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Study on Formulation Development and Quality Evaluation of Muffins Incorporated with Ragi

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A B S T R A C T

Finger Millets (Ragi) is a gluten-free food, commonly used like porridge. Ragi being rich in minerals, dietary fiber and being the richest source of calcium it can be formulated in muffin. Therefore enhancing the nutritious value of the muffin. The present study is based on the formulation, development, and quality evaluation of ragi muffins. So, four different samples were taken for recipe standardization and the ratios are made with 5%, 10%, 15%, and 20% refined flour replacement with ragi flour. Finally prepared muffin were analyzed for physical properties, chemical properties and sensory attributes.

Introduction

Muffin, a cereal-based snack. Flour is the main ingredient to prepare muffins and gluten is the major protein constituent of wheat flour. Muffins should be very light, so light in fact that when one picks them up one is surprised that anything of their size should weigh so little. Ragi (*Eleusine coracana*) belongs to the family Gramineae and is commonly known as Finger millet or mandua, which is an important minor millet grown in India.

It is very nutritious with respect to minerals, dietary fiber, and essential amino acids. Amongst cereals, Ragi provides the highest level of calcium including antioxidants and phytochemicals. So, it is usually converted into flour and a variety of preparations. Several methods of processing of ragi have been developed to make the final product more attractive in flavor, appearance, taste, and consistency.

Statement of the problem

According to the National Research council, Millets are gluten-free since they are not a type of wheat, barley, or rye grain, the three groups of whole grains that naturally contain the protein gluten. Instead of containing gluten, Finger millet is rich in protein, iron, calcium, phosphorus, fiber, and vitamin content.

Finger millet is considerably rich in minerals specifically; it is the richest source of Calcium among cereals that is three times higher than brown rice, wheat, or maize and than that of milk.

It is also rich in iron and fiber, essential amino acids like lysine and methionine which are important in human health and growth. (Mc Donough *et al.*, 2000). Ragi is considered safe for those with a gluten allergy, easier for most people to digest, much less likely to cause negative reactions, and are "nontoxic."

Ragi is an ideal food for the obese because its digestion is slow due to which the carbohydrates take a longer time to get absorbed. By eating preparations made from ragi, the constant desire to eat is curbed, thus reducing calorie intake. At the same time, it supplies an abundant quantity of calcium, phosphorus, iron, vitamin B1, and B2 and prevents malnutrition in spite of restricted food intake. Tryptophan—an amino acid present in ragi—reduces excess appetite and helps to control weight gain.

Materials and Methods

The present study is carried out in the Department of food science and technology MGM College of Food Tech. (affiliated to V.N.M.K.V.), Parbhani.

The chemicals, glassware‟s and instruments required for the current entitled project were obtained from Department of Food Science and Technology, MGM college of Food Technology, Aurangabad.

Ragi flour, refined flour, sugar, shortening, baking powder, egg, milk were purchased from local market. The trial-based method was used to create the recipe.

Different variations were done and suitable was used to formulate the recipe. The independent variable for the experiment is the concentration of Ragi flour used to prepare muffins.

Formulation of a recipe

The recipe formulation for the ragi incorporated muffin was carried out. The muffin was made as per the recipe formulation and coded names A, B, C, and D were given to each recipe.

Preparation of Ragi flour

Ragi flour was ground with the help of a grinder. The ragi were powdered in the laboratory pulverized to a fineness that 90% of the powder passed through a 400 µ sieve. The flour obtained was sealed in a plastic container and stored at ambient conditions for further processing.

Preparation of Ragi flour incorporated muffin

In the present study, four different formulations of muffin were prepared. One formulation was prepared without Ragi flour (control) and another four were formulated with ragi flour at different levels. The first ingredients were divided into dry and wet ingredients.

The dry ingredients included refined flour, ragi flour, and baking powder. The wet ingredients were egg, oil, milk, and sugar. The egg was beaten for 2 min prior to addition of milk and oil. In a separate bowl, all dry ingredients were thoroughly mixed. Later, both dry and wet ingredients were combined to obtain mixed muffin batter.

The batter was filled in a paper muffin cup. The muffins were baked at 175ºC in the oven for 20±3 min

Physicochemical analysis

Moisture content

The moisture content of the sample was determined by a hot air oven at 100 ± 5°C to get constant weight. The same method was used by Ranganna, 1986.

Crude fat

The crude fat content of the samples was determined by solvent extraction method using Soxhlet apparatus and solvent petroleum ether.

Crude protein

The crude protein content of the samples was determined indirectly by measuring total nitrogen content by the micro Kjeldahl method. Factor 6.27 was used to convert the nitrogen content to crude protein as per Ranganna (1986).

Crude fiber

The crude fiber content of the samples was determined by fiber plus.

% of Crude Fiber = (W3 / W) x 100

Sample weight= W

CWBA = W1

CWAA = W2

W3 = (W1-W2)

Total ash

Total ash content of the samples was determined by following the method given by Ranganna (1986) using a muffle furnace.

Formula: final weight of sample /initial weight of sample *100

Carbohydrate

The carbohydrate content of the sample was determined by a different method as by Ranganna (1986).

Carbohydrate (%) = 100-(protein + fat + ash + crude fiber + mineral).

Minerals

Mineral content was estimated with the standard procedure by Atomic absorption spectrophotometry (AAS). Mineral content value was calculated with the help is given formula;

Mineral content(mg /kg) = AAS result (in ppm mg /kg) *Calculating factor

Calculating factor = volume (ml)/weight if sample (g)

Texture

Texture lab pro was used to analyse the texture.

The color

The colour is a major attribute towards acceptance of any baked good. The Hunter Colorimeter was used for the analysis of color. The Hunter is a filter colorimeter which separates the components of reflected color into a three-dimensional color scale. The L, a, b color scale views color in a similar manner to which the human eye sees color, with L measuring light to dark color components, a is a red-green scale and b is a yellow-blue scale.

Sensory evaluation

The sensory evaluation of ragi incorporated muffin for various attributes including color, flavor, taste, texture and overall acceptability was carried out using semi trained panel members using hedonic rating.

On trial days, Ragi incorporated muffin were placed in plates, labeled with random codes. Panelists were given water and puffed rice to neutralize their mouth between the samples. The ragi incorporated muffin sample were presented in randomly coded order and judges were asked to rate their acceptance by giving a score for all the parameters. Judgments were made through rating products on a 9 point Hedonic scale with corresponding descriptive terms ranging from 9

„like extremely" to 1 „dislike extremely". Sample with highest rating was chosen.

Results and Discussion

This work was carried out for the preparation of a standard quantity of different muffin formulations with different proportions of Ragi flour with Refined flour. As muffin is, a product widely flavored and consumed by the general population as a healthy breakfast food. At first, the major raw materials were subjected to proximate analysis.

Physiochemical analysis of Ragi flour muffin

The moisture content, protein, fat, crude fiber, ash, and carbohydrate of ragi flour muffin were found as given in Table.

Texture

Texture lab pro was used to analyse the texture.

The (TPA) Texture parameter analysis of muffins prepared with different variations of ragi flour shown in the Table. As the level of ragi flour increased from 5% to 15% in muffins, there was an increase in Fracturability, hardness, Gumminess, springiness and cohesiveness value.

With 5% variation. The muffins had lowest hardness and cohesiveness values indicating a tender and crumbly texture lacking the typical cohesiveness of the normal muffins. At 20 % level of ragi flour, the adverse effect was more pronounced. there was a decrease in Fracturability, hardness, Gumminess, springiness, and cohesiveness value, however springiness values did not vary significantly

It was seen that the incorporation of Ragi decreases the volume of muffins. The decrease in volume of Ragi incorporated in the muffin may be justified by the diluting effect of gluten caused by Ragi flour which led to lower loaf volume of muffin. Ragi is a gluten-free cereal with no gluten which directly affects the volume while baking. The same was aslo observed by Mickee, 2015. Ragi contains a very high amount of β-glucan flour which results in a decrease in the volume of muffin.

Higher the β-glucan content lower will be the volume of the muffin. As the ragi flour is denser than wheat flour, using the same mass volume will be smaller for ragi flour.

Mineral

Mineral content was estimated with the standard procedure by Atomic absorption spectrophotometry (AAS). the AAS conc. (PPM) value was finally calculated with the help is given formula ;

Mineral content(mg /kg) = AAS result (in ppm mg /kg) *Calculating factor

Calculating factor = volume (ml)/weight if sample (g)

Color

It was observed that As the percentage of Ragi flour increases, the color of cake changes from light brown to dark brown hence reducing the acceptance based on colour, However, the texture was slightly decreased with supplementation but taste described no undesirable change. Similar results were found by Sudha *et al.*, 10 and Zubairuddin *et al.*,

A muffin with 5% variation of ragi flour was found to have a high L value which means it was the lightest of all. When the comparative study was done with the whole muffin w.r.t crumb part of the muffin, there was a significant difference in the L value. Results of hunter colorimeters are depicted in the Table below.

The sample with 15% variation got the higher score may be due to the appropriate amount of ragi flour. The result is in accordance with Masoodi and Bashir (2012) who found that the colour of the fortified bread attained more dark colour as the supplementation was increased.

Sensory properties

Statistical analysis of sensory scores obtained from 5 semi-trained panelists using a 9-point hedonic rating scale (9= like extremely, 1= dislike extremely) for Ragi muffin formulation. Panelists are those who have tasted muffins. Here A (5% Ragi flour 95% refined flour), B (10 ragi flour 90% refined flour), C (15% refined flour 85% refined flour), and D (20% ragi flour 80% refined flour)

Appearance

Color plays a significant role in the appearance of the product**.** Not only color but texture and browning of outer surface also affects the appearance of the muffin.

Sometimes uneven baking can lead to uneven browning. it was observed that The Refined flour-Ragi flour composite cake of 15% variation got 8 score on hedonic scale rating, which was highest among all.

Texture

The mean sensory score for texture was found to be 7.6, 8, 7.7, and 7.5 for muffin formulation 5%, 10%, 15%, and 20% formulation respectively and is shown in Fig 4.5. Statistical analysis showed that the partial substitution of refined flour with ragi flour no significant effect on the texture of the different muffin formulations. None of the samples was significantly different from each other except a sample with 10% variation with got hedonic scale rating of 8.

The Refined flour-Ragi flour composite cake had the grainy texture as reported by panellists (up to 20 % of ragi flour) and at an average got a hedonic scale rating of 8. The cake prepared from 25% and above maida-Ragi composition had an excessive grainy appearance which caused reduction in its texture acceptability. The lower scores of appearances may be due to decrease in sponginess of cake resulting from a decrease in gluten content.

Taste

The mean sensory score for taste were found to be 7.4, 7.9, 8.1, and 8.1 for muffin formulation 5%, 10%,15%, 20% respectively and is plotted in Fig. 4.6.

Statistical analysis showed that the partial substitution of refined flour with ragi flour had significant effect on the taste of the different muffin formulations. 5% variation sample got the lowest rating as it did not impart much taste due to less percentage of ragi flour variation.

Sample with 15% and 20% variation were not significantly different from each other as sweetener, shortening agent and leaving agent used were same for all formulation and taste from these ingredient overcome the taste of ragi and refined flour.

Flavor

The mean sensory scores for flavor were found to be 7.6, 7.8, 8, and 7.9 for muffin formulation 5%, 10%, 15%, and 20% respectively. Statistical analysis showed that the partial substitution of Refined flour with Ragi flour had a significant effect ($p<0.05$) on the Flavor of the different muffin formulations. Products with 15% variation of Ragi flour got highest score which was significantly different from other formulation which is shown in Fig.

The flavor of native Ragi is mild and during heating there arises a combination of volatile and nonvolatile compound, including or produced from phenolic, amino acid and peptides, sugars and fatty acids (Welch and McConnell, 2014).

The flavor of sample with 15% ragi flour variation got a high rating; however, the product with 20% variation was found to be of balanced flavor giving as a whole of blended flavor which was preferable to other product formulations. Ragi and refined flour dont have similar flavors, so many will find that an ragi flour has a heartier flavor than refined flour. It is also somewhat sweeter than refined flour.

Table.1 Chemical composition of Ragi flour muffin

Parameter	5%	10%	15%	20%
Moisture (in 10g)	2.8	2.9	3.4	3.0
Protein% (in gm)	0.17	0.74	0.87	0.91
Ash (4g)	0.84	1.34	0.81	1.07
Fat (4.5g)	0.24	0.23	0.25	0.27
Crude fibre	2.5	2.6	2.7	3.0

Table.2 Effect of Ragi flour on the texture of the muffins (TPA)

Variation	Fracturability	Hardness	Cohesiveness (%)	Springiness(%)	Gumminess
5%	4.45	3.35	45	81.08	1.50
10%	5.90	4.48	58	78.94	2.80
15%	7.80	6.25	66	76.92	4.12
20%	7.60	6.0	64	76.91	3.84

Table.3 Mineral content in ragi flour incorporated muffin (mg/kg)

Parameter	Fe	Zn	Mn	Cu
5%	40	13.25	2.25	1.87
10%	54	16.5	4.75	1.9
15%	61.5	19.25	10.5	1.94
20%	89.25	20.75	13.0	1.95

Table.4 Influence of ragi flour on the crumb color and muffin color as a whole.

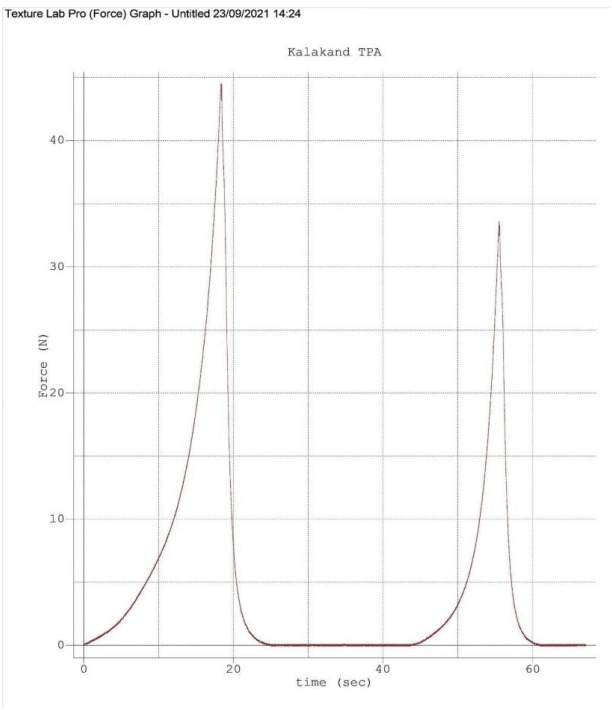
% variation	Ragi muffin (whole)			Ragi muffin crumb		
	L	a	b	L	a	b
5%	63.15	1.54	17.07	48.30	2.57	14.60
10%	60.37	1.72	18.82	46.14	5.12	20.69
15%	56.41	3.21	17.47	43.49	8.90	22.73
20%	54.77	3.23	17.00	45.26	7.38	20.11

Table.5 Proximate composition of product

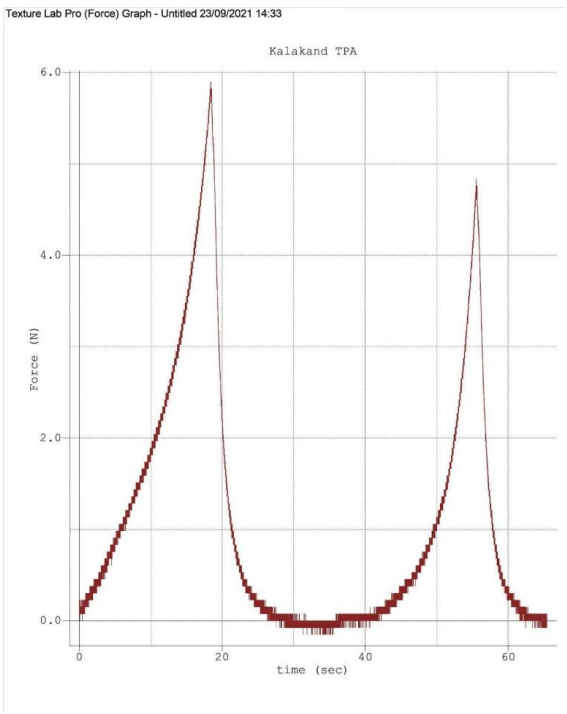
Parameters	Product C (15% ragi flour incorporated muffin)	Control sample (100% refined flour)
Moisture	3.4±0.01	10.9± 0.01
Crude protein	2.8±0.5	10.62± 0.01
Crude fat	0.25± 0.025	1 ± 0.025
Crude fiber	2.7±0.5	0.35± 0.015
Crude ash	0.81± 0.025	0.66± 0.025
carbohydrates	8.54± 0.25	76.61± 0.025

The moisture content, protein, fat, crude fiber, ash and carbohydrate of the product were found as given in the table.

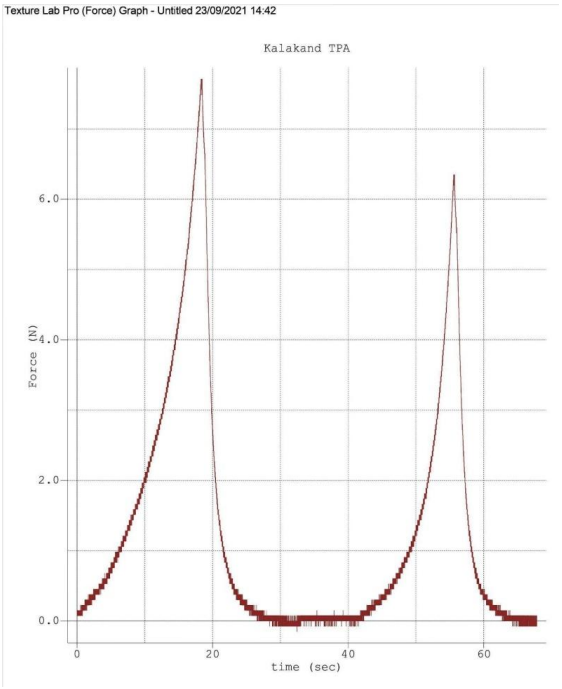
Fig.1



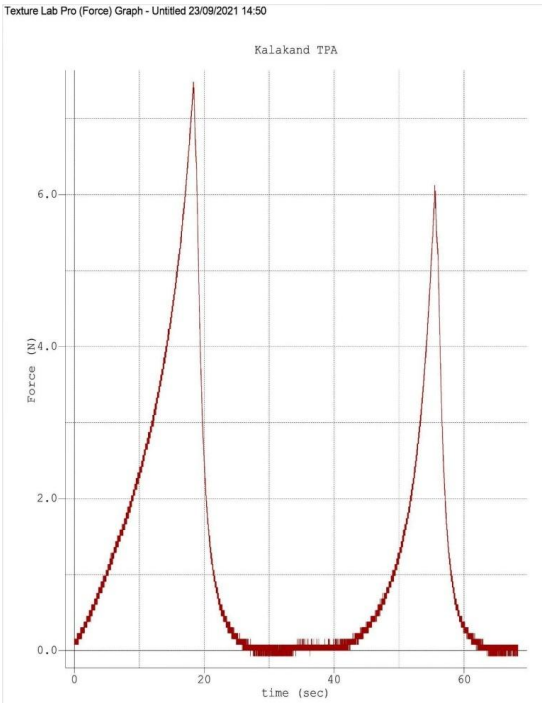
5% ragi muffin



10% ragi muffin



15% Ragi muffin



20% Ragi muffin

Fig.2 Mean sensory scores for Appearance of muffins of different formulations.

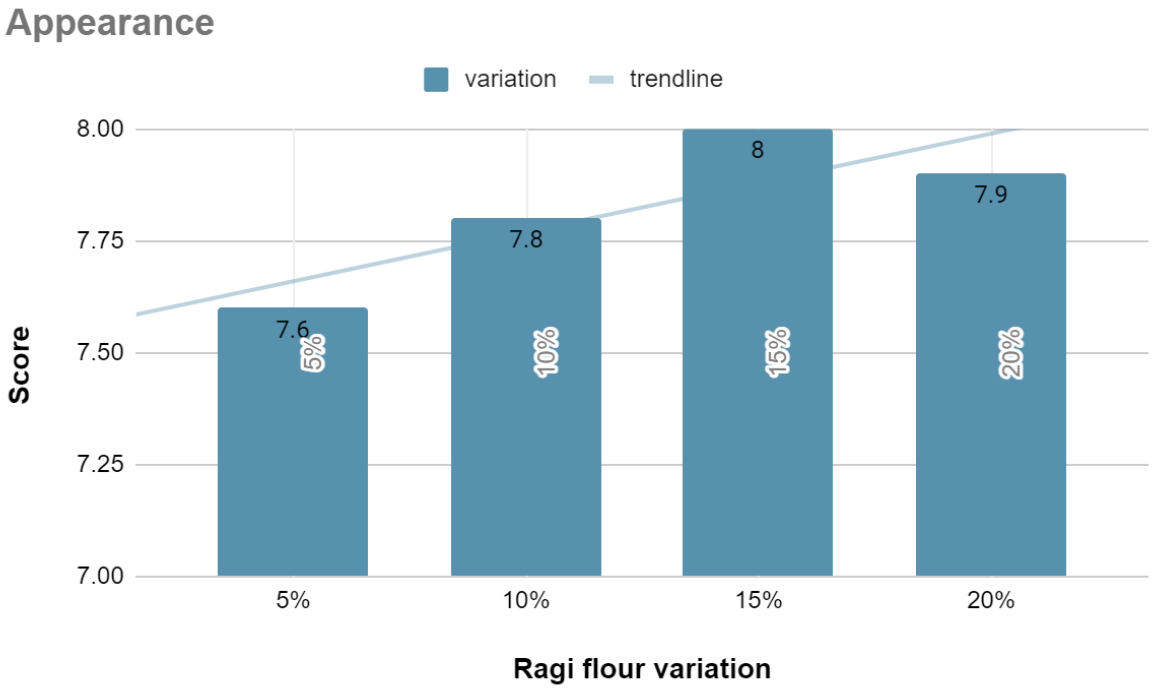


Fig.3 Mean sensory scores for texture of muffins of different formulations.

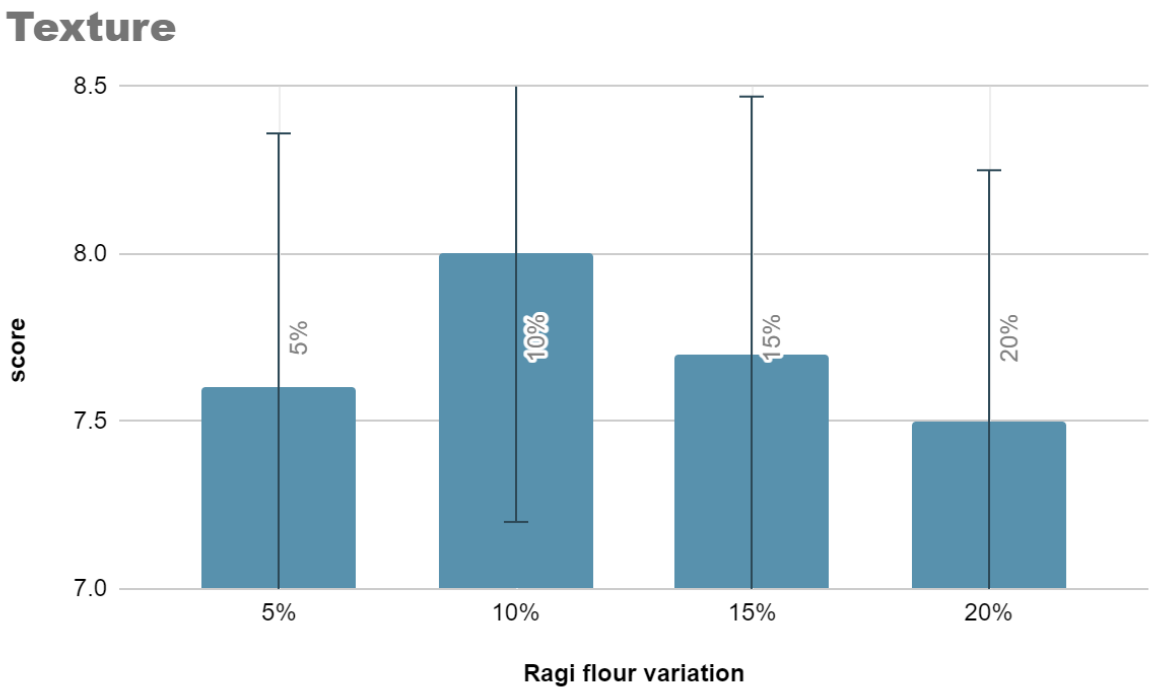


Fig.4 Mean sensory scores for taste of muffins of different formulations. Bars with similar alphabets at the top are not significantly different.

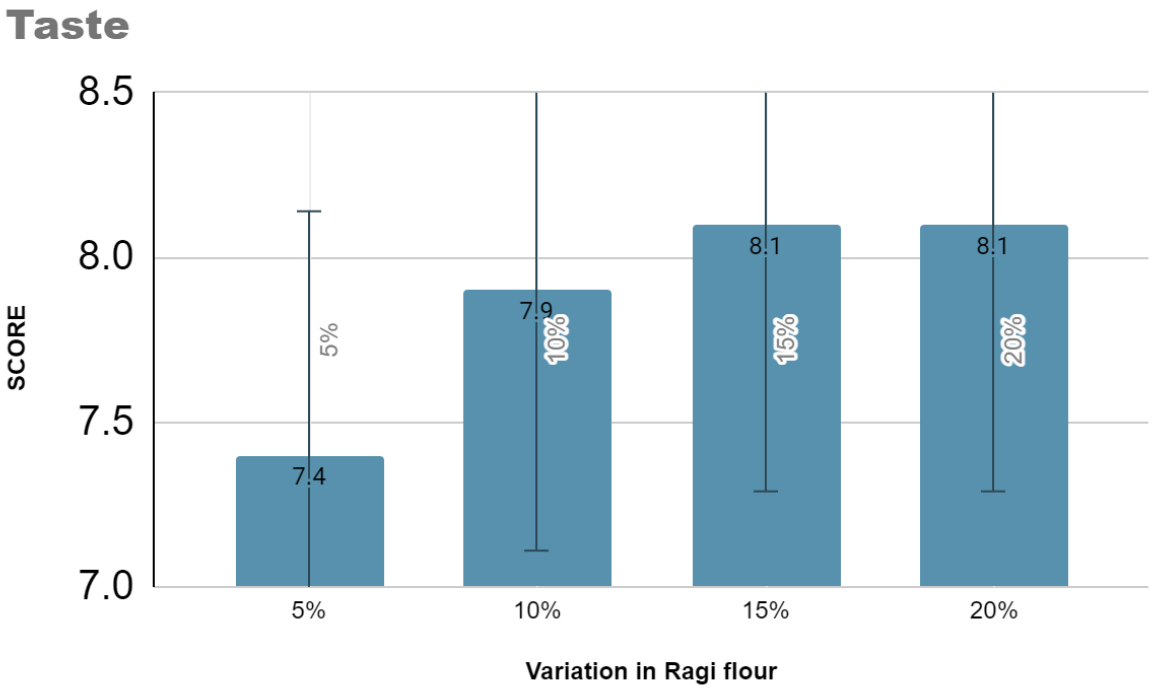


Fig.5 Mean sensory scores for flavor of muffins of different formulations.

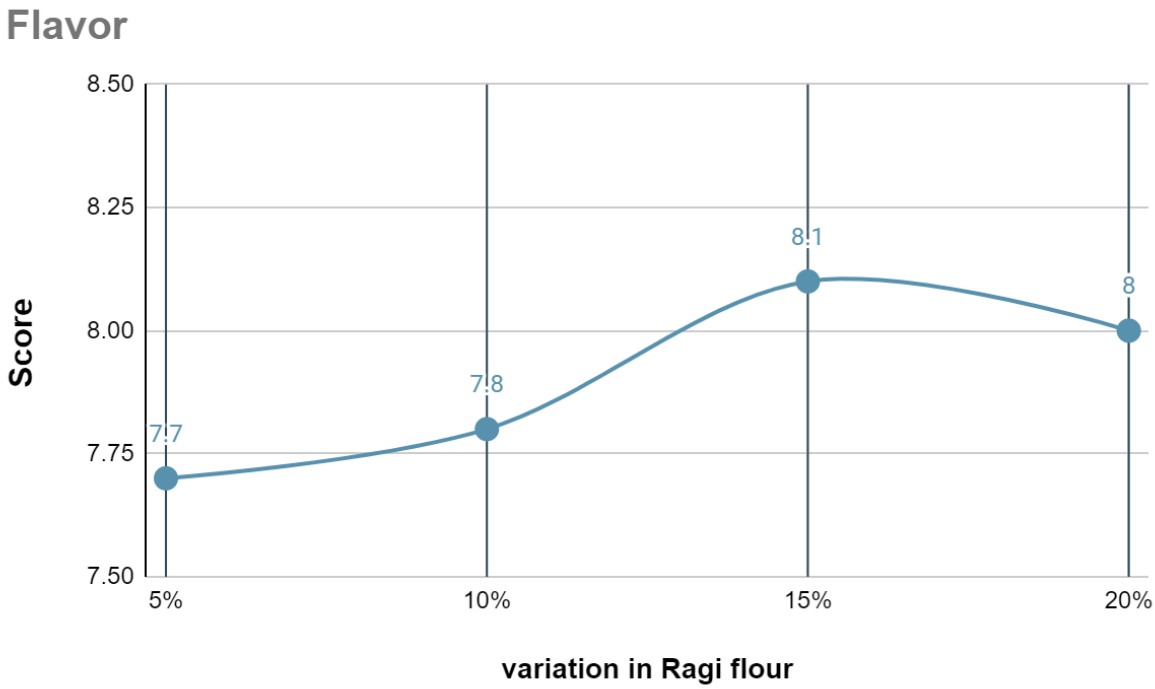
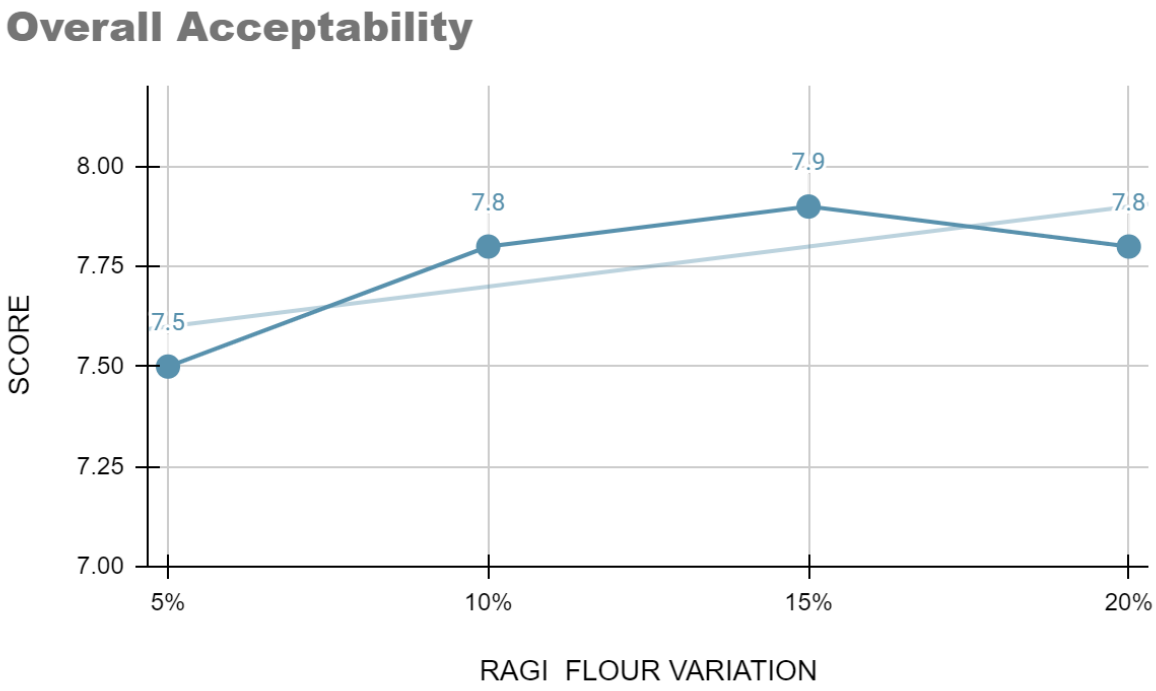


Fig.6 Mean sensory scores for overall acceptability of muffins of different formulations. Bars with similar alphabets at the top are not significantly different.



Overall acceptability

The mean sensory score for overall acceptability were found to be 7.5,7.8,7.9, and 7.8 for the muffin formulation A, B, C, and D, respectively, which is plotted in Fig. Statistical analysis showed that partial substitution of refined flour with ragi flour had a significant effect ($p<0.05$) on the overall acceptability of the different muffin formulations.

The product B and D were not significantly different to each other but significantly different to other samples. The product C got the highest score than product A, B, and D. Similarly, 20% ragi flour variation provides good flavor, color and solubility capacity might have provided good mouth feel in sample D.

Appearance, color and flavor of product C was very much liked. Therefore product C got a high score in terms of overall acceptability as shown in Fig. The overall acceptability of the 15% Ragi flour incorporated muffin was found to be significantly superior.

Proximate composition of product

Thus from statistical sensory analysis, the best product was found to be sample C muffin containing 15% of ragi flour and 85% refined flour. The proximate composition of sample C and control muffin (100% refined flour) were presented in Table 5.6.

Recommendations

On the basis of the research, the following conclusions can be drawn. Since the work was done under controlled conditions on a small scale, its generalization may warrant some reservations.

Ragi flour is superior to wheat flour in terms of minerals crude protein, crude fat, crude fiber and total ash

The ragi flour can be further incorporated up to 20% with 80% Refined flour, with no adverse effect on the sensory quality of the muffin, however, one can increase the substitution of ragi flour with refined flour upto 50%.

The nutritional quality of the ragi muffin seemed to be enhanced in the case of mineral, fiber and protein content.

The chemical and microbiological analysis of the product shows the acceptability of muffin was up to four days at room temperature without any artificial preservatives used.

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