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RESEARCH PAPER

Development of technology for fortificatin of fig (*Ficus carica* L.) fruit into its value added product- fig toffee

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SUMMARY : The new consumption trends observed in the current society forces the companies to develop new and healthier products to satisfy the consumers demand. In this sense, a new fruit toffee formulated with healthy soy protein isolate, ragi powder, papaya pulp and a high fig fruit percentage could be an interesting product to develop. The fig toffee was prepared from finely ground fig pulp and other ingredients (liquid glucose, sucrose, edible fat and skim milk powder) in appropriate proportion. The fig pulp was fortified by addition of other ingredients such as soy protein isolate, ragi powder, papaya pulp followed by concentrating to about half of its volume by heating with continuous stirring. The mass was then heated to a thick consistency (750 – 80^0 Brix) followed by spreading as sheet of 1 cm thickness on a smeared (with edible fat) flat aluminum tray and dried for 2 hours in a cabinet drier at 60±5^{0}C temperature. Fig toffee is easier to handle during transportation, storage and also open further fields of application that may promote fig toffee processing and fortification at industrial scale in future. The products prepared by fortification of figs *viz.*, fig toffees were assessed for their physico-chemical and sensory parameters and were found for cheeper and also they were rich in nutrients like protein.

KEY **W**ORDS : Fig pulp, Papaya pulp, Fig toffee, Sensory parameters

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Fig (*Ficus carica* L.) belongs to the family Moraceae. The fig is a native of Southern Arabia. In India, its commercial production is limited to a few centers in Maharashtra and South India. In Maharashtra, it is cultivated on commercial scale in adjoining areas of Pune and Aurangabad (Anonymous, 2002). Figs have a great importance in nutrition due to being important source of carbohydrates. They contain essential amino acids and are rich in vitamins B_1, B_2 and C and minerals. Fresh figs are very sensitive to microbial spoilage, even in cold storage conditions; thus they must be preserved in some way (Sandhu, 1990).

Nutrient losses are found to occur during food processing and storage. Food fortification has come into picture several decades back and refers to the addition of essential nutrients which are originally deficient or lost during processing. Foods can be fortified with nutrients either in powder or liquid form (Sarojini *et al*., 2009).

Toffee is one of the essential products largely consumed by children. The confectionary products due to its varied taste and flavour have a wide acceptance in children throughout the world. The conventional toffees are generally made from sugar, skim milk powder and other artificial colours and flavours. Efforts have been made to incorporate the natural fig pulp in

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the toffee in forms of vitamins and minerals and to popularize the product among children as well as adults. Previously elderly people were abusing to eat such toffees because this leads to obesity due to increased calorie intake, atherosclerosis on account of higher fat content and dental caries because of its clinging to the teeth. Therefore, efforts have been made to incorporate the natural fig pulp which has good flavour, colour in the toffee to increase the nutritive value of the fig fruit toffee.

EXPERIMENTAL METHODS

Fortification of fig toffee :

The fig toffee was prepared from finely ground fig pulp and other ingredients (liquid glucose, sucrose, edible fat and skim milk powder) in appropriate proportion. The fig pulp was fortified by addition of other ingredients such as soy protein isolate, ragi powder, papaya pulp followed by concentrating to about half of its volume by heating with continuous stirring (Table A). The mass was then heated to a thick consistency (750 – 80^0 Brix) followed by spreading as sheet of 1 cm thickness on a smeared (with edible fat) flat aluminum tray and dried for 2 hours in a cabinet drier at 60±5^{0}C temperature. Then it was cut in to toffees of uniform size and wrapped first into butter paper followed by toffee wrapper (Thakur *et al.*, 2007) (Fig. A).

Chemical analysis :

The fresh fortified fig toffees were analyzed for moisture, ash, T.S.S., pH, acidity, sugar, protein, fat, fibre, ascorbic acid, β-carotene and potassium by the methods given by A.O.A.C. (1990) and Ranganna (1995).

Sensory evaluation :

The sensory evaluation of fortified fig toffees samples were examined by trained/semi-trained judges on nine point Hedonic scale for its colour and appearance, taste, flavour, consistency and overall acceptability (Amerine *et al.*, 1965).

Statistical analysis :

The data obtained on various parameters were recorded

Table A: Formulation of ingredients for fig toffee

(a) Formulation of ingredients for soy fortified fig toffee

Sr. No.	Ingredients	Samples			
		ST_0	ST_1	ST_2	ST_3
1.	Fig pulp (g)	100	95	90	85
2.	Sugar (g)	60	60	60	60
3.	SMP (g)	15	15	15	15
4.	Vegetable fat (g)	5	5	5	5
5.	Liquid glucose (g)	10	10	10	10
6.	Soy protein isolate	0	3	5	7

(b)Formulation of ingredients for ragi fortified fig toffee

Sr. No.	Ingredients	Samples			
		RT_0	RT_1	RT_2	RT_3
1.	Fig pulp (g)	100	90	80	70
2.	Sugar (g)	50	60	70	80
3.	SMP (g)	15	15	15	15
4.	Vegetable fat (g)	5	5	5	5
5.	Liquid glucose (g)	10	10	10	10
6.	Ragi powder (g)	0	5	10	15

(c)Formulation of ingredients for papaya fortified fig toffee

Sr. No.	Ingredients	Samples			
		PT_0	PT_1	PT_2	PT_3
1.	Fig pulp (g)	100	100	100	90
2.	Papaya pulp (g)	0	10	20	30
3.	Sugar (g)	60	60	60	60
4.	SMP (g)	15	10	0	0
5.	Vegetable fat (g)	5	0	0	0
6.	Liquid glucose (g)	10	10	10	10

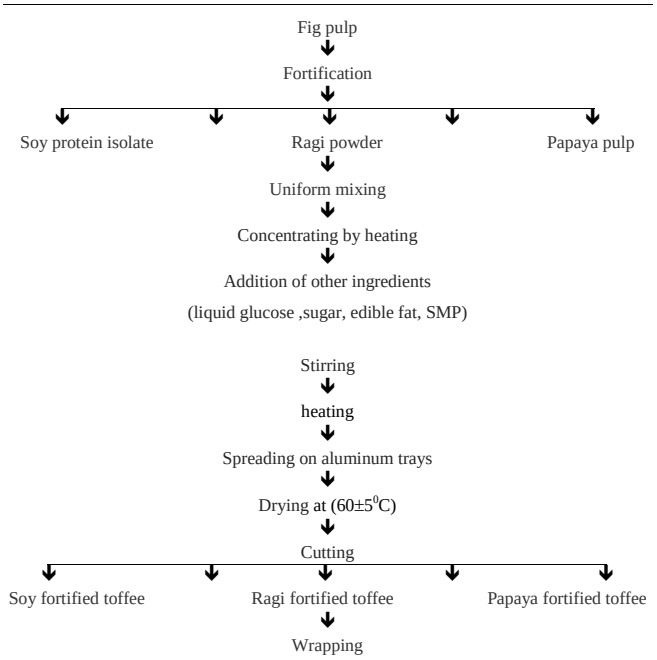

Fig. A: Flow chart for fortification of fig bar

and statistically analyzed by Completely Randomized Design (CRD) as per the method proposed by Panse and Sukhatme (1967).

EXPERIMENTAL FINDINGS AND ANALYSIS

The results of the present study as well as relevant discussions habe been presented under following sub heads:

Chemical parameters of fig fruit :

The chemical parameters of fig fruits with respect to its moisture, ash, T.S.S., pH, acidity, sugar, protein, ascorbic acid, β-carotene and calcium were studied in detail. The data pertaining to various chemical properties of fig fruit are depicted in Table 1.

The chemical composition results obtained in the present investigation revealed that the moisture content of fig fruit was 79.2 per cent.The total acidity as citric acid content of Dinkar cultivar was observed as 0.17 per cent against pH value of 5.3. It was also revealed that the fig contained 20°Bx total soluble solids. The values observed for reducing and non-reducing sugar content of Dinkar cultivar were found to be 14.98 and 1.70 per cent, respectively. The value of calcium content found in fig fruit was 80 mg/100g.

Chemical parameters of fortified fig toffee :

The most accepted sample (based on sensory evaluation of four samples) of fig toffee was subjected to chemical analysis and the data pertaining to the present investigation is tabulated in Table 2.

Table 1 : Chemical properties and nutritional composition of fresh fig fruit

Sr. No.	Chemical parameters	Measurement/value
1.	Moisture (%)	79.2
2.	Ash (%)	0.88
3.	T.S.S. (°Bx)	20
4.	Acidity (%) (as citric acid)	0.17
5.	T.S.S. : acid ratio	117.64
6.	pH	5.3
7.	Total sugar (%)	16.68
8.	Reducing sugar (%)	14.98
9.	Non-reducing sugar (%)	1.70
10.	Protein (%)	2.98
11.	Calcium (mg/100g)	80
12.	β-Carotene (µg/100g)	39.12
13.	Ascorbic acid (mg/100 g)	12.97

Table 2 : Chemical properties and nutritional composition of fortified fig toffee

Sr. No.	Parameters	Content / value
1.	Moisture (%)	16.2
2.	Ash (%)	4.5
3.	T.S.S.(0Bx)	75
4.	Acidity (%)	0.35
5.	T.S.S.: acidity	214.28
6.	pH	5.4
7.	Total sugar (%)	61.28
8.	Reducing sugar (%)	44.12
9.	Non-reducing sugar (%)	17.16
10.	Protein (%)	13.43
11.	Ascorbic acid (mg/100g)	4.7

It can be seen that the fortified fig toffee (soy) contained 16.2 per cent moisture (w.b.). The ash content of fortified fig toffee was found to be 4.5 per cent.

The fig toffee contained 75⁰ Brix total soluble solids. The total acidity as citric acid content of fig toffee was 0.35 per cent against the recorded pH value of 5.4. The result reveals that the fig toffee contained 61.28 per cent total sugar. The value of reducing sugar was found to be 44.12 per cent, where as the fig toffee contained 17.16 per cent non-reducing sugars. There was increase in protein content by 4.5 per cent *i.e.*13.43 per cent in soy fortified fig toffee which is 21 per cent of the RDA.

There was significant loss of ascorbic acid occurred while preparation of fig toffee. The fig toffee contained only 4.7 mg of ascorbic acid per 100 g.

Table 3 : Sensory score of fig toffee as affected by addition of soy protein isolate at different level

Sample	Colour and appearance	Taste	Flavour	Texture	Overall acceptability
ST_0	7.74	8	7.9	7.58	7.54
ST_1	7.52	8.12	8.18	8.06	7.98
ST_2	8.08	8.58	8.44	8.46	8.5
ST_3	7.6	8.06	7.42	7.94	7.94
SE±	0.1	0.06	0.09	0.14	0.1
C.D. at 5% level	0.31	0.2	0.28	0.42	0.32

Soy fortified fig toffee variations	
Sample	Ragi fortified fig powder (%)
S_0	00
S_1	3
S_2	5
S_3	7

Sensory evaluation :

It was found that texture and taste of toffee were influenced by the incorporation of soy protein isolate, ragi powder, papaya pulp. The fig toffees prepared from different levels of soy protein isolate (00 per cent *i.e.* control sample and 3, 5 and 7 per cent) were evaluated for their organoleptic properties. The sensory analysis of soy fortified fig toffee showed that the best quality toffee with respect to sensorial parameter was obtained when the formulation contained 95 g fig pulp, 60 g sugar, 15 g SMP, 5 g vegetable fat, 10 g liquid glucose , 5g soy protein isolate. The mean values of scores for colour and appearance, taste, flavour, texture and overall acceptability are presented in Table 3.

Conclusion :

In the present research work as mentioned above, the soy protein isolate was utilized as a novel food ingredient for enrichment of fig toffee. The value added products prepared by processing of fresh figs *viz.*, fortified fig toffee were assessed for their cost of production. The production cost of fig toffee (Rs. 120.65 per kg) was compared with similar products available in the market at present (Rs. 130.65 per kg). However, comparison with market products showed that fortified fig toffee were far cheaper and also they were rich in nutrients like protein.

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