Chapter 6
Addressing Hidden Hunger via Improving Soil Health and Crop Nutrients Through Nanofortification

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ABSTRACT

Micronutrient deficiency represents a significant challenge in developing regions, particularly in Asia and Africa, where agricultural systems often yield foods lacking essential vitamins and minerals. These nutrient-poor diets are commonly consumed by low to middle-income families, exacerbating disease burden at global level. The nutritional health crisis stems from ineffective food systems failing to provide sufficient nutrients, especially to vulnerable populations. Many strategies such as food fortification, dietary diversification, nutritional education supplementation have been implemented for addressing this issue. Additionally, advancements such as nano-chelating technology offer promising solutions by reducing reliance on chemical fertilizers and enabling the crop biofortification along with crucial micronutrients. Biofortification involves crop breeding to enhance their nutritional content, has emerged as a key

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approach in recent years. By enhancing the vitamin and mineral profiles of crops, these interventions aim to improve overall soil and human health.

1. INTRODUCTION

A significant portion of the global population, approximately one-sixth, is grappling with a pressing issue of hunger exacerbated by malnutrition, presenting a dire challenge for human civilization (Singh et al., 2021). Termed "hidden hunger," the critical predicament predominantly afflicts impoverished and developing nations. Despite consuming seemingly sufficient quantities of food, individuals may still suffer from inadequate intake of essential vitamins and minerals, crucial for proper bodily function. Staple crops, while providing calories, often mask this invisible hunger, impeding proper growth and development. Globally, around two billion people endure micronutrient deficiencies, with pregnant women and children under five facing the highest risks of adverse health effects. Micronutrient deficiencies contribute significantly to mortality and morbidity, imposing substantial health and economic burdens on developing nations. Despite the challenges, targeted interventions such as industrial fortification, food supplementation and nutrition education programs are being implemented to address the issue. Recently, a plant science-based approach has emerged as a promising strategy useful for enhancing the micronutrient content of the staple food crops, known as biofortification (Zhao & McGrath, 2009). By breeding or genetically modifying crops, biofortification aims to increase their nutritional value, potentially offering substantial health and economic benefits, particularly to impoverished populations. While the potential benefits of biofortification are evident, the widespread release and adoption of biofortified crop varieties remain limited. Plant scientists have been diligently working on biofortification for years, but few varieties have been successfully introduced. As such, the true impacts of biofortification are yet to be fully realized. This chapter will delve into the current status of biofortification in India and other developing countries, examining the plant science-based aspects of this approach.

World's one-sixth population is facing major challenge with context to hunger due to malnutrition that has created a critical situation in front of human civilization (Singh et al., 2022; Singh, Rajput, Varshney, et al., 2023). This critical situation is called as "hidden hunger" and this issue has affected many poor as well as developing countries. Nearly about 30 vitamins and minerals that the human body is incapable of manufacturing in adequate amounts by its own are important. People should ideally try to meet their vitamin and mineral needs by their diet rather than the supplements. People may even appear to be consuming an adequate amount of food but the calories of staple crops tend to disguise an invisible hunger that impacting the growth and development of people. Globally, about two billion people are drastically affected by the deficiency of micronutrients. The consequences are much severe and long-lasting, moving from one generation to another generation. Pregnant women and children under the age of five have micronutrient deficiency, resulting into high risk with context to health.

Micronutrient deficiencies can often lead to mortality as well as morbidity causing immense burden on health. This burden on the health can even cause significant economic costs in the developing world. Moreover, there are some more targeted micronutrient interventions that may be implemented. It includes food supplementation, industrial fortification, and nutrition education programs. A plant science-based approach has been proposed to be a strategy for breeding and genetically modified staple food crops to get higher micronutrient contents (Hafeez et al., 2013; Monreal et al., 2015; Singh, Rajput, Pandey, et al., 2023; Welch, 2002). This enhancement in the plant science-based nutrition approach is termed as