RICE BRAN AS A FUNCTIONAL FOOD INGREDIENT

R. Sahul Hameed1, I. Maheswari2
1Department of Home Science
2Faculty of Rural Oriented Sciences
1,2The Gandhigram Rural Institute-Deemed University, Gandhigram, Dindigul, Tamil Nadu, India

Abstract: Food for Specific Health Uses (FOSHU) in Japan defined “Functional food as foods containing active ingredients or compounds that have determined health effects or to reduce the risks of a disease or enhance health related conditions on regular consumption by humans beyond nutrient functions”. Rice bran is a by product of cereal processing and it is widely used as animal feed rather than human consumption. Rice bran is highly nutritious because it provides 11g moisture, 48.4g carbohydrate, 13.5g protein, 21.13% fat, 4.3g fiber and 6.6 g ash per 100g of rice bran. Rice bran protein is considered as one of the good sources of Essential Amino Acids (EAAs) such as tryptophan, histidine, methionine, cysteine and arginine. Researchers found that the protein quality of rice bran is comparable to animal protein based on Protein Efficiency Ratio (PER) which is 2.0-2.5. Biopeptides derived from rice bran proteins have shown array of health benefits over many non communicable diseases such as diabetes, hypertension, cardio vascular disease, cancer etc. Similarly rice bran oil is rich in natural antioxidant namely vitamin E and oryzanol which prevent free radical formation. Dietary fibre in rice bran may act as anticarcinogen and prevent certain types of cancer cell formation. Such a valuable product (Rice bran) has been underutilized as animal feed thus rice bran can be included in human diet as functional ingredients to mitigate the life threatening diseases.

Key words: Rice bran – Biopeptides – Oryzanol – Dietary fibre - functional food

I. INTRODUCTION

Rice is one of the most important staple foods for over half of the world’s population since it provides more than one fifth of the calories consumed by human worldwide. Rice is the second leading cereal crop grown in at least 114 countries especially East and South Asia, the Middle East, Latin America and West Indies. Global rice production is 645 million tons and 90% of the total production is shared by Asian farmers (Sharif et al., 2014). Rice is a processed product derived from milling of paddy grains which yield 70% of white rice as the major product and by-products consisting of 20% rice husk, 8% rice bran and 2% rice germ (De Deckere and Korver, 1996; Van Hoed et al., 2006). Nutritional value of rice, rice bran and husk is presented in Table 1.

<p>| Nutritional Value of Rice and its by-products |</p>
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Nutrients per 100g of food</th>
<th>Rice fractions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White rice *</td>
<td>Rice bran*</td>
</tr>
<tr>
<td>1.</td>
<td>Moisture (g)</td>
<td>13.3</td>
</tr>
<tr>
<td>2.</td>
<td>Carbohydrate (g)</td>
<td>79</td>
</tr>
<tr>
<td>3.</td>
<td>Protein (g)</td>
<td>6.4</td>
</tr>
<tr>
<td>4.</td>
<td>Fat (g)</td>
<td>3.6</td>
</tr>
<tr>
<td>5.</td>
<td>Dietary fibre (g)</td>
<td>0.4</td>
</tr>
<tr>
<td>6.</td>
<td>Ash (g)</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Source: * Nutritive value of Indian foods, NIN, ICMR, Hyderabad, India (2004)
** Nutritive value of commonly available feeds and fodders in India, Animal nutrition Group, National Dairy Development Board, Ananad-388 001 (2012), *** Not available
Rice bran is the hard outer layer of rice consisting mostly of pericarp, seed coat, nucellus, aleurone layer, embryo and partial endosperm portions which are taken out in fine grain form during de-husking and milling of paddy. Compared to white rice, rice bran is highly nutritious because it contains 11% moisture, 48.4g carbohydrate, 13.5g protein, 21.13% fat, 4.3g fiber and 6.6 g ash per 100g of rice bran and array of micronutrients like oryzanols, tocopherols, tocotrienols and phytosterols (Hernandez et al., 2000; Jiang & Wang, 2005). Rice bran is used in animal feed or discarded as a waste earlier and is now finding high value products for preparation of nutraceutical and functional food ingredients. According to Food for Specific Health Uses (FOSHU) in Japan, Functional food is a food containing active ingredients or compounds that have determined health effects or to reduce the risks of a disease or enhance health related conditions on regular consumption by humans beyond nutrient functions. The health benefits associated with consumption of rice bran are briefly reviewed hereafter.

a. Rice bran proteins

Rice bran contains 12-15% protein of which 37% albumin, 36% globulin, 22% glutelin, and 5% prolamin (Betschart et al., 1977). Wang et al. (1999) found that amino acid composition of rice bran proteins showed similar or higher levels in valine, cystine, phenylalanine, threonine, histidine, arginine, alanine, aspartic acid, and glycine contents than casein. When compared with the essential amino acid requirement for infants as recommended by FAO/WHO/UNU (1985), rice bran protein isolate had high valine (63 mg/g of protein), histidine (29 mg/g of protein), and tyrosine (33 mg/g of protein) contents. However, leucine, isoleucine, lysine, threonine, and tryptophan were the limiting amino acids in rice bran isolate. Only lysine (47 mg/g of protein) and threonine (37 mg/g of protein) were the limiting amino acids in rice bran protein isolate when compared to the essential amino acid requirement (Joint FAO/WHO/UNU, 1985) for 2-5-year-old children. The protein efficiency ratio (PER) has been widely used as an indicator of protein nutritional quality. The PER values for rice bran concentrates range from 2.0 to 2.5, compared to 2.5 for casein. Protein digestibility of rice bran is greater than 90% (Wang et al., 1999).

Rice bran protein is hypoallergenic thus may serve as a suitable ingredient for infant food formulations and restricted diets of children with food allergies (Helm and Burks, 1996). Furthermore, biologically active di- and tri-peptides identified in rice bran proteins were possess activities that can be applied in the management of hypertension, oxidative stress, type 2 diabetes mellitus and other aberrant cellular processes (Udenigwe, 2016). Antidiabetic and antidiyslipidemic activity of rice bran protein hydrolysates was also reported by Boonloh et al. (2015). Bioactive peptides derived from rice bran protein possess the ability to reduce the risks of chronic complications including obesity or Alzheimer’s disease was investigated by Kannan et al. (2012). A pentapeptide, Glu-Gln-Arg-Pro-Arg (EQRPR) isolated from rice bran showed nearly 70% adipocyte viability and 45% reduction in cell cytotoxicity on amyloid-induced neuronal cells. The findings suggest that rice bran derived biopeptides may protective role against obesity, Alzheimer’s disease and possibly diabetes.

b. Rice bran oil

Rice bran contains 12–22 percent oil by weight. Oil can be extracted from rice bran by pressing or solvent extraction process using food grade n-hexane or in solvent free process using ohmic heating or supercritical fluid technology however oil recovery from rice bran is higher in solvent extraction and solvent free extraction methods. Crude rice bran oil is rich in unsaturated fatty acids and bioactive compounds such as γ-oryzanol, phytosterols, tocopherols, and tocotrienols (Friedman, 2013). It contains mainly oleic acid (38.4%), linoleic acid (34.4%) and alpha-linolenic acid (2.2%) as unsaturated fatty acids, and palmitic (21.5%) and stearic (2.9%) acids as saturated fatty acids (Sayre et al. 1990). Compared to vegetable oils, crude rice bran oil is rich source of
unsaponifiable fractions (up to 5%) mainly composed by sterols (43%), triterpene alcohols (28%) 4-methyl-sterols (10%) and less polar components (19%) (Sayre et al., 1990).

Phytoestrogens include: catechin (200 mg%), epicatechin (200 mg%), epigallocatechin (350 mg%), epicatechin gallate (300 mg%) and epigallocatechin gallate (470 mg%). (Bhargava et al., 2001). Rice bran oil contains a little variable quantity of tocotrienols (from 72 to 612 ppm, especially beta and gamma-tocotrienols), but it is naturally very rich in tocopherol (100 mg%) (Rukmini and Raghuram, 1991; Rogers et al., 1993). Studies indicate that gamma oryzanol found in rice bran oil is a potent antioxidant and highly effective in stopping tissue oxidation than vitamin E which is abundant in all vegetable oils (Xu et al., 2001). Patel and Naik (2004) reported that the rice bran oil has the property of lowering low density lipoprotein cholesterol and total serum cholesterol and increasing the high density lipoprotein cholesterol and it could be used as potential efficacy in reducing the cardiovascular disease risk (Cicero & Derosa, 2005). The antihyperlipidemic effect of rice bran oil may attribute to multifaceted actions of gamma oryzanol, phytoestrogens, tocopherols and tocotrienols (Rong et al., 1997; Xu et al., 2001; Patel & Naik, 2004; Cicero & Derosa, 2005).

c. Rice bran dietary fibre

Rice bran contains 25.3 g of dietary fibre per 100 g. Dietary fibre in rice bran includes cellulose, hemicelluloses (13 per cent) and pentosans (6.5 per cent) which are all insoluble fibres. It also contains in addition about 2 per cent soluble dietary fibre. Dietary fibre content of stabilized rice bran was reported by Bhosale and Vijayalakshmi (2015) and found that total dietary fibre content was 23.34 g/100g. Insoluble and soluble fibre content of rice bran were 21.17 and 2.1 g/100g respectively which indicate that rice bran contain high amount of insoluble dietary fibre than soluble dietary fibre. The role of dietary fibre in lowering the risks of developing coronary heart disease, stroke, hypertension, diabetes, obesity, and certain gastrointestinal diseases were discussed elsewhere (Anderson et al., 2009).

II. CONCLUSIONS

India is the second largest producer of rice and consequently majority of the Indian population is dependent on rice since it is a staple food for them. Though the bran is rich in micronutrients like oryzanol, tocopherol, tocotrienols, phytoestrogens, and dietary fibers it has been underutilized due to ignorance, presence of impurities like arsenic and silica, difficulties stabilize the rice bran and prone to rancidity. Rice bran could be used to develop health promoting products to combat life threatening diseases/disorders which have hypolipidemic, anti-tumor, anti-oxidant, ergogenic and laxative properties.

REFERENCES


