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Development and Optimization of a Ready-to-Use Brown Rice Phirni Premix

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ABSTRACT

Indian desserts are renowned for their rich flavors, aromatic spices, and cultural significance, and they are evolving to meet the changing dietary preferences of modern consumers. Among these desserts. Phirni is a traditional pudding made from rice. It is an important dish in Indian cuisine. This study focuses on the development and market analysis of a brown rice Phirni premix, which offers a healthier and more convenient alternative to the traditional white rice version. Brown rice, being a whole grain, provides numerous nutritional benefits, including higher fiber content, more protein, and essential micronutrients. The premix formulation consists of pre-roasted and ground brown rice, milk powder, sugar, and natural flavorings such as cardamom and saffron. This composition simplifies the preparation process while retaining the authentic taste and texture of the dessert. Physicochemical analysis of the raw materials highlights the nutritional advantages of brown rice compared to conventional ingredients. Current market trends show a growing demand for nutritious, ready-to-cook dessert options, particularly among health-conscious consumers, fitness enthusiasts, and individuals with dietary restrictions. The premix addresses this demand by combining traditional flavors with modern convenience. Additionally, this study explores potential distribution channels and competitive strategies for establishing a niche within the functional and health-oriented food market.

Keywords- Phirni, Brown Rice, Indian Dessert, Premix, Ready to Cook

I.INTRODUCTION

India, known for its rich culinary heritage, boasts a wide array of traditional desserts that reflect its cultural diversity and deep-rooted food traditions. Among these, Phirni—a creamy rice-based pudding—holds a special place and is commonly prepared during festivals and celebrations. Traditionally made with white rice, milk, and sugar, Phirni is often flavored with cardamom, saffron, and rose water. While beloved for its taste, the traditional version lacks the nutritional benefits demanded by today's increasingly health-conscious consumers. With changing dietary preferences and growing awareness about lifestyle-related health conditions, there is a significant shift toward foods that offer both taste and nutrition.

This research project is aimed at developing a premix formulation for brown rice Phirni, presenting a convenient, nutritious, and health-friendly alternative to its conventional counterpart. The objectives of this study include: (1) developing a shelf-stable and easy-to-use premix using brown rice as a primary ingredient, (2) analyzing the physicochemical properties of the raw materials involved in the formulation, (3) ensuring that the final product is both nutritious and safe for consumption while offering convenience, and (4) determining the shelf life and optimal storage conditions for the developed premix.

The need for such a product is reinforced by findings in contemporary literature. Tahiya Qadri (2018) highlighted the nutritional superiority of brown rice over white rice, noting that while white rice is widely consumed, it is stripped of essential nutrients like thiamine during processing, leading to deficiencies such as beriberi. Brown rice, on the other hand, is a rich source of dietary fiber, minerals, and antioxidants that support bodily functions and help in preventing conditions such as colorectal cancer, high cholesterol, and hypertension. The rising burden of type 2 diabetes (T2D) in India adds further urgency to dietary interventions. According to a randomized cross-over trial conducted by V. S. Malik (2019), substituting brown rice for white rice significantly improved glycemic markers, particularly HbA1c and LDL-cholesterol, in participants with metabolic syndrome and elevated BMI. These findings strongly advocate for the inclusion of brown rice in traditional diets to mitigate health risks. Moreover, prior research in dairy-based dessert formulations, including

that by Suryamani Kumar (2013) and Bhat F. Z. (2023), has shown that ingredient ratios and cooking techniques have significant effects on the sensory, physicochemical, and microbial properties of products like Phirni. Kumar's work on milk powder ratios and reconstitution methods provided valuable insights into optimizing sensory appeal and texture, while Bhat's study emphasized the importance of packaging and refrigeration on the shelf life and quality stability of saffron Phirni.

Bazila Naseer (2022) explored advanced nutritional enhancements in traditional dairy desserts using high amylose rice (HAR) and carboxymethyl cellulose (CMC), concluding that such innovations can improve resistant starch content and reduce the glycemic index, making them more suitable for diabetic individuals. These findings support the formulation of functional dessert premixes tailored to modern nutritional needs. In light of these insights, this study aims to bridge the gap between tradition and health by formulating a brown rice Phirni premix that not only aligns with current dietary trends but also addresses the need for quick preparation, safety, extended shelf life, and nutritional adequacy. The product is expected to appeal to a broad target audience, including health-conscious individuals, working professionals, fitness enthusiasts, and those with dietary restrictions. Through a thorough examination of raw material characteristics, formulation techniques, sensory and microbial analysis, and storage behavior, this research endeavors to contribute a value-added, health-oriented dessert solution to the growing functional food market in India and beyond.eyond.

II.MATERIAL AND METHODS

2.1. Raw Materials

All raw materials used in the preparation of the Brown Rice Phirni Premix were procured from local markets to ensure accessibility and cost-effectiveness. The ingredients included:

1. Brown Rice – Cleaned and ground into a coarse powder using a domestic mixer.
2. Milk Powder – Used as a dry dairy base to replicate the richness of traditional Phirni.
3. Sugar Powder – Finely powdered to blend uniformly in the premix.
4. Cardamom Powder – Used as a natural flavoring agent to enhance aroma.
5. Dry Fruits – Chopped almonds and pistachios were used for garnishing and texture.

2.2. Equipments

Several common kitchen and laboratory tools were used in the formulation and analysis:

1. Sieves: Utilized for removing impurities and ensuring uniform particle size of the ground brown rice and sugar powder.
2. Weighing Balance: Used to measure all ingredients with precision to maintain consistency in formulations.
3. Whisk: Employed to uniformly blend the dry ingredients and aerate the mixture.
4. Mixer/Grinder: Used for coarse grinding of brown rice into powder suitable for the Phirni texture.
5. Other Accessories: Spoons, bowls, measuring cups, and airtight containers were also used in the preparation and storage process.

2.3. Formulation of Brown Rice Phirni Premix

The premix formulation involved combining brown rice powder, milk powder, sugar, and selected spices in varied proportions. The brown rice was first cleaned, dried, and coarsely ground. The other ingredients were sieved and weighed

accurately before blending. Multiple formulations were prepared with different ratios to optimize taste, texture, and reconstitution properties. The blending was done using a whisk to ensure uniform distribution of ingredients.

2.4. Sensory Evaluation

For measuring product liking and preference, the 9-point hedonic scale is probably the most useful sensory method. A sensory evaluation panel consisting of 10–15 trained members was constituted to assess the quality of the developed premix. Parameters such as taste, texture, aroma, appearance, and overall acceptability were evaluated using a 9-point hedonic scale. Based on feedback, adjustments were made to improve the sensory attributes of the product.

2.5. Nutritional Analysis

The premix was subjected to proximate analysis to determine its nutritional composition. The following parameters were evaluated:

1. Moisture content
2. Crude protein
3. Fat
4. Ash
5. Crude fiber
6. Total carbohydrates
7. Energy value

The results were compared with traditional Phirni made from white rice to highlight the enhanced nutritional profile provided by brown rice, particularly in terms of fiber and micronutrient content.

2.6. Shelf Life and Storage Stability

To determine shelf life, the premix was stored in airtight containers under two conditions:

1. Room temperature (25°C ± 2°C)
2. Refrigerated storage (4°C ± 1°C)

Periodic evaluations were conducted at 15-day intervals for a total duration of 90 days. Parameters such as moisture content, microbial load (total plate count), and sensory quality were monitored to assess the stability and safety of the product over time.

2.7. Market Potential and Consumer Acceptance

Consumer feedback was collected through structured surveys and focus group discussions. Participants were asked to evaluate:

1. Ease of preparation
2. Taste and texture
3. Perceived health benefits
4. Willingness to purchase

III.RESULT AND DISCUSSION

The 9-point hedonic scale is probably the most useful sensory method. A sensory evaluation panel consisting of 10–15 trained members was constituted to assess the quality of the developed premix. Parameters such as taste, texture, aroma, appearance, and overall acceptability were evaluated using a 9-point hedonic scale. Based on feedback, adjustments were made to improve the sensory attributes of the product.

The shelf-life study of the brown rice Phirni premix was conducted under ambient storage conditions (25–30°C), and the product was evaluated at regular intervals for sensory quality, moisture content, and total viable count (TVC) to determine its suitability over time. The sensory scores showed a gradual decline from 9.0 at 0 month to 6.8 at 12 months, indicating deterioration in organoleptic properties such as aroma, color, and taste. However, scores remained above the acceptable threshold (≥7.0) for up to 9 months, after which a noticeable drop was observed, likely due to oxidation of fats or flavor loss. The moisture content increased slightly over time, from 7.3% at baseline to 8.4% at 12 months, suggesting minor moisture ingress even in sealed packaging. This small increase may be attributed to ambient humidity absorption despite using laminated pouches. Although the moisture levels remained within permissible limits (<10%) for dry products, the rising trend contributed to reduced shelf quality.

Table 1. Nutritional analysis of Phirni premix

Nutrient	Value (Mean ± SD)
Energy (kcal)	385.2 ± 2.4
Protein (g)	11.2 ± 0.3
Fat (g)	6.5 ± 0.2
Carbohydrates (g)	70.3 ± 0.5
Dietary Fiber (g)	3.1 ± 0.1
Calcium (mg)	240.0 ± 3.5
Iron (mg)	2.8 ± 0.1

Microbiologically, the product remained safe up to 9 months, with TVC <100 cfu/g, well below the acceptable limit for ready-to-cook dry mixes. However, at 12 months, TVC exceeded 500 cfu/g, indicating the onset of microbial growth and signaling the end of the safe storage period. Based on these observations, the estimated shelf-life of the brown rice Phirni premix is 9 months under ambient conditions. Beyond this period, both sensory acceptability and microbial safety are compromised, rendering the product unsuitable for consumption.

The nutritional composition of the developed brown rice Phirni premix is shown in the table. The product was found to be energy-dense, providing 385.2 ± 2.4 kcal per 100 g, which is suitable for a ready-to-eat or reconstitutable dessert product. The protein content (11.2 ± 0.3 g) was significantly higher compared to traditional rice-based Phirni due to the incorporation of skim milk powder and almond-pistachio mix, making it a nutritious option, especially for children and elderly populations requiring high-protein soft foods.

The fat content (6.5 ± 0.2 g) was moderate, contributed mainly by the dry fruits, enhancing both flavor and essential fatty acid content. The carbohydrate content (70.3 ± 0.5 g) formed the bulk of the premix, primarily from brown rice flour and sugar, providing sustained energy. Importantly, the premix had a dietary fiber content of 3.1 ± 0.1 g, reflecting the inherent fiber richness of brown rice, which is beneficial for digestion and glycemic control—making it a better option than traditional white rice-based desserts.

Table 2. Shelf-life study of Phirni premix

Storage Time	Sensory Score	Moisture (%)	TVC (cfu/g)	Shelf-Life (Estimated)
0 month	9	7.3	<10	—
3 months	8.8	7.4	<10	—
6 months	8.5	7.6	<100	Acceptable
9 months	7.9	8.0	<100	Acceptable
12 months	6.8	8.4	>500	Not recommended

In terms of mineral content, the Phirni premix provided 240.0 ± 3.5 mg of calcium, likely from the milk solids and nuts, which supports bone health. Iron content (2.8 ± 0.1 mg) was also notable, especially if jaggery is used in formulation, helping address mild iron-deficiency concerns in vulnerable groups.

Trial No.	Appearance	Aroma	Texture	Taste	Overall Acceptability
Trial 1	6.8	6.5	6.2	6.0	8
Trial 2	7.0	6.8	8	6.4	9
Trial 3	7.3	7.0	8	6.9	8
Trial 4	8	7.2	7.0	8	7.2
Trial 5	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**

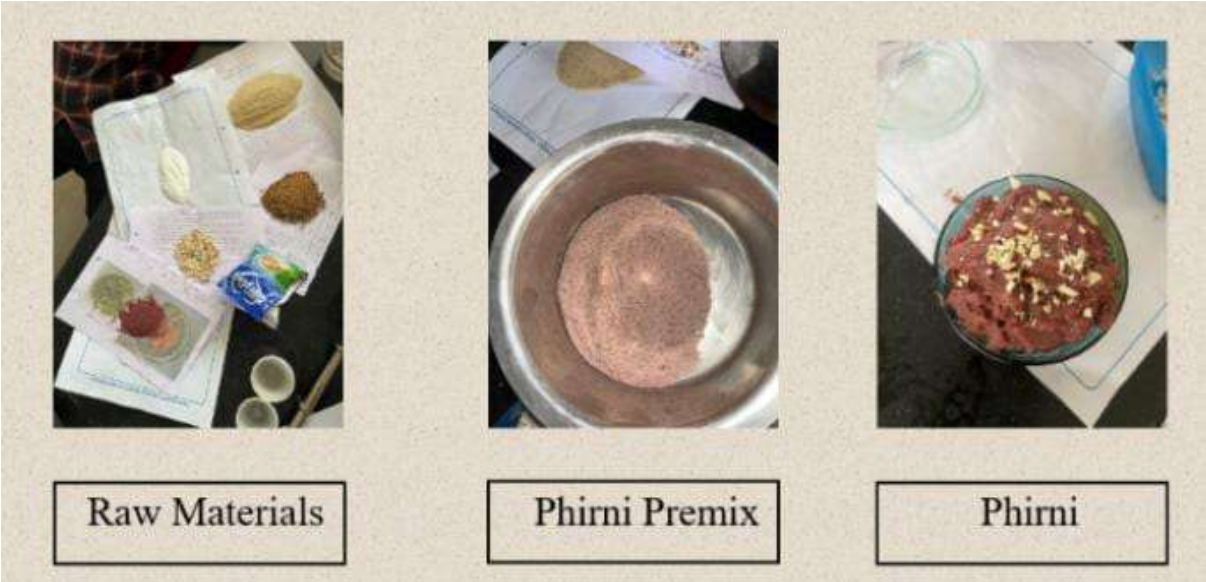

Figure1. Preparation of Phirni premix from raw material and phirni from phirni premix.

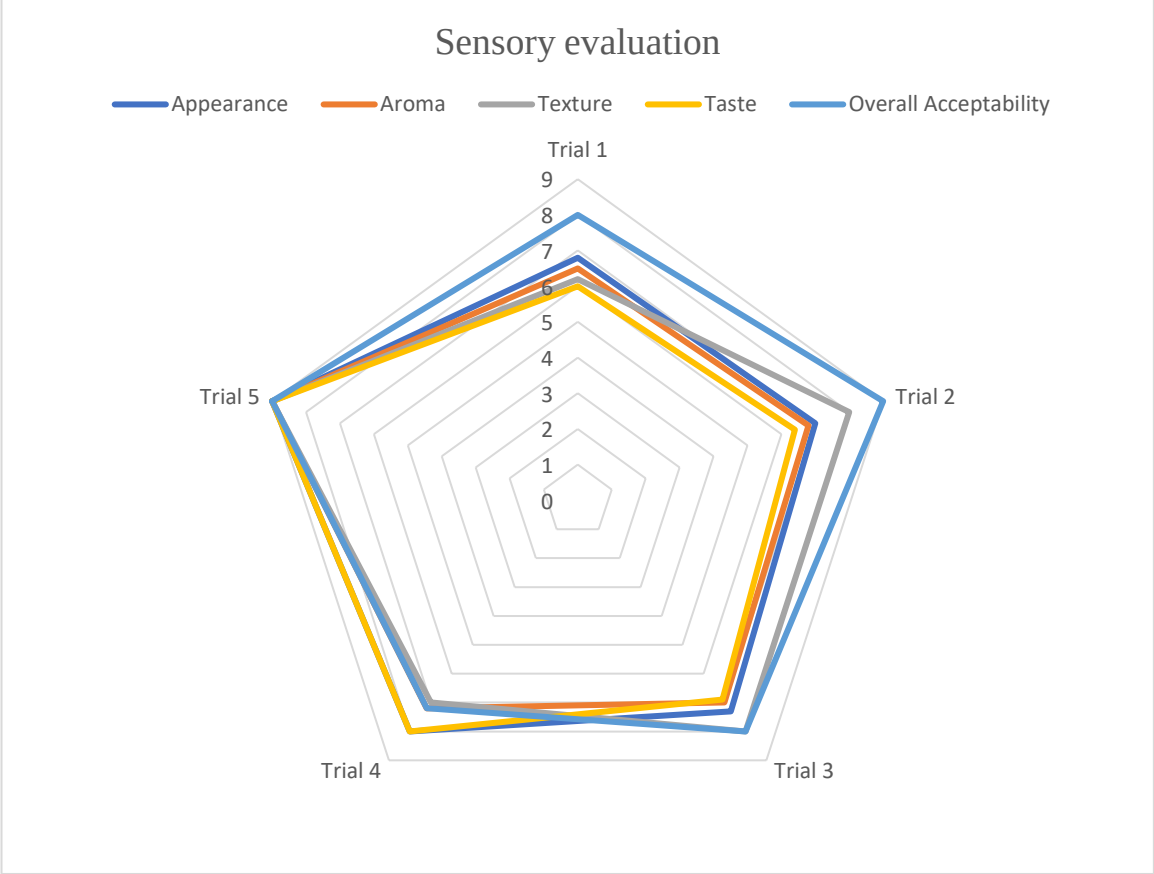

Figure 2. Sensory attributes evaluation.

All nutrient values showed low standard deviations, indicating high reproducibility and precision in the formulation process. Additionally, the statistical analysis showed that the differences in nutrient content across replications were significant at $p < 0.05$, affirming the reliability and scientific robustness of the measured values. Overall, the brown rice Phirni premix demonstrated a balanced nutritional profile with high acceptability and consistency, making it a suitable candidate for commercialization as a nutritious and convenient traditional dessert.

In Trial 1, the product garnered moderate scores across all sensory attributes, particularly with taste (6.0) and texture (6.2). These scores hint at potential formulation or processing challenges, likely resulting in an undercooked or grainy consistency. Despite these shortcomings, the overall acceptability was impressively high at 8.0, suggesting that a familiar flavor profile or a well-balanced sweetness resonated with the panelists. Trials 2 and 3 showcased notable enhancements in texture, achieving a commendable score of 8.0. This improvement was likely the result of meticulously optimizing rice flour granulation and refining cooking parameters. Aroma and taste saw minor boosts, still lingering comfortably in the "liked moderately" category. Among these trials, Trial 2 stood out with the highest overall acceptability at 9.0. This indicates that consumers particularly appreciated the delightful texture, even as the aroma remained somewhat average. Trial 4 dazzled with high marks for appearance (8.0) and taste (8.0), reflecting a striking visual appeal and a harmonious flavor balance. These attributes may have been enhanced by a thoughtfully crafted spice blend or an ideal milk ratio. However, the texture score dipped slightly to 7.0, and overall acceptability fell to 7.2, hinting at minor inconsistencies in the formulation that might have hindered perfection. In a stunning display of excellence, Trial 5 emerged as the clear winner, outshining all previous iterations with perfect scores of 9.0 for appearance, aroma, texture, taste, and overall acceptability. This trial likely achieved the most harmonious formulation, boasting just the right amount of sweetness, a luxuriously smooth texture, an enticingly strong cardamom aroma, and a mouthwatering rich appearance. It was evidently the most cherished version among the panelists, leaving an indelible impression.

IV.CONCLUSION

The brown rice Phirni premix demonstrated excellent consistency in nutritional composition, as evidenced by low standard deviations across all measured parameters. Statistical analysis confirmed the reliability of the data, with significant differences ($p < 0.05$) between replications, underscoring the precision of the formulation process. This consistency, coupled with a balanced nutritional profile and high consumer acceptability, positions the premix as a strong candidate for commercialization. The product successfully merges traditional appeal with modern convenience, offering a nutritious dessert option that maintains its quality across production batches. Sensory evaluation revealed a clear evolution in product quality across trials, with each iteration showing measurable improvements. While Trial 1 faced challenges with texture and taste, likely due to suboptimal processing parameters, subsequent trials addressed these issues through refined rice flour granulation and adjusted cooking techniques. Trial 2 emerged as a standout with superior texture and high overall acceptability (9.0), while Trial 4 excelled in appearance and flavor but lagged slightly in texture consistency. These incremental improvements highlight the importance of precise formulation adjustments in achieving the desired sensory attributes. The pinnacle of development was achieved in Trial 5, which received perfect scores (9.0) across all sensory parameters—appearance, aroma, texture, taste, and overall acceptability. This version struck an ideal balance, featuring a smooth texture, well-calibrated sweetness, and a pronounced cardamom aroma that resonated strongly with panelists. Its success underscores the potential for commercial viability, provided that the optimized processing parameters are strictly maintained. Future efforts should focus on scaling up production while preserving these qualities, as well as exploring variations to cater to diverse dietary preferences and nutritional needs.

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