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Standardization and development of tamarind candy by blending with mango pulp

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Abstract
This study was carried out to investigate the quality attributes of tamarind candy developed from blend of Tamarind and mango. The blend was in different ratio of 100% tamarind (T1), 90% Tamarind + 10 % Mango pulp (T2), 80% Tamarind + 20% mango pulp (T3) and 70% tamarind + 30% mango pulp (T4). The samples were produced and stored at ambient temperature of (28+0.02). The products were analyzed every month for a period of 3 months for physico-chemical microbial parameters and the sensory evaluation was done at 45 days interval. The results revealed that statistically significant reduction at 1% level in moisture content was found. Increase in the TSS of the prepared products was non- significant. No significant reduction in acidity was observed in all the products with increase in the storage period. Reducing sugars increased significantly in all the treatments of candy and toffee as the storage period increased. As the storage period increased no significant reduction was found in the total sugar content in all the products except in toffee in which it was increased significantly. There was no significant difference in the sensory qualities as the storage period increased. The overall acceptability was the highest in candy prepared with 100% tamarind pulp (T_1). Negligible growth of microbes was observed in all treatments of candy. All the products stored without any deterioration in physicochemical, sensory quality and microbial count and are consumer acceptable up to 3 months of storage as per the study.

Keywords: tamarind, blending, mango, pulp

Introduction

Most of the fruits are seasonal and their availability is confined to a particular period of the year. Besides, the post-harvest losses are also more, as the fruits are highly perishable. The only way to make the fruits available throughout the year is by preserving them in the processed form without losing much of their nutritive value (Srivastava and Kumar, 2002) [5]. Processing standards have been worked out for most of the fruits like mango, banana, grape, citrus etc. But very less work has been done on tamarind. Tamarind is native fruit of Africa. It belongs to Leguminosae family with botanical name *Tamarindus indica.* L. The tamarind is prized for its shade and shelter (M.D. Chaturvedi, 1956) [2]. It is one of the important tropical fruit tree, and is widely grows in India. It yields 150-500 Kg fruits per season and the fruit weight vary from 15-30 gms (Duke, 1981) [4]. There are only a few varieties of tamarind grown in India, some are sweet and some are sour. Fruit is the most important part of the tree and it is the most acidic of all fruits and contains an uncommon plant acid i.e. tartaric acid 8-18% (Duke, 1981) [4]. India is the chief producer and consumer of tamarind in the world. It is estimated that, India produces about 3,00,000 MT of fruits and export tamarind products, worth about Rs.50.0 Crores per annum. The pulp is rich in phosphorous (110 mg/100 g), calcium (17 mg/100 g), and iron (17 mg/100 g). Tamarind pulp is the chief agent for souring food products like *sauces, chutneys, sambar, rasam* and some beverages. The fruit pulp is the important raw material for the manufacture of tamarind pulp concentrate and soft drinks. The pulp of the fruit is used extensively in the local confectionery industry in several developed countries (Lewis, 1964) [6].

Dehydration is one of the methods to preserve tamarind. Due to high acidity, in the tamarind fruit, the utilization of these fruits for preparation of various processed products are limited. Tamarind also has hypoglycemic and hypocholestrolemic effect and it helps in reducing obesity (www.tamarind manual.htm). Blending of fruits like mango will be helpful to enhance the sensory quality characteristics such as color, flavour, taste, and overall acceptability of the prepared products. Keeping the above facts in view an experiment was planned to prepare candy by blending with mango pulp for better utilization of tamarind.

Materials and Methodology

a) Procurement of raw material

Red variety tamarind was procured from local market, Hyderabad.

b) Preparation of tamarind candy

Extraction of tamarind pulp

Tamarind was procured from local market and seeds were removed and the tamarind was cleaned properly. Then the tamarind was soaked in water in the 1: 1.5 ratio, heated up to 100^0C, then cooled and crushed. After crushing it was passed through a siever to obtain pulp. The pulp so obtained was used for the preparation of products. The flow diagram for extraction of tamarind pulp was given in (Fig 1).

Tamarind
↓
Cleaning
↓
Soaking in water (in 1: 1.5 ratio)
↓
Heating up to 100^0C
↓
Cooling
↓
Crushing
↓
Passing through a siever
↓
Pulp

Fig 1: Flow -chart for extraction of tamarind pulp

Extraction of mango pulp

Mangoes were procured from local market and cleaned properly. Then the mangoes were peeled and cut in to pieces and then it was passed through a pulper machine to obtain pulp. The pulp so obtained was used for blending for the preparation of products. The flow diagram for extraction of mango pulp was given in (Fig 2).

Mango
↓
Cleaning
↓
Peeling
↓
Cutting in to pieces
↓
Passing through a pulper machine
↓
Pulp

Fig 2: Flow -chart for extraction of mango pulp

Tamarind juice (100g)
↓
Addition of sugar (200g)
↓
Boiling
↓
Addition of glucose syrup (400g)
↓
Boiling
↓
Pouring in to molds
↓
Cooling
↓
Removing from molds
↓
Wrapping
↓
Storing

Fig 3: Flow-chart for the preparation of tamarind candy.

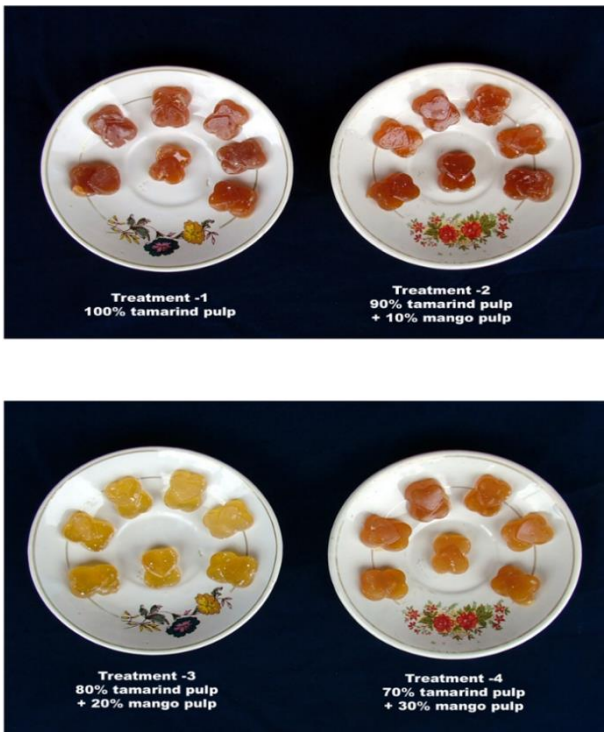

Fig 4: Tamarind candy by blending with mango pulp

Prepared products were analyzed for their physico-chemical parameters, sensory attributes, and microbial count by standards procedures

Physico-chemical parameters of tamarind candy

a) Moisture (%)

The moisture content of the samples was determined by using the method of AOAC (1975) [1].

Ten gm of sample was taken in to a petridish with lid and the exact weight was noted down (W1). The sample was dried in an oven at 100 to 105 degrees till constant weight was obtained. The sample was cooled in a dessicator and the final weight was taken (W2).

Calculation

$$\text{Moisture \%} = \frac{\text{initial weight (W1)} - \text{final weight (W2)}}{\text{Initial weight (W1)}}$$

b) Total soluble solids (^{0}Brix)

The percentage of total soluble solids was determined using ERMA hand refractometer by placing a drop of the filtered juice on the refractometer prism. Before taking the reading, the refractometer was tested for error with distilled water (Ranganna, 1986) [10].

c) Acidity (%)

Ten grams of homogenized sample was taken and made up to 100-ml. volume in a volumetric flask. The contents were than filtered through whatmann No.1 filter paper; an aliquot of 1 ml. was taken for titration against 0.1 N NaoH using phenolphthalein indicator and light pink colour as end point, to estimate titrable acidity in terms of tartaric acid. (AOAC, 1975) [1].

Calculations

Factor for acidity: One ml. of N/10 NaoH = 0.0075g of tartaric acid.

$$\text{Per cent tartaric acid:} \frac{\text{Titre value x Normality of NaoH x 75 x 100}}{\text{Volume of the sample x volume of aliquot taken x 1000}}$$

d) Reducing sugars (%)

Reducing sugars were determined by the method of Lane and Eyon (AOAC, 1975) [1]. Ten grams of samples was transferred to 250 ml volumetric flask using a little amount of distilled water.2 ml of lead acetate. Solution was added to the flask for precipitation of colloidal matter and kept aside for 10 min. Then 2 ml of potassium oxalate solution was added to this solution to precipitate the lead and then the volume was made up to 250 ml using distilled water. And the contents were then filtered through whatman no.1 filter paper. Reducing sugars in the lead free solution were then estimated by taking this solution in burette and titrating against 10 ml of standard fehling's solution mix of A and B (1:1), using methylene blue as an indicator and formation of brick red precipitate as an end point. Keeping the fehling's solution boiling on the heating mantle carried out the titration.

e) Total sugars (%)

For total sugars, 50 ml of filtered sample was taken in a 250 ml conical flask to which 50 ml water and 5 gm of citric acid was added boiled gently for 10 mints to complete the inversion of sucrose, then transferred to 250 ml volumetric flask and neutralized with 1N NaoH. The volume was made up to the mark and determined the total sugar as invert sugars (AOAC, 1975) [1].

f) Sensory evaluation (Peryam *et al*, 1957) [9]

The sensory scoring was done by a panel of 10 members in the laboratory of Post Graduate and Research center using a scorecard developed for the purpose. Scorecard was prepared keeping in view of the quality characteristics of the products. Descriptive terms were given to various quality attributes like appearance, colour, flavour, texture, consistency, taste and overall acceptability. Numerical scores were assigned to each attribute (Peryam and pilgrim, 1959) [9]. A five-point scale was adopted to score each of the attributes, while scoring, highest score (5) was assigned to most preferred characteristic and least score (1) to the least desired characteristics.

g) Microbial Examination of the Products

i) Total bacterial counts (Cruikshank *et al*, 1975) [3]

For estimating bacterial population in different samples, dilution plate method was followed. (Cruikshank *et al*., 1975) [3]. One gram of sample was thoroughly mixed in 9 ml of sterile saline water, from this, 1 ml of sample was transferred through a sterile pipette to a screw cap tube containing 9 ml sterile saline water, and this gives a dilution of 10^2. Similarly, serial dilutions were made. One ml. of the sterile serially dilute of sample was placed in the sterile petridish to which cooled plate count agar medium was added and mixed thoroughly with the suspension and then allowed to set and then incubated at 28 $\pm$ 2^{0}C for 48 hrs. Individual colonies were counted and multiplied.

ii) Yeast and Molds

Dilution plate method was followed for yeast and mold content (Cruikshank *et al*., 1975) [3]. Potato dextrose agar medium was used for estimating the fungal population.

h) Statistical analysis

The data were subjected to statistical analysis as per the procedure described by Panse and Sukhatme (1985) [8]. The experimental design was complete randomized design with factorial concept.

Result and Discussion

Physico chemical characteristics of tamarind candy

a) Moisture (%)

Moisture recorded in different treatments and days of storage is given in Table 1. The table indicated that significant change in moisture content during the storage period. Among the treatments employed for preparation of tamarind candy, initially T_4 recorded significantly highest moisture content (35.073%) and the least was recorded in T_1 (35.006%).

During storage, there was significant decrease at 1% level in the mean moisture content of the samples from 0 day (35.043%) to 90 days (35.008%) of storage period. The interaction effects between days of storage and treatments were significant (at 1% level). However, a very slight decrease in moisture was observed among all the treatments during the storage period.

Table 1: Effect of storage period on moisture (%) in tamarind candy at room temperature

Treatments	Moisture (%)				
	0	30	60	90	Mean
T_1	35.006	35.013	35.006	35.006	35.01
T_2	35.013	35.013	35.010	35.013	35.02
T_3	35.046	35.006	35.006	35.006	35.02
T_4	35.073	35.023	35.013	35.006	35.02
Mean	35.043	35.011	35.007	35.008	
		F value	SEd±	CD at 5%	
Treatments (F_1)		**	0.006	0.0135	
Periods (F_2)		* *	0.006	0.135	
F_1 *F_2 Interaction		* *	0.013	0.027	

Where, T_1: tamarind pulp 100%, T_2: tamarind pulp 90%+mango pulp10%, T_3: tamarind pulp 80%+mango pulp 20%, T_4: tamarind pulp 70%+mango pulp 30%, * * Significant at 1% level, NS- non significant.

b) Total Soluble Solids (Brix)

Total soluble solids recorded in different treatments and days of storage were given in Table 2. No significant change was observed in total soluble solids during the storage period. Treatments recorded significant differences, whereas interactions were found non-significant. Among the treatments employed for preparation of tamarind candy, initially all the products prepared was with regard to TSSs on par with each other (85.00ºB). During storage, the mean increase in total soluble solids from 0 days (85.00ºB) to 90 days (85.127ºB) of storage was not significant. The interaction effects between days of storage and treatments were also not significant. However a slight increase in TSS was observed among all the treatments during the storage period.

Table 2: Effect of storage period on TSS (ºBrix) in tamarind candy at room temperature

Treatments	TSS(ºBrix)				
	0	30	60	90	Mean
T_1	85.00	85.01	85.02	85.03	85.01
T_2	85.00	85.013	85.03	85.04	85.01
T_3	85.00	85.016	85.04	85.04	85.02
T_4	85.00	85.016	85.05	85.39	85.02
Mean	85.00	85.014	85.03	85.0127	
		F value	SEd±	CD 5%	
Treatments (F_1)		* *	0.061	0.1208	
Periods (F_2)		NS	0.061	NS	
F_1 & F_2 Interaction		NS	0.123	NS	

Where, T_1: tamarind pulp 100%, T_2: tamarind pulp 90%+mango pulp10%, T_3: tamarind pulp 80%+mango pulp 20%, T_4: tamarind pulp 70%+mango pulp 30%, * * Significant at 1% level, NS- non significant.

c) Acidity (%)

Acidity values recorded in different treatments and days of storage are given in Table 3. No significant change in acidity was observed during the storage period. Treatment recorded significant differences, whereas interactions were found to be non-significant. Among the different treatments, initially T_4 (0.585%) recorded significantly highest acidity value and least was recorded in T_1 (0.531%). During storage, there was no significant decrease in acidity from 0 day (0.56%) to 90 days (0.55%) of storage. T_4 recorded maximum acidity value (0.582%), and least acidity value was recorded in T_1 (0.527%) at '90' day of storage. The interaction effects between days of storage and treatments were non- significant. However a very slight decrease in acidity was observed among all the treatments during the storage period.

Table 3: Effect of storage period on acidity (%) in tamarind candy at room temperature

Treatments	Acidity (%)				
	0	30	60	90	Mean
T_1	0.531	0.531	0.529	0.527	0.530
T_2	0.553	0553	0.550	0.549	0.551
T_3	0.561	0.561	0.559	0.558	0.561
T_4	0.585	0.585	0.583	0.582	0.584
Mean	0.56	0.56	0.55	0.55	
		F value	SEd±	CD at 5%	
Treatments (F_1)		* *	0.0001	0.0002	
Periods (F_2)		NS	0.0001	NS	
F_1 & F_2 Interaction		NS	0.0002	NS	

Where, T_1: tamarind pulp 100%, T_2: tamarind pulp 90%+mango pulp10%, T_3: tamarind pulp 80%+mango pulp 20%, T_4: tamarind pulp 70%+mango pulp 30%, * * Significant at 1% level, NS- non significant.

d) Reducing sugars (%)

Reducing sugar content of tamarind candy recorded in different treatments and days of storages is given in Table 4. There was significant change in reducing sugars during the storage period, among the different treatments and interactions. All the treatments differed significantly from one

another. Among the different treatments employed for tamarind candy preparation, initially T_4 recorded significantly highest reducing sugars (37.930%) and least was recorded in T_1 (33.204%). During storage, there was a significant increase in mean reducing sugar content of the samples from 0 day (35.591%) to 90 days (39.064%) of storage period. The interaction effects of treatments and days of storage were also found to be significant. T_4 recorded the maximum reducing sugar content (41.535%) at 90 days of storage; whereas T_1 at 0 days (33.204%) recorded the minimum reducing sugar content.

Table 4: Effect of storage period on reducing sugars (%) in tamarind candy at room temperature

Treatments	Reducing Sugars (%)				
	0	30	60	90	Mean
T_1	33.204	33.204	34.850	36.230	34.372
T_2	34.985	34.985	36.175	38.345	36.123
T_3	36.245	36.245	37.958	40.149	37.649
T_4	37.930	37.930	36.860	41.535	38.564
Mean	35.591	35.591	36.460	39.064	
		F value	SEd±	CD at 5%	
Treatments (F_1)		* *	0.058	0.1153	
Periods (F_2)		* *	0.058	0.1153	
F_1 & F_2 Interaction		* *	0.117	0.2305	

Where, T_1: tamarind pulp 100%, T_2: tamarind pulp 90%+mango pulp10%, T_3: tamarind pulp 80%+mango pulp 20%, T_4: tamarind pulp 70%+mango pulp 30%, **Significant at 1% level, NS- non significant.

e) Total Sugars (%)

Total sugar content of tamarind candy recorded in different treatments and days of storage is given in Table 5. No significant change in total sugar content was observed during the storage period. Treatments recorded significant differences where as interactions recorded were found non-significant. Among the treatments, initially T_4 recorded highest (57.977%) total sugar content and least was in T_1 (53.235%). During the storage, there was no significant increase in the mean total sugar content of candy from 0 day (55.569%) to 90 days (57.718%) of storage period. The interaction effects of treatments and days of storage were also found to be non-significant during different storage periods.

Table 5: Effect of storage period on total sugars (%) in tamarind candy at room temperature.

Treatments	Total Sugars (%)				
	0	30	60	90	Mean
T_1	53.235	54.566	55.235	55.545	54.645
T_2	54.957	55.344	56.244	56.555	55.775
T_3	56.107	57.107	58.104	58.787	57.526
T_4	57.977	58.815	59.566	59.985	59.086
Mean	55.569	56.458	57.287	57.718	
		F value	SEd±	CD at 5%	
Treatments (F_1)		* *	0.009	0.0184	
Periods (F_2)		NS	0.009	NS	
F_1 * F_2 Interaction		NS	0.018	NS	

Where, T_1: tamarind pulp 100%, T_2: tamarind pulp 90%+mango pulp10%, T_3: tamarind pulp 80%+mango pulp 20%, T_4: tamarind pulp 70%+mango pulp 30%, * * Significant at 1% level, NS- non significant.

f) Sensory evaluation of tamarind candy

The data presented on overall acceptability scores of tamarind candy was given in Table 24 and Fig (9). The table indicated significant differences among the treatments. However, there was no significant change in the overall acceptability scores of tamarind candy during storage. Of all the treatments of tamarind candy, the overall acceptability score was significantly highest for T_1 (4.97) followed by T_2 (4.80), T_3 (4.80) and T_4 (4.60).

Table 6: Effect of storage period on overall acceptability in tamarind candy at room temperature.

Treatments	Overall Acceptability			
	0	45	90	Mean
T_1	4.97	4.97	4.97	4.97
T_2	4.80	4.80	4.60	4.73
T_3	4.80	4.80	4.60	4.72
T_4	4.60	4.60	4.30	4.50
Mean	4.81	4.81	4.60	
		F value	SEd±	CD at 5%
Treatments (F_1)		* *	0.0397	0.0778
Periods (F_2)		NS	0.0458	NS
F_1* F_2 Interactions		NS	0.0794	NS

Where, T_1: tamarind pulp 100%, T_2: tamarind pulp 90%+mango pulp10%, T_3: tamarind pulp 80%+mango pulp 20%, T_4: tamarind pulp 70%+mango pulp 30%, * * Significant at 1% level, NS- non significant.

g) Microbial load of tamarind candy

The results obtained for microbial load in tamarind candy samples are presented in Table 25. The microbiological examination showed that no yeast and mold count was observed till 60 days of storage. T_2 recorded higher load ($4x10^1$) followed by T_3 ($3x10^1$) T_4 ($3x10^1$) and the least was observed in T_1 ($1x10^1$) at the end of 90 days storage period. The bacterial growth was not observed in the tamarind candy samples at 60 days of storage period. The bacterial growth was observed at 90 days only. T_2 recorded higher bacterial count ($3x10^1$), followed by T_3, T_4, and T_1 ($2x10^1$) at the end of 90 days storage. The interaction effect between days of storage and treatments were not significant.

Table 7: Effect of storage period on microbial load (colony forming units/gm) in tamarind candy at room temperature.

Treatments	Microbial Load (colony forming units/gm)							
	0 Days		30 Days		60 Days		90 Days	
	Bacteria	Y&M	Bacteria	Y & M	Bacteria	Y & M	Bacteria	Y & M
T_1	-	-	-	-	-	-	$2x10^1$	$1x10^1$
T_2	-	-	-	-	-	-	$3x10^1$	$4x10^1$
T_3	-	-	-	-	-	-	$2x10^1$	$3x10^1$
T_4	-	-	-	-	-	-	$2x10^1$	$3x10^1$

Where, T_1: tamarind pulp 100%, T_2: tamarind pulp 90%+mango pulp10%, T_3: tamarind pulp 80%+mango pulp 20%, T_4: tamarind pulp 70%+mango pulp 30%, * * Significant at 1% level, NS- non significant.

Conclusion

The present study was undertaken for value addition to tamarind products. Experiments were 222 conducted on development of tamarind candy by blending with different proportion of mango pulp. The results of the experiments are briefly summarized that tamarind candy were prepared by blending with different levels of mango pulp. All the products stored without any deterioration in physicochemical, sensory quality and microbial count and are consumer acceptable up to 3 months of storage without any deterioration. Hence, it can be concluded that blending with mango pulp can bring value addition to tamarind products.

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