



"Post-Harvest Processing and Functional Formulation of Kodo Millet-Based Dip -Tea"

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KEYWORDS

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ABSTRACT:

This study explores the post-harvest processing and formulation of Kodo millet (*Paspalum scrobiculatum*) into a functional dip-tea beverage. Kodo millet, a highly nutritious and drought-resistant grain, undergoes post-harvest treatments such as cleaning, soaking, germination, drying, and milling to enhance its nutritional profile and bioavailability. The processed millet is then combined with lime powder, dried mint, turmeric, and ginger oil to create a caffeine-free, antioxidant-rich tea. These ingredients contribute to the tea's health benefits, including improved digestion, enhanced immunity, and anti-inflammatory properties. Sensory evaluation and nutritional analysis indicate high consumer acceptance and superior health benefits compared to conventional teas. This research highlights the importance of post-harvest management in value addition and promotes the potential of millet-based functional beverages as a sustainable and nutritious alternative to traditional tea products.

1. INTRODUCTION

Tea bags are a convenient and popular way to consume herbal and functional teas, offering ease of use and consistency in flavor. In recent years, there has been growing interest in developing tea products that incorporate nutrient-rich grains and herbs for enhanced health benefits. This study focuses on the formulation of Kodo millet (*Paspalum scrobiculatum*) dip-tea bags, integrating its nutritional advantages with medicinal ingredients such as lime, mint, turmeric, and ginger oil.

Kodo millet, one of the hardiest millets cultivated in India, has been traditionally valued for its high fiber, protein, and mineral content. It has been described as a "nutritious millet" that has received less attention compared to other staple grains in terms of research and development (Durga Shankar Bunkar *et al.*, 2021). Known for its resilience in arid conditions, Kodo millet is also gaining recognition for its potential health benefits, including its role in managing diabetes, heart disease, and oxidative stress.

The inclusion of turmeric and ginger oil in the dip-tea formulation enhances its functional properties, as both ingredients are widely acknowledged for their anti-inflammatory and antioxidant effects. Research indicates that turmeric is "a powerful weapon against inflammation"

and has potential benefits in protecting the heart and brain (Marni *et al.*, 2018). Similarly, mint and lime contribute to digestion and immune support, making this tea blend a wholesome and refreshing beverage choice.

By developing a caffeine-free dip tea using Kodo millet and medicinal herbs, this project aims to offer a functional alternative to conventional tea and coffee, catering to health-conscious consumers. The research and formulation process outlined in this study demonstrate the potential of millet-based beverages in modern dietary trends.

2. MATERIALS AND METHODS

2.1 Material Procurement:

Kodo millet (*Paspalum scrobiculatum*) was sourced from an authorized organic supplier, Phalada Pure and Sure Organic Company, Bangalore. The grains were thoroughly cleaned to remove husk, immature and damaged grains, and other impurities. The cleaned grains were stored in an airtight organic container under refrigeration at 4°C for further analysis. During procurement, the moisture content of the seeds was recorded as 5.73%.



2.3 Preparation of Germinated Kodo Millet Flour:

1. The Kodo millet grains were washed and soaked in water for 24 hours at room temperature.
2. The soaked seeds were germinated in a pilot-scale seed germinator (Macro Scientific Pvt. Ltd., Bangalore) at 25°C for 48 hours, maintaining a relative humidity of 80-90% using trays with water.
3. Both germinated and ungerminated seeds were separated. The germinated seeds were ground to extract milk and passed through a mesh sieve to obtain a uniform liquid.
4. The liquid was dried at 45°C for 8 hours to reduce the moisture content to less than 7%, and the dried powder was roasted in a non-stick pan.

2.4 Preparation of Other Ingredients:

Mint Powder (*Mentha piperita*): Fresh mint leaves were obtained from local farmers in Shinkarghatta. The leaves were cleaned, shade-dried for 2-3 days, and then ground into fine powder.

Lime Powder (*Citrus aurantiifolia*): Limes were procured from local vendors in Shimogga. The dried lime peels were processed into powder and stored in a desiccator to control moisture content.

Turmeric Powder (*Curcuma longa*): Turmeric roots were obtained from the Malnad region and processed using a pestle and mortar to preserve aroma, texture, and color. The powder was stored in an airtight container with silica bags.

Ginger Oil (*Zingiber officinale*): Ginger oil was directly purchased from MIHI Organic Foods, Madurai, Tamil Nadu, and used in the tea formulation without further processing.

2.5 Formulation of Kodo Millet Dip-Tea Bags:

1. Germinated Kodo millet powder, mint powder, lime powder, turmeric powder, and ginger oil were weighed accurately according to a formulated composition.
2. The ingredients were thoroughly mixed to ensure homogeneity and improve flavor, texture, and nutritional properties.
3. The blended mixture was filled into biodegradable, heat-sealed tea bags, ensuring product safety and environmental sustainability.

2.6 Composition for control sample, sample A, sample B

Materials	% composition of the ingredients		
	Control Sample	Sample A	Sample B
Kodo millet	-----	2.5gm	4.5gm
Mint	0.5g	0.6gm	0.7gm
Lime	0.5g	0.4gm	0.4gm
Ginger oil	10 drops	0.1gm	0.1gm
Turmeric	0.2g	15 drops	25gm

Table: 1 (% composition of the ingredients)



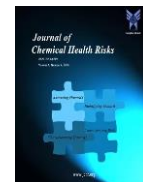
Figure: 1 (showing the tea bags with composition of ingredients)

2.7 Biochemical Analysis of the Tea Bag Formulations:

1. **Protein Estimation (Biuret Test):** The sample was treated with Biuret reagent (copper sulfate mixed with a strong base such as sodium hydroxide). A violet or purple color indicated the presence of proteins.
2. **Carbohydrate Estimation (Molisch's Test):** The sample was mixed with a-naphthol and sulfuric acid. A violet ring formation confirmed the presence of carbohydrates.
3. **Vitamin C Estimation:** The titration method using iodine was performed to determine ascorbic acid concentration.
4. **Calcium and Magnesium Analysis:** Atomic Absorption Spectroscopy (AAS) and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) were used.
5. **Iron and Zinc Analysis:**
 Iron: Analyzed using colorimetric methods with ortho-phenanthroline.
 Zinc: Detected via ICP-MS (Inductively Coupled Plasma Mass Spectrometry).

Parameters	Test method
Colour	Visual inspection
Oduor/ Taste	Organoleptic
Appearance	Visual inspection
Moisture content	IS – 1485 :1993
Acid insoluble ash	IS – 1485 :1993
Storage	Store in a cool and dry place

Table: 2 (Parameter test)



2.8 Packaging and Storage:

The formulated dip-tea bags were packed in airtight, biodegradable heat-sealed pouches retain volatile oils and bioactive compounds of the ingredients. The tea bags were stored in a cool, dry place to maintain freshness and potency.

3. RESULTS AND DISCUSSION

3.1 Sensory Evaluation

The sensory evaluation of the Kodo millet dip-tea bags was conducted using a 9-point hedonic scale with 15 panelists aged 20-50 years. The evaluation covered parameters such as appearance, flavor, aroma, and mouthfeel.

The results indicated that the Kodo millet dip-tea samples (Sample A and Sample B) had higher acceptability than the control sample, particularly in flavor, aroma, and mouthfeel. Most panelists found the Kodo millet tea to have a pleasant taste and stress-relieving properties, making it a suitable caffeine-free alternative to traditional tea and coffee.

Samples	Appearance	Flavour	Smell \ Aroma	Feel after drink
Control	7.36 ± 1.2	5.45 ± 2.20	7.45 ± 1.43	4.72 ± 2.32
Test sample	8.27±0.78	8.45±0.82	8.45±0.68	8.63±0.8

Table: 3 Statistical Analysis

3.2 Nutritional Analysis:

The nutritional composition of the control sample, Sample A, and Sample B was analyzed using standard biochemical methods.

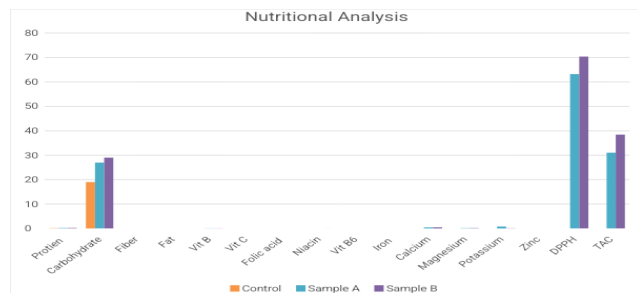


Figure: 2 showing graphical representation of comparative graph for nutritional analysis of control sample A sample B.

4. CONCLUSION

The development of Kodo millet dip-tea bags successfully integrates the nutritional benefits of Kodo millet, mint, lime, turmeric, and ginger oil, creating a functional and health-promoting beverage. The sensory evaluation results indicated high consumer acceptance, with panelists appreciating the flavor, aroma, and mouthfeel of the millet-based tea over traditional dip-tea samples.

Nutritional analysis confirmed that Kodo millet-based dip tea is rich in proteins, vitamins, and essential minerals, making it a suitable caffeine-free alternative to conventional tea and coffee. The incorporation of antioxidant-rich ingredients like turmeric and ginger oil enhances its health benefits, particularly for digestive health, immunity, and stress relief.

The biodegradable packaging of the dip-tea bags ensures environmental sustainability, aligning with modern consumer preferences for eco-friendly products. This study highlights the potential of millet-based beverages in the functional food industry, encouraging further exploration of other millet varieties for similar innovative applications.

Overall, Kodo millet dip tea can serve as a nutritious, herbal alternative, supporting health-conscious lifestyles while contributing to the diversification of millet-based products in the market.

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