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Colored Wheat: Nutritional Revolution

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INTRODUCTION

Among the major cereals, rice, wheat and maize are widely grown due to their high demand in the food industry. Wheat is one of the most important food grain crops. Most of the cultivated wheat varieties are amber in color, but, nowadays, colored wheat that is rich in phytochemicals and anthocyanins, getting popular around the world because of their associated health benefits. Purple wheat was developed in the nineteenth century, whereas blue wheat emerged in the first part of the twentieth century as a result of mating of *Triticum aestivm* and various wild wheat relatives such as, *Triticum monococcum* L. spp. *aegilopoides*, *Thinopyrum ponticum* and *Thinopyrum bessarabicum.*

Wheat's colors are caused by phytochemicals such as phenolic compounds, carotenoids, flavonoids and anthocyanin. Anthocyanins are typically found in the pericarp of grains, and their concentration determines whether the colour is purple, blue, or a combination of the two. The yellow colour comes from carotenoids in the endosperm, whereas the red comes from phlobaphenes in the outer layer. Black grained wheat has the highest content of anthocyanin, followed by blue grained wheat, purple grained wheat, red grained wheat and amber colored wheat.

Carotenoids present in the endosperm give the yellow hue, whereas phlobaphenes found in the outer layer give the red colour. Colored wheat has been shown to help in the prevention and treatment of a variety of chronic diseases such as, cancer, oxidative liver damage, capillary fragility, diabetes, cardiovascular disease (CVD), inflammation, obesity, ageing and hyperglycemia

Nutritional Composition

Wheat grains are high in TDF, minerals, phytochemicals, vitamins, and other bioactive components, as well as carbohydrates, lipids, and proteins (macronutrients and micro-nutrients). Anthocyanins and carotenoids are two natural pigments found in colorful wheat. Colored wheat is attracting a lot of interest from food makers and academics because of its health-promoting and disease-preventing properties.

a. Micro-nutrients

B-group vitamins [B_1 (thiamine), B_2 (riboflavin), B_3 (niacin), B_6 (pyridoxine) and B_9 (folate)] and vitamin E (tocopherol) are abundant in colored wheat. Apart from vitamins B and E, it has a trace amount of vitamin A (β-carotene), vitamin D (calciferol) and vitamin K (phylloquinone).

Types	Na	Mg	Ca	Fe	Cu	Zn
Blue	30.1	430	310	40-47	10	34-39
Green	15.5	337	272	50	__	40
Black	21.4	450	184	40-80	3.5	29-79
Purple	__	__	419.6	37-45	4-7	26-40.7
Red	__	__	__	37	6.8	32
Common	7.7-27.3	320-1160	270-345	26.5-344	3.5	16-41

Where, Na- Sodium, Mg- Magnesium, Ca- Calcium, Fe- Iron, Cu- Copper and Zn- Zinc

b. Macro-nutrients

Types	Protein(%)	TDF(%)	Ash(%)	Fat(%)	Starch(%)
Purple	11-20	10-15	1.5-2.8	1.3	49.1-60.2
Blue	13-16	13-13.8	2-2.6	1.2	12-15.3
Black	10-13	13	1.5-2.3	1.5	__
Red	16	__	2.5	__	__
Common	11-15	12-16.5	1.5-2	1.4	59.4

Where, TDF- Total Dietary Fiber

c. Bioactive compounds

Types	TAC(mg/Kg C3G eq)	TPC(g/kg)	TFC(mg/100g)	TAA(mmol TE/Kg)
Purple	13.1-175	6.24 (CE)	22-103(CE)	7.6-41
Blue	69-210	6.9(CE)	__	6.5-25
Black	129-200	0.659(GAE)	32(RE)	__
Red	5.5-159	3.3 (CE)	11.1(CE)	6.7-16
Common	0.5-14	4.8(CE)	9.8(CE)	7-19.3

Where, TFC- total flavonoid content, C3G- cyanidin 3 glucoside, TE- trolox equivalents, TPC- total phenolic content, CE- catechin equivalent, TAA- total antioxidant activity, GAE- gallic acid equivalent, TAC- total anthocyanin content and RE- rutin equivalent.

Constraints in Colored Wheat Production

There are various constraints in the production of colored wheat, some of which are as follows;

- The most major issue in developing colored wheat germplasm is low yield (Garg *et al*., 2016). Black wheat has a lower productivity (45-50 q ha-1) than conventional wheat, which produces a grain yield of 55-60 q ha-^{1}
- People are unaware of the varied colored wheat lines
- Seeds are out of reach for the average person

Future Needs: -

1. There are various characteristics of anthocyanin from cereals that have been understudied in terms of genetics, chemistry, and biological activity. As a result, further study is needed to discover, isolate, and characterise these compounds so that their eventual influence on human health may be determined.
2. The creation of high-yielding cultivars that are disease-resistant and tolerant of harsh climatic conditions will have a significant impact on public perception and, eventually, acceptability across the world.
3. The federal and state governments should purchase it at a higher minimum support price (MSP) in order to introduce it as a mid-day meal supplement.
4. The product must be popularized by making it more widely available in the market.

CONCLUSION

The presence of anthocyanin and other beneficial compounds like flavonoids and carotenoids in colored wheat has piqued the interest of researchers and food processors over the last several decades. This wheat's ability to prevent sickness and promote health is attributed to its antioxidant content. Isolated pigments from the outer bran layer have the potential to prevent illnesses such as cancer, CVD, and other oxidative stress-induced chronic diseases, in addition to their potential to replace artificial colorants in the food business. Anthocyanin-rich colored wheat can be beneficial in the creation of innovative food items when employed as whole grain or the extracted bran layer. Colored wheat has been shown in numerous

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studies to have a high nutritional content, antioxidant activity, and higher utilization for the production of high-value food items such as bread, biscuits, pasta, noodles, bars, and crackers, indicating that it has the potential to replace conventional wheat. There are several methods for analyzing and extracting anthocyanin and other beneficial components from colored wheat. However, more research is needed to determine the impact of processing on the colored wheat's bioactive components and antioxidant qualities, in order to promote its effective use by food manufacturers.