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**FORMULATION OF FERMENTED BLACK RICE MUFFIN****Govindh M<sup>1</sup>, Dr. Sindhu S<sup>2</sup>**<sup>1</sup>Student, Department of Food Processing Technology, PSG College of Arts & Science,  
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**ABSTRACT**

Muffins are small cakes highly appreciated by consumers owing to its sweet taste, soft, moist crumb and chewy texture making it suitable for snacks. However, consumers always demand for foods that not only satisfy their hunger but also provide the essential nutrients to ensure physical and mental health by preventing nutrient deficiency. This research study has been designed with an objective to formulate muffin incorporated with black rice with sour starter culture and method of preparation to quench the demand. Black rice flour was substituted in the control muffin at 60, 50 and 40 per cent in wheat flour and designated as Variation 1, 2 and 3 respectively. The formulated control and black rice sour starter muffins were subjected to sensory evaluation using a 9 point Hedonic Scale. The sensory properties like colour and appearance, taste, flavour, texture and the overall acceptability of the muffin were assessed and the scores were statistically analysed using mean and standard deviation to find the most acceptable variation. It was observed that variation 2 containing 50% of the black rice flour muffin was highly acceptable in all sensory characteristics.

**Keywords:** Bakery, sour starter, black rice, muffin, nutrients

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**1. INTRODUCTION**

Baked products are one of the energy - dense, convenient foods with inflated demand (Sheikh *et al*, 2023). It holds an important part in the human diet, widely accessible, providing a good quantity of macronutrients and minerals (Gherghina *et al*, 2015). Muffins are small cakes highly appreciated by consumers due to their sweet taste and soft, moist crumb and chewy texture making it suitable for breakfast, brunch and snacks. Muffins are fat in water emulsion obtained from an egg-sugar-water-fat mixture as a continuous phase, air bubbles represent a discontinuous phase and the refined flour is in a dispersed phase. Muffins are usually loaded with sugar and fat and lack essential nutrients like protein, fibre and healthy fats. However, consumers always demand for foods that not only satisfy their hunger, nonetheless it also provides the essential nutrients to ensure physical and mental health by preventing nutrient deficiency and nutrient related disease. Hence, the consumers' preferences were shifted to alternate and innovative choices of nutrient -dense ingredients in bakery products without comprising the traditional method of manufacturing and quality of the finished product (Moldovan *et al*, 2023 and Lădaru *et al*, 2021). In this context, this research study has been designed with an objective to formulate muffin incorporated with traditional food ingredients and method of preparation to quench the demand. Black rice is an indigenous food ingredient that has been considered as a functional food due to the presence of flavonoids particularly anthocyanin, phenolics, fibre, vitamins and minerals which helps to prevent non-communication diseases (Vamshipriya, 2022). Sourstarter fermentation is one of the traditional ways adopted to make bakery foods which comprises a complex food ecosystem of yeasts and lactic acid bacteria (Akamine *et al*, 2023). Products prepared using sour starter fermentation promise better sensory characteristics, enhanced shelf life, nutrient content and improving gut health (Graça *et al*, 2021) .

**2. METHODOLOGY****2.1 Selection of ingredients and its pre-preparation**

The ingredients selected for the study include black rice, wheat flour, egg, butter, baking powder, chocolate powder, cocoa powder and vanilla essence were procured from the local shops of Coimbatore, Tamil Nadu.

The black rice was cleaned and soaked (5 to 6 hours), dried and ground into flour using a hammer mill. The flour was sieved (US 80 mesh) and used for the formulation of muffins. A sour starter culture was prepared with equal amounts of wheat flour, black rice flour, kneaded to a dough using water and allowed to rest in a sterilized glass jar for 10 to 12 hours for natural fermentation. The process was repeated for three - four times to improve fermentation and used for the formulation of black rice muffin.

**2.2 Preparation of sour starter muffin**

A control muffin was prepared by using refined flour without sour starter culture since commercial muffins were prepared without the addition of sour starter culture. Initially, butter (35 %) was creamed to a fluffy texture and sugar

powder (60 %) was added and creamed till white and fluffy. Egg (1 no) was whipped until it formed a stiff peak and vanilla essence was added. It was added to the butter-cream mixture part by part and beaten well. The refined flour (100 %), baking powder (3 %), chocolate powder (40 %) and cocoa powder (45 %) were sieved to remove lumps and enhance aeration and fine texture. The mixed dry ingredients were added to the cream-egg mixture part by part and folded to make a thick batter. This homogenous batter was then poured in dusted muffin pans and baked at 180°C for 30 - 40 minutes.

To prepare black rice flour sourstarter muffin, black rice flour was substituted in the control muffin at 60, 50 and 40 per cent in refined flour and designated as Variation 1, 2 and 3 respectively. The batter was prepared with the same ingredients as of control. However, the sourstarer culture (25 %) was added to the final batter and left for fermentation for a period of one hour at room temperature. After proofing, the fermented batter was poured in muffin mould and baked.

The steps involved in the production of black rice sour starter muffin .The steps involved in the production of black rice sour starter muffin is presented in figure 1.

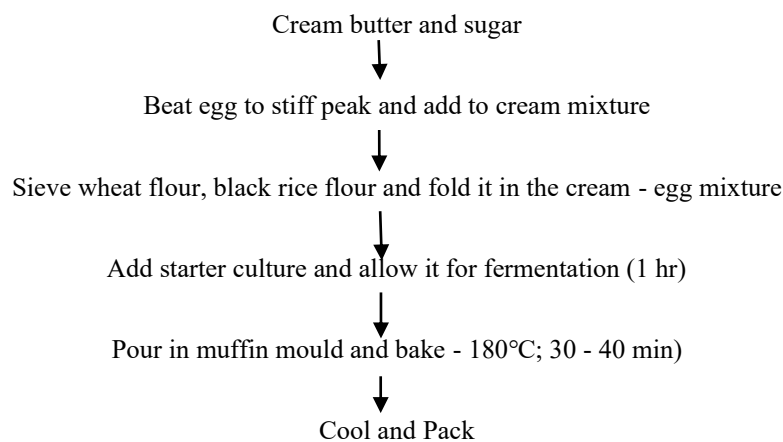


Figure 1

### Processing of black rice sour starter muffin

#### 2.3 Sensory Analysis of the formulated muffin

The formulated control and black rice muffins were subjected to sensory evaluation using a 9 point Hedonic Scale ranging from 1 (dislike extremely) to 9 (like extremely) by a panel of 20 semi-trained members. The sensory properties like colour and appearance, taste, flavour, texture and the overall acceptability of the muffin were assessed and the scores were statistically analysed using mean and standard deviation to find the most acceptable variation.

#### 2.4 Calculation of cost of the formulated muffin

Cost analysis was made to find the price of the product for marketing. The standard cost of the wheat flour, black rice, sugar, cocoa powder, chocolate powder, butter and egg was utilised from the local market where the ingredients were purchased. In addition, the cost of the packaging material, production charges and profit were included to know the selling price of the product.

## 3. RESULTS AND DISCUSSION

### 3.1 Mean scores of sensory evaluation of the formulated muffins

The mean scores of the sensory evaluation of the formulated muffins are presented in Table I.

Table 1 : Mean scores of the sensory evaluation of the formulated muffins

Criteria	Control	Variation 1	Variation 2	Variation 3
Colour and appearance	7.10 ± 1.37	7.50 ± 1.60	<b>7.60 ± 1.37</b>	7.45 ± 1.46
Texture	6.50 ± 1.72	6.75 ± 1.90	<b>6.50 ± 1.96</b>	6.60 ± 1.95
Taste	6.80 ± 1.47	7.25 ± 1.86	<b>7.40 ± 1.53</b>	7.25 ± 1.78
Flavour	6.50 ± 1.63	6.80 ± 1.82	<b>7.05 ± 1.87</b>	7.05 ± 1.82
Overall acceptability	6.40 ± 1.42	6.89 ± 1.52	<b>7.05 ± 1.94</b>	6.83 ± 1.99

From Table I, it is evident that among the three variations of formulated black rice sour starter muffin, variation 2 containing 50% of the black rice flour muffin was highly acceptable in all sensory characteristics. It was observed that the colour and appearance of all the formulated muffins were dark brown and appealing; the texture became dry on increasing the quantity of black rice flour. Similar pattern was observed in taste and flavour of the formulated product.

Gomes *et al* (2022) developed a muffin by incorporating 10 percent green pea flour at 80 percent wheat flour and 10 percent whole wheat flour. The acceptability of the product was determined by the moisture and softness. The texture of the muffin was greatly increased by green pea flour. The attributes of colour, taste, texture and overall acceptance were evaluated, where muffins obtained scores higher than 7 (“moderately liked”), indicating good acceptance. Similarly, Yalcin *et al* (2021) incorporated Grape Seed Flour (GSF) in two different doses 7.5% and 15% to muffins prepared using whole wheat (*Triticum aestivum L.*) flour, whole siyez wheat (*Triticum monococcum L.*) flour, and whole oat (*Avena sativa L.*) flour and there was no significant differences between muffin samples ( $p > .05$ ) in various sensory attributes and the GSF added functional muffins were found to be acceptable according to sensory analysis results

### 3.2 Cost of the formulated muffin

Among the three variations, variation 2 - containing 50 percent black rice flour muffin costs Rs. 50 per 100 g which was found to be slightly higher than the commercially available muffins. This difference in price can be attributed to the incorporation of black rice flour which is more expensive than the typically used refined wheat flour. Hence, the developed sourstarter muffin offers good nutrient content including complex carbohydrates, B complex vitamins and minerals at an affordable cost than the muffins made using refined flour.

## 4. CONCLUSION

Muffins are a type of popular bakery item known for its taste. Incorporation of superfoods like black rice and addition of sour starter culture as a natural leavening agent adds variety to the muffins, brings the benefits of fermented foods, and curtails the use of chemical leaveners. Development and commercialization of such products adds value to regular muffins, thereby improving the demand for traditional, under-exploited grains which in turn increases its production. Such products would also satisfy the demand of the people who seek healthier options of bakery products enhancing their nutritional status. The study suggests the use of various traditional under-exploited grains for the development of bakery products and to ascertain its acceptability and quality characteristics for further research.

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