RESEARCH PAPER

FOOD SCIENCE
RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 8 | Issue 1 | April, 2017 | 35-42
DOI : 10.15740/HAS/FSRJ/8.1/35-42

# Studies on the effect of stabilized rice bran supplementation on physico-chemical, microbial and textural quality of bread

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This project was designed to evaluate the suitability of stabilized rice bran for the supplementation of bread. Freshly milled rice bran was treated with autoclave heating for its stabilization. The effect of stabilized rice bran supplementation on physico-chemical, microbial and textural quality of wheat bread was determined. Blends of wheat flour and rice bran (95:5, 90:10, 85:15 and 80:20) were used to bake bread with 100 per cent wheat flour as control. The physical properties of bread were evaluated and found that loaf weight increased with increasing per cent of rice bran flour into refined wheat flour. The loaf volumes of bread made from composite flour were lower than those made from control wheat flour. The effect of different levels of stabilized rice bran on crust and crumb colour of bread was evaluated. Results showed that lightness of crust and crumb of wheat bread gets decreased with increased level of stabilized rice bran. Also, redness (a) and yellowness (b) increased with increased level of stabilized rice bran. The proximate composition of the bread samples was analyzed. The moisture, crude protein, crude fat, crude fibre and ash contents increased significantly from 31.12 per cent to 33.98 per cent, 11.87 per cent to 13.38 per cent, 1.52 per cent to 3.95 per cent, 0.82 per cent to 2.65 per cent and 1.52 per cent to 2.09 per cent, respectively; with increased level of supplementation. The carbohydrate contents decreased with increased level of supplementation from 53.13 per cent to 43.92 per cent. The microbial properties shown that there was no significant difference in total plate count and yeast and mould count of functional wheat bread on increasing the supplementation of rice bran flour. The texture profile analysis showed that hardness and chewiness of functional wheat bread was increased with increase in supplementation of rice bran flour. There was no significant difference in springiness and cohesiveness of wheat bread supplemented with stabilized rice bran.

**Key Words :** Composite Bread, Rice bran, Supplementation, Microbial quality, Textural quality.

**How to cite this article :** Sangle, J.K., Sawate, A.R., Patil, B.M. and Kshirsagar, R.B. (2017). Studies on the effect of stabilized rice bran supplementation on physico-chemical, microbial and textural quality of bread. *Food Sci. Res. J.*, **8**(1): 35-42, **DOI : 10.15740/HAS/FSRJ/8.1/35-42**.

## INTRODUCTION

Bread is one of the most popular and wide spread baked products in the world and its quality depends on several physical (*i.e.* texture, volume, colour) and organoleptic characteristics (e.g. volatiles), which could be influenced by many factors, such as flour type and other ingredients, bread-making procedure, fermentation, cooking time and temperature. In the recent years, bread showed an increasing attention as a potential functional food based on its great diffusion and consumption. Thus, industries and researchers are involved in optimizing

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bread-making technology to improve the variety, quality, taste and availability of active compounds, adding such components with nutritional and functional properties (Balestra *et al*., 2011) with the final aim to formulate a product with physiological effectiveness encountering consumers acceptance in terms of appearance, taste and texture (Siro *et al*., 2008). Maintaining and enhancing bread quality is therefore essential to human health. Various efforts have been made to improve the nutritional quality of wheat products through supplementation with a wide range of non-traditional ingredients (Hooda and Jood, 2003).

Rice is a staple food for more than half of humanity. The major rice growing countries are China, India, Indonesia, Bangladesh, Thailand, Burma, Vietnam, Japan and the Philippines. Rice bran is a by-product obtained from outer rice layers and is a good source of protein, mineral, and fatty acids, and dietary fibre content (Mccaskill and Zhang, 1999). Also rice bran is used for the enrichment of some foods, due to its high dietary fibre content.

Rice bran constitutes the brown covering of the grain beneath the outer husk. It constitutes 8 per cent of the weight of the whole grain and contains most of the nutrients (65%). During milling process rice bran containing nutrients is completely removed. Around 60 million metric tons of rice bran is produced worldwide each year and almost all of it is either thrown away or used as low level animal and poultry feed. Rice bran is a very rich source of nutrients containing vitamins, minerals, oils, wax, trace elements, antioxidants, phytosterols, and phytochemicals. It is a good source of manganese, magnesium, vitamins B1, B2, B6, and minerals *i.e.*, potassium, calcium, phosphorus, and pantothenic acid. Recent information indicate that its high nutrient contents are hard to ignore (Rabbani and Ali, 2009).

Immediately following the milling process, rapid deterioration of the crude fat in the bran by lipase and, to a lesser extent, oxidase occurs and makes the bran unfit for human consumption. Lipases are enzymes present naturally in paddy which are become active and rapidly hydrolyzed the unsaturated fat into free fatty acids and glycerol. These fatty acids are oxidized by atmospheric oxygen and become rancid (Faiyaz *et al*., 2007). The deterioration of rice bran by lipase and lipoxygenase is affected by storage temperature and packaging conditions. Oxidative rancidity by lipoxygenase should increase in the presence of oxygen and the rate of hydrolytic, and oxidative rancidity should increase with increased storage temperature and packaging conditions. Therefore, bran stored in sealed bags should have a longer shelf-life than bran exposed to the atmosphere (Fatemeh *et al.*, 2000). Stabilization of rice bran can helps to overcome the problems. High temperatures above 120ºC denature the enzyme responsible for lipid degradation in rice bran oil without destroying the nutritional value of the rice bran (Lakkakula *et al.*, 2004).

Yeast is needed in dough leavening to generate adequate carbon dioxide as well as to obtain a fine aerated structure of bread. Destruction of yeast cells caused a reduction in gas production and hence, affected quality of the final bakery products (Newberry *et al*., 2002). Baking is important because several fundamental complex physical processes are coupled during baking, such as, evaporation of water, volume expansion, gelatinization of starch, denaturation of protein and crust formation etc. As soon as the dough is properly baked into bread, a product with superior quality and sensory features occurs. Fresh bread usually presents an appealing brownish and crunchy crust, a pleasant aroma, fine slicing characteristics, a soft and elastic crumb texture, and a moist mouth feel (Giannou *et al.*, 2003).

## METHODOLOGY

The research work was carried out at Department of Food Engineering, College of Food Technology, Vasantarao Naik Marathwada Krishi Vidhyapeeth, Parbhani, Maharashtra in the year 2016. The rice bran was procured from the Shri Laxmi Narsinhma Rice Mill, Secunderabad. Wheat flour and bread ingredients were collected from Parbhani local market. Chemicals required for preparation and analysis of bread were obtained from Department of Food Engineering, College of Food Technology, V.N.M.K.V., Parbhani. Other required materials and machineries were obtained from College of Food Technology, Parbhani.

**Collection and processing of rice bran:**

The rice bran, one of the valuable by products of rice milling, is normally finely granulated, light tan in colour and has a bland flavour. The sample namely full fatted raw rice bran was procured from the Shri Laxmi Narsinhma Rice Mill, Secunderabad.

## Stabilization of rice bran:

The stabilization method reduces or inhibits the activity of lipase enzyme. This process increases the shelf-life of the rice bran. The autoclave method of stabilization was tried to get a well stabilized full fatted raw rice bran (Rosniyana *et al*., 2009).

## Formulation and preparation of bread:

Stabilized rice bran was used in preparation bread in different quantities for value addition. Coarseness of rice bran was removed using sieving method. Formulation of functional wheat bread supplemented with stabilized rice bran is given in Table A and the recipe for preparation of bread is outlined and mentioned below in Table B.

**Table A : Formulation of wheat bread supplemented with stabilized rice bran**

| Treatments | Refined wheat flour (%) | Stabilized rice bran(%) |
|---|---|---|
| (Control) $T_0$ | 100 | 0 |
| $T_1$ | 95 | 5 |
| $T_2$ | 90 | 10 |
| $T_3$ | 85 | 15 |
| $T_4$ | 80 | 20 |

**Table B : Bread recipe used in bread production**

| Sr. No. | Ingredients | Weight (g) |
|---|---|---|
| 1. | Flour | 100.0 |
| 2. | Water | 60 .0 |
| 3. | Sugar | 25.0 |
| 4. | Shortening | 5.0 |
| 5. | Salt | 1.5 |
| 6. | Yeast | 5.0 |
| 7. | SMP | 1.0 |
| 8. | GMS | 0.2 |
| 9. | Calcium propionate | 0.15 |

**Sieving and mixing of ingredients along with refined wheat flour and rice bran**
↓
**Fermentation (at $21-26^0$C)**
↓
**Knock back**
↓
**Dividing**
↓
**Intermediate proofing**
↓
**Molding and panning**
↓
**Pan proofing**
↓
**Baking ($200^0$C for 20 min.)**
↓
**Cooling (2 hrs)**
↓
**Slicing**
↓
**Wrapping**

**Fig. A : Flow sheet for preparation of wheat bread (Rodge *et al.*, 2012)**

## Preparation of wheat bread using stabilized rice bran (Fig. A):

## Physical analysis of bread:

– *Loaf weight:* The loaf weight was measured directly by using weighing balance.

– *Loaf volume:* The loaf volume was determined by (AACC, 2000) method.

– *Specific volume:* The specific volume of bread was calculated according to (AACC, 2000).

– *Crumb to crust ratio:* It will be determined by separating crust and crumb using sharp blade and weighing each component (Barett *et al*., 2005).

## Proximate analysis of wheat flour, rice bran and bread samples:

The proximate composition of wheat flour, stabilized rice bran and bread was analyzed. Proximate composition such as moisture, fat, crude protein, ash and crude fibre were determined as per (AOAC, 2005) and carbohydrate by difference method. The carbohydrate content was estimated by the difference method (Ihekoronye and Ngoddy, 1985).

## Microbial quality of functional bread:

In the study of microbial quality of functional bread, the study was undertaken examination of the Total Plate Count (TPC). The total plate count of functional bread was determined by using simply a Total Plate Count agar and results noted in cfu/ml. Yeast and mould count was calculated using Potato dextrose agar and results noted in cfu/ml (Tarar *et al*., 2010).

## Texture profile analysis of functional wheat bread supplemented with stabilized rice bran:

Texture analysis of bread prepared using different levels of rice bran flour was performed using a texture analyzer (TA-XT Plus™, Stable Micro Systems, UK) as adopted by the standard method by AACC, method 74-

09 (A.A.C.C., 2000).

**Statistical analysis:**

Triplicate data of the all experimental treatments were statistically analyzed by Completely Randomized Design (CRD) using analysis of variance (ANOVA) in SAS statistical software. The analysis of variance revealed at the significance of S.E. and C.D. at 5 per cent level is mentioned wherever required (Panse and Sukhatme, 1967).

## OBSERVATIONS AND ASSESSMENT

Table 1 summarizes the proximate composition of wheat flour and the stabilized rice bran. It was observed that obtained wheat flour found to contain 13.47 per cent of moisture. The lower moisture content of wheat flour justifies the suitability for long term storage without deterioration. The carbohydrate content of wheat flour was found to be 71.43 per cent with the protein content of 12.71 per cent. Higher protein content is important for strong elastic dough which having high water absorptive capacity, excellent gas holding properties and will yield bread with good volume, grain and texture. The observed values for crude fat and ash content were 0.94 per cent and 0.71 per cent, respectively. The stabilized rice bran contains 6.74 per cent moisture, 17.14 per cent fat, 13.11 per cent protein, 9.9 per cent ash, 7.0 per cent crude fibre and 46.08 per cent of carbohydrate. The results were in agreement with previously reported results by (Quilez *et al.*, 2013; Pacheco *et al.*, 2009; Rodge *et al.*, 2012 and Priyanka *et al.*, 2013).

It can be clearly seen from Table 2 that loaf weight increased with increasing per cent of rice bran flour into refined wheat flour. The loaf weight was found higher in $T_4$ (254.15 g) and lowest value was in $T_0$ (251.30 g). The loaf volume of bread decreased progressively from $T_0$ (784.05 ml) to (759.35 ml) $T_4$. The volumes of bread made from composite flour were lower than those made from control wheat flour. These findings is in agreement with that reported by Feili *et al.* (2013) who have also found lower volumes of associated with composite as opposed to 100 per cent wheat. Morad *et al*. (1984) concluded that the substitution of hard wheat flour significantly decreased the loaf volume of pan bread. This can be attributed to lower level of gluten network in the dough and consequently less ability of dough to rise due to the weaker cell wall structure. Specific volume of $T_1$ and $T_2$ treatments were comparable to control treatment. Specific volume decreased progressively with increasing amount of rice bran flour in composite bread. Crust to crumb ratio in the present investigation was found to be decreased progressively and linearly highest crust to crumb ratio was found in control $T_0$ (0.282) followed by $T_1$ (0.277). whereas, minimum was found in $T_4$ (0.259).

**Table 1 : Proximate composition of refined wheat flour and stabilized rice bran**

| Constituents | Amount (%) | |
|---|---|---|
| | Refined wheat flour | Stabilized rice bran |
| Moisture | 13.47 | 6.74 |
| Fat | 0.94 | 17.14 |
| Protein | 12.71 | 13.11 |
| Ash | 0.71 | 9.9 |
| Crude fibre | 0.64 | 7.0 |
| Carbohydrate | 71.43 | 46.08 |

*Each value is average of three determinations

**Table 2 : Physical properties of functional wheat bread supplemented with stabilized rice bran**

| Sample | Loaf weight (g) | Loaf volume (ml) | Specific loaf volume (ml/g) | Crust to crumb ratio |
|---|---|---|---|---|
| $T_0$ | 251.30 | 784.05 | 3.12 | 0.282 |
| $T_1$ | 252.61 | 778.46 | 3.08 | 0.277 |
| $T_2$ | 253.04 | 773.55 | 3.05 | 0.269 |
| $T_3$ | 253.56 | 765.89 | 3.02 | 0.261 |
| $T_4$ | 254.15 | 759.35 | 2.98 | 0.259 |
| S.E. ± | 0.087 | 0.092 | 0.022 | 0.017 |
| C.D. (P=0.05) | 0.263 | 0.271 | 0.067 | 0.054 |

The effect of different levels of stabilized rice bran on crust colour of bread was presented in Table 3. Results showed that lightness of crust of wheat bread gets decreased with increased level of stabilized rice bran. Also, redness (a) and yellowness (b) increased with increased level of stabilized rice bran. The results are similar to those reported by Feili *et al.* (2013) and Tuncel *et al.* (2014).

The effect of different levels of stabilized rice bran on crumb colour of bread was presented in Table 4. Results showed that lightness of crumb of wheat bread gets decreased with increased level of stabilized rice bran. Also, redness (a) and yellowness (b) increased with increased level of stabilized rice bran. The results are similar to those reported by Feili *et al.* (2013) and Tuncel *et al.* (2014).

Results of the proximate composition of the bread samples are presented in Table 5. The moisture, crude protein, crude fat, crude fibre and ash contents increased significantly ($p<0.05$) from 31.12 per cent to 33.98 per cent, 11.87 per cent to 13.38 per cent, 1.52 per cent to 3.95 per cent, 0.82 per cent to 2.65 per cent and 1.52 per cent to 2.09 per cent, respectively; with increased level of supplementation. This is in agreement with (Farrell, 1994), who earlier reported that rice bran is a good source of proteins, lipids, dietary fibre and minerals and could be an effective tool in supplementing lysine and methionine deficient foods such as wheat, maize and sorghum to overcome the prevailing malnutrition problem. The carbohydrate contents decreased with increased level of supplementation from 53.13 per cent to 43.92 per cent. This is expected since there is very little carbohydrate left in rice bran after milling. The results were in agreement with previously reported results for this kind product (Mumtaz *et al*., 2005 and Michael *et al*., 2013).

Protein in the diet helps primarily to build and maintain

**Table 3 : Effect of different levels of stabilized rice bran on crust colour of bread**

| Treatments | Colour values | | |
|---|---|---|---|
| | L value | a value | b value |
| (Control) $T_0$ | 43.98 | 14.34 | 27.08 |
| $T_1$ | 44.66 | 14.98 | 28.21 |
| $T_2$ | 42.45 | 15.75 | 28.92 |
| $T_3$ | 41.90 | 16.95 | 29.85 |
| $T_4$ | 41.19 | 17.49 | 30.67 |

*Each value is average of three determinations

**Table 4 : Effect of different levels of stabilized rice bran on crumb colour of bread**

| Treatments | Colour values | | |
|---|---|---|---|
| | L value | a value | b value |
| (Control) $T_0$ | 66.77 | 1.58 | 12.10 |
| $T_1$ | 64.28 | 2.31 | 12.85 |
| $T_2$ | 60.40 | 3.27 | 13.54 |
| $T_3$ | 59.65 | 3.70 | 14.18 |
| $T_4$ | 57.40 | 4.34 | 15.03 |

*Each value is average of three determinations

**Table 5 : Chemical composition of wheat bread supplemented with stabilized rice bran**

| Treatments | Proximate composition (%) | | | | | |
|---|---|---|---|---|---|---|
| | Moisture | Fat | Protein | Ash | Crude fibre | Carbohydrate |
| $T_0$ | 31.12 | 1.52 | 11.87 | 1.52 | 0.82 | 53.13 |
| $T_1$ | 31.81 | 2.04 | 12.08 | 1.67 | 1.98 | 50.41 |
| $T_2$ | 32.74 | 2.51 | 12.39 | 1.76 | 2.23 | 48.35 |
| $T_3$ | 33.29 | 3.47 | 12.91 | 1.85 | 2.59 | 45.86 |
| $T_4$ | 33.98 | 3.95 | 13.38 | 2.09 | 2.65 | 43.92 |
| S.E. ± | 0.159 | 0.139 | 0.141 | 0.025 | 0.014 | 0.050 |
| C.D. (P=0.05) | 0.180 | 0.418 | 0.426 | 0.075 | 0.043 | 0.151 |

**Table 6 : Microbial properties of functional wheat bread supplemented with rice bran**

| Sr. No. | Sample | Total plate count (cfu/ml) | Yeast and mold count (cfu/ml) |
|---|---|---|---|
| 1. | $T_0$ | 2.1 x $10^2$ | 1.2 x $10^2$ |
| 2. | $T_1$ | 2.1 x $10^2$ | 1.3 x $10^2$ |
| 3. | $T_2$ | 2.2 x $10^2$ | 1.3 x $10^2$ |
| 4. | $T_3$ | 2.2 x $10^2$ | 1.4 x $10^2$ |
| 5. | $T_4$ | 2.3 x $10^2$ | 1.4 x $10^2$ |

*Each value is the mean of three determinations

**Table 7 : Texture profile of functional wheat bread supplemented with stabilized rice bran**

| Sample | Hardness (kg) | Springiness | Cohesiveness | Chewiness (kg-sec) |
|---|---|---|---|---|
| $T_0$ | 1.943 | 1.06 | 0.935 | 1.925 |
| $T_1$ | 1.999 | 1.05 | 0.979 | 2.054 |
| $T_2$ | 2.099 | 1.10 | 0.947 | 2.186 |
| $T_3$ | 2.145 | 1.08 | 1 | 2.316 |
| $T_4$ | 2.188 | 1.08 | 0.915 | 2.162 |
| S.E. $\pm$ | 0.026 | 0.005 | 0.009 | 0.024 |
| C.D. (P=0.05) | 0.081 | 0.017 | 0.029 | 0.074 |

body cells, while fat supplies essential fatty acids. Crude fibre plays an important role in the prevention of many diseases of the digestive tract. It has been reported that intake of more fibre results in increasing faecal bulk and lowering of plasma cholesterol (Kehlon *et al*., 1994).

The microbial properties of bread supplemented with stabilized rice bran were shown in Table 6. The results shown that there was no significant difference in total plate count and yeast and mould count of functional wheat bread on increasing the supplementation of rice bran flour. The highest value of total plate count was found in $T_4$ sample while lowest value of total plate count was found in $T_0$ sample. Also, the highest value of yeast and mould count was found in $T_4$ sample while lowest value of yeast and mould count was found in $T_0$ sample. The results were in agreement with previously reported results of (Ogundare and Adetuyi, 2003).

The texture profile of bread supplemented with stabilized rice bran was shown in Table 7. Hardness and chewiness of functional wheat bread was increased with increase in supplementation of rice bran flour. The highest hardness 2.188 (kg) was found in $T_4$ sample. The lowest hardness 1.943 (kg) was found in $T_0$ sample. There was no significant difference in springiness and cohesiveness of wheat bread supplemented with stabilized rice bran. The highest chewiness was found in $T_3$ sample, while lowest value of chewiness was found in $T_0$ sample. The results were in agreement with previously reported results of (Feili *et al.*, 2013).

## Conclusion :

Acceptable and nutritious bread was produced from composite flours of wheat and autoclaved (stabilized) rice bran. Rice bran supplementation significantly improved the nutritional quality of the bread. There was least differences in loaf volume and specific volume of bread supplemented with stabilized rice bran. There was no significant difference in total plate count and yeast and mould count of functional wheat bread on increasing the supplementation of rice bran flour. There was no significant difference in springiness and cohesiveness of wheat bread supplemented with stabilized rice bran. It can be concluded from the results that upto 15 per cent stabilized rice bran can be successfully incorporated in the bread to improve the nutritional attributes while maintaining other quality attributes of bread. As, Bread is a staple food for many countries. Therefore, it is concluded that stabilized rice bran can be used to replace wheat flour in product development to achieve the objectives of reducing the cost of cereal based stable foods and developing health enhancing bread for the consumers.

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**Received :** *30.01.2017;* **Revised:** *18.02.2017;* **Accepted :** *27.02.2017*