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# Evaluation Of Antioxidants In Little Millet(*Panicumsumatrense)* Muffins

**Mantasha Hasan[1*], Dr. Mudita Verma[2], Er. Abhirup Mitra[3], Dr. S.S. Tripathi[4]**

[1*,2,3,4]Invertis University,Bareilly

**Abstract:**
Little millet (***Panicumsumatrense)*** can be identified as Kutki or Samai in India. It has wide range of health benefits and is rich in carbohydrates , proteins ,dietary fibers, antioxidants and minerals. The purpose of the study is to utilize little millet flour along with whole wheat flour for the production of muffins and to highlight the antioxidant properties and shelf life of little millet muffins. Soaking of little millets grains for about 25-30 minutes and was done as a pretreatment. The result of anti -nutritional analysis showed that controlled sample of muffins ( whole wheat muffins) have Tannin Content (0.0061 %) and Phytates (3.46mg\100gm).
The result of phyto chemical analysis showed that muffins produced from little millet flour have DPPH activity (82.57%),Total Flavonoid Content(1.7 mg QE\gm), Total Phenolic Content (120 mg GAE\gm), Tannin Content (0.0085%) and Phytates (0.00856%).
The result of sensory evaluation for overall acceptability that carried out for little millet muffins revealed that the acceptance of panelists for this product overall acceptability. It concludes that the little millet muffins is recommended as an healthy and better option for breakfast and dessert.

**Keywords:** Little millets, Muffins , Antioxidants , DPPH radical scavenging activity, Tannins ,Phytates.

**Introduction:**
Little millet belongs to the Kingdom **Plantae**, Order **Poales**, Family **Poaceae**, Genus**Panicum** and Species **sumatrense**. Little millet (**Panicumsumatrense L.)** is cultivated in India under a variety of agro-ecological conditions and is additionally recognized as samai, samo, moraio, vari, and kutki. Little millet is an adaptable crop that can tolerate drought and water logging to some extent better than most other cereal crops. As a result, it can supply us with food security even under adverse weather circumstances. Little millet contains vitamin B as well as minerals such as potassium, phosphorus, iron, zinc, and magnesium. As a result, it may address nutritional sensitive agriculture, which tries to improve nutrition in order to battle the current situation of micronutrient deficiency. Little millet is grown in the following Indian regions: in southern states like Karnataka, Tamil Nadu, Andhra Pradesh, in northern state like Uttarakhand, in central like Chhattisgarh, Madhya Pradesh, in eastern states like Odisha, Jharkhand, and in western states like Gujarat and Maharashtra **( Anuradha *et al.,* 2020)**
An antioxidant can be referred to as an organic compound that, when present at low quantities compared to those of an oxidisable substrate, considerably hinders or limits its oxidation. The physiological purpose of antioxidants, according to this concept, is to prevent destruction of cellular components caused by free radical chemical reactions. Antioxidants play a crucial part in the body's defense mechanism against Reactive Oxygen Species (ROS), which are hazardous byproducts originated throughout normal cell aerobic respiration. Antioxidants in food inhibit undesired changes in the flavor and nutritional characteristics of a product. Millets and cereal grains are the most widely consummated foods in India. They include a wide array of the phenolics which are excellent sources of naturally occurring antioxidants.**(Sindhu and Radhai 2018).** Little millets contain high levels of antioxidants that consist of polyphenols, phenolic compounds, tannins, and flavonoids, that perform a substantial part in encouraging health by eradicating diseases associated with lifestyle such as diabetes, cardiovascular disease, obesity, cataract, cancers, inflammation, and gastrointestinal problems, all of which are major issues in the nation itself today. Polyphenols tend to be the most abundant phytochemicals, with antioxidant, metal chelating, and reducing properties. These antioxidants present in little millet promote health, delay the aging process, minimize the risk of metabolic syndrome, and boost the body's immune response. Polyphenols' bioactive exhibit anti-carcinogenic, anti-inflammatory, antiviral properties, and neurological protective effects.**( Indirani and Devasena 2021)**
The baking business has become one of the world's fastest spreading food sectors. Bread, biscuits, and cookies are among the most trending foods from bakeries. Such items serve as vital food snacks for youngsters as well as grown-ups. Refined wheat flour is most frequently utilized in the preparation of bakery items. However, a diet high in dietary fiber and protein, rather than only carbohydrates, is required to address the growing number of health issues like obesity, constipation, and other chronic diseases.
There is a global consumption of tremendous amounts of low-protein and low-fiber bakery items such as cakes, cookies, and biscuits. As a result, there has been an increase in studies into raising fiber and protein intake in the diet. Baking items play a significant role in the food sector. As the manufacturing of bakery items expands, consumers now have a wider selection of bakery product options. Customers have more options because the bakery sector offers a wide variety of baked goods, which encourages the business to further innovate and fortify its products in order to satisfy stand out to clients who are concerned about their health. Globally, the incidence of diabetes and obesity is increasing rapidly owing to food habits, and in order to combat them, there has been a surge of preference for foods that are packed with dietary

fiber, complex carbohydrates, low in calories and glycemic index, and phytochemicals. As a result, the food industry is currently focusing on boosting the nutritive content of such goods. As of right now, there is a trend toward developing healthy bakery items. Dietary fiber is now thought to be a necessary component of baked goods. It aids with the absorption of fat from the digestive tract, for the relief of gastrointestinal pain, and the prevention of many malignant tumors.Many changes have occurred in the food sector over the last few decades, mostly as a result of the development and application of new technologies to fulfill rising customer demand for convenience items. **(Bijlwan*et al.*, 2019)**

Muffins are baked desserts that have grown in popularity as people's eating habits change. The quality of a muffin is determined by the components used, such as flours, eggs, flavoring, shortening, and leavening agents, as well as the conditions under which it is prepared. The inclusion of non-gluten-forming ingredients such as millet flour, oats, or fiber-rich items may have an impact on muffin quality. Muffins are quite popular since they are eaten for breakfast or as snacks. They are mostly sweet items that are well-liked by customers owing to their pleasant flavor and texture. The standard mix for producing classic muffins is produced using wheat flour, vegetable oil, eggs, sugar, and water or milk**( Paneria, and Dr. Agarwal ,2023)**. Due to its gluten concentration, wheat flour is the most significant component in muffins, as it is in other bakery products. Gluten is a key protein component of wheat that is responsible for flour processing properties in the bakery industry and contributes to baked product structure. However, it is not acceptable for intake for those who have celiac disease, a severe type of a spectrum of illnesses known as gluten sensitivity in genetically sensitive individuals who are permanently intolerant to gluten. As a result, these individuals must adhere to a gluten-free diet for the rest of their lives. Because little millet does not contain gluten and is high in total minerals and fiber content, it has tremendous potential for generating value-added baked goods that can also be ingested by gluten-intolerant persons.

Millets have a high potential for use in many food systems due to their nutritional value and economic relevance. They may be used in a variety of food items, particularly confections like breads, biscuits, cakes, cookies, muffins, pies, pancakes, and morning breakfast cereals. Little millets are thought to be the best for baking purposes. The purposes of this research were to formulate little millet muffins, assess their overall acceptance , to figure out the finished muffin's proximate composition, and analyze the muffin's phytochemical and antinutritional factors contents.

## Materials and Methods:

### Materials:

Little Millet is procure from online shopping website Amazon.in from the brand name Manna Ethnic Millets. They provide certified low glycemic index Little Millets. Wheat flour, little millet flour, baking soda, baking powder, butter(room temp.), milk, powdered sugar, salt, vanilla extract, and yoghurt all that was needed for the little millet muffins formulation that were picked up from the nearby market of **Badaun, Uttar Pradesh.**

The little millet flour was obtained by soaking the clean and healthy grains of little millet for at least 1-2 hours or overnight , then were dried in sunlight or in hot air oven and then grounded with the help of electric mixer grinder. The grounded content was sieved through a sifter to obtain fine and smooth flour.

**Table1. Composition of developed muffin formulation**

| Muffin Variation | WFM (Wheat flour muffin) | WLM1 (Wheat flour+Little Millet flour muffin) | WLM2 | WLM3 | Ingredients |
|---|---|---|---|---|---|
| Wheat Flour | 100% | 50% | 40% | 30% | Baking powder-1tsp.(5.69gm)<br>Baking soda-1\2 tsp.(2.84gm)<br>Butter (room temp.)- 1\2 cup (115gm)<br>Milk-1 cup (237 ml)<br>Powdered sugar-1\2 cup (65 gm)<br>Salt- A pinch<br>Vanilla extract-1 tsp.(4.2 gm)<br>Yoghurt-1\2 cup (125gm)<br>Wheat flour-1.5 cup(187gm)<br>Little millet flour-1\2 cup (60gm) |
| Little millet Flour | - | 50% | 60% | 70% | |

### Methods:

### Formulation of muffins

The elements were combined in the right proportions and order to yield muffins. The top-notch raw material was picked since it didn't possess microbiological impact and foreign particles.

Firstly, pre heat the microwave oven at 356°F (180°C) and after that a large bowl was taken and to ensure ideal batter mixing and a smooth consistency, dry ingredients like wheat flour, sugar, baking powder, baking soda, and a little millet flour were sifted thoroughly.

Subsequently, take another large bowl , add butter and powdered sugar in proportionally, and combine them thoroughly. Afterwards, add yoghurt, vanilla extract or other optional flavoring ingredients and combine all dry and wet ingredients in batches along with milk and mix well. Everything was fold lightly by using cut and fold method in fixed direction either clockwise or anticlockwise to incorporate air into the batter which increase the volume of batter, provide texture

and fluffiness to the muffin. Whipping was the next step in order to accomplish the appropriate falling consistency. Following that, the mixture was half-filled into a muffin tray that had been brushed with oil or butter. Eventually, the muffins had been baked in a microwave oven that was preheated to 356°F (180°C) approximately to 20 mins to half an hour, or until they turned golden brown. The muffins had been weighed, wrapped in cling wrap, and kept in a tightly sealed plastic jar at 15-18°C in cool and dry place, once they had cooled.

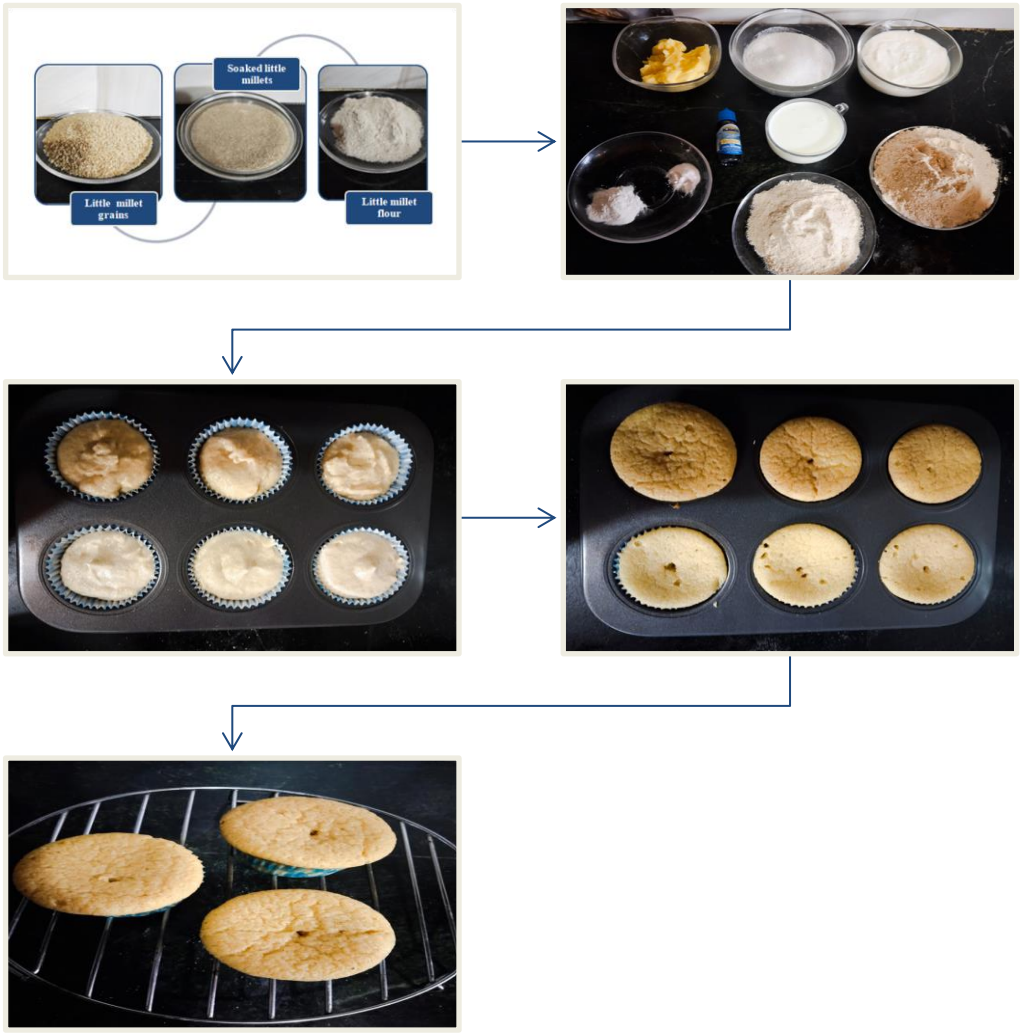


**Fig.1 Preparation of Muffins**

**Sample Preparation**
Aqueous ethanol (ethanol: water; 70:30;50:50 v/v), methanol (methanol: water, 70:30;50:50 v/v), acetone (acetone: water70:30;50:50 v/v), and absolute ethanol, methanol, acetone, and water were used to extract little millet muffins (2.0 g) for a full day at room temperature in an orbital shaker (REMI,C1S-24BL).Using Whatmann No. 1 filter paper, the extracts were filtered out of the residues. With the new solvent, the residues were extracted twice, and the extracts were then mixed. Prior to being utilized for additional examination, the extracts were refrigerated at 5±2°C.

**Sensory Evaluation:**
Panelists scored all muffin samples on a hedonic scale from 1 (dislikeextremely) to 9 (like extremely) in three parallel sessions for sensorypreference tests.

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**Result and discussion:**

**Table.2 Anti nutritional factors analysis of developed muffins**

| Anti nutritional factors analysis | WFM (100% wheat flour) | WLM1(50% wheat flour + 50% little millet flour) | WLM2(40% wheat flour + 60% little millet flour) | WLM3( 30% wheat flour + 70% little millet flour) |
|---|---|---|---|---|
| Tannin Content(%) | 0.0061±0.002 | 0.0085±0.001 | 0.0088±0.001 | 0.0092±0.003 |
| Phytate Content ( mg\100gm) | 3.46±0.04 | 8.30±0.05 | 13.50±0.08 | 18.23±0.10 |

**Phyto chemical analysis:**

**Table.3 Phytochemical analysis of developed muffin**

| Phytochemical analysis | WFM (100% wheat flour) | WLM1 (50% wheat flour + 50% little millet flour) | WLM2 (40% wheat flour + 60% little millet flour) | WLM3 ( 30% wheat flour + 70% little millet flour) |
|---|---|---|---|---|
| DPPH activity(%) | 78.48±0.39 | 82.57±0.41 | 86.57±0.43 | 88.19±0.44 |
| Total Flavonoid Content (mg QE/gm) | 1.3±0.18 | 1.7±0.21 | 1.24±0.04 | 2.35±0.04 |
| Total Phenolic Content (mg GAE/gm) | 110±4.65 | 120±4.21 | 127.8±4.05 | 146.60±4.74 |
| Moisture Content(%) | 26.4±0.14 | 27.4±0.17 | 29.2±0.15 | 32.8±1.36 |
| Protein Content(%) | 4.49±0.05 | 5.68±0.04 | 7.20±0.05 | 8.50±0.06 |
| Fat content(%) | 22.07±0.11 | 22.30±0.12 | 25.87±0.13 | 27.84±1.86 |
| Total Ash(%) | 1.48±0.03 | 1.64±0.03 | 2.20±0.03 | 3.47±0.04 |

**Sensory Evaluation:**

The statistical evaluation of sensorial properties of developed muffins was done by 10 semi trained panelists which are given in Table 4. The 50-50 flour ratio of muffin had the highest hedonic rating (8.0) for all sensorial attributes. On the contrary 30-70 flour ratio of muffin received the minimum overall acceptability score (7.07).

**Table.4 Sensory Evaluation of developed Muffins**

| Particular | WMF1 (50% wheat flour + 50% little millet flour) | WLM2 (40% wheat flour + 60% little millet flour) | WLM3 (30% wheat flour + 70% little millet flour) |
|---|---|---|---|
| Overall Acceptability | 8.26 | 7.77 | 7.74 |

**Health benefits of little millets:**

- Little millets elevate glucose metabolism because of their low carbohydrate content, slow digestibility, low glycaemic index, and water-soluble gum content. Trypsin, amylase, glucosidase, pepsin, and lipases are among the digestive enzymes that are inhibited by millet polyphenols. Because of α-amylase inhibition, the grains slow down the absorption of glucose from the intestines and release sugars into the blood gradually.
- Minor millets' resistant starch and dietary fiber promote glucose tolerance, which has hypoglycemic and hypolipidemic effects. Thus, those who suffer from lifestyle problems like obesity, diabetes, or cardiovascular disease are advised to eat little millets.
- The antioxidants found in little millet, such as polyphenols, phenolic compounds, tannins, and flavonoids, are exceptionally high in health-promoting properties and help to prevent lifestyle diseases like diabetes, cardiovascular disease, overweight, cataracts, tumors, inflammation, and gastrointestinal issues which are increasingly prevalent.
- The largest class of phytochemicals, polyphenols, have the ability to reduce, chelate metals, and act as antioxidants.Antioxidants boost immunity, minimize metabolic syndrome, retard aging, and promote overall health. Polyphenols possess bioactive traits ranging from antiviral, anticarcinogenic, anti-inflammatory, and neuroprotective effects. Little millet is exceptional because of its high PUFA content.
- Little millet is high in cholesterol and strengthens the body when taken. It also promotes healthy cholesterol in the body, making it ideal for growing children.
- The complex carbohydrates in little millets break down gradually, making them ideal for people suffering from diabetes.
- High phosphorus content (220 mg/100 g) in little millet is beneficial for repairing tissues, weight loss and energy production after vigorous physical activity.
- It also aids in the body's detoxification.
- Asthma and other respiratory conditions are reported to be treated by little millet.
- Little millet does not consist of gluten. It is an ideal substitute for people who choose to stick to a gluten-free diet or who have celiac disease or gluten-sensitive enteropathy.

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**Fig.2 Health Benefits Of Little Millet**

**Conclusion and future recommendations:**

Millets have significant potential to become staple food crops over the world, particularly in developing nations, due to their ease of availability and broad distribution, as well as the presence of a vast variety base. Millets outperform basic food crops like as wheat and rice in harsh climatic circumstances in arid and semi-arid locations with limited water supplies and difficult soils.

Millet crops are an inexpensive source of high-quality proteins, macro and micronutrients, minerals, and organic compounds, all of which are essential for good physical and mental growth. Millets are a godsend in the fight against malnutrition, food insecurity, and climate change because they provide a variety of health benefits, including the avoidance of many common and deadly diseases. However, in order to fully realize the untapped potential, people must be educated about the health benefits of millets, and farmers should be pushed to plant more millets by offering incentives. Millets' health and nutritional benefits should be advertised and marketed effectively. Governments should work together to boost millet consumption per capita in order to reduce expenditures for diseases caused by malnutrition. Millets can be regarded a superfood, full of essential nutrients, and a cure-all for a variety of diseases. Millets plays important role in the Bakery Industry-

- **Nutritional Enhancement**:The baking industry frequently relies on refined wheat flour, which lacks the nutritious value of whole grains. Adding millets to bread, biscuits, muffins, and other baked goods not only improves their nutritional content but also gives a distinct flavor and texture.
- .**Gluten-Free Alternatives:** With the growing knowledge of gluten intolerance and celiac disease, millets are good gluten-free alternatives to traditional grains. This keeps taste and texture intact while enabling people with dietary restrictions to enjoy a wide range of bakery products.
- **Sustainability:** Millets are tolerant crops that require little water and thrive in arid and semi-arid climates. By encouraging millet planting, the baking business may help to promote sustainable agriculture and protect water resources.
- **Diversification:** Millets have a variety of textures and flavors, making them ideal for experimenting with different bread creations. From crunchy cookies prepared with finger millet flour to soft bread made with sorghum, millets bring new ideas to the bakery aisle.

**Future recommendations:**

2023 is designated as the International Year of Millet. India, as a pioneer in millet cultivation and consumption, is well-positioned to shape the world baking industry's future direction. Here are some major ways.

- **Research and Development:**The Indian government, in conjunction with academic institutes and the commercial sector, is funding research to create millet-based baking goods that fulfill international quality and safety requirements.
- **Policy Support**: India has established a number of initiatives to promote millet production and consumption, including incorporating millets into the Public Distribution System and the National Food Security Act. These rules not only encourage healthy eating, but they also ensure a steady market for millet crops.
- **Education and Awareness:**Public awareness efforts are being launched to educate people about the health advantages of millets and encourage their inclusion in regular meals. Bakeries are also urged to educate customers on the benefits of millet-based goods.
- **Global Export Potential:**India is boosting its exports of millet-based baking items to overseas markets, particularly in places where there is a rising need for gluten-free, healthful solutions. The government intends to become a global leader in the manufacture and export of millet-based baked products.

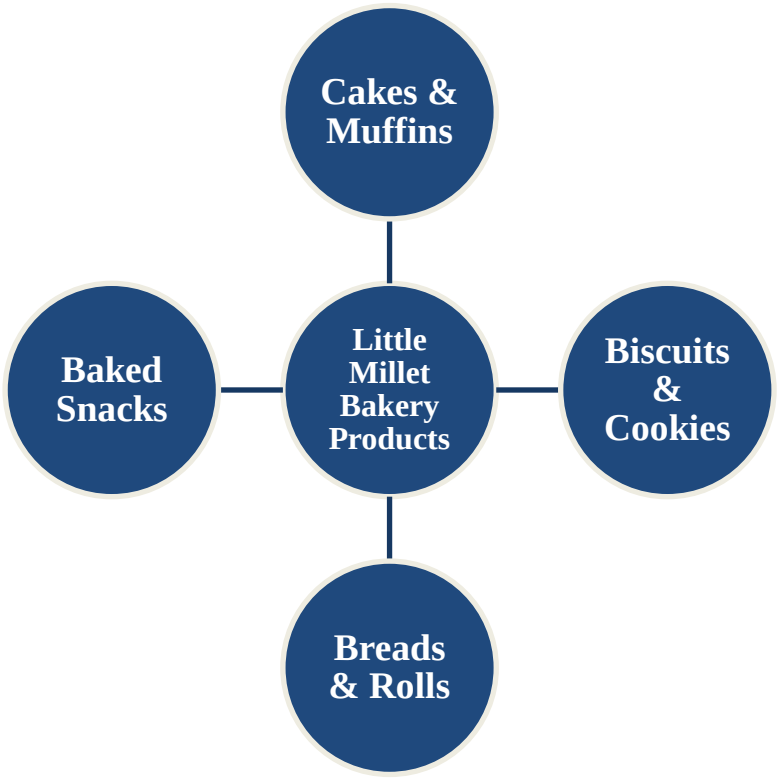


**Fig.3 Value added bakery products made from little millet**

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