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## Original Research Article

## Immune-boosting health blend: A combination of barnyard millet and sunflower seeds

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## ABSTRACT

**Background:** Nutrients are crucial for develop growth and well-being, impacting cognitive function, immune strength, and physical development. Health mixes, rich in essential nutrients stand as innovative solutions to combat malnourishment, offering a convenient means to address nutritional deficiencies and promote the health of future generations. Millets, especially barnyard millet, stand out as rich sources of micronutrients, offering high nutritional value with minerals like iron, calcium, and phosphorus, aiding in various health benefits, despite the presence of anti-nutritional factors effectively mitigated through cooking.

**Aims and Objective:** This study aimed to develop a nutrient-rich health mix using unpolished barnyard millet (BM) while partially replacing it with sunflower seeds. The objectives include conducting sensory evaluation and analyzing the proximate composition of the selected variation.

**Materials and Methods:** The health mix was develop by partially replacing sunflower seeds powder in six formulations with soaked and steam-cooked unpolished barnyard millet flour. Nutrient enrichment was achieved by adding green gram dal flour, skimmed milk powder, roasted almonds, and poppy seeds. Sensory evaluation involving 30 participants, rated on a 0-9 hedonic scale, guided the selection of a specific variation for subsequent analysis of its Proximate Composition.

**Results:** The application of soaking and steam cooking methods on barnyard millet-based health mixes resulted in nutrient-rich products with favorable sensory properties. Notably, the health mix variant BMH3 scored the highest in sensory evaluation, offering elevated levels of calories, protein, Carbohydrate, fiber, iron, calcium, and phosphorus.

**Conclusion:** The results affirm the success of developing a palatable and cost-effective value-added product. The nutrient-rich health mix, particularly variant BMH3, proves to be a successful and healthy option for consumers.

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## 1. Introduction

In our daily lives, the need for a health mix is crucial as it provides a convenient and nutritionally balanced solution to support overall well-being. A health mix serves as a quick and accessible source of essential nutrients, contributing to a balanced diet and promoting sustained energy throughout the day. Millets, standing as the sixth most essential

crop globally and supporting a third of the world's population, are celebrated for their nutritional advantages over primary grains. Termed "Nutri-Cereals," varieties like barnyard millet present an attractive alternative with higher nutrient levels compared to widely consumed cereals.<sup>1,2</sup> Barnyard millet [BM], a highly nutritious and versatile food, boasts essential fatty acids like linoleic, palmitic, and oleic acid. Abundant in minerals such as iron, calcium, and magnesium, it contributes to cholesterol reduction

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through magnesium and niacin with phosphorus aiding fat metabolism and energy conversion, barnyard millet stands out as one of the least allergic grains, supporting a healthy digestive system and preventing constipation. Despite anti-nutritional factors, low phytic acid levels can be mitigated through techniques like soaking or roasting, Enriching micronutrient accessibility. Utilizing millet-based products proves economically viable, highlighting their exceptional medicinal and nutritional qualities.<sup>3,4</sup> Processing techniques such as soaking, germination, malting, fermentation, and applying thermal and mechanical treatments to grains is reported to enhance nutrient content, extend flour shelf life, diminish anti-nutritional factors, and alleviate bitterness.<sup>5</sup>

## 2. Objectives

1. Formulating a nutritious health mix using steam-cooked unpolished barnyard millet
2. Enhancing with almonds and sunflower seeds, and assessing the sensory attributes of the resulting health drink
3. Analysing the proximate composition of the chosen health mix variation and comparing it with the control version.

### 2.1. Raw materials

The study was conducted at the Department of Food Science and Nutrition, located in Yuvaraja's College-an autonomous institution affiliated with the University of Mysore in Mysuru. Key ingredients including unpolished Barnyard Millet, Green gram dhal, Almonds, Sunflower seeds, poppy seeds, skim milk powder, Cardamom powder.

### 2.2. Method used for development of health drink

Barnyard Millet was initially subjected to cleaning, soaking, and steam cooking (12 min), and drying in a hot air oven for 6 hours at 110°C. It was then blended into a fine powder and sieved with a mesh size of 100 mm to obtain a uniform fine powder. Almonds were soaked overnight, the husk was removed, and then they were dried and powdered similarly to Barnyard Millet. The almond powder, cooked barnyard millet flour, and sunflower seeds were dry-roasted separately until aromatic. Finally, skimmed milk powder and cardamom powder were added. All these ingredients were blended according to different formulations.<sup>6,7</sup>

### 2.3. Preparation of health drink with variable formulations

The developed health mix in variety of formulations (20g) was blended thoroughly with 200 ml of hot milk and subjected for sensory evaluation.<sup>8</sup>

### 2.4. Evaluation of sensory properties of health drink

The developed product underwent evaluation for its organoleptic properties using a nine-point hedonic scale (ranging from 0 to 9), assessed by a panel of semi-trained evaluators. All six formulations, including the control, were reviewed for subsequent analysis.<sup>9</sup>

### 2.5. Estimation of proximate composition of Health Mix

The nutritional analysis of selected variation and control was conducted in triplicates using established A.O.A.C. (2005) methods.<sup>10,11</sup> Crude fiber content was determined utilizing a crude fiber analyzer. Carbohydrate content was calculated by subtracting the combined values of moisture, protein, fat, and ash content from 100 per 100g of the sample. Moisture content was assessed using a hot air oven at 98 to 100°C, protein content by the Micro-Kjeldhal method for total nitrogen, ash percentage through high-temperature incineration (600°C) in a muffle furnace, and fat content estimated using the Soxhlet apparatus.<sup>12</sup> Additionally, crude fiber content was evaluated employing a crude fiber analyzer.<sup>13</sup> The computation of carbohydrate content involved deducting the sum of moisture, protein, fat, and ash content from 100 per 100g of the sample. The energy values were calculated using the formula: Energy value = [(Protein × 4) + (Carbohydrate × 4) + (Fat × 9)] (14). Additionally, the mineral analysis for iron and phosphorus utilized Atomic Absorption Spectrometry (AAS) due to its acknowledged accuracy and precision.<sup>14</sup>

### 2.6. Statistical analysis

Each sample underwent triplicate extractions, and the presented data represents the average value along with the standard error derived from these triplicate determinations. Statistical significance was assessed using the Holm Sidak method, with a pre-established significance level of  $p \leq 0.05$ . This method facilitated a rigorous analysis of the data to identify any significant findings or differences.<sup>15</sup>

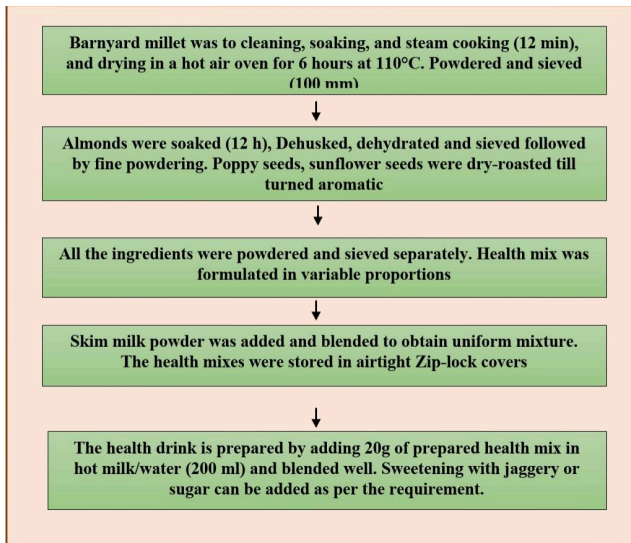
### 2.7. Formulation of health drink

The product was developed using Barnyard Millet, poppy seeds powder, green gram dhal powder, skim milk powder, almonds in the ratio of 5:2:1:1 respectively. The health mixes were made into six formulations by partially replacing sunflower seeds powder with cooked unpolished Barnyard millet flour in different ratios (0%, 5%, 10%, 15%, 20%, and 25%) and the rest were kept constant.

## 3. Results and Discussion

### 3.1. Sensory evaluation of health drink

The sensory analysis of the developed product revealed that, BMH3 variation was most acceptable among all other



**Figure 1:** Procedure of Preparation of Health drink from Steam cooked Barnyard Millet Flour enriched with Nuts and Oil Seeds.



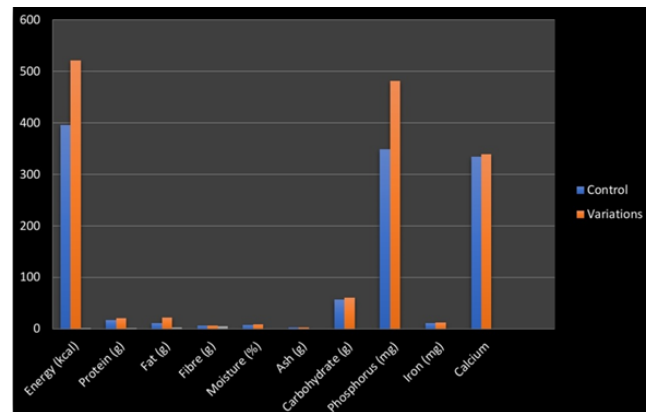
**Figure 2:** Health drink prepared from different formulations of health mix from Barnyard Millet flour including control.

variations and when compared to the control as well. The colour of the health mix remained unchanged and blended well with milk. The same goes for consistency. The flavour and taste in each formulation varied slightly but overall, 10% incorporation of sunflower seed powder based health drink acquired majority of sensory scores. Therefore, it was considered to be the best in terms of sensory properties. Poppy seeds provided authentic flavour profile to the drink with almonds and sunflower seeds. As the millet was

subjected for soaking and cooking, the Ringling bitterness was found to be reduced considerably.

### 3.2. Proximate analysis of developed health drink

The selected variation of health mixes (BMH3) underwent proximate analysis, revealing elevated moisture and fat levels attributed to the ingredients used. Almonds, sunflower seeds, and skimmed milk powder contribute rich sources of beneficial polyunsaturated and monounsaturated fats, supporting favourable cholesterol levels and providing additional heart-health advantages. Additionally, the developed Barnyard millet health blend exhibited increased iron and phosphorus content.



**Figure 3:** Graphical representation of proximate composition of health mix from barnyard millet (Control and BMH3)

### 3.3. Cost analysis of health mix per 100g

The cost of the Health mix was calculated by adding the entire ingredients rate in the market. Additional Rs.15.5 was added as the labour, gas, tax, electricity and packaging of the millet based health mix. The cost of 100 g of health mix is Rs.68 and Rs. 680/Kg.

## 4. Conclusion

The study was aimed to develop a nutritionally rich health mix using unpolished barnyard millet, employing soaking and steam cooking. Variant BMH3 stood out in sensory evaluations, offering elevated levels of fiber, iron, calcium, and phosphorus. This finding confirms formulating a superior, most appealing, value-added product. Beyond taste, 10% incorporation of sunflower seeds was a nutrient-rich composition with enhanced amount of nutrients with gluten free nature made it and is gluten free made it an excellent choice as a wholesome dietary supplement, and the study highlights its economic feasibility for widespread adoption as a health-enhancing option.

**Table 1:** Sensory scores of different variations of health drink made out of health mix developed from unpolished, soaked and cooked barnyard Millet Values are mean ± SD (n=30)

Attributes	BMH1 0%	BMH2 5%	BMH3 10%	BMH4 15%	BMH5 20%	BMH6 25%
Appearance	7.70±0.14	8.01±0.11	7.98±0.13	7.93±0.15	7.83±0.15	7.70±0.15
Colour	8.18±0.12	7.82±0.13	8.11±0.11	8.11±0.15	8.01±0.11	7.98±0.15
Consistency	7.98±0.14	7.80±0.13	7.80±0.13	7.96±0.11	7.79±0.12	7.67±0.11
Taste	7.89±0.14	7.80±0.16	7.91±0.13	7.99±0.16	7.89±0.13	7.76±0.15
Flavour	7.75±0.16	7.80±0.12	8.07±0.16	8.47±0.12	8.03±0.14	7.98±0.12
Overall Acceptability	8.01±0.11	8.30±0.19	8.10±0.20	8.07±0.17	7.99±0.18	7.87±0.19

Sensory scores of different variations of Health drink made out of health mix developed from Unpolished, soaked and cooked Barnyard Millet Values are mean ± SD (n=30)

**Table 2:** Proximate composition of health drink made from barnyard millet based health mix (Control and BMH3), values are mean ± SD (n=3) \*p value < 0.05 (Holm Sidak method)

Nutrients	Control 0%	[BMH3] 10%
Energy (kcal)	395.88±0.01	521.42±0.11*
Protein (g)	16.98±0.02	20.91±0.06
Fat (g)	11.1±0.05	21.70± 0.03*
Fibre (g)	6.92±0.12	7.11 ± 0.01
Moisture (%)	7.45±0.04	8.54± 0.06
Ash (g)	2.65±0.07	3.54± 0.14
Carbohydrate (g)	56.88±1.04	60.62±1.32*
Phosphorus (mg)	348.5±0.08	482.03±1.01*
Iron (mg)	12.04±0.01	13.02±0.03
Calcium	334.10±0.05	339.74±0.02

**Table 3:** Cost of Health mix From Barnyard millet enriched with nuts and oil seeds

Ingredients	Cost in Rs/Kg	Cost/100g	Amount (g)	Cost (Rs)
Barnyard Millet	400	40	50	20
Green gram dhal	230	23	20	4.6
Skim milk powder	500	50	10	5
Almonds	990	99	10	9.9
Sunflower seeds	500	50	10	5
Poppy seeds	800	80	10	8
Production charges- Gas, electricity and labour charges				15.5
Total cost of developed product per 100g				68 Rs

### 5. Source of Funding

None.

### 6. Conflict of Interest

None.

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