



## Biofortification- A Futuristic Pathway to Overcome Malnutrition

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### INTRODUCTION

A nutritious diet is the primary need of human kind for proper growth and development of body and well as mental health. It helps for prevention of different kind of diseases and disorders. Due to this, working efficiency of human also reduced so it has the serious impact on socio economic condition of a country. The Sustainable Development Goals (SDGs) has aim to remove all forms of malnutrition from world up to 2030. To achieve these goals availability of healthy food to every citizen of a nation is the responsibility of governments.

**Malnutrition-** This condition caused by consumption of unbalanced Diet. It having different forms-

**Under nutrition-** Lack of enough food caused this type of malnutrition.

**Stunting-** Low weight under five year children due to food, health care.

**Wasting-** Due to acute food shortage, thin & low height upto five year's children. Micronutrient deficiency to suboptimal intake/absorption of nutrients.

**Overweight & obesity-** Excessive weight as per height. BMI  $\geq 25$  is considered overweight, while  $\geq 30$  is treated as obesity.

In India, the different types of malnutrition prevailing, which mentioned below--

- ❖ 15.2% of people are undernourished.
- ❖ Stunting varies greatly (12.4-65.1%) across districts, with 239 of 640 districts having stunting levels above 40%.
- ❖ 58.4% of the children (6-59 months), 53% of the adult women and 22.7% of adult men are affected due to anemia.
- ❖ 70% of children (<5 years) are estimated to be iron deficient.
- ❖ 38% of children (<5 years) are estimated to be deficient in zinc.

- ❖ India loses over Rs 1200 Crores in GDP per year to vitamin and mineral.

### Nutrients & their role in human body-

**Protein:** It provides essential amino acids for growth and tissue repair. Its deficiency resulted into to poor intellectual development, kwashiorkor and marasmus disorders among humans.

**Lysine:** Important for protein synthesis, metabolic activities. Deficiency leads to fatigue, dizziness, nausea, anaemia, delayed growth, loss of appetite etc.

**Tryptophan:** Also important proteins synthesis. Weight loss and slow growth in children are the major symptoms of tryptophan deficiency.

**Iron:** Important for proper functioning of muscle and brain tissues. It carries oxygen from the lungs to various tissues by red blood cell haemoglobin. Its deficiency leads anemia.

**Zinc:** Most important element which serves as cofactor in as many as 300 enzymes required in humans. Zinc deficiency leads to retardation in growth, loss of appetite, impaired immune function and increased susceptibility to infections.

**Calcium:** Important to build and maintain strong bones and teeth, muscle movement and cardiovascular function. Deficiency leads to osteoporosis means brittle bones, dental problems etc.

**Vitamin-A:** Known as 'retinol' and is essential for visual system, growth and development, maintenance of epithelial cell integrity, immune system and reproduction.

**Vitamin-C:** Important for good skin, bone, teeth and cartilage.

**Anthocyanins:** Responsible for red, purple, and blue colours in plant parts. Act as antioxidants and help removing harmful free radicals produced inside the body. This is antidiabetic,

anticancer, anti-inflammatory, anti-microbial, and anti-obesity effects.

**Oleic acid:** It is a mono unsaturated fatty acid present in oil. Monounsaturated fat in the diet is associated with decreased low-density lipoprotein (LDL) cholesterol and reduced risk of coronary heart disease.

**Linoleic acid:** It is a polyunsaturated fatty acid present in oil. It reduces total and LDL cholesterol, therefore good for cardiovascular functions.

### Anti-nutritional factors:

**Erucic acid:** It is a monounsaturated fatty acid found in rapeseed and mustard oil. High concentration of erucic acid in edible oils impairs myocardial conductance, causes lipidosis in children and increases blood cholesterol.

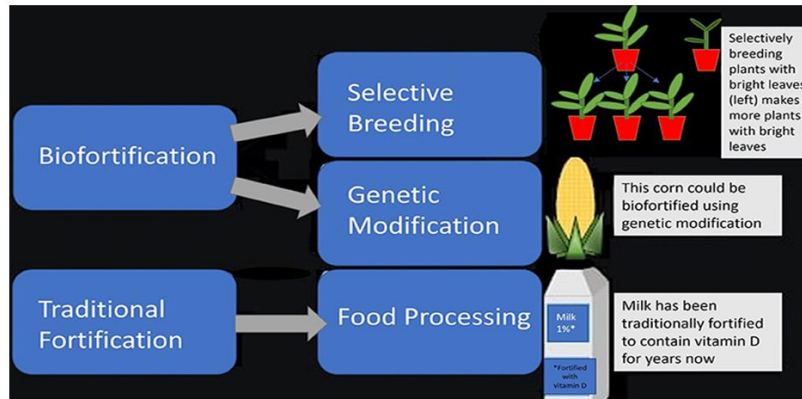
**Glucosinolates:** Found in Brassicaceae family. Higher consumption is detrimental to animal health; which in turn lowers feed efficiency and weight gains particularly in non-ruminants such as pigs and poultry.

**Kunitz trypsin inhibitor (KTI):** It is a non-glycosylated protein, mainly found in soybean that possesses adverse effects on growth of humans primarily through inhibition of trypsin in the digestive tract leading to indigestion.

**Lipoxygenase:** An enzyme that plays role in the development of unpleasant flavour in foods made from soybean by oxidation.

### BIOFORTIFIED Meaning-

Any grain/vegetable/fruit that having increased micronutrient content through breeding method or genetic modification; called biofortified crop and this process known as Biofortification. Why biofortification is essential? This is genuine question.



- ❖ During 1950-51, India's food produced 50 M T food grain and now approx. 285 MT.
- ❖ During 1550-51, India's population was: 42 crores while current 138 crores.
- ❖ We increased total production but quality of food degraded means important nutrients are far below the required level.

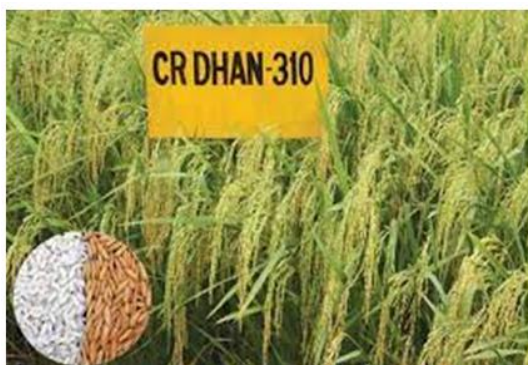


**Scope of Biofortified foods:-**

- ❖ Against child health
- ❖ Against women's and men's health
- ❖ To improve our Economy; by reducing costs of medicines and health care
- ❖ To improve nation's productivity

**Biofortified varieties of food grains, millets, oil seeds, vegetables etc.:-**

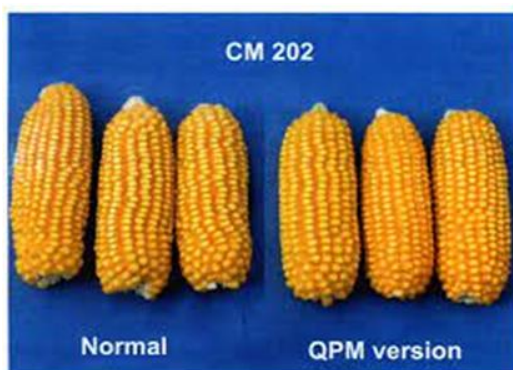
- ❖ CR Dhan- 310 - rich in protein (10.3 % in comp 8 %)
- ❖ CR Dhan 315 - Zinc (27.4 ppm in comp 12-16 ppm )
- ❖ Zinco Rice MS – rich in Zinc (27.4 ppm in comp 12-16 ppm )







- ❖ Vivek maize (QPM-9) – Rich in Lysine (4.19 % in protein in comp 1-2 % in normal varieties) and Tryptophen (0.83 % in protein in comp 0.3 -0.4 % in normal varieties)
- ❖ Pusa Vivek ( QPM 9 Improved)- Rich in provitamin-A (8.15 ppm in comp 1-2 %), lysine (2.67 % in protein) and tryptophan (0.74 % in protein)



- ❖ Wheat: WB-02- Rich in iron (40 ppm in copm. 28-30 ppm) & Zinc (42 ppm in copm. 30-32 ppm) in normal varieties.
- ❖ Pusa Tejas : HI -5859 (Durum)- Rich in protein ( 12% in copm. 8-10%), iron (41 ppm in copm. 28-30 ppm) and Zinc ( 42.8 ppm in copm. 30-32 ppm).
- ❖ Karan Vandana ( DBW- 187)- Rich in iron ( 43.1 % in copm. 28-30 ppm).
- ❖ UAS- 375- Rich in protein (13 % in copm. 8-10%)
- ❖ Mustard- Pusamustard-30- Erucin content in oil is 1.40% in copm. >40% in other varieties.
- ❖ Pusa Double Zero Mustard 31- Countries first canola quality Indian mustard variety. Very low in Erucic quantity ( 0.76% in copm. >40 %) & Glucosinoids ( 29.41 ppm in copm. > 120 ppm ) as compared popular varieties.
- ❖ Masoor- Pusa Ageti- Rich in Iron ( 65 ppm in comp 45 ppm)
- ❖ Masoor- IPL 220- Rich in Iron ( 73 ppm in comp 45 ppm ) and Zinc ( 51 ppm in comp 35 ppm )
- ❖ Soyabean- NRC-127- Country's first Kunitz Trypsin Inhibitor (KTI- Heat Treatment before processing in food and feed) free variety. Free from KTI in comparison to 30-45 mg/g of seed meal in popular varieties
- ❖ Oil Content : 19.1 %, protein content : 39 %, Grain yield : 18 q/ha, maturity:104 days



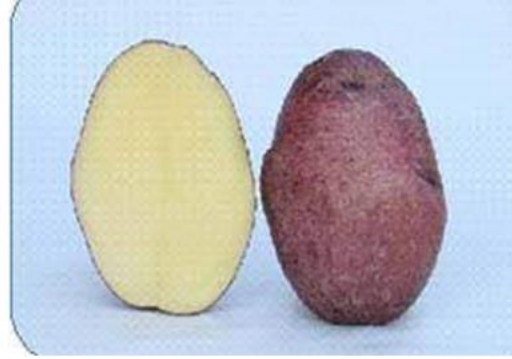
- ❖ Soyabean- NRC-147- Rich in oleic acid –Lowering cholesterol & Heart diseases (42.0% in comp to 22-25 % )



- ❖ Cauliflower- PUSA Beta Carotene -1- Country's first provitamin-A rich cauliflower Rich in provitamin-A (8.0-10.0 ppm in comp to negligible content)



- ❖ Potato- Kufri manik- Rich in anthocyanin (0.68 ppm) in comparison to negligible content in popular varieties  
High in antioxidant, Tuber yield: 23.0 t/ha, maturity: 90-100 days



- ❖ Sweet potato- Bhu Sona- Rich in provitamin-A (14.0 mg/100g in comparison to 2.0-3.0 mg/100g ), Tuber yield: 19.8 t/ha



- ❖ Greater Yam- Shree Neelima- Rich in anthocyanin (50.0 mg/100g in comparison to negligible , crude protein (15.4 % in comp 2.7 % crude protein ) and zinc (49.8 ppmin comp 22-32 ppm , Tuber yield: 35.0 t/ha, Maturity: 240-270 days



- ❖ Okra/ Bhindi- Kashi Lalima – Rich in Anthocyanin





- ❖ Pusa Safed baingan-1- High phenol content (31 mg in comp 3.16 mg GAE/100 gm) and high Antioxidant quantity ( 3.48 CUPRAC)



Pomegranate: Solapur LAI- Rich in iron (5.6 mg/100 gm in copm. 2.7mg/100 gm), zinc (0.60 mg/100 gm in copm. 0.50 mg/100 gm) and Vitamin-C ( 19.4 mg/100 gm in copm. 14 mg/100 gm ) in fresh arils as compared Ganesh variety; which is most popular.



**Vitamin – A rich rice (Golden rice) vs**

