

Study of Black Rice from Molecular to Genomic Level

Muneeba Maryam¹

¹Research Scholar, Baba Saheb Bhimrao Ambedkar Bihar University, Muzaffarpur, India

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Abstract: Black rice is the most popular food variety globally & is consumed as a Staple food due to its high nutritional value. The consumption of black rice is increasing more of because it maintains good health for patient. This rice appears black due to the presence of anthocyanin in rice bran-lysine, tryptophan & other essential pigments anthocyanin & amino acid found in it. It also contains many antioxidants beside of carbohydrate, lipid, protein, dietary fiber, vitamin E and minerals. This rice type offers several health advantages & reduces the risk of several ailments & chronic ones. Black Rice scientifically verified therapeutic benefits are the focus of my researched from molecular to genomic level.

Keywords: Anthocyanin, Chronic, Genomic, Molecular, Nutrition, Sequencing, Transcription.

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I. INTRODUCTION

Black rice is a fundamentally Kharif crop, sowing time June to July and harvesting time around November to December, rainfall is more than 100cm, temperature around 25 C or above.

India is the second largest producer of rice & China is first. In India most cultivated area are Assam, West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra.

India is biggest exporter of rice (aromatic, Basmati Rice). Black Rice originated in China during ancient times about 3 centuries ago. In United States it was first introduced in 1990. Asian Countries make over 90% of Black Rice. Other countries apart from China and India which grow black rice are Thailand, Bangladesh, & Indonesia, Dr. Gir Raj Tripathi, Associate Professor at Central Department of Bio Technology initiated the experiment on Black Rice in 2008.

➤ Classification:

- Kingdom – Plantae
- Division- Magnoleophyta
- Class – Lilopsida (Monocots) Order –Poales
- Family –Poaceae
- Genus - Oryza Species-Sativa

➤ Benefits & Uses of Black Rice:

Black rice stabilizes high blood pressure, protects heart health due to high amount of dietary fiber & it also decreases lipid levels, helps to detoxify the body, aids in safety &

weight management, beneficial in iron replacement therapy keep away from cancer because it lowers the development of cancer cells, diabetics is better controlled, allergies are lessened, digestive system is strengthened, anti-inflammatory good for skin, hair & eyes.

It nourishes kidney yin, strengthen spleen system & warms liver system. Black Rice sap is incorporated in anti-aging, anti-wrinkle formation & skin whitening, cosmetic in China. Its sap is used in edible vinegar & alcohol production.

➤ Nutritional Profile of Black Rice:

Table 1 Nutritional Profile of Black Rice:

Carbohydrate (g)	76.17	(Per 100)
Fat (g)	2.68	(Per 100)
Protein (g)	8.5	(Per 100)
Fiber (g)	3.4	(Per 100)
Iron (mg)	3.5	(Per 100)

- Minerals : P, Zn & Many Other Vitamins : Mainly Vitamin E & B
- Amino acids : At least 17 amino acids (Lysine, Methionine, Arginine & Glycine etc.)

Antioxidants content six times higher than brown or white rice mainly due to presence of anthocyanin.

• Rice Grain Consists of:

- ✓ Bran : Protect the seed (Fiber, Vitamin B, & Mineral)

- ✓ Endosperm : Gives energy to the seed (Carbohydrate, Protein & Vitamins)
- ✓ Germ : Nourishment for the event (Phytochemicals, Vitamin B & E, Minerals)

➤ *Diseases of Black Rice:*

Southern Rice Black Steaked Dwarf Virus (SRBSDV) is the most damming rice infesting virus which causes severe standing & poorly developed roots in rice plants there by posing serious threat to rice.

• *Others Major Disease of Rice in India*

- ✓ Blast Disease (fungal) by *pyricularia oryzae*
- ✓ Brown spot (fungal) by *cochliobolus miyabeanus*
- ✓ Downy mildew (fungal) by *sclerophthora macrospora*
- ✓ Crown sheath rot (fungi) by *Gaeumannomyces graminis*
- ✓ Blight disease (bacterial) by *Xanthomonas oryzae*
- ✓ Rice wrinkled stunt disease (RWSD) & witches broom Disease (WBD) are seed born (viral).

II. METHODOLOGY

The study of Black Rice from molecular to genomic level could be challenging & interesting area because of the following few reasons: namely first identification of important key genes & their closely associated pathways because these are the key targeting genes for:

➤ *Intervention of Any Plant Disease.*

- In the improvement of crop production
- Maintenance of balance with surrounding environment to sustain in the ecological environment.
- Genome evolution of this rice & many other challenging black rice genome organizations.

➤ *There have been Studies on the Genome Comparison of Rice with other Species Like Maize etc. in Search for Primers in Genome \ Evolution & their Correlation with Phenotypic Behaviors.*

- Another important study shows that the color of the rice is associated with genome level organization leading to phenotype & can be related to flavonoid bio-synthesis pathways. Even the color carried by the rice is proposed to be controlled by some complementary genes.
- Since Genes are multifunctional, available genome data (micro array) RNA sequence data etc. allow one to search & identify genes which are responsible for certain function from expressed genes in these data available.
- Their associated transcription factors.
- Further interesting black rice genome evolution can also be concealed with higher level of organisms including the search for the origin of diversity of certain gene / protein.
- Endophyte bacteria with host supportive genetics determinates in their genome induce growth and antioxidants actively related gene functions in transcript of black rice (*Oryza Sativa L*)
- However, the identification of key genes of a certain function & their associated pathways to understand how do these functions are organized connecting genotypic to

phenotypic are not fully studied. Since genome complexity is related to the black rice genome evolution, studies in this perspective are not done systematically & moreover, identification of key genes which could be a target gene of black rice disease & their associated pathway are not systemically done so far.

➤ *We Could Like to Purpose of the Interesting Issue Which have not been Addressed Properly or Fully from Different Perspective as Discussed Below :-*

- Identification of key genes in black rice PPI complex networks: we propose to study the following few objectives:
 - ✓ We will search for and mine all the genes involved in black rice & then construct PPI network from these collected genes.
 - ✓ From the constructed PPI network, key genes & their associated pathways will be identified with the network theoretical method.
 - ✓ Then the identified key genes & their associated pathways will be studied in terms of their functions, roles in regulating the whole genome organization & their topological properties in maintaining the network stability.
- Prediction of controlling genes of flavor & column of black rice. We will collect the involved or over expressed genes with respect to these function, which are experimentally verified from various black rice databases. Then the test of genes will be mapped to the whole genome & identify key genes for these function, then we will investigate various network properties down to functional level
- Identification of target genes of black rice disease: The genes involved or over expressed in a particular black rice disease will be mined. Then these list of genes will be mapped to the whole genome & identify key gene for the disease for possible disease intervention. Then we will go down to gene/protein structure level and their properties.
- Complex genome organizations: All the whole genome (NGS Data) of different varieties of black rice across the world will be mines. The complexity parameters such as thrust exponent, fractional dimension & other related parameters will be calculated for all these black rice varieties & will be compared to investigate:
 - ✓ The diversity & evolution of black rice genome.
 - ✓ Comparative study of these genomes & origin of black rice etc.

III. RESULTS

Black Rice is highly nutritious cereal grain. It has gained a significant role due to its exceptional health promoting properties and rich in nutritional compositions in comparison to other varieties of rice. It is not only an important source of carbohydrate but it also contains high levels of proteins, multiple vitamins, dietary fiber, minerals and other bioactive compounds particularly anthocyanin, due to which its colour is purple black. These natural pigments pauses strong anti-oxidant properties that help in protecting the body against oxidative stress against unstable molecules

and reduce the risk of various chronic diseases. Anti-oxidative means having the ability to stop or slow down the oxidation. Oxidation is a chemical process in our body due to which some cells damaged by unstable molecules called as free radicals. Anti-Oxidative agents neutralize these free radicals to prevent structural damage in our body. Due to these findings the study of black rice demonstrate a potential to consider it as functional food for numerous health problems. Regular consumption of black rice may contribute improved health. Black rice also stabilizes high blood pressure and protect heart due to its high amount of dietary fiber and reducing cholesterol levels and preventing the oxidation of low density lipoprotein. It also helps in detoxifying the body, hence it is also beneficial in Kidney and Liver diseases. It is also beneficial in weight management and in iron replacement therapy, due to which it also lowers the development the cancer. It also helps in diabetics, due to its relatively low glycemic index and high fiber content, so it is a suitable dietary option for individuals with diabetes or dose at the risk of developing disease. Furthermore, the anti-oxidants presents in black rice exhibit anti inflammatory and immune boosting activities, so it is over all best for health. Black rice sap is incorporated in anti-aging , anti-wrinkle formation and skin whitening as cosmetic in China. It sap is also used in vinegar and alcohol producing industries.

From agricultural point of view black rice represents a valuable crop that enhance biodiversity. Black rice has opportunities for farmers for high value especially rice variety. Although its cultivation is generally lower than that of white rice. Due to its low yield and limited awareness. Black rice awareness among people will increase its demand in market. Promoting improved cultivation practices, quality seeds and farmer education can help in increasing the productivity of black rice. The improvement of genome, phenotype and anthocyanin compound. The colour of rice is controlled by some complementary gene. Since these gene are multi-functional, the function of particular gene can be expressed through the available genome data (micro array), RNA sequence data etc. Then by identifying particular gene responsible for certain function and can be expressed by genotype of the available data and pathway. Then by the knowledge of associated transcriptional factors the genome evolution of black rice can be improved better than the previous varieties. Through these processes we also identify the key genes which are responsible for target gene of black rice disease and their associated pathway. By improving the genotype of the grain one can also increase the phenotype of the black rice. Through these study one can also improve the variety of grain in low scarcity of water such as thrust. Overall black rice is best grain for unhealthy person. The study also indicates that black rice has significant role in food industry also. It can be used as flour, breakfast cereal, beverages, noodles etc. Its natural black or dark brown colour make it attractive for the point of study. Its production and awareness among people particularly for health conscious.

IV. CONCLUSION

Despite of its many advantages, certain challenges remains in our mind such as higher production cost, limited availability, longer cooking time etc. Therefore, furthermore, research will enhance these problems. Public awareness and nutritional education can also play a vital role in accepting the black rice among consumers. Black rice is a valuable functional food with exceptional nutritional and medicinal value. It also contains anti-oxidant, anti-inflammatory and health promoting properties. Its adverse food applications make it and excellent alternative grain than white rice. I will focus greater emphasis on research, cultivation, processing and consumer education. Its awareness among unhealthy person is increasing worldwide. Research on black rice will ensure the full potential of these ancient grain for future generation.

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