Review Article

Brown Rice as Useful Nutritional Source

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Abstract | Rice is widely consumed food entity in half of the world's population. Brown rice is unrefined, coarse and unpolished whole grain rice which is directly obtained by removing only husk. In Brown rice, the embryo may or may not be left undamaged depending upon the hulling process. Brown rice may become white rice when the bran layer is exposed of in the milling process. In present era where diseases are common and people are in search of nutritious diet containing minerals and essential compounds, brown rice is found to be healthiest and minerals rich food commodity. Due to its appearance, color and texture it is rarely used. Brown has a meek nutty flavor and may become rancid more rapidly, but it is extreme more nutritious as compared to processed rice. Brown rice is the whole grain rice and is high in fiber contents. Brown rice is also rich in phosphorous, magnesium, thiamin, selenium, manganese, niacin and vitamin B6. This review entails important and healthiest aspects of brown rice to include it in regular diet.

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Introduction

For over almost 7000 years rice has its importance as it has been cultured as main, significant and vital crop. At present a large number of populations almost half depend on rice for their food requirements (Izawa and Shimamoto, 1996). For many centuries rice has been important and chief food in Asian countries. It is staple element of our daily consumed food source (Hudson et al., 2000; Sun et al., 2010). Almost all types of rice are available throughout whole year (Cho and Lim, 2016).

Brown rice

Brown rice is untreated whole grain and is formed by removing the outermost layers of seed. Mostly rice is taken in milled white form, that is formed by milling and polishing of brown rice which causes removal of the bran from the grain whereas brown rice contains the germ and bran layers, that are rich in nutrients and includes vitamins, dietary fiber, minerals, and some other unmeasured dietary components (Hudson et al., 2000; Kim et al., 2011). As brown rice has bran and embryo, a large variety of bio-functional and nutritional components are present (Cho and Lim, 2016).

Brown rice is produced by removing hull or husk portion only and due to its brown color it is known as brown rice however, its appearance is reddish and purplish too. By the 20th century, progress of grain-processing technology made large-scale production of refined grains possible. Through this refining, the outer bran and germ parts of rice grains (brown rice) are removed to produce white rice that mainly consists endosperm having starch (Sun et al., 2010).

White or milled rice is formed when bran portion is also removed along with husk or hull. Brown rice have

slight nutty flavor and is more chewer than polished rice. Despite its rich content of bioactive compounds brown rice is rarely consumed as a staple food due to its dark appearance and hard texture (Wu et al., 2013; Bergman, 2019). Due to presence of free fatty acids and their accumulation, brown rice has short shelf life that is usually 3 to 6 months. Drying temperature and time are important regarding brown rice because they affect brown rice properties significantly (Jaisut et al., 2009). Brown rice are utilized less due to their texture and color (Cho and Lim, 2016).

Effects of milling

Brown rice obtained by removal of only the outermost part that is known as Hull thus retaining most of nutrients whereas the complete milling that cause brown rice to change in white rice involves polishing that causes reduction in nutritional content such as vitamin B3 reduces up-to 67 %, vitamin B1 reduces up-to 80%, vitamin B6 reduces up-to 90%, manganese and phosphorus reduces almost half, iron reduces up-to 67%, and about all necessary fatty acids and dietary fibers are lost (Babu et al., 2009). Milling removes bran and germ portion i.e. rich in fiber, proteins minerals and vitamins. This also results in loss of thiamin up-to 80% (Oh and Oh, 2004). Whole grain rice is known as brown rice. They are unpolished rice and are important from their nutritional aspects. They are made by removing dry outer covering of rice i-e husk. It comes in short as well as long grain size and more chewer than white rice. As they have their bran and germ layer, their nutrition values are retained (Kim et al., 2011).

Brown rice and their cultivation

Rice was first domesticated almost 8000 to 9000 years ago in Yangtze River valley of China. Rice is now grown all around the world and supporting half of the world's population as food source (Hu et al., 2012). Asian cultivated rice is *O. saliva*, which is grown throughout the world. Rice requires growing conditions such as lowland that has been irrigated and fed low, also rain fed upland and ecosystems vulnerable to flood (Khush, 1997). Pakistan cultivates rice as third largest crop, where cotton at first and wheat stands at second. Rice cultivated on an almost 2.5 million hectares area and forms total 16 % total cereals exist (Asghar et al., 2014). In Pakistan total two crop seasons exist, i.e. Kharif and Rabi. "Kharif" that is the first sowing season and lasts from April to June where as harvestation is done from October to December. Crops that are regarded as Kharif crops are Rice, cotton, sugarcane, maize, mash, bajra, jowar and mun. Kharif crop cultivation depends on irrigation water (MFGoP, 2011-12). Latitude of rice in which rice are grown is from 55°N and 36°S (Khush, 1997).

Benefits of brown rice on polished rice

Brown rice has number of benefits and positive aspects as compared to polished rice as it has higher amount of laxative such as high fibers contents that prevents from gastro intestinal disease, rich amount of vitamin B that prevents from beriberi, high in fat also that is good energy source. Also brown rice has high phytic acids content that act as antioxidants (Butsat and Siriamornpun, 2010) also decrease cholesterol and thus prevent from cardiovascular disease and is has lower glycemic index that prevents from diabetes type 2. Some other benefits include economics as Brown rice causes 50-60 % of fuel savings as less milling and polishing steps are involved. Short milling steps, less labor, and also less equipment cost as no polishers needed. Thus in total greater output is received and economy benefits are more as compared to polished rice. One most prominent benefit is greater recovery of milling which is 10% more than polished rice (Babu et al., 2009).

Difference between brown rice and other varieties

Refined grains are down when compared with unrefined grains as they have lesser content of minerals, vitamins, fibers, phenols, unsaturated fatty acids and phyto-esterogens (Jang et al., 2001). In terms of sustenance brown rice contains nourishment as juxtaposed with other rice varieties i.e. it is healthier one. There is not much difference in brown rice and other rice types such as parboiled rice, Matta rice, white rice, basmati, samba, wild rice, flattened rice, golden rice etc but main difference lies in nutritional values, when it comes to nutritional contents brown rice variety is on upper hand than other providing the best fuel needed for our body requirements. As milling results in loss of bran and germ portion of grain, it results in loss of nutrient content, because they are not present evenly in grain. Nutrients and phytochemicals are present in greater concentrations in the outer portion of the grain (Slavin et al., 1999).

Comparison with white rice variety

Brown rice is healthy alternative for as compared to white rice (Cáceres, et al., 2014). The only major difference between white and brown rice is milling

that converts brown rice to white riceand reduces nutritional content of it. As milling removes bran in which most nutrients resides white rice is poorer nutritional sources and having dramatically decrease amount of fibers, nutrients, vitamins B and also important constituent thiamin.

Detail analysis on acceptance of brown rice as food

Information regarding acceptability of brown rice instead of white rice is usually neglected because of lack of awareness, however according to one study brown rice were introduced into diet of Chinese adults and results were checked through long term clinical trials and randomized experiments regarding lower risk of type 2 diabetes. Thirty two Chinese adults of shanghai took part in order to carried out quantitative and qualitative research by group talks and discussions, and questionnaires were also filled by them. Out of thirty two participants most of them 30 consumed white rice as daily food source and less number of participants only 8 somehow tried brown rice before. Main difficulty on acceptance of brown rice instead of white rice was rough texture, high price, and unpalatable tastes (Zhang et al., 2010).

Similarly, in one more study carried out in 2009 among South Indian adults and those factors were identified that were main barriers for acceptance of brown rice. Experiment was conducted among adults with normal body and those who were overweight, Results were deduced according to group discussions in which included dietary practices, perceptions of brown rice, factors effecting preferences regarding rice, culture, and barriers influencing brown rice acceptance and those results showed that most of them favored rice based foods (Kumar et al., 2011).

In previous case most participants, on basis of taste and quality, considered brown rice inferior to white rice but most of them after learning about their nutritional value showed willingness for intake of brown rice. Those results provide important information and showed the importance of increasing awareness regarding nutritional value of brown rice. So results proved that convincing public to take brown rice instead white one would be slow process but this can be overcome by promoting its health benefits and nutritional values.

Germinated brown rice (GBR)

One more important aspect of brown rice is GBR that is known as germinated brown rice (Tian et al., 2004). GBR is also whole food as only outer hull is removed (Patil and Khan, 2011). This germination is done to improve taste, increasing nutritional content of brown rice and improving health (Wu et al., 2013). GBR is simply brown rice soaked in water, till it starts to bud. It is new cereal diet product, has attracted public attention due to its characteristics. Those nutrients that are present in bran include Arabinoxylan, vitamins and amino butyric acid (Ho et al., 2012). Germinated brown rice uses physiologically active substances present in bran. The nutrients that are present in seed become way too easy to absorb and digest during process of germination. There are evidences that, when GBR is germinated it shows excellent assimilation and increases important compounds. GBR has its medical importance as from experiments its anti-adipogenic role has been identified similarly anti-obesity effects on body weight of GBR, expression of genes relating adipo genesis has been studied in high fat induced-obese mice. Germinated brown rice is such as innovation that conserves all important nutrients. Thus, GBR contains vitamins, minerals that are helpful in various diseases and enhance health benefits. They have lower glycemic index which causes a complete balance in blood sugar level, helps is weight loss and also provides a good source of energy.

Germination also causes production of bioactive compounds such as Gamma Amino Butyric Acid (Cho and Lim, 2016). This bioactive compound have role in mental and muscle relaxation. GBR also can prevent from oxidation damage as it has antioxidant compounds e-g Orizanol, Proanthocynin. GBR is good source of GABA which is amino acid produced by brain. GABA is required for brain functioning, usually almost all GABA is used by brains and it becomes diminished which results in higher risk of insomnia, anxiety, and irritability. GABA is neuro-transmitter so it has important function in keeping stress low and providing relaxation and sleep. It has also played important role in fighting chronic diseases (Cáceres et al., 2014). It usually lessens risks of cancer, cardiovascular disease, diabetes and Alzheimer's disease. It has its important role in providing physiological impacts such as anti-hyperlipidemia and antihypertension (Wu et al., 2013). GBR is also good source of magnesium. Magnesium plays role in regulation by regulating calcium balance. Magnesium controls calcium channel, preventing

their entrance into nerves thus providing relaxation. If magnesium is low in our body calcium causes over activation of nerves and thus resulting in too much contraction so, in inadequate amount of magnesium causes high blood pressure, asthma, spasms of heart and migraines, muscle cramps and spasm, soreness and fatigue too. The nutrients GBR contains include vitamins, minerals, dietary fibers, and essential amino acids and also e bioactive components are present. So, germinated brown rice will soon become an essential and important health food.

Health benefits

Whole grains have fiber, oligosaccharides vitamins resistant starch, phytate, minerals, phytoesterols, phytoesterogens. These bioactive compounds account for their protective effects (Newby et al., 2007). The intake of whole grains has been found protective against diabetes, CVD, obesity and cancer (Slavin, 2004). Brown rice has immense number of health benefits. Brown rice is also considered as whole grains as it contains all 3 portions e.g. bran, germ and endosperm. Endosperm causes protein production, bran provides almost 80% minerals and germ layer is made up of Vitamin E, unsaturated fatty acids, minerals, antioxidants and phytochemicals. Brown rice provide a number of health advantages because it has proven effective in number of diseases and those conditions that lead to chronic symptoms and ultimately are life menacing.

Brown rice and diabetes

White rice is associated with high cause of type 2 diabetes T2D (Ho, 2012) and brown rice with lower risk. One of the researches conducted shown that brown rice is beneficial in diabetes and in condition hyperlipidemia. This is because sugar released by brown rice is 23.7 % less than that released by milled rice and this is because it has low glycemic index. The reason behind it is difference on physiochemical properties and high amount of dietary fibers and polyphenols and also due to presence vitamins and minerals (Sun et al., 2010). This indicates that brown rice has blood glucose lowering effect. So, in order to prevent type 2 diabetes carbohydrate intake should be from brown rice rather than white rice (Panlasigui and Thompson, 2006).

Brown rice and cancer prevention

According to dietary guidance whole grains reduce risk of cancer that is one of the chronic diseases in this includes cancer such as of gastric cancer and colonic cancer. The main reason is that presence of protective components such as resistant starch, dietary fiber etc. (Slavin et al., 1997).

There are reports that suggest that some compounds present in rice act against chemical-induced mutagenicity, prevent tumor promotion, suppress carcinogenicity and established neoplastic growth in rodents. A very little is known about detailed mechanism but most evidences suggests that some molecules having chemo preventive and antitumor properties are present in Bran portion of rice. These all are biologically active substances (Hudson et al., 2000). Brown rice extracts bran in fact inhibits cell growth, they were analyzed chemically and found to contain phenolic compounds that prevent and assist in growth inhibition. The rate of breast and colon cancer in Asia is low as compared to western world. Because rice is special dietary portion of their food Colon and breast tumor suppressive properties of brown rice were investigated.

Detailed analysis

Extracts of Brown rice, its white milled counterpart and bran from brown rice were taken by treating them with ethyl acetate by boiling them. This property of cancer treatment is due to presence of phenolic compounds that controls proliferation of breast and colon cells and also their colony forming property. Extracts were studied with help of liquid chromatography and were divided into nine fractions. Brand extracts decreased amount of MDA MB 468, HBL 100 breast cells and colon derived SW 480 cells including human colonic cells also. They also reduced their colony formation. 3-(4, 5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2*H*-tetrazolium assay were used to deduce these results their extraction was 100µ g/ml All cell types were decreased due to eight type of phenols present in brown rice. Tricin, ferulic acids, methoxycinnamic acid decreased cell viability of cancer cell lines. Caffeic acid lessened number of all types of cells except HBL 100. Tricin and other phenols effects colony formations of SW 480 cells. Tricin and other phenols were applied at 50 µM and 200 mM respectively. Tricin, caffeic and ferulic acid combinely inhibited colonogenicity of MDA MB 468 cells when applied at 50 µM. The most anticologenic compound among them was Tricin.

Table 1: *Difference between brown and polished rice.*

mg/100g	Brown rice	Polished rice
Niacin	4.7	1.6
Ribiflavin	0.05	0.03
Thiamin	0.34	0.07
Magnesium	187.0	13
Iron	1.9	0.5

Oh and Oh, 2004

Table 2: *Nutritional aspects of brown and white rice.*

Parameters	Brown rice	White rice
Calories	232	232
Protein	4.88g	4.10g
Carbohydrate	49.7g	49.6g
Fat	1.17g	0.205g
Dietary fiber	3.32g	0.74g
Thiamin (B1)	0.223mg	0.176mg
Riboflavin (B2)	0.039mg	0.021mg
Vitamin B6	0.294mg	0.103mg
Niacin (B3)	2.730mg	2.050mg
Folacin	10mcg	4.1mcg
Vitamin E	1.4mg	0.426mg
Phosphorus	142mg	57.4mg
Selerium	26mg	19mg
Potassium	137mg	57.4mg
Zinc	1.05mg	0.841mg
Magnesium	72.2mg	22.6mg

Babu et al., 2009

Results

Brown rice has such compound in them that act as cancer chemo preventive compounds. This property may be associated with phenols that are present in brown rice such as tricin. Levels of such phenols are certainly low compared to brown rice. Such substances inhibit proliferation and colony forming ability of colon and breast cells. A big difference is present in anti-proliferative and anti-cologenic characters among white and brown rice. (Hudson, et al., 2000)

Brown rice promotes weight loss: Whole grains such as brown rice is helpful and protect against cancer, obesity, CVD and diabetes. It has known for providing health benefits as it contains nutrients and phytochemicals. Studies have been made regarding it that it's feeding support weight loss, antioxidant protection, and improvement of blood lipid level. Consumption of whole grains for disease protection is far more effective and beneficial than individual nutrients and phytochemicals taken from them (Slavin, 2004).

Coronary artery disease: Intake of whole grains results into lower concentration of serum insulin and also enhances insulin sensitivity thus preventing coronary artery disease and hyperinsulinemia leading to diabetes. Higher intake of nutrients such as polyunsaturated fatty acids dietary fiber, vitamin E is related to lower chances of occurring of coronary artery diseases CAD (Jang et al., 2001).

Prevention from gall stones: Brown rice is good mean of preventing gall stones especially in women. This is due to insoluble fiber; insoluble fiber reduces risk of gall stones. A total 17% risk is reduced in women eating them. And 5 gram of brown rice causes reduction almost 10%. Thus this is due to insoluble fiber that reduces chances of cholecystectomy in women (Tsai et al., 2004).

Brown rice and their antioxidant property

Cereal grains have many free phenolic compounds including their glycosides too. Also trace minerals and phytoesterogens with prominent hormonal effects are found in whole grains (Slavin et al., 1999). These exist in solution form and have sufficient amount of insoluble phenolic compounds that are mostly bound with polysaccharides and found in cell wall. Phenolic compounds are secondary metabolic product and widely present in plant kingdom. There are authentic researches that indicate that phenolic compounds have antioxidant characteristics. (Tian et al., 2004)

Antioxidants have protective functions in the body such as reaction with free radicals these free radicals known to attack DNA, lipids and protein Also these radicals can at as initiating factor for many chronic diseases. Various physiological effects on human body are due to presence of phenolic compounds. They prevent damage caused by lipid and low density lipoprotein and in result prevent risk of cancer and coronary heart disease. Although major dietary source of these compound are fruits and vegetables but many researches indicate cereals intake as to increase their amount in human body (Miller, 2001). Currently consumption of phenolic compounds is neglected and major reason for this is these compounds are confined to bran layers and are lost when during processing seed coats are separated. Same happens in case of rice that most of phenolic compounds are lost with bran

layer remover (polishing). Eight types of phenols have been identified in brown rice extracts and intact brown rice. These include protocatechuic acid, *p*-coumaric acid, caffeic acid, ferulic acid, sinapic acid, vanillic acid, methoxycinnamic acid, and tricin. Bran and husk portions have great values of antioxidant properties. They have high content of phenolic acids such as ferulic acid mainly found n brand portion and vanillic acid is evident in bran. High levels of ferulic and p-coumeric acid are higher than other varieties of rice such as milled one (Zhou et al., 2004). Antioxidant property of brown rice (PUSA Basmati), milled fraction of brown rice and enzyme treated brown rice is assessed. The overall sequence of antioxidant activity is brown rice > enzyme treated rice > milled rice (Das et al., 2008). Around 80-90 % total phenolic acids are present in brown rice. Brown rice is an important source of lipid-soluble antioxidants in which includes tocotrienols, ferulatedphytosterols (γ-oryzanol) and tocopherols (Britz et al., 2007).

Nutritional aspects

Components of whole grains have biologically active compounds such as high amounts of B vitamins such as (thiamin, riboflavin, pantothenic acid and niacin), minerals such as calcium, magnesium, potassium, phosphorus, sodium, and iron, higher levels of basic arginine and lysine (basic amino acids). Brown rice has more nutritional importance because it contains more nutrients then white rice, whether it is un-milled or partly milled (Wu et al., 2013). As brown outer part i.e. Rice bran of rice kernel consist of pericarp layer, aleurone layer, germ layer and sub-aleurone layer so this portion is rich in nutrients such as fat, protein and dietary fiber. Also a great amount of Furthermore, it contains minerals is present such as K, Ca, Mg, and Fe (Sharif et al., 2014). Bran portion of rice is known to contain proteins, carbohydrates, vitamins, lipids and minerals in large amounts (Saunders, 1985; Masironi et al., 1977).

Brown rice contains starch: Whole grains have compounds such as oligosaccharides, dietary fiber and resistant starch (Slavin et al., 1999; Slavin, 2004). Brown rice (Oryza sativa Indica) contains more starches as compared to wild rice specie (*Zizaniapalustris* L). Their yield is 64.4 % whereas Starch from wild rice yield is only 38.3% on a whole seed basis (Hoover et al., 1996).

Brown rice has lower glycemic index: Glycemic index (GI) is one indication used for comparison of the glycemic activity towards foods. Glycemic index (GI) of brown rice is lower than white rice. It was found that the GI for white rice was 64 (Kim et al., 2011) and for brown rice 55. According to one data analysis Glycemic and insulin index of rice was determined. High amylose rice are with lower GI and insulin index than normal amylose content. Insulin index was relatively lower than GI but it is correlated with GI positively the results show that a number of rice varieties including white, parboiled rice are with high GI index (Miller et al., 1992). As per data of Harvard Health Publications, the average glycemic index of brown rice is 50 and of white rice GI is 89. Although recommendations are not completely consistent, intake of white rice, in general, creates a stronger postprandial blood glucose response as calculated by the glycemic index (GI) than the same amount of brown rice (Sun et al., 2010). Higher rates of GI are related to type 2 diabetes mellitus (Hu et al., 2012).

Brown rice is rich in selenium: As a large number of populations rely on rice, level of selenium is of serious concern and has severe impacts on human body. Husk and brans portions of grain have 10 times higher proportions of inorganic selenium compared to its endosperm portion. Selenium is one of the most important trace element (Zhang et al., 2006). Across 1 billion populations around world, insufficient selenium intake is serious health issue. Cereals can be rich source of selenium. Se content in crops varies according to region diversification (Williams et al., 2009). Selenium is essential for human body and a number of roles are played by it regarding human health. Selenium is an important regarding antioxidant property and production of hormone known to be thyroid one. This property associated to the fact that is constituent of glutathione peroxidase and as well as thio-redoxin reductase. These enzymes by reducing free radicals can suppress oxidative damages. Active site is formed by selenium on enzyme known to be glutathione peroxidase. There is accumulation of selenium in bran portions of grain. This accumulation is specifically in pericarp and aleurone tissues of bran part.

Brown rice contains magnesium: Brown rice is also a good provider of rich amount of manganese and magnesium. Almost half of manganese lost in milling process. Magnesium is important nutrient having

great role in preventing asthma, lowering blood pressure, lessening migraine headaches, lowering chances of heart attacks. Magnesium balance calcium level thus regulates communication between nerves and provides muscle relaxation. Calcium channel is control by magnesium as it reduces the chances of calcium from entering to nerves and activating them and keeping state of relaxation. Less amount of magnesium thus cause high blood pressure, migraine headache, spasm, tension, fatigue and soreness. Magnesium also one of component found in bones about two third of human body present in bones. Physical structure is also maintained thus Brown rice provides adequate amounts of magnesium to keep these sources up whenever body needed it. About 21% of magnesium is provided by brown rice, one cup can fulfilled this amount needed on daily basis (Jiamyangyuen and Ooraiku, 2008).

Brown rice is very high in fiber: Brown rice is one of whole grain cereals that have rich concentration of dietary fiber, starch and oligosaccharides. Rice can fulfill nearly 80% of energy requirements in some areas, thus contributing on large scale but they are important relating their proportions of micronutrients and proteins (Williams et al., 2009). Consumption of fiber is related to lessen risk of several diseases as mentioned such as colon cancer, obesity, heart disease, diverticulosis etc. Brown rice is complete package in providing fibers thus preventing from cancer. Bran portion specifically contains fibers and oils that are essential. These fibers prevent from gastrointestinal and heart diseases. According to National Cancer Institute one should eat 25 grams of fiber a day. 3.5 grams of fiber is provided by a cup of brown rice whereas white rice is unable to provide even 1g of fiber per cup.

Shelf life of brown rice

One of major reason of less consumption of brown rice is its shelf life. So various treatments are done in order to prevent rancidity and retain antioxidants. In them included dry heat, wet heat and microwave even due to its higher nutritional benefits brown rice is not consumed due to its vulnerability to rancidity. The oil present in brown rice is actual cause of rancidity and effect by oxidation. One of the main reasons for this is due to fast reactions of enzymes such as lipases. Shelf life of brown rice is 2-3 months. Brown rice thus requires appropriate storage. This can be done by in activating lipases and many processes have been developed to achieve this goal in them included are low temperature, storage in vacuum, use of polyethylene and nylon films, storage in altered atmosphere, aluminum pouches and packaging materials 42Shelf life can be increase greatly by freezing sometimes parboiling of brown rice is also done in order to increase shelf life (Sharp and Timme 1986; Bergonio et al., 2016).

Conclusions and Recommendations

Brown rice is whole grain formed by removing only the outermost husk portion. It is far more-better than polished rice that involves complete removal of bran and husk thus leaving only endosperm portion. Also it has many benefits as compared to white rice. Germinated Brown rice is one of its innovative forms having greater amount of nutrients. Brown rice is iconic source of food having greater amount of number of nutrients such as proteins, carbohydrates, dietary fiber, fat, thiamin, riboflavin, niacin magnesium, phosphorus, potassium, selenium zinc etc. This impressive composition relates to reduction and prevention in diseases such as cancer, diabetes, weight loss and coronary artery disease. They are also associated with their remarkable antioxidant property. Many procedures have been developed to increase its shelf life. So world should be aware of benefits of Brown rice should be consumed because of their benefits and nutritional content which justifies it.

Author's Contribution

Naseem Zahra: Conceived the idea, data collection, wrote paper, wrote abstract and conclusion, overall management of review.
Shajia Jabeen: Data collection, technical input, wrote introduction of paper.

Conflict of interest

There is no conflict of interest.

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