Revolutionizing Nutrition with Black Wheat: A Comprehensive Insight into Its Nutraceutical Value

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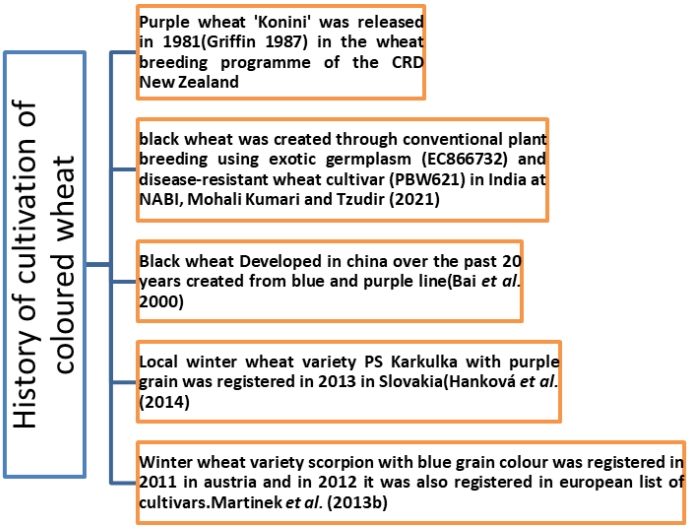
Functional foods are a topic of ongoing industrial use and research. Functional meals can alter a number of bodily processes and boost wellbeing, lowering the risk of diseases linked to a sedentary lifestyle (Monika Garg *et al.* 2016). Widespread interest is currently being shown in functional foods manufactured from pigmented grains (including maize, rice, and wheat) that are high in antioxidant chemicals (Abdel-Aal et al; 2006). Given that healthy people can contribute to both society and the economy, a healthy population is one of the nation's most precious resources. The health of individuals and significant portions of the population, particularly in developing nations, may be threatened by acute diseases and chronic ailments. To suit human needs, food is supplemented with nutrients in many nations.

Cereals are essential among all dietary items and are essential to a balanced diet. Apart from being an important part of diet providing major sources of carbohydrates, proteins, B vitamins and minerals for the world's population and also rich in various health promoting components having health promoting benefits which are often referred to as phytochemicals or plant bioactive substances (Goldberg G 2003). Wheat is an excellent source of carbohydrates, proteins, minerals, and dietary fibre. It also contributes significantly to the daily caloric needs of the wheat-eating population. When it comes to area and production, wheat is next behind rice among food grains. With a 12% share of global wheat production, India is currently the second-largest producer of wheat after China. Wheat accounts for around 21.8% of the entire area covered by food grains and about 35.5% of the overall amount of food grains produced. (Source: http://wheat prod1.dacnet.nic.in/ history.htm).

Although wheat is a significant part of the diet in underdeveloped nations, its zinc level is not particularly high. To satisfy the body's needs, wheat grains' zinc concentration must be 45.0 mg/kg (Liu *et al* 2017). Indian bread wheat, also known as aestivum, and pasta wheat, also known as durum wheat, have low levels of iron (27–55 ppm), and zinc (20-50 ppm). Only 28.48 mg/kg of zinc is found on average in wheat grains worldwide, which is much less than the quantity that is generally advised. In India, the average zinc content of wheat cultivars is 28.31 mg/kg. Since the 1960s, the average grain zinc content of wheat has been 31.84 mg/kg with a range of 8.00 to 88.20 mg/kg [Wang *et al.* (2012), Oury *et al.* (2006)].

Fig. 1. Diagrammatic representation of colored wheat history of cultivation



The common wheat variety is amber or white in colour all across the world. Till today there are following three new varieties of wheat registered by Plant Germplasm Registration Committee under National Bureau of Plant Genetic Resources (NBPGR), ICAR New Delhi as given below: Wheat (Triticum aestivum) National ID:IC 0620914 : INGR No.:17001: Blue grain (aleurone) color, IC 0620915 : INGR No.:17002: Wheat Purple grain (pericarp) color and IC 0620916: INGR :17003:Wheat with Black grain colour (Purple pericarp + Blue aleurone). (Source: DARE/ICAR Annual Report 2017–18 Department of Agricultural Research and Education (DARE) and ICAR). Scientists from NABI led by Monika Garg used a hybrid between high-yielding Indian cultivars and colorful wheat imported from Japan and America, which is high in zinc and as rich in anthocyanins and not only developed coloured wheat lines using established biotechnology techniques but also transmitted them to various businesses who have

inked agreements with this Department of Biotechnology lab are already growing them (source: https://www.krishijagran.com). (source: https://krishijagran.com 7/05/2019).

The genotypes of wheat that have colorful caryopses, such as purple, blue, black, yellow, and white ones, are currently gaining relevance. Due to the presence of the anthocyanin pigment, numerous studies and research projects are currently being conducted on the use of coloured wheat grains for their health advantages. Currently, coloured grain is being prioritized more in research since it is a source of neutraceutical chemicals. Colored wheat contains higher proportions of phenolic compounds, which are primarily represented by ferulic acid, vanillic acid, and p-coumaric acid (Kequan *et al*. 2005, Liu 2007), in addition to anthocyanins. These compounds may be used as functional foods or as key functional ingredients in products made from wheat (Pasqualone *et al*., 2015; Ficco *et al*., 2014).

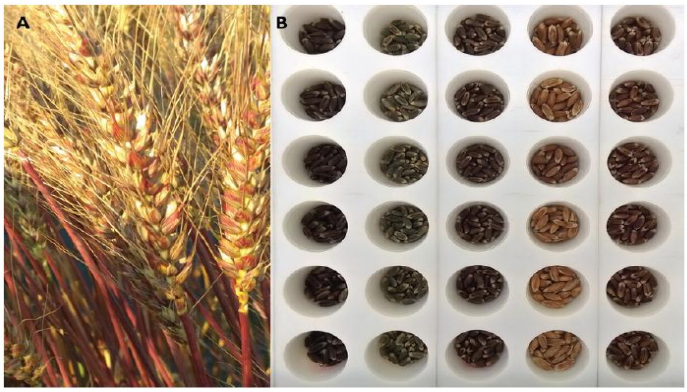


Fig.2 A: Anthocynin Pigmentation wheat (Purple clum and glume) during ripening.B: Pigmented grains of selected single spikes :Left to right: black, blue, deep purple, red and purple grains. (Source: Heinrich Grausgruber *et al*(2018)).

Black wheat (28 times more anthocyanins) may be utilised to generate unique and colourful dishes due to their phytochemical makeup and distinctive colours (Ficco *et al*., 2014) and has the potential to offer extra health advantages over those that standard wheat cultivars typically offer. Consuming black wheat is linked to a number of health advantages, including endothelial cell protection, reducing heart and cardiovascular illnesses (CVD), and acting as anticancer agents (Dykes 2007 and Liu 2007). Additionally, it includes procyanidins and anthocyanins which makes it a possible source of nutraceuticals and functional materials. These bioactive substances are linked to a lower chance of chronic diseases like diabetes, obesity, cancer, and cardiovascular disease from developing (Zhang 2015 and Ma 2017). According to He and Ning (2003), black wheat "Qinhei No. 1" had low sodium and fat content and higher contents of some amino acids, including lysine, methionine, isoleucine, and glutamic acid. It also contains higher contents of iron, zinc, manganese, copper, selenium, magnesium, potassium, and phosphorus. Black wheat has a high zinc concentration of 34.80 mg/kg(Huang *et al* 2018). The organic chromium (trivalent chromium) concentration of the black wheat "03Z4-439" is also around four times higher than that of regular wheat, a property that can be used to cure diabetes. However, there is very little study on the anti-diabetic effects of black grain wheat, and neither human nor animal experimentation is available (Liu 2018). According to mice studies at NABI, black wheat helps to prevent the deposition of fat, enhance insulin tolerance, manage glucose levels, and lower blood cholesterol. The variants contain significant amounts of proteins and important micronutrients like zinc in addition to anthocyanins. As a result, black wheat is an option that may be utilized to fortify wheat flour with high contents of iron, zinc, and micronutrients.

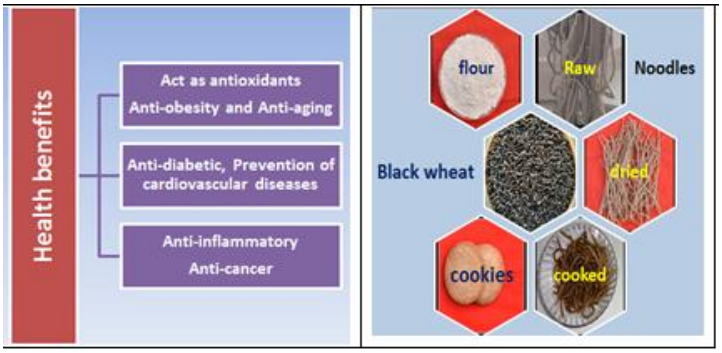


Fig. 3. Diagrammatic representation nutraceutical benefits and value addition of Black wheat

Ensuring food and nutritional security of fast-growing population will pose a huge challenge in future. Black wheat being healthier than white wheat, can be a good alternative in the National Nutrition Mission (NNM) or "Poshan Abhiyaan" for improving the nutritional status of young children, adolescent girls, and women. BGW has to be given more

consideration as a substitute source of nutrients and health-protective elements in the human diet due to its valuable compositions.

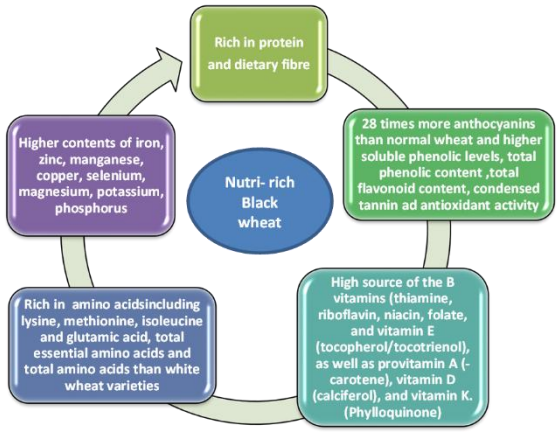


Fig. 4. Diagrammatic representation of nutritional importance of Black wheat

The consumption of foods based on Black wheat would be important step towards alleviating protein malnutrition. Black wheat flour had good functional properties make it useful in different foods formulation. It also implies that it may be worthwhile for industry to take up the production of Black wheat value added products and increasing cultivation by farmers. Such promotion of Black wheat value added products into diet in India could go a long way towards not only alleviating micronutrient deficiencies but also towards the development of functional, nutraceutical foods for preventing or curing of many lifestyles related diseases.

Areas for future research

- Investigation should be carried out to improve the desirable properties of black wheat for food processing and value addition without decreasing its nutrient value.
- The clinical studies with human subjects should be undertaken to investigate Black wheat nutrient bioavailability and the positive effect on immune system.
- The technology should be developed to minimize the processing induced losses in nutrients content in value added products from Black wheat.

This will allow it to be used in a larger range of food products, which will undoubtedly benefit people's health. All of these characteristics, however, are influenced by the wheat grain's genotype, post-harvest treatments, storage conditions (such as temperature), and the environment in which it grows.

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