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Research Article

A Novel Granule-Based Formulation as a Health Supplement With an Extended Shelf Life, Derived From the Pulp of Bael (*Aegle marmelos*) and Various Herbs

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Bael (*Aegle marmelos* L. Correa) is a fruit known for its historical significance and contains nutritional and medicinal properties. It is a good source of essential vitamins and minerals to maintain human health. The objective of this study was to maintain the quality and shelf-life of ripe bael pulp through value addition, which could provide additional nutritional value and freshness to the mouth. Eight formulations (F_1–F_8) were prepared by the wet granulation method using bael powder and other selected herbs such as *Zanthoxylum*, clove, fennel, and menthol crystals added in different combinations for the synergetic effect of the formulations. The evaluation study targeted the nutritional value, organoleptic properties, and shelf-life of all eight formulations. The nutritional composition of F_5, found superior in our study, was 7.35% moisture, 0.49% fat, 4.72% protein, 85.73% carbohydrate, 366 kcal energy, 1.58% total ash, 3.64% total sugar, 30.05% fiber, 11.30 mg vitamin C, and 3.42 mg Iron. The mineral composition was found to be 167.32 mg calcium, 29.75 mg magnesium, 185.46 mg phosphorus, and 2.53 mg zinc with total antioxidants of 85.5 mg. The total plate count was 7.3×10^3 CFU with yeast and molds of 1.3×10^3 CFU, and coliform < 10 was found in the Formulation F_5. The organoleptic score for the formulation's taste, flavor, and overall acceptability was found superior in F_5 at 8.23, 8.15, and 8.61, respectively, followed by F_4. The shelf-life of granules was found to be excellent and acceptable, up to six months at room temperature. This study concluded that bael granule formulation (F_5) prepared from fennel, *Zanthoxylum*, mint, clove, and sugar was the best as a mouth freshener and health supplement, which also improved the quality and shelf-life of bael pulp, improving its availability in the off-season.

Keywords: health supplement; herbal product; minerals; mouth freshener; nutraceutical; organoleptic

1. Introduction

Bael (*Aegle marmelos* L. Correa) is a perennial fruit tree belonging to the family Rutaceae, which is very well known in the ancient history of India. Hindus consider it a sacred tree, as they worship Lord Shiva, and it cannot be completed without its trifoliate leaves. It is also known as a medicinal plant, because almost all parts of it are used in medicine and herbal preparations, and traditionally used in several health problems [1, 2]. It is a good gut immunity and digestion medicine, generally recommended for treating stomach-related problems. Bael has antibacterial, antimicrobial, antioxidant, anthelmintic, antispasmodic, and anti-inflammatory properties for human oral care, making them useful in the treatment of oral infections [3–5]. Bael fruit is very delicious and the richest source of riboflavin.

Various studies on bael reveal that it acquires various nutritional elements such as minerals, carbohydrates, vitamins, and fibers, which make it highly nutritious and have immense health benefits [1]. It contains moisture (61.0%), total soluble solids (38.53%), carbohydrate (30.6%), ascorbic acid (23.70 mg), total sugars (18.34%), nonreducing sugar (12.41%), reducing sugar (5.93%), fiber (2.9%), mineral (1.9%), protein (1.6%), riboflavin (1.2%), phosphorus (0.05%), potassium (0.6%), iron (0.3%), acidity (0.25%), fat (0.2%), vitamin B1 (0.01%), vitamin C (0.01%), calcium (0.009%), and vitamin A (186 IU) [6, 7]. Most fresh fruit is used as juice, squeezed, filtered, and sweetened to obtain a drink [5, 8]. Bael has a very short shelf life, and fresh fruit can be stored only for 15–20 days at room temperature. Fruit powder can be stored for 8–10 months when packed in 400-gauge polypropylene, while the value-added product of bael can be stored for more than one year [9]. To enhance the shelf life of fruit pulp and reduce postharvest losses, several products such as jam, jelly, toffee, candy, panjiri, RTS, and nectar are made from bael fruit by using diverse postharvest technologies which are commercially available in the market (Table 1). The bakery product (cookies) was prepared by using bael pulp and other ingredients such as refined wheat flour, shortening (vegetable ghee), sugar powder, ammonium bicarbonate, sodium bicarbonate, and milk/water at different levels, and the results of overall acceptability were observed better at a 7.5% level [10]. Bael toffee was prepared by using bael pulp (100 g), sugar (140 g), milk powder (40 g), ghee (10 g), corn flour (2.5 g), citric acid (0.5 g), cardamom, cinnamon, and preservative (KMS). The organoleptic properties such as color, taste, and texture were found to be dark brown, sweet, and smooth, respectively [11]. The processing of bael has unlimited possibilities, which can be processed into slices, powder, granules, pulp, liquid, confectionery etc [12], but a formulation which could serve as a nutraceutical combined with natural ingredients commonly used in home remedies would be a valuable added health-promoting product, and this study primarily aimed for such a formulation. *Foeniculum vulgare* (fennel) was one of the ingredients commonly used in home remedies, especially related to the digestive system [13]. *Zanthoxylum armatum*, known as "Timoor," was used in traditional medicine to cure conditions such as dental cavities, diarrhea, mouth freshener, stomachic, toothache, and carminative. Many phytochemical compounds such as alkaloids, tannins, amino acids, terpenoids, and glycosides are present in the extract of the leaves of *Zanthoxylum armatum* [14, 15]. Mint was also used in the formulation, as it is an aromatic herb used in the pharmaceutical, cosmetics, food, flavor, and fragrance industries, mostly recognized worldwide for its antioxidant and antimicrobial features. Mint is generally used in mouth fresheners, toothpaste, cough drops, chewing gums, beverages, candies, jellies, syrups, ice creams, teas, and confectioneries [16]. Cloves are one of the ingredients that have antioxidant, antimicrobial, antithrombotic, antiseptic, antipyretic, analgesic, and chemoprotective effects, traditionally used as food preservatives and for many therapeutic purposes [17–19]. The flowering of bael occurs from May to June, and the fruit needs 10-11 months to ripen from the bloom. The fruit appears in the market from the end of March to April, but it disappears very soon, within 2-3 months from the market, because of its short shelf-life and being perishable in nature. However, the demand for fresh bael fruit and its products remains available for the whole year because of its diverse health-boosting properties. Hence, there is a need for value addition of the fruit pulp, which may secure its availability by enhancing the shelf life of fruits and providing nutrient-rich quality products. This study aimed to develop a formulation using fruit pulp and other ingredients that maintain availability and enhance the pulp's quality and shelf life.

2. Materials and Methods

The materials used in the preparation of the eight formulations described in Table 2 included powders of bael fruit pulp (*Aegle marmelos*), fennel seeds (*Foeniculum vulgare*), *Zanthoxylum* seeds (*Zanthoxylum armatum*), cloves (*Syzygium aromaticum*), menthol crystals (*Mentha arvensis*), sugar, and water, each in varying quantities. The ripened fruits of bael were collected from the experimental fields of Acharya Narendra Deva University of Agriculture and Technology (ANDUAT), Kumarganj, Ayodhya. *Zanthoxylum* seeds, fennel seeds, menthol crystal, and sugar were purchased from the local market. All the ingredients used have proven to be effective and play an important role in maintaining health and providing freshness in the mouth (Table 3). *Zanthoxylum* and mint have antibacterial, insecticidal, larvicidal, and other antimicrobial properties, which protect the granules from microbes' attack, resulting in an enhanced product shelf life referred to in Table 3.

Proper processing techniques were followed to preserve the nutritional content of bael (such as vitamins, minerals, and antioxidants) and help maintain its natural flavor and aroma, leading to higher organoleptic scores. The granules were prepared following the steps described in Figures 1 and 2.

Initially, the collected bael fruits were washed and cleaned with water, then the pulp was separated from the fruit's skull, and the seeds were removed. Separated pulp was dried up to 12% moisture in the oven, and a measured amount of dry bael pulp, *Zanthoxylum* seed, and clove was ground through a grinder, and the powder was sifted by using a fine sieve in Vessel A. The appropriate drying and grinding techniques can maintain bael's natural flavor, color, and nutritional content, while overprocessing can lead to a loss of aroma and taste. The consistency of 70°B TSS in sugar syrup was prepared in Vessel B. The menthol crystals were heated separately at 52°C till they changed into liquid form. After that, the ingredients of Vessel A and Vessel B were thoroughly mixed with menthol in Vessel C. Following that, a measured quantity of fennel seeds was added to Vessel C and stirred in a clockwise direction for 10–15 min. Then, it was allowed to cool, spread out on a plate, and rest overnight for drying. After proper drying, the product was filled into a 20 g plastic packet and labeled, and then the product was stored in a cool and dry place.

Table 1: Comparative study of the nutritional composition of Formulation F_5 with other commercial products available in the market.

S. N.	Composition	Granules F_5	CIMAP Phal-se	Veganic bael candy	Farm star
1.	Fat (%)	0.49	—	—	0.2
2.	Protein (%)	4.72	0.28	0.45	—
3.	Carbohydrate (%)	85.73	8.86	87.59	1
4.	Energy (kcal/100 g)	366	36.9	352	70
5.	Fiber (%)	30.05	—	—	3
6.	Vitamin C (mg/100 gm)	11.30	3.76	12.75	1
7.	Iron (mg/100 g)	3.42	0.56	—	—
8.	Calcium (mg/100 g)	167.32	6.06	—	—
9.	Phosphorus (mg/100 g)	185.46	4.38	0.00	—

Table 2: Ingredients and their percentage used in the preparation of granule-based formulations.

Ingredients	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8
Bael powder	85.65	68	58	48	38	28	58	68
Fennel seed	—	13	23	23	33	43	23	23
Sugar	14	14	14	24	24	24	14	4
Zanthoxylum powder	—	4	4	4	4	4	4	4
Clove powder	—	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Menthol crystal	—	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Water	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35

Table 3: Ingredients used in the formulation and their medicinal properties.

S. N.	Ingredients	Properties	References
1.	Bael powder	Rich in nutrition, antioxidant, antimicrobial, inhibiting gastrointestinal problems, different cardiac issues, hepatoprotective, radioprotective, and antidiabetic	[18]
2.	Fennel seed	Antimicrobial, antiflatulent, stimulant, carminative, expectorant, antibacterial, antidiabetic, anticancer, antihyperlipidemic, antioxidant, and anticancer	[20, 21]
3.	Zanthoxylum	Antioxidant, anticancer, anti-inflammatory, analgesic, antibacterial, insecticidal, larvicidal, and other biological actions	[14]
4.	Clove	Antioxidant and antimicrobial	[22, 23]
5.	Mint	Antioxidant, antinociceptive, anti-inflammatory, antimicrobial, anticarcinogenic, antiviral, antiallergic, and antitumorigenic	[24]
6.	Sugar	As a preservative and sweetener	[25]
7.	Water	For maintaining the moisture	—

2.1. Analysis of Granule-Based Formulation. The organoleptic and nutritional properties of bael are significant factors that enhance the overall quality and consumers' acceptance of bael granules.

2.2. Chemical Analysis. On the basis of the organoleptic score, F_5 was selected as the formulation for chemical analysis, and the product was analyzed for its nutritional properties by the Regional Food Research and Analysis Center, Department of Horticulture and Food Processing, Government of Uttar Pradesh, Lucknow, India. The chemical composition of moisture (%), fat (%), total ash (%), total sugar (%), fiber (%), iron (mg/100 g), magnesium (mg/100 g), and zinc (mg/100 g) were analyzed by using the approved protocols of the Food Safety and Standards Authority of India (FSSAI) Lab Manual–Fruit and Vegetable: 2016. The other nutrients and minerals were also analyzed by using methods such as IS:7219:1973 RA:2020 (protein, %), IS:1656:2007 RA:2022 (carbohydrate, %), IS:5838:1970 RA:2020 (vitamin C, mg/100 g), RFRAC/INST SOP-15 (calcium, mg/100 g), RFRAC/INST SOP-48 (phosphorus, mg/100 g), and RFRAC/INST SOP-88 (total antioxidant, mg/100 g). The following methods performed the microbial load testing: IS: 5402:2012 (total plate count, CFU/100 g), IS: 5403:1999 (yeast and mold, CFU/100 g), and IS:5401 (P-1) 2012 (coliform, CFU/100 g), respectively.

2.3. Organoleptic Test. A panel of 15 semitrained members assessed the product for organoleptic evaluation, taste, and overall acceptability, scoring on nine points in Table 4 based on the hedonic scale [26]. The members tested the final product, and the marks were rated based on product quality. The mean value of the rating was recorded.

2.3.1. Stability Study. To assess the shelf-life and stability of the bael-based formulation, a 6-month stability study was conducted according to the International Council for

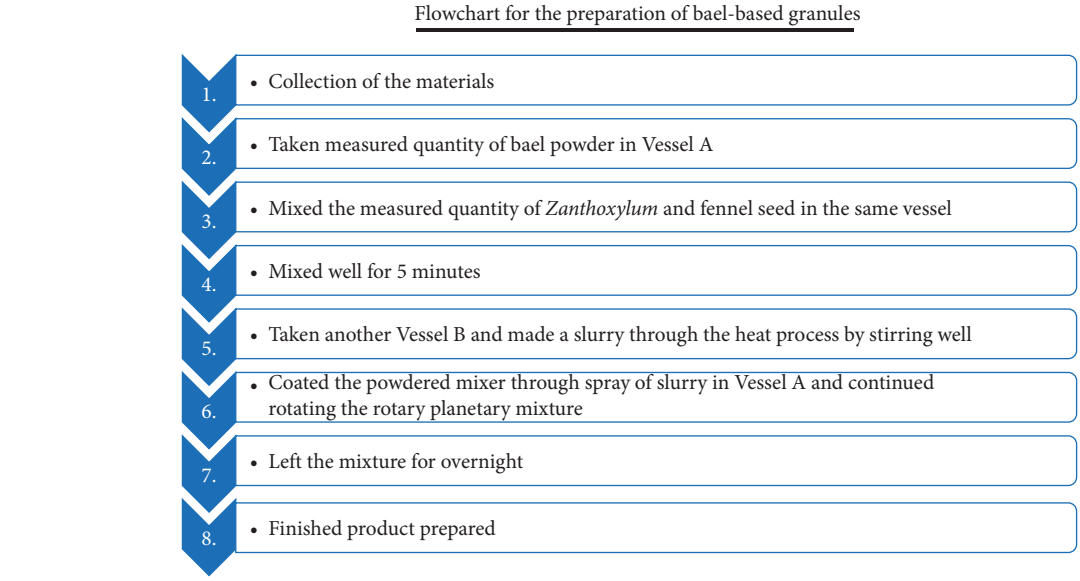


Figure 1: Flowchart for the preparation of bael-based granules with other natural ingredients.



Figure 2: Bael pulp to the final prepared granules.

Table 4: List of organoleptic scores.

Organoleptic score	Rating
9	Liked extremely (LE)
8	Liked very much (LVM)
7	Liked moderately (LM)
6	Liked slightly (LS)
5	Neither liked nor disliked (NLND)
4	Disliked slightly (DS)
3	Disliked moderately (DM)
2	Disliked very much (DVM)
1	Disliked extremely (DE)

Harmonization (ICH) Q1A (R2) guidelines on the stability testing of new products [27].

2.3.2. Sample Preparation. The final product prepared from bael pulp powder–based granules was packed in 20 g food-grade plastic pouches, properly sealed, and labeled.

2.3.3. Storage Conditions. Samples were stored in stability chambers under the following ICH-recommended conditions (Table 5).

Table 5: International Council for Harmonization (ICH) guideline for storage of finished products.

Storage condition	Temperature	Relative humidity	Duration
Long-term	25°C ± 2°C	60% ± 5% RH	12 months
Accelerated	40°C ± 2°C	75% ± 5% RH	6 months
Intermediate	30°C ± 2°C	65% ± 5% RH	6–12 months

2.3.4. Testing Intervals. Samples were withdrawn from the stability chambers at 0, 3, and 6 months and analyzed on the following parameters.

2.3.4.1. Organoleptic Properties. Color, aroma, texture, and taste were analyzed.

The color of the formulation was measured visually and compared with the help of a leaf color chart.

2.3.4.2. Moisture Content. The oven-drying method was used to assess the moisture content [28].

2.4. Statistical Analysis. The data of the organoleptic test (taste, flavor, and overall acceptability) of Table 6 were statistically analyzed to find the significance of the results by using the ANOVA statistics method, and the results were expressed as SEm± and CD at 5%.

3. Results and Discussion

3.1. Nutritional and Mineral Composition. The chemical analysis of F_5 was carried out to evaluate the formulation's nutritional and mineral properties; the results are depicted in Table 7. The nutritional composition of the granules (F_5) includes 7.35% moisture, 0.49% fat, 4.72% protein, 85.73% carbohydrate, 366 kcal of energy, 1.58% total ash, 38.64% total sugar, 30.05% fiber, and 11.30 mg of vitamin C. In the same sample, the minerals analyzed included 3.42 mg of iron, 167.32 mg of calcium, 29.75 mg of magnesium, 185.46 mg of phosphorus, and 2.53 mg of zinc, among others. Venkateshan et al. conducted similar experiments on 10 formulations of bael [29]. Biswas et al. reported that the fresh pulp of bael fruit contains 61.20% moisture, 2.48% protein, 0.47% fat, 3.04% crude fiber, 1.29% total ash, and 10.21 mg of vitamin C [30]. Srivastava et al. prepared various formulations of bael candy, with the highest nutritive value found in Formulation T_2, which provided energy (310 kcal), protein (0.73 g), fat (0.11 g), carbohydrate (76.60 g), fiber (1.09 g), calcium (36.95 mg), iron (0.28 mg), and phosphorus (18.28 mg) [31]. The natural sugars in bael contributed to its sweetness and tangy flavor. These components also have nutritional benefits, such as providing energy and simultaneously improving digestion. The texture of bael granules, whether gritty or smooth, is significantly influenced by their high fiber content. While this fiber benefits digestive health, improper processing can negatively affect the texture.

3.2. Antioxidant and Antimicrobial Composition. The Formulation F_5 was tested to evaluate the antioxidant, antimicrobial, and antibacterial properties, the results of which are presented in Table 8. A total antioxidant level available in the formulation was 85.5 mg. The same formulation was also analyzed for microbial load. The total plate count was found to be 7.3×10^3 CFU. The total fungal count of the formulation was also analyzed, and it was observed to be 1.3×10^3 CFU concerning yeast and mold. The total bacterial population of coliform bacteria was < 10 coliform, respectively. Sagar and Kumar reported that the total antioxidant of bael powder was decreased significantly with an increase in storage period. Bael powder could be stored for 6 months at low temperature and 4 months at room temperature after packaging in 200 gauge high-density polyethylene or 400-gauge low-density polyethylene pouches with maximum nutritional quality in respect to reducing sugar, phenol, ascorbic acid, and total antioxidant during storage [32]. Gurjar et al. reported that bael antioxidant value (FRAP) was 13.45 ± 0.27 mmol/g at 180 days after fruit set and 22.6 ± 0.23 mmol/g at 335 days after fruit set [33].

Table 6: Evaluation of organoleptic score of taste, flavor, and overall acceptability of bael granules.

Formulations	Taste	Flavor	Overall acceptability	Mean
F_1	6.51	6.82	6.68	6.68
F_2	6.75	6.89	6.96	6.87
F_3	7.27	7.48	7.89	7.55
F_4	8.15	8.07	8.45	8.22
F_5	8.23	8.15	8.61	8.33
F_6	5.32	5.14	5.64	5.37
F_7	7.32	7.59	7.63	7.51
F_8	6.53	6.82	6.67	6.67
SEm±	0.10	0.12	0.12	0.10
CD at 5%	0.30	0.36	0.36	0.31

Table 7: Chemical composition (F_5) of bael-based granules.

S. N.	Composition	Chemical parameters
1.	Moisture (%)	7.35
2.	Fat (%)	0.49
3.	Protein (%)	4.72
4.	Carbohydrate (%)	85.73
5.	Energy (kcal/100 g)	366
6.	Total ash (%)	1.58
7.	Total sugar (%)	38.64
8.	Fiber (%)	30.05
9.	Vitamin C (mg/100 gm)	11.30
10.	Iron (mg/100 g)	3.42
11.	Calcium (mg/100 g)	167.32
12.	Magnesium (mg/100 g)	29.75
13.	Phosphorus (mg/100 g)	185.46
14.	Zinc (mg/100 g)	2.53

Table 8: The result of the antioxidant and antimicrobial tests of the formulation (F_5).

S. N.	Parameters	Result
1.	Total antioxidant (mg/g)	85.5
2.	Total plate count (CFU/g)	7.3×10^3
3.	Yeast and mold (CFU/g)	1.3×10^3
4.	Coliform (CFU/g)	< 10

Rajan et al. observed an in vitro antioxidant activity of fruit pulp ranging from 37.11 ± 3.50 to 158.99 ± 59.46 μg/mL for aqueous extract and from 35.02 ± 8.10 to 283.06 ± 135.80 μg/mL for alcoholic extract. The phenolic compounds had a concentration of 147.66 ± 11.06 mg/g in the aqueous extract and 158.66 ± 28.67 mg/g in the alcoholic extract [34].

3.3. Evaluation of Organoleptic Score. The evaluation of the organoleptic score of bael granules assessed their sensory properties. Organoleptic evaluation typically includes physical parameters such as appearance, color, aroma, taste, texture, and overall acceptability. The result of the organoleptic score of bael granules showed significant differences among the formulations, and the details of the organoleptic score are shown in Table 6 and Figure 3. The organoleptic score for the taste, flavor, and overall acceptability of granules prepared from F_5 was found to be significantly higher, i.e., 8.23, 8.15, and 8.61, respectively, followed by F_4 (8.15), (8.07), and (8.45), respectively. A similar study was conducted by Ullikashi et al. and reported that high organoleptic scores (color 7.8, flavor 7.9, texture 7.9, taste 7.6, and overall acceptability 7.3) of bael jam were obtained from Sample-2 (bael fruit with 100% sugar + lime) [12]. Bhatt and Verma developed bael fruit toffee by incorporating various herbs such as cardamom and cinnamon and assessed the acceptability of the products. The mean score was (flavor) 6.4, (texture) 6.19, (taste) 6.43, and (overall acceptability) 6.27 [35]. Kaur et al. prepared Gajrela products by using bael pulp and other ingredients such as milk (250 mL), khoa (10 g), carrots (80 g), bael pulp (20 g), sugar (6 g), and stevia powder (20 mg). The percentage of carrots was reduced, and bael pulp was incorporated at the B-1 (10%), B-2 (20%), B-3 (30%), and B-4 (40%), and the result of overall acceptability was found to be the highest for B2 (7.87), followed by C (7.58) and B1 (7.54) [36]. An average bitterness and balanced taste profile increased the overall acceptability of the product. The granules, which are neither too hard nor too soft, provided a pleasant feeling of freshness in the mouth. Storage of the granules in a cool and dry place away from direct sunlight can maintain the product's color, aroma, taste, texture, and overall acceptability for a long time.

Based on chemical composition and taste evaluation, the best granule formulation (F_5) was placed in airtight containers and stored at room temperature. Color, texture, taste, flavor, and overall acceptability were evaluated at 1-, 2-, 3-, and 6-month intervals. The results were found, and there was no changes in texture up to 6 months; the color, however, changed from yellowish brown to light yellowish from 2 to 3 months and light yellowish to dark yellowish from 3 to 6 months, as described in Table 9. The result showed that the storage life of bael powder can be enhanced up to 6 months at room temperature by adopting the above process. Venkateshan et al. conducted experiments on 10 different formulations and found that Formula F6 (which consists of 1 kg of bael flesh, sugar maintained at 70° Brix, and 0.2% saffron) was superior during storage periods at initial, 30, and 60 days. This formulation scored as follows: color scores of 8.42, 8.58, and 8.11; flavor and taste scores of 8.33, 8.21, and 8.06; texture scores of 8.42, 8.34, and 8.19; overall acceptability scores of 8.51, 8.39, and 7.93; and shelf life of 65.63 days [29].

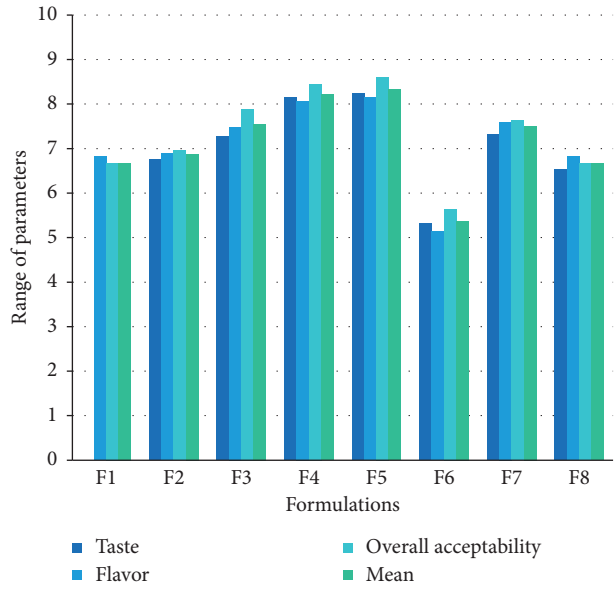


Figure 3: Organoleptic score of bael granules.

3.4. Nutritional Composition of Other Commercial Products Available in the Market. Several industries have developed some value-added products of bael that are commercially available in the market. A study was conducted to compare the nutritional composition of these products with a selected granule-based formulation (F_5) shown in Table 1.

1. CIM PHAL-SE: A granule-based product of bael was developed by CSIR-CIMAP, Lucknow, as a nutraceutical product available commercially in the market. The major compounds were carbohydrate (8.86%), energy (36.9 kcal), fiber (0.56%), protein (0.28%), vitamin C (3.76 mg), vitamin E (0.25 mg), thiamin (0.21 mg), riboflavin (0.006 mg), protein (0.28%), and iron (0.65 mg).
2. Bael candy: A dry bael candy was developed by VEGANIC Pvt. Ltd., Veganic, Shop No. 7/571, Near Lahori Gate Police Station, New Delhi-110006, which is commercially available in the market. It has carbohydrate (87.59%), energy (352 kcal), protein (0.42 g), and vitamin C (12.75 mg).
3. Bael murabba: The product, developed by Farm Star Products, Near Pole No. 40, Lodia Mohalla, Shikarpur, South West Delhi, Delhi-110043, contains fat (0.2%), carbohydrate (1%), energy (70 kcal), fiber (3%), and vitamin C (1 mg).

4. Discussion

Dried bael fruit powder is the best for curing diarrhea because it inhibits several strains of bacteria (*Vibrio cholera*, *Escherichia coli*, and *Shigella* sp.) that cause diarrhea. Ripped fruit extract helps in lowering blood sugar levels, owing to its bitter flavor,

Table 9: Evaluation of the shelf-life of granules on the basis of organoleptic taste at room temperature.

Storage month (room temperature)	Color	Texture	Taste	Flavor	Overall acceptability
0	Yellowish brown	Granule	8.23	8.15	8.61
1	Yellowish brown	Granule	8.23	8.15	8.61
2	Yellowish brown	Granule	8.21	8.12	8.60
3	Light yellowish	Granule	8.18	8.10	8.59
6	Dark yellowish	Granule	8.02	8.08	8.18

and also helps in the treatment of chronic gastrointestinal disorders. Diabetes is known to occur in the human body due to a lack of insulin, so, in the treatment of diabetes, it is required to get insulin externally, in a similar fashion, bael can replace insulin by enhancing the external glucose uptake ability [18]. Drying is one of the oldest methods of food preservation, which reduces water activity sufficiently to prevent or delay bacterial growth [37]. Sugar is also used as a preservative, because it absorbs free water and increases osmotic pressure; sugar reduces water activity in a food system, resulting in reduced microbial and mold growth as well as extending the storage life of food [25]. Sagar and Kumar reported that the total antioxidant of bael powder decreased significantly when increasing the storage period. Powder could be stored up to 6 months at low temperature and 4 months at room temperature after packaging in 200 gauge high-density polyethylene or 400-gauge low-density polyethylene pouches to maintain maximum nutritional quality with respect of reducing sugar, phenol, ascorbic acid, and total antioxidant during storage [32].

5. Conclusion

Beal is a delicious fruit with high nutritional value, and it is responsible for managing several lifestyle diseases. It has been used in the Ayurveda system of medicine since ancient times. The ripened fruit is only available in the summer because of its ripening and perishable nature, and the shelf-life of the fruit is very short. To ensure the long-term availability of bael pulp, it is essential to add value, which will enhance the pulp's nutritional value and shelf life. The formulated mixture will enhance bael pulp's taste, flavor, quality, and shelf life, making it available around the year with retained nutritional value. The prepared granule will provide freshness and nutrients and help to maintain the healthy digestive system of the human being. The person addicted to gutka and tobacco may find it as an alternative to minimize their addiction while providing essential nutrients. Therefore, this formulation may benefit related industries involved in nutraceuticals. With the added advantage of an extended shelf-life, it may provide nutrition and serve as a mouth freshener and a health supplement. The findings of this study may popularize bael cultivation, providing higher profits to the farmers, and its processing and value addition will enhance the availability of bael granules throughout the year, amply benefitting the processors and retailers.

Data Availability Statement

The data of this manuscript will be available on request.

Conflicts of Interest

The authors declare no conflicts of interest.

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