

# Loaf Characteristics and Sensory Properties of whole Wheat Bread Fortified with Sorghum and Rice Flour

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**Abstract:** Bread is a common staple food in developing countries and also in many other regions of the world. The loaf characteristic and sensory attributes of bread samples prepared by using different composite flours in which ratio of whole wheat flour, sorghum flour and rice flour kept as 100:0:0 (F1), 80:10:10 (F2) and 60:20:20 (F3) was evaluated. The composite flours F1, F2 and F3 were subsequently used for making bread samples i.e. whole wheat bread (WWB), sorghum rice bread-1 (SRB-1) and sorghum rice bread-2 (SRB-2), respectively. The results indicated that significantly higher loaf weight (g) was recorded in SRB-2 followed by SRB-1 and WWB. Significantly higher bread height (cm) was noticed in SRB-1 followed by WWB and SRB-2. The bread sample WWB was found to have significantly higher volume and specific volume followed by SRB-1 and SRB-2. It was also revealed that significantly higher average score for bread crust color was perceived by WWB. However, bread sample SRB-1 perceived significantly higher score ( $P < 0.05$ ) for crumb color, texture, aroma, taste and overall acceptability. It is concluded from present study that fortification of bread with different proportions of rice and sorghum flour was found to improve sensory attributes of the bread samples rather than loaf characteristics.

**Keywords:** Bread, whole wheat flour, sorghum flour, rice flour and sensory attributes.

## INTRODUCTION

The nutritional insufficiency or malnutrition is increasing day by day in most of the developed countries. It is now extensively needed to enhance strategic use of nutritionally rich and inexpensive food sources to combat against malnutrition and its related health risks. Fortification of less nutritional food commodities can enhance the nutritional properties of food [1]. It is known that bread occupies exceptional position among all bakery goods in all regions of the world. Bread is considered as main staple cereal based food worldwide. It is a basic part of human diet in many countries from centuries due to its characteristic sensory properties and nutritional quality. Bread wheat flour is used to prepare bread [2] and its fortification with other cereal based flour i.e. sorghum, rice, barley and maize etc. can elevate nutritional aspect of bread. In countries, where bread wheat is not a major domestic crop, effort can be made to substitute part of the wheat flour by other available flours to compensate the nutritional insufficiencies [3].

Bread is a fermented food product. It is prepared from bread wheat flour, yeast, water and salt by sequence of unit operations such as mixing, kneading, shaping, fermenting and baking and slicing [4]. Loaf characteristics are important to examine in order to estimate the quality attributes of bread. It is fact that

formulation and production of fortified cereal based commodities especially bread is increasing continuously and for this reason, it is mandatory to explore quality attributes and sensory properties of these foods. It is fact that cereals provide essential nutrients and can prevent malnutrition and related health issues [5].

Sorghum (*Sorghum bicolor* L. Moench) is known as king of cereals. It is a chief cereal which is produced for providing food for over 500 million consumers in semi-arid tropical regions [6]. Sorghum is a good source of energy, proteins, carbohydrates, fats, polyunsaturated fatty acid, minerals and vitamins. However, rice is gluten free with sodium low levels. Rice has less protein, fat and fiber content but has high amount of digestible carbohydrates. Rice has bland taste, white color with hypoallergenic properties [7].

Therefore, present study is planned to prepare fortified bread by substituting whole wheat flour by sorghum and rice flours and to examine the quality attributes and sensory perceptions of these fortified bread.

## MATERIALS AND METHODS

### Materials

The flour of whole wheat, sorghum and rice were purchased from local mill located in main market of Hyderabad, Sindh. Other ingredients needed for bread making such as, instant dry yeast, shortening, salt and

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sugar were procured from the local market of same city. After purchasing, material was brought to the Baking Science Laboratory of Institute of Food Sciences and Technology, Sindh Agriculture University, Tandojam for preparing fortified bread samples. Bread samples prepared for present study were utilized for examining their loaf characteristics and sensory evaluation.

### Formulation of Composite Flour

The composite flour samples were formulated using whole wheat flour (WWF), sorghum flour (SF) and rice flour (RF) in ratio of 100:0:0 (F1), 80:10:10 (F2) and 60:20:20 (F3). All composite flour samples were blended properly, packed in sealed bags, coded and stored till further use.

### Preparation of Bread

The method described by [8] was used with slight modification to prepare bread samples. For the preparing bread sample, flour was properly mixed with other ingredients (Table 1) and was mechanically kneaded using dough mixer for about 10-15 minutes in order to obtain dough. The dough was recovered from the dough mixer and fermented for one hour at room temperature ( $28\pm 2^{\circ}\text{C}$ ) in a pan covered with lid. Followed by fermentation, pan containing dough was kept into preheated reel oven for baking at  $250^{\circ}\text{C}$  for 30 minutes. After baking, loaves were taken from the pan, cooled (at room temperature) and packed in polyethylene bags after appropriate coding as WWB, SRB-1 and SRB-2 prepared from composite flour F1, F2 and F3, respectively. Finally, bread samples were evaluated for their loaf characteristic and for sensory evaluation. Other two replicates of bread samples were carried out in similar way in different days.

## Loaf Characteristic and Sensory Evaluation of Bread Samples

Loaf weight (g), loaf height (cm), loaf volume ( $\text{cm}^3$ ) and loaf specific volume ( $\text{cm}^3/\text{g}$ ) of all bread samples were examined according to the methods of [9]. However, sensory characteristics i.e. crust color, crumb color, oral texture, manual texture, aroma, taste and overall acceptability was determined on the basis of nine point Hedonic scale (representing as, 9=Like Extremely, 8=Like Very Much, 7=Like Moderately, 6=Like Slightly, 5=Neither Like nor Dislike, 4=Dislike Slightly, 3=Dislike Moderately, 2=Dislike Very Much, 1=Dislike Extremely).

### Statistical Analysis

The data so obtained was analyzed according to statistical procedure of computerized statistical package (i.e. Student Edition of Statistics Version 8.1). ANOVA was done to achieve differences in average values through Least Significant Difference at  $p < 0.05$ .

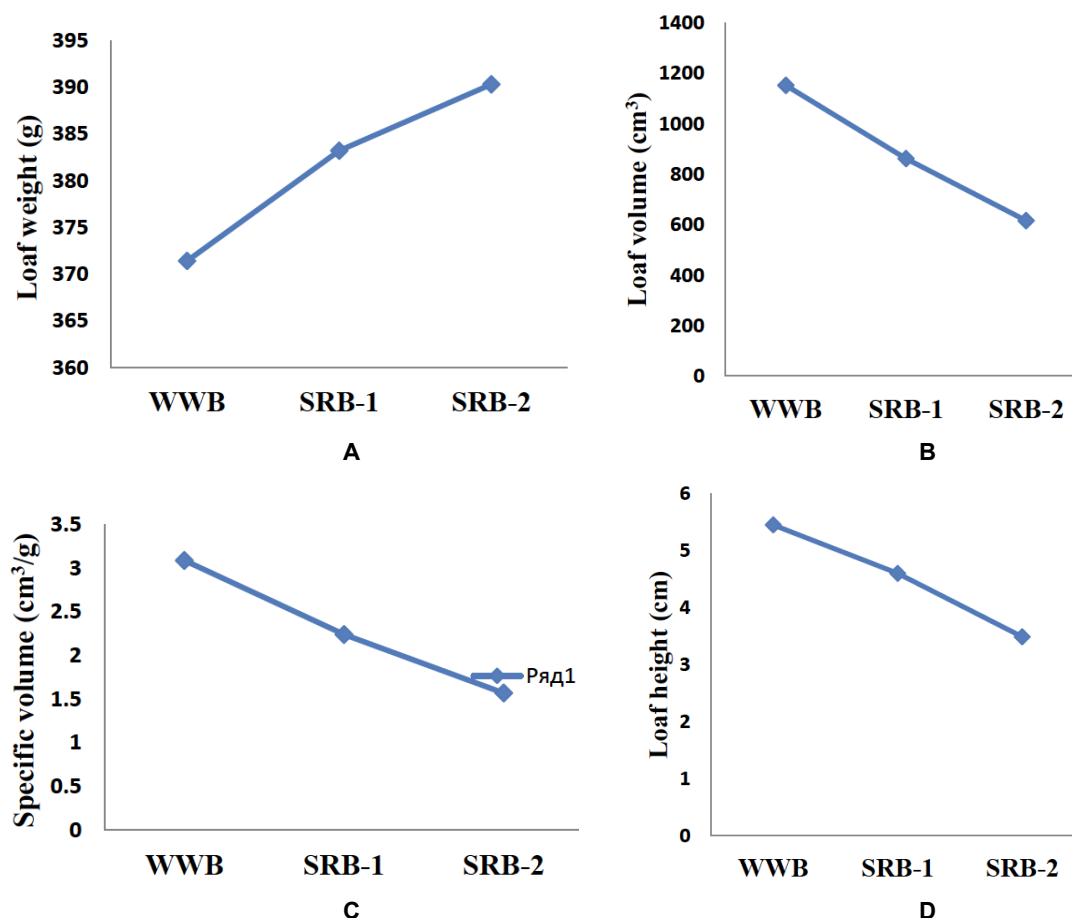
## RESULT AND DISCUSSION

### Loaf Characteristics

The results for loaf weight (g) are presented in Figure 1, it was found that loaf weight (g) of bread samples WWB, SRB-1 and SRB-2 was 371.4, 383.2 and 390.3g, respectively. The loaf weight of SRB-1 and SRB-2 was significantly higher ( $p < 0.05$ ) than WWB. These results revealed that loaf weight of bread samples increased with increasing level of sorghum and rice flour. Similar results were obtained by [10], according to them, the loaf weight of bread samples was increased with increasing level of non-wheat flour (cocoyam flour). Loaf volume ( $\text{cm}^3$ ) of bread samples is

**Table 1: List of Ingredients (g) Used to Prepare Fortified Bread Samples with Different Composite Flour**

Ingredients	Bread samples		
	WWB	SRB-1	SRB-2
F1	400	-	-
F2	-	400	-
F3	-	-	400
Water (ml)	300	300	300
Fat/Shortening (g)	60	60	60
Sugar (g)	22.5	22.5	22.5
Yeast (g)	15	15	15
Salt (g)	2.5	2.5	2.5
Total weight of dough (g)	800	800	800



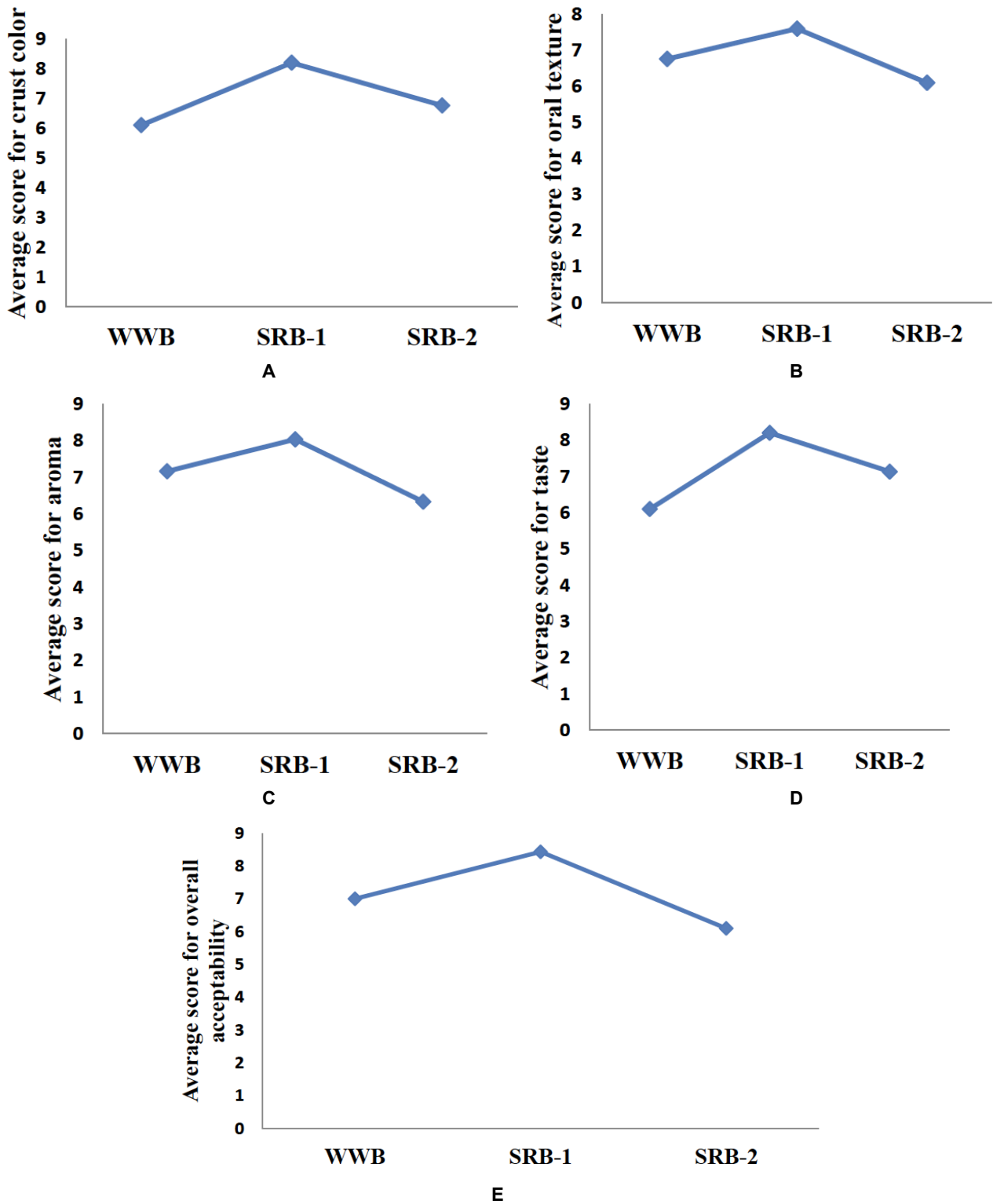
**Figure 1:** **A** Average weight (g), **B** Average volume (cm<sup>3</sup>), **C** Average specific volume (cm<sup>3</sup>/g) and **D** Average height (cm) of bread samples prepared with different formulations of wheat, rice and sorghum flour.

given in Figure 2 which remained 1152.0, 862.1 and 615.9cm<sup>3</sup> for WWB, SRB 1 and SRB 2, respectively. Bread samples SRB-1 and SRB-2 were found to have significantly lower ( $p < 0.05$ ) loaf volume in comparison to WWB which clearly shows that substitution of whole wheat flour with sorghum and rice flour is the reason behind this. Decrease in loaf volume with subsequent addition of non-wheat flour might be due to less retention of carbon dioxide (CO<sub>2</sub>) in SRB-1 and SRB-2 as explained by [11]. It is also obvious that substitution of wheat flour by other flour reduces the gluten fraction which is the source of elasticity in dough. This elasticity helps in retaining carbon dioxide produced during fermentation. Reduced gluten fraction in SRB-1 and SRB-2 caused a compact, compressed, less aerated texture and decreased raise in loaf size. These results are in agreement with [12-13], according to them, addition of dietary fiber rich substances in baking products reduce loaf volume. Similar trend of results were obtained for specific volume of loaf in present study and are given in Figure 1. Specific volume of loaf (cm<sup>3</sup>/g) remained 3.09, 2.24 and 1.57 cm<sup>3</sup>/g for WWB, SRB-1 and SRB-2, respectively.

Specific volume of loaf of SRB-1 and SRB-2 was significantly lower ( $p < 0.05$ ) than that of WWB. It is ultimate that bread samples with reduced volume will also have reduced specific volume. Present results are in-line with the findings of [14, 15-16], who reported decrease in loaf volume and specific volume with the increased substitution of wheat flour with other flour. The findings for loaf height (cm) are given in Figure 1 which indicates that loaf height remained 5.45, 4.60 and 3.49cm for WWB, SRB-1 and SRB-2, respectively. Loaf height of fortified bread samples SRB-1 and SRB-2 was significantly lower ( $p < 0.05$ ) than that of WWB. It is understandable that loaves with reduced volume will also have short height. It is reported by [17] that more fiber can decrease bread expansion and thus reduced bread size. Sorghum is more in fiber content, might be its fortification in SRB-1 and SRB-2 is the reason of decrease in loaf height.

### Sensory Evaluation

The results for sensory attributes of control and fortified bread samples are presented in Figure 2. The score for all sensory attributes i.e. crust color, crumb



**Figure 2:** A Average score for crust color, B Average score for oral texture, C Average score for aroma, D Average score for taste, E Average score for overall acceptability of bread samples prepared with different formulations of wheat, rice and sorghum flour.

color, manual texture, oral texture, aroma, taste and overall acceptability remained significantly higher ( $p < 0.05$ ) for fortified bread sample SRB-1 in comparison to SRB-2 and WWB. In between SRB-2 and WWB,

significantly higher ( $p < 0.05$ ) score for all sensory attributes was recorded in WWB. This significant increase in average score for all sensory attributes in SRB-1 is might be due to appropriate formulation of

whole wheat, sorghum and rice flour at ratio 80:10:10, respectively. Present results are in accordance with the finding of [10], in their study, whole wheat bread sample fortified with 10% non-wheat flour (cocoyam flour) was recorded to have significantly higher score for taste. In another study, conducted by [16], bread sample fortified with 5% non-wheat flour (cocoa pod husk powder) perceived higher score for crust and crumb color. The results for manual and oral texture are in agreement with the [18], according to them, fiber contained in bread may constrain the expansion of gas cells and results a harder, compact and tough bread texture. It is logical that less addition of fiber rich non-wheat flour for bread making is ideal for retaining textural properties of the breads. In present finding, higher score perceived by SRB-1 for aroma and overall acceptability might be due to its perfect substitution level of whole wheat flour with sorghum and rice flour.

## CONCLUSION

Present study concludes that fortified bread samples i.e. SRB-1 and SRB-2 prepared from the substitution of whole wheat flour with sorghum and rice flour were found to have less improved loaf characteristics than that of control bread sample (WWB). However, sensorial properties of fortified bread sample i.e. SRB-1 perceived better score for all attributes in comparison to WWB and SRB-2.

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