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Pigmented rice: A potential ingredient for extruded products review paper

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Abstract
Pigmented rice is majorly of two varieties black and red. Pigmented rice varieties are packed with vitamins and nutrients. Their key nutrients are as follow; anthocyanins, protein, phytochemicals and polyphenols. They are known to prevent many precarious diseases like Alzheimer's disease and cancer but due to its production being limited to certain parts of the world they are still not utilised up to its full potential. They are cultivated in South East Asia and some part of Africa. India is the second largest rice producer country but the consumption of pigmented rice is restricted to North Eastern parts of the country. Owing to its excellent nutritional profile it has been used in medicinal purposes since ancient times in china and some parts of Korea. Its health benefits are being recognized and therefore is gaining popularity among white rice consuming population of the world. With their flavour comparable to white rice with slight nutty twist they are a natural superfood that can boost one's immunity. The pigmented rice is an important future crop for the world to counter the primary health problems in our society and provide ample of nutrients to the body that are not present in the white rice.

Keywords: Pigmented rice, potential ingredient, extruded products

Introduction
Rice is a major cereal crop and is the only cereal which is consumed in whole grain form. It acts as a staple food for more than half of the population in world and provides instant energy to our body. It is widely preferred cereal in Asia which produces about 95% of it. (Bhattacharjee). India is the second largest producer of rice but the sowing of pigmented rice is restricted to some parts of Northeast and in Western Uttar Pradesh, Punjab, and Gujarat etc. India produces majorly 3 different pigmented rice – black rice, red rice and purple rice. All three are unique in its functional properties and have different pigment concentration. Eleven different colour varieties are known to exist ranging from the commonly seen white to dark purple or black coloured rice (Ramiah (1993)). Coloured rice such as black and red rice consumptions has increased in Korea due to its health benefits and many other parts of the world. Chinese traditional medicines have been using pigmented rice as an ingredient since ancient times and it is an amelioration sight in it. (Ma *et al* (2006)). Still white rice is more popular than pigmented rice in India due to lack of production and awareness about pigmented rice's thearapeutical benefits. Pigmented rice has the potential of boosting kidney function, treating, healing anaemia, inhibiting blood stasis, stimulate blood circulation, treating diabetes. According to WHO recommendations rice-based ORS is reported to be better than glucose-based ORS. Indian pharmacopoeia recommends pigmented rice drinks (chilled) excellent for inflammatory diseases and dyuria (watt (1891)) [10]. Since rice is a gluten free grain it can be added to the diet of people suffering from celiac disease

The primary pigment which is responsible for the different coloured rice is the Anthocyanin which is a plant pigment responsible for red and dark purple. A familiarly found Anthocyanins is acetylated procyanidin which acts as a free radical scavenger (Oki *et al*. (2002)) [7]. Anthocyanins are not only responsible for its colour but it also enhances the antioxidant activity, anticancer, and hypoglycaemic effects (Nam *et al*, 2006; Philpott *et al*, 2006). Therefore, coloured rice has potential of becoming functional food.

2. Black Rice benefits
It was first found in China and was introduced in India much later; Assam and Manipur are the two states where it was first grown in India and later spread through entire northeast and some states of north like Punjab. Its flavour is comparable to that of white rice with a twist of nutty flavour. Though tea and coffee contain antioxidants but black rice is a rich source of antioxidants. (Sutharut *et al* (2012)) [9] Apart from this it also contains vitamin B, Vitamin E, magnesium, calcium, iron and zinc.

Black rice is even known to cure cancer, Alzheimer disease, diabetes, heart disease and gallstones and many doctors recommend to add it in diet. Therefore, it is very important to promote functional foods made from it due to its therapeutic benefits.

3. Red Rice benefits

Red rice is believed to have anti-inflammatory properties, prevent allergy and manages weight loss. The manganese present in this variety strengthens metabolism, whereas magnesium lowers the blood pressure and reduces migraine. Calcium and magnesium together help in keeping bones and teeth strong and also protects from the risk of arthritis and osteoporosis. Selenium on the other hand boosts immunity (Bhat, F. M *et al* (2015)) [1]. Red rice has low glycaemic index compared to white rice which indicates the rate how quickly and how much food raises a person's blood sugar level. White rice is polished and milled brown rice which reduces many essential nutrients present in bran and germ layer (Kim, M. K *et al* (2008)) [4]. It has high sodium content and traces of other minerals like magnesium, selenium and manganese.

Table 1: Nutritional composition of pigmented rice

Rice	Moisture	Ash	Protein	Fiber	Amylose	Carbohydrate	Iron
Red rice	11.2g	1.1g	7.7g	2.5g	26.1g	78.3g	0.91mg
Black rice	12.5g	1.90g	10.4g	1.18g	94.61g	72.5g	1.48mg

Source: (Yodmanee *et al*. (2011)) Physical, chemical and antioxidant properties of pigmented rice grown in Southern Thailand

4. Nutritional composition and bodily benefits of pigmented rice

4.1 Water: The moisture/water present in rice related to the cooking time. Higher the moisture content of a rice variety lower is the cooking time and as the starch present in rice gelatinises quickly if the adequate water is present for it.

4.2 Ash: Ash content of a sample quantifies the amount of minerals present in a sample. They are also colour known to affect the colour of the sample.

4.3 Amylose: It is directly related to glycaemic index. High amylose content signifies that the rice has low glycaemic index which means that the food does mot increase the blood sugar to a great extent.

4.4 Carbohydrate: They are the main energy providing source in our body. Simple sugars such as glucose is important for the functioning of our brain.

4.5 Protein: The organic protein that is abundantly found in rice plays a vital role in proper functioning of our body and also in tissue repairing. This rice protein is often extracted from rice using natural methods for its benefit of being highly digestible and non-allergic protein.

4.6 Magnesium: More than 300 metabolic function in our body including muscle functioning, nervous system and immune system need magnesium. It also regulates blood sugar level of body and can help in prevention of diabetes, heart diseases and blood pressure.

4.7 Manganese: Manganese is a trace element which is required by our pancreas, kidney, liver and bones in certain amount for its functioning. Enzyme superoxide dismutase (SOD) contains MN which is a major antioxidant in our body and reduces inflammation. In adults' stroke is a major cause of epilepsy and manganese being a vasodilator dilates the veins for proper flow of blood to the brain.

4.8 Iron: Benefits of iron are not unheard of; it is a very important part of our blood pigment and helps in carrying oxygen throughout our body. Iron is known to cure anaemia, reduces fatigue, improves muscle strength, boosts immunity, improves concentration, reduces bruises, restores sleep cycle etc.

4.9 Zinc: Although it is a trace element required in few mg in out body but pigmented rice can prove to be a good source of it. European journal of immunology says that our body needs zinc for the activation of T-lymphocytes which directly plays a key role in boosting our immunity. According to WHO, zinc can be useful in treating diarrhoea. It is also said to help in wound healing.

4.10 Vitamin E: Vitamin E also known as tocopherol is very commonly found in our oil through various sources. It is present in good amount in rice and is known for its various health benefits. It is known to prevent skin cancer, acts a skin moisturiser, wound healer, treats eczema symptoms, reduces psoriasis symptoms, prevents sunburn and improves nail health.

4.11 Vitamin B: Vitamin B and its complexes are very important nutrients required for one's health. They are useful in many ways and must be present in one's diet. Black and red rice are a good source of these complexes which are known to reduce stress, anxiety and depression symptoms, boost mood, enhances neurological functioning, DNA production and red blood cell production.

5. Conclusion

Pigmented rice is far more beneficial and therapeutic than the normally consumed white rice but people are slowly becoming familiar with its uses and importance around the world. Pigmented rice needs to be incorporated in daily diet to see its complete potential as a functional food. It is an excellent source of vitamins and minerals which are very essential by our body. It can be self-consumed or fortified in other instant food products to boost their nutrition profile. Though its production and consumption has grown in some parts of the world but still hasn't reached up to its full capacity. They can totally change the image of rice in India is considered a high fat starch containing cereal and is avoided by individual who are health conscious. RTS and RTE foods which use rice as an ingredient can replace white rice with pigmented rice which would help in new product development, increase the nutrients present, increase market value of the product and would produce a super food which will have it all. If the production of these rice increases and awareness would be spread using all media about its benefits, we can help in reducing health related problems and minimise the use of artificial medicines.

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