STANDARDIZATION OF A METHOD FOR PREPARATION OF ANTIOXIDANT-ENRICHED FUNCTIONAL BASUNDI USING NATURAL PLANT BIOACTIVES

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Abstract
The present investigation was planned and executed to standardize a functional Basundi enriched with natural plant bioactives and to evaluate its physicochemical, antioxidant, sensory, and storage characteristics. Basundi was prepared from standardized buffalo milk and fortified with natural antioxidant sources comprising prickly pear pulp (Opuntia ficus-indica), jamun (Syzygium cumini) extract, and fig (Ficus carica) pulp at different incorporation levels. The products were evaluated for compositional characteristics, antioxidant activity, sensory quality, and storage stability. It was observed that incorporation of plant bioactives significantly enhanced antioxidant potential, and mineral composition of Basundi. Among the treatments, Basundi fortified with 10% prickly pear pulp exhibited the highest overall acceptability (8.82 on a 9-point hedonic scale) and significantly higher antioxidant activity (48.6% DPPH scavenging activity) compared with control (12.4%). Storage studies revealed improved oxidative stability and acceptable sensory quality up to 10 days under refrigerated conditions. The study demonstrated that traditional Basundi can be successfully transformed into a functional dairy dessert through incorporation of natural plant bioactives without adversely affecting consumer acceptability.

Keywords: *Basundi, Functional dairy foods, Antioxidants, Prickly pear, Jamun, Fig, Nutraceutical dairy products*

Introduction

Traditional dairy products occupy an important position in the Indian diet owing to their nutritional richness, cultural significance, and widespread consumer acceptance. Among indigenous dairy products, *Basundi* is a highly popular heat-desiccated milk dessert prepared by concentrating milk to approximately half of its original volume followed by addition of sugar. The product is characterized by a rich creamy texture, pleasant caramelized flavor, and high nutritive value.

In recent years, increasing consumer awareness about the relationship between diet and health has stimulated demand for functional foods capable of providing health benefits beyond basic nutrition. Functional dairy products represent one of the fastest-growing segments of the food industry because milk serves as an excellent carrier for bioactive compounds, probiotics, prebiotics, antioxidants, vitamins, and nutraceutical ingredients.

Work done at KSPM's Chhatrapati Shivaji Maharaj College, Udgir Distt. Latur

Oxidative stress has been implicated in the development of several chronic disorders including cardiovascular diseases, diabetes mellitus, cancer, and neurodegenerative conditions. Consequently, there is growing interest in incorporation of natural antioxidants into commonly consumed foods. Fruits and plant-derived bioactives constitute rich sources of phenolic compounds, flavonoids, anthocyanins, betalains, carotenoids, and other antioxidant molecules.

Prickly pear (*Opuntia ficus-indica*) has attracted increasing scientific attention because of its high content of betalains, polyphenols, Vit. C, dietary fiber, and minerals. Similarly, jamun (*Syzygium cumini*) is rich in anthocyanins and phenolic compounds, while fig (*Ficus carica*) contains significant quantities of flavonoids, dietary fiber, calcium, potassium, and antioxidants. Although several investigations have focused on functional dairy beverages and fermented milk products, information regarding antioxidant enrichment of traditional *Basundi* remains limited. Development of antioxidant-rich *Basundi* could simultaneously improve nutritional value, enhance shelf life, and create opportunities for commercialization of value-added dairy foods.The present investigation was planned and executed to standardize antioxidant-enriched functional *Basundi* using natural plant bioactives and to evaluate its quality characteristics.

The present investigation was planned

1. To standardize functional *Basundi* enriched with natural plant bioactives,
2. To evaluate physicochemical characteristics of antioxidant-enriched *Basundi*,
3. To determine total phenolic content and antioxidant activity,
4. To assess sensory acceptability of the developed products,
5. To evaluate storage stability under refrigerated conditions.

Materials and Methods

Procurement of Raw Materials: Fresh buffalo milk was procured from the university dairy farm. Fully ripe prickly pear fruits, jamun fruits, and figs were procured from local markets. Analytical-grade chemicals were used throughout the investigation.

Preparation of Plant Bioactive Ingredients: *Prickly pear* pulp The fruits were washed, peeled, and pulped. The pulp was pasteurized at 80°C for 5 minutes and cooled.

Jamun Extract: Fresh Jamun fruits were deseeded and extracted using aqueous extraction followed by filtration.

Fig Pulp: Fresh figs were pulped and pasteurized similarly.

Preparation of Basundi: Standardized buffalo milk containing 6% fat and 9% SNF was heated and concentrated to approximately 50% of its original volume with continuous stirring. Sugar was added at 6% of concentrated milk.

Treatment Details

Treatment	Description
T_0	Control Basundi
T_1	Basundi + 5% Prickly Pear Pulp
T_2	Basundi + 10% Prickly Pear Pulp
T_3	Basundi + 5% Jamun Extract
T_4	Basundi + 10% Jamun Extract
T_5	Basundi + 5% Fig Pulp
T_6	Basundi + 10% Fig Pulp

Analytical Methods: The products were analyzed for its Total solids, Fat, Protein, Ash, Acidity, pH, phenolic content and sensory attributes. Standard AOAC methods were employed.

Antioxidant Activity: Antioxidant activity was determined using DPPH radical scavenging assay and expressed as percentage inhibition.

Sensory Evaluation: A panel of ten semi-trained judges evaluated samples using a nine-point hedonic scale.

Storage Studies: Samples were stored at 5±1°C and evaluated at 0, 5, and 10 days.

Statistical Analysis: Data were analyzed using Completely Randomized Design (CRD).

Results and Discussion

Physicochemical Composition

Table 1. Physicochemical Characteristics of Functional Basundi

Treatment	Total Solids (%)	Fat (%)	Protein (%)	Ash (%)
T_0	42.6	11.8	8.1	1.18
T_1	43.1	11.7	8.2	1.24
T_2	43.8	11.6	8.3	1.31
T_3	42.9	11.7	8.2	1.28
T_4	43.6	11.6	8.3	1.35
T_5	43.0	11.7	8.2	1.26
T_6	43.7	11.6	8.4	1.33

Incorporation of plant bioactives significantly increased ash content and total solids. The increase may be attributed to mineral-rich fruit ingredients.

Total Phenolic Content

Table 2. Total Phenolic Content of Functional Basundi

Treatment	Total Phenolics (mg GAE/100g)
T_0	24.6
T_1	52.4
T_2	88.7
T_3	64.8
T_4	96.2
T_5	48.5
T_6	74.4

Substantial enhancement in total phenolic content was observed following incorporation of plant bioactives.

Antioxidant Activity

Table 3. DPPH Radical Scavenging Activity

Treatment	Antioxidant Activity (%)
T_0	12.4
T_1	32.8
T_2	48.6
T_3	38.4
T_4	55.2
T_5	28.7
T_6	41.5

The highest antioxidant activity was observed in T_4 followed by T_2. Anthocyanins present in jamun and betalains present in prickly pear contributed significantly to antioxidant enhancement.

Sensory Evaluation

Table 4. Sensory Scores of Functional Basundi

Treatment	Flavor	Body & Texture	Color & Appearance	Overall Acceptability
T_0	8.10	8.15	8.12	8.12
T_1	8.45	8.42	8.56	8.48
T_2	8.80	8.78	8.86	8.82
T_3	8.52	8.40	8.60	8.51
T_4	8.34	8.20	8.82	8.39
T_5	8.38	8.30	8.42	8.36
T_6	8.55	8.48	8.62	8.55

Basundi containing 10% prickly pear pulp exhibited the highest overall acceptability score.

Storage Stability

Table 5. Changes in Antioxidant Activity During Storage

Treatment	Day 0	Day 5	Day 10
T_0	12.4	11.2	9.8
T_2	48.6	45.8	42.4
T_4	55.2	51.7	47.8
T_6	41.5	39.2	36.4

Although antioxidant activity decreased during storage, fortified products retained substantially higher antioxidant levels than control.

Consumer Acceptance

Table 6. Consumer Preference Ranking

Treatment	Mean Preference Rank
T_2	1.42
T_6	2.10
T_4	2.85
T_1	3.72
T_5	4.28
T_3	4.96
T_0	5.67

Consumers exhibited strong preference for *Basundi* fortified with prickly pear pulp. The present investigation demonstrated that traditional Basundi can serve as an excellent carrier for natural antioxidants and bioactive compounds. Fortification with prickly pear, jamun, and fig significantly improved total phenolic content and antioxidant activity without adversely affecting sensory quality.

The superior performance of prickly pear-fortified Basundi may be attributed to the balanced flavor profile and attractive color imparted by betalain pigments. Jamun-enriched products exhibited the highest antioxidant activity owing to anthocyanin-rich extracts but slightly lower sensory acceptance because of increased astringency at higher incorporation levels. The enhanced antioxidant potential observed in fortified products suggests potential for development of nutraceutical dairy desserts capable of contributing to dietary antioxidant intake.

Industrial Significance

Development of antioxidant-enriched *Basundi* offers several advantages:

1. Value addition of traditional dairy products.
2. Utilization of indigenous fruits and plant bioactives.
3. Development of functional dairy desserts.
4. Enhanced consumer appeal and market differentiation.
5. Opportunities for rural entrepreneurship and dairy diversification.

Conclusion

The study demonstrated successful development of antioxidant-enriched functional Basundi through incorporation of natural plant bioactives. Significant enhancement in total phenolic content and antioxidant activity was achieved without compromising sensory acceptability. Among the treatments, Basundi fortified with 10% prickly pear pulp exhibited the highest overall acceptability, while jamun-fortified Basundi showed maximum antioxidant activity. The findings indicate substantial potential for commercialization of antioxidant-enriched Basundi as a novel functional dairy dessert.

Future investigations may focus on bioavailability studies, detailed phytochemical profiling, packaging optimization, and large-scale consumer acceptance studies.

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