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## Studies on preparation of toffee from dragon fruit

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### Abstract

The present investigation on “Studies on preparation of toffee from dragon fruit” was undertaken to study the nutritional quality of dragon fruit and to optimize ingredients for preparation of toffee from dragon fruit. The recovery of pulp was 70%. The fresh dragon fruit pulp contained 87.80 percent moisture, 11.07 0Brix TSS, 0.42 percent acidity, 8.14 percent total sugars, 4.30 percent reducing sugar, 9.90 mg/100 g ascorbic acid. Preliminary studies were conducted to standardize optimum levels of sugar, fat, skim milk powder. Among various combinations of toffee T1: 1000 g dragon fruit pulp, 1000 g sugar, 50 g fat, 100 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin and T2: 1000 g dragon fruit pulp, 1000 g sugar, 25 g fat, 50 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin were found better than other combinations in respect to organoleptic properties and nutritional quality.

The storage studies indicated gradual decrease in moisture and ascorbic acid with advancement of storage period. While TSS, titrable acidity, total sugars, reducing sugars increased slightly with storage period. The rates of increase and decrease were relatively higher in toffees stored in butter paper wrapper than metallic film wrapper.

Result obtained from storage study showed that toffees prepared from dragon fruit can be stored in metallic film wrapper up to 3 months with minimum losses in sensory quality and chemical composition than butter paper.

**Keywords:** Dragon fruit, preparation, toffee, analysis, storage period

### Introduction

Dragon fruit is a perennial, epiphytic tropical climbing cactus with a triangular fleshy jointed stems which belongs to family Cactaceae and of genus *Hylocereus* (Cheah *et al.*, 2016; Tripathi *et al.*, 2014 and Gunasen *et al.*, 2006) [7, 36, 14]. There are three species of dragon fruit which include *Selenicereus megalathus* (white flesh with yellow peel dragon fruit), *Hylocereus undatus* (white- flesh with red peel dragon fruit) and *Hylocereus polyrhizus* (red flesh with red peel dragon fruit). *Hylocereus undatus* is the most cultivated and consumed species of dragon fruit. The fruits of this species present market demand, due to its very attractive sensory characteristics (De Mello, 2014) [9]. Until recently, this fruit was unknown and has come to represent a growing niche in the exotic fruit market due to appreciation of the organoleptic characteristics when eaten raw or inserted in gastronomy (Granulado *et al.*, 2012) [13]. The dragon fruit was introduced in India late 90s. But the area under dragon fruit is still very limited. In India, it is cultivated on very limited scale. A very few farmers of Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat and Andhra Pradesh have taken up dragon fruit cultivation. The total area under dragon fruit cultivation is less than 100 acres (Tripathi *et al.*, 2014) [36].

Now a day's farmers of Karnataka and Maharashtra are gaining the much more knowledge about the cultivation of dragon fruit and the area under the dragon fruit will go too increased in future days because of its low requirement of water and tillage practices. The biggest advantage of this crop is that once planted, it will grow for about 20 years and one hectare could accommodate 1000 to 2000 dragon fruit plants. It bears fruit in the second year after planting and attains full production within five years. The fruit weight ranges from 300 to 800 g and each plant produces 40 to 100 fruits per year. One plant normally yields 15 to 25 kg of fruits (Tripathi *et al.*, 2014) [36]. The dragon fruit features a mouthwatering light sweet taste, an intense shape, color, and not forgetting its outstanding flowers. The flower is so beautiful that its nick name is “Novel woman” or “Queen of the night” (Luders *et al.*, 2006) [21]. The dragon fruit is eaten by cutting the fruit and its texture is sometimes likened compared to that of the kiwifruit due to the presence of black, crunchy seeds. The flesh, which is eaten raw, is mildly sweet and low in calories. Seeds are eaten together with the flesh, have a nutty taste and are rich in lipids (Ariffin *et al.*, 2009) [14].

In addition to being tasty and refreshing, this beautiful fruit boasts of a lot of water and other vital minerals with varied nutritional ingredients. The edible part of dragon fruit (64.50% of total fruit wt.) contains moisture 82.5-83%, protein 0.16-0.23%, fat 0.21-0.61%, calcium 6.3-8.8 mg, phosphorus 30.2-36.1 mg, iron 0.5-0.61 mg, vitamin-C 8-9 mg (Tripathi *et al.*, 2014) [36]. It also contains nutrients, such as carbohydrate, flavonoid, thiamine, niacin, pyridoxine, glucose, and polyphenol (Vaillant and Imbert, 2006) [37]. The dragon fruit contains beta-carotene, lycopene and vitamin E, with average concentrations of 1.4 mg/100 g, 3.4 mg/100 g and 0.26 mg/100 g of edible portion, respectively (Charoensiri *et al.*, 2009) [6]. The seed of dragon fruit contains 50% essential fatty acids, i.e. 48% linoleic acid and 1.5% linolenic acid (Ariffin *et al.*, 2009; Rui H *et al.*, 2009 and Azis *et al.*, 2009) [4, 31, 5]. Thus, dragon fruit has potential for use as a source of functional ingredients to provide nutrients that may prevent nutrition related diseases and improve physical and mental well-being of the consumers. Different studies conducted with the dragon fruit emphasized its functional properties helping to reduce the risk of chronic diseases in the human body and also helpful in reducing blood sugar levels in people suffering from type 2 diabetics (Stintzing *et al.*, 2003; Yong *et al.*, 2009 and Wichienchot *et al.*, 2010) [35, 40, 39].

In India the indigenous fruits are processed into a number of value added products like, jam, juice, jelly, cheese, preserves etc. But the exotic fruits like kiwi, avocado, mangosteen, dragon fruit and their processed fruit products are rarely available in our markets as well as very little work has been done on processing of dragon fruit in our country. So there is scope for utilizing dragon fruit remains bright in India. A number of locally processed fruit products are now available in the market. If quality products from dragon fruit are developed, it might be welcomed by the consumers, because of this dragon fruit has gained much interest in the society due to its exotic features attractive colors, nutritional value and pleasant taste. Therefore this study was planned keeping in view on medicinal and nutritional importance of dragon fruit, to utilize them by processing product as toffee including other value added product would provide opportunity for commercial exploitation of this fruits.

### Materials and Methods

The experiment was conducted in the laboratory of Department of Food Science and Technology, Post Graduate Institute at Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2021-2022.

### Packaging material

The packaging materials like metallic film wrapper and butter paper were purchased from the local market.

### Ingredients

The major ingredients for the preparation of toffee such as dragon fruit, sugar, salt, vanaspati ghee i.e fat, skim milk powder were purchased from local market. Maltodextrin and starch were used from laboratory store.

### Method

#### Procedure for preparation of toffee

The procedure for preparation of toffee is shown in Fig. 1.

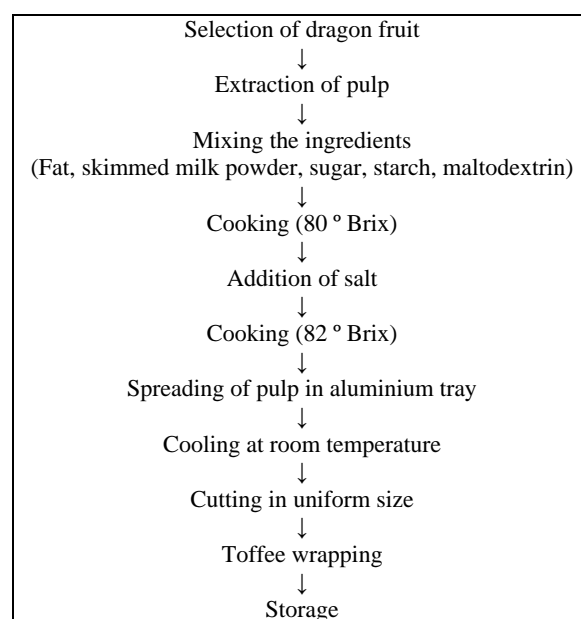


Fig 1: Flow sheet for preparation of dragon fruit toffee

Table 1: Treatment details

Treatments	Pulp (g)	Sugar (g)	Salt (%)	SMP (g)	Fat (g)	Starch (%)	Maltodextrin (%)
T0	1000	500	2	100	50	6	2
T1	1000	750	2	100	50	6	2
T2	1000	1000	2	100	50	6	2
T3	1000	500	2	50	25	6	2
T4	1000	750	2	50	25	6	2
T5	1000	1000	2	50	25	6	2

### Physico-chemical analysis of raw material and toffees

The method described in A.A.C.C. (2000) [1] for determining moisture was used. Length and diameter of fruit measured by using vernier caliper. TSS of fruit juice was determined by using Digital refractometer. The acidity of the toffee will be determined by titration with 0.1N NaOH using phenolphthalein as indicator described by Rangana (1986) [12]. Sensory evaluation will be carried out with respect to colour and appearance, flavor, texture, taste and overall acceptability by a panel of semi-trained judges on basis of 9 points Hedonic scale as reported by Amerine *et al.* (1965) [2]. Vitamin C will be determined by 2, 6- dichlorophenol indophenols dye method. The total sugar and reducing sugar will be estimated by volumetric method of Lane and Eynon (1923) as reported by Rangana (1986) [12].

### Packaging and storage of toffees

The selected treatment T1: 1000 g dragon fruit pulp, 1000 g sugar, 50 g fat, 100 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin and T2: 1000 g dragon fruit pulp, 1000 g sugar, 25 g fat, 50 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin were packed in metallic film wrapper and butter paper and stored for 90 days. The toffees were drawn at an interval of 30 days and evaluated for chemical and sensory quality.

### Sensory evaluation of toffees prepared from dragon fruit

Sensory evaluation of dragon fruit toffee was carried on by 9 point hedonic scale. The average scores of the ten judges for different quality characteristics viz. Colour and appearance, flavour, texture, taste and overall acceptability were recorded.

### Statistical analysis

All experiments were carried out by using Factorial Completely Randomized Design (FCRD). The data obtained in the present investigation were analyzed for the statistical significance according to the procedure given by Rangaswamy (2010) [10].

### Results and Discussion

**Table 2:** Physical parameters of dragon fruit

Sr. No.	Parameters	Mean value
1	Shape	Oval or elliptical
2	Diameter/ fruit (cm)	7.6
3	Length / fruit (cm)	9.6
4	Weight/ fruit (g)	247
5	Pulp recovery (%)	70
6	Loss (%)	30

**Table 3:** Chemical parameters of dragon fruit pulp

Sr. No.	Parameters	Mean value
1	Total soluble solids (°Brix)	11.07
2	Moisture (%)	87.80
3	Titration acidity (%)	0.42
4	Total sugar (%)	8.14
5	Reducing sugar (%)	4.30
6	Ascorbic acid (mg/100g)	9.90

All results are mean of three replications.

**Table 5:** Chemical composition of toffee prepared from dragon fruit preliminary trial

Treatment	Moisture (%)	TSS (° brix)	Titration Acidity (%)	Total Sugars (%)	Reducing Sugars (%)	Ascorbic Acid (mg/100 g)
T0	15.10	82.42	0.24	72.18	34.14	64.10
T1	14.90	82.65	0.23	72.13	34.11	63.12
T2	14.96	82.90	0.22	72.12	34.06	62.16
T3	14.88	82.74	0.24	72.16	34.13	64.16
T4	14.86	82.71	0.23	72.14	34.10	64.08
T5	14.98	82.92	0.21	72.10	34.08	62.12
Mean	14.94	82.72	0.23	72.13	34.10	63.29
SE±	0.241	0.350	0.212	0.178	0.31	0.220
CD at 5%	0.686	0.997	0.180	0.534	0.93	0.627

All values are mean of three replications

### Changes in sensory parameters of dragon fruit toffee during storage

**Table 6:** Sensory evaluation of dragon fruit toffee during storage

Treatment	Colour and appearance	Texture	Flavour	Taste	Overall acceptability
<b>Initial</b>					
T0P1	8.40	8.50	8.60	8.30	8.45
T0P2	8.40	8.50	8.60	8.30	8.45
T1P1	8.60	8.70	8.80	8.50	8.65
T1P2	8.60	8.70	8.80	8.50	8.65
T2P1	8.80	8.90	9.00	8.70	8.85
T2P2	8.80	8.90	9.00	8.70	8.85
<b>Final</b>					
T0P1	7.90	7.98	8.13	7.83	7.96
T0P2	7.91	7.99	8.14	7.84	7.37
T1P1	8.24	8.31	8.40	8.07	8.26
T1P2	8.01	8.12	8.28	7.89	8.08
T2P1	8.37	8.50	8.58	8.30	8.44
T2P2	8.13	8.21	8.28	8.00	8.16

Maximum score out of 9

**Table 4:** Sensory evaluations of fresh toffees prepared from dragon fruit

Treatment	Colour and appearance	Texture	Flavour	Taste	Overall acceptability	Rank
T0	8.4	8.5	8.6	8.3	8.45	3
T1	8.1	8.4	8.1	8.2	8.20	6
T2	8.6	8.7	8.8	8.5	8.65	2
T3	8.3	8.4	8.2	8.3	8.30	4
T4	8.2	8.2	8.4	8.3	8.28	5
T5	8.8	8.9	9.0	8.7	8.85	1
Mean	8.4	8.51	8.51	8.38	8.45	-
SE±	0.040	0.057	0.041	0.039	0.040	
CD at 5%	0.113	0.114	0.115	0.111	0.113	

Maximum score out of 9

The organoleptic evaluation of toffees prepared from dragon fruit were carried out. The toffees were prepared and presented to panel of ten judge for assessing the quality and acceptability of product. Organoleptic evaluation of was carried out using a 9 point hedonic scale of sensory characteristics such as colour, texture, taste and overall acceptability.

T1: 1000 g dragon fruit pulp, 1000 g sugar, 50 g fat, 100 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin and T2: 1000 g dragon fruit pulp, 1000 g sugar, 25 g fat, 50 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin were selected and kept for 3 months for storage study. Chemical analysis and sensory evaluation was done at interval of 30 days.

Whereas;

**T0:** 1000 g dragon fruit pulp, 500 g sugar, 50 g fat, 100 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin

**T1:** 1000 g dragon fruit pulp, 1000 g sugar, 50 g fat, 100 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin

**T2:** 1000 g dragon fruit pulp, 1000 g sugar, 25 g fat, 50 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin

**P1:** Packaging material (metallic film wrapper) P2: Packaging material (butter paper)

The data in table 6 shows that all toffees remained in good condition at ambient temperature during the entire storage period of 3 months. The toffees stored in metallic film wrapper showed good quality than butter paper during 3 months of storage. The overall acceptability score of dragon fruit toffee was decreased from 8.65 to 8.26 in metallic film wrapper and from 8.65 to 8.08.

## Changes in chemical parameters of dragon fruit toffee during storage

**Table 7:** Chemical analysis of dragon fruit toffee during storage

Treatment	Moisture (%)	TSS (%brix)	Titration Acidity (%)	Total Sugar (%)	Reducing Sugar (%)	Ascorbic Acid (mg/100g)
<b>Initial</b>						
T0P1	15.10	82.42	0.24	72.18	34.14	64.10
T0P2	15.10	82.42	0.24	72.18	34.14	64.10
T1P1	14.96	82.90	0.22	72.12	34.06	62.16
T1P2	14.96	82.90	0.22	72.12	34.06	62.16
T2P1	14.98	82.92	0.21	72.10	34.08	62.12
T2P2	14.98	82.92	0.21	72.10	34.08	62.12
<b>Final</b>						
T0P1	14.86	83.02	0.38	73.09	35.08	63.29
T0P2	14.83	83.08	0.41	73.02	35.05	63.30
T1P1	14.66	83.40	0.37	73.14	35.02	61.35
T1P2	14.63	83.37	0.40	73.11	35.04	61.36
T2P1	14.78	83.44	0.37	73.22	35.01	61.31
T2P2	14.65	83.38	0.38	73.12	35.02	61.38

All values are mean of three replications

Whereas

**T0:** 1000 g dragon fruit pulp, 500 g sugar, 50 g fat, 100 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin

**T1:** 1000 g dragon fruit pulp, 1000 g sugar, 50 g fat, 100 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin

**T2:** 1000 g dragon fruit pulp, 1000 g sugar, 25 g fat, 50 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin

**P1:** Packaging material (metallic film wrapper) P2: Packaging material (butter paper)

The data in Table 7 shows that TSS (%brix), Titration acidity (%), Total Sugar (%) and Reducing Sugar (%) are increased throughout the storage period. Except moisture and ascorbic acid they showed decrease in storage period in final analysis as compared to initial analysis. Toffees stored in metallic film wrapper shows better quality than butter paper.

### Conclusion

The results obtained in the present investigation indicated that better quality toffee of dragon fruit can be prepared by 1000 g dragon fruit pulp, 1000 g sugar, 25 g fat, 50 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin and another combination 1000 g dragon fruit pulp, 1000 g sugar, 50 g fat, 100 g skim milk powder, 6% starch, 2% salt, 2% maltodextrin was also good for toffee preparation. These treatments also showed superior sensory score in respect of quality over other treatments. Toffee stored in metallic film wrapper showed better chemical and organoleptic performance than butter paper wrappers. Toffee could be stored in good condition beyond 90 days in metallic film wrappers at room temperature. Toffee stored in metallic film wrapper showed less microbial growth than stored in butter paper.

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