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Biofortification – A Way to Increase Nutrition in Staple Foods

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SUMMARY

Deficiencies in micronutrients such as zinc, iron and vitamin A can cause profound and irreparable damage to the body which include blindness, growth stunting, mental retardation, learning disabilities, low work capacity, and even premature death. Over one half of world's population is affected by this micronutrient deficiency. Biofortification is one option to overcome these deficiencies through supplementation of fortified food, especially for the rural poor. Biofortification of staple food crops is a new public health approach to control vitamin A, iron, and zinc deficiencies in poor countries.

INTRODUCTION

Development of micronutrient-dense staple crops by using various traditional breeding practices and modern biotechnological approaches is biofortification. This approach is advantageous in many ways. Firstly, it capitalizes the regular daily intake of large amount of staple food by all family members. Secondly, it is one time investment programme. Once the fortified seeds are developed, recurrent costs are low and the germplasm can be shared internationally. Thirdly, biofortification provides the feasible means of reaching under nourished populations in the relatively remote areas, providing naturally fortified foods to people with limited asses to commercially marketed fortified foods. Fourth, the biofortified crop system is highly sustainable, once in place. Finally, breeding for higher trace mineral density in seeds will not incur a yield penalty. Biofortification have an important effect for increasing farm productivity in developing countries in an environmentally beneficial way. Mineral-packed seeds sell themselves to farmers because these trace minerals are essential in helping plants resist disease and other environmental stresses. Moreover, a higher proportion of seedlings survive, initial growth is more rapid, and ultimately yields are higher. Biofortification requires that agricultural research make direct linkages with the human health and nutrition sectors.

Is Breeding for Fortified Foods Scientifically Possible?

Due to some characters that are already present in the staple crops, it will be possible to improve the content of several limiting micronutrients together, thus pushing populations toward nutritional balance.

- Substantial useful genetic variation exists in key staple crops for the concentrations of b-carotene, other functional carotenoids, iron, zinc, and other minerals.
- Breeding programs can readily manage nutritional quality traits, which for some crops are highly heritable and simple to screen for;
- Desired traits are sufficiently stable across a wide range of growing environments; and
- Traits for high nutrient content can be combined with superior agronomic characteristics and high yields.

Possible Methods of Developing Biofortified Staple Foods

Selective Breeding

Selective breeding starts with the search of seed or germplasm banks for the crop varieties which have high nutrient content naturally. Then these varieties are crossbred with the varieties having high yield to produce seeds with both high yield and high nutrient content. Nutritive value of the selected varieties should possess sufficient amount of nutrients to have a positive impact on human health. Varieties must be developed with the involvement of nutritionists who study whether the consumers of the improved crop can absorb the extra nutrients. Radiation breeding has been used to develop the bread wheat with high iron and zinc.

Harvest Plus, a major NGO in the development of biofortified crops primarily use conventional breeding techniques, and have not yet spent more than 15% of their research budget on genetically modified crops when conventional methods fail to meet nutritional requirements.

Genetic Modification

Most well-known example of genetically modified crop for its nutritional value is Golden Rice. Genes from a common soil bacterium Erwinia and maize are incorporated in the latest version of Golden Rice, which contains increased level of beta-carotein that can be converted into vitamin A by the body. It is being used as a potential new way to address vitamin A deficiency.

Seed Priming

Seeds are considered to be an important part of crop life cycle as it influences the propagation of critical phases like germination and dormancy. Seed priming before sowing is considered to be one of the promising ways to provide value-added solutions to maximize the natural potential of seed to set the plant for maximum yield potential with respect to both quality and quantity. Positive effect on the shoot and root growth of seedlings of wheat (*Triticum aestivum* L.) when treated with iron-oxide nanoparticles. This innovative cost-effective and user-friendly method of biofortification has proven to increase grain iron deposition upon harvesting. Hence, the intervention of nanotechnology in terms of seed priming could be an economical and user-friendly smart farming approach to increase the nutritive value of the grains in an eco-friendly manner.

What are the Strategic Advantages of Biofortification?

The biofortification strategy seeks to take advan- tage of the consistent daily consumption of large amounts of food staples by all family members, including women and children who are most at risk for micronutrient malnutrition. The biofortification strategy seeks to take advan- tage of the consistent daily consumption of large amounts of food staples by all family members, including women and children who are most at risk for micronutrient malnutrition. The biofortification strategy seeks to take advan- tage of the consistent daily consumption of large amounts of food staples by all family members, including women and children who are most at risk for micronutrient malnutrition.

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- Once the nutritionally fortified varieties are produce, they will be continue to be grown and consumed year after year, proving it’s one time investment.
- Breeding for higher trace mineral density in seeds will not incur a yield penalty.
- Further, fortified seeds also have more plant vigour, seedling survival, faster initial emergence and grain yield.

Further Challenges Accompanied With Biofortification of Staple Foods

- To expand research on prebiotics and iron absorption.
- Improve the efficiency with which minerals are taken up from soil into the roots of the plant.
- Increase the capacity of storage tissue to accumulate minerals in a form that does not impair vegetative growth and development of the plant.
- Reduce the level of antinutritional compounds such as phytic acid, which inhibit the absorption of minerals in the gut.

CONCLUSION

Scientific evidence shows that biofortification is technically feasible. Predictive cost-benefit analyses have shown biofortification to be important in the armamentarium for controlling micronutrient deficiencies. The challenge is to get consumer acceptance for biofortified crops, thereby increasing the intake of the target nutrients. With the advent of good seed systems, the development of markets and products, and demand creation, this can become a reality. Plant breeders need to be aware of both the major influence that agricultural research may have had on nutrient utilization in the past (e.g., the bioavailability of micronutrients in modern cultivars vs. bioavailability in traditional cultivars), and the potential of plant breeding for future improvements in nutrition.

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