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Biofortified varieties: Way to build nutritional immunity to fight against Covid-19 pandemic- A review

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Abstract
Biofortification is convenient, cost effective and sustainable way to incorporate micronutrients into a crop plants. This will help to people to maintain the nutritional status and gain the diverse diet. Biofortification help in fighting against micronutrient deficiency in developing countries, where diets are dominated by staple food crops. Also, apart from this Biofortified varieties are rich in Vitamin A, Iron and Zinc concentrates that can have a measurable impact on nutritional security. Currently, Biofortified varieties will be the immunity booster for the people to fight against covid-19 pandemic.

Keywords: Biofortification, covid-19, transgenic, nutrition

Introduction
Biofortification" or "biological fortification" refers to nutritionally enhanced food crops with increased bioavailability to the human population that are developed and grown using modern biotechnology techniques, conventional plant breeding and agronomic practices.
It differs from usual fortification because it focuses on making plant foods more nutritious as the plants are growing, rather than having nutrients added to the foods when they are being processed. Biofortification focuses on enhancing the mineral nutritional qualities of crops at source, which includes processes that increase both mineral levels and their bioavailability in the edible part of staple crops.
Biofortified crops with increased bioavailable concentrations of essential micronutrients are deployed to consumers through traditional practices used by agriculture and food trade which therefore provides a feasible way of reaching undernourished and low income group families with limited access to diverse diets, supplements, and fortified foods. From an economic viewpoint, Biofortification is a one-time investment and offers a cost-effective, long-term, and sustainable approach in fighting hidden hunger because once the Biofortified crops are developed; there are no costs of buying the fortificants and adding them to the food supply during processing.

Current need of Biofortification
Today whole world is facing big challenge to fight against Covid-19. Everybody is asking about its remedies and vaccines. Yet no such vaccine is developed to fight against covid-19. Ministry of Ayush, Government of India has given guidelines to build immunity with immunity booster treatment/dose. Biofortified varieties will be the Immunity booster for People to fight against covid-19. Biofortified varieties are rich in vitamins A, iron and zinc concentrations that can have a measurable impact on nutritional status. Collectively, these nutrients play crucial roles in humans and dictate our physical and mental development. Many micronutrients act as cofactors for the functioning of various enzymes in the human body and thereby regulate important functions and metabolic processes in our body. Biofortification of crop plants can provide enough calories to meet the energy needs along with providing all the essential nutrients needed for sound health.

Approaches of biofortification
i) Transgenic breeding.
Transgenic breeding approach of biofortification is used when there is limited or no genetic variation in nutrient content among crop varieties. It relies on the access to the unlimited genetic pool for the transfer and expression of desirable genes from one species to another which is independent of their evolutionary and taxonomic status. When a particular micronutrient does not naturally exist in crops, transgenic approaches remain the only feasible

option to fortify these crop with the particular nutrient. The ability to identify and characterize gene function and then utilize these genes to engineer plant metabolism has been a key for the development of transgenic crops. Transgenic approaches can also be used for the simultaneous incorporation of genes involved in the enhancement of micronutrient concentration, their bioavailability and reduction in the concentration of antinutrients which limit the bioavailability of nutrients in plants. In addition, genetic modifications can be targeted to redistribute micronutrients between tissues, enhance the micronutrient concentration in the edible portions of commercial crops, increasing the efficiency of biochemical pathways in edible tissues, or even the reconstruction of selected pathways. Development of transgenically Biofortified crops initially involves substantial amount of funds, efforts, and investment during research and development stage, but in a long run, it is a cost-effective and sustainable approach, unlike nutrition-based organizational and agronomic biofortification programs.

ii)Agronomic approach

Agronomic means requires physical application of nutrients to improve the nutritional and health status of crops. Consumption of such crops improves the human nutritional status. Macro nutrients like nitrogen, phosphorus, and potassium (NPK) containing fertilizers are important and necessary to improve crop yield. Micro nutrients like Fe, Zn, Cu, Mn, I, Se, Mo, Co, and Ni are found in varying degrees in the edible portion of certain plants and are usually absorbed from the soil. Improvement of the soil micronutrient status by their application as fertilizers can contribute to decrease in micronutrient deficiency in humans. Agronomic biofortification is simple and economical, but needs special attention in terms of source of nutrient, application method and effects on the environment. Application of biofertilizer and organic manure is useful for increasing the nutrient availability of soil and which results in increased nutrients in crop.

Biofortification of rice plants by foliar spray of iron is an effective way to promote iron concentration in rice grains. Foliar application of zinc has been reported as an effective agronomic practice to promote rice and wheat grain zinc concentration and zinc bioavailability. Iron micronutrient profile of barley has been improved by the application of various organic and inorganic biofertilizers. The concentration of zinc and iron in grains has been enhanced by the application of biofertilizers along with inorganic fertilizers and vermicompost. Increase in beta-carotene in potato and cauliflower has been observed with irrigation and chemical fertilizer treatments. The success of agronomical biofortification is highly variable due to the differences in mineral mobility, mineral accumulation among plant species and soil compositions in the specific geographical location of each crop. This is cost effective and simple method of biofortification.

iii) Conventional breeding

Biofortification through conventional breeding in the most accepted way of biofortification. It offers a sustainable, cost-effective alternative to transgenic and agronomic-based approaches. Sufficient genotypic variation in the trait of interest is necessary for conventional breeding to be feasible. Conventional breeding of approach of biofortification is useful to improve the levels of vitamins and mineral elements in crops especially in vegetables and fruit crops. In conventional plant breeding, parent lines with high nutrients are crossed with recipient line with desirable agronomic traits over several generations to produce plants with desired nutrient and agronomic traits. However, breeding strategies have to sometimes rely on the limited genetic variation present in the gene pool. In some cases, this can be overcome by crossing to distant relatives and thus moving the trait slowly into the commercial cultivars. Alternatively, new traits can be introduced directly into commercial varieties by mutagenesis.

Biofortified varieties in India

Nutritious diet is vital for proper growth and development in humans. It helps preventing diseases, besides maintaining the body metabolism for physical- and mental- well being. Food provides energy, protein, essential fats, vitamins, antioxidants and minerals to meet our daily metabolic requirement. Most of them cannot be synthesized in human body, therefore are to be supplemented through diet. So far, the focus has been on the development of high yielding varieties primarily to feed the ever increasing populations. Till now more than 5600 varieties of different crops have been released of which numbers of biofortified varieties are negligible. These biofortified varieties assume great significance to achieve nutritional security of the country.

Table 1: Biofortified varieties in India

Sr. No.	Crop	Mineral content	Variety
1.	Rice	Protein-10.3%	CR Dhan 310 (Pure Line variety)
		Zinc-22.6%	DDR Dhan 45
2.	Wheat	Zinc-42.0 ppm	WB 02
		Iron 40.0 ppm	
		Iron-40.0 ppm	HPBW 01
		Zinc-40.6 ppm	
3.	Maize	Provitamin-A-8.15 ppm	Pusa vivek QPM9 Improved (Hybrid)
		Lysin-2.67%	
		Tryptophan-0.74%	
		Tryptophan-0.91%	Pusa HM 4 Improved
		Lysine-3.62%	
		Tryptophan-1.06%	Pusa HM 8 Improved
		Lysine-4.18%	
		Tryptophan-0.68%	Pusa HM 9 Improved
		Lysine-2.97%	
4.	Pearl Millet	Iron – 73.0 ppm	HHB 229
		Zinc-41.0 ppm	

		Iron-73.0 ppm	AHB 1200
		Iron-81.0 ppm	Phule Dhanshakti
		Iron-87.0 ppm	Phule Mahashakti
5.	Barnyard millet	Calcium (452.5 ppm)	Phule Barti-1
6.	Lentil	Iron-65.0 ppm	Pusa ageti massor
7.	Mustard	Erucic acid- < 2.0%	Pusa mustard 30
		Erucic acid- < 2.0%	Pusa double mustard 31
		Glucosinolates < 30.0 ppm	
8.	Cauliflower	β carotene 14.0mg/100g	Pusa beta kesari 1
9.	Potato	β carotene 90.0 mg/100g	Bhu sona
10.	Sweet potato	Anthocyanin 90.0 mg/100g	Bhu krishna
11.	Tomato	β carotene (5.93 mg/100g)	Phule Kesari
12.	Pomegranate	Iron-5.6-6.1 mg/100 g	Solapur lal
		Zinc-0.64-0.69 mg /100 g	
		Vitamin-19.4-19.8 mg /100g	
13.	Grape	Antioxidants	Pusa navrang
14.	Mango	β carotene, Vitamin C	Pusa surya, Pusa pitamber

Conclusion

Indian agriculture is undergoing a shift from food security to nutrient security. Biofortification will be helpful for nutrient security with immunity booster to fight against covid-19. At present, Biofortification is a way to reach populations where supplementation and conventional fortification activities may be difficult to implement. India is now surplus in food production but at the same time, we are facing the problems of under nutrition, poverty and recently facing covid-19 pandemic. So, biofotified varieties are a way to improve immunity and nutritional security in developing and under developed countries.

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