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Original Research Article

Formulation and evaluation of mathri developed with partial replacement of wheat flour with brown top millet flour (*Brachiaria ramosa*)

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ABSTRACT

Brown top millet (*Brachiaria ramosa*) is one of the nutri-cereals. It is rich in nutrients such as fibre, calcium, potassium, manganese, and zinc. It is considered a low glycaemic food. Mathri, also known as mathiya, is a ready-to-eat snack served with hot beverages. In this study, Mathri was prepared with brown top millet flour, wheat flour, salt, ajwain, oil, and water in six different variations (0%, 20%, 40%, 60%, 80%, and 100%) and labelled as WHF1, BTM2, BTM3, BTM4, BTM5, and BTM6, respectively. This product was evaluated for its sensory attributes by using 20 semi-trained panellists. It was observed that the 40% variation had high acceptability, while the 100% variation had lower acceptability compared to the standard and other variations. Therefore, Mathri prepared using 40% brown top millet flour was used for further estimation of nutritional components. It was found to be rich in protein, fat, fibre, energy, and calcium when compared with the control.

1. Introduction

Mathri, also referred to as mathiya or mathari, is a popular Rajasthani deep-fried snack. It consists of savoury, salty, flaky, and crispy crackers made with wheat flour, water, and ajwain. Mathri is typically enjoyed with tea during snack time or paired with pickle.[1] The development of this snack was influenced by the need to preserve food that would remain edible for several days. The prepared product is often stored in large jars at room temperature. Mathri is a highly favoured snack to carry along while traveling.[2]

Brown top millet (BTM) is predominantly cultivated in arid regions of temperate subtropical and tropical areas, particularly on lands with limited fertility and moisture.[3] It is one of the nutritious minor millets known as "Korale" or "Karlakki" in the Karnataka region. Brown top millet also goes by other vernacular names such as Markra or Murat in Hindi and Kula Samai or Pala pul in Tamil. The cultivation of brown top millet is still limited to specific areas.[4] It is a highly nourishing food among all millets, known for its high energy content. Consumption of dietary fibre has been associated with various health benefits, including maintaining bowel movement, preventing constipation, and regulating blood glucose levels. Additionally, brown top millet is a rich source of micronutrients such as iron, calcium, potassium, magnesium, zinc, phosphorus, and B-complex vitamins. Millets have a low glycaemic index and are rich in polyphenols and antioxidants, making them effective for managing diabetes.[3]

2. Objectives

1. The objective is to develop Millet-based Mathri by partially replacing wheat flour with brown top millet flour and conduct an organoleptic evaluation of the product.
2. The goal is to create mathri that is low in gluten and qualifies as a low glycaemic food.

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3. The aim is to analyse the sensory attributes of the developed mathri and evaluate its nutritional composition.

3. Materials and Methods

3.1. Raw materials

The present study was carried out in the Department of Food Science and Nutrition, Yuvraja's College; an Autonomous institution affiliated with the University of Mysore, located in Mysuru, Karnataka. The raw materials, including wheat flour, brown top millet flour, ajwain, oil, and salt, were procured from the local market in Mysuru.

3.2. Method

Mathri was prepared by combining different proportions of wheat flour and barnyard millet flour. Hot oil was poured into the mixture, followed by the addition of ajwain and salt. The ingredients were mixed well. Water was added to make semi-hard dough. Which was then divided into small balls. The dough balls were rolled into round shapes with a diameter of 5 cm and a thickness of 0.5 cm. Subsequently, the mathri was deep-fried on a medium flame until it turned golden brown and became crisp.

3.3. Sensory evaluation

The developed product, Mathri, was evaluated for its organoleptic properties, including colour, appearance, flavour, texture, aftertaste, and overall acceptability. A total of 30 semi-trained panellists participated in the sensory evaluation, using a 1 to 9 point hedonic scale to rate the quality of the BTMF. The mean value of the 30 scores was used for evaluation.

3.4. Proximate analysis

Each sample were analysed in triplicates. The proximate estimation was conducted following the standard AOAC (1990) method for the selected variation, BTMF3, as well as the control. These methods are known for their accuracy and precision. The moisture content was determined using a hot air oven set at 98-100 degrees Celsius. The protein content was estimated using the standard Micro-Kjeldahl method, which involves determining the total nitrogen content. Fat analysis was performed using the Soxhlet method, while ash (%) was estimated by incinerating the food sample at a high temperature of 550^{o}C for 6 hours in a muffle furnace. Crude fiber was estimated using a Crude Fiber Analyzer. The carbohydrate content was calculated by subtracting the sum of the moisture, protein, fat, and ash content per 100 g of the sample from 100.[5] Calcium and iron were estimated using Inductively Coupled Plasma Mass Spectrometry (ICP-MS).[6]

4. Statistical Analysis

The data obtained was statistically analysed using standard methods provided by Snedecor and Cochran[7] and the significance of differences was determined using Duncan's multiple range test, considering $p \leq 0.05$ as significant.[7,8]

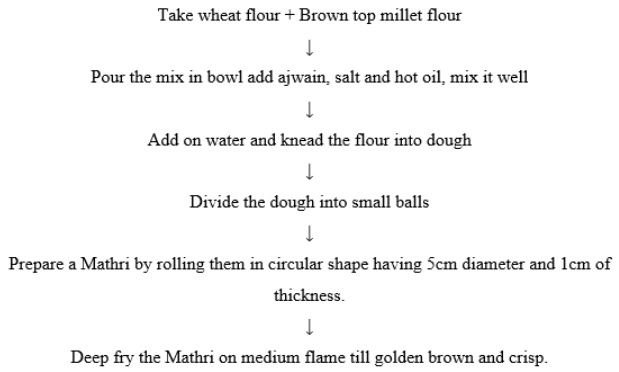

Fig. 1: Flow chart for preparation of brown top millet mathri.

5. Formulation of the Product

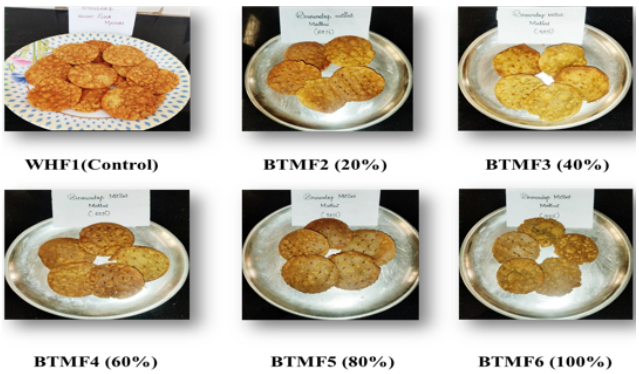

Fig. 2: Different variation of Mathri developed from BTMF in comparison with wheat flour Mathri.

6. Results and Discussion

The study aimed to prepare millet mathri by partially replacing wheat flour with Browntop millet flour. The data focuses on the impact of incorporating different proportions of browntop millet flour (20%, 40%, 60%, 80%, and 100%) on the sensory attributes of mathri. The results are presented in Table 2. The scores obtained for sensory attributes of BTMF2 and BTMF3 were comparable to the control, while BTMF4, BTMF5, and BTMF6 exhibited lower scores and were less acceptable compared to other variations.

The proximate analysis was conducted to determine the composition of the accepted browntop millet flour mathri (BTMF3) and the control, and the results are displayed in

Table 1: Formulation of the product (ingredients g/100gm) for preparation of Brown top millet flourMathri.

Ingredient	WHF1	BTMF2	BTMF3	BTMF4	BTMF5	BTMF6
Wheat flour (g)	100	80	60	40	20	-
Browntop millet flour (g)	-	20	40	60	80	100
Ajwain (g)	0.5	0.5	0.5	0.5	0.5	0.5
Salt (g)	2	2	2	2	2	2
Oil (ml)	15	15	15	15	15	15
Water (ml)	60	60	60	60	60	60

Table 2: Sensory evaluation of mathri with respect to appearance, colour, taste, texture, flavour and overall acceptability were carried out.

Variation	Appearance	Colour	Texture	Taste	Flavour	Overall acceptability
WFM1 (control)	8.5±0.5*	8.3±0.5*	8.5±0.5*	8.4±0.6	8.3±0.4	8.5±0.5
BTMF2 (20%)	8.25±0.44*	8.25±0.44	8.12±0.34	8.25±0.57	8.11±0.47	8.21±0.47
BTMF3 (40%)*	8.06±0.25	8.12±0.34	8.43±0.51*	8.43±0.51*	8.25±0.44*	8.35±0.44*
BTMF4 (60%)	7.75±0.44	7.68±0.47	7.87±0.61	7.68±0.70	7.62±0.71	7.93±0.68
BTMF5 (80%)	7.06±0.25	6.75±044	7.0±0.51	6.93±0.92	6.75±0.44	6.93±0.44
BTMF6 (100%)*	6.0±0.51	6.0±0.51	6.06±0.77	5.87±0.5	5.81±0.54	5.75±0.44

Values are mean ± SD, $p \leq 0.05$ (Holm sidak method) n=30

Table 3: Nutritional composition ofMathri from browntop millet flour (40%) compared with standard.

Nutrients	Mathri (Standard)	BTM 3 (40%)
Moisture (%)	11.14 ±0.43	10.28 ±1.10
Carbohydrate (g)	54.79 ±0.31	48.35 ±2.12
Protein (g)	10.52 ±0.25	13.33 ±0.71*
Fat (g)	15.63 ±0.15	18.51 ±0.15*
Fiber (g)	6.91 ±0.51	8.32 ±0.13*
Energy (kcal)	401.91±0.48	412.83 ±0.11*
Ash (g)	1.01 ± 0.19	1.21 ± 0.07*
Calcium (mg)	36.11 ±2.0	47.73 ±1.09*
Iron (mg)	4.16 ±0.13	3.32 ±0.11

Values are mean±SD, $p \leq 0.05$ (Holm sidak method) n=3

Table 3. BTMF3 showed higher values for energy, protein, and fat compared to the control, whereas carbohydrate content was lower. Additionally, the fibre, ash, and calcium content were increased in browntop millet flour mathri.

7. Conclusion

Mathri is typically prepared using wheat flour or Maida flour. In this study, we aimed to develop mathri by incorporating browntop millet flour along with wheat flour. Wheat flour is known for its high gluten content, while millets are rich in dietary fibre and have a low glycaemic index. Browntop millet flour, specifically, is gluten-free and contains beneficial components such as polyphenols, antioxidants, and micro minerals like calcium.

In our study, Mathri partially replaced with 40% of browntop millet flour was found to be acceptable on par with the control group, this selected variation exhibited superior nutritional properties, with higher levels of fibre and minerals such as calcium, along with lower carbohydrate content which makes the mathri a low glycaemic index food. The high fibre content creates a fibrous network that slows down the digestion of glucose, resulting in a slow release of glucose into the bloodstream. Additionally, the absence of gluten contributes to its low gluten content, making it suitable for individuals with gluten sensitivity. Overall, the inclusion of browntop millet flour in the mathri recipe enhances its nutritional profile, transforming it into a low glycaemic and low gluten snack option.

8. Source of Funding

None.

9. Conflict of Interest

None.

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