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Processing, value addition and effect of nutritional quality of fig fruit by osmatic dehydration

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Abstract
Fig fruits are storehouse of essential nutrients and phytochemicals which are rich in antioxidants and it is much valued in both the fresh and processed forms. Fig fruit is highly perishable due to their high water activity. It is essential to process the fig fruits to add value to it and also to increase their usage in our daily diet. Osmotic dehydration of fig fruit was carried out by using sugar as an osmotic agent at different concentration and the process was standardized and physico-chemical parameters and organoleptic characteristics of osmotically dehydrated fruits and control sample were studied. Results showed that the sample steeped in 50° Brix was found to good quality and highly acceptable by the consumers. The chemical content of osmotically dehydrated fig fruits were moisture - 9.47 per cent, TSS - 80.4º Brix, acidity - 0.11 percent, pH - 5.40, total sugar - 76.04 g/100g, reducing sugar - 4.29 g/100g, fibre - 5.94g/100g, ash - 5.94 g/100g, vitamin C - 10.97 mg/100g, antioxidant - 109.34 mg/g, water activity - 0.744 and colour Lab values were 75.41, -1.50 and 15.04 respectively. From the osmotically dehydrated fig fruits, the products laddu, fudge, cake, and cookies were prepared and organoleptic characteristics were studied. The incorporation levels of dehydrated fig fruits in the products were 5, 10, 15, 20 and 25 per cent respectively. Among the different level of incorporation 15 per cent scored higher consumer acceptability with respect to colour and appearance, flavor, texture, taste with optimum amount of nutritional content.

Keywords: Fig fruit, osmotic dehydration, organoleptic evaluation and brix

Introduction
Fig *(Fiscus carica L.)* is cultivated since ancient times and its remains found in at least 5000 B.C. In India, its cultivation is mostly confined to western part of Maharashtra, Gujarat, Uttar Pradesh, Karnataka, Punjab and Tamil Nadu. Fig is a delicious, nutritive fruit and has many medicinal properties. The health benefits of figs include promoting bowel function due to the high level of fibre. Figs are amongst the most alkaline foods, making them useful in balancing the pH of the body. It is a source of calcium which has many functions including promoting bone density and also contains several medical components such as flavones which can be used in cardiovascular disease medicine production. Additionally, Figs have good amount of vitamin A, C and E which are considered an antioxidants can effectively prevent deficiencies and vision destroying diseases like macular degeneration (Wang *et al*., 2017; Bansode *et al*., 2012) [11, 2]. Fig is consumed fresh, dried, preserved, freezed, canned and candied fruit. Being highly perishable fruit, the dried fruits can be stored for 6-8 months whereas fresh fruit is stored in refrigerator only for 2-3 days. The natural colour, flavor and texture of fruits are lost during mechanical dehydration process. Therefor to achieve good quality of dehydrated fruit a technique *viz.*, osmotic dehydration is useful in combination with other drying methods. The product obtained by osmotic dehydration is more stable during storage due to low water activity impaired by solute gain and water loss. Shrinkage of the final product is avoided by osmotic dehydration techniques. Because of this, the present investigation was carried to study the fixing an optimum concentration of osmotic agent for osmotic dehydration of fig fruit.

Material and Methods
The study was conducted at Community Science College and Research Institute, Tamil Nadu Agricultural University, Madurai.

The firm and ripened fig fruits (local variety) were purchased from local market and washed in running tap water than the fruits were steam blanched for 3-5 min for softening and also pre-sterilization to inactivate any insects present in them. After cooling the fruits were soaked in 30 (T_1), 40 (T_2), and 50 °brix (T_3) sugar syrup containing 0.5% KMS solution (1:2 fruit: sugar syrup ratio) for a period of 24 hrs. After the soaking period, the sugar syrup was drained out and the soaked fruits were pressed by using pressing machine. The pressed fruits in each treatment were dried at a temperature of 60 °C in a cabinet drier till it becomes dried (constant values obtained). A control (T_0) sample was also kept for comparison.

Organoleptic qualities (ASTM, 1968) [1] were analysed for all the treatments for the selection of best treatment. The selected osmotically dehydrated fig fruit was analysed for nutritional characteristics (Ranganna, 1995) [9] and the products *laddu* (fig 1), *fudge* (fig 2),*cookies* (fig 3) and *cake* (fig 4) were prepared by adding dehydrated fig fruits in level of 5, 10, 15, 20 and 25 per cent. The prepared products were organoleptically evaluated and the best level of incorporation was selected for each product.

Results and Discussion

Organoleptic evaluation

The organoleptic evaluation of osmotic dehydrated fig fruit at different concentrations it was found that the overall acceptability of 8.29 soaked with 50° brix followed by 40° brix (7.36) and 30° brix (6.69). The lowest acceptability of 5.75 was in control (Table 1). Similar results were obtained by Chavan *et al*. (2010) [3] and Chenlo *et al*. (2006) [4].

Nutrient content

The significant results were found between fresh and dehydrated fig fruit nutrient content (Table 2). The moisture content of fresh and osmotically dehydrated fig fruit was 79.80 and 9.47 percent respectively. This is due to the hypertonic sugar solution which replaces the moisture content and increases the shelf life. The TSS content of the fresh and dehydrated fig was 19 and 80.4 brix respectively. The acidity content was decreased to 0.11% from 0.19% after dehydration. The pH content of figwas increased from 5.10 to 5.40 after osmotic dehydration. The total sugar content of fresh and dehydrated fig was 18.04 and 76.04 g/100g respectively. The reducing sugar content of dehydrated fig fruit was 4.29 g/100g which was decreased from 8.35 g/100g after dehydration. The ash content and fibre was found to be increased from 1.57g to 1.93 g and 2.05g to 5.94 g respectively due to removal of water during osmotic dehydration. The vitamin C content of the dehydrated fig fruit was decreased from 39.0mg/100g to 10.97 mg/100g after osmotic dehydration.The antioxidant value of dehydrated fig was109.34 mg. The water activity was found to be 0.744 aw in dehydrated fig fruit. The colour lab values were 74.41,-1.50 and 15.04 for dehydrated fig fruit. The similar results were in line with earlier finds of Dhingra et al. (2008) [5]; Hooti et al. (2008) [6] and Paakkomen and Mattila (1991) [8].

Product development

The selected osmotically dehydrated fig fruit (ODF) (50° brix) was used to prepare products such as laddu, fudge, cookies, cake and boli. All products were prepared by adding osmotically dehydrated fig fruits (ODF) in powder form (5, 10, 15, 20 and 25 per cent). The prepared products were organoleptically evaluated and based on the sensory evaluation it as found that for laddu prepared with adding 15 per cent ODF, fudge with 25 per cent ODF, cookies with 10 ODF, cake with 15 per cent ODF and boli with 20 per cent ODF was accounted highest organoleptic values (Fig. 6). The similar studies were also reported by Lerici *et al.* (1985) [7] and Sharma *et al.* (2006) [10].

T_o - control, T_1 - 30° brix, T_2 - 40° brix and T_3 -50° brix

Fig 1: Osmotically dehydrated fig fruit (ODF)

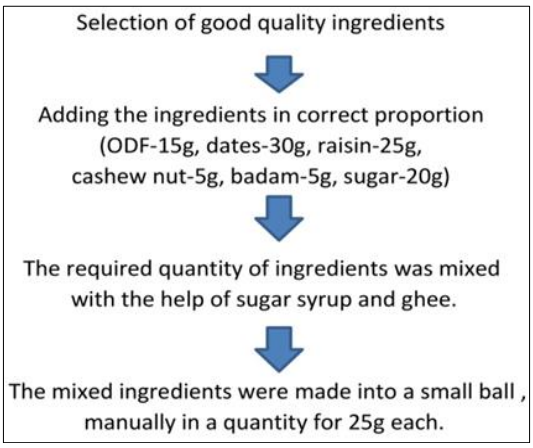


Fig 2: Preparation of ODF incorporated *laddu*

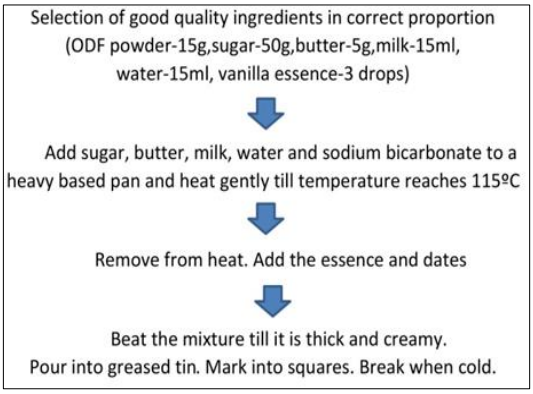


Fig 3: Preparation of ODF incorporated *fudge*

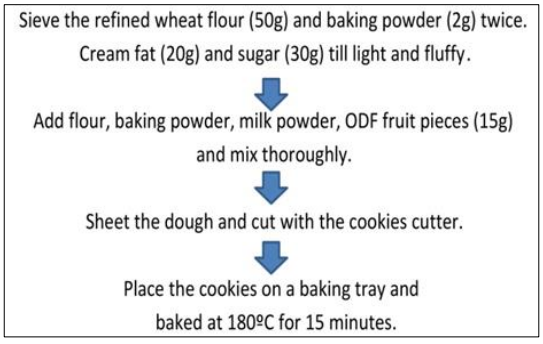


Fig 4: Preparation of ODF incorporated *Sweet cookies*

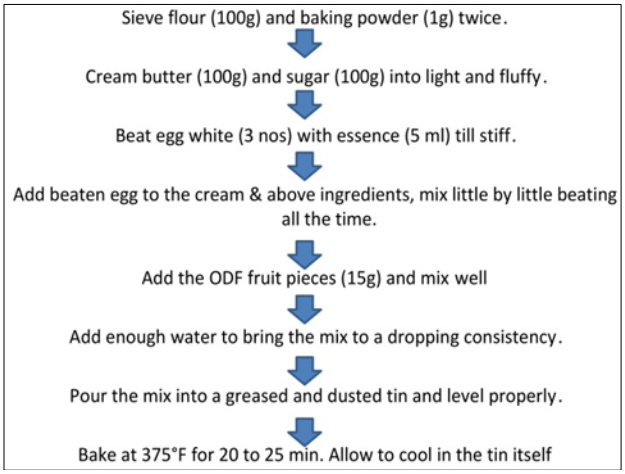
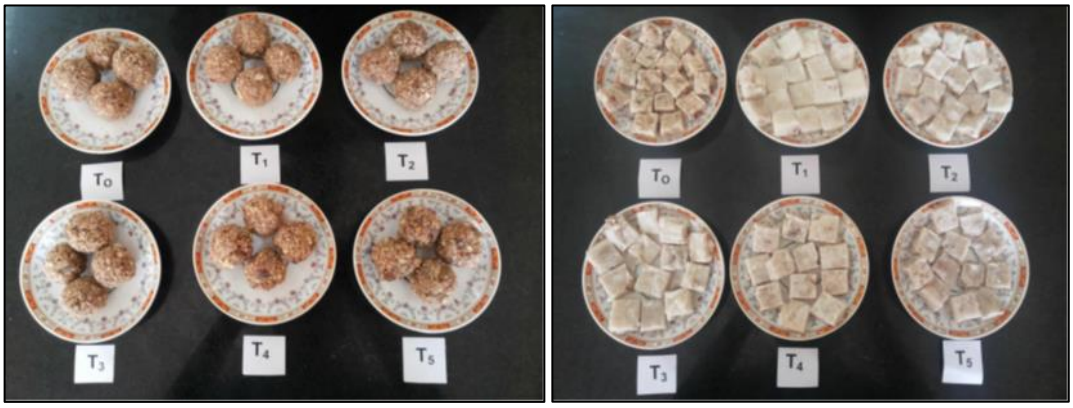


Fig 5: Preparation of ODF incorporated *cake*



Laddu Fudge

Cookies Cake

Fig 6: Osmotically Dehydrated Fig fruit incorporated products

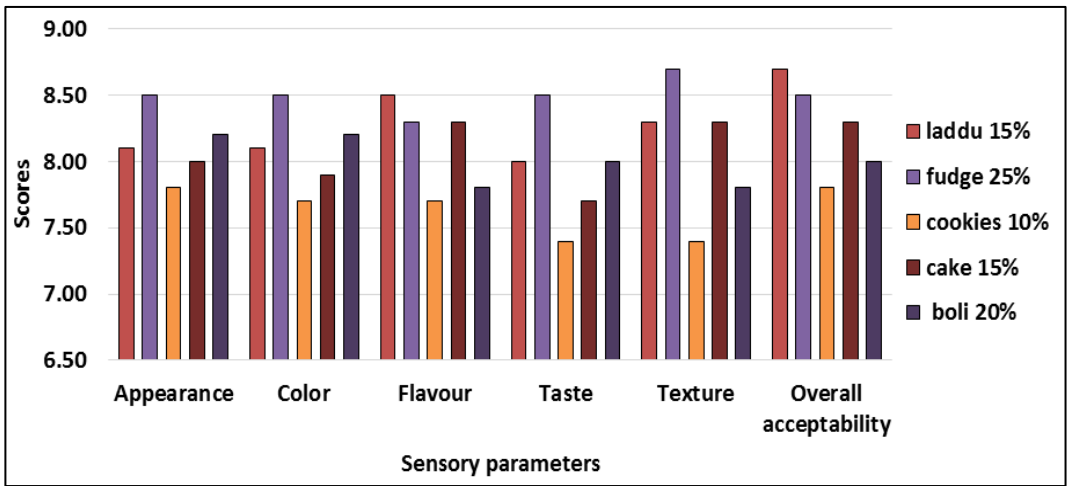


Fig 7: Organoleptic score values for ODF incorporated products

Table 1: Organoleptic evaluation of osmotic dehydrated fig fruit

Treatments	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
Control	6.13	5.25	6.00	5.50	5.89	5.75
30° brix	6.38	6.75	6.58	6.63	7.25	6.69
40° brix	7.13	7.19	7.83	7.38	7.25	7.36
50° brix	8.25	8.17	8.63	8.25	8.11	8.29

Table 2: Nutritional characteristics of osmotic dehydrated fig fruit

Particulars	Fresh fig	Dehydrated fig
Moisture (%)	79.80±2.021	9.47±0.193
TSS (°brix)	19±0.156	80.4±0.186
Acidity (%)	0.19±0.001	0.11±0.001
pH	5.10±0.100	5.40±0.029
Total sugars(g/100g)	18.04±	76.04±
Reducing sugars(g/100g)	8.35±0.028	4.29±0.143
Fibre(g/100g)	2.05±0.053	5.94±0.133
Ash(g/100g)	1.57±0.008	1.93±0.024
Vitamin C(mg/100g)	39.0±0.928	10.97±0.149
Antioxidant(mg/g)	110.05±0.907	109.34±2.455
Water activity(aw)	0.94±0.019	0.744±0.018
Colour values L	70.30±0.191	75.41±1.795
a	-4.65±0.094	-1.50±0.008
b	12.37±0.143	15.04±0.173

*Values reported are mean± SD of three replicates.

Conclusion

From the study it could be concluded that the fig fruits treated with 50° brix osmotic solution was found best treatment in terms of drying characteristics and also sensory evaluation and also higher nutritional quality. The developed products such as laddu, fudge, cookies, cake and boli by adding osmotically dehydrated fig were found high overall acceptability during sensory evaluation. Addition of osmotically dehydrated fig fruit in different products provides us a good value addition and scope for the fruit with nutritional value.

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