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THERAPEUTIC USES OF RICE BRAN AND ITS COMPONENTS

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ABSTRACT: Rice bran is the cuticle existing between the rice and husk of the paddy and consists of embryo and endosperm of the seeds of *Oryza sativa*, family Gramineae. It is obtained as a by product in rice mill during polishing of rice obtained after dehusking of paddy. Rice bran contains about 15% of fixed oil and is obtained by the solvent extraction method. It contains oleic acid, linolenic acid as unsaturated fatty acid and palmitic acid, stearic acid as a saturated fatty acid. The minor components of the rice bran, *i.e.* gamma oryzanol, phytosterols, and other phytosterol conjugates are examined to have antioxidant property against the free radicals. It is believed that rice bran serves as an important functional food that has cholesterol-lowering properties, cardiovascular health benefits, and anti-tumor activity. The oryzanol component acts as a protective agent against UV light-induced lipid peroxidation and hence can be used as a potent sunscreen agent. The ferulic acid and its esters present in gamma oryzanol stimulate hair growth and prevent skin aging.

INTRODUCTION: Rice bran is the cuticle existing between the rice and husk of the paddy and consists of embryo and endosperm of the seeds of *Oryza sativa*, family Gramineae. It is obtained as a by product in rice mill during polishing of rice obtained after dehusking of paddy. Rice bran contains about 15% of fixed oil and is obtained by solvent extraction method [1]. Rice bran's oil and unsaponifiable lipid content is high compared with other grains. Unrefined rice bran oil contains about 20% saturated, 40% monounsaturated and 40% polyunsaturated fatty acids and contains tocotrienols, gamma oryzanol, and beta-sitosterol.

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Rice bran oil contains large concentrations of several compounds that could potentially prevent chronic diseases such as coronary heart disease and cancer. It is noted that rice bran contains high levels of both tocopherols and tocotrienols which comprise vitamin E and act as antioxidants in the body. Oryzanols components are complex compounds that can act as an antioxidant, improving solubility in cell membranes and potentially lowering cholesterol [2].

Rice bran oil is the oil extracted from the germ and inner husk of rice. It is notable for its high smoke point and its mild flavors that make it suitable for high-temperature cooking methods such as stir frying and deep frying. It is popularly used cooking oil. A natural component of rice bran oil lowers cholesterol, and ongoing research shows its potential as an anticancer and anti-infection agent in humans. Long term use of tocotrienols might reduce overall cancer risk according to published

research in the European Journal of Cancer. Phytosterols are nutrients with many health benefits and are more abundant in rice bran oil than any other oil. Scientific research suggests that Phytosterols reduce cholesterol, provide anti-inflammatory effects, inhibit the growth of cancer cells, improve the immune system and have other health benefits. There are 27 different phytosterols in rice bran oil. Although, rice bran oil has been tested to reduce cholesterol levels, it is important to recognize its high omega-6 content. Rice bran oil contains a high amount of omega-6 fatty acid (linoleic acid) and virtually no omega-3 (linolenic acid). High consumption of omega-6 poly-unsaturated fatty acids may increase the likelihood of both breast cancer and prostate cancer.

The dietary imbalance that exists in rice bran oil can create all sorts of problems to body processes, including a tendency towards inflammation. This imbalance has been implicated in higher rates of diabetes, cancer, heart disease, stroke, arthritis and skin disorders [3]. Also, it has a high smoking point (254 degrees Celsius) which prevent the oil from breaking down to form toxic substances [4]. Unfortunately; raw rice bran has a very short shelf life due to its high-fat content and a potent lipase enzyme. To prevent rice bran from becoming rancid, it must undergo a stabilization process. Stabilization subjects the rice bran to heat and pressure which inactivate the lipase enzyme without destroying the nutritional value of the rice bran.

Physical Properties: Rice bran constitutes about 10% of rough rice grain and contains 18% to 22% oil. It is pale, yellow, odorless with acid index <0.50, the density at 20 degrees between 0.920 and 0.930, the refractive index at 20degrees between 1.471 and 1.475. The smoke point that is the temperature at which a fat or oil produces a continuous wisp of smoke is >200 degrees Celsius. It gives a pleasant flavor, lightly sweet [5]. The moisture content of crude rice bran oil ranges from 0.5% to 1%. The iodine value is 95-100, and the saponification value is 187 [6, 7].

Chemical Composition: Rice bran constitutes about 10% of rough rice grain and contains 18% to 22% oil. The oil contains 20-25% saturated and 80-85% unsaturated fatty acids. It contains oleic acid, linolenic acid as unsaturated fatty acid and palmitic acid, stearic acid as a saturated fatty acid. In contrast to other refined oils, crude rice bran oil contains a rich unsaponifiable fraction (up to 5%) mainly composed by sterols, triterpene alcohols. Phytosterols include beta-sitosterol, campesterol, stigmasterol, squalene, gamma oryzanol. Rice bran oil contains a variable quantity of tocotrienols especially beta and gamma tocotrienols but its naturally very rich in tocopherols [5].

Nutritive Value of Rice Bran: Rice bran is a rich source of proteins, fats, minerals, and micronutrients such as B-vitamins and trace elements [8].

TABLE 1: NUTRITIVE VALUE OF RICE BRAN

Nutrient	Content per 100 g
Protein	16.5 g
Fat	21.3 g
Minerals	8.3 g
Total complex carbohydrates	49.4 g
Dietary fiber	25.3 g

Constituents of Rice Bran:

Gamma Oryzanol: It is the active molecule of rice bran oil. It is the mixture of ferulic acid esters of triterpene alcohols [5]. It is credited for cholesterol-lowering properties as a combination of unsaponifiable constituents [8]. Preliminary evidence, including small double-blind, placebo-controlled trials, suggests that the gamma oryzanol portion of rice bran oil may contribute an additional cholesterol-lowering benefit beyond the effects of the fatty acids [9, 10, 11, 12]. Gamma oryzanol is thought to work by impairing cholesterol absorption in the digestive tract [13]. Additionally, gamma oryzanol has antioxidant properties. It has been hypothesized that antioxidants can help protect against heart disease, cancer, and other illnesses.

Tocols (Vitamin E): Rice bran contains tocopherols and tocotrienols. While both act as an antioxidant, tocotrienol is better than tocopherol in this respect. Tocotrienols have also been shown to have a special role in reducing blood cholesterol and protect against heart diseases by reducing de novo synthesis of cholesterol in the body by inhibiting the key enzyme HMGCo A reductase [14] and is also reported to act as an anticlotting factor. A research group at the University of Texas at

Austin, headed by Dr. Kimberly Kline, confirmed earlier results that tocotrienols slow down the growth of human breast cancer cells [15, 16].

Phytosterols: The hypocholesterolemic potential of phytosterols has been demonstrated both in man and experimental animals [17]. There are some phytosterols in the unsaponified fraction of rice bran oil. These phytosterols act at the intestinal level by interfering with the absorption of cholesterol from the gut.

Therapeutic Uses of Rice Bran:

Antioxidant Property: The antioxidants at cellular and molecular levels are known to deactivate the natural by-products of the oxidative metabolism that are popularly known as free radicals [18, 19, 20]. The minor components of the rice bran, *i.e.* gamma oryzanol, phytosterols, and other phytosterol conjugates are examined to have antioxidant property against the free radicals [21, 22]. The ferulic acid ester of the gamma oryzanol is known to be a potent antioxidant which has stabilizing properties at elevated temperatures [23].

Studies have shown that one test tube of gamma oryzanol is four times as effective as vitamin E in inhibiting the cellular oxidation. When compared with the four vitamin E components (alpha-tocopherol, beta-tocopherol, alpha-tocotrienol, and beta-tocotrienol) the components of gamma oryzanol showed higher antioxidant capacities. All these factors can be used to develop nutraceuticals and other food ingredients from the chemically suitable and biologically functional compounds of the rice bran that are known to have antioxidant properties [24, 22, 25, 27]. Stabilized rice bran contains large concentrations of several compounds and has the potential to prevent a range of chronic diseases. It is believed that RB serves as an important functional food that has cholesterol-lowering properties, cardiovascular health benefits and anti-tumor activity [28, 29].

Lowering Cholesterol: Phytosterols have purported to be cholesterol-lowering agents since the 1950s. Most studies undertaken thus far have focused on the action of beta-sitosterol and sitostanol in reducing LDL and circulating cholesterol levels. These results indicate that these agents may be hypolipidemic agents in mild hypercholesterolemia by altering the lipid metabolism, for instance reducing liver acetyl Co-A carboxylase and malic acid activities [30, 32]. Gamma- oryzanol was also found to have similar hypocholesterolemic effects.

Coronary Heart Disease (CHD): The consumption of dietary fiber that is present in cereals has shown to reduce the risk of coronary heart disease (CHD) mortality by reducing blood pressure, lowering blood cholesterol levels and improving insulin sensitivity [33, 36]. The risk of CHD mortality was inversely related to the consumption of dietary fiber from cereals or fruits [37, 39]. For the assessment of coronary heart diseases, levels of individual circulating cholesterol are considered more important than total cholesterol. LDL is directly associated with the development of cardiovascular diseases, whereas HDL has an inverse relationship [30, 40, 42].

In human diets, supplementation of soluble sitostanol significantly reduced total circulating cholesterol and LDL levels by 7.5% and 10 % respectively [43, 44]. Addition of dietary phytosterols has been found to increase Lecithin – Cholesterol Acyl Transferase (LCAT) levels in blood [30, 44, 47]. This, in turn, facilitates the sequestration of cholesterol within the hydrophobic core of HDL cholesterol [48].

Colorectal Cancer: Phytosterols have shown to inhibit tumors induced by chemicals in animals. The production of coprostanol and other neutral sterols and bile acids by colonic micro-flora from dietary cholesterol, have been established as factors in colon carcinogenesis [49]. Secondary bile acid products also aid in the development of colon cancer. Studies have suggested that dietary phytosterols significantly alter the levels of fecal cholesterol, cholesterol breakdown products, and bile acids by decreasing the epithelial cell proliferation [50, 51].

This may be due to suppression of bacterial metabolism of cholesterol and secondary bile acid in the colon and by an increase of excretion of cholesterol itself [30, 52]. Bingham *et al.,* [53] studied the relationship between dietary fiber consumption and the incidence of colorectal cancer. The amount of dietary fiber consumption gave the relative risk

estimates in a set of individuals who were grouped by sex-specific, cohort-wide quintiles and from linear models relating the hazard ratio to fiber consumption expressed as a continuous variable. The results showed that the intake of dietary fiber was inversely related to the occurrence of colorectal cancer.

The highest protective effect was shown at the left side of the colon whereas the least protective effect was at the rectum. The value of the adjusted relative risk for the highest versus lowest quintile of dietary fiber was 0.58 (0.41-0.85). Hence it was interpreted that by an approximate doubling of total fiber intake in individuals with low average dietary fiber intake, the risk of large bowel cancer reduced greatly by 40% [54, 55].

Anti - Ageing / Cosmetics and Personal Care: The oryzanol component acts as a protective agent against UV light-induced lipid peroxidation and hence can be used as a potent sunscreen agent. The ferulic acid and its esters present in gamma oryzanol stimulate hair growth and prevent skin aging [56, 57]. Rice bran contains approximately 500 ppm of tocotrienols [58]. Tocotrienols when applied to the skin penetrate and get absorbed rapidly. Majorly they get accumulated at the strata corneum of the skin and act as the first line of defense with their antioxidant property. They stabilize the free radicals generated in the skin when exposed to oxidative rays. They protect the skin against UV induced skin damage and skin aging and thus help in skin repair. The efficacy of sunscreens containing compounds that reduce penetration of or absorb ultraviolet radiation is augmented by using tocotrienols in them [56, 57, 59].

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REFERENCES:

1. Textbook of Pharmacognosy, Nirali Prakashan, 10.24, 10.25.
2. 2http://www.agctr.lsu.edu/Communications/LouisianaAgriculture/agmag/45_4_articles/ricebran.asp
3. 3- www.mercola.com http://timesofindia.indiatimes.com http://www.heloifoods.com
4. http://www.medindia.net/patients/lifestyleandwellness/rice-bran-oil.htm#ixzz3NrBsvxOo
5. Sayre, B., Saunders, R. (1990) Rice bran and rice bran oil. Lipid Technology 2,72-76
6. http://www.riceactive.com/?page_id=203
7. SEA Hand Book, by the solvent extractors' Association of India, 2009
8. Afinisha Deepam LS and Arumughan C: Effect of saponification on the composition of unsaponifiable matter in rice bran oil. J Oleo Sci 2012.
9. Rong N, Ausman LM and Nicolosi RJ: Oryzanol decreases cholesterol absorption and aortic fatty streaks in hamsters. Lipids 1997; 32: 303-309.
10. Sasaki J, Takada Y and Handa K: Effects of gamma-oryzanol on serum lipids and apolipoproteins in dyslipidemic schizophrenics receiving major tranquilizers. Clin Ther 1990; 12: 263-268.
11. Cicero AF and Gaddi A: Rice bran oil and gamma-oryzanol in the treatment of hyperlipoproteinaemias and other conditions. Phytother Res 2001; 15: 277-289.
12. Most MM, Tulley R and Morales S: Rice bran oil, not fiber, lowers cholesterol in humans. Am J Clin Nutr 2005; 81: 64-68.
13. Berger A, Rein D and Schafer A: Similar cholesterol-lowering properties of rice bran oil, with varied gamma-oryzanol, in mildly hypercholesterolemic men. Eur J Nutr 2004.
14. Sugano M and Tsuji E: Rice bran oil and cholesterol metabolism. J Nutr 1997; 127: 5215-5245.
15. Yu W, Simmons-Menchaca M, Gapor A, Sanders BG and Kline K: Induction of apoptosis in human breast cancer cells by tocopherols and tocotrienols. Nutr Cancer 1999; 33: 26-32.
16. Nesaretnam K, Stephen R and Dils R: Tocotrienols inhibit the growth of human breast cancer cells irrespective of estrogen receptor status. Lipids 1998; 33: 461-469.
17. Qureshi AA, Burger WC, Peterson DM and Elson CE: The structure of an inhibitor of cholesterol biosynthesis isolated from harley. J BioI Chern 1986; 261: 10544-10550.
18. Patel M and Naik SN: Gamma-oryzanol from rice bran oil-A review. J Sci Ind Research 2004; 63: 569-578.
19. Higash-Okai K, Kanbara K, Amano K, Hagiwara A and Sugita C: Potent antioxidative and antigenotoxic activity in the aqueous extract of Japanese rice bran - association with peroxidase activity. Phytotherapy Res 2004; 18b: 628-633.
20. Graf E and Eaton JW: Antioxidant functions of phytic acid. Free Radic Biol Med 1990; 8: 61-69.
21. Kochhar SP: Stable and healthful frying oil for the 21st century. INFORM 2000; 11: 642-647.
22. Wang T, Hicks KB and Moreau R: Antioxidant activity of phytosterols, oryzanol & other phytosterol conjugates. 2002.
23. Zhimin X, Godber JS and Xu Z: Antioxidant activities of major components of gamma-oryzanol from rice bran using a-linolenic acid model. JAOCS 2001; 78: 465-469.
24. Patel M and Naik: Gamma-oryzanol from rice bran oil-A review. J Sci Ind Research SN 2004; 63: 569-578.
25. Fukushi J: Antioxidant effects of oryzanol. In edible rice bran oil part - III, Pa: Hokkaido-Ritsu Eisei Kenkyushoho, 1966: 111-114.
26. Nakatani N, Tachibana Y and Kikuzaki H: Establishment of a model substrate oil for antioxidant activity assessment by oil stability index method. JAOCS 2001; 78: 19-23.
27. Xu Z, Hua N and Godber JS: Antioxidant activity of tocopherols, tocotrienols & γ-oryzanol components from rice bran against cholesterol oxidation accelerated by 2,2'-Azo-bis (2-methylpropionamidin) Dihydrochloride. J Agric Food Chem 2001; 49: 2077-2081.
28. Hu W, Wells JH, Tai-Sun S and Godber JS: Comparison of isopropanol and hexane for extraction of vitamin E and

oryzanols from stabilized rice bran. JAOCS 1996; 73: 1653-1656.
29. Lichtenstein AH, Ausman LM, Carrasco W, Gualtieri LJ and Jenner JL: Rice bran oil consumption & plasma lipid levels in moderately hypercholesterolemic humans. Arterioscler Thromb 1994; 14: 549-556.
30. Ling WH and Jones PJH: Dietary Phytosterols: A review of metabolism, benefits and side effects. Life Sciences 1995; 57: 195-206.
31. Kahlon TS, Saunders RM, Sayre RN, Chow FI and Chiu MM: Cholesterol-lowering effects of rice bran & rice bran oil fractions in hypercholesterolemic hamsters. Cereal Chem 1992; 69: 485-489.
32. Yoshino G, Kazumi T, Amano M, Tateiwa M and Yamasaki T: Effects of γ-oryzanol on hyperlipidemic subjects. Curr Therapeutic Res 1989; 45: 543-552.
33. Truswell AS: Cereal grains & coronary heart diseases. Eur J Clin Nutr 2002; 56: 1-14.
34. Mellen PB, Walsh TF and Herrington DM: Whole grain intake & cardiovascular disease: a meta-analysis. Nutr Metab Cardiovasc Dis 2008; 18: 283-290.
35. Whelton SP, Hyre AD, Pedersen B, Yi Y and Whelton PK: Effect of dietary fibre intake on blood pressure: a meta-analysis of randomized, controlled clinical trials. J Hypertens 2005; 23: 475-481.
36. Rimm EB, Ascherio A, Giovannucci E, Spiegelman D and Stampfer MJ: Vegetable, fruit & cereal fiber intake & risk of coronary heart disease among men. JAMA 1996: 447-451.
37. Martinette TS, Marga CO, Hendriek CB, Frans JK and Daan K: Dietary fiber intake about coronary heart disease and all-cause mortality over 40 yr: the Zutphen Study. Am J Clin Nutr 2008; 88: 1119-1125
38. Mark AP, Eilis O, Katarina A, Gary EF and Uri G: Dietary fiber and risk of coronary heart disease: a pooled analysis of cohort studies. Arch Intern Med. 2004; 164: 370-376.
39. Kromhout D, Bosschieter EB and de Lezenne Coulander C: Dietary fiber & 10-year mortality from coronary heart disease, cancer & all causes-The Zutphen Study. Lancet 1982; 320: 518-522.
40. Sayre B and Saunders R: Rice bran & rice bran oil. Lipid Technol 1990; 272-76.
41. Margolis S and Dobs AS: Nutritional management of plasma lipid disorders. J Am Coll Nutr 1989; 33S-45S.
42. Laraki L, Pelletier X, Mourot J and Derby G: Effects of dietary phytosterols on liver lipids and lipid metabolism enzymes. 1993;
43. Brown L, Rosner B, Willett WW and Sacks FM: Cholesterol-lowering effects of dietary fiber: a meta-analysis. Am J Clin Nutr 1999; 69: 30-42.
44. Vanhanen HT, Blomqvist S, Ehnholm C, Hyvönen M and Jauhiainen M: Serum cholesterol, cholesterol precursors, and plant sterols in hypercholesterolemic subjects with different apoE phenotypes during dietary sitostanol ester treatment. J Lipid Res 1993; 34: 1535-1544.
45. Moghadasian MH and Frohlich JJ: Effects of dietary phytosterols on cholesterol metabolism & atherosclerosis: clinical & experimental evidence. Am J Med 1999; 107: 588-594.
46. Laraki L, Pelletier X and Derby G: Effects of dietary cholesterol & phytosterol overload on Wistar rat plasma lipids. Ann Nutr Metab 1991; 35: 221-225.
47. Shephard J and Packard CHJ: Human plasma lipoproteins Walter de Gruyter, Berlin: 1989; 55-78.
48. Vanhanen H and Miettinen TA: Pravastatin & lovastatin similarly reduce serum cholesterol and its precursor levels in familial hypercholesterolemia. Eur J Clin Pharmacol 1992; 42: 127-130
49. Cummings JH and Macfarlane GT: Colonic microflora: nutrition and health. Nutrition 1997; 13: 476-478
50. Fuchs CS, Giovannucci EL, Colditz GA, Hunter DJ and Stampfer MJ: Dietary fiber and the risk of colorectal cancer and adenoma in women. N Engl J Med 1999; 340: 169-176.
51. Pietinen P, Malila N, Virtanen M, Hartman TJ and Tangrea JA: Diet and the risk of colorectal cancer in a cohort of Finnish men. Cancer Causes Control 1999; 10: 387-396.
52. Faivre J and Bonithon-Kopp C: Chemoprevention of colorectal cancer. Recent Results Cancer Res 1999; 151: 122-133.
53. Bingham SA, Day NE, Luben R, Ferrari P and Slimani N: Dietary fiber in food & protection against colorectal cancer in the European Prospective Investigation into Cancer & Nutrition (EPIC) : an observational study. 2003;
54. Bonithon-Kopp C, Kronborg O, Giacosa A, Ulrich R and Jean F: Calcium and fibre supplementation in prevention of colorectal adenoma recurrence: a randomised intervention trial. Lancet 2000; 356: 1300-1306.
55. Agudo A, Slimani N, Ocke MC, Naska A and Miller AB: Consumption of vegetables, fruit and other plant foods in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohorts from 10 European countries. Publ Health Nutr 2002; 5: 1179-1196.
56. Noboru K and Yuso T: Oryzanol containing cosmetics. Japanese Patent 1970; 70: 32078
57. Shugo M: Anti-dandruff and anti-itching shampoo. Japanese Patent 1979; 79: 36306.
58. Eitenmiller RR: Vitamin E Content of fats and oils: nutritional implications. Food Technol 1997; 51: 78-81
59. Tomeo AC, Geller M, Watkins TR, Gapor A and Bierenbaum ML: Antioxidant effects of tocotrienols in patients with hyperlipidemia and carotid stenosis. Lipid 1995; 30: 1179-1183.

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