Black Rice the New black gold of India


Abstract— Rice is the most common food in the world since time immemorial, outer layer of rice kernel contains anthocyanin pigment in them which is responsible for the colour of rice bran. Pigmented rice variety are admired all over the world and have history of Heritage. Black Rice is a nutrient rich variety of rice which is mainly cultivated in Asian countries. Black rice has been involved in the field of medicine other than cooking and fodder for cattle. It contains high nutrient value and beneficial amino acids like lysine and tryptophan in which possesses lots of health benefits, other than benefits black rice cultivation provides path of entrepreneurship to many farmers. Black Rice cultivation can generate great employment opportunities and producer can earn profit from the sale of black rice. The theme of this paper is to provide information regarding nutrient contents, its production in the world and to let you know the benefits of black rice on health, including phytochemical profile of it, techniques and methods of its cultivation followed by its demand in market and profit margin from its sales in market.

Index Terms— Profit, Black Rice, Entrepreneurship, Heritage.

I. INTRODUCTION

Black Rice, belonging to the Oryza sativa L., is a species that is affiliated as superfood novel and has highly beneficial attributes, it was once consumed only by the royal kingdom. Black Rice also called as forbidden rice, emperor’s rice, or longevity rice, it earned its name because it was forbidden for everyone but the emperor to ensure their well belonging and long life. It is mainly known for its high levels of antioxidants and superior nutritional value.

The three major benefits of eating black rice are:
• It has great antioxidant properties,
• Its anti-inflammatory actions,
• Appetite, weight and fat-controlling properties.

Anthocyanins are a group of flavonoid plant pigments which gives black rice its purple black colour, and to other plant based foods like blueberries and purple sweet potatoes. Research shows that anthocyanins have strong anticancer, anti-inflammatory, and antioxidant properties. (S. Sharma et al., 2018)

Furthermore, studies on animal, and population have shown that eating foods high in anthocyanins helps to protect against cancer, heart disease, several chronic diseases, and obesity.

II. NUTRIENTS

• As compared to the regular white rice, Black rice is packed with higher amount of proteins, vitamins and minerals.
• As compared to white rice, the black rice has got 9.1 grams of protein per 100 grams while white rice has 6.3 grams of protein per 100 grams.
• it has a lower glycemic index, which is beneficial for diabetic patients.
• it contains the initial 18 amino acids, Iron, Zinc, Copper, carotene, good amount of Vitamin E.
• its arsenic content is greater than white rice.
• it also improves the production of adiponectin in body.
• decrease levels of the hormone leptin, which is responsible for appetite-regulating.
• Black rice is comparatively high in several antioxidants.

Antioxidants are the compounds that protects our cells against oxidative stress caused by free radical molecules.
• In addition to anthocyanin, black rice contains several types of flavonoids and carotenoids and over 23 plant compounds with beneficial antioxidant properties.

Although being the least popular than other rice varieties, it has the highest overall antioxidant properties, capacity and activity. Therefore, having black rice in your diet is the easiest way of protecting ourselves from diseases. (S. K. Sharma, 2019)

Black rice contains:
• Iron: 6% of the Daily Value (DV) or 2.4
• Energy: 356 kcal
• Protein: 8.89 g
• Total lipid (fat): 3.33 g
• Carbohydrate, by difference: 75.56 g
• Fiber: 4.7 grams per 100 grams
• Fatty acids: 0 g
• Cholesterol: 0 mg

III. PRODUCTION

Black rice has been grown and eaten all over Asia for centuries. In India, it’s mostly grown in the north-eastern state Manipur, where it’s known as chak-hao.

The leading producing countries include:
• China: 148.87 mmT
• India: 112.91 mmT
• Indonesia: 37.01 mmT
• Bangladesh: 32.65 mmT
• Vietnam: 28.47 mmT
• Thailand: 20.37 mmT
• Burma: 13.21 mmT
• Phillipines: 12.24 mmT

IV. HEALTH BENEFITS

Black rice is a major source of anti inflammatory agents, therefore is a great source of health. (Dias et al., 2017)
FLAVONOIDS: decreases risk of heart disease development.

ANTHOCYANINS: anthocyanins in black rice controls the production of cell-protective agents by turning on genes in the body that control the production of cell-protective agents. The breast cancer cells present in women are reduced by anthocyanins. As well as it is a great way to control obesity.

One of the anthocyanins present in black rice is known as C3G, or Cyanidin-3-glucoside which shows the satisfying properties to control appetite by decreasing the levels of leptin in blood and boosting adiponectin.

C3G to burns the stored fat, and establishes a healthier body weight overall. (Ichikawa et al., 2001)

Anthocyanins prevents the aging of cells, stem inflammation, develops eyesight, enhances cardiovascular health, improves the functioning of brain, and stabilizes insulin. Develop cholesterol and triglyceride levels.

Black rice contains the two carotenoids that are responsible for eye health and development namely lutein and zeaxanthin. It protects eyes from harmful blue light waves and prevents damaging of free radicals. Antioxidants are also playing an important role in protecting eyes against age-related macular degeneration (AMD), which is causing blindness worldwide. (Kumar & Murali, 2020)

● Phyto-Chemical Profile of Black Rice

Black rice is rich in antioxidants and possess antioxidative as well as antimicrobial activities as its main component is the anthocyanins (Coloured pigments). Which are helpful in improvement of neurological and visual health. ( Mellitus, 2012)

Major part of anthocyanins present in black rice are mixture of Cyanidin-3-glucoside and Peonidin-3-glucoside at the rate of 0.05-2.86 mg/g and 0.05-0.5 mg/g respectively.Moreover black rice contains many other anthocyanins in very trace amount such as Cyanidin-3-O-rutinoside,Cyanidin-3-O-galactoside,Cyanidin-3-O-gentiobio side,Cyanidin-3-O-arabinoside,Cyanidin-3,5-diglucoside,Cyndin-3-(6"-O-p-coumaryl)glucoside,Peonidin-3-O-rutinoside,Peonidin-3-(6"-O-p-coumaryl)glucoside,Delphi nino-3-O-galactoside,Delphinidin-3-O-arabinoside,Malvidin-3-O-glucoside,Pelargonidin-3-O-glucos ide,and Pelargonidin-3,5-diglucoside[Bordiga et al.2014;Pereira-car o et al.2014a,b;Shao et al.,2014a,b;Sompong et al.2011]

Mainly the Black rice bran part is major source of anthocyanins. About 95% of total anthocyanin content present in bran part while only 5 % of total anthocyanin content is present in embryo. (Prasad et al., 2019)

Due to its anticancer, hyperlipidemia, hypoglycemic, antiatherosclerotic, antiinflammatory and antioxidative effects in ancient china it is considered as “Black Pearl” or “Medicine Rice” or “Longevity Rice”.

As it is rich in anthocyanin it also shows free radical scavenging activity which prevent the release of free radical.

● Amino acid in black rice and their physiological roles

Both the efficiency and deficiency of amino acids are proportional to the protein production in our body so its important to trace the amount of amino-acid in our diets to produce required amount of protein or it results in nutrition imbalance

In addition Rapamycin complex 1 pathway which shows direct influence over bone growth,muscle growth,internal organ growth,immune factors regulation and energy balance of a person and it is greatly (gracefully) responsive to amino acid accessibility,i.e. if the content of the amino acids are imbalanced in our body it will cause stunned growth.

Amino acids play vital roles in our body such as it behaves like adapting point for numerous functions connected to gene expression,which includes modulation of protein physiology that intervene and M-RNA (messanger RNA) conversion.

Studies were conducted and it is concluded that the amount of superior protein and amino acids of black rice is higher then white rice or other ordinary rice.

Ammonia is byproduct as excessive amino acid are converted into ammonia by the removal of amine group in the liver.Further gluconeogenesis takes place of organic acids which converted to glucose or are used directly metabolically. However,glutamate is determined in the kidney.

Amino acid asparagine required to make protein in the cells are made with the help of asparagin synthetase.

V. SOME OTHER SCIENTIFICALLY PROVED BENEFITS OF BLACK RICE

A. Anti-inflammatory properties:-

Researches were conducted at the university of suwon,south Korea in which two groups of animals were taken.Group A animals consumed black rice while Group B animals consumed ordinary,brown, and red rice.It is found that in Group A animals black rice suppressed skin inflammation(Dermatitis) while in Group B animals other rice didn’t show such affects thats why it is concluded that Black rice shows many pharmacological activities and it is helpful in treating chronic diseases related with inflammation.majorly TNF-alpha and interferon are responsible for inflammation in the intestine.[59] In inflamed region the leukocytes movement are considered which cause chronic inflammatory bowel disease. As Cyanidin-3-O-glucoside is abundant in black rice bran it helps in the management of chronic gut inflammation.

B. Effects over obesity:-

It is reported that if black rice consumed regularly it will helps in weight management. This is because black rice is unpolished and thats why it is rich in fibre.Thus fibre rich food are easily digestible. It also helps in body detoxification.[1]on Black rice consumption it gives feeling of fullness and person doesn’t feel hungry which reduces food ingestion and help in calories management in diet as it have low fat and low calories it also reduces fatty acids
synthesis thus it reduces intracellular lipid accumulation between the tissues.

C. Prevention of cardiovascular disease:
Early studies showed that black rice bran rich in polyphenols like anthocyanins which are beneficial to Cardiovascular health.[Stoellet et al.2004] by lowering LDL(low density lipoprotein) or bad cholesterol and increasing HDL(high density lipoprotein) or good cholesterol levels. (Saha, 2016)

American health association and the 2005 Directory guidelines for Americans recommended an increase in the black rice consumption to prevent health disease.
Consumption of black rice decreases the chances of both atherosclerosis and heart attack. Simply we can say that anthocyanins prevent the accumulation of bad cholesterol over heart valves and also reduces blood plasma levels of cholesterol.

D. Anti-cancer effects:
Scientist name Lambert and Delcourt(2008) reported that carotenoids reduce the incidence of cancer and cardiovascular disease. It is also found that anthocyanin extract of black rice bran is able to reduce the growth of liver cancer cells Black rice also have importance in treating skin cancer. Skin cancer is more common in developed countries and it is directly linked with UV radiation. Thus it disrupts the immune system and cause increment of skin carcinogens. UV radiation causes phosphorylation of kinases and damage DNA levels. This is so because UV radiation increases the production of reactive oxygen species. Thus application of anthocyanin (Cyanidin-3-O-glucoside) prevent UV radiation effects and act as anti-cancer agent. Basically free radical cause damage to body by sowing carcinogenic effects and anthocyanins protects body from such free radical.

E. Anti-diabetic effects of black rice:-
Black rice contains low amounts of sugar and high amounts of fibre. After consumption of black rice it doesn’t fluctuate the blood sugar levels and it is beneficial in management of diabetes mellitus. According to research done by Zerrati et al.(2008).It is found that rice grains amylase contents are varying and its effect on blood sugar are also varying according to the consumed rice variety. In his research he examined the glyamic effects of 50 gm carbohydrates in the basmati, kazemi and sona pearl varieties of rice. Glycemic effects of sona pearl (Black rice) variety was lower than other two varieties.

• ANAEMIA:- The reason behind dark colour of Black rice is iron richness. Thus It is rich source of iron. It shows beneficial effects over ANAEMIA [7].
• Other benefits:- It is also useful in allergies thus black rice bran restricts the release of histamine. Which leads in decrease in inflammation [1] Black rice is rich in fibre so this helps to the patient suffering from constipation by increasing bowel movements [1]

VI. APPLICATION OF BLACK RICE IN BAKERY PRODUCTS

A. Black rice powder in cake
The black rice powder in cake is actually and a great idea but there is a little change in the texture of the cake prepared from black rice it was observed that the cake made was hard in achieving and having. The crust formation problem on the top moreover it was realised that the cakes are less sponge than the regular ones but besides this the cakes are rich in an antioxidant protein content and the anthocyanin present in the black rice flour makes these cakes more healthy and acceptable to the people than the traditional cakes made from wheat flour.

B. Black rice powder in bread
Breads are generally made by the process of fermentation and is traditionally made with wheat flour the bread made from black rice powder have many advantages as it is easy to digest as compared with the wheat flour bread moreover replacing the black rice in wheat flour can be healthy alternative for the diabetic patients.

C. Black rice powder in cookies / biscuits
Black rice has high fibre content which allow to hold more amount of moisture in the cookies it was observed that these cookies were more dark due to anthocyanin but there was no noticeable change in the texture of cookies.

D. Use of black rice in making fast food
We all are aware of how healthy the fast food is these days and also our dependency for the same we can not replace the fast food but we can make the fast food rich in nutrients and convert the junk food to the healthy food.
The pasta and noodles are easy to make and are consumed around the world due to its taste but the floor used to make them takes more time to digest absorbs less water and has poor nutrient content in it but rather we can use the black rice flour mixed with regular flour and increase the digestibility of these fast food without much change in the taste and texture.

E. Black rice in traditional food
Payasam:- it is a traditional South Indian sweet and rice which is made by adding milk and sugar to the rice and cardamom powder for the flavour the payasam made from pigment red rice is blackish purple in colour which is highly acceptable by the people in commercial market (S. K. Sharma, 2019)
Pongal:- it is the festival food of South India which is prepared from broken rice of the held kernels of some specific varieties the Pongal made from black rice is quite famous among the people these days due to its health benefits along.

VII. TYPES AND VARIETIES OF BLACK RICE

1) Black sticky rice :
it is also known as Black glutinous rice. It has sticky texture and grains size is shorter. It is used to make sweet dishes in Asian countries

2) Italian black rice :
It rich buttery Aroma and its characteristic are similar to Italian black rice and Chinese black rice. Grains are long in size of Italian black rice.
3) **Black japonica rice**: under 10 variety of rice a mixture of both short grain and medium grain are grown on same field. It has a mild sweet spiciness.

4) **Thai black Jasmine rice**: it is originated from Thailand and combines Jasmine rice with chinese black rice. Floral Aroma is a characteristic of jasmine rice of Thailand and due to combination it is also shown in Thai black Jasmine rice.

**VIII. CULTIVATION OF BLACK RICE**

Rice cultivation includes techniques involving primitive ways to highly mechanized ways. Black rice is an important crop having high nutritional value. To get good quality and quantity of yield it is very much important to manage field and crop properly. For proper field and crop management it is important to know the techniques which provide good deal to the farmer. Rice crop also demands water more than any other crop of same duration. When and how much water to be supplied is also a major concern ‘wild rice’ cultivation. For good yield it is also required to remove weeds as and when required. Herbicide used for this should be effective. Fertilization is also practiced for increasing yields nowadays green manures like Sesbania spp. and plants like Azolla and Anabena are also being used.

**A. Broadcasting method**

under the seeds of black rice are soaked in water and after pregermination they are broadcasted in the field. The easiest method of broadcasting is by hand as it requires less input but by hand broadcasting yields also get reduced. Depending upon the variety seeds can take hours to days for pre germination. For one hectare of land at an average 100 kg of seeds are required. The seeds after pre germination get sprouted. Then sprouted seeds are broadcasted in the puddled field uniformly. Sprouted seeds should have radical ranging from 1 to 2 millimetres in length.

**B. Drilling method**

under this method two persons are required where one drills the land while the other sows the seed. this method is commonly practiced in a plant area or in areas having improper irrigation facility or lacks facility of irrigation.

**C. Japanese method**

Under this method high yielding variety of seeds are sown in raised nursery beds. The uprooted seedling are then transplanted in equidistant rows in mainland. YouTube equidistant transplantation weeding and fertilizing becomes easy and are done on regular basis.

**D. Transplantation methods**

Under this method seedlings are transplanted in the field. For preparing seedlings seeds are sown in the nursery and after four to five weeks seedlings are uprooted. These uprooted seedlings are planted in the field. this is labour intensive method of cultivation as for transplantation labours are required and seedlings are transplanted by hands. this method can be practised in areas having good rainfall and full supply of labour. This method provides the highest yields as compared to other cultivation methods.

**CONCLUSION**

Black Rice Black wheat or any series of varieties show the great results and hope for better nutritional food in future. Anthocyanin being the new trending pigment and the higher cultivation value as per the present scenario brings a new change in the cultivation of Rice in India and the world.

**REFERENCES**