

Anthocyanin Biofortified Colored Wheat developed at NABI

Long term obesity, poor nutrition or pollutants in environment, lead to chronic oxidative stress in the body that results in increased level of free radicals and cellular dysregulation. In that case, our body becomes more prone to life style disorders like obesity, cardiovascular diseases, diabetes, cancer, aging etc. Consuming sufficient amount of anti-oxidants in our diet helps in removing free radicals from our body and thus lifestyle disorders are prevented.

Anthocyanins are good antioxidants that are present in fruits like blueberries, blackberries, jamun etc. We must have sufficient amount of colored fruits in our diet and recommended daily allowance (RDA 2010) is 500 gms of fruits every day to prevent oxidative stress. Consuming fruits also increases our sugar intake which is not good for health. As an alternate; extract of anthocyanin can be an option, but it is not cost effective.

Colored wheat (purple and black) has been developed at NABI keeping in view these issues. Common wheat grains across the world are white (amber) in color. The colored wheat, rich in anthocyanin is quite uncommon and is not available in India as of now. Color in the wheat grain is due to anthocyanins that have antioxidant activity. It has been developed by crossing exotic germplasm (EC866732) procured from Japan with a high yielding and disease resistance wheat cultivar PBW621. Yield of black wheat developed by NABI is 20% lower than high yielding cultivars due to substitution of Agropyron chromosome that gives it blue color. Consuming color wheat rich in anthocyanins on daily basis is a viable option compared to the fruits. It gives an opportunity to help revitalize our body and cashing the richness of fruits without the fear of consuming high sugar content. It is also higher in dietary fibers, and zinc compared to normal wheat.

Healthy Colored Wheat-

1. Color (**Black and purple**) in colored wheat is due to the presence of high anthocyanins (40-140 ppm) that develop naturally in the field at the time of grain filling.
2. Anthocyanins are naturally occurring **antioxidants** that give **goodness of fruits like Blueberries and Jamun** and come under the list of healthy **Nutraceutical** under Schedule VI B of FSSAI's Nutraceutical Regulations.
3. According to nutrient requirements and **RDA for Indians (2010)**, the **anthocyanins are anti-oxidants** that prevent **oxidative damage** and help in **delaying ageing**, reducing **cancer, cardiovascular diseases, diabetes** and other disorders.

Coloured Wheat in FOCUS

1. Colored wheat has been developed at National Agri-Food Biotechnology institute (NABI) after the **research of 7 years by routine plant breeding method**.
2. It is not genetically modified (**non-GMO**).
3. It has been protected by filing **PATENT** application.
4. It has been registered with National Bureau of plant genetic resources (**NBPGR**) with registration numbers INGR17001, INGR17002, INGR 17003.
5. Further, it has been approved for human consumption by Food safety and standards authority of India (**FSSAI**) vide F.No.04/Std/PA/FSSAI/2018.

COLORED WHEAT – QUALITY ASSURED

1. **Laboratory experiments** at NABI have confirmed its high anthocyanin content, **antioxidant** and **anti-inflammatory activity**. doi.org/10.1016/j.jcs.2016.08.004
doi.org/10.1371/journal.pone.0194367
2. Healthy whole Colored wheat is **rich in anthocyanins, proteins, dietary fibre and minerals**.
3. **Mouse research** at NABI have shown its preventive effects in regulating blood **glucose homeostasis**, managing insulin resistance, lowering serum **cholesterol**, preventing **fat deposition** in models of diet induced obesity
doi.org/10.1002/mnfr.201900999

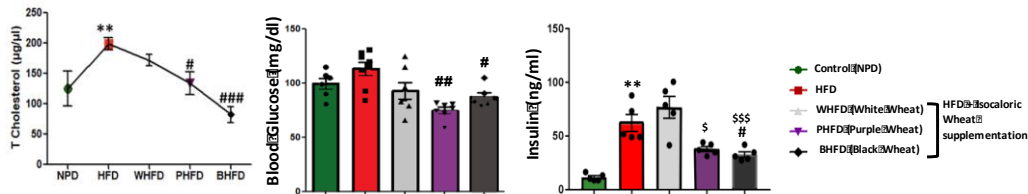


Figure 1. Lower total cholesterol, blood glucose and insulin levels in black and purple wheat fed high fat diet mice

4. NABI studies have shown preventive effect on unpredictable **stress** induced antioxidant enzymes in induced stress study in mouse.
5. Colored wheat chapatti has good taste, soft texture, higher dietary fibers, protein content, phenolic compounds, anthocyanin content, and antioxidant activity.
doi.org/10.3390/molecules25215071

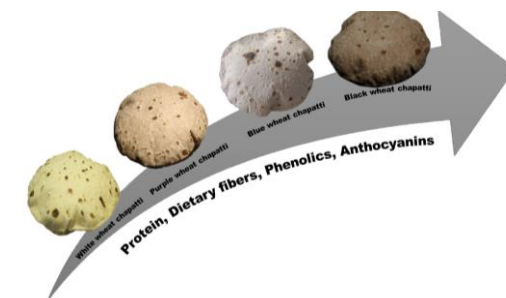


Figure 2. Characteristics of chapatti prepared from different colored wheat

6. Studies at NABI indicated that Black wheat has antimicrobial properties against bacteria and yeast that cause diseases in humans. doi.org/10.3390/molecules25245785
7. Hypoglycemic effect of black wheat (developed in China) in diabetic patients has been published in Journal of Therapeutics and Clinical Risk Management. 2018; 14: 247–256
8. Protective effect of anthocyanin-rich wheat against early stages of neurodegenerative disorders in mouse model of Alzheimer’s disease has been published in Journal Nutrients 2020. <https://www.mdpi.com/2072-6643/12/12/3877>

COLORED WHEAT- HEALTHY KITCHEN

1. Colored wheat can be a healthier product for **children and adults**.

2. Whole wheat chapatti, paratha, nan, thepla, roti, puri, parotta, phulka, **bread, biscuits, cakes, pizza base, noodles**, burger, kulcha, **wheat puffs, roasted snacks, dalia** (Coarse grinded wheat granules) etc., can be prepared from it.



Figure 3. Wheat (amber, black, blue, purple), Bread and Biscuits prepared from purple, black and amber wheat