

## Properties, Health Benefits and Medicinal Uses of *Oryza sativa*

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**Abstract:** Rice is full of hereditary assorted qualities, with many varieties harvested worldwide. Rice cultivation is the main activity as well as income source upto 100 million people in Africa and Asia. Rice has got potential in many foods categories. Further having nutritional as well as medicinal importance, the byproducts of rice are also beneficial and important. By products from ever growing rice provide several helpful and worthy products. The inedible items, which are discarded via the milling method, but the edible parts might be changed into a number of the given below recommended products. Rice are proven to cure skin disorders. The rice is boiled, worn out and so allowed to cold and mashed. The rice is converted into a paste and molded into balls and which may be applied to skin blemishes, sores, boils and swellings. Different natural herbs are usually used with the rice balls to improve their therapeutic effects. Sticky rice often is used to treat heart-burn, stomach upsets and indigestion. Brown rice extracts had been utilized to treat warts, breast and stomach cancer and also many parasitic diseases. They have been used to treat diarrhea, indigestion and nausea.

**Key words:** Therapeutic Uses • Medicinal Applications • Rice

### INTRODUCTION

Rice (*Oryza sativa*) which belongs to the family Gramineae and subfamily Oryzoides is the 2nd most vital cereal crop so, main foods for over 50% of the world's human population.

Rice is a grain which belongs to the grass family. This is associated to different grasses plants like barley, oats and wheat which produce grain for foods and called as cereals. Rice includes two species (*Oryza glaberrima* and *Oryza sativa*) of grass, indigenous to subtropical and tropical southeastern Africa and Asia, which both give above one fifth of the calories used by human beings. It provides approximately 23% of gross cropped area, 35% of the area under foods grains as well as 44% of area under cereals. This is harvested under diverse cultural condition or over broad geographical range.

**History of Rice:** *Oryza sativa* have been traced back to 5000 BC, but the practice of rice growing is believed to have originated in areas of China and southern and eastern Asia, in about 2000 BC. Rice cultivation is considered to have begun simultaneously in many countries over 6500 years ago. Rice has been cultivated in China since ancient times. Chinese records of rice

cultivation go back 4000 years. Most believe the roots of rice come from 3000 BC India, where natives discovered the plant growing in the wild and began to experiment with it. African rice has been cultivated for 3500 years. In the Middle East and Mediterranean Europe, it started around 800 BC. Rice spread throughout Italy and then France, after the middle of the 15<sup>th</sup> century, later propagating to all the continents during the great age of European exploration. In 1694, rice arrived in South Carolina, probably originating from Madagascar. The Spanish brought rice to South America at the beginning of the 18th century. Over 2 billion people in Asia alone derive 80% of their energy needs from rice, which contains 80% carbohydrates, 7–8% protein, 3% fat and 3% fiber [1]. Until recently, rice was considered only a starchy food and a source of carbohydrates and some amount of protein. Rice protein, though small in amount, is of high nutritional value [2].

Recent studies have unraveled a number of unknown properties of rice, some of which have been reported in ancient literature. The ancient literatures of rice-growing Asian countries such as Thailand, Myanmar, China, Malaysia, Indonesia, India and Pakistan have attributed some medicinal properties to rice, in addition to it being the mainstay as food. In early oriental writings, whole

brown rice was mentioned as the perfect food. In China, the medicinal value of rice was known as far back as in 2,800 BC, when it was used by royal Chinese physicians for healing purposes. It was believed to restore tranquility and peace to those who were easily upset. Dried, sprouted rice grains were used to aid in digestion, toning muscles and expel gas from the stomach and intestines. The Chinese believe rice strengthens the spleen as well as stomach, increases appetite and cures indigestion. They use red rice yeast for various ailments. Traditional Malaysian medical writings prescribe boiled rice 'Greens' as an eye lotion and for use in acute inflammation of the inner body tissues. The application of dried powdered rice is recommended for skin ailments. In Cambodia, the hulls of mature plants are considered useful for treating dysentery. Hulls of three-month-old rice plants are diuretic. In the Philippines, rice polish (bran, *tiki tiki*) is extracted and used as an excellent source of vitamin B to prevent and cure beri-beri [3].

#### **Immunostimulant and Therapeutic Potential of Rice Bran:**

Rice is also known as an important immunostimulant and therapeutic agent against avian coccidiosis. Martinez *et al.* [4] described the increased cytotoxic potential of natural killer (NK) cells by means of rice bran derived Arabinoxylans (MGN-3) against murine neuroblastoma. For this study, NK cells activity by means of MGN-3 addition was evaluated for their phenotypic, cytotoxic and cytometric bead potential on cultured cell lines both *in vivo* and *in vitro* respectively for two weeks. MGN-3 showed significantly increased activity for CD25 and CD69 receptors without alteration of induced-self antigens and other non-catalytic receptors. Moreover, carcinoma cells growth was also inhibited due to increased NK cells cytotoxicity. These results concluded the immunoregulatory efficacy of NK cells and their beneficial remedial application for neural carcinoma.

Choi *et al.* [5] reported the immunomodulatory activity of rice bran derived arabinoxylans through increased natural killer (NK) cell potential and modulated cytokine level in humans. Eighty healthy individuals randomly taking six capsules of 3 g rice bran arabinoxylan daily for 8 weeks were involved for this study. While measurement of NK cell activity by cytotoxic assay and serum cytokine levels including tumor necrosis factor  $\alpha$ , interferon- $\gamma$ , interleukin-2, 10, 4 and 12 by cytokine assay. They suggested that inclusion of rice bran-derived arabinoxylan in broiler diets to protect the immunodeficiency disorders in birds.

Ghoneum *et al.* [6] evaluated anticancer effect of rice bran derived arabinoxylan on cultured human and mice breast cancer cells. For this study nonmetastatic MCF-7 human and metastatic 4T1 mice breast cancer cells were used. MGN-3 increased apoptosis, DNA damage and inhibition of cellular proliferation in 4T1 cells. It was also concluded that rice bran derived arabinoxylans have a potent chemotherapeutic effect against metastatic breast cancer.

Ani *et al.* [7] conducted a study to evaluate comparative effects of feeding rice milling waste (RMW) and Roxazyme G2® enzyme on the performance of broiler chicks. Enzyme supplementation significantly reduced feed intake and improved the performance of birds in terms of average daily weight gain, protein efficiency ratio and feed cost. Enzyme supplementation significantly reduced feed intake and improved the performance of birds in terms of average daily weight gain, protein efficiency ratio and feed cost. These results concluded that feeding rice milling waste (RMW) improved growth rate through increased feed intake in broiler chicks.

Rohman *et al.* [8] described the nutritional significance of rice for diabetic patients in Asia. Besides other cereals, there is an increased dietary intake of rice due to glucose rich contents. Similarly rice derivatives including its bran and oil in traces have also been reported to exhibit beneficial effects on health. Fat free rice bran would be resulted on further processing of rice husk. Fat free fraction of rice bran contained carbohydrates rich contents. These contents of rice derivatives exhibit their therapeutic potential against cardiac diseases and cancer in terms of hypocholesterolemia and hypoglycemic effects.

Hajto *et al.* [9] reported the role of immune response against carcinogenesis in human. Certain studies of cancer patients recommended plant immunomodulators for improvement of immune function. Conventionally phytotherapy including mistletoe extract with *Viscum album* derived lectin, rice bran derived arabinoxylan and wheat germ extract derived 2,6-dimethoxy-p-benzoquinone might inhibit hepatoma metastasis. These phyto-immunomodulators exhibited their optimum potential at dose rates of 0.5-1ng/kg, 12-45 mg/kg and 50-80 mg/kg twice as well as four times on weekly administration. Moreover, some survey based reports also showed inhibitory potential of a phyto-immunomodulator, lectin against metastasis in later phase. These results concluded the immunostimulant potential of combined conventional and phyto-immunomodulators therapy against oncogenesis than conventional treatment.

Saikia *et al.* [10] conducted a study to evaluate comparative pharmacological properties of polysaccharides of Bora rice (*Oryza sativa*), Tamarind seed (*Tamarindus indica*) and Drumstick (*Moringa oleifera*) for use as active therapeutic ingredients in drug delivery system. Among all these polysaccharides Bora rice starch showed comparatively highest mucoadhesiveness and greater value of powder flow than others. Hence the polysaccharides of bora rice, tamarind and drum stick might be effective therapeutic agents under controlled conditions.

Sato *et al.* [11] described the comparative immunostimulant potential of modified arabinoxylan derived from rice bran (MGN-3) and lipopolysaccharide (LPS) in broiler chickens. MGN-3 showed an increased cellular immunity in terms of splenic monocytes and macrophages at 100 ppm dietary level against colibacillosis but cytokines levels decreased two hours later than LPS. It is suggested that MGN-3 might be suitable immunoregulator for T-cells stimulation in growing broiler chickens against colibacillosis.

Ali *et al.* [12] evaluated *in vitro* immunostimulant potential of rice bran arabinoxylan (RBA) in twenty healthy individuals. For this study, enzymatically hydrolyzed RBA was administered at dose rate of 1gm and 3gm into two groups of ten individuals with each for 60 days. Both groups showed increased cytokines particularly INF- $\gamma$ , TNF- $\alpha$ , epidermal growth factor, IL-1 $\alpha$ , -1 $\beta$ , -8 and 10 as well as NK cell activity for viral and cancer cells apoptosis in humans. These results suggested the immunopotent role of RBA for early recovery in immunocompromised patients.

Fang *et al.* [13] elaborated the anti-inflammatory and therapeutic results of acid hydrolysed Feurloylated Oligosacchrides (FO) from rice bran *in vitro*. For this purpose, FO were administered at dose rate of 0.1-100  $\mu$ g/ml to cultured murine leukaemic macrophages. These natural antioxidants showed an increased TNF- $\alpha$ , IL-1 $\beta$ , IL-6 production and suppressed Prostaglandin E2 (PGE2) in RAW264.7 macrophages. These results concluded intestinal and systemic immunostimulant activity of antioxidants against cardiovascular and inflammatory disorders.

Zheng *et al.* [14] evaluated the immunomodulatory potential of rice bran derived arabinoxylan (MGN-3) at variable doses for hepatotoxic cytokine against rat hepatitis. This study involved administration of D-GalN at dose rate of 400mg/kg b.wt. post-treatment with MGN-3 and saline to 4 weeks male rats. Hepatic transaminase,

IL-18 and mRNA levels were also examined 1 day post D-GalN injection. Experimentally MGN-3 increased D-GalN caused hepatic lesions at dose rate of 20mg/kg b.wt. on oral and intraperitoneal administration. Moreover, low molecular weight of MGN-3 favoured the protective potential against hepatic damages due to suppression of D-GalN based inflammatory response. These results suggested the protective effect of low molecular weight associated MGN-3 with IL-18 against hepatic disorder.

Reshmi and Nandini [15] reported the comparative therapeutic potential of two different rice varieties. *Njavara* and Asian rice varieties were used for this study. Both these rice varieties were evaluated for anti-diabetic and antioxidant efficacy. They were supplemented to 5 diabetic patients for three months and determined blood glucose level. Blood glucose levels of these patients were examined at 45 and 90 days post supplementation. Results showed reduced blood glucose level in all diabetic patients on post supplementary examination. DDPH assay for antioxidant potential was also determined. *Njavara* supplemented patients exhibited elevated inhibitory potential for free radicals in blood on DDPH assay.

Henderson *et al.* [16] demonstrated the therapeutic potential of rice bran against hepatoma, pulmonary carcinoma, breast and colon cancer. The chemoprophylactic efficacy might be associated with chemical constituents of rice husk. These components include vitamin-E, ferulic acid, tricin, saturated fatty acids and sterols. Based on studies rice bran ingredients have been reported to exhibit inhibited cytoproliferation, arrested growth and apoptosis for cancer cells. These substances also exert their anti-inflammatory effect through production of reactive oxygen species in tissues. Moreover, these chemicals exhibit immunostimulant activity through regulation of intestinal microflora and anti-carcinogenic enzymes against bowel cancer. Cheap in cost and availability suggested the rice bran as a suitable nutraceutical worldwide as well as its commercial application for chemoprophylaxis.

Kannan *et al.* [17] evaluated the anti-cancer efficacy of rice bran derived peptides. This study was based on isolation and characterization of rice bran derived peptides. For this purpose, G.I secretory stable peptides were obtained through thermostabilized fat free rice husk. These low molecular weight rice brans derived peptides inhibited cancer cells proliferation. Moreover, these peptide fractions were further purified and quantified through spectrometry and chromatography for their immunostimulant function. Viable cancer cells were

quantified by cell titer assay. Purified peptide fractions inhibited 84% and 80% proliferation of human colorectal carcinoma, hepatoma and breast carcinoma @ 600-700 µg/ml respectively. Spectrometry and genome sequencing resulted in pentapeptide with 685.378 Dalton molecular weight. These results concluded the rice bran derived pentapeptide as natural chemotherapeutic agent for cancer.

Rao *et al.* [18] conducted a study to evaluate the comparative antioxidant and anti-tumor potentials of rice bran extracted from various rice varieties. This study involved methanolic extracts of Njavara, Yamini, Jyothi and Vasumathi rice varieties. These four rice bran extracts were in vitro analyzed for their free radical production, reduction efficacy and cytotoxicity in murine brain cancer cells based on phenolic contents. Among all these rice bran extracts Njavara exhibited higher antioxidant potential in terms of reducing potential, cytotoxicity and phenolic contents than others. Moreover, increased quantity of extracts also increased their reducing and antioxidant potentials. Hence these results concluded the better antioxidant and inhibitory potentials of Njavara rice for brain carcinoma as well as a potent nutraceutical.

Noaman *et al.* [19] demonstrated the oncostatic activity of rice bran derived arabinoxylans (MGN-3) in female mice with Ehrlich ascities carcinoma (EAC). For this purpose, MGN-3 was administered at dose rate of 25 mg/kg intraperitoneally six times in a week for 25 days. MGN-3 resulted suppressed tumor growth, lipid peroxidation and increased antioxidant activity. These results revealed dietary inclusion of MGN-3 due to antioxidant and immunostimulatory potentials.

Deniz *et al.* [20] evaluated the role of rice bran (RB) with and without enzyme in growth performance of broiler chicken. For this study 416 day old chicks divided into 8 groups with 4 replicates and 13 chicks each were reared for 42 days. 10%, 15% and 20% RB was offered to them with and without enzymatic dietary inclusion. Feed intake and weight gain were decreased with increased dietary RB level on 21 day. FCR and feed intake were increased with decreased yield carcass on 42th day at 20% RB level. These results concluded dietary inclusion of rice bran for increased digestive organs size without enzymatic supplementation in broiler chicken.

Liao *et al.* [21] reported the growth-inhibiting and immunopotentiating effects of milled rice (MT9) and (BT9) water extracts derived cultured agranulocytes (MNC-CM) against human leukemic cells. These agranulocytes

differentiated leukemic cells into macrophages with superoxide production and increased phagocytosis as well as the higher levels of interferon- $\alpha$  and tumor necrosis factor- $\alpha$ .

Cicero and Derosa [22] demonstrated the prophylactic potential of rice bran against cardiovascular disorder. Certain constituents of rice bran including Vitamin-E, fats, polysaccharides and saponins have been reported for improvement of lipid cholesterol level in both human and animal models. Moreover, these rice bran constituents also regulated pituitary gland function, antioxidant and inhibitory potentials of gastric secretion as well as platelet clumping. These effects suggested the prophylactic efficacy of rice bran components against cardiovascular disease.

Nam *et al.* [23] evaluated the quantitative anti-cancer potential of rice bran extract. This study involved human herpesvirus and phorbol tumor promoter. The anti-tumor potential involved cytotoxic efficacy for selective cancer cells. Moreover 70% methanolic extracts of five different rice varieties were also used for monkey cancer cells. Among all these rice bran extracts white rice extract inhibited activity of tumor promoter in cancer cells. These results concluded the application of more nutraceutical varieties of rice.

Maeda *et al.* [24] described the prophylactic efficacy of water soluble rice bran (HRB) for acute coryza in old people. This study involved Arabinoxylan derivation from rice bran through dissolving of rice bran carbohydrates in water. Water soluble rice fraction (RB) was used as control. Both these types of rice bran were administered to 70-95 years old fifty aged people for 6-weeks. Symptoms score and duration of symptoms were lower and shorter for HRB treated group than that of RB due to increased NK cell activity. These results concluded beneficial effects of HRB for eradication of stress in acute respiratory tract infection.

Chan *et al.* [25] evaluated the anti-cancer potential of rice extracts. This study involved treatment of murine leukemic, human lymphoid leukemic and human cervical carcinoma cells with juvenile rice extract and matured rice extract. G ex involved water supplemented (W ex), chitosan contained (C ex), glutamated (G ex) as well as combined glutamated and chitosan (CG ex) rice extracts. Among all these germinated extracts, CG ex showed comparatively highest proliferation inhibition but G ex also exhibited the similar potential against L1210 and Molt4 cells growth significantly due to higher

$\gamma$ -aminobutyric acid (GABA) content than N ex. Moreover, both G ex and CG ex increased murine leukemic cells apoptosis than others. These results concluded that GABA riched rice extracts had immunostimulant potential against both leukemic and cancer cells.

## CONCLUSION

Rice improves health through instant energy, stabilizing blood sugar level, good bowel movement and is also an important source of vitamin B<sub>1</sub> to body. Further, it induces resistance against high blood pressure, skin rupture, heart diseases and dysentery. So, it is concluded that rice (*Oryza sativa*) has immunostimulatory and therapeutic potential playing an important role in immunity, that's why it is considered as one of the most important herbal crop.

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