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# Biofortification: Way Forward to Nutritional Security

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Biofortification has been derived from the Greek word "bios" meaning "life" and the Latin word "fortficare" meaning "to make strong". It is defined as the method of breeding crops to increase and improve nutrient contents of foods including micronutrients and their precursors.

## Rationale for Biofortification

Biofortification, the process of breeding nutrients into food crops, provides a comparatively cost-effective, sustainable, and long-term means of delivering more micronutrients. The biofortification strategy seeks to put the micronutrient-dense trait in those varieties that already have preferred agronomic and consumption traits, such as high yield and disease resistance.

The biofortification strategy seeks to put the micronutrient-dense trait in those varieties that already have preferred agronomic and consumption traits, such as high yield. Marketed surpluses of these crops may make their way into retail outlets, reaching consumers in first rural and then urban areas, in contrast to complementary interventions, such as fortification and supplementation, that begin in urban centers. Biofortified staple foods cannot deliver as high a level of minerals and vitamins per day as supplements or industrially fortified foods, but they can help by increasing the daily adequacy of micronutrient intakes among individuals throughout the life cycle.

There are three approaches of biofortification
a) Agronomic practices, i.e. fertilizer application to the soils to increase plants iron and zinc content
b) Conventional plant breeding (increase in iron content in pearl millet and beans, zinc content in rice, maize and wheat, tryptophan and lysine in maize and pro-vitamin A content in maize and sweet potato and
c) Genetic modification such as rise in β-carotene in rice and decrease in phytic acid in cereals.

Three primary issues have been identified that are required to make biofortification successful: (i) a biofortified crop must be high yielding and profitable to the farmer, (ii) the biofortified crop must be shown to be efficacious and effective at reducing micronutrient malnutrition in humans, and (iii) the biofortified crop must be acceptable to both farmers and consumers in target regions where people are afflicted with micronutrient malnutrition.

## Advantages of Biofortification

- Biofortification helps in achieving overall health improvement in the people.
- Such crops are more resilient to diseases, pests, droughts, etc. and provide better yields.
- It offers a food-based, sustainable and low-dose alternative to iron supplements.

- It has the potential to reach the poorest section of society (who cannot afford food supplements) and will also benefit farmers.
- It is highly cost-effective since once the initial research is done, the process can be easily replicated and scaled.
- Biofortification done through non-genetically modified methods (like traditional plant breeding done in India) is a better alternative then introducing GM crops that face implementation barriers.
- In a country such as India, that faces huge nutritional challenges, biofortification is a sustainable, cost-effective method that can help resolve this challenge.

## Biofortification Examples

The following are some common examples of biofortification of food crops:

- Iron biofortification – Rice, sweet potato, beans, legumes, cassava
- Zinc biofortification – Rice, wheat, sweet potato, maize, beans
- Provitamin A carotinoid biofortification – Cassava, maize, sweet potato
- Amino acid and protein biofortification – Cassava, sorghum

## Challenges of Biofortification

- Produce crops for human nutrition with increased iron concentration. Biofortification strategies alternative to reduction in concentration of phytic acid or polyphenols should be explored further, in order to increase iron absorption without loss of their beneficial effects.
- Crops biofortified with prebiotics have the potential to partially circumvent the "iron paradox" caused by host–pathogen competition for iron, by favoring amelioration of gut health and gut-associated immune defense.
- Improve the efficiency with which minerals are mobilized in the soil.
- Improve the efficiency with which minerals are taken up from the soil into the roots of the plant.
- Improve the transport of minerals from the roots to storage tissues, such as grain.
- Increase the capacity of storage tissues to accumulate minerals in a form that does not impair plant vegetative growth and development, but remains bioavailable for humans.
- Reduce the level of antinutritional compounds such as phytic acid, which inhibit the absorption of minerals in the gut.

## Conclusion

The development of biofortification as a micronutrient intervention strategy faces many challenges. Understanding and quantifying the losses of micronutrients, in particular of provitamin A, with storage, processing, and cooking, quantifying the bioavailability of micronutrients in usual diets, and overcoming the low bioavailability of iron require a comprehensive research program.