Quality Standardization of Bakery Cake with Rice Flour as a Fat Replacer

A. Yadav, G. Prasad, L. N. Sethi, S. Roy, N. Kumar

Abstract: Bakery products constitute one of the most consumed foods in the world. Among them, cakes are particularly popular and especially associated with consumer due to its special delicious taste and organoleptic characteristics. Generally, the fat content of cake (20-30%) is higher than other bakery product. As excessive intake of fat is associated with health disorder so market demands increase for lower-fat products as well as to maintain the taste of the products. There are mainly three categories of a fat substitute and these are a lipid, protein, and carbohydrate-based fat substitute. Among these, the carbohydrate-based fat substitute was used for this study. To full fill the above purpose, two variety of rice (Bora and Komal) was selected for the replacement of fat in cake because of unique functional properties (water and oil absorption capacity, solubility, and emulsifying properties) of rice flour. Selection of composition for the preparation of bakery cake was done by using a different percentage of fat replacer and finally, the sensory analysis was carried out to determine the quality of the prepared bakery cake. The observed result indicated that water and oil absorption capacity of Bora rice flour was higher than Komal rice flour. However, the solubility of Komal rice flour was slightly higher than Bora rice flour. Meanwhile, the emulsifying capacity and stability of Bora rice were observed higher than Komal rice flour. Observed results of the sensory parameter of cake prepared at different concentration of Bora rice flour exhibit higher value compared to Komal rice flour. So, Bora rice flour could be used as a fat replacer up to 20% for the preparation of the cake.

Keywords: Bakery cake, Fat replacer, Functional property, Sensory parameter, Statistical analysis, Optimization.

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1. INTROCUTION

Bakery products constitute one of the most consumed foods in the world. Indian bakery industry is the largest among the food industries of the world with an annual turnover of about Rs. 3000 corers. The annual production of bakery products (organized sector), which includes bread, biscuits, pastries, cakes, buns, Rusk, etc., is estimated 4.7 million tones and the present per capita consumption of bakery products is 1 or 2 kg per annum [1]. Cakes are particularly popular among other bakery product and especially associated with consumer due to its particular organoleptic characteristics. Their quality mostly depends on ingredients used in the recipe i.e., Wheat flour, egg, fat, sugar, and leavening agents, as well as on conditions existing during their preparation (e.g. mixing, baking). These ingredients play an important functional role in the structure and eating quality of the product [2], [3]. More specifically, a cake batter represents a complex emulsion and foam system which is processed by being heat set. The baking of cakes leads to a light, aerated structure as well as to the formation of a great number of volatile compounds, which play a major role in developing their typical flavor. These compounds are mainly the result of the Maillard reaction, which occurs between reducing sugars and the -NH2 function of amino acids, peptides, and proteins [4]. The selection of raw materials as well as alteration of the making process can modify cake structure and aroma composition.Generally, the fat content of cake (20-30%) is higher than other bakery product (Food Technology article, 2004). Fat in cake is usually derived from shortening, which assists in the entrapment of air bubbles into the cake batter during mixing and helps to leave the products [5], [6]. Also, shortening tenderizes the crumb, impart moistness to the product and enhances mouth feel [2], [6]. Cake shortenings are usually formulated from blends of processed oils and fats, which may be derived from vegetable, marine or animal sources [3]. Though fat is a very important ingredient in bakery product however excessive intake of fat is associated with health disorder such as obesity, high blood cholesterol, and coronary heart disease, etc. Fat reduction in food is a major concern in now a day, as market demands increase for lower-fat products as well as to maintain the taste of the product. In the last 30 years, overweight and obesity increases with increasing population accounting more than in 1400 million adults [7]. The U.S. Public Health Service has recommended that dietary fat consumption should be less than 30% [8]. Moreover, now a day's consumer also demands low-fat food product without affecting the quality of the product [9]. It is a challenging task for the food process industry to produce food by reducing or by eliminating their fat content. Because fat not only contributes to textural attributes but also affect the sensory characteristics of the food product. But in response to the current public health status, there has been continued effort to replace the fat in food with other ingredients such as gums, fibers, and mucilage. These additives are generally used, called fat substitute or fat replacer. The replacer which is used it should have good mimetic property. Generally, fat replacer that used for fat replacement is starch derivative. The best source of starch is rice and other types of cereals. Rice

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flour contains 60 to 70% of starch and is excellent energy-rich food for human. Assam, the state in India, produces rice varieties with a wide range of apparent amylose content [10]. These varieties of rice include Bora rice, Komal rice, etc. Generally, the high and intermediate amylose varieties are consumed as staple foods throughout the state, the low amylose and waxy varieties are often used to made special products like pithas, snacks, etc. [11]. This low amylose rice flour contains rich nutritional components including protein, fat, moisture, vitamin B and others. Due to the low content of amylose (0-2%, w/w) in Bora rice, Bora rice flour is not easily aged and the cooked rice is stickier, softer and easier to adhere together [12].In recent years, rice, especially rice flour, because of its unique functional properties, is used in a number of novel foods such as tortillas, beverages, processed meats, puddings, salad dressings and gluten-free breads [13], [14]. The application of Bora rice flour in these products mainly takes advantage of the soft and sticky nature of cooked Bora rice flour. The special sticky characteristics of glutinous rice flour also make it effective to improve the stability of puddings, sauces, gravies against water separation during freezing-thawing cycles [15], [16]. Meanwhile, Komal rice (soft rice) having amylose content of (0-10%) has a special property, it needs cooking and soaking in water for 1 hour will become soft and ready to eat. It was also used in making various types of local food such as snacks, pithas etc.So, in the present study, the detailed functional properties of these Bora rice flour (sticky rice) and Komal rice flour (soft rice) were analyzed and experimented as fat replacer or fat substitute of a bakery cake.

2 Materials and Methods

This section deals with details methodology involved in rice flour preparation, analysis of functional properties of rice flour, analysis of textural properties of rice flour and margarine, preparation of bakery cake, sensory and physical analysis of prepared cake.

2.1 Ingredients

The ingredients such as flour, sugar, salt, egg, essence and margarine and required for preparation of the cake. Margarine is an important ingredient for the preparation of cake that provides tenderness and volume to the cake. Considering the respond of the consumer for the need for low fat cake, Komal and Bora rice are selected as a fat replacer. These rice varieties contain the starch (60-70%) along with their ingredients (protein, fat, moisture, vitamin B and others) which could be used as fat replacer with the determination of functional properties of the rice flour.

2.2 Preparation of rice flour

Rice flour was prepared by the dry milling method from dried rice grains after soaking (Shin et al., 2010). Rice grains were washed 3 times, soaked in water for 1 h, and dried at 35±5 ºC in tray dryer until the crack was developed in grains. Milling was performed using a flour mill (Saral systems, Ahmedabad). The resulting flour was sieved through a 63-mesh sieve to obtain finer flour. After that, it was packed in polyethylene bags and stored at room temperature (≈25°C) for preparation of the cake.

2.3 Determination of functional properties of flour

2.3.1 Water and oil absorption capacity

Water and oil absorption capacity were determined according to AACC (2000). A 0.5 g of rice flour was weighed in a test tube and distilled water is added until wet. The tubes were centrifuged at 6400 rpm for 10 minutes. The supernatant discarded and swollen sample weighed. WAC was calculated as:

$$WAC\ (\%) = (S_{sw}-S_w)/S_w \times 100 \quad (1)$$

where:
S_{sw}= swollen sample weighed.
S_w= initial sample weighed.

Similarly, a 0.5 g of rice flour was weighed in a test tube and corn oil was added until complete wet. The tubes were centrifuged at 6400 rpm for 10 minutes. The supernatant discarded and swollen sample weighed. OAC was calculated as:

$$OAC\ (\%) = (S_{sw}-S_w)/S_w \times 100 \quad (2)$$

2.3.2 Solubility

Solubility was determined according to [17]. Suspension of fat replacer (30ml, 1% w/v) was placed in a water bath at 30, 60, 70, 90ºc for 30 min and continuously stirred. The suspension was centrifuged at 3200 rpm for 15 min. Aliquots of supernatant were dried in an oven at 125ºc for overnight until a constant weight is reached. The solubility of rice flour was calculated as:

$$Solubility\ (\%) = W_f/W_i \times 30/10 \times 100 \quad (3)$$

Where:
W_i = initial weight.
W_f = final weight.

2.3.3 Emulsifying Properties

The procedure was described by [18] was used for determination of both emulsifying capacity (EC) and emulsifying stability (ES). Flour suspension (60ml) of different concentration (0.1, 0.5 and 1% w/v) was mixed with 6 ml of commercial oil and homogenized for 1 min. The suspension was centrifuged at 3200 rpm for 10 minutes. Emulsifying capacity was calculated as:

$$EC= (E_v/T_v)\times 100 \quad (4)$$

where, E_v = emulsion volume, T_v = total volume.

2.4 Selection of composition for fat substitute

In order to maintain the organoleptic properties of cake, the different mixture of margarine and rice flour concentration was selected for the experimental trails. Both the rice flour powder was mixed with margarine at different proportions (rice flour: margarine = 10:90, 20:80, 30:70, and 40:60) to find out the textural properties of samples (1control + 4 concentration of rice powder). The detail for the mixture of different proportion of rice flour and margarine are shown in Table 1.

Table 1
Mixture of different proportion of rice flour and margarine

Sample	Margarine proportion (%)	Rice flour proportion (%)
1	100	0
2	90	10
3	80	20
4	70	30
5	60	40

TABLE 2
FORMULATION OF CAKE BATTER AT DIFFERENT CONCENTRATION OF MARGARINE

Ingredients	Control	Sample 1 10% replacement	Sample 2 20% replacement	Sample 3 30% replacement	Sample 4 40% replacement
Flour (g)	50	50	50	50	50
Egg (ml)	40	40	40	40	40
Sugar (g)	50	50	50	50	50
Water (ml)	20	20	20	20	20
Margarine(g)	30	27	24	21	18
Fat replacer (g)	0	3	6	9	12
Baking powder (g)	1.75	1.75	1.75	1.75	1.75
Vanilla (ml)	0.5	0.5	0.5	0.5	0.5
Essence (ml)	0.5	0.5	0.5	0.5	0.5

2.4 Preparation of Cake
Creaming mixing procedure was used for the preparation of the cake. The composition considered for the preparation of control cake were wheat flour (50 g), egg (40ml), sugar (50 g), salt (0.4g), margarine (30 g), water (20 ml), baking powder (1.75ml), vanilla (0.5ml) and essence of lemon and almond (0.5ml). Composition of different cake and fat replacer of Komal rice and Bora rice (cake batter) considered for preparation of cake are presented in Table 1 and 2, respectively. Vegetable fat was replaced by rice flour at a different level according to the response obtained from response surface methodology.Initially, flour, sugar, baking powder, water, and salt were beaten together in a mixer bowl (prestige, India) on speed 1200 rpm for 5 minutes. Then add the mixture of egg, vanilla, and essence of flavor to the batter and mix it properly on speed 2400 rpm. After that, add margarine and rice flour mixture to it and mix properly for 10 minutes. Then the batter was poured into cupcake case uniformly.

2.5 Baking and Storage
The prepared cake sample of different concentration of fat replacer was placed in an aluminum-baking pan (5.5 cm × 4 cm) and baked all at a time in a convective oven at 130 ^{0} C for 20-25 min. During baking, each pan was rotated twice by 180^{0} (after 5 and 10 min) for uniform baking. After baking, the cake was removed from the pan and were wrapped in a transparent film to prevent the effect of moisture and microorganism and stored at room temperature for 24 hours.

2.6 Sensory Analysis
The sensory parameter such as appearance, aroma, taste, and texture for the prepared cakes was evaluated using a 5-point hedonic scale by a panel of 10 judges [19]. Five persons (3 male, 2 female) from Tura College of Home Science department and other five members (staff) from IICPT, regional center, Guwahati were selected for the sensory evaluation. In order for the panellists to become familiar with this type of test, a series of preliminary trials took place during which the panellists were advised how to evaluate cake characteristics. The sensory evaluation of cake samples was carried out step by step procedure for appearance followed by aroma, texture, and taste. The panellists were instructed to rate the sample after judging the different parameters mentioned above based on following 5-point hedonic scale: 1- very bad, 2-bad, 3-average, 4-good, 5-very good. Panellists were also instructed to refrain from eating, drinking, smoking or chewing gum before 30 minutes of the testing session and wash their mouth with water before testing. Panellists were instructed to judge and evaluate cakes in a clockwise fashion, starting with the sample placed below the coded mark.The appearance was judged based on surface characteristics such as crust color, the outer form of the cake. Aroma evaluation was performed based on the smell that emerges from a prepared cake. Taste analysis was carried out using tongue and it was judged based on sweetness, flavor, etc. Texture analysis was performed using finger and mouth and it was judged on the basis of a textural parameter such as moistness, sponginess of the prepared cake.

2.7 Statistical Analysis
Data obtained during the physical and sensory evaluation of cake were subjected to analysis of variance (ANOVA) and Duncan's test using the software program of Statistical Package for the Social Sciences (SPSS, edition 8.0), to assess significant differences among samples. Differences were considered significant when $P < 0.05$.

2.8 Experimental Design and Procedure for Optimization
For maximizing the sensory parameter of prepared bakery cake, the independent variables chosen were the weight of margarine and rice flour. Thirteen experiments were performed according to a second-order central composite rotatable design (CCRD) with two variables and five-level of each variable. Based on the concentration, the level of margarine and rice flour was kept in the range of 18 to 30 g and 0 to 12 g respectively. The predicted results for the combination of variable levels used in the CCRD are shown in Table 3. Each experimental run contains the same composition of wheat flour, egg, sugar, baking powder, water and essence of flavor except margarine.Numerical optimization technique of the Design-Expert 9.0.5.1, (Stat Ease Inc., Minneapolis, USA) was used to construct the experimental design as well as sensory analysis. Total combinations were generated for the two independent variables (margarine and rice flour). In this experiment, margarine was set at minimum and rice flour was set at maximum value and experiments at the center point (0, 0) were repeated for 5 times to find out the optimized value. However, the responses viz. Appearance, aroma, taste, and texture kept at maximum value to obtain the best organoleptic properties of baked cake product.

TABLE 3
FIVE LEVELS TWO FACTORS EXPERIMENTAL DESIGN FOR OPTIMIZATION OF THE COMPOSITION OF MARGARINE AND RICE FLOUR

Experimental Trial	Coded and actual value	
	Margarine	Rice Flour
1	(-1)21	(+1)9
2	(+1)27	(-1)3
3	(0)24	(0)6
4	(-1.41)18	(+1.41)12
5	(0)24	(0)6
6	(+1.41)30	(-1.41)0
7	(-1)21	(+1)9

8	(+1)27	(-1)3
9	(0)24	(0)6
10	(+1.41)30	(-1.41)0
11	(-1.41)18	(+1.41)12
12	(-1.41)18	(+1.41)12
13	(+1.41)30	(-1.41)0

3 Result and Discussions

This section contains overall results and discussion of the evaluation of functional properties of rice flour, analysis of textural properties of rice flour and margarine mixture, sensory analysis and optimization of prepared cake.

3.1 Water and oil absorption capacity of rice flour

The observed water absorption capacity and oil absorption capacity of selected fat replacer used in this study were given in Table 4. The observed result showed that WAC of Bora rice flour 184.00% was higher than that of Komal rice flour 152.50%. This result was closely similar (192%) [20]. The highest WAC was found in Bora rice flour could be due to the presence of a higher amount of starch and fiber. Starch has good imitating properties of fat, so the rice flour could be used as a substitute for fat.Oil absorption capacity (OAC) characteristics represent the ability of rice flour to bind with oil and retain the flavor. The OAC of Bora rice and Komal rice flour were found 83.19% and 64.29%, respectively. It was observed that Bora rice has higher OAC than Komal rice flour which could be used as better flavor retainer.

Table 4
Observed water and oil absorption capacity of Bora and Komal rice flour

Experimental Trial	Water absorption capacity (%)		Oil absorption capacity (%)	
	Bora rice	Komal rice	Bora rice	Komal rice
1	183.50	152.34	83.54	64.37
2	184.75	152.87	83.25	64.21
3	184.21	152.30	82.78	64.30
Mean	184.15	152.50	83.19	64.29
St. deviation	0.62	0.31	0.38	0.08

3.2 Solubility of rice flour

The solubility of selected fat replacer (30ml, 1% w/v) suspension was investigated at different temperature of 30, 60, 70 and 90ºc as shown in Figure 1. Solubility indicates the ability of solids to dissolve or disperse in an aqueous solution (mostly in water) [21] and also indicate the stickiness property of rice flour. The observed result showed that Bora rice has low solubility compared to Komal rice flour. Highest solubility 3.14% was observed in Komal rice flour compared to Bora rice flour. Figure 1 shows that the solubility of rice flour increases with increase in temperature. However, low differences were observed in case solubility of the Komal rice flour. The low solubility of rice flour attributed to the presence of a low amount of amylose because amylose constitutes the larger percentage of the amorphous component of the starch granules where water penetration into the granule is more distinct [22].

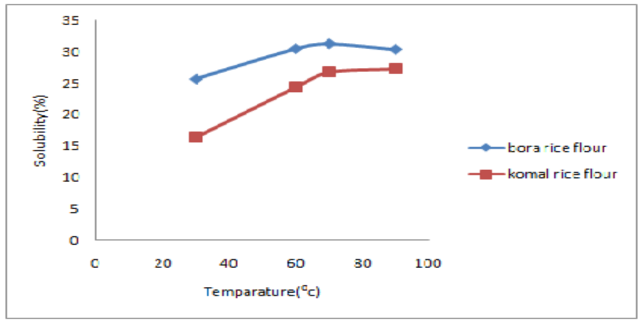

Fig. 1. Solubility of Bora and Komal rice flour at different temperature

3.3 Emulsifying Properties of rice flour

Observed results of emulsion capacity and stability are shown in figure 2 and 3, respectively. This result of emulsifying capacity (46.54 and 37.61%) and stability (38.24 and 38.36%) were closely similar to 41.48% and 40.21% [20]. Figure 2 showed that the emulsion capacity for both the rice flours increased with increase in concentration. However, the highest emulsion stability was observed 38.28% in Komal rice flour at 0.5% concentration and for Bora rice flours it was 38.45% at 1% concentration. So, this rice flours might be used to assist in the emulsion for preparation of bakery food.

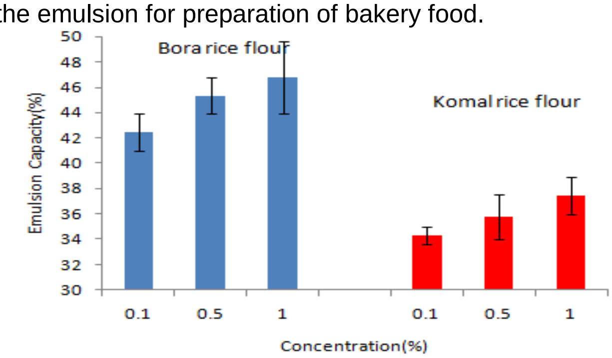

Fig. 2. Variation of the emulsifying capacity of Komal and Bora rice flour at different concentration

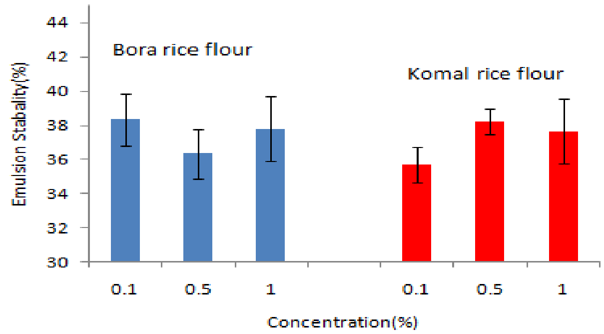

Fig. 3. Variation of emulsifying stability of Komal and Bora rice flour at different concentration

3.4 Textural properties of margarine and rice flour mixture

Figure 4 and 5, show firmness and adhesiveness of both rice flour and margarine composition at different concentration, respectively. Observed results showed that firmness, as well as adhesiveness, decreases when the concentration of rice flour increases. It is because of the fat coats the surface of the flour particles which inhibiting the development of the gluten proteins. The free fat, therefore, disrupts the gluten network resulting in a softer mixture [23].But more difference was observed in case of addition of Komal rice flour compared to

Bora rice flour because of less firmness. Reduction in fat level decreases the adhesiveness of margarine as well. At 40% replacement of fat by Komal and Bora rice flour, the composition exhibited the lowest value of firmness 33.254 and 26.054 g respectively. However, at 10% replacement of fat by Bora and Komal rice flour, the composition exhibited the highest value 48.473 and 47.56 g respectively.

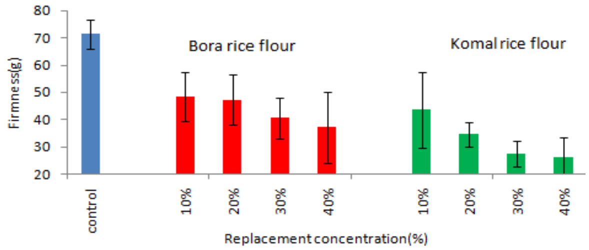

Fig. 4. *Effect of firmness on margarine on the addition of rice flour at different concentration*

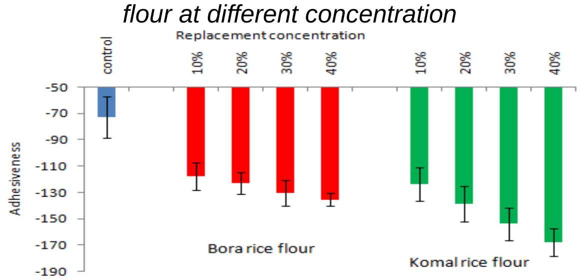

Fig. 5. *Effect of adhesiveness on margarine on the addition of rice flour at different concentration*

3.5 Sensory evaluation of prepared cake

Sensory evaluation of prepared cake samples (B-10, 20, 30, 40 and K-10, 20, 30, 40 respectively) with different percentage of composition of margarine and both the rice flour as shown in plate 1 is presented in Table 5. Appearance characteristics include color, size, shape, surface texture etc. The observed result showed that cake sample B-10, B-20, obtained a high score of 3.3 and B-40 obtained the lowest score of 2.7 with the replacement of fat by Bora rice flour. While in case of replacement of fat by Komal rice flour K-10 obtained the highest score of 3.4 and K-40 obtained the lowest score 2.3. The panellists expressed that the unexpectedly light color of the sample prepared using Komal rice flour compared to Bora rice flour. Apart from this, panellist observed more crack was developed in the sample containing Komal rice flour compared to Bora rice flour. This may be a reason for obtaining a low score for appearance to sample containing Komal rice flour.

TABLE 5

OBSERVED SENSORY PARAMETERS OF PREPARED CAKE AT DIFFERENT CONCENTRATION OF FAT REPLACER

Prepared cake	Sensory Parameters			
	Appearance	Aroma	Taste	Texture
Control	3.5±0.43	3.8±0.33	3.5±0.43	4.0±0.23
Cake sample prepared with Bora rice flour				
B-10	3.3±0.57	3.6±0.59	3.4±0.64	3.8±0.41
B-20	3.3±0.62	3.6±0.47	3.4±0.62	3.5±0.62
B-30	3.1±0.51	3.5±0.61	3.2±0.42	3.7±0.45
B-40	2.7±0.48	3.3±0.56	3.1±0.23	3.2±0.53
Cake samples prepared with Komal rice flour				
K-10	3.4±0.34	3.3±0.47	3.2±0.33	3.5±0.59
K-20	2.8±0.34	3.1±0.39	3.4±0.56	3.2±0.25
K-30	2.5±0.36	2.6±0.31	3.2±0.78	2.9±0.65
K-40	2.3±0.21	2.8±0.76	2.4±0.71	2.7±0.24

Aroma depends upon the baking condition and duration of the preparation of the cake. The observed result showed that B-10 and B-20 obtained highest score 3.6 and B-40 acquired lowest score 3.3 in replacement of fat by Bora rice flour, while in replacement of fat by Komal rice flour, K-10 attained highest score 3.3 and K-30 obtained lowest score 2.6. According to panellists, unpleasant smell emerges from B-20, K-20 and K-30.Since fat acts as a flavor carrier, the perception of taste is enhanced. Obtained result showed that B-10 obtained highest score 3.4 and B-40 achieved lowest score 3.1 in case of replacement of fat by Bora rice flour while in replacement of fat by Komal rice flour, K-20 obtained highest score 3.4 and K-40 obtained lowest score 2.4.Good qualities of cake having good texture characteristics. Texture characteristics include sponginess and moistness of the cake. The observed result showed that B-10 obtained the highest score of 3.8 while B-30 obtained the lowest score of 3.2. Meanwhile, replacement of fat by Komal rice flour, K-10 achieved highest score of 3.5 and K-40 obtained the lowest score 2.7, respectively. From the sensory analysis of the prepared cake, it was found that Komal rice could be feasible (Hedonic scale 3 and above) as a fat replacer up to 10%, whereas Bora rice could be feasible as a fat replacer up to 30% may because of better functional and textural properties. However, in order to maintain low-fat content in bakery cake, the sensory parameters need to be compromised.

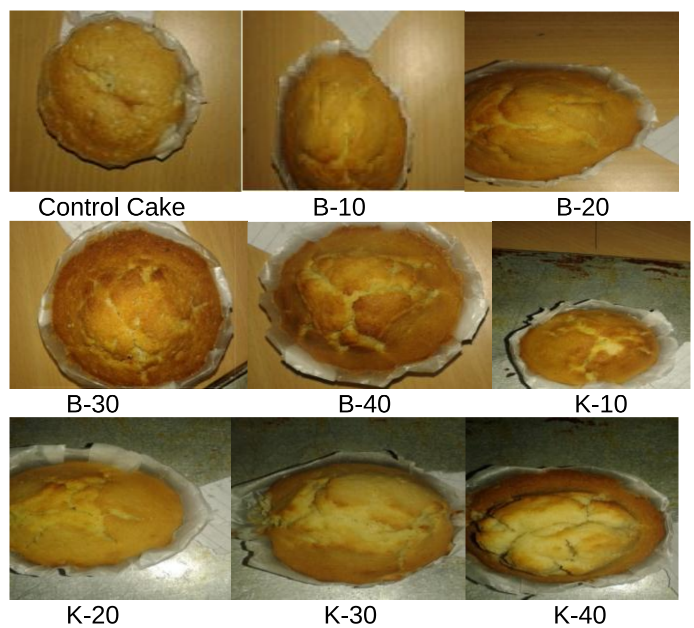

Plate 1*. A view of cake prepared at different concentration of fat (B-10, B-20, B-30, B-40 and K-10, K-20, K-30, K-40)*

3.6 Optimization of cake composition

The numerical optimization technique (Design Expert 9.0.5.1 software) was used to get the optimum values of the independent variables i.e. margarine and Bora rice flour. The response variables selected for optimization were appearance, aroma, taste, and texture. The optimum condition was optimized by minimizing the concentration of margarine and maximizing Bora rice flour.The optimum value of margarine and rice flour was found to be 24 g and 6 g respectively at the desirability of 0.712. At this optimum condition, the sensory value of appearance, aroma, taste, and texture was found to be 3.45, 3.82, 3.60, and 3.41 respectively. These optimum conditions can be used for the preparation of bakery cake with retention of desired quality attributes.

3.7 Statistical analysis of sensory parameter

Statistical analysis was carried out to find out significant difference among the scores. Analysis of variance (ANOVA) was carried out for different sensory parameter viz. Appearance, aroma, taste, and texture of prepared cake and results revealed that there were no significant (P<0.05) differences in the value of all these sensory parameters at different concentration of fat (Table 6.). By Duncan Multiple Range Test (DMRT), it was found that the treatments significantly affect the different sensory parameter viz. Appearance, aroma, taste, and texture of a prepared cake. The observed result showed that the appearance of sample K-10 obtained a significantly high score of 3.4 while sample K-40 obtained a low score of 2.3 compared to another sample. Similarly, it was found that the aroma of prepared cake sample B-10 and B-20 obtained a significantly high score of 3.6 while the sample K-30 obtained a significantly low score of 2.6. In the case of taste, observed results revealed that the sample B-10, B-20, and K-20 obtained a significantly high score of 3.4 and sample K-40 obtained a significantly low score of 2.4. In the context of texture analysis, DMRT test revealed that the sample B-10 obtained a significantly high score of 3.8 while sample K-40 obtained a significantly low score of 2.7 (Table 7.).

TABLE 6
ANALYSIS OF VARIANCE (ANOVA) FOR THE DIFFERENT SENSORY PARAMETER OF CAKE

Source	Sum of square	df	Mean square	F	Significance
Appearance					
Sample	41.119	8	5.140	86025.143	0.000
Panel	8.533	9	0.948	198.280	0.000
Sample x Panel	37.40	72	0.519	36.571	0.000
Error	4.677	180	0.026	20.036	0.000
Total	2322.00	270			
Aroma					
Sample	61.452	8	7.681	188.545	0.000
Panel	3.959	9	0.440	10.798	0.000
Sample x Panel	47.80	72	0.664	16.278	0.000
Error	7.333	180	0.041		0.000
Total	2485.00	270			
Taste					
Sample	57.256	8	9.231	188.545	0.000
Panel	3.957	9	0.440	10.798	0.000
Sample x Panel	47.80	72	0.664	16.278	0.000
Error	9.456	180	0.041		0.000
Total	2485.00	270			
Texture					
Sample	49.430	8	6.179	556.083	0.000
Panel	4.667	9	0.519	46.667	0.000
Sample x Panel	52.20	72	0.725	65.250	0.000
Error	2.000	180	0.011		0.000
Total	3042.00	270			

TABLE 7
DUNCAN MULTIPLE RANGE TEST (DMRT) VALUE FOR DIFFERENT SENSORY PARAMETER

Prepared cake	Appearance	Aroma	Taste	Texture
Control	3.5±0.43g	3.8±0.33f	3.5±0.43e	4.0±0.23e
B-10	3.3±0.57f	3.6±0.59e	3.4±0.64e	3.8±0.41e
B-20	3.3±0.62f	3.6±0.47e	3.4±0.62e	3.5±0.62e
B-30	3.1±0.51e	3.5±0.76e	3.2±0.42d	3.7±0.45e
B-40	2.7±0.48c	3.3±0.56d	3.1±0.23d	3.2±0.53b
K-10	3.4±0.34g	3.3±0.47d	3.2±0.33d	3.5±0.59e
K-20	2.8±0.34d	3.1±0.39d	3.4±0.56e	3.2±0.25b
K-30	2.4±0.36b	2.6±0.31b	3.2±0.78d	2.9±0.65a
K-40	2.3±0.21a	2.8±0.61b	2.4±0.71a	2.7±0.24a

4 CONCLUSION

Bora rice flour has better functional properties than Komal rice flour which can be used for the preparation of bakery products. Textural properties (firmness and adhesiveness) of Bora rice flour was found closer value to margarine than Komal rice flour. So, Bora rice flour could be more feasible to use as a fat replacer for preparation of cake due to its consistency of firmness as well as adhesiveness and inhibiting the development of the gluten proteins. The score in the hedonic scale for the sensory parameters (Appearance, aroma, taste, texture) through panellist was optimized by design expert software. Optimized value of sensory parameter revealed that 20% of margarine can be replaced by Bora rice flour and also found more significant with the statistical analysis. So, Bora rice flour could be used as a fat replacer up to 20% for the preparation of the cake.

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