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Biofortification: An Option for Nutrition Revolution

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SUMMARY

Malnutrition has emerged as one of the most serious health issues worldwide. The consumption of unbalanced diet poor in nutritional quality causes malnutrition which is more prevalent in the underdeveloped and developing countries. Thus biofortification of crop varieties is considered as one of the most sustainable and cost-effective approach where the nutrients reach the target people in natural form. Biofortification is an upcoming, promising, cost-effective, and sustainable technique of delivering micronutrients to a population that has limited access to diverse diets and other micronutrient interventions. The biofortified food crops, especially cereals, legumes, vegetables, and fruits, are providing sufficient levels of micronutrients to targeted populations. Although a greater emphasis is being laid on transgenic research, the success rate and acceptability of breeding is much higher. Besides the challenges biofortified crops hold a bright future to address the malnutrition challenge.

INTRODUCTION

Fortification is the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health. Biofortification is the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology. Biofortification differs from conventional fortification in that biofortification aims to increase nutrient levels in crops during plant growth rather than through manual means during processing of the crops. Furthermore, 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 (Garg et al., 2018). Furthermore, in the next few decades, a major population increase might take place in the developing world and with the changing climatic conditions; achieving food security will pose a greater challenge (Bazuin et al., 2011, Das et al., 2013). Thus, organizations such as the World Health Organization and the Consultative Group on International Agricultural Research (CGIAR) have included the development of nutritionally enhanced high-yielding biofortified crops as one of their main goals (Bouis, 2003).

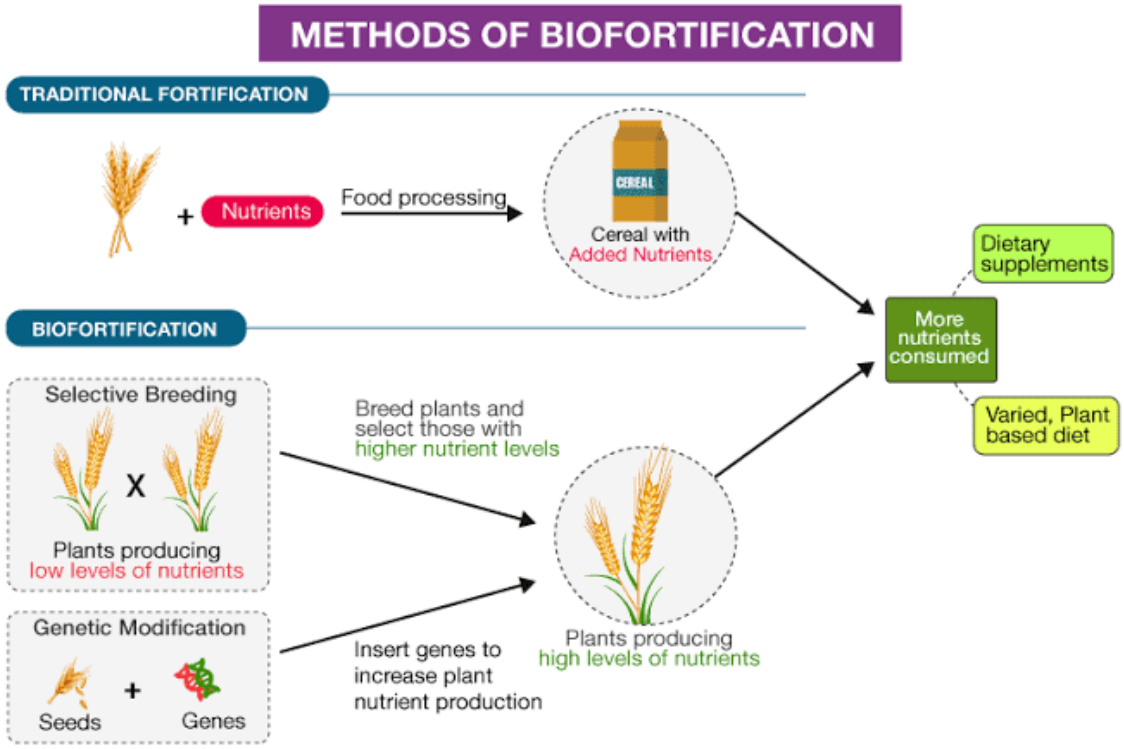
Alleviating Hidden Hunger: Interventions

The term "hidden hunger" has been used to describe the micronutrient malnutrition inherent in human diets that are adequate in calories but lack vitamins and/or mineral elements. The diets of a large proportion of the world's population are deficient in Fe, Zn, Ca, Mg, Cu, Se, or I, which affects human health and longevity and therefore national economies. Mineral malnutrition can be addressed by increasing the amount of fish and animal products in diets, mineral supplementation, and food fortification and/or increasing the bioavailability of mineral elements in edible crops. However, strategies to increase dietary diversification, mineral supplementation, and food fortification have not always proved successful. For this reason, the biofortification of crops through the application of mineral fertilizers, combined with breeding varieties with an increased ability to acquire mineral elements, has been advocated (Singh et al., 2016).

Methods of Biofortification

Selective breeding: Using this method, plant breeders search existing varieties of crops which are naturally high in nutrients and then crossbreed these high-nutrient varieties with high-yielding varieties of crops, to provide a seed with high yields and increased nutritional value. This method is prevalent at present, as it is less controversial than genetically engineering crops.

Genetic modification: Golden Rice is an example of a GM crop developed using genetic modification. It contains genes from a common soil bacterium Erwinia and contains increased levels of beta-carotene which can be converted by the body into vitamin A.



Seed Priming: Seed priming before sowing maximizes the natural potential of seed to set the plant for maximum yield potential with respect to both quality and quantity. Positive effects on the shoot and root growth of seedlings of wheat can be observed when treated with iron-oxide nanoparticles.

Advantages of Biofortification

Biofortification of crops ensures a regular access of nutritive food to the rural and poor population and in good proportions without any change in dietary patterns. The biofortification strategy seeks to take advantage 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. Nutritionally improved varieties will continue to be grown and consumed year after year, even if government attention and international funding for micronutrient issues fade. Moreover, biofortification provides a truly feasible means of reaching malnourished populations in relatively remote rural areas, delivering naturally fortified foods to people with limited access to commercially marketed fortified foods, which are more readily available in urban areas. In fact, biofortification may have important spin-off effects for increasing farm productivity in developing countries in an environmentally beneficial way. Mineral packed seeds sell themselves to farmers because, as recent research developments proved that seeds rich in trace elements are stronger to resist against biotic and abiotic stresses including diseases and environmental stresses (Bouis 2003). Further, fortified or enriched seeds also have more plant vigour, seedling survival, faster initial emergence and grain yield.

Limitations of Biofortification

The biofortification must not be considered as a sole sufficient method to that can fight back huge demon of hidden hunger. To address the root cause of malnutrition a "***top-down***" approach is needed i.e. social equality, education and financial security for complete eradication of hidden hunger. Secondly, biofortification is still in its developing stage and thus, a continuous research work and huge financial investments are required. This may lead to concentration and privatization of seeds in the hands of a few transnational corporations that exacerbates

the vulnerability of poor farmers. Thirdly, the concept of biofortification poses a threat to ongoing erosion of biodiversity. Overcoming this limitation could require an expensive certification process or the introduction of colour or appearance differences. Also, transgenic crops face more regulatory hurdles compared to their conventionally bred counterparts. Another major consideration that this approach lacks is missing the focus on the 9 to 24 month age group, where consumption of staple foods is very low and yet relatively higher micronutrient requirements. This limits the contribution of biofortification to micronutrient adequacy for this age group. Thus, researchers need to better understand the potential of biofortification impact on infants through the mother's micronutritional status. Biofortified foods can be as good as but not better than other foods and thus add just one more option to address nutrient insufficiency among the many that exist. (Bouis et al., 2011)

CONCLUSION

A strong bonding of agriculture to nutrition and health can provide sustainable solution to hidden hunger. Methods like fortification, supplementation and dietary diversification. Methods like fortification, supplementation and dietary diversification definitely play a significant role in countering the hidden hunger. Conventionally bred crops with enhanced nutritional value have proved successful in improving the health of individuals and also acceptable on wide scale. The mass acceptance of these crops needs more education and awareness sessions, although, genetically engineered crops do have received a clear scientific consensus on the safety issues. Combining conventional breeding with Marker Assisted Selection and genetic engineering strategies will be more effective and feasible for breeding desirable cultivars with higher yield, concentrated micronutrients, and improved micronutrients bioavailability in biofortification breeding programs. Complete removal of hidden hunger is possible neither through any individual scheme or method nor is a one day effort. Biofortification provides a feasible means of reaching malnourished populations in relatively remote rural areas, delivering naturally fortified foods to people. Agronomic biofortification is a short-term solution and represents a complementary approach to breeding. A comprehensive strategy involving multiple types of interventions adapted to conditions in specific countries and regions is required.

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