

Original Research Article

A Comparative Assessment of Quality Features and Physicochemical Characteristics of Rice Bran Supplemented Breads with Local Breads

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ABSTRACT

Aims: Qualitative assessment of rice bran supplemented bread with local breads.

Study design: The study was designed to identify good quality bread between rice bran supplemented bread and local breads.

Place and Duration of Study: Sample: Five different varieties of rice brans (BR-5, BR-10, BRRI-28, BRRI-39, and Kalijira) were collected from Noor-Habib Grain Industries Ltd. Sopura, Rajshahi, Janata Auto Rice and Flour Mills Ltd. Bogura, North Bengal Auto Rice Mills, Naogan, Biswas Rice Mills, Natore, and Chaudhuri Auto Rice Mills Dinajpur respectively. The research was carried out at Natural Products Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories, Rajshahi, Bangladesh.

Methodology: A comparative analysis of prepared rice bran supplemented bread and locally available bread has been done for the parameters such as moisture, ash, Fiber, Fat, protein, carbohydrate, total sugar, saponification value, FFAs and iodine value.

Results: The prepared rice bran bread contained wheat flour and five different varieties of rice bran named BR-5, BR-10, BRRI-28, BRRI-39 and kalijira. The physicochemical characteristics of prepared rice bran supplemented bread such as moisture, ash, Fiber, Fat, protein, carbohydrate, total sugar, saponification value, FFA and iodine value were varied from 26.0-28.4 %, 2.17-2.83%, 1.54-1.96%, 6.95-8.04%, 6.64-7.25%, 43.2-46.3%, 5.60-6.80%, 150-169 mg KOH/g fat, 1.16-1.51 mg KOH/g fat, 92.1-100 g I₂/100g fat respectively. On the other hand, physicochemical characteristics of locally available bread like moisture, ash, Fiber, Fat, protein, carbohydrate, total sugar, saponification value, FFA and iodine value were found to be ranged from 31.1-32.9%, 2.70-2.93%, 2.04-2.61%, 7.91-8.12%, 5.49-6.21%, 39.9-41.4%, 7.13-8.61%, 138-149 mg KOH/g fat, 1.63-1.86 mg KOH/g fat, 57.4-71.0

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g I₂/100g fat respectively.

Conclusion: It may be concluded that prepared rice bran supplemented bread might be considered superior quality than the locally available bread.

Keywords: Rice bran supplemented bread, aleurone layer, tocoferol, nutritional effect solubility, denature, free fatty acid, iodine value.

1. INTRODUCTION

Rice bran, a by-product of rice milling, is a rich source of oil [1], protein [2], minerals [3], and vitamins [4] and includes seed coat, aleurone layer germ and some portion of subaleurone layer of the starchy endosperm [5]. Rice bran accounts for 6% to 8.5% by weight of the rough rice depending upon the paddy variety and area of cultivation [6]. Crude rice bran oil contains 2-4% tocoferol, which has nutritional effect [7]. In Bangladesh the diet of the masses consists largely of polished rice obtained from the automatic rice mills and is more or less deficient in fat, protein, minerals and vitamins. Bangladesh occupies important position on the rice growing countries in the world. A wide variety of rice are extensively cultivated in Bangladesh with an annual production of 28 million tons [8]. Rice bran contains vitamin B₁ and vitamin A, which prevents beriberi and eye afflictions respectively [9]. If lipase activity is not controlled it will produce a high FFA which is not fit for human consumption [10]. Therefore, in the present study five new varieties of rice bran have been selected at different ratio for comparing their nutritional characteristics of prepared supplemented rice bran bread with market bread.

2. MATERIAL AND METHODS

The experiment was conducted in Natural Products Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories Rajshahi, Bangladesh. Five different varieties of rice brans (BR-5, BR-10, BRRI-28, BRRI-39, and Kalijira) were collected from Noor-Habib Grain Industries Ltd Sopura, Rajshahi, Janata Auto Rice and Flour Mills Ltd, Bogura, North Bengal Auto Rice Mills, Naogan, Biswas Rice Mills, Natore, and Chaudhuri Auto Rice Mills Dinajpur respectively. The bran samples contain some undesirable particle such as hull, broken rice and other foreign matters. So the bran samples were sieved through 30 mesh to separate the coarse and foreign particles and used immediately taken to the laboratory in fresh condition. The physicochemical characteristics such as moisture [11], Ash [12], Protein [2], Fibre and carbohydrate [13], FFA and saponification value [14,15] and iodine value were determined by Hanus methods [16]. All the chemicals used in this study were of analytical grade. Ethanol, n-Hexane, methanol, chloroform, petroleum ether, and ethyl acetate were purchased from Merck Germany, BDH England, and Sigma USA. Before use, all the solvents were further purified by distillation.

2.1 Preparation of bread using different varieties of rice bran and wheat flour

Wheat flour (85-95%) and (5-15%) of properly sieved fresh rice bran flour were mixed with required amount of water, vegetable fat, sugar, yeast, milk powder, salt etc. The whole mass was kept undisturbed for 3-4 hours. Then it was needed for proper mixing. Weighed amount of kneaded mass (properly mixed mass) was taken in a dice of desired size. The dice along with the mass was baked in the baking oven for the production of final product (bread).

73 **2.2 Solubility of proteins in aqueous solution and different solvents**

74 The solubility of protein of prepared rice bran breads was followed as reported by method
 75 [17]. The sample (5g) was mixed separately in a container containing 200ml distilled water.
 76 The mixture was stirred for 20 minutes at room temperature and then centrifuged at
 77 2000rpm for 10 minutes. The clear extract was filtered and the residue was extracted with
 78 two portion of 50 ml distilled water for 20 minutes. These extracts were combined and the
 79 total protein content was determined using the method of [2]. The residue left removal of
 80 water soluble materials especially protein was extracted in the same way using three
 81 portions of 2% NaCl solution. After this extraction the residue was extracted for 20 minutes
 82 with 80% alcohol at 70°C. Finally the residue was suspended in three successive portions of
 83 0.25% NaOH solution and stirred for 20 minutes. The above protein content of extracted
 84 solution in each of the solvent was determined by the Lowry method.

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87 **3. RESULTS AND DISCUSSION**

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89 From the results shown in table 1 and 2, the moisture, ash and fiber content of the prepared
 90 rice bran breads were found to be varied from 26.0-28.4%, 2.17-2.83% and 1.54-1.96%
 91 while that of locally available breads were found to be ranged 31.1-32.9%, 2.70-2.93% and
 92 2.04-2.61% respectively. It is important to note that the locally available breads contained
 93 slightly higher percentage of moisture, ash and fiber than the prepared rice bran breads. It
 94 can also be observed from comparison of the major nutrient contents of prepared rice bran
 95 bread and locally available market bread that the prepared rice bran breads contained higher
 96 percentage of carbohydrate and protein while the locally available bread in the market
 97 contained slightly higher amount of fat and total sugar.

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100 **Table 1. Analysis of nutrient compositions of prepared bread (supplemented of**
 101 **different varieties of rice bran with wheat flour), (g/ 100g).**

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Wheat flour and bran ratio (w/w)		Moisture	Ash	Fiber	Fat	Protein	Carbohydrate	Total sugar	Reducing sugar
BR-5	95% + 5%	28.1±0.25	2.56±0.04	1.66±0.06	7.01±0.27	6.64±0.09	44.1±0.35	6.40±0.30	0.56±0.07
	90% + 10%	27.2±0.12	2.64±0.06	1.88±0.09	7.34±0.26	6.73±0.07	44.5±0.32	6.21±0.28	0.48±0.08
	85% + 15%	27.1±0.11	2.72±0.05	1.96±0.06	7.50±0.28	6.82±0.08	44.8±0.39	6.08±0.18	0.63±0.06
BR-10	95% + 5%	28.4±0.29	2.67±0.06	1.59±0.03	7.49±0.21	6.70±0.06	45.2±0.40	6.59±0.25	0.61±0.04
	90% + 10%	27.5±0.15	2.77±0.07	1.64±0.08	7.72±0.25	6.81±0.05	45.4±0.34	6.48±0.29	0.73±0.09
	85% + 15%	27.1±0.11	2.83±0.04	1.70±0.05	7.81±0.23	6.88±0.08	45.8±0.29	6.35±0.32	0.80±0.08
IRRI-28	95% + 5%	27.3±0.13	2.30±0.03	1.54±0.07	7.86±0.20	7.09±0.09	45.6±0.25	6.04±0.27	0.69±0.02
	90% + 10%	27.0±0.09	2.41±0.06	1.61±0.06	7.91±0.29	7.18±0.07	46.0±0.46	5.85±0.29	0.75±0.07
	85% + 15%	26.5±0.08	2.49±0.05	1.76±0.09	8.04±0.23	7.25±0.05	46.3±0.49	5.60±0.24	0.84±0.04
BRRI-39	95% + 5%	28.1±0.25	2.45±0.04	1.78±0.05	6.95±0.19	6.84±0.08	44.4±0.47	6.51±0.23	0.55±0.05
	90% + 10%	27.1±0.25	2.61±0.03	1.80±0.06	7.01±0.25	6.88±0.04	45.2±0.28	6.40±0.36	0.69±0.04
	85% + 15%	26.9±0.09	2.70±0.06	1.85±0.06	7.25±0.24	6.93±0.03	45.4±0.35	6.12±0.40	0.73±0.07
Kalijira	95% + 5%	26.4±0.07	2.17±0.02	1.96±0.5	7.12±0.22	7.03±0.05	43.2±0.67	6.80±0.23	0.64±0.09
	90% + 10%	26.1±0.10	2.31±0.02	1.90±0.06	7.41±0.24	7.17±0.08	44.3±0.24	6.71±0.21	0.69±0.06
	85% + 15%	26.0±0.12	2.40±0.03	1.95±0.08	7.59±0.26	7.20±0.06	44.5±0.21	6.54±0.30	0.78±0.09

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103 Table 2. Analysis of nutrient compositions of locally available market breads (g/100 g).
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Name of the local company	Moisture	Ash	Fiber	Fat	Protein	Carbohydrate	Total sugar	Reducing sugar
Kundo Bread & Co, Rajshahi	31.1±0.90	2.70±0.10	2.04±0.25	8.12±0.15	6.21±0.41	41.4±0.97	7.13±0.76	0.78±0.10
Moshen Bread & Co, Rajshahi	32.1±0.98	2.81±0.12	2.61±0.21	7.91±0.12	5.49±0.36	40.8±1.00	8.25±0.69	0.95±0.11
Nowhata Bread & Co, Rajshahi	32.9±0.99	2.93±0.09	2.32±0.24	8.04±0.13	6.00±0.38	39.9±0.89	8.61±0.78	0.75±0.09

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107 The solubility of protein present in prepared rice bran breads and locally available breads are
108 also used as criteria for considering as the quality characteristics. The results indicated that
109 the protein contents of the ingredients were drastically denatured due to baking at relatively
110 high temperature and made the protein insoluble in aqueous solution as well as in mild to
111 harsh solvents. As shown in Table 3, and 4, the percentage of denature protein of prepared
112 rice bran breads were varied from 35% to 66% while the market breads were varied from
113 79% to 91%. So, the protein in market breads were more denatured as compared to that of
114 prepared rice bran breads.

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117 Table 3. Solubility of protein in prepared rice bran bread (wheat flour and rice bran) in
118 different solvents (g /100g).

Wheat flour and bran ratio (w/w)	Total protein %	water soluble protein %	water in soluble protein % in different solvents			Total (water soluble + water in soluble)	% of protein denatured	
			2% NaCl	80% Alcohol	0.25% NaOH			
BR-5	95% + 5%	6.40±0.19	0.81±0.09	0.98±0.35	0.21±0.10	1.02±0.12	3.02±0.35	47±0.02
	90% + 10%	6.21±0.17	0.96±0.08	1.00±0.36	0.30±0.11	1.14±0.10	3.40±0.34	55±0.11
	85% + 15%	6.08±0.16	0.99±0.07	1.06±0.28	0.41±0.09	1.26±0.11	3.72±0.30	61±0.65
BR-10	95% + 5%	6.59±0.18	0.75±0.09	1.09±0.29	0.31±0.09	1.31±0.12	3.46±0.36	52±0.21
	90% + 10%	6.48±0.17	0.80±0.07	1.21± 0.30	0.42±0.12	1.42±0.10	3.85±0.32	59±0.22
	85% + 15%	6.35±0.19	0.83±0.06	1.30± 0.29	0.50±0.08	1.56±0.09	4.19±0.33	66±0.13
IRRI-28	95% + 5%	6.80±0.18	0.71±0.08	0.61±0.34	0.21±0.04	0.89±0.08	2.42±0.34	35±0.15
	90% + 10%	6.71±0.20	0.83±0.07	0.74±0.28	0.31±0.08	0.96±0.09	2.84±0.28	42±0.24
	85% + 15%	6.54±0.17	0.62±0.04	0.89±0.27	0.46±0.09	1.10±0.10	3.07±0.29	47±0.17
BRRI-39	95% + 5%	6.51±0.14	0.70±0.08	1.10± 0.29	0.08±0.08	1.12±0.12	3.00±0.29	46±0.94
	90% + 10%	6.40±0.19	0.75±0.07	1.24±0.25	0.12±0.07	1.36±0.11	3.47±0.30	54±0.54
	85% + 15%	6.12±0.20	0.84±0.09	1.38±0.27	0.15±0.09	1.44±0.10	3.81±0.35	62±0.17
Kalijira	95% + 5%	6.04±0.16	0.63±0.05	0.94±0.30	0.12±0.06	0.99±0.13	2.68±0.32	47±0.89
	90% + 10%	5.85±0.14	0.72±0.08	0.99±0.25	0.19±0.12	1.24±0.11	3.14±0.31	54±0.81
	85% + 15%	5.60±0.12	0.89±0.09	1.11±0.27	0.28±0.11	1.36±0.09	3.64±0.34	65±0.19

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120 **Table 4. Solubility of protein in locally available market bread in different solvents (g/100**
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Name of local company	Total protein %	water soluble protein %	water in soluble protein % in different solvents			Total (water soluble + water in soluble)	% of protein denatured
			2% NaCl	80% Alcohol	0.25% NaOH		
Kundo Bread & Co, Rajshahi	4.51±0.49	1.15±0.25	0.86±0.15	0.25±0.08	1.86±0.15	4.12±0.30	91.0±0.02
Moshen Bread & Co, Rajshahi	3.65±0.42	0.98±0.22	1.08±0.16	0.31±0.07	1.54±0.14	3.91±0.32	84.0±0.78
Nowhata Bread & Co, Rajshahi	4.51±0.41	0.65±0.20	0.79±0.14	0.41±0.09	1.75±0.17	3.60±0.29	79.0±0.01

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The quality characteristics such as saponification value, FFA, and iodine values of rice bran breads and market available breads were compared and the results are tabulated in table 5, and 6. It was observed that the saponification values as well as iodine values of rice bran breads were much higher than that of locally available market breads. The higher iodine values indicated that the amount of unsaturated fatty acids is predominant in prepared rice bran bread. It is also interesting to note that the % of FFA of market breads were higher than that of prepared rice bran breads.

Table 5. Quality of fat in prepared rice bran supplemented bread, (g/ 100g).

Wheat flour and bran ratio (w/w)	Saponification value	FFA	Iodine value	
BR-5	95% + 5%	159±0.50	1.26±0.07	92.1±0.52
	90% + 10%	155±0.32	1.35±0.08	93.0±0.61
	85% + 15%	150±0.44	1.40±0.09	93.9±0.72
BR-10	95% + 5%	166±0.02	1.16±0.07	94.0±0.75
	90% + 10%	161±0.09	1.42±0.09	94.9±0.55
	85% + 15%	156±0.61	1.45±0.07	96.0±0.49
IRRI-28	95% + 5%	160±0.71	1.31±0.08	95.0±0.47
	90% + 10%	155±0.21	1.43±0.06	97.0±0.43
	85% + 15%	150±0.98	1.49±0.09	99.2±0.51
BRRI-39	95% + 5%	166±0.87	1.21±0.08	93.0±0.54
	90% + 10%	160±0.00	1.29±0.09	95.1±0.47
	85% + 15%	155±0.86	1.35±0.06	97.0±0.49
Kalijira	95% + 5%	169±0.37	1.32±0.09	98.0±0.47
	90% + 10%	165±0.71	1.40±0.05	99.1±0.49
	85% + 15%	163±0.79	1.51±0.07	100±0.59

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Table 6. Quality of fat in locally available market bread.

Name of the local company	Saponification value	FFA	Iodine value
Kundo Bread & Co, Rajshahi	142±0.56	1.63±0.11	71.0±0.09
Moshen Bread & Co, Rajshahi	138±0.98	1.71±0.13	63.1±0.07
Nowhata Bread & Co, Rajshahi	149±0.78	1.86±0.12	57.4±0.98

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“One-way analysis of variance” (ANOVA) between the variable responses and the factors (treatments) in all the Tables have been carried out. And a pairwise mean comparison performed in this analysis using Tukey’s test determine that the independent variables (factors) on the response variables were significant (p-value<0.05: p-value<0.01).

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4. CONCLUSION

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This study may conclude that the prepared supplemented rice bran breads contained higher percentage of carbohydrates and proteins than locally available bread. The denaturation of protein and % of FFA in market bread have high compared to the prepared rice bran bread. So, on the nutritional point of view, prepared rice bran bread may be considered superior than the locally available bread.

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COMPETING INTERESTS

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Authors have declared that no competing interests exist.

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AUTHORS’ CONTRIBUTIONS

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This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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REFERENCES

1. Raghavenor Rao, S. N., Ananthachar, T. K. & Desikachar, H. S. R. Oil content of bran from rice milled to different degrees of polishing. *J. Food Sci. Technol.*, 1965;2, 115-16.
2. Lowry OH, Rosebrough NJ, Farr AL, Randall RL. Protein measurement with the folin phenol reagent. *J. Biol. Chem.* 1951;193,265-275.
3. Tao J, Rao R M and Liuzzo J A. Selected thermo-physical properties of rice bran. *Appl. Eng. Agric.* 1994;10:709-711.
4. Yokochi, K. Rice bran processing for the production of rice bran oil and characteristics and uses of the oil and deoiled bran. In *Proceedings of Rice By-Products Utilization*, International Conference, Valencia, Spain. *Rice Bran Utilization*, edited by S. Barber and E. Tortosa. Valencia: Institute for Agricultural Chemistry and Food Technology. 1974;Vol. III.
5. Gariboldi, F. Parboiled rice. In *Rice chemistry and technology*, 1st ed.; Houston, D.F., Ed.; American Association of Cereal Chemists: Eagan, MN, USA. 1972; pp. 358-380.
6. Kent N L. *Technology of cereals*. P. 243. Pergamon press, Oxford. 1960.
7. Luh Bor S. *Rice Utilization: Vol.-11: Second edition*. Van Nostrand Reinhold, 115 Fifth Avenue, New York, New York 10003 USA. 2003.
8. Maksud AM, Haussain MG, Absar N, Shahjahan M. Investigation on rice bran: Composition of rice bran and its oil, *Bangladesh J. Sci. Ind. Res.* 1998;33(2), 170-177.
9. Zarei, I.; Brown, D.G.; Nealon, N.J.; Ryan, E.P. Rice Bran Metabolome Contains Amino Acids, Vitamins & Cofactors, and Phytochemicals with Medicinal and Nutritional Properties. *Rice* 2017, 10, 24.
10. Nasirullah, Krishnamurthy, M.N. & Nagaraja, K.V. *J Am Oil Chem Soc.* 1989;66: 661.
11. Parquot, C., *Standard Methods for the Analysis of Oils, Fats and Derivatives*, 6th ed., IUPAC Appl. Chem. Div., Commission on Oils, Fats and Derivatives, 1979.
12. KA Williams. *Oils, Fats and Fatty Foods*, 4th ed., J. & A. Churchill Ltd., London. 1966;124-391.
13. AOAC. *Official Methods of Analysis*. 14th Edition, Association of Analytical Chemists, Washington DC. 1984;249-252.
14. "Official and Tentative Methods of the American Oil Chemists' Society," Vol I & II, Third edition, AOCS, Champaign, IL, 1966, Method Cd 11-57.
15. Hasan, M. S., Jahan, R., Alam, M. A., Khatun, M. K., & M. Al-Reza, S. Study on Physicochemical Properties of Edible Oils Available in Bangladeshi Local Market. *Archives of Current Research International*. 2016; 6(1), 1-6.
16. Boekenoogen HA. *Analysis and characterization of oils, fats and fat products*. London: Interscience, 1964. 421 p.
17. Phongthai, S., Homthawornchoo, W. and Rawdkuen, S. Preparation, properties and application of rice bran protein: A review. *International Food Research Journal*. 2017;24(1): 25-34.