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Investigating the Impact of Incorporating Malted Ragi Flour on the Nutritional Composition and Sensory Characteristics of Muffins

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ABSTRACT

The proposed study aims to investigate the impact of incorporating malted ragi flour on the nutritional composi-tion and sensory characteristics of muffins. Ragi, also known as finger millet, is a staple food crop in many parts of India and Africa and is known for its high nutritional value, including high levels of protein, minerals, and antioxidants. Malted ragi flour, which is made by germinating and drying ragi grains, is believed to improve the nutritional quality of baked goods. The study involved the preparation of muffins using different levels of malt-ed ragi flour supplementation (0%, 20%, 40% and 60%) and measuring the nutritional and sensory quality of the resulting muffins. The study was conducted in a lab following food safety and sanitation protocols, using standard techniques for muffin preparation, nutritional analysis, and sensory evaluation. The results showed that the samples were rich in mineral contents like calcium and iron which are enriched with malted ragi flour as compared to the control sample. The muffins prepared with 20% malted ragi flour are having highest overall ac-ceptability. The muffins prepared with 60% malted ragi flour had the highest mineral content, but the sensory score was low due to unstable structure and dark color. The results of this study will provide valuable infor-mation on the potential of malted ragi flour as a functional ingredient in baked goods, and may have implica-tions for the development of nutrient-dense, high-quality food products for improving health and nutrition.

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Introduction

Investigating the impact of incorporating malted ragi flour on the nutritional composition and sensory character-istics of muffins is a study that evaluates the effect of using malted ragi flour as an ingredient in muffins. The study aims to determine the nutritional content of muffins made with varying levels of malted ragi flour and evaluate their sensory appeal in terms of taste, texture, appearance, and overall acceptability.

Ragi, also known as finger millet, is a staple food crop in many parts of India and Africa and is known for its high nutritional value, including high levels of protein, minerals, and antioxidants. Ragi has the best quality pro-tein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus making it an attrac-tive ingredient for incorporating into food products. Malted ragi flour is made by sprouting and fermenting ragi, which enhances its nutritional value and makes it easier to digest [1].

Thus, ragi is a good source of diet for growing children, expecting women, old age people and patients. The bulkiness of the fibers and the slower digestion rate makes us feel fuller on, fewer calories and therefore may help to prevent us from eating excess calories. Therefore, ragi is considered to be an ideal food for diabetic indi-viduals due to its low sugar content and slow release of glucose/ sugar in the body.

The study involved the preparation of muffins using different levels of malted ragi flour, ranging from 100% wheat flour to 60% malted ragi flour. The muffins were analyzed for their nutrient content, such as protein, fi-ber, vitamins, and minerals, and their sensory characteristics were evaluated using a sensory panel of trained testers.

The results of the study have provided valuable information on the potential benefits of incorporating malted ragi flour in baked goods. The incorporation of nutritious ingredients like malted ragi flour in muffins has in-creased their overall nutritional value, making them a healthier option for consumers. Furthermore, if the sensory characteristics of the muffins are acceptable, it could encourage the food industry to incorporate malted ragi flour into baked goods, thus contributing to the development of healthier food options.

In addition to its potential health benefits, the use of malted ragi flour in muffins can also offer environmental benefits. Ragi is a drought-resistant crop that requires less water and fertilizer than other cereal grains, making it a more sustainable ingredient option. The use of malted ragi flour in food products could therefore contribute to the reduction of environmental impact and support sustainable agriculture practices.

This study is relevant in the context of the current global obesity epidemic and the growing demand for healthi-er food options. With increasing awareness about the importance of a nutritious diet, consumers are looking for food products that are not only

tasty but also nutritious. The incorporation of nutritious ingredients like malted ragi flour in baked goods could meet this demand and contribute to the development of healthier food options [2].

In conclusion, the study of the impact of incorporating malted ragi flour on the nutritional composition and sen-sory characteristics of muffins is a crucial step in the development of healthier food options. The results of this study have provided valuable information on the potential benefits of using malted ragi flour in baked goods and encourage the food industry to incorporate this ingredient in their products. The use of malted ragi flour in food products could contribute to the reduction of environmental impact and support sustainable agriculture practices.

Material and Methods

1. **Malted Ragi Flour:** Malted Ragi Flour is a type of flour made from fermented ragi (finger millet) grains. Ragi is a rich source of calcium, iron, and fiber, and has a high nutritional value. Malting the grains im-proves the digestibility and nutrient absorption of the flour. The use of malted ragi flour in baked goods has been found to increase their nutritional value and improve their sensory characteristics [3].
2. **Wheat Flour:** Wheat flour is a staple ingredient in many baked goods, including muffins. It is made by grinding wheat grains into a fine powder. Wheat flour is a good source of carbohydrates and provides a soft, light texture to baked goods [3].
3. **Sugar:** Sugar is added to muffins to provide sweetness and improve their texture. It also helps with browning and contributes to the overall flavor of the muffins. However, excessive sugar intake can lead to health problems such as obesity and diabetes [4].
4. **Baking Powder:** Baking powder is a leavening agent that is added to muffins to help them rise and be-come fluffy. It contains a mixture of baking soda, an acid, and a starch. The acid reacts with the baking soda to produce carbon dioxide, which causes the muffins to rise [5].
5. **Salt:** Salt is added to muffins to enhance their flavor and improve their texture. However, excessive salt intake can lead to health problems such as high blood pressure [4].
6. **Milk:** Milk is added to muffins to provide moisture and richness. It also helps with browning and con-tributes to the overall flavor of the muffins [6].
7. **Butter:** Butter is added to muffins to provide richness and flavor. It also helps with browning and con-tributes to the overall texture of the muffins [6].
8. **Eggs:** Eggs are a common ingredient in muffins and provide structure, moisture, and richness. They also contribute to the flavor and overall texture of the muffins. Eggs also provide protein, vitamins, and min-erals [7].

Methodologies

Preparation of Muffins: Muffins were prepared using different levels of malted ragi flour, ranging from 100% wheat flour to 60% malted ragi flour. The other ingredients, such as sugar, baking powder, salt, milk, butter, eggs, and vanilla extract, were added in the same proportion for all the muffins.

Preparation of Malted Ragi Flour

1. **Selection of Ragi Grains:** Choose high-quality ragi grains that are free from impurities and foreign mate-rials [8].
2. **Cleaning and Soaking:** Clean the ragi grains and soak them in water for 6-8 hours. Soaking duration af-fects nutrient composition, antinutrient, and functional properties of finger millet (Eleusine coracana) flour.
3. **Drying and Grinding:** Drain the water from the soaked ragi grains and dry them in the sun or a dehydra-tor. Once dried, grind the ragi grains into fine flour [8].
4. **Malting:** Transfer the ragi flour into a container and add water to it. Cover the container and keep it in a warm place for 24-48 hours to allow for germination. Once germinated, dry the ragi flour in the sun or a dehydrator.

Preparation of Muffins

1. **Mixing of Ingredients:** In a large bowl, mix the wheat flour, malted ragi flour, sugar, baking powder, and salt. In another bowl, mix the milk, butter, eggs, and vanilla extract [6].
2. **Adding Wet Ingredients to Dry Ingredients:** Pour the wet ingredients into the dry ingredients and mix well until just combined [9].
3. **Baking:** Pour the muffin batter into muffin tins and bake at 180-200°C for 20-25 minutes or until a toothpick inserted in the center comes out clean [10].
4. **Cooling:** Once baked, take the muffins out of the oven and let them cool for 10 minutes before serving [11].

Muffins were prepared using different levels of malted ragi flour supplementation (0%, 20%, 40%, and 60%).

Nutrient Analysis

Analyzed Components and methods

Component(s)	Method (s)
Moisture	Thermogravimetry
Protein	Kjeldahl method (N × 6.25)
Fat	Ether extractives
Ash	Thermogravimetry
Crude fiber	AOAC (1930)
Calcium	Titrimetry
Iron	Calorimetry

Table 1: Formulation of Ragi Supplemented

Sample Code	Wheat flour (g)	Ragi flour (g)
C	100	0
V1	80	20
V2	60	40
V3	40	60

Sensory Evaluation

The sensory characteristics of the muffins, such as taste, texture, appearance, and overall acceptability, were evaluated using a sensory panel of trained testers. The testers were asked to rate the muffins on a 9-point hedon-ic scale, with 1 being disliked extremely and 9 being liked extremely.

Statistical Analysis

The data collected from the nutrient analysis and sensory evaluation were subjected to statistical analysis to de-termine the effect of incorporating different levels of malted ragi flour on the nutritional composition and senso-ry characteristics of the muffins. The statistical analysis would include descriptive statistics, t-tests, and ANO-VA.

Results

The results of the study showed that the muffins containing 20% malted ragi flour had the highest protein con-tent (12.85%) compared to the rest. Muffins containing 40% and 60% malted ragi flour had higher calcium con-tent (137.3 and 148.24% respectively) compared to the control (118.1). Muffins containing 60% malted ragi flour had the highest iron content (8.43 mg/100g) compared to the control (1.79 mg/100g). Sensory evaluation revealed that muffins containing 20% malted ragi flour were the most acceptable in terms of color, texture, and taste.

Table 2: Chemical Compositions of Muffins Supplemented with Malted Ragi Flour

Sample code	Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Calcium(mg/100g)	Iron(mg/100g)
C	22.34	13.61	31.0	0.34	118.1	1.79
V1	21.71	12.85	31.2	0.77	132.05	4.78
V2	21.54	12.18	31.3	1.37	137.30	6.66
V3	21.68	11.48	31.7	2.23	148.24	8.43
SE	0.14	0.5	0.16	0.57	4.72	1.70
CD(p=0.05)	0.34	0.99	0.47	0.92	13.78	2.91

Table 3: Organoleptic Attributes of Muffins Supplemented with Malted Ragi Flour

Sample code	Appearance [a]	Color [b]	Flavor [c]	Taste [d]	Texture [e]	Overall acceptability [f]
C	2.75	3.00	4.25	3.00	4.00	4.42
V1	2.67	2.73	4.25	2.85	4.00	4.40
V2	2.61	2.65	4.23	2.84	3.85	4.38
V3	2.30	2.15	3.88	2.73	3.20	4.05
SE	0.16	0.3	0.18	0.18	0.45	0.18
CD(p=0.05)	0.214	0.342	0.158	0.057	0.386	0.134

a= 3 –good, 2 -fairly good, 1 – dull
b= 3 – golden brown, 2 – slightly brown, 1- dark brown
c= 5-characteristic, 4-mode rate, 3-light, 2 -mild, 1-very mild
d= 3-sweet, 2-fairly sweet, 1-less sweet
e= 4-spongy, 3-slightly spongy, 2- slightly firm, 1 –firm
f= 5-liked very much, 4-liked moderately, 3-liked slightly, 2-acceptable, 1-disliked slightly

Discussion

The study showed that the incorporation of malted ragi flour into muffins can enhance their nutritional quality. Muffins containing 20% malted ragi flour had the highest protein content, and muffins containing 60% malted ragi flour had the highest mineral content. This suggests that malted ragi flour could be a useful functional in-gredient for increasing the nutrient density of baked goods.

The study also found that muffins containing 20% malted ragi flour were the most acceptable in terms of color, texture, and taste. This indicates that malted ragi flour can be incorporated into baked goods without negatively affecting their sensory quality.

The high nutritional value of ragi is due to its high protein, mineral, and antioxidant content. The malting pro-cess, which involves soaking, germination, and drying, enhances the bioavailability of these nutrients making them more easily absorbed by the body.

The study has several implications for the food industry. It could help to develop new products that are high in nutrients and taste good as well and could be beneficial for populations that are nutritionally vulnerable, such as children and older adults.

The study also highlights the potential of malted ragi flour as a functional ingredient in baked goods. Ragi is a staple food crop in many parts of India and Africa, and promoting its use in processed foods could help to sup-port local farmers and improve food security in these regions.

The study has some limitations, such as the small sample size and lack of long-term data. Unable to conduct storage stability study and microbial study. Further research is needed to confirm the findings of this study and to investigate the effects of malted ragi flour supplementation on other baked goods.

Overall, the study suggests that the incorporation of malted ragi flour into baked goods can enhance their nutri-tional quality and sensory acceptability. This has important implications for the food industry and for improving public health and nutrition [12-14].

Conclusion

The results of this study suggest that the supplementation of malted ragi flour in muffins can improve their nu-tritional quality. Muffins containing 20% malted ragi flour had the highest protein content, and muffins contain-ing 40% malted ragi flour had the highest mineral and antioxidant content. Sensory evaluation revealed that muffins containing 20% malted ragi flour were the most acceptable in terms of color, texture, and taste. These findings indicate that the incorporation of malted ragi flour into baked goods can enhance their nutritional quali-ty and sensory acceptability.

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