and fiber account for 11-30% and the seed about 25—40%. The most outstanding characteristic of tamarind is its sweet acidic taste, the acid it mostly tartaric acid (10%). The latter is synthesised in tamarind leaves in the light and translocated to the flowers and fruits. Tartaric is an unusual plant acid formed from the primary carbohydrate products of photosynthesis, and once formed, it is not metabolically used by the plant. The content of tartaric acid does not decrease during fruit ripening, suggesting it is not utilized in fruit development. At this time of fruit development; reducing sugars increase to 30—40% giving the sour fruit a sweeter taste. As a result, tamarind is known to be simultaneously the most acidic and sweetest fruit. Besides being a rich source of sugars, tamarind fruit is an excellent source of vitamin B (Ajayi et al. 2006) and also contain minerals and exhibit high antioxidant capacity that appear to be associated with a high phenolic content, thus can be an important food source (El-Siddig et al. 2006).

Table 1. Details of treatments employed during the development of tamarind juice.

Sl. No.	Ingredients	T_1	T_2	T_3
1.	Tamarind (g)	10	10	10
2.	Sugar (g)	25	20	30
3.	KMS (g)	0.1	0.1	0.1
4.	Water (ml)	250	250	250

Materials and Methods

Collection of fruits

Well matured and clean tamarind was used during this study. The tamarind was procured from the local market of APMC, Shivamogga (Table 1).

Methodology of preparing tamarind juice

Tamarind juice was first prepared without stabilizer and subjected for sensory evaluation. The best treatment was again chosen for standardization with stabilizers with different treatments (Table 2, Figs 1 and 2).

Tamarind fruits
↓
Soak the fruit in water for 10min
↓
Extract the pulp
↓
Prepare syrup with sugar and water, boil to dissolve the sugar
↓
Dissolve KMS in a small quantity of juice, then add into whole juice
↓
Bottling
↓
Storage

Fig. 1. Flow sheet for tamarind juice preparation.

Table 2. Details of treatments employed during the development of tamarind juice with stabilizers.

SL. No.	Ingredients	T_1	TS_2	TS_3
1.	Tamarind (g)	10	10	10
2.	Sugar (g)	25	25	25
3.	Acacia (%)	—	1.5	—
4.	CMC (%)	—	—	0.5
5.	KMS (g)	0.1	0.1	1.2
6.	Water (ml)	250	250	250

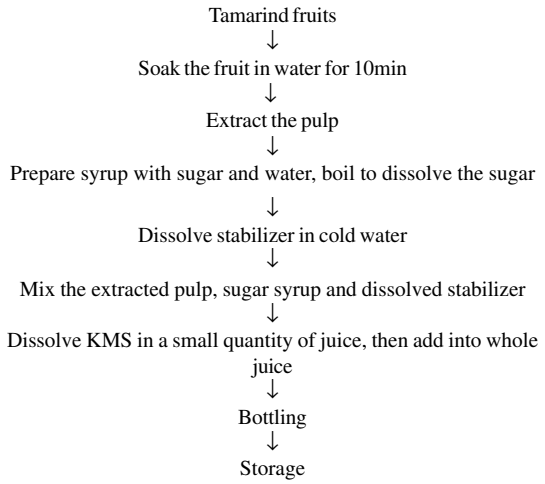

Fig. 2. Flow sheet for juice preparation.

Nutritional evaluation

Total soluble solids (TSS)

The TSS of tamarind juice of different combinations were measured using Digital pocket Atago Hand Refractrometer (Model : PAL 3) and expressed as degree Brix (^{o}B).

Titrable acidity

Titrable acidity of tamarind juice samples were determined by visual titration method (Ranganna 1995).

Preparation of sample : Ten gram of sample was taken in a 100 ml beaker and a little quantity of distilled water was added to it. The juice was boiled for one hour frequently replacing the water which was lost due to evaporation. The pulp was filtered using Whatman No. 4 filter paper and the filtrate was used for analysis.

Procedure : Ten ml of filtrate was taken in a conical flask and titrated against 0.1 N NaOH solution using 1 or 2 drops of phenolphthalein indicator. Formation of pink color was recorded as the end point of filtration. Then, the acidity expressed as the percentage of anhydrous citric acid was calculated as follows :

Calculation :

$$\text{Titratable acidity\%} = \frac{\text{Titre value} \times \text{N of NaOH} \times \text{volume} \times \text{Equivalent weight made up of citric acid}}{\text{Aliquot taken for titration} \times \text{weight of sample}} \times 100$$

Ascorbic acid

Ascorbic acid of tamarind juice was determined by 2, 6-dichlorophenol indophenols visual titration method (Ranganna 1995).

Preparation of 2, 6-dichlorophenol indophenols dye solution : In a beaker, 52 mg of 2, 6-dichlorophenol indophenols dye and 42 mg of sodium bicarbonate were dissolved using 150 ml hot distilled water. Then, the volume was made up to 200 ml with distilled water.

Preparation of 4 per cent oxalic acid : Forty gram of oxalic acid was dissolved in 900 ml distilled water. Then, the volume was made up to 100 ml distilled water.

Standard ascorbic acid : Fifty mg of L-ascorbic acid was dissolved in a small quantity of 4% oxalic acid in a 50 ml volumetric flask and the volume is made up to 50 ml with 4% oxalic acid. 10 ml of this stock solution was diluted to 100 ml using 4% oxalic acid. Therefore, the standard ascorbic acid contained 0.1 mg of ascorbic acid per ml of solution.

Standardization of dye : One ml of standard ascorbic acid solution and 5 ml of 4% oxalic acid were taken in a conical flask and titrated against the dye solution. The end point was light pink color which persisted for at least 5—10 seconds. The dye factor was then calculated as :

$$\text{Dye factor} = 0.1 / \text{Titre value}$$

Preparation of sample : Ten gram of sample was taken in a 100 ml volumetric flask and 50 ml of 4% oxalic acid was added. The sample was thoroughly mixed and the volume was made up to the mark using 4% oxalic acid. The solution was filtered using

What man No.4 filter paper and the filtrate was used for analysis.

Procedure : Ten ml of ascorbic acid extract was taken in a conical flask and titrated against the standard dye solution. The end point was light pink color that persisted for 5—10 seconds.

Calculation :

$$\text{Ascorbic acid, mg/100g} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Volume taken for titration} \times \text{Weight of the sample}} \times 100$$

Sugars

Sugars present in tamarind juice were estimated by following the method outlined earlier.

Preparation of sample : Ten gram of sample was blended with 80 ml distilled water in a 100 ml volumetric flask and the sample was neutralized with IN NaOH using phenolphthalein indicator. This solution was boiled gently for one hour with occasional stirring. Boiling water was added to maintain the original level. It was cooled and transferred to 100 ml volumetric flask, volume was made up using distilled water and was also filtered through Whatman No. 4 filter paper. From this solution, 50 ml was pipetted out in to a 250 ml volumetric flask, 100 ml water and 2 ml lead acetate was added and was allowed to stand for 10 minutes. Then the excess lead was precipitated by adding 1.8 ml potassium oxalate solution. It was made up to mark with distilled water and filtered through Whatman No. 4 filter paper and the filtrate was used for analysis.

Procedure : Ten ml of Fehling's solution (Fehling's No. 1 (25 ml) + Fehling's No. 2 (25 ml) with 25 to 50 ml of distilled water was taken in a conical flask, heated to boil and titrated against the filtrate sample using methylene blue as an indicator. The end point of titration was brick red color. The reducing sugar was calculated using equation.

Calculation :

$$\text{Reducing sugar (\%)} = \frac{0.05 \times \text{volume made up}}{\text{Titre value} \times \text{weight of sample}} \times 100$$

Total sugars : Fifty ml of the filtrate (prepared for reducing sugar estimation) was hydrolyzed with 10 ml of 6 N HCl at room temperature for 24 h in 250 ml volumetric flask. Add 4 drops of phenolphthalein indicator to hydrolyzed sample and was neutralized with 10% NaOH and the volume was made up to 250 ml with distilled water. Since all the sugars present in the sample were now converted to reducing sugars, estimation of reducing sugars in the aliquot as explained in the previous section gave the total sugar present.

Calculation :

$$\text{Total sugar (\%)} = \frac{0.05 \times \text{volume made up} \times 100}{\text{Titre value} \times 25 \times \text{weight of sample}} \times 100$$

Non-reducing sugars : The non-reducing sugar contents of the tamarind juice samples were determined by method of difference as :

Non-reducing sugars = Total sugars – Reducing sugars.

Sensory evaluation of tamarind juice

Prepared tamarind juice of different combinations (3 products using different sugar concentration and stabilizers) were evaluated by a panel of 10 judges for sensory attributes such as color/appearance, texture, taste (aroma and sweetness) and overall acceptability in order to identify best one sample. Numerical scoring method with maximum 9 point hedonic scale (Lim 2011) was adopted for evaluating the products and the samples were ranked for quality parameters from higher to lower in descending order of acceptability.

Statistical analysis

The experimental data were analyzed as per the statistical design using the ARIS computer facility of

College of Agriculture, Shivamogga to study the main treatment effects (Sundaraja et al. 1972). The limit of probability fixed for the test of significance was p=0.05.

Results and Discussion

Table 3 shows the average score obtained by the three tamarind juice products for color /appearance, texture, taste and overall acceptability.

The product T_1 was found to be superior in all quality parameters that is color/appearance, texture, taste and over all acceptability. However the overall acceptbility score of developed products varied from 4.0 to 8.30 . T_1 was highly acceptable as compared to other products.

The results also show that there is a significant difference at (p>0.05) between different tamarind juice i.e. T_1, T_2 and T_3 for quality attributes of color /appearance, texture, taste and overall acceptability. Among the three treatments T_1 was selected for further investigation with stabilizers.

Table 4 shows the average score obtained by the three tamarind juice with stabilizers for color/appearance, texture, taste and overall acceptability.

The product T_1 was found to be superior in all quality parameters that is color/appearance, texture,taste and overall acceptability. However the overall acceptability score of developed products varied from 4.3 to 8.3. T_1 was highly acceptable as compared to other products.

Table 3. Organoleptic scores of tamarind juice for various sensory attributes.

Treatments	Quality parameters			
	Color	Texture	Taste	Overall acceptability
T_1	7.9	8	8.1	8.2
T_2	5	5.2	4.4	4
T_3	4	3.7	3.7	4
Mean	5.6	5.63	5.4	5.4
F value	65.55	65.28	64.5	90.20
CD	0.721	0.778	0.848	0.736
p value	4.34×10^{-11}	4.52×10^{-11}	5.2×10^{-11}	1.11×10^{-11}
SEm	0.25	0.27	0.29	0.25

Table 4. Organoleptic scores of tamarind juice with stabilizers for various sensory attributes.

Treatments	Quality parameters			
	Color	Texture	Taste	Overall acceptability
T_1	8.2	8.4	8.3	8.3
TS_2	4.7	4.3	4.7	4.3
TS_3	4	4.3	3.9	4.6
Mean	5.63	5.66	5.63	5.73
F value	69.39	73.44	77.65	65.05
CD	0.778	0.796	0.767	0.796
p value	2.29×10^{-11}	1.2×10^{-11}	6.35×10^{-11}	4.73×10^{-11}
SEm	0.269	0.276	0.265	0.267

The results also show that there is a significant difference (p>0.05) between different tamarind juice i.e. T_1 TS_1 and TS_2 for quality attributes of color/ appearance, texture,taste and overall acceptability.

Nutritional qualities of developed products are presented in Table 5. The TSS content varied from 11.7 ± 0.02 to 12.30 ± 0.05. According to Indian standards, the TSS of juices should not be less than 10.0% (BIS 5861,1993). Taking these standards in to consideration, the developed T_1, TS_1 and TS_2 had appreciable TSS levels in the present study.

Titratable acidity of the products varied from 0.36 ± 0.01 to 0.42 ± 0.01. However, the ascorbic acid content was 1.8 in TS_1 and TS_2, 2.2 in T_1 product. Vitamin C is an antioxidant that protects the body against free radicals, strengthens immune system and keeps gums healthy (Umesh et al. 2010).

Total sugar content of developed samples varied from 12.13 ± 0.11 to 12.16 ± 0.09. Non reducing sugars (%) content was same in T_1 and TS_1 (10.94) and 10.86 in T_1. Reducing sugar content was 1.9 in T_1 and highest was seen in TS_2 (1.29).

Conclusion

The developed tamarind juice of different combination with respect to sugar and without stabilizer is found to be accepted by consumers with regard to

Table 5. Nutritional qualities of tamarind juice with stabilizers.

Constituents	Treatments T_1	T_1	TS_2
TSS (°B)	12.3 ± 0.05	12.1 ± 0.10	11.7 ± 0.2
Titratable acidity (%)	0.4 ± 0.01	0.42 ± 0.01	0.36 ± 0.01
pH	2.81 ± 0.01	2.72 ± 0.01	2.79 ± 0.01
Ascorbic acid (mg/100g)	2.2 ± 0.10	1.8 ± 0.03	1.8 ± 0.10
Total sugar (%)	12.13 ± 0.11	12.15 ± 0.98	12.16 ± 0.09
Reducing sugar (%)	1.19 ± 0.12	1.21 ± 0.20	1.29 ± 0.05
Non reducing sugar (%)	10.94 ± 0.21	10.94 ± 0.89	10.86 ± 0.06

overall acceptability. There was a significant difference between the different treatments and juice with stabilizers is not acceptable with respect to its color, taste, texture and overall acceptability.

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