

Black Rice As Potential Superfood-A Review

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ABSTRACT

Rice (*Oryza sativa* L.) is the major cereal crop in most of the developing countries. Black rice is a type of pigmented rice with black bran covering the endosperm of the rice kernel. Black rice 'Chakhao' is an aromatic and pigmented rice variety popular in Asia. Black rice, also known as forbidden rice or purple rice, is a type of rice that has a striking dark color and a rich history. Black rice (*Zizania aquatica*) is a rice variety formed by the mutation of Kala4 gene. In the world it is mainly cultivated in Southeast Asian countries like China, Thailand and India. China accounts for 62% of black rice production in the world followed by Sri Lanka, India, Indonesia and Philippines. In India black rice is grown in North-eastern states like Manipur, Mizoram, Meghalaya, Assam and some parts of Odisha. Black rice is black in color due to the presence of the anthocyanin pigment on the outer layers (bran) of the rice kernel. Black rice is rich in tocopherols (vitamin E), iron and antioxidants. Black rice has high levels of protein, fiber, vitamins (Vitamin B1, Vitamin B2, folic acid) and minerals (iron, zinc, calcium, phosphorous and selenium) compared to that of white rice. The major essential amino acids present in black rice are lysine and tryptophan. It also possesses lot of health benefits like antioxidant activity, anti-inflammatory properties, lipid oxidation, anti-diabetic, anti-ageing and anti-cancer effects. The use of black rice as an ingredient in food processing might help in creating value added products.

Keywords: Black rice; Antioxidants; Anthocyanin; Colorants

INTRODUCTION

Black rice is the native of the common rice species (*Oryza sativa*) and the scientific name of black rice is (*Zizania aquatica*)(1). Other common names of black rice are purple rice, forbidden rice, heaven rice, imperial rice, king's rice and prized rice. Initially black rice was reserved only for the kings of China and Indonesia due to its high price and enormous medicinal properties to cure various illnesses. It is known as Chak-hao Ambi in Manipur (Chak-hao means 'delicious' and ambi means 'black') and thus refers to delicious black rice. In Odisha it is known as Kalabati (kala means 'black and bati means 'rice' in oriya). In south India it is found Keelapoongudi village in karaikudi district of Tamil Nadu and it is called as 'kavuni rice'. Black rice is almost six times richer in antioxidant activities, have high protein content (8.16%) and low fat content (0.07%) (Thomas *et al.*, 2013)(2) as compared with other rice varieties, is gluten free, gut friendly and a natural cleaner with many medicinal values (Jha *et al.*, 2017)(3). The presence of dark purple color on the outer covering (pericarp) of the rice grain appears to be in black color and thus it became black rice. The purple color pigment is anthocyanin which is a rich antioxidant and is naturally present in many berries like blueberry, black currant and vegetables like eggplant (brinjal). Black rice is a rich source of iron, antioxidants and vitamin E, thus ensures good health and increases the overall life span of human beings. A recent study reported that pigmentation in black rice results from the activity of the Kala4 gene, which is necessary for anthocyanin synthesis (Pratiwi *et al.*, 2017)(4).

History of Black Rice

Black rice has an incredibly rich cultural history. In ancient china and Indonesia black rice was 4 considered so superior, tasty and rare that it was exclusively reserved for the emperor and used as a tribute food. Common people were not allowed to have this. So it was called "Emperor's rice". The Emperor says, "Hands off the black rice! It's mine". Royal families and kings of ancient China used to eat this special rice to ensure their longevity and good health. It was also known as "Forbidden rice" as the name might imply, consuming it without approval from the proper authorities can have life threatening consequences for those involved. But with changing of time it is now available to the different parts of world. Black rice is commonly cultivated and eaten in Manipur, called "Chakho ambi" in, Manipuri language which is commonly known as "Manipuri Chakho" which is eaten during community feasts. "Chakho" means delicious and "amubi" means black, thus translating the name to "delicious black rice". China is the richest country in the black rice resources (62%) followed by Srilanka (8.6%), Indonesia (7.2%), India (5.1%), Bangladesh (4.1%) and few in Malaysia (Chaudhary, 2003)(7). So far they have developed 200 varieties including 52 high yielding varieties (Biswas, 2018)(8).

TYPES AND VARIETIES OF BLACK RICE

1. **Black Japonica Rice:** This type of rice is a mix of short and medium sized rice grains grown on the same field. It has an earthy flavor with a mild sweet spiciness (5).
2. **Black Glutinous Rice:** It is also known as the 'Black Sticky Rice'. This type has a short grain size and has a sticky texture. The grains are unevenly colored and generally used to make sweet dishes in Asia.
3. **Italian Black Rice:** This variety has long rice grains and has the characteristics of both Chinese black rice and Italian rice with a rich buttery aroma (5).
4. **Thai Black Jasmine Rice:** It is of a medium grain size and originated from Thailand that combines Chinese black rice with jasmine rice. Jasmine rice is native of Thailand and has a subtle floral aroma which is also observed in Thai black jasmine rice due to the combination

NUTRITIONAL PROFILE OF BLACK RICE IN COMPARISON WITH RED, BROWN AND WHITE RICE

Table 1: This table represents the nutritional profile of different rice varieties in per 100 g serving [6].

Rice Variety	Carbohydrates (g)	Protein (g)	Fat (g)	Fiber (g)	Iron (mg)	Tocopherol (mg)	Thiamin (mg)	Riboflavin (mg)	Zinc (mg)
Black rice	34 ± 0.05	8.5 ± 0.5	2 ± 0.06	4.9 ± 0.3	3.5 ± 0.15	12.54 ± 0.34	0.46 ± 0.032	0.403 ± 0.04	3.16 ± 0.05
Red rice	23 ± 0.04	7 ± 0.05	0.8 ± 0.01	2 ± 0.6	5.5 ± 0.14	10.77 ± 0.24	0.33 ± 0.15	0.105 ± 0.03	1.91 ± 0.036
Brown rice	24 ± 0.07	7.9 ± 0.07	0.8 ± 0.02	1.8 ± 0.5	2.2 ± 0.07	2.2 ± 0.76	0.54 ± 0.07	0.1 ± 0.2	1.8 ± 0.05
White rice	28 ± 0.03	2.7 ± 0.04	0.3 ± 0.01	0.6 ± 0.1	1.2 ± 0.19	0.1 ± 0.14	0.7 ± 0.06	0.03 ± 0.33	1.41 ± 0.039

HEALTH BENEFITS OF BLACK RICE:

Continuous consumption of white rice as staple food grain has resulted in malnutrition, anemia and aggravated diabetes (Jena and Mishra, 2019). In such case, black rice becomes an alternative and has the potential to become a functional food due to its health benefits.

1. Anthocyanins such as cyanidin-3-O-glucoside and peonidin-3-O-glucoside are the major constituents of black rice which function as antioxidants. Black rice is a kind of colored rice rich in anthocyanins, flavonoids, phenolic acids and other active substances [23], which has the functions of effectively removing free radicals that damage lipids, protein and DNA, resisting cancer, allergy, obesity and preventing arteriosclerosis and cardiovascular diseases. Anthocyanin has a protective effect against inflammation, protection from cardiovascular diseases, atherosclerosis and carcinoma.
2. Black rice is super food for people suffering from diabetes and alzheimer's disease (Jena et al., 2019).
3. It helps to protect arteries, controls blood lipid, prevent oxidative DNA damage, reduces cholesterol levels as well as cancer cell invasion and decreases cancer risk/prevent tumors. (Adom and Liu, 2002; Kim et al., 2010). Black rice contains more dietary fiber, starch digestion speed is relatively slow, blood glucose index is only 55 (rice is 87), therefore, eating black rice will not cause blood glucose fluctuations as eating ordinary rice. Through the study on the hypoglycemic effect of several procyanidins and the combination with common food ingredients, the results showed that black rice is the raw material for developing low glycemic index foods and can be used in the adjuvant treatment of diabetes mellitus .
4. Vitamin E, an important antioxidant present in black rice is beneficial for maintain eye and skin health, skin firmness, restore elasticity and promote hair growth. Chinese medicine believes that black rice has the functions of nourishing yin and kidney, strengthening stomach and warming body, improving eyesight and promoting blood circulation, smoothing dampness and benefiting essence, and warming tendons. It can be used as medicine and food. It has excellent effect in treating dizziness, night blindness and tinnitus. Functional evaluation studies have proved that black rice has health functions such as scavenging free radicals, biological anti-oxidation, delaying aging, improving iron-deficiency anemia, lowering blood lipids, and inhibiting arteriosclerosis. Therefore, eating more black rice has an positive impact on our health. Studies have shown that nutritional powder made with black rice as the main raw material can not only promote the growth of young rats, but also increase the content of four trace elements Ca, Fe, Mg and Zn in the serum , and increase hemoglobin and red blood cells in the blood of mice.
5. Black rice bran is one of processed foods derived from plants and has a decreasing effect in blood sugar concentration. In medicine, black rice mainly has anti-aging, reducing blood glucose, regulating blood lipid, and can participate in the regulation of various related diseases. . In the research of black rice anthocyanin in delaying the aging of fruit flies, the quantitative black rice anthocyanin feeding of fruit flies can extend the life span of fruit flies and delay the senescence of fruit flies.
6. It also helps support memory function and coordination (Saha, 2016).

7. Black rice is associated with the reduction in weight when consumed regularly as it has low fat and calories and also useful for patients suffering from chronic constipation as it helps in improving the bowel movements.
8. It improves body's resistance to disease, improves damage to liver cells (hepatitis and cirrhosis), prevents impaired kidney function, slows down antiaging. All kinds of tumors and cancer diseases have always been a problem that people are worried about and want to overcome and solve. In recent years, the anti-cancer and anti-tumor effects of black rice anthocyanins have attracted more and more attention. Black rice anthocyanins can inhibit the growth and proliferation of breast cancer cells, and promote the apoptosis of cancer cells
9. Anthocyanins function as antioxidants, responsible for anti-adipogenic activities and other black rice components, such as ferulic acid and coumaric acid contribute to the proosteogenic effects (Jang et al., 2015).
10. Black rice can also increase immunity, improve liver function, prevent impaired kidney function, clean cholesterol in the blood, etc. It prevents hardening of the arteries and formation of uric acid in the body (Yuniarti et al., 2019)

Conclusion and Future Aspect

Black rice is a variety of rice which has several promising health benefits. The high antioxidant activity of black rice makes it a super food and its application as an ingredient in traditional and modern Indian food products like black rice Kheer, black rice cake/muffins, black Rice cheela, black rice sev-as a snacks etc. can create highly nutritious foods. Anthocyanin, the main pigment of black rice has gained attraction among the researchers due to its high antioxidant activity, health benefits and natural coloring properties for use in other food applications. Black rice is rich source of tocopherols (vitamin E), iron, antioxidants and the overall nutritional profile of black rice has made it a functional ingredient in food processing. Consumption of black rice by individuals those who show allergic symptoms to other cereal grains has proved to be beneficial and also helps in reducing the risk of developing cardiovascular diseases, diabetes and obesity. Black rice has a great potential to replace various food supplements and become a super food for the people. Awareness and productivity among people specially in the areas where black rice is not grown may be spread to eradicate the malnutrition issues upto some extent.

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