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# Black Wheat

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Wheat is an important cereal crop grown worldwide, belongs to the grass (Gramineae) family. Due to its exceptional processing quality, it plays a significant role in the human diet as a staple food. This cereal is essential for making various products such as bread, biscuits, pasta, and noodles. Recently, coloured wheat has gained lots of attentions due to its health beneficial properties (Saini *et al*., 2020; Sharma *et al*., 2018). Different colours of anthocyanin bio-fortified wheat *viz*., purple, blue and black depend upon the types and position of anthocyanins in wheat layers (Garg *et al*., 2016). The purple colour is due to localization of anthocyanins in the pericarp layer, blue in the aleurone layer, while, and black is combination of the two. These characteristics are controlled by the bHLH-MYC transcription factor (Jiang et al. 2018). Black-coloured wheat has garnered attention for its nutritional value, containing antioxidants, B vitamins, folic acid, selenium, magnesium, manganese, zinc, calcium, iron, copper, potassium, fibre, and amino acids. This nutrient-rich composition makes black wheat a valuable addition to a balanced diet.

## Discovery scenario

Black wheat is a form of pigmented wheat that is developed by crossing purple and blue varieties of wheat and thus the black colour is due to the anthocyanins present in both pericarp and aleurone layer. Black wheat was first originated in the laboratory of the Institute of Crop Genetics, Shanxi Academy of Agricultural Science, after 20 years, beginning in 1970 (Dhua *et al*., 2021). Blue-grained hexaploid wheat was formed by crossing *Triticum aestivum* with *A. glaucum*, and the 'purple 12-1' was formed by crossing *Triticum aestivum* with *Elymus dasystachys*. Then the 'blue-purple 114' was developed by crossing blue-grained hexaploid wheat with 'purple 12-1' (Preedy and Watson, 2019). Then the first black wheat that was developed was named 'Black 76' and, gradually, this variety was formed by crossing 'purple 12-1' as the male parent (associated with the mutation in the pericarp) and 'blue–purple 114' as the female parent (as a result of wild introgression) (Kumari and Tzudir, 2021). In India, the black wheat variety was first prepared after seven long years of work and dedication by Dr. Monika Garg at the National Agri-Food Biotechnology Institute (NABI), Mohali. They crossed the Japanese variety (EC866732) with the high-yielding wheat cultivar PBW621. The resulting variety was named 'NABI MG'.

## Black wheat farming in India

Black wheat, or *Kala Gehu*, holds significant potential for transforming India's wheat industry. Its cultivation is similar to that of regular wheat. Initially, black wheat displays a green stem and grain, transitioning to a distinct blackish hue at maturity, typically achieved in 130–135 days under Indian climatic conditions, signaling harvest time. However, it yields less and features smaller grains compared to conventional wheat varieties. Currently, black wheat seeds are limited in local stores, though they are accessible through NABI. Despite cultivation efforts in regions like Madhya Pradesh, Punjab, Haryana, and Gujarat, its adoption among farmers remains limited, likely due to its lower yield.

## Advantages and health benefits

Among all the available pigmented wheat varieties, black wheat (BW) has garnered increasing attention for its high nutritional profile, good sensory attributes, and notably, its health-promoting activities (Beta *et al*., 2019). Garg *et al*. (2016) have also emphasized the potential of new products derived from unconventional wheat, particularly pigmented or colored varieties, for their improved functional and nutritional properties. Black wheat is utilized in the production of functional foods or related colorants. Notably, 75% of the total carbohydrate content is concentrated in the endosperm of black wheat, with its protein content being 10-15% higher than that of normal wheat. Its nutritional composition includes carbohydrate (62.10%), crude protein (20.50%), crude fiber (2.40%), lipid (1.60%), and ash (1.90%). Additionally, it contains arabinoxylan, a non-starch polysaccharide, dietary fiber, sugars, and structural polymers like lignin and cellulose. Furthermore, black wheat contains essential amino acids, vitamins (such as vitamin E, vitamin B3, B5, and vitamin K), and minerals (including zinc, iron, copper, calcium, and phosphorus), with special mention to its zinc and iron concentrations. The presence of unsaturated fatty acids contributes to improving heart health and addressing cardiovascular issues.

## Challenges ahead

Although colored wheat is a research trend, its commercialization remains a challenge, with the area under cultivation of colored wheat currently accounting for less than 0.01% of the total wheat-growing area. The major hurdle for widespread adoption lies in market generation and consumer awareness creation. To address this, collaboration between government programs and industry is essential to promoting this healthier option of wheat. Furthermore, there is immense research potential, including innovative product development, large-scale human trials for functional validation, and breeding aimed at improving anthocyanins, as well as additional phytonutrients like lutein and tocopherols. Research efforts also target enhancing proteins, minerals such as iron, zinc, and selenium, and improving biotic and abiotic stress tolerance and yield.

## Conclusion

Colored wheat, particularly black wheat (BW), has garnered significant attention as a subject of study and holds promise for the development of high-quality commercial foods. It serves as an excellent source of bioactive phytochemicals known for their preventive effects against inflammation, metabolic syndrome, obesity, diabetes, dyslipidemia, aging, and neurodegeneration. The contents and compositions of anthocyanins, carotenoids, and flavonoids present in colored wheat warrant further study and evaluation. Currently, only a few varieties of black wheat have been developed. To meet future demands, modern breeding technologies and genetic engineering should be employed to create BW varieties with higher yields and enhanced adaptability to different agro-climatic conditions. The eventual widespread adoption of black wheat as a trendy functional food in many countries is anticipated. However, a crucial challenge lies in generating market interest and raising consumer awareness of its large-scale commercialization. To address this, there is a need to develop end-product-oriented cultivars tailored to regional preferences, emphasizing high yields and rich contents of anthocyanins, carotenoids, phenolic, vitamins, and minerals. Associating functionality with these cultivars through in vitro and in vivo studies can further enhance their market appeal.

## References


1. Beta, T., Li, W., and Apea-Bah, F. B. (2019). Flour and bread from black, purple, and blue-colored wheats. In *Flour and breads and their fortification in health and disease prevention* (pp. 75-88). Academic Press.
2. Dhua, S., Kumar, K., Kumar, Y., Singh, L., and Sharanagat, V. S. (2021). Composition, characteristics and health promising prospects of black wheat: A review. *Trends in food science & technology*, **112**: 780-794.
3. Garg, M., Chawla, M., Chunduri, V., Kumar, R., Sharma, S., Sharma, N. K., and Singh, S. P. (2016). Transfer of grain colours to elite wheat cultivars and their characterization. *Journal of Cereal Science*, **71**: 138-144.
4. Garg, M., Sharma, N., Sharma, S., Kapoor, P., Kumar, A., Chunduri, V., and Arora, P. (2018). Biofortified crops generated by breeding, agronomy, and transgenic approaches are improving lives of millions of people around the world. *Frontiers in Nutrition*, **5**: 301899.
5. Jiang, W., Liu, T., Nan, W., Jeewani, D. C., Niu, Y., Li, C., and Wang, Z. (2018). Two transcription factors TaPpm1 and TaPpb1 co-regulate anthocyanin biosynthesis in purple pericarps of wheat. *Journal of experimental botany*, **69**(10): 2555-2567.
6. Kumari, S., and Tzudir, L. (2021). Black wheat: next big thing in India's agricultural landscape. *Biotica Research Today*, **3**(4): 240-242.
7. Preedy, V. R., and Watson, R. R. (Eds.). (2019). *Flour and breads and their fortification in health and disease prevention*. Academic press.
8. Saini, P., Kumar, N., Kumar, S., Mwaurah, P. W., Panghal, A., Attkan, A. K., and Singh, V. (2021). Bioactive compounds, nutritional benefits and food applications of colored wheat: A comprehensive review. *Critical reviews in food science and nutrition*, **61**(19): 3197-3210.
9. Sharma, S., Chunduri, V., Kumar, A., Kumar, R., Khare, P., Kondepudi, K. K., and Garg, M. (2018). Anthocyanin bio-fortified colored wheat: Nutritional and functional characterization. *PloS one*, **13**(4): e0194367.