



Research Article

Development and nutritional evaluation of Ayurvedic-Based nutritional supplements: An exploratory study

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Abstract

Background: Nutritional deficiencies, particularly iron and protein insufficiency, are prevalent among school-going children and contribute to health issues like anemia and stunted growth. Traditional Ayurvedic principles offer a holistic approach to addressing these gaps. This study explores the development of an Ayurvedic-based supplementary product aimed at alleviating common nutritional deficiencies in children. **Objective:** To develop and evaluate an Ayurvedic-based supplementary product to improve iron and protein intake among school-going children, aiming to alleviate common dietary deficiencies. **Methodology:** Four experimental formulations were developed, three trials of biscuits and one trial of granules. Ingredients included *Mudga* (*Vigna radiata* (L.) R. Wilczek), *Masha* (*Vigna mungo* (L.) Hepper), *Navaneeta* (butter), *Sharkara* (sugar), *Bala* (*Sida cordifolia* L.) churna, *Sariva* (*Hemidesmus indicus* R. Br.) churna, *Trikatu* churna, *Saindhava Lavana* (rock salt), *Loha Bhasma*, milk, and ghee. Initial biscuit trials were evaluated for taste, texture, and palatability; however, issues of bitterness and poor texture prompted modification of ingredient proportions and ultimately a shift to a granule-based formulation. The granules were analyzed for macronutrients and iron content. **Results:** The granule-based product demonstrated significant levels of iron and protein, along with other essential nutrients, making it a promising product for addressing malnutrition in children. **Conclusion:** The Ayurvedic-based granule supplement offers a promising solution to combat nutritional deficiencies, particularly iron and protein, in school-aged children. Its rich nutritional profile, coupled with adherence to Ayurvedic principles, makes it an effective tool for improving children's health and combating malnutrition.

Keywords: Nutritional supplements, Granules, Iron, Protein, School-going children, Malnutrition, Ayurvedic formulations

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Introduction

Malnutrition among school-going children, particularly iron and protein deficiencies, remains a pressing issue globally, especially in developing countries (1). This research aims to formulate a novel nutritional supplement based on classical Ayurvedic principles for the enhancement of nutrition in children. Ayurvedic principles offer nutritional guidance and a therapeutic approach to addressing modern health challenges, such as protein and iron deficiencies, which are prevalent in school-going children (2).

The main ingredients of this nutritional supplement, *Mudga* (green gram) (3) and *Masha* (black gram) (4), are high in protein, facilitate digestion, and support tissue nourishment. *Sharkara* (sugar) offers a rapid energy boost, while *Navaneeta* (butter), is a rich source of omega-3 fatty acids. *Trikatu*, *Sariva*, and *Bala Churna* are added to promote proper digestion. *Loha Bhasma* aids in addressing nutritional inadequacies, especially in situations of iron deficiency, while *Saindhava Lavana* naturally improves the flavor.

The study was conducted in collaboration with the KLE College of Hotel Management and Catering Services, focusing on a product that can be easily consumed and accepted by children while delivering the necessary nutrients. The study aligns with traditional Ayurvedic formulations and modern nutritional analysis to create an effective, palatable, and culturally acceptable supplement.

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Materials and Methods

Source of Data and Materials

Relevant Ayurvedic texts, including *Laghutrai* and *Bruhatrai* and articles/books on the subject matter. All the Raw ingredients were procured from the GMP-certified KLE Ayurveda Pharmacy, Kasbhag, Belagavi. Preparation of the Nutritive products was carried out at the Pathya unit of KAHAR Shri B. M. K Ayurveda Mahavidyalaya Belagavi and KLE College of Hotel Management and Catering Services, Belagavi. Nutritional testing was done at Kemya Laboratory, Belagavi.

Ingredients Used

The following ingredients were used based on Ayurvedic and nutritional principles: *Mudga* (*Vigna radiata* (L.) R. Wilczek, Fabaceae, *Masha* (*Vigna mungo* (L.) Hepper, Fabaceae, *Navaneeta* (butter), *Sharkara* (sugar, *Saccharum officinarum* L.), *Bala* (*Sida cordifolia* L., Malvaceae, *Sariva* (*Hemidesmus indicus* R. Br., Apocynaceae, *Trikatu* (mixture of *Piper nigrum* L., *Piper longum* L., and *Zingiber officinale* Roscoe, in the ratio of 1:1:1), *Saindhava Lavana* (rock salt), *Loha Bhasma* (calcined iron preparation), Milk and Ghruta (clarified butter).

Plan of the Study

The study involved preparing multiple formulations based on Ayurvedic principles and conducting nutritional analysis to assess their effectiveness. Four experimental formulations were developed: three trials of biscuits and one trial of granules. Each trial varied in ingredient proportion and preparation method to improve palatability, texture, and acceptability. Granules were finalized and evaluated for their iron percentage. The proportion of ingredients, Temperature and outcome of the trial mentioned in Table 1.

Methodology

Trial 1 – 3: Biscuit preparation

The flour of *Mudga* and *Masha* was first sieved and blended with *Triticum dicoccum* flour. The mixture was then combined with sugar, baking powder, butter, and spices, after which milk was added dropwise to achieve the required consistency. The dough was kneaded properly, shaped into biscuits, and baked at 160°C for approximately 13–19 minutes.

Trial 4: Granule preparation

To begin the preparation procedure, the flour of *Masha* and *Mudga* was sieved using a 60-mesh size. Ghee was then added to the flour and roasted over low heat. 360 ml of milk and 100 grams of sugar were mixed in a different container, brought to a simmer, and constantly stirred. After the mixture had thickened, the roasted flour and additional ingredients, including *Loha bhasma*, *Churna* of *Bala*, *Sariva* and *Trikatu*, and *Saindhava lavana* were added in the required amounts. After preparing a homogenous mixture, it was allowed to dry in the shade. From this mixture, granules were prepared and kept in an airtight container.

Nutritional Analysis

The prepared granules were analyzed for macronutrients, including fat, protein, carbohydrates, fiber, and micronutrients like iron. Nutritional testing was done at Kemya Laboratory, Belagavi.

The Granules were found to be rich in key nutrients. *The iron content of the granules (81.8 mg/100g) is significant, particularly for addressing iron-deficiency anemia in children. The protein content (8.2 g/100g) and energy value (401 Kcal/100g) support growth and development.* [Table 2]

Table 1: Experimental formulations of Nutritional supplementation

Ingredient (per batch)	Trial 1 (Biscuits)	Trial 2 (Biscuits)	Trial 3 (Biscuits)	Trial 4 (Granules – Final)
<i>Triticum dicoccum</i> flour (g)	80	80	80	–
<i>Mudga</i> (<i>Vigna radiata</i>) flour (g)	23	27	27	50
<i>Masha</i> (<i>Vigna mungo</i>) flour (g)	22	18	18	25
Sugar (g)	55	55	55	100
Milk	q.s.	q.s.	q.s.	360 ml
Baking soda	¼ tsp	¼ tsp	¼ tsp	–
Baking powder	¼ tsp	¼ tsp	¼ tsp	–
Cardamom	¼ tsp	¼ tsp	¼ tsp	–
Salt	1 pinch	1 pinch	1 pinch	–
<i>Saindhava Lavana</i> (Rock salt, pinch)	–	–	–	1 pinch
<i>Loha Bhasma</i> (mg)	–	–	40	500
<i>Bala</i> (<i>Sida cordifolia</i>) churna (g)	–	–	–	3
<i>Sariva</i> (<i>Hemidesmus indicus</i>) churna (g)	–	–	20	3
<i>Trikatu</i> churna (g)	–	–	10	–
<i>Saindhava Lavana</i> (Rock salt, pinch)	–	–	–	1 pinch
Yield	18 biscuits	19 biscuits	20 biscuits	Granules
Outcome	Slight bitterness due to higher <i>Masha</i> .	Improved taste & texture after reducing <i>Masha</i> .	Poor texture and taste due to Ayurvedic additives.	Best acceptability, nutritionally rich (Iron 81.8 mg/100 g, Protein 8.2 g/100 g). Final product.

Results

Table 2: Nutritional analysis of Nutritive product

Sl.n	Test	Result	Unit	Test method
1	Total fat	8	g/100g	FSSAI Manual (Spices & Condiments)
2	Fiber	3.7	g/100g	
3	Moisture	4.1	g/100g	
4	Protein	8.2	g/100g	IS 7219:2010
5	Total Sugar	39	g/100g	Sugar & Confectionery Product
6	Iron	81.8	mg/100g	FSSAI Manual (Metals)
7	Total	74	g/100g	By Calculation
8	Energy value	401	K Cal/	By Calculation

Discussion

Selection of Ingredients

Mudga (Green Gram) and *Masha* (Black Gram) are traditionally used for their high digestibility and protein content. These ingredients support growth and development, while *Loha Bhasma* is used in Ayurveda for its iron-rich properties, making it ideal for addressing iron-deficiency anemia.

Mudga (Green Gram) is a highly digestible protein-rich pulse, containing 20-25% protein, which offers a superior Net Protein Utilization (NPU) compared to other pulses. It is rich in minerals and B-group vitamins, making it an excellent source of nutrition. The nutritional analysis of Green Gram reveals it contains 24.5% protein, 1.2% fat, 3.5% minerals, and 59.9% carbohydrates, along with significant amounts of calcium (75 mg), phosphorus (405 mg), and iron (8.5 mg). (5)

Masha (Black Gram) is rich in soluble and insoluble fibers, aiding digestion by bulking up stool and stimulating peristalsis. It also contains high levels of magnesium and potassium and is considered a "*balakara*" in traditional medicine. Its nutritional profile includes 24% of thiamine (B1), 21% of riboflavin (B2), 10% of niacin (B3), and high amounts of folate (54%) and magnesium (75%). (6)

Sariva (*Hemidesmus indicus*) promotes digestion and helps with conditions like menorrhagia and epistaxis. Its roots contain beneficial compounds like coumarin, sterols, tannins, and carotenoids, as well as high levels of vitamin C. (7)

Trikatu is known for stimulating digestion and enhancing liver and pancreas function, improving overall digestive efficiency, and increasing the bioavailability of other drugs. (8)

Bala (*Sida cordifolia*) is recognized for its rejuvenating properties, with a composition that includes fatty oils, phytosterols, and alkaloids, making it useful for strengthening the body and managing vata disorders. (9)

Milk is a complete food, rich in proteins (casein), fats (retinol and vitamin D), lactose, and essential minerals like calcium. Its nutritional value includes 3.2% protein, 4.1% fat, and 87% water, along with significant amounts of calcium (120 mg) and trace minerals, providing a well-rounded source of nourishment. (10)

Each of these raw drugs contributes distinct and complementary properties, both nutritionally and therapeutically, supporting the overall formulation.

Preparation Methodology

Initially, three trials were conducted to prepare a biscuit-based product using *Masha* and *Mudga* flour. The developmental process involved multiple challenges. Initially, biscuits were prepared across three trials. In **Trial 1**, although the biscuits were baked successfully, they had a slight bitterness, attributed to the higher proportion of *Masha*. In **Trial 2**, the proportion of *Masha* was reduced, which improved the taste and texture. This trial demonstrated that modification of ingredient ratios could address sensory limitations. However, in **Trial 3**, when Ayurvedic additives such as *Loha Bhasma*, *Trikatu*, and *Sariva* were introduced, the texture became hard and the taste less acceptable. This indicated that direct incorporation of classical Ayurvedic ingredients in baked products may not be compatible with maintaining desirable sensory qualities.

The final granule form was found to be more practical for consumption and more easily accepted by children when mixed with milk or warm water.

Final Product Evaluation

The granules were nutritionally dense, providing essential nutrients like iron and protein, which are crucial for the growth and development of school-going children. (11 – 15) The texture and taste were also acceptable, and the product can be easily consumed as a supplement to the daily diet.

Dose Calculation and Safety

Given that adolescents are particularly vulnerable to malnutrition, especially iron deficiency, the dosage of Ayurvedic drugs (such as *Loha Bhasma* and *Trikatu*) was carefully calculated to ensure safety, adhering to the recommended daily allowance. These values indicate that the granules are a promising nutritional supplement, with a particularly high iron content, which is crucial for combating anaemia.

Further Scope of the Study

- **Stability Study:** Long-term stability of the granules under various storage conditions should be evaluated.
- **Clinical Trials:** Conduct clinical trials on different age groups to assess the efficacy of the supplement in improving hemoglobin levels and overall health.

Limitations of the Study

- **Solubility Issues:** The solubility of the granules in liquid form was not optimal, which could affect ease of administration. Future formulations could consider alternative binding agents or processing methods to improve solubility.

Strengths of the Study

- **Ease of Preparation:** The granules are easy to prepare and administer.
- **Cost-Effectiveness:** The product is affordable and can be produced on a large scale.
- **Nutritionally Rich:** The granules are rich in essential nutrients, addressing key deficiencies in children.

Anticipated Outcome

The granules are expected to act as a viable nutritional supplement for school-going children, addressing issues of malnutrition and helping in the prevention of anemia and other deficiency-related health concerns.

Conclusion

This study demonstrates the potential of Ayurvedic-based granules as a nutritional supplement to combat malnutrition in school-aged children. Further clinical trials and large-scale studies will be essential to establish its long-term benefits and broader applicability in public health initiatives.

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