

Sensory Characteristics of Standardized Gluten Free Black Rice Biscuit Incorporated with Little Millet

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Abstract

Black rice biscuit incorporated with little millet (BRB-LM) presents a promising avenue for enriching snack foods with nutrients. This study aimed to evaluate the sensory characteristics of biscuits based on a combination of black rice flour and little millet flour. The semi trained panelist are involved in sensory evaluation using nine-point hedonic scale and focused on attributes such as Appearance, texture, color, taste and overall acceptability. Statistical analysis, using one-way ANOVA, is conducted to compare the three different formulations (Black rice flour + Little Millet flour) 7:3 (T1), 3:2 (T2), and 1:1 (T3) respectively. The results showed that the combination of black rice flour and little millet flour significantly influenced the sensory characteristics of the biscuits. Among the three formulations, T3, with 50% black rice flour and 50% little millet flour, emerged as the preferred option across all sensory variables, including appearance, texture, color, taste and overall acceptability. This suggests that incorporating little millet flour into black rice biscuits not only enhances their nutritional value but also improves their sensory appeal, making them a potentially popular and nutritious snack choice.

Key words: Black rice biscuit, Little millet, Sensory evaluation, Texture, Color, Aroma, Taste

In recent years, the food industry has experienced rapid growth in Ready-to-Eat Convenience snacks, which have attracted consumers for their convenience. These products are popular for their appealing qualities, reasonable prices, taste, appearance, and texture. Ready-To-Eat (RTE) products include a wide range of options, such as sweet, salted, fried, canned, fast, baked, dried, or preserved foods, with diverse formulations. In the traditional cereal consumption landscape, various foods like bakery items, extruded foods, instant snacks, fast food, breakfast cereals, biscuits, and bars have been prevalent. Cereals and pulses are crucial in producing RTE food products [1].

The term "biscuit" comes from the Latin words "bis" and "coctus," enjoyed by a wide range of people for their various flavors, long shelf life, and affordability, can be considered a type of confectionery with low moisture content. Typically eaten with tea or coffee, simple biscuits are made from basic ingredients such as wheat flour, water, sugar, fat, and eggs. These ingredients are combined into dough, with the option of adding additional ingredients as needed [2]. Rice is a staple food in many countries, and the rising popularity of black rice is particularly noteworthy. It is now being consumed more widely as a functional food, appreciated for its health promoting properties [3]. Rice, scientifically known as *Oryza sativa* L. and a member of the Poaceae family, is a staple food for approximately two-thirds of the world's population, earning it the title of the "queen among cereals" [4]. Black rice, known for its black bran covering the rice kernel's endosperm, includes

varieties like the aromatic and pigmented 'Chakhao,' which has become popular in Asia. The demand for this unique rice variant is increasing in India and globally due to its perceived health benefits. Unlike being a staple food, it is consumed as a functional food because of its high anthocyanin content, a key bio-active compound [5]. Black rice is also referred to as purple rice, forbidden rice, heaven rice, imperial rice, king's rice, and prized rice. It is notable for being a rich source of fiber and an excellent plant-based protein provider, containing the highest amount of antioxidants, protein, and dietary fiber among all rice varieties. Black rice has become increasingly popular recently due to its many health benefits. It can help prevent and manage conditions such as heart disease, cancer, diabetes, and high blood pressure, leading to an improved quality of life [3].

On the other hand, little Millet, a traditional Indian crop, is highly regarded for its rich nutritional content, making it popular among health-conscious individuals. Little Millet, also known as Samai, plays a crucial role in the Indian diet, providing valuable nutraceuticals and micronutrients with medicinal properties. Recognized for its health benefits, this minor cereal, *Panicum sumatrense*, contains bioactive compounds like phenolic compounds, tocopherols, and carotenoids. With a low glycemic index, it is particularly beneficial for diabetic patients. Rich in phosphorus and fiber, Little Millet aids in reducing body fat. Its antioxidant properties and low-calorie content contribute to maintaining a balanced diet and supporting weight loss efforts [6]. These tiny gluten-free grains are an ideal addition to the diets of individuals

engaged in yoga, workouts, and cardio due to their non-acid-forming nature [7]. Here, the present study is planned to evaluate the sensory attributes (appearance, Color, taste, texture, and overall acceptability) of standardized gluten-free black rice biscuits incorporated with varying levels of little millet using the 9-point hedonic scale.



Fig 1 Black rice [8]



Fig 2 Little millet [9]

MATERIALS AND METHODS

Selection and procurement of ingredients

All the ingredients required for the study such as Black rice, little millet, Country sugar, Butter, Baking soda and Vanilla essence are procured from the local market from Pammal, Chennai.

Processing of black rice flour

The black rice was first cleaned to remove any dirt and debris, then dried. Next, it was firmly roasted in a pan before being ground into flour at a mill. Finally, the flour was packed, sealed, and stored.

Processing of little millet flour

The little millet was cleaned to remove dirt and debris, then dried. It was firmly roasted in a pan and ground into flour at a mill. Finally, the flour was packed, sealed, and stored.

Processing of brown sugar

Brown sugar is taken and powdered in a mixer.



Fig 3 Method of preparation of biscuits



Fig 4 Different treatments of biscuits

Table 1 Different proportions of ingredients

Treatment	Black flour (G)	Rice	Little millet flour (G)	Country sugar (G)	Sodium bicarbonate (G)	Butter (G)	Vanilla Essence (ml)
Control	100	-	-	100	5	100	1
T1	70	-	30	100	5	100	1
T2	60	-	40	100	5	100	1
T3	50	-	50	100	5	100	1

A consumer acceptability test was conducted with a semi-trained panel consisting of 30 members to evaluate differences among similar food products and assess the intensities of taste, texture, color, and appearance characteristics. Standardized biscuits were assessed using a 9-point hedonic scale by the 30 panelists. The third treatment

product (T3) was specifically evaluated for color, taste, texture, appearance, and overall acceptability. To prevent carryover effects, panelists were provided with a glass of water to rinse their mouths between samples. The panelists responses were recorded and tabulated.

Table 2 Mean and standard deviation scores of control and treatment group

Sensory attributes	Appearance	Colour	Taste	Texture	Overall acceptability
Control	8.4±0.62	8.46±0.57	7.83±0.64	7.8±0.92	8.0±0.85
T1	5.2±0.80	6.13±0.68	5.46±0.57	5.7±0.53	5.73±0.52
T2	5.56±0.50	5.9±0.74	5.9±0.71	6.53±0.62	6.36±0.61
T3	8.56±0.50	8.6±0.49	8.66±0.54	8.46±0.62	8.66±0.47

RESULTS AND DISCUSSION

Sensory evaluation is a critical scientific method used to assess products based on taste, smell, touch, and sight. Food quality, essential for consumer choices, relies heavily on sensory evaluation. It ensures food quality, helps develop products, and meets consumer preferences. In a study comparing a control Black rice biscuit (C) and three treatment biscuits (T1, T2, T3), Treatment III (T3) showed significantly higher acceptability scores for appearance, color, taste, texture, and overall acceptability compared to the other treatments, scoring 8.56, 8.6, 8.66, 8.46, and 8.66, respectively.

1) Appearance

The sensory evaluation scores for the “Appearance” attribute were recorded for a control group and three treatment groups (T1, T2, T3). Each score is presented as a mean value with a standard deviation. T1 and T2 received lower scores, indicating that their appearance was less favorable compared to the control. In contrast, T3 received a higher score, suggesting that the changes made in T3 potentially improved the product’s

appearance compared to the control. These findings provide valuable insights into consumer perceptions of the product’s appearance, which can help in making adjustments to meet aesthetic preferences and enhance overall consumer acceptance.

2) Colour

Color is a key characteristic of food products that significantly influences consumers’ attention and serves as an indicator of whether they will like the product or not. The data presents sensory evaluation scores for the “Colour” attribute across different samples, including a control group and three treatment groups (T1, T2, T3). Each score is represented as a mean value with a standard deviation. T1 and T2 received lower scores, indicating that their color was perceived less favorably compared to the control. In contrast, T3 received a higher score, suggesting that the changes made in T3 potentially improved the product’s color compared to the control, likely due to the increased concentration of little millet flour. The ash content of the black rice biscuit incorporated with little millet was high, approximately 1.95, which is also thought to influence the color of the biscuits.

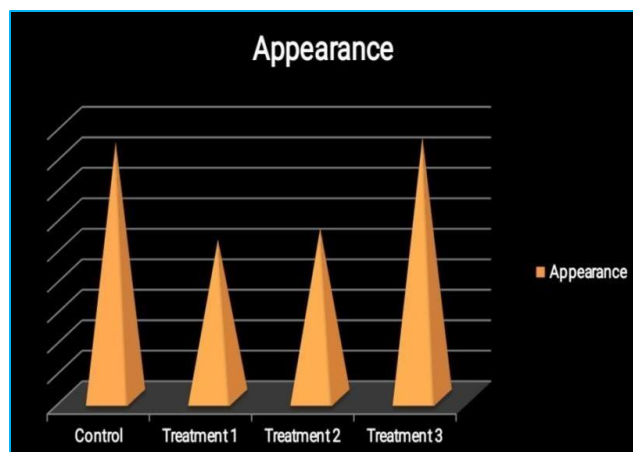


Fig 5 Appearance of control and treatment Biscuits

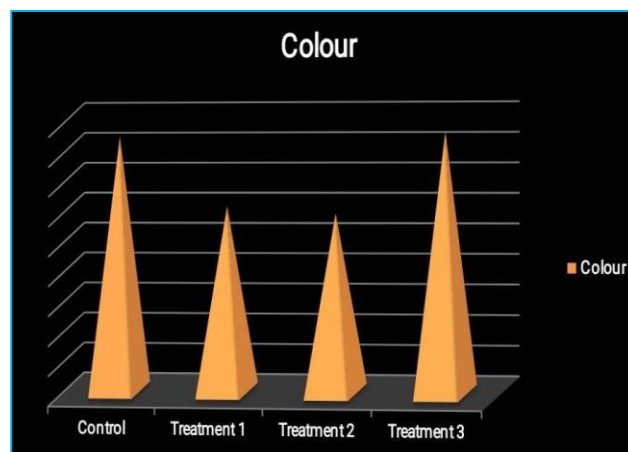


Fig 6 Colour of control and treatment Biscuits

3) Taste

The sensory evaluation scores for the “Taste” attribute show significant differences among the samples, including a control group and three treatment groups (T1, T2, T3). Specifically, T3 stands out with a taste score of 8.66 ± 0.54 ,

indicating a more favorable taste evaluation compared to T1, T2, and the control. This improvement in taste in T3 suggests that the modifications made in this treatment group have positively impacted the taste profile.

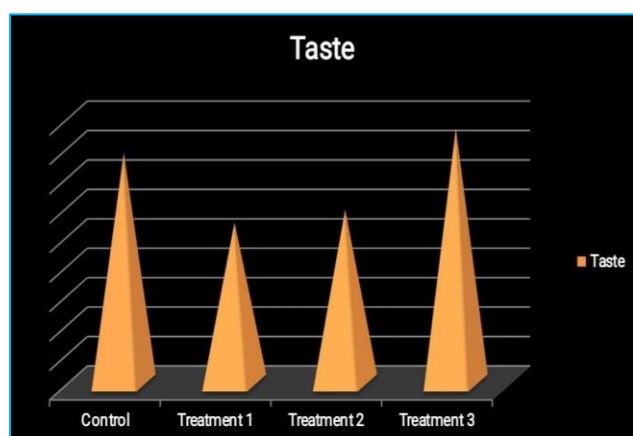


Fig 7 Taste of control and treatment biscuits

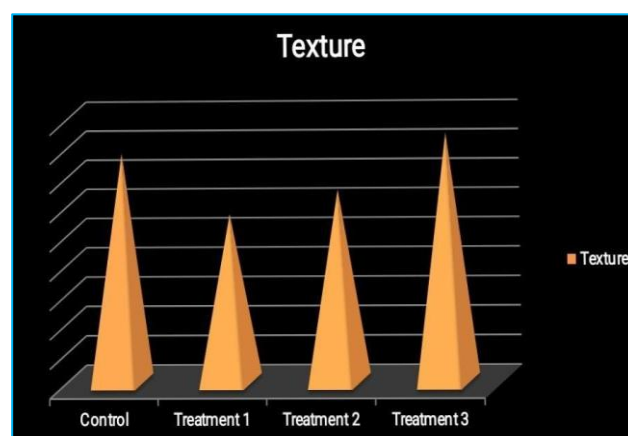


Fig 8 Texture of control and treatment biscuits

4) Texture

The sensory evaluation scores for the “Texture” attribute show significant differences among the samples, which include a control group and three treatment groups (T1, T2, T3).

Particularly, T3 stands out with a superior texture, with a mean score and standard deviation of 8.46 ± 0.62 , indicating a more favorable assessment compared to T1, T2, and the control.

5) Overall acceptability

It was observed that T3 received the highest mean score (8.66 ± 0.47), compared to T1 (5.73 ± 0.52), T2 ($6.36 \pm$

0.61), and the Control (8.0 ± 0.85), indicating that T3 was preferred by the panelists based on the mean scores and standard deviations.

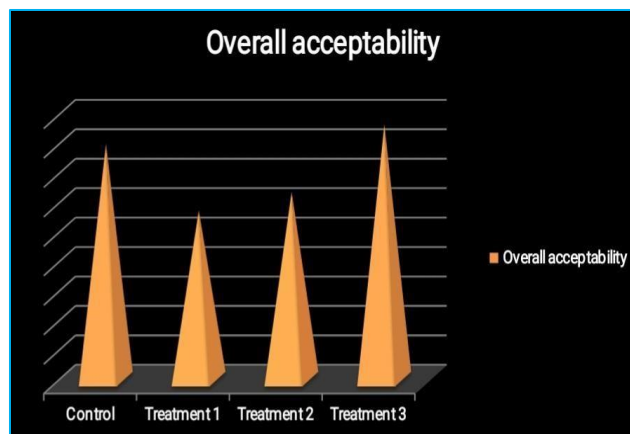


Fig 9 Overall acceptability of control and treatment biscuits

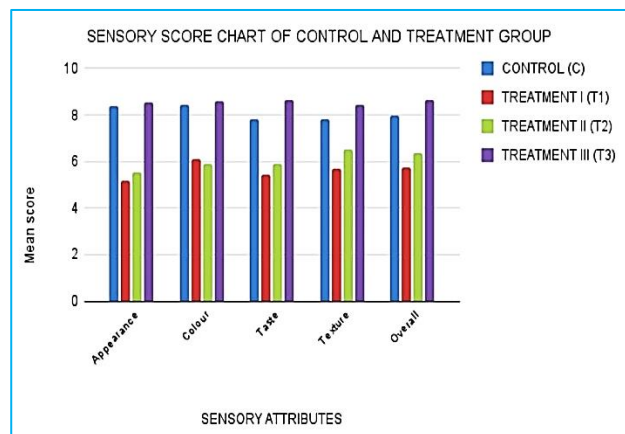


Figure 10: Sensory score chart of control and treatment group

The results of statistical tests indicated a significant difference in the overall acceptability of black rice flour biscuits incorporated with mung bean flour. This suggests that black rice

biscuits with a ratio of 40% black rice flour and 40% mung bean flour achieved the highest level of acceptability among the tested variations [10].

Table 3 Statistical inference of control and Treatment III

Sensory attributes	Types	Mean	Standard deviation (SD)	t - value [d.f/v=19 (n-1)]	(0.05%)
Appearance	Control	8.40	0.62	0.258	
	Treatment III	8.56	0.50		
Colour	Control	8.46	0.57	0.339	
	Treatment III	8.60	0.49		
Taste	Control	7.83	0.64	1.370	
	Treatment III	8.66	0.54		
Texture	Control	7.80	0.92	0.0018	
	Treatment III	8.46	0.62		
Overall acceptability	Control	8.03	0.85	0.0007	
	Treatment III	8.66	0.47		

*t-value indicates that significant difference at 5% level significance

The t-values for appearance and color are 0.258 and 0.339, respectively, indicating no significant difference between the groups. However, for taste, texture, and overall acceptability, the t-values are 1.370, 0.0018, and 0.0007 respectively, suggesting a significant difference between the groups. These results indicate that modifications made to the treatments had a noticeable impact on taste, texture, and overall acceptability compared to the control group.

CONCLUSION

The study on gluten-free black rice biscuits with little millet highlighted treatment III superior taste, texture, and

overall acceptability compared to the control group, showcasing the formulation's potential for high-quality, nutritious biscuits. These biscuits are not only palatable but also rich in fiber, suitable for individuals with celiac disease and diabetes. Additionally, they are rich in iron, calcium, and vitamin B₁₂, offering benefits for iron deficiency and neurological disorders. This ready-to-eat, cost-effective option provides convenience while meeting various dietary needs and offering numerous health benefits. Incorporating little millet flour into black rice biscuits not only boosts their nutritional value but also enhances their sensory appeal, potentially making them a popular and nutritious snack choice.

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