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 byproduct in rice mill after dehusking of paddy. Rice bran contains about 15% of fixed oil and is obtained by solvent extraction method. It contains oleic acid, linolenic acid as unsaturated fatty acid and palmitic acid, stearic acid as 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 ageing.

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 byproduct 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. 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 an 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 high amount of omega-6 fatty acid (linoleic acid) and virtually no omega-3 (linolenic acid). A high consumption of omega-6 polyunsaturated 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, density at 20 degrees between 0.920 and 0.930, refractive index at 20 degrees 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 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 variable quantity of tocotrienols especially beta and gamma tocotrienols but its naturally very rich in tocopherols 5.

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

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Content per 100g</th>
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<tbody>
<tr>
<td>Protein</td>
<td>16.5g</td>
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<tr>
<td>Fat</td>
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<tr>
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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 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 HMGCoA 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 cells15, 16.

Phytosterols:
The hypocholestorelemic potential of phytosterols has been demonstrated both in man and experimental animals. 17 There are a number of 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 have shown to reduce the risk of coronary heart disease (CHD) mortality by reducing blood pressure, lowering blood cholesterol levels and improving insulin sensitivity 33, 34. 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/or secondary bile acid in the colon and by increase of excretion of
cholesterol itself. 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 where as the least protective effect was at 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 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 ageing. 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 ageing 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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