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Development of value added products prepared from bael (*Aegle marmelos* L.) powder and its quality evaluation

Vipul Chaudhary, Vivak Kumar, Harsh P Sharma, Vijay Kumar Singh, Vaishali, Arjun Sanjay Paul, Ankur Mahendra Arya and Sunil

Abstract
The present study was undertaken to develop value added food product by incorporating Bael powder well as to evaluate organoleptic quality of prepared food product. The product bread, soup and sharbat the highest score of respectively 7.20, 7.60 and 7.40 for all the sensory parameters was obtained (T_2- 20 g Bael powder) 20 percent. The overall acceptability of the bread, soup and sharbat samples were perceived to be desirable by the panelists and therefore the score awarded was beyond "like moderately" range. The bread, soup and Sharbat samples T_2 was more acceptable than other bread, soup and Sharbat samples. The product were organoleptically evaluated for the colour, appearance, texture, taste flavour and overall acceptability using Nine point Hedonic scale. Sensory evaluation revealed highest score for Overall acceptability for the treatment T_2 that is at 20 percent enrichment. It can be therefore concluded that Bael powder can be suitably incorporated in various products.

Keywords: Bael powder, Sensory evaluation, value added product, bread, soup and sharbat

Introduction
Bael (*Aegle marmelos* L.) belongs to the family Rutaoeae, is commonly found in dry deciduous forests. In India, it is known by several names like elephant apple, curd apple, monkey fruit, kavat, curd fruit and kath bel (Mazumder *et al.*, 2006) [7]. The bael is native to India and Sri Lanka. It is a rare phenomenon to find a well planted bael orchard. It is an ideal tree to be exploited for growing in wasteland common in wild dry plains, cultivated along roads edges of fields and occasionally in orchards (Veeraraghavathatham *et al.*, 1996) [13]. In India it is grown in Deccan, Maharashtra, Madhya Pradesh, Uttar Pradesh, Chhattisgarh, Bihar, Jharkhand and Karnataka.

It can be planted under all conditions of soil and climates (Anon, 1956) [1]. The tree is very hardy, tolerance to drought and salinity and thrives better in deep, well drained soils of dry forests. It prefers slightly acidic sail but can be grown on a variety of soils. Its cultivation as a fruit tree is rare, but fruits of naturally occurring trees in community lands, forests and on road sides are used for sherbet, chutney and pickle making.

Bael is highly nutritive with a great medicinal use and the richest source of riboflavin. The roots are sweet, astringent, bitter and febrifuge. They are useful in curing dyspepsia, dysentery, and diarrhea, vitiated condition of vata, vomiting, cardiopalmus, stomachalgia, intermittent fever, seminal weakness, swelling, uropathy and gastric irritability in infants scope (Chaudhary *et al.*, 2020) [3-4]. The bark decoction for malaria and leaves are useful in opthalmia, deafness, and diabetes and asthmatic complaints. The flowers allay thirst vomiting. The unripe fruits are acrid, astringent, bitter, digestive, sour, stomachia and are useful in dysentery-diarrhea and stomachalgia. The ripe fruits are sweet, aromatic, cooling, febrifuge, laxative, good tonic for heart and brain and cure dyspepsia. Bael has a high tannin content which makes it an effective cure for dysentery and cholera. There is as much as 9% tannin in the pulp of wild fruits, less in the cultivated types and rind contains up to 20%. (Shukla and Singh, 2008) [11].

There has been a great increase in the production rate of bael fruits over the years, and this may be due to its increased consumption pattern in the tropics. It is common experience that 20-25% of the fruit is completely damaged and spoiled before it reaches the consumer. Therefore, to utilize the produce at the time of glut and to save it from spoilage, the development of low cost processing technology of bael fruit is highly required (Chaudhary

et al., 2020) [3-4]. It will also generate enough opportunities of self-employment by starting small scale processing unit or cottage industry that will be remunerative to the growers. The preparation of bael products with simple technology and its utilization in the form of juice, jam, jelly and powder has a great scope (Kaur *et al.*, 2000) [6]. Therefore, the present investigation is planned to produce the dried bael fruit powder with a view to promote the utilization of constituents of bael fruit and value added products from bael fruit powder. Value addition help in nutrient enhancement and reducing the post-production losses. Considering the nutritional importance and consumer acceptability, Bael powder is used to develop value added products which is ready to eat and preferred for people of all age groups (Saikia and Jasmin, 2020) [9]. (Thukral, 2017) [14] studied the sensory, functional and nutritional qualities of bael fruit powder and to utilize fruit powder for value added products (Srilakshmi, 2009) [12].

Demands for sensory methodology and technology have grown tremendously around the world, due mainly to the advent of total quality. In addition, the need for understanding people as consumers is something that has been constantly growing and becoming a target of all food industry. Sensory analysis fits into this context as an analytical tool used to translate the link between food products and the consumer, expressing numerical values that can be analyzed and verifying its accuracy through statistical support. Nowadays, most large consumer food companies have departments dedicated to sensory evaluation. Only human sensory data provide information on how consumers perceive or react to food products in real life. (Schiffman, 1996) [10].

Materials and Methods

Procurement and Processing of ingredients

Raw ingredients like refined wheat flour, Bael powder, corn flour, ghee, oil, hydrogenated fat (dalda), jaggery, sugar and salt were purchased from the local market.

Development of products from Bael fruit powder

The Bael powder was used for the preparation of baked products by utilizing bael powder in three proportion i.e.0%, 10% and 20% in standardized recipes. Refined flour was replaced with bael powder for the preparation of cookies and bread. Bael powder in combination with jaggery was used for the preparation of sharbat. Bael powder in combination with corn flour was used for the preparation of soup. These products were prepared in three different proportions, T_0 contained 0% bael powder, T_1 contained 10% bael powder and T_2 contained 20% bael powder.

Development of bread

Wheat flour was mixed with bael powder and bread were prepared according to the following treatments using the recipe described below:

Treatments

T_0 - 0 g bael powder & 100 g wheat flour
T_1 - 10 g bael powder & 90 g wheat flour
T_2 - 20 g bael powder & 80 g wheat flour

Ingredients

Sugar: 5 g/100 g
Yeast: 2 g/100 g
Ghee: 10 g/100 g
Salt: 5g/100 g

Method

Activated yeast with lukewarm water and small amount of sugar. Kneaded flour and bael powder into soft dough with water. Kept dough to ferment for 3 hours at 27 °C, added fat and kneaded vigorously to get smooth soft dough. Kept for 30 minute, moulded in the tin at 38 °C for 55 minute. The tin were placed in deck oven at 230 °C for 15 minutes. The bread were kept out from oven and cooled at room temperature.

Development of bael powder soup

Corn flour was mixed with bael powder and soup were prepared according to the following treatments using the recipe described below:

Treatments

T_0 - 15g tomato powder & 90 g corn flour
T_1 - 10 g bael powder & 90 g corn flour
T_2 - 20 g bael powder & 80 g corn flour

Ingredients

Chili powder: 4 g/100 g
Bael powder: 1 g/100 g
Cumin powder: 1 g/100 g
Garlic powder: 2 g/100 g
Onion powder: 2 g/100 g
Salt: 10 g/100 g

Method

1. Dissolved the mixture of all ingredients in warm water.
2. Boiled for 2-3 minutes.
3. Mixture was garnished with fried bread crumbs
4. Served hot

Development of bael powder Sharbat

Bael powder Sharbat was prepared according to the following treatments using the recipe described below:

Treatments

T_0 - 0 g bael powder
T_1 - 10 g bael powder
T_2 - 20 g bael powder

Ingredients

Jaggery: 30 g/100 ml
Lime: 2.5 ml/100 ml
Black salt: 2 g/100 ml
Chilled water: 80 ml/100 ml

Method

1. Dissolved the mixture of all ingredients in chilled water.
2. Until the properly mixing
3. Served chilled

Organoleptic evaluation of Development of products from Bael fruit powder

Organoleptic evaluation of Development of products from Bael fruit powder and evaluation was carried out in this experiment. The 9 point Hedonic Scale was used to compare the control with the formulated samples. Sensory evaluation was conducted in sensory evaluation laboratory, Department of agricultural engineering (Process and Food Engineering). The panelists were selected solely on the basis of interest, time available and lack of allergies to food ingredients used in

study. On every occasion, the panelists were provided with coded disposable paper cups containing the sample under investigation. Sensory evaluation was carried out under ambient conditions. A comfortable area without distractions (isolated booths) under fluorescent lighting and controlled temperature was used. Water was supplied to clean the pallets between the evaluations of two samples. Samples were tested for different parameters like color, taste, texture, flavor, and overall acceptability. All these tests including the testing for consumer acceptance was done by sensory panelist according to 9 point hedonic scale for sensory evaluation as described by (Peryam and Giradot 1952) [8].

Results and Discussion

Sensory evaluation

Sensory quality is evaluated on three parameters i.e. taste, color, flavor texture and overall acceptability. The score ranged from 1 to 9 which represented "Like extremely" to "dislike extremely", the dried powder samples were tasted by 10 judges. The sensory evolution Development of products from Bael fruit powder scoring was done to work out the overall acceptability of the product for the consumer. Color and texture were scored by visualization of eyes, flavor was scored by smelling and taste was scored by tasting the dried pineapple slices samples. The average score recorded by judges was considered, presented and discussed under suitability quality attributes (Chaudhary *et al.*, 2019) [5].

Development of bread

Proximate composition of bread

Proximate composition i.e. the moisture, crude protein, fat, ash, fibre and total carbohydrates content of bread prepared by using bael powder have been depicted in Table 1 and Fig. 1.

The fiber content of bael powder bread sample T_1 and T_2 were found to 1.49% and 2.18% respectively. The fiber content of the control sample T_0 was found to be 0.95% which was lowest as compared to the bread prepared from bael powder. The Fiber content of bread ranged from 0.95 to 2.18. This increase in fibre content was due to incorporation of bael powder. The ANOVA for fiber content of bael powder bread variations (T_0) 0 g Bael powder, (T_1) 10 g Bael powder and (T_2) 20 g Bael powder samples. It was observed that treatments effects on fiber content were found significant at 5% level of significance.

The ash content of the bael powder bread sample T_1 and T_2 were found to 2.04% and 2.39% respectively. While the ash content of control sample T_0 was found to be 1.50%. The highest ash content was found in sample T_3 i.e 2.39% as compared to the rest of samples T_1 and lowest ash content in the sample T_0. The ash content of bread ranged from 1.50 to 2.39% respectively. Ash content of bread increased with the incorporation of bael powder. The ANOVA for Ash content of bael powder bread variations (T_0) 0 g Bael powder, (T_1) 10 g Bael powder and (T_2) 20 g Bael powder samples. It was observed that treatments effects on fiber content were found significant at 5% level of significance.

The fat content of the bael powder bread sample T_1 and T_2 were found to 4.45% and 4.64% respectively. The fat content of the control sample T_0 was found to be 4.01% which was lowest as compared to the bread prepared from bael powder. The fat content of bread varied from 4.01 to 4.64%. Fat content of bread increased with the incorporation of bael powder. The ANOVA for fat content of bael powder bread variations (T_0) 0 g Bael powder, (T_1) 10 g Bael powder and (T_2) 20 g Bael powder samples. It was observed that treatments effects on fiber content were found significant at 5% level of significance.

The ascorbic acid content of the bael powder bread sample T_1 and T_2 were found to 3.50 and 6.98mg/100 g respectively. While the ascorbic acid of control sample T_0 was found to be 0.08mg/100 gm. The highest ascorbic acid was found in sample T_2 i.e 6.98mg/100 gm as compared to the rest of samples T_1 and lowest ascorbic acid in the sample T_0. Increase in ascorbic acid content of bael powder incorporated bread was observed with the increase in incorporation of bael powder. The ANOVA for ascorbic acid content of bael powder bread variations (T_0) 0 g Bael powder, (T_1) 10 g Bael powder and (T_2) 20 g Bael powder samples. It was observed that treatments effects on fiber content were found significant at 5% level of significance.

The protein content of the bael powder bread sample T_1 and T_2 were found to 12.35% and 13.10% respectively. While the protein content of the control bread sample was found 11.96%. The bread sample T_2 had highest protein content and it increased gradually with the increase in bael powder content in samples. So, with the incorporation of bael powder, protein content increased in the bread samples as compared to the control baels samples. The ANOVA for protein content of bael powder bread variations (T_0) 0 g Bael powder, (T_1) 10 g Bael powder and (T_2) 20 g Bael powder samples. It was observed that treatments effects on fiber content were found significant at 5% level of significance.

The moisture content of the bael powder bread sample T_1 and T_2 were found to 33.03% and 34.40% respectively. The control sample made of 100% of wheat flour had lowest moisture content while the sample made of 20% of bael powder had highest moisture content. The higher moisture content moisture content in bread samples were due to the large amount of water required in optimum dough preparation and less baking time then the control bread. The ANOVA for moisture content of bael powder bread variations (T_0) 0 g Bael powder, (T_1) 10 g Bael powder and (T_2) 20 g Bael powder samples. It was observed that treatments effects on fiber content were found significant at 5% level of significance.

The total carbohydrates of the bael powder bread sample T_1 and T_2 were found to 47.89% and 51.07% respectively. The total carbohydrates of the control sample T_0 was found to be 45.09% which was lowest as compared to the bread prepared from bael powder. Bhadra (1997) total carbohydrate content of bread prepared by incorporating bael powder varied from 45.09 to 51.07%. Increase in total carbohydrates of bael powder incorporated bread was observed with the increase in incorporation of bael powder. The ANOVA for total carbohydrates content of bael powder bread variations (T_0) 0 g Bael powder, (T_1) 10 g Bael powder and (T_2) 20 g Bael powder samples. It was observed that treatments effects on fiber content were found significant at 5% level of significance.

The sensory evaluation revealed that all the sensory attributes viz. colour, crispness, taste, flavor, texture, of all the baels samples in fresh condition are shown in the table no. 2 the overall acceptability score of the all sample were found 6.80%, 6.90%, 7.01%.

Table 1: Proximate composition of Bread prepared using bael powder

Treatments	Fiber content (%)	Ash content (%)	Fat content (%)	Ascorbic acid (mg/100 g)	Protein content (%)	Moisture content (%)	Total carbohydrates (%)
T_0	0.95	1.50	4.01	0.08	11.96	32.14	45.09
T_1	1.49	2.04	4.45	3.50	12.35	33.03	47.89
T_2	2.18	2.39	4.64	6.98	13.10	34.40	51.07
Mean	1.54	1.98	4.37	3.52	12.47	33.19	48.02
SEm±	0.04	0.02	0.01	0.15	0.01	0.16	0.03
CD (P=0.05)	0.16	0.07	0.05	0.61	0.05	0.65	0.11
T_0 - 0 g Bael powder, T_1 - 10 g Bael powder, T_2 - 20 g Bael powder							

Quality Evaluation of Value Added Products Prepared from bael powder

Sensory quality attributes were evaluated or fresh as well as stored bael powder based value added products. The samples were served to group of 10 semi-trained panelists comprising male and female of different age groups and eating habits. The various sensory quality attributes viz., colour, flavor, taste, texture and overall acceptability were evaluated on 9-point Hedonic Scale.

Sensory evaluation of bread

Sensory characteristics of the all samples were determined by taking the sensory attributes flavour, colour, taste, texture and overall acceptability. Sensory attributes of all kind of samples were evaluated in fresh condition. Hedonic rating test method was used for the evaluation of different samples in fresh condition had been presents in Table 2.

The study was conducted under fresh condition. The results of sensory characteristics of bread samples have been presented in Table 2 and Figures 2 the measurements of different attributes, describing quality were respectively. Different sensory attribute were evaluated in fresh condition. Fresh condition the flavor scores of bread samples T_0, T_1, and T_2 were found to be 6.80, 7.20 and 7.80 and colour scores were found to be 7.10, 7.30 and 7.60 and taste scores were found to be 6.50, 7.00 and 6.60 and texture scores were found to be 6.50, 6.70 and 6.80 respectively.

The flavour of the bread samples were perceived to be desirable by the panellists and therefore the score awarded was beyond “like slightly” range. Colour of all bread samples was also acceptable to the panel. The taste of bread samples was sweet which resembled to one of the four basic tastes namely sweet, bitter and sour.

The overall acceptability of the bread samples were perceived to be desirable by the panelists and therefore the score awarded was beyond “like slightly” range. The bread sample T_2 was more acceptable than other bread samples.

Table 2: Evaluation of sensory attributes of bread samples

Sample code	Colour	Flavour	Taste	Texture	Overall acceptability
T_0	7.10	6.80	6.50	6.50	6.72
T_1	7.30	7.20	7.00	6.70	7.05
T_2	7.60	7.80	6.60	6.80	7.20
T_0 - 0 g Bael powder, T_1 - 10 g Bael powder, T_2 - 20 g Bael powder					

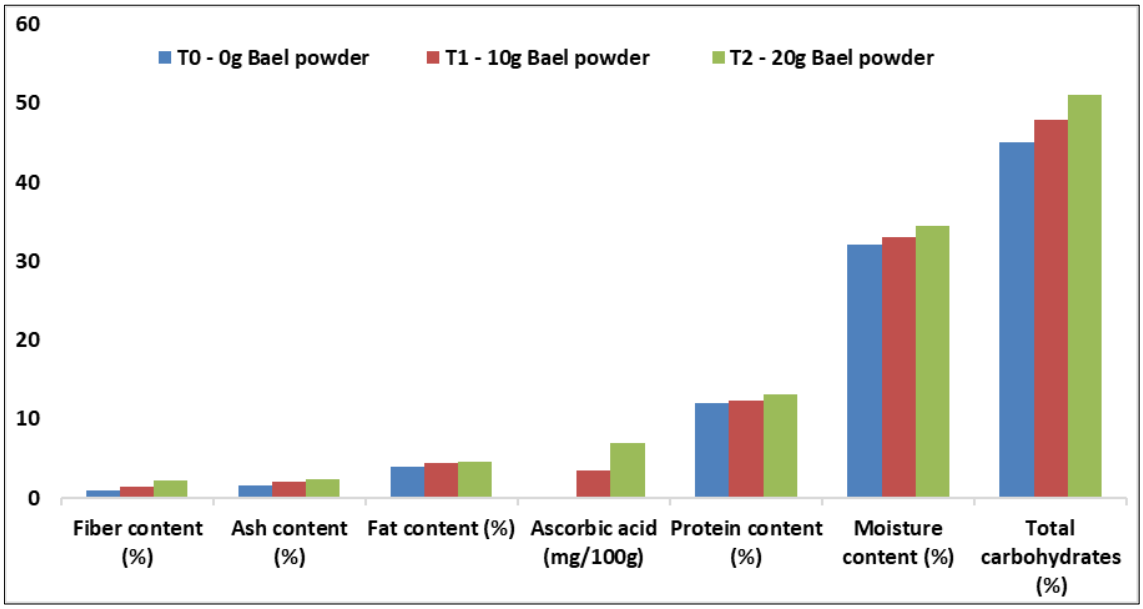

Fig 1: Proximate composition of Bread prepared using bael powder

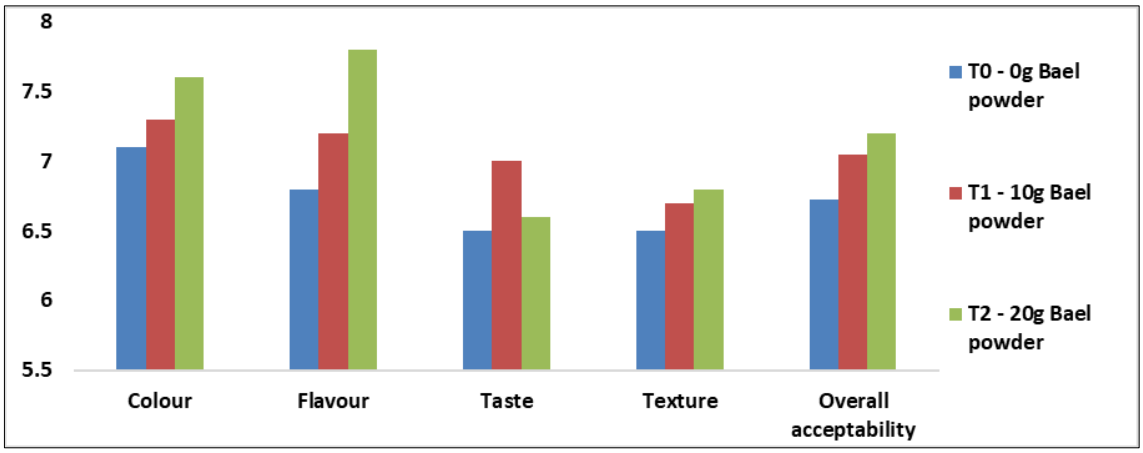

Fig 2: Evaluation of sensory attributes of bread samples.

Sensory evaluation of soup

Sensory characteristics of the all samples were determined by taking the sensory attributes flavour, colour, taste and overall acceptability. Sensory attributes of all kind of samples were evaluated in fresh condition. Hedonic rating test method was used for the evaluation of different samples in fresh condition had been presents in table 3.

The study was conducted under fresh condition. The results of sensory characteristics of Soup samples have been presented in table 3 and figures 3 the measurements of different attributes, describing quality were respectively. Different sensory attribute were evaluated in fresh condition. During fresh condition the flavor scores of Soup samples T_0, T_1, and T_2 were found to be 6.80, 7.70 and 8.20 and color scores of Soup samples T_0, T_1, and T_2 were found to be 7.30, 7.60 and 7.90 and taste scores of Soup samples T_0, T_1, and T_2 were found to be 6.80, 6.90 and 6.70 and overall acceptability scores of Soup samples T_0, T_1, and T_2 were found to be 6.97, 7.40 and 7.60 respectively.

The flavor of the Soup samples were perceived to be desirable by the panelists and therefore the score awarded was beyond "like moderately" range. Color of all Soup samples was also acceptable to the panel. The taste of Soup samples was sweet which resembled to one of the four basic tastes namely spicy, bitter, sour and salty.

The overall acceptability of the Soup samples were perceived to be desirable by the panelists and therefore the score awarded was beyond "like moderately" range. The Soup sample T_2 was more acceptable than other Soup samples.

Table 3: Evaluation of sensory attributes of soup samples\

Sample code	Colour	Flavour	Taste	Overall acceptability
T_0	7.30	6.80	6.80	6.97
T_1	7.60	7.70	6.90	7.40
T_2	7.90	8.20	6.70	7.60
T_0 - 0 g Bael powder, T_1 - 10 g Bael powder, T_2 - 20 g Bael powder				

Sensory evaluation of Sharbat

Sensory characteristics of the all samples were determined by taking the sensory attributes flavour, colour, taste and overall acceptability. Sensory attributes of all kind of samples were evaluated in fresh condition. Hedonic rating test method was used for the evaluation of different samples in fresh condition had been presents in table 4.

The study was conducted under fresh condition. The results of sensory characteristics of Sharbat samples have been presented in table 4 and figures 4 the measurements of different attributes, describing quality were respectively. Different sensory attribute were evaluated in fresh condition. During fresh condition the flavor scores of Sharbat samples T_0, T_1, and T_2 were found to be 6.90, 7.60 and 7.90 and colour scores of Sharbat samples T_0, T_1, and T_2 were found to be 7.20, 7.50 and 7.80 and taste scores of Sharbat samples T_0, T_1, and T_2 were found to be 6.40, 6.90 and 6.50 and overall acceptability scores of Sharbat samples T_0, T_1, and T_2 were found to be 6.83, 7.33 and 7.40 respectively.

The flavour of the Sharbat samples were perceived to be desirable by the panelists and therefore the score awarded was beyond "like moderately" range. Color of all Sharbat samples was also acceptable to the panel. The taste of Sharbat samples was sweet which resembled to one of the four basic tastes namely sweet, bitter and sour.

The overall acceptability of the Sharbat samples were perceived to be desirable by the panelists and therefore the score awarded was beyond "like moderately" range. The Sharbat sample T_2 was more acceptable than other Sharbat samples.

Table 4: Evaluation of sensory attributes of Sharbat samples

Sample code	Colour	Flavour	Taste	Overall acceptability
T_0	7.20	6.90	6.40	6.83
T_1	7.50	7.60	6.90	7.33
T_2	7.80	7.90	6.50	7.40
T_0 - 0 g Bael powder, T_1 - 10 g Bael powder, T_2 - 20 g Bael powder				

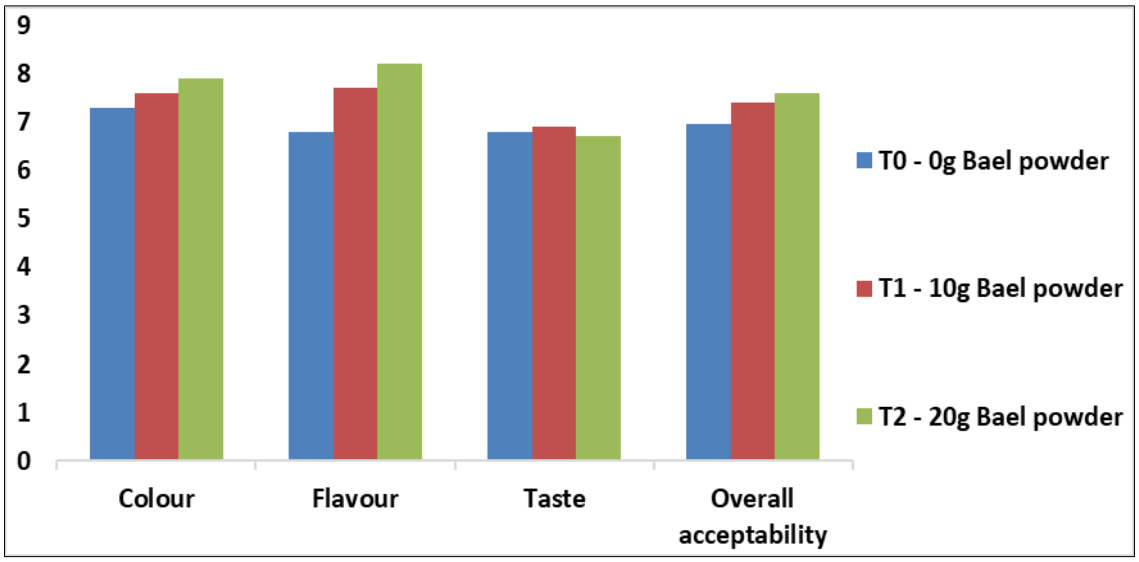

Fig. 03: Evaluation of sensory attributes of Soup samples

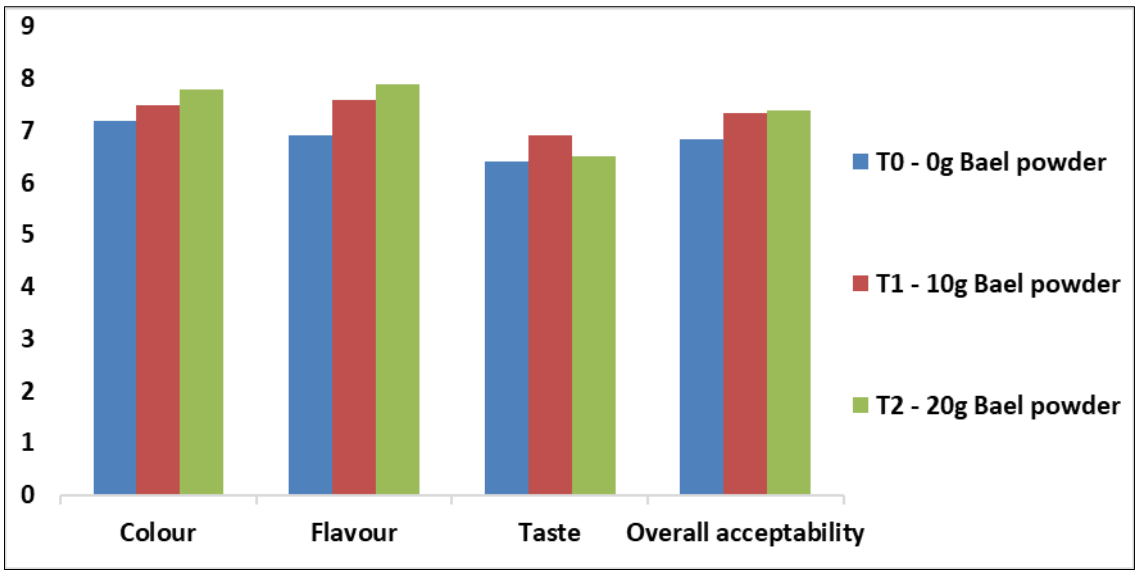

Fig. 4. Evaluation of sensory attributes of Sharbat samples

Conclusion

It is concluded that value added products prepared from bael powder was acceptable at all three levels-0, 10 and 20 percent (T_0-0 g Bael powder, T_1- 10 g Bael powder and T_2- 20 g Bael powder) samples. The bael powder was used for the preparation of Bread, soup and sharbat. Bread prepared by incorporating 20% bael powder contained significantly higher Quality parameters, moisture, ash, protein, fat, fiber, total carbohydrates and ascorbic acid as compared to the control. In bread, soup and sharbat the highest score of respectively 7.20, 7.60 and 7.40 for all the sensory parameters was obtained (T_2-20 g Bael powder) 20 percent. The overall acceptability of the bread, soup and sharbat samples were perceived to be desirable by the panelists and therefore the score awarded was beyond "like moderately" range. The bread, soup and Sharbat samples T_2 was more acceptable than other bread, soup and Sharbat samples. Addition of bael powder increased the nutrient density of the all products as compared to the control. The study thus indicated that products prepared by incorporating bael powder were sensory and nutritional value superior than control products and could be stored safely.

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