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Recipe standardization for preparation of Tamarind candy

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Abstract
Tamarind is an underutilized but very high potential fruit crop in India. Tamarinds are rich in nutrients and have enormous health benefits. Tamarind and its value added products are liked by people of all ages. One such processed product is tamarind candy. Candy or toffee made from tamarind is a very old product but literature related to recipe for preparation of tamarind is scanty hence an attempt has been made to standardize the recipe of tamarind candy. Recipe 1 (T_1), Recipe 2 (T_2), Recipe 3 (T_3) and Recipe 4 (T_4) have difference in amount of jaggery used. T_1 have only sugar, T2, T3 and T4 has been a combination of sugar and jaggery of 150 g, 250 g and 450 g respectively. From the above results it can be concluded that highest amount of desirability is observed in candy prepared with Recipe 1 (T_1) with complete sugar and Recipe 2 (T_2) with 150g sugar replaced with jaggery. In terms of taste and overall acceptibility, Recipe 1 (T_1) and Recipe 2 (T_2) stands neck to neck. But in terms of retaining Vitamin C, Recipe 2 (T_2) is quite better than Recipe 1 (T_1). Partial replacement of sugar used for candy preparation with jaggery can not only reduce direct sugar intake but also help to acquire minerals and health benefits associated with jaggery consumption. Hence, for preparation of tamarind candy with fortified minerals, Recipe 2 (T_2) containing 850 g sugar and 150 g jaggery can be used.

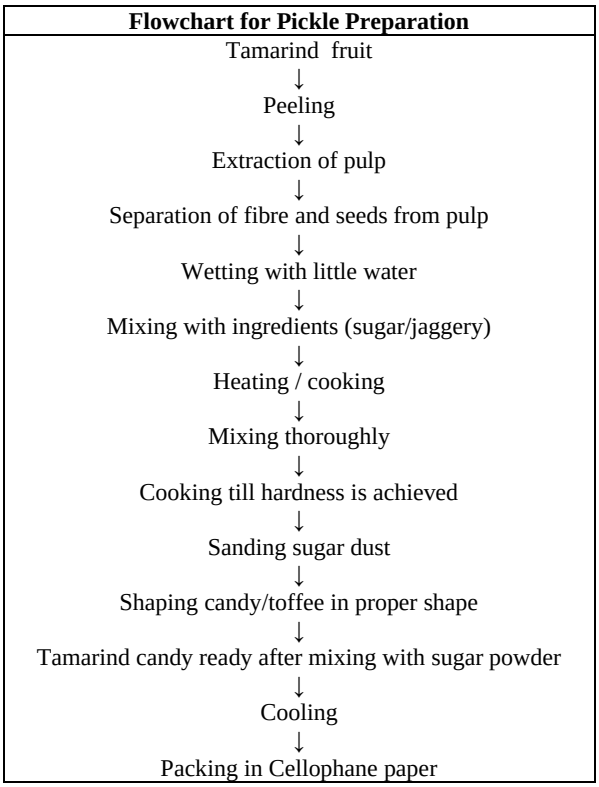
Keywords: Tamarind, Indian-date, tamarindus, jaggery candy, tamarind candy

Introduction
Tamarind (*Tamarindus indica* L.) a tree species of family Leguminaceas (Caesalpiniaceae) is a minor fruit crop of tropics and subtropics [1]. Tamarind is basically originated from dry savanna region of tropical Africa and can survive in changing climate scenario [2]. India is the highest producer, exporter and consumer of tamarind in India [3]. In southern part of India, tamarind is a basic ingredient in diet and different recipes. In India it is known as imli. The word tamarind is originated from the Arabic word 'Tamar-u'l-Hind' because the dark brown pulp of the fruit was thought to resemble dried dates [4]. It was therefore called the Tamere-hindi or 'date of India. It is called Indian date because of the colour of its dry pulp. Tamarind contains tartaric acid which is mainly used as an acidulant and hence utilized in preparation of various Indian dishes [4]. Tamarind fruit is a pack-house of nutrients. Around 70-75% of the fruit weight is constituted with pulp whereas seeds, peel and fibre consist of remaining 25-30 % [5]. It is enormously rich in carbohydrates and protein, fibre, minerals and all other nutrients [6]. Tamarind can effectively reduce body sodium-potassium imbalance and recover iron deficiency. Tamarind is a rich source of minerals such as iron, phosphorus, potassium, calcium. Ripe fruit pulp is rich in minerals such as potassium (62-570 mg/100g) and phosphorus (86-190 mg/100g) [7]. Vitamins such as thiamin, and niacin is high but Vitamin A and C is low [8]. It is rich in organic acid like tartaric acid, citric acid, succinic acid, oxalic acid and quinic acid [9]. Tamarind is a pack house of bio-absorbable nutrients and is available in utilization and absorption form [10]. Tamarind is also rich in ascorbic acid and citric acid. Tartaric acid endorses iron absorption in blood stream [11]. The best thing about tamarind is its delicious sour-sweet blend and a sweet-acidic pulp [12]. Due to such properties tamarind is utilized as antiseptic, carminative and febrifuge and regulating the problems related to intestines and digestion. The TSS of the pulp can vary from 54 - 69.9^{O} Brix [13]. The pectin content per 100 g pulp is 2 - 3.5%. Chrysanthemin and leucocyanidin are the anthocayanin pigments which are responsible for the colour development of the pulp in red type and brown type respectively [14].

Amid all the benefits, most of the tamarind cultivars are hard to be consumed raw because of its acidic nature and sourness. Therefore, there is a need to process the fruit into a desirable product so that it can be stored for a longer duration and be also demanding. Among several other products like jam, fruit bar, puree, sauce, pulp powder, pickle and beverages, tamarind candy stays an exception in terms of consumer preference and quality. Tamarind candy is one of the most liked product by consumers because of its natural sour-sweet blend. Candies are prepared after boiling tamarind pulp with sufficient amount of sugar and cooking it with very less amount of water [15]. But there is a need to standardize tamarind candy procedure for a better quality and higher shelf life.

2. Materials & Methods

Fresh tart tamarind is purchased from local market. Spices, oil, salt were procured from local market. The design of experiment was Completely Randomized Block Design (CRD) with 4 treatments and 5 replications. Candy was prepared according to procedure illustrated below.



Flowchart for Pickle Preparation

Treatment Details: Treatment is actually the recipe for tamarind candy preparation is tabulated in table 1. The main difference among the recipe is the amount of sugar content and jaggery content.

Table 1: Recipe charts for preparation of tamarind candy

Ingredients	Recipes			
	Recipe 1 (T_1)	Recipe 2 (T_2)	Recipe 3 (T_3)	Recipe 4 (T_4)
Tamarind pulp	1 kg	1 kg	1 kg	1 kg
Sugar	1 kg	850 g	700 g	600 g
Jaggery	0 g	150 g	300 g	400 g

3. Results and Discussion

Table 2 highlights the physio-chemical composition of fresh tamarind. Vitamin C content of fresh tamarind was 0.841 mg/100g. Titratable acidity was 30.45%. Moisture percent was 28.2% and total sugar content was 18.4 %. TSS was observed to be 43^{O}B and pH was 3.26.

Table 2: Physico-chemical composition of tamarind used for experiment

Attributes	Value / 100g
Vitamin C	0.841 mg/100g
TSS	43 ^{O}B
Titratable acidity	0.67 %
Moisture percent	28.2%
Total sugar	18.4 %
pH	3.26

Table 3 highlights the variation in TSS (^{O}B) of tamarind candy during storage. At 0 days of storage, TSS was more or less same in tamarind candy prepared by different recipes. But at 3 month of storage, candy prepared by Recipe 1 (T_{31}) is

having maximum TSS of 85.25 ^{O}B followed by 85.21 ^{O}B in Recipe 2 (T_2), 85.16 ^{O}B in Recipe 3 (T_3) and 85.13 ^{O}B in Recipe 4 (T_4). Similar trend has been observed in pickle prepared by different recipe at 6th month of storage. The highest TSS was observed in Recipe 1 (T_1) followed by Recipe 2 (T_2), Recipe 3 (T_3) and Recipe 4 (T_4) which are 85.38 ^{O}B, 85.30 ^{O}B, 85.24 ^{O}B and 85.20 ^{O}B respectively. The main reason behind this might be due to the fact that moisture loss from the main product is a continuous process. With declining moisture, the TSS also increases. This increase is evident throughout the storage. But increase in TSS in case of candy prepared with solely sugar (T_1) is highest in storage as compared to that when jaggery proportion is increased. Jaggery is known to hold the moisture a lot better inside the candy as compared to that of sugar. This is why as jaggery concentration increases, loss in moisture is less and product have a lower increase in TSS.

Table 3: Effect of different recipe on TSS (^{O}B) of tamarind candy during storage

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T_1)	85.25	85.25	85.38
Recipe 2 (T_2)	85.22	85.21	85.30
Recipe 3 (T_3)	85.16	85.16	85.24
Recipe 4 (T_4)	85.13	85.13	85.20
S.Em. (±)	0.012	0.012	0.012
CD (0.05)	NS	0.035	0.035

Table 4 highlights the variation in titratable acidity (%) of tamarind candy prepared from different recipes. At 0 days of storage, the titratable acidity was more or less same in all candy prepared by different recipes. At 3rd month of storage, candy prepared by Recipe 1 (T_1), Recipe 2 (T_2), Recipe 3 (T_3), and Recipe 1 (T_1) was at par with each other which was 0.532%, 0.533%, 0.533% and 0.532%. Similar case was observed even after 6 months of storage where candy prepared by Recipe 1 (T_1), Recipe 2 (T_2), Recipe 3 (T_3), and Recipe 1 (T_1) was at par with each other which was 0.527%, 0.526%, 0.527% and 0.526% respectively. Titratable acidity does not change with changing treatment which signifies that even the substitution of sugar with jaggery does not affect the acidic nature of the sweet – sour tamarind candy.

Table 4: Effect of different recipe on titratable acidity (%) of tamarind candy during storage

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T_1)	0.535	0.532	0.527
Recipe 2 (T_2)	0.535	0.533	0.526
Recipe 3 (T_3)	0.534	0.533	0.527
Recipe 4 (T_4)	0.536	0.532	0.526
S.Em. (±)	0.000	0.001	0.001
CD (0.05)	NS	NS	NS

Table 5 highlights the variation in pH of tamarind candy prepared from different recipes. Throughout the storage, a decline in pH value was observed. At 0 days of storage, highest value of pH was observed in Recipe 3 (T_3) followed by Recipe 1 (T_1), Recipe 2 (T_2) and Recipe 4 (T_4) which was 3.33, 3.328, 3.326 and 3.326 respectively. No significant differences among the treatments were observed. At 3rd month of storage, highest pH was observed in Recipe 2 (T_2), Recipe 3 (T_3), Recipe 4 (T_4) and Recipe 1 (T_1) which was 3.306, 3.306 and 3.302 respectively. At 6th month of storage, highest pH was observed in Recipe 1 (T_1) which was 3.274 followed by 3.268 in Recipe 2 (T_2), Recipe 3 (T_3) and Recipe 4 (T_4). Clearly, the treatments have no effect on pH value of the candy

Table 5: Effect of different recipe on pH of tamarind candy during storage

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T_1)	3.328	3.302	3.274
Recipe 2 (T_2)	3.326	3.306	3.268
Recipe 3 (T_3)	3.33	3.306	3.268
Recipe 4 (T_4)	3.326	3.306	3.268
S.Em. (±)	0.003	0.003	0.003
CD (0.05)	NS	NS	NS

Table 6 highlights the variation in total sugar (%) of tamarind prepared from different recipes. Throughout the storage, the total sugar content keeps on increasing. At 0 days of storage, the total sugar was highest in Recipe 4 (T_4) followed by Recipe 3 (T_3), Recipe 2 (T_2) and Recipe 1 (T_1) which was 53.434%, 53.189%, 53.035% and 52.672%. At 3rd month of storage, highest total sugar (%) was observed in Recipe 2 (T_2) followed by Recipe 4 (T_4), Recipe 3 (T_3) and Recipe 1 (T_1) which was 54.394%, 54.291%, 54.149% and 53.585%. At 6th month of storage, highest total sugar was observed in Recipe 4 (T4) followed by Recipe 3 (T3), Recipe 2 (T2) and Recipe 1 (T1) which was 55.706%, 55.295%, 55.122% and 54.575% respectively. Total sugar content is higher when jaggery was added because of the fact that the amount of total sugar in a smaller amount of jaggery is more for the same amount of polished crystal sugar. Similar case had been observed at 6th month of storage, when high percentage of crystallized sugar was replaced by jaggery, the total sugar increases drastically.

Table 6: Effect of different recipe on total sugar (%) of tamarind candy during storage

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T_1)	52.672	53.585	54.575
Recipe 2 (T_2)	53.035	54.394	55.122
Recipe 3 (T_3)	53.189	54.149	55.295
Recipe 4 (T_4)	53.434	54.291	55.706
S.Em. (±)	0.017	0.122	0.026
CD (0.05)	0.051	0.369	0.079

Table 7 highlights the variation in reducing sugar (%) of tamarind candy prepared from different recipes. At 0 days of storage, the reducing sugar was maximum in Recipe 1 (T_1), Recipe 2 (T_2), Recipe 3 (T_3) and Recipe 4 (T_4) which was 17.536%, 13.819%, 13.322% and 12.182% respectively. Similar observation was observed at 3rd month of storage. Highest reducing sugar (%) was observed in Recipe 1 (T_1), Recipe 2 (T_2), Recipe 3 (T_3) and Recipe 4 (T_4) which was 18.506%, 14.806%, 14.084% and 13.297%. Same trend was observed after 6th month of storage which was 20.121%, 16.183%, 15.348% and 14.345% in Recipe 1 (T_1), Recipe 2 (T_2), Recipe 3 (T_3) and Recipe 4 (T_4). A lower rate of reducing sugar in recipe prepared with jaggery might be due to the fact that jaggery has a very high amount of sucrose and a very low amount of reducing sugar like glucose and fructose [16]. Reducing sugar content in jaggery is only about 6.8 – 14.2 % [17]. That is why in recipe where sugar is partially substituted by jaggery, the reducing sugar of candy is reduced.

Table 7: Effect of different recipe on reducing sugar (%) of tamarind candy during storage

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T_1)	17.536	18.506	20.121
Recipe 2 (T_2)	13.819	14.806	16.183
Recipe 3 (T_3)	13.322	14.084	15.348
Recipe 4 (T_4)	12.182	13.297	14.345
S.Em. (±)	0.068	0.057	0.039
CD (0.05)	0.207	0.172	0.119

Table 8 illustrates the variation in ascorbic acid content (mg/100 g) of tamarind candy prepared from different recipes. At 0 days of storage, the ascorbic acid content of the candy does not vary too much with the treatments. At 3rd month of storage, highest ascorbic acid was present in Recipe 2 (T_2) followed by Recipe 4 (T_4), Recipe 3 (T_3) and Recipe 1 (T_1) which was 0.396 mg/100 g, 0.394 mg/100 g, 0.381 mg/100 g and 0.371 mg/100 g respectively. At 6th month of storage, highest ascorbic acid was present in Recipe 4 (T_4), Recipe 3 (T_3), Recipe 2 (T_2) and Recipe 1 (T_1) which was 0.325 mg/100 g, 0.318 mg/100 g, 0.313 mg/100 g and 0.220 mg/100 g respectively. It can be observed that ascorbic acid decline is a natural process in storage. But rate of decline is low in case of candy where jaggery is added. This might be due to the fact that jaggery has better capacity to reduce loss of Vitamin C during storage as compared to plain sugar candy. Even small amount of addition of jaggery as in T_2 (Recipe 2) has significantly reduce the loss of vitamin C during storage of candy.

Table 8: Effect of different recipe on ascorbic acid (mg/100 g) of tamarind candy during storage

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T_1)	0.429	0.371	0.220
Recipe 2 (T_2)	0.423	0.396	0.313
Recipe 3 (T_3)	0.433	0.381	0.318
Recipe 4 (T_4)	0.431	0.394	0.325
S.Em. (±)	0.005	0.005	0.003
CD (0.05)	N/A	0.016	0.009

Table 9 illustrates the variation in total plate count (10^{-5} log CFU) of tamarind candy prepared from different recipes. At 0 days of storage, the total plate count (10^{-5} log CFU) was more or less same in candy prepared by different recipes. But at 3rd month and 6th month of storage, the TPC also seems to increase quite a bit. The rate of increase in TPC is quite natural. The bacterial population multiplicated in the produce and population is increased.

Table 9: Effect of different recipe on total plate count (10^{-5} log CFU) of tamarind candy during storage

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T_1)	13.8	32.8	62.6
Recipe 2 (T_2)	14.4	33.2	61.4
Recipe 3 (T_3)	14	32.6	62.6
Recipe 4 (T_4)	15	32.8	62.2
S.Em. (±)	0.57	0.74	1.51
CD (0.05)	NS	NS	NS

Table 10 highlights the variation in flavour, texture, sourness, sweetness and overall acceptability of tamarind candy prepared from different recipes at 6th month of storage. In terms of flavour, highest score of 7.8 was given to Recipe 1 (T_1) and Recipe 2 (T_2). High score was also observed in Recipe 3 (T_3) which was 7.3. But a very poor flavour of 6.8 was observed in Recipe 4 (T_4) which might be due to high addition of jaggery. In terms of texture, highest value was observed in Recipe 1 (T_1) followed by Recipe 2 (T_2), Recipe 3 (T_3) and Recipe 4 (T_4) which was 9, 8.8, 7.6 and 6.6 respectively. With increasing jaggery concentration, the texture seems to be softening which is not liked by consumers. Sourness is high in case of Recipe 1 (T_1) followed by Recipe 2 (T_2), Recipe 3 (T_3) and Recipe 4 (T_4) which was 8, 8, 7.8 and 7.6 respectively. Sweetness was high in case of Recipe 4 (T4) which was 8. More sweetness of jaggery seems to mask the sourness as in case of Recipe 3 (T_3) and Recipe 4 (T_4). In terms of overall acceptability, best liked recipe was Recipe 1 (T_1) with complete sugar and Recipe 2 (T_2) with 150g sugar replaced with jaggery. However Recipe 3 (T_3) and Recipe 4 (T_4) is also good but overall acceptability is low as compared to Recipe 1 and Recipe 2.

Table 10: Effect of different recipe on organoleptic property (9 point hedonic scale) of tamarind candy during storage

Treatment details	At 6th month of storage				
	Flavour	Texture	Sourness	Sweetness	Overall acceptability
Recipe 1 (T_1)	7.8	9	8	7.8	8.8
Recipe 2 (T_2)	7.8	8.8	8	7.6	8.8
Recipe 3 (T_3)	7.4	7.6	7.8	7.2	7.6
Recipe 4 (T_4)	6.8	6.6	7.6	8	7.4
S.Em. (±)	0.17	0.50	0.24	0.44	0.29
CD (0.05)	0.55	NS	0.78	NS	NS

3. Conclusion

From the above results it can be concluded that highest amount of desirability is observed in candy prepared with Recipe 1 (T_1) with complete sugar and Recipe 2 (T_2) with 150g sugar replaced with jaggery. In terms of taste and overall acceptability, Recipe 1 (T_1) and Recipe 2 (T_2) stands neck to neck. But in terms of retaining Vitamin C, Recipe 2 (T_2) is quite better than Recipe 1 (T_1). Partial replacement of sugar used for candy preparation with jaggery can not only reduce direct sugar intake but also help to acquire minerals and health benefits associated with jaggery consumption. Hence, for preparation of tamarind candy with fortified minerals, Recipe 2 (T_2) containing 850 g sugar and 150 g jaggery can be used.

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