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BIOFORTIFIED VARIETIES-SUSTAINABLE WAY TO ALLIVATE MALNUTRITON

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ARTICLE ID: 052

Biofortification:

Increase in the nutritional value of crops through crop breeding is termed as **biofortification**. This can be done either through conventional selective breeding, or through genetic engineering. The process of increasing the density of vitamins and minerals in a crop through plant breeding, transgenic techniques, or agronomic practices is termed as Biofortification. A measurable amount of improvement in human health and nutrition can be observed by consuming biofortified staple crops.

Ordinary fortification can be differentiated from biofortification on the basis of the fact that ordinary fortification mainly focuses on adding nutrients to the food when food is being processed rather than that biofortification mainly focuses on making plant food more nutritious as the plants are growing (Bailey, 2008). This is important because rural poor are not able to access commercially fortified food but they can grow biofortified varieties and have nutritious food (Islam, 2008). WHO estimated that biofortification can help in curing about 2 billon people that are suffering from iron deficiency-induced anemia. So, biofortification is an upcoming strategy that can play an important role in dealing with deficiency of nutrients in low and middle-income countries.

What is malnutrition?

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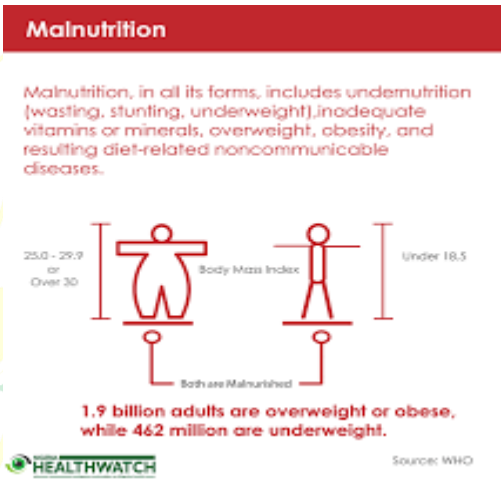
The imbalance, deficiency or excess of nutrients in a person's daily intake refers to Malnutrition. Malnutrition is broadly categorised into two groups:

1. Under nutrition
2. Over nutrition

Under nutrition includes stunting (low height for age), wasting (low weight for height), underweight (low weight for age) and micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals).



Over nutrition includes overweight, obesity and diet-related non-communicable diseases (such as heart disease, stroke, diabetes, and cancer overweight, obesity and diet-related non communicable diseases).

An appropriate nutrition is important for proper growth and development of human. Proper nutrition is important for maintaining metabolism, physical and mental health of human being. Food is good source of energy, protein, essential fats, vitamins, antioxidants and minerals to meet our daily metabolic requirement. Many nutrients cannot be synthesized by body so it can be supplemented through diet. Further, anti-nutritional factors present in edible parts of the food exert adverse affects on human health. Consumption of unbalanced foods affects billions of people worldwide, and leads to poor health and socio-economic conditions.

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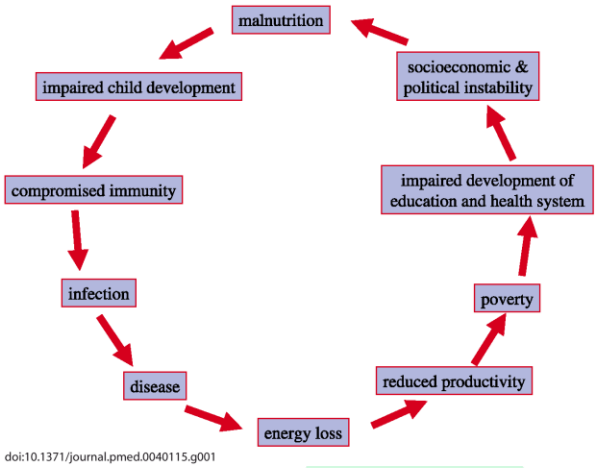

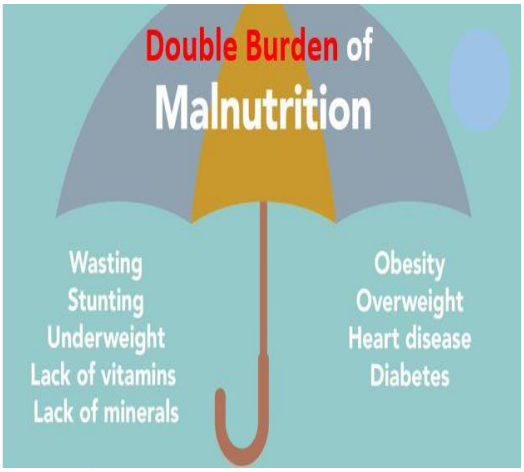

To fulfil the requirement of nutrients and vitamins among people, development of high yielding varieties is primary step that have been taken by Indian Council of Agricultural Research (ICAR). ICAR has developed improved nutrition quality in high yielding varieties of cereals, pulses, oilseeds, vegetables and fruits. Till now more than 5600 varieties of different crops have been released of which number of biofortified varieties are negligible. These biofortified varieties assume great significance to achieve nutritional security of the country.

Important Biofortified varieties released by ICAR, 2017

Sr. No.	CROP	VARIETY	NUTRIENTS	YIELD
1.	Rice	CR Dhan 310 (Pure line variety)	Protein: 10.3%	45.0 q/ha (grain yield)
2.	Rice	DRR Dhan 45 (Pure line variety)	Zinc: 22.6 ppm	50.0 q/ha (grain yield)
3.	Wheat	WB 02 (Pure line variety)	Zinc: 42.0 ppm and Iron: 40.0 ppm	51.6 q/ha (grain yield)
4.	Wheat	HPBW 01 (Pure line variety)	Iron: 40.0 ppm and Zinc: 40.6 ppm	51.7 q/ha (grain yield)
5.	Maize	Pusa Vivek QPM9 Improved (Hybrid)	Provitamin-A: 8.15 ppm, Lysine: 2.67% and Tryptophan: 0.74%	55.9 q/ha [Northern Hills Zone (NHZ)] and 59.2 q/ ha [Peninsular Zone (PZ)] (grain yield)
6.	Maize	Pusa HM4 Improved (Hybrid)	Tryptophan: 0.91% and Lysine: 3.62%	64.2 q/ha (grain yield)

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7.	Maize	Pusa HM8 Improved (Hybrid)	Tryptophan: 1.06%) and Lysine: 4.18%	62.6 q/ha (grain yield)
8.	Maize	Pusa HM9 Improved (Hybrid)	Tryptophan: 0.68% and Lysine: 2.97%	52.0 q/ha (grain yield)
9.	Pearl millet	HHB 299 (Hybrid)	Iron: 73.0 ppm, Zinc: 41.0 ppm	32.7 q/ha (grain yield), 73.0 q/ha (Dry fodder yield)
10.	Pearl millet	AHB 1200 (Hybrid)	Iron: 73.0 ppm	32.0 q/ha (grain yield), 70.0 q/ha (Dry fodder yield)
11.	Lentil	Pusa Ageti Masoor (Pure line variety)	Iron: 65.0 ppm	13.0 q/ha (grain yield)
12.	Mustard	Pusa Mustard 30 (Pure line variety)	erucic acid <2.0%	18.2 q/ha (seed yield), 37.7% (Oil content)
13.	Mustard	Pusa Double Zero Mustard 31 (Pure line variety)	Erucic acid <2.0%, Glucosinolates <30 ppm,	23.0 q/ha (seed yield), 41.0% (Oil content)
14.	Cauliflower	Pusa Beta Kesari 1 (Pure line variety)	β-carotene-8.0-10.0 ppm	40.0-50.0 t/ha (curd yield)
15.	Potato	Bhu Sona (Pure line variety)	β-carotene-14.0 mg/100 g	19.8 t/ha (tuber yield), 27.0-29.0% (Dry matter), 20.0% (Starch), 2.0-2.4% (Total sugar)
16.	Sweet Potato	Bhu Krishna (Pure line variety)	Anthocyanin:90.0 mg/100g	18.0 t/ha (Tuber yield), 24.0-25.5%(Dry matter), 19.5% (Starch), 1.9-2.2% (Total sugar)
17.	Pomegranate	Solapur Lal (Hybrid)	Iron: 5.6-6.1 mg/100g, Zinc: 0.64-0.69 mg/100g & Vitamin C: 19.4 -19.8 mg/100 g	23.0-27.0 t/ha (Fruit yield)

Important role of Biofortified varieties in alleviation of malnutrition:

- Biofortification is cost-effective means for delivering micronutrients to population. More than 20 million people in farm households in developing countries are now growing and consuming biofortified crops.

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- Biofortified varieties have long term cost effectiveness due to which it can be available to rural and un-reserved populations.
- Biofortification, however, has two key comparative advantages: its long-term cost-effectiveness and its ability to reach underserved, rural populations.
- In the long-term, increasing the production of micronutrient-rich foods and improving dietary diversity will substantially reduce micronutrient deficiencies.
- Biofortification puts a solution in the hands of farmers, combining the micronutrient trait with other agronomic and consumption traits that farmers prefer. After fulfilling the household's food needs, surplus biofortified crops make their way into rural and urban retail outlets.
- Biofortified crops are also a feasible means of reaching rural populations who may have limited access to diverse diets or other micronutrient interventions. Target micronutrient levels for biofortified crops are set to meet the specific dietary needs of women and children, based on existing consumption patterns.
- An upfront investment in plant breeding for yielding micronutrients rich biofortified planting material by farmers to at zero marginal cost is important for supplementation and commercial fortification programs.

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