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# Influence of malted finger millet and red kidney bean flour on quality characteristics of developed bread

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ABSTRACT

The effects of malted finger millet (MFM) and red kidney bean flour (RKF) substitution on nutritional, sensory, and textural characteristics of yeast leavened bread was investigated in this study. Based on the preliminary studies optimized level of substitution of either MFM or RKF in refined wheat flour in the recipe was fixed at 20 g/100 g of wheat flour. The bread with MFM exhibited better sensorial characteristics and textural attributes in comparison to the RKF incorporated bread. But the addition of RKF showed higher nutritional and mineral composition when compared with the MFM substituted bread. The results further indicated a requirement for optimization of processing conditions to maximize bread quality attributes for better commercial acceptability.



## 1. Introduction

Bakery foods are the major cereal products available to consumers. Bread has been the principal food in over half of the countries around the world (Chung & Pomeranz, 1983). Hence an increased consumer demand for nutritious bread led to considerable efforts to develop breads that combine health benefits with good sensorial properties. The bakery sector is presently focusing on use of high fiber, high protein, low calorie in prepared products (Indrani & Venkateswara Rao, 2000) but some studies opines lower peak viscosities for substituted flours when compared to commercial white wheat flour due to the high amount of dietary fiber and low amount of total carbohydrate present in the samples (Hung, Maeda, & Morita, 2007). Hence the optimum pasting properties and structural characteristics such as specific volume for the development of baked products is a concern. Regardless the use of whole grain wheat flour is one strategy for the development of healthy breads as the consumption of whole grain has been shown to reduce the risk of colorectal cancer, cardiovascular diseases, diabetes and obesity (Slavin, 2005; Topping, 2007). The use of composite flours for bread making is also recent development across the globe owing to some economic, social and health reasons.

Finger millet (*Eleusine coracana*) also known, as 'ragi' is consumed without dehulling. It is the principal food grain of the rural population belonging to low-income groups. The tiny millet grain has a dark brown seed coat, richer in polyphenols. Ravindran (1991) has showed that finger millet has carbohydrate of 81.5 g, protein 9.8 g, crude fiber 4.3 g and mineral 2.7 g per 100 g sample, which is comparable to other cereals and millets. Its crude fiber and mineral content is markedly higher; its protein is relatively better balanced; it contains more lysine, threonine and valine in comparison to other millets. Malting of cereal grains (rice and ragi) was shown to bring about dynamic changes in the physicochemical/structural features of grain (Rao Shyama Prasad et al., 2006). Moreover malted finger millet is already being utilized as a nourishing food for infants and is considered as wholesome food for diabetics (Subba Rao, Sai Manohar, & Muralikrishna, 2004).

Red kidney bean (*Phaseolus vulgaris*) is very low in sodium, and saturated fatty acids but rich in unsaturated fatty acids such as linoleic acid (Barampama & Simard, 1993). They are not only a good source of both soluble and insoluble dietary fiber but also health benefits, including reduced risk of heart disease and colon cancer (Hughes, 1991). All legume storage proteins are relatively low in S-containing amino acids, methionine, cysteine and tryptophan, but the amounts of lysine, an essential amino acid, are much greater than in cereal grains (Ampe et al., 1986; Rockland et al., 1981). Therefore, legume and cereal proteins are nutritionally complementary, with respect to lysine and sulfur amino acid contents (Marcello Duranti, 2006) and a balanced blend or mixture of both

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grains has a greater nutritional value than either ingredient alone (Kadam & Salunkhe, 1985).

With this background, work was undertaken to study and compare the individual influence of malted finger millet flour and red kidney bean flour on the sensory attributes, textural properties, and nutrient composition of yeast leavened bread.

## 2. Materials and methods

Refined wheat flour, finger millet grains, red kidney beans (dried), salt, sugar, active dry yeast and oil were brought at the local market and special concern was given to use the same brand names throughout the work.

### 2.1. Preparation of blends

To provide maximum nutritional benefit in bread, finger millet grain was malted and milled to flour. To obtain malted finger millet flour (MFM), the finger millet grain at first was washed and cleaned properly with water. Cleaned finger millet was steeped in the water at 30 °C for 12 h and germinated at 25 °C for 2 days in a sterile moistened cloth bag kept in dark. Moistened conditions were maintained throughout the germination period by spraying water. The germinating grains were dried under direct sun on flat stainless steel trays for 2 h to arrest germination. The dried germinated grains were introduced into grinder mill to obtain malted finger millet flour and the obtained flour was cooled and stored at 4 °C in air tight containers.

To prepare red kidney bean flour (RKF), the seeds were washed, cleaned and kept for drying in hot air oven at 50 °C for 12 h. The dried seeds were then finely ground and stored at 4 °C in air tight containers.

The prepared flours i.e., MFM & RKF were then combined with refined wheat flour at 10 g, 20 g, and 30 g level individually and the quality of prepared breads was studied.

### 2.2. Pasting properties and yeast leavened bread making characteristics

A Rapid Visco Analyser (RVA) (Newport Scientific PVT, Ltd., Warriewood, Australia) was used to determine the pasting properties of the flour mixes. Analysis was performed on the flours in triplicate according to the standard Newport Scientific method for whole meal flour (4 g flour, 14 g moisture basis) with slight modification: flour samples (2 g dry weight) was transferred to an RVA canister, and double distilled water was added to the flour to give a final weight of starch suspension of exactly 25 g. The starch suspension was held in the RVA at 50 °C for 1 min, heated from 50 to 95 °C at a rate of 12 °C/min, held at 95 °C for 2.5 min, cooled to 50 °C at a rate of 12 °C/min, and held at 50 °C for 2 min (Li, Hasjim, Dhital, Godwin, & Gilbert, 2011). The heating process was accompanied with a constant shear at 960 rpm for the first 10 s followed by a constant shear at 160 rpm until the end of the analysis. The peak viscosity, breakdown, setback, final viscosity, and pasting temperature of the flour were identified from the pasting curve using Thermocline Version 2.2 software (Newport Scientific, Warriewood, NSW, Australia). For bulk density determination, a circular container of known volume was filled with the sample of flour and gently tapped. The excess flour was leveled off and the content was weighed. The bulk density was calculated as the ratio of mass of contents to volume of container. Average of three replications was reported. Breads with different formulations were prepared by straight dough method of bread preparation (AACC Method 10-10.03). The ingredients were added based on a percentage flour weight. After baking, the bread loaf was kept for cooling for 2 h on a cooling rack. The cooled bread loaf was then weighed on weighing balance to obtain total loaf weight. The cooled loaf of bread samples were then taken up for volume calculation by rapeseed displacement method (Lopez, Pereira, & Junqueira, 2004) prior to slicing. The specific volume was calculated by dividing loaf volume by loaf weight.

### 2.3. Finding the best addition level of MFM & RKF in bread

MFM and RKF were incorporated individually at 0 g, 10 g, 20 g, and 30 g substitution to refined wheat flour. For deciding the best amount of substitution of refined wheat flour with MFM & RKF, sensory evaluation of the products was conducted based on overall external appearance: color, texture, flavor, taste and overall acceptability. An initial group of 16 members (generally who consume bread or other baked cereal products everyday) were recruited for the panel formation from the Department of Food Science & Technology, Pondicherry University, Puducherry. The training was carried out in sessions of 1.5 h divided into two parts: a) training in general aspects of sensory techniques and analyses b) training in more specific aspects of bread and closely related products. Regular training sessions were held with standard tests to monitor the ability of each panelist. The samples were coded with random alphabet codes and the panelists evaluated three breads in one session. After six months of training, a study to identify the discriminating capacity, & reproducibility for each panelists was conducted .Seven panelists were selected after the consecutive sessions on the basis of their ability to correctly identify characteristics. Three of the original set of 16 members was eliminated due to irregular attendance and the remaining 6 members failed to recognize aroma for which they were not selected. Bread samples on a white plate labeled with random one alphabet codes were presented to the observers, seven panelists, were asked to evaluate the above attributes of the samples and to rate each attributes on a scale from 1 (dislike extremely) to 9 (like extremely) using a 9 point hedonic scale (Meilgaard, Civille, & Carr, 1991). This experiment was conducted under a controlled environment, in a cool place.

### 2.4. Proximate composition analysis and WD-XRF studies

The optimized products of MFM bread and RKF bread were analyzed for moisture (method 44-16), protein (method 46-10), ash (method 08-01) and fat (method 30-10) using the American Association of Cereal Chemists (AACC, 2000) methods. Dietary fiber (method 991.43) was determined according to AOAC (1999) method. All analyses were conducted in triplicate. For the mineral estimation by WD-XRF (Bruker), the bread samples were ashed (AACC, 2000 method 08-01). Prior to ashing the crumb and crust of bread were separated. For preparation of sample, two g of the ash samples was crushed and mixed with 0.5 g boric acid (granulated) with a mortar and pestle. The prepared sample was then made into a 34 mm dia. pellet with the help of a 40 ton hydraulic press machine (10 ton pressure, 20 min pressing time). The pellets were then introduced in the sample slots of WD-XRF and analyzed further.

### 2.5. Color, texture and microstructure studies

The color parameters of breads were measured using a Hunter Lab color flex model A60-1012-312 (Hunter Associates laboratory, Reston, VA). The equipment was standardized each time with white and black standards. Samples were scanned to determine lightness ($L^*$), red-green ($a^*$) and yellow-blue ($b^*$) color components.