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## Preparation and evaluation of fruit candy from unripe mango

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**Abstract**

The present investigation was undertaken under the laboratory of Department of Post-Harvest Technology, Faculty of Horticulture, BCKV, Nadia during May 2017 to May 2018 with three replications comprising eight treatments *viz.* T1: Hot water blanching + Powder sugar, T2: Steam Blanching + powder sugar, T3: Steam blanching + 40°Brix sugar syrup, T4: Without blanching + powder sugar, T5: Hot water blanching + honey, T6: Steam blanching + honey, T7: Hot water blanching + 40° Brix honey syrup and T8: Without blanching + honey. Major objectives of the experiment were

- To select suitable method for processing of unripe mango candy
- To study the effect of blanching in the development of candy and
- To study the quality of processed candy during storage.

It was also observed that in fresh unripe mango candy hot water blanching with 40°Brix sugar syrup (T3) contain 76.63°Brix TSS, 74.50 % total sugar, 48.82 % reducing sugar, ascorbic acid of 7.40 mg / 100 g. and acidity 1.1 %. Hot water blanching with 40°Brix honey (T7) also gives better result in terms of 78.23°Brix TSS, 77.00 % total sugar, 35.48 % reducing sugar, 7.75 mg / 100 g of ascorbic acid and acidity 1.1%. The 40°Brix sugar syrup scored highest rating of 8.77 on 9-point hedonic scale with respect to overall acceptability. And also, in storage time the retention of biochemical properties was maximum in T7 followed by T3.

**Keywords:** Unripe mango, blanching, fruits candy

**Introduction**

Mango (*Mangifera indica*) is a deep-rooted evergreens tropical fruits crop. Mango fruits is good sources of vitamin, minerals, calories. Mango rich in Energy (60 Kcal), Carbohydrates (14.98 g), Protein (0.82 g), Fat (0.38 g), Fiber (1.6 g), Vitamin-C (36.4 mg), Vitamin-E (1.12 mg), Vitamin-A (1082 IU), Niacin (669 g), Pantothenic acid (160 g), Pyridoxine (119 g), Riboflavin (38 g), Thiamin (28 g), Folates (43g), Vitamin-K (4.2 g), Potassium (168 mg), Phosphorus (14 mg), Calcium (11mg), Magnesium (10 mg), Sodium (1 mg), Copper (110 g), Iron (160 g), Manganese (27 g), Zinc (90 g),  $\beta$ -Carotene (445 g),  $\alpha$ -Carotene (17 g). (United States Department of Agriculture 2016) [24].

The production of mango in India was 2262.77 Ha, 19686.93 MT, during 2016-2017 (HNB data base 2016-2017) [3]. If these fruits are processed into candy at the grower's level, they can sale it at good price and consumers will have the taste during off season. Candy is a sweet food prepared from fruits or vegetables by impregnating them with sugar syrup followed by draining of excessive syrup and then drying the product to a shelf stable state. Fruits and vegetables like apples, ginger, mangoes, guava, carrot and citrus peels have been used to prepare candies (Mehta and Bajaj, 1984) [15]. Candy is prepared using osmotic dehydration process. In candy preparation, the solutes used are generally sugar syrup with fruit cubes. This is multicomponent diffusion process. In this process water, flow from fruits cubes to solution and along with water some components of fruits such as minerals, vitamins, fruit acids etc. also move into the solution, while sugar and migrate towards the fruit's tissues.

**Materials and Methods**

The laboratory work was carried out in the departmental laboratory of Post-Harvest Technology, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia (West Bengal) during May 2017 to May 2018 with eight treatments comprising three replications *viz.* Hot water blanching + Powder sugar (T1), Steam Blanching + powder sugar (T2), Steam

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Blanching + 40<sup>0</sup>Brix sugar syrup (T3), Without blanching + powder sugar (T4), Hot water blanching + honey (T5), Steam blanching + honey (T6), Hot water blanching + 40<sup>0</sup>Brix honey syrup (T7) and Without blanching + honey (T8). The fruits were peeled off and cut into small cubes in uniform size then mango cubes were blanched in boiling water at  $98 \pm 2$  °C or in steam for 2-5 minutes as per the method suggested by Kadam *et al.*, (1991) [10]. After that mango cubes are added in the sugar after impregnating overnight, mango pieces were separated from solution and the TSS of the drained syrup was increased by heating the syrup or adding some sugar or honey upto 60<sup>0</sup>Brix and kept for overnight. Next day the TSS was increased upto 70<sup>0</sup>Brix and then 75<sup>0</sup>Brix on 4<sup>th</sup> day respectively. The mango pieces were removed from the concentrated syrup after that, those pieces were dried by keeping it at room temperature under the ceiling fan for four hours and then packed in the polythene bags.

Fresh fruits as well as prepared fresh and stored candies were analyzed for total sugar, reducing sugar, non-reducing sugar by Lane and Eynon Method, and ascorbic acid by 2, 6-Dichlorophenol-Indophenol visual Titration Method Ranganna (2010) [20].

Sensory characteristics of prepared fresh and stored candies were taken by using testing panel. The panel consisted of 10 panelists. Different sensory characteristics like stickiness, taste, flavour, colour and overall acceptability were evaluated based on 9-point hedonic scale.

In this study, Candy of each treatment was packed under polypropylene pouches (50 $\mu$  thickness of 100g packets) and was stored during May-December (2017) at room temperature for a period of 6 months and observations were recorded initially after the candy preparation at an interval of 3 months and 6 months respectively.

## Results and Discussion

### Nutritional composition of fresh unripe mango

**Table 1:** Bio-chemical properties of fresh unripe mango.

Fresh	Bio-chemical properties			
	TSS ( <sup>0</sup> Brix)	Reducing sugar (%)	Total sugar (%)	Ascorbic acid (mg/100g)
	6.69	2.38	5.10	238.00

### Nutritional composition of unripe mango candies at different storage periods

#### Total Soluble Solids (<sup>0</sup>Brix)

The TSS content of unripe mango candy increased with the advancement of storage period in all the treatments. In initial (0 day) period of storage the maximum TSS (78.23<sup>0</sup>Brix) was found in (T7) whereas the minimum TSS (75.37<sup>0</sup>Brix) was found in (T4) and at the 3 months (90 days) after storage the maximum TSS (79.15<sup>0</sup>Brix) was found in (T7) whereas the minimum TSS (76.03<sup>0</sup>Brix) was found in (T4) and at the final (180 days) period of storage the maximum TSS (80.85<sup>0</sup>Brix) was found in (T7) whereas the minimum TSS (77.25<sup>0</sup>Brix) was found in (T4). (Table-2)

It is evident from the data that total soluble solids content (TSS) of candy increased with the advancement of storage period up to 180 day in all the treatments. However, in present investigation, the rate of increase in TSS content of product was influenced significantly by treatments like blanching method, methods of sugar and honey addition and their interactions. The increase in TSS content of unripe mango candy during storage was probably due to conversion of free polysaccharides into soluble sugars. An increase of

TSS during storage period was also reported by Sharma *et al.* (1998) [23] in apple candy, Pawar (2010) [17] in banana slices. Similar results were also obtained from Deka (2005) [6] (an increasing trend of TSS was observed when stored at ambient and low temperature in lime, aonla, mango, pineapple spiced RTS beverage which support the present results).

#### Total sugar (%)

The total sugar content of unripe mango candy increased with the advancement of storage period in all the treatments (Table-2). In the initial period (0 days) of storage the maximum total sugar of unripe mango candy 77% was found in T7 whereas the minimum total sugar 73.41% was found in T4 and at the 3 months (90 days) of storage, the maximum total sugar 77.62% was found in T7 whereas the minimum total sugar 74.95% was found in T4. while at the final (180 days) period of storage, the maximum total sugar content 78.85% was found in T7 whereas the minimum total sugar content 75.25% was found in T4.

The data recorded in present investigation indicates that total sugars content of unripe mango candy was increased with in advancement of storage period up to 180 day. An increase in total sugars during storage period was also reported by Gupta *et al.* (1980) [8] in ber candy, Sharma *et al.* (1998) [23] in apple candy, in banana slices. The increase in reducing sugars as well as total sugars corresponded to the increase in total soluble solids (TSS) and unlimited decrease in non-reducing sugars. The increased level of total sugars was probably due to conversion of starch and pectin into simple sugars. The treatment (T7) recorded the highest percentage of total sugars during entire period of storage. Similar finding was recorded by Ahmed *et al.* (1986) [2]

#### Reducing sugar

During the storage period, the reducing sugar content of the prepared candies slightly increased. From table-2, it was observed that at the time of initial storage (0 day), reducing sugar content of unripe mango candies were found maximum in T3 which is at about 48.82% and minimum reducing sugar of 32.56% was found from T8. After 3 months (90days) storage, the reducing sugar content was found maximum in T3 (49.60%) and minimum 34.21% (T8) while at the final (180 days) period of storage the maximum reducing sugar content 52.54% was found in (T3) whereas the minimum reducing sugar content 36.24% was found in (T8).

It was observed that the reducing sugar slightly increased in probably because of hydrolysis of sugar during storage periods. Ewaidah (1992) [7] also found that the content of reducing sugar increased in different packaging materials during storage periods. The increase in reducing sugars as well as total sugars corresponded to the increase in total soluble solids (TSS) and unlimited decrease in non-reducing sugars. The increased level of reducing sugar was probably due to conversion of starch and pectin into simple sugars. The treatment (T7) recorded the highest percentage of reducing sugars during entire period of storage. Similar finding were recorded by Ahmed *et al.* (1986) [2]

#### Ascorbic acid

At the day of storage (0 day), ascorbic acid of unripe mango candies was found maximum 12.75 (mg/100g) in T4 and minimum of 7.40 (mg/100g) in T3. After 3 months (90 days) of storage, ascorbic acid in preserved candies slightly decreased in all the treatments. Maximum ascorbic acid found 12.05 (mg/100g) in T4 and minimum ascorbic acid found

7.00 (mg/100g) in T1. Also, after 6 months (180 days) of storage, ascorbic acid in preserved candies slightly decreased in all the treatments. Maximum ascorbic acid found 11.30 (mg/100g) in T4 and minimum ascorbic acid found 6.70 (mg/100g) in T1. (Table-2)

The decrease in ascorbic acid in candies during storage might be due to oxidation or irreversible conversion of L-ascorbic acid into dehydro ascorbic acid oxidase (ascorbimase). The decrease in ascorbic acid is also might be due to its oxidation to dihydroxy-ascorbic acid during storage period and high

temperature during tray drying. An in decrease in ascorbic acid during storage period was also reported by Gupta *et al.* (1980) [8] in ber candy, Kumar *et al.* (1998) [13] in papaya candy, in guava slices, Rani and Bhatia (1985) [21] in pear candy, Agrawal and Chopra (2004) [1] in aonla candy. Similar reduction in ascorbic acid content has also been reported in guava beverage (Pandey and Singh, 1998) [16]. Rabbani (1992) [19] observed that ascorbic acid content decreased continuously during storage of mango beverages.

**Table 2:** Changes in bio chemical parameters of unripe mango candy during storage period

Nutritional composition	Storage period (Months)	Treatments								C.D	SE(m)
		T1	T2	T3	T4	T5	T6	T7	T8		
TSS ( <sup>0</sup> Brix)	0	76.50	76.30	76.63	75.37	77.19	76.65	78.23	77.01	0.354	0.117
	3	77.00	76.95	77.20	76.03	78.40	78.15	79.15	78.15	0.358	0.119
	6	78.50	78.50	78.09	77.25	79.25	79.05	80.85	78.85	0.366	0.121
Total sugar (%)	0	74.50	74.06	74.50	73.41	76.55	76.25	77	76.10	1.906	0.630
	3	75.66	75.50	76.22	74.95	77.09	77.35	77.62	77.00	N/A	0.649
	6	76.24	76.26	76.52	75.25	77.14	77.62	77.75	77.58	1.611	0.533
Reducing sugar (%)	0	47.07	45.25	48.82	44.24	35.25	34.28	35.48	32.56	1.551	0.513
	3	49.39	48.02	49.60	47.27	37.00	36.54	37.25	34.21	1.509	0.499
	6	50.35	48.60	52.54	47.00	38.85	38.52	39.56	36.24	1.587	0.525
Ascorbic acid (mg/100g)	0	7.50	8.20	7.40	12.75	7.77	7.95	7.75	11.05	1.140	0.377
	3	7.00	7.70	7.10	12.05	7.25	7.36	7.30	10.58	1.459	0.483
	6	6.70	7.06	6.90	11.30	6.90	7.00	6.95	9.95	1.746	0.577
Acidity (%)	0	1.2	1.2	1.1	1.5	1.1	1.0	1.1	1.2	0.175	0.058
	3	1.3	1.4	1.4	1.7	1.4	1.3	1.3	1.5	0.157	0.052
	6	1.6	1.6	1.7	1.8	1.5	1.6	1.4	1.6	0.217	0.072

### Acidity

At the day of storage (0 day), acidity of unripe mango candies was found maximum 1.5% in T4 and minimum 1.0% in T6. After 3 months (90 days) of storage, ascorbic acid in preserved candies slightly decreased in all the treatments. Maximum acidity 1.7% found in T4 and minimum acidity found 1.3 in (T1, T6, T7). Also, after 6 months (180 days) of storage, acidity in preserved candies slightly increase in all the treatments. Maximum acidity 1.8 found in T4 and minimum acidity found 1.4% in T7.

The increase in acidity may be caused due to conversion of sulphurous acid in products. Similar findings were found in bael products (Kenghe, 2008) [11], carrot candy (Madan and Dhawan, 2005) [14].

### Sensory evaluation of unripe mango candies in different storage period

#### Color

The color rating of unripe mango candy decreased gradually from 90 to 180 days with the advancement of storage period in all the method of treatments. In the initial period (0 days) of storage the maximum color rating (8.93) was found in T1 whereas the minimum color rating (6.90) was found in T4 and at the final (180) days of storage period the maximum color rating (8.33) was found in T1 (whereas the minimum color rating (6.00) was found in T4.(Table-3)

The color of the product decreased with the advancement of storage period. In that treatment of hot water blanching + direct addition of powder sugar (T1) was effective in retention of maximum color score of the product up to 180 day of storage. The deterioration of color is due heating and oxidation in the product. The possible explanation for better retention of color as a result at drying method might be because of heating treatment. Similar, beneficial effect of hot enzymatic treatment for retention of the color during storage of the product was recorded by Couri *et al.* (2003) [5] in

cashew apple. Chan and Cavaletto (1982) [4] also determined that there was 30% loss of ascorbic acid in guava puree, 56% in papaya puree and significant loss in color of both puree after 6 months ambient storage. Among the various recipe treatments in present study, the highest initial color value was recorded at T1.

#### Taste

The taste rating of unripe mango candy decreased gradually from 90 to 180 days with the advancement of storage period in all the method of treatments. In the initial period (0 days) of storage the maximum taste rating (8.87) was found in T3 whereas the minimum taste rating (7.23) was found in T8 and at the final (180) days of storage period the maximum taste rating (8.33) was found in T3 whereas the minimum taste rating (6.67) was found in T8. (Table-3)

The results indicated that the taste value of unripe mango candy decreased with the increase in storage period up to 180<sup>th</sup> day. The rate of reduction in taste value was significantly affected by blanching method, methods of sugar and honey addition and their interactions. Among the different treatment, the highest taste value was retained in T3 in unripe mango candy. The taste value decrease might be due to removal of tannins and inactivation of enzymatic activity by heat treatment, presence of optimum sugar concentration resulted slow deterioration process and helped in maintaining the organoleptic taste. To support the present results, Khurdia and Anand (1981) [12] observed that the organoleptic quality of phalsa beverage was decreased during storage and it was acceptable only for four months.

#### Overall acceptability

The data on changes in overall acceptability content of unripe mango candy under the influence of different treatments like blanching method, methods of sugar and honey addition and their interactions are presented in Table-3.

The overall acceptability rating of unripe mango candy decreased gradually from 90 to 180 days with the advancement of storage period in all the method of treatments. In the initial period (0 days) of storage the maximum overall acceptability rating (8.83) was found in T7 whereas the minimum overall acceptability rating (7.30) was found in T8 and at the final (180) days of storage period the maximum overall acceptability rating (8.33) was found in T3 whereas the minimum overall acceptability rating (6.67) was found in T8. The mean data of overall acceptability of mango candy as influenced by blanching method, methods of sugar and honey addition and their interactions. Treatment T3 and

T7 exhibited highest overall acceptance during entire period of storage. Treatment as compared to flavor, taste and general appearance are important consideration of overall acceptance of the product.

As discussed earlier, that the T3 treatment helped in maintaining the color, taste, texture and flavor of the product during storage, which ultimately resulted in higher overall acceptance score up to 180 day of storage. The present finding is in accordance to that reported by Shahadan and Abdullah (1995)<sup>[22]</sup> in banana. Similar finding were obtained by Pilania *et al.* (2010)<sup>[18]</sup> and Hariram (2007)<sup>[9]</sup>.

**Table 3:** Organoleptic score of unripe mango candy during storage period

Treatments	Storage period								
	Colour			Taste			Overall acceptability		
	0 day	90 days	180 days	0 day	90 days	180 days	0 day	90 days	180 days
T1	8.93	8.67	8.33	8.67	8.33	8.00	8.60	8.37	8.00
T2	8.83	8.33	7.67	8.33	8.00	7.73	8.27	8.00	7.73
T3	8.33	8.00	7.67	8.87	8.50	8.33	8.77	8.50	8.33
T4	6.90	6.33	6.00	7.73	7.33	7.00	7.50	7.33	7.00
T5	8.37	8.00	7.67	8.50	8.37	8.00	8.40	8.33	8.00
T6	8.10	8.00	7.33	8.40	8.33	7.73	8.33	8.27	8.00
T7	8.67	8.33	8.00	8.77	8.50	8.00	8.83	8.50	8.30
T8	7.20	7.00	6.67	7.23	7.00	6.67	7.30	7.00	6.67

### Summary and Conclusion

This study indicates that candies can be easily prepared from unripe mango slices. The processed candies can be stored in polyethylene pouch at ambient condition up to six months. This product (candy) will be useful in order to minimize the wastage, by promoting the product as export item and uplifting the nutritional and socioeconomic status of vulnerable commodities of West Bengal.

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