Biofortification and Biotechnology

Jessy Cristiana

Institute of Horticulture and biotechnology, India

INTRODUCTION

Unseen starvation is insidious. It affects individuals who may tend to eat sufficient amounts of food on the outside, mostly staple crops grown by small-scale farmers. Yet, an unseen hunger which influences human health and well-being of marginal people is masked by the calories of many staple crops. Unseen hunger refers to the condition of malnutrition where key minerals and vitamins that keep people healthy are absent from the body. It impacts more than two billion persons worldwide. Micronutrient deficiencies such as zinc, iron and vitamin A deficiencies may cause deep and irreversible damage like; blindness, stunting of growth, cognitive impairment, learning difficulties, poor working ability, and even early mortality.

Poverty and Malnutrition

Poverty forces people to eat single staple food to meet their simple appetite, but they do not supply the vital vitamins and minerals required for a stable body. During cycles of increasing food costs, this issue is compounded when eating a more nutritious diet is financially prohibitive, a situation even in the absence of financial disturbances.

Science of Biofortification

Traditional plant breeding started hundreds of years ago, is not new to the world. As early as 8-10 thousand years, farmers have been altering the genetic composition of the crops of their choice. Earlier farmers have selected plants and seeds based on their appearance and utility and saved future cultivation. When better understanding of genetic science emerged, in order to produce improved hybrids of plants, plant breeders were able to choose those desirable characteristics in a plant.

How to Achieve

Crop Biofortification can be achieved by using conventional breeding techniques, providing that genetic diversity between and within crops is an advantage for the desired trait (such as high protein content). In few staple crops like rice, traditional breeding techniques cannot be used to boost any complicated characteristics such as vitamin A, as there are no natural rice varieties rich in this vitamin. Almost all plants produce pro-vitamin A in green organs but not in grains. Limitation of conventional breeding also realized while breeding for vegetatively propagated varieties; potato and cassava. Moreover, traditional breeding can modify essential characteristics of the crops that consumers prefer, such as flavor. Therefore, the techniques of agricultural biotechnology and advanced genetic engineering (GM) constitute a very useful, complementary approach for producing more nutritious crops.

For increased content of proteins

Human get essential amino acids only through food as human cells do not produce these amino acids. Human body also not able to store amino acids therefore, daily intake is required. Plate of poor and marginalized is usually protein deficient due to high cost and availability of protein rich food. Rice, potato and cassava are good source of carbohydrate but very poor in protein. Sporamin A, storage protein of sweet potato; AmA1, seed albumin from *Amaranthus hypochondriacus*; ASP1, essential amino acids rich synthetic protein are most suitable candidates for biofortification. In rice and cassava, ASP1 has been successfully introduced and expressed, and efforts are ongoing to improve expression and increase protein accumulation levels in transgenic plants.

High vitamin A

In Africa and Southeast Asia, vitamin A deficiency, especially prevalent among infants, causes permanent blindness and increased susceptibility to illness and mortality. As mentioned earlier paddy plants produce β-carotene (provitamin A) in green parts but not in the seeds. With the help of genetic engineering golden rice was developed. It has two genes; CRT1 and PSY which encode phytoene desaturase and phytoene synthase. Both the genes are from different organisms, PSY is from daffodil while CRT1 is from a bacterium. In addition to rice, canola, carrots, cauliflower, potatoes and tomatoes were also produced with a higher β-carotene content.

Iron-rich crops

In nearly all nations, iron deficiency anemia affects more than 2 billion people, making iron deficiency the most prevalent micronutrient malnutrition globally by far. In fruits, wheat, and red meat, iron is found. The bioavailability of iron in plants, however, is limited, and in rice, the issue is exacerbated by the presence of phytate, a potent iron resorption inhibitor, and the lack of factors that improve iron resorption. Scientists have also had to increase the content of iron in grains, decrease the phytate level, and incorporate resorption-enhancing influences. The expression in the endosperm of rice of iron storage protein ferritin from French beans and soybeans results in a 3-fold increase in iron in seeds.

Tomatoes with increased folic acid

In women, especially over 30 years of age develop folic acid deficiency which is in the core of anemia in pregnant women from marginal families. Most of the folic acid available in food is in the form of folate. As tomato is another important component in cooking and is a chap source of folate scientists have decided to engineer tomatoes with higher folate content. To achieve this genes catalyzing folate precursor synthesis were overexpressed.

CONCLUSION

Biofortified developed by any means (conventional or genetic engineering) are not a solutio. A adequate and diverse diet for the world's population remains the overarching priority of global nutrition. Biofortified crops, however, can supplement current approaches with micronutrients and can have a tremendous effect on the lives and health of millions of people, including those most in need.