

Transforming food systems for health and sustainability.

Alexander Schmidt*

Institute of Food Science, Berlin University, Germany

Introduction

Genomic selection and gene editing, specifically CRISPR-Cas technology, offer transformative potential for developing crops with superior nutritional profiles and increased resilience. These biotechnological tools are crucial for creating sustainable food systems capable of addressing global food security and improving human nutrition in the face of climate change and population growth [1].

Understanding dietary patterns globally connects to sustainable food systems and diverse health outcomes. Defining what constitutes a sustainable diet is complex, and nutritional epidemiology must integrate environmental impacts with health benefits when formulating dietary guidelines [2].

Achieving transformative change in global food systems demands critical pathways toward a healthier, more equitable, and environmentally sustainable future. This involves recognizing the deep connections between dietary patterns, agricultural practices, and social determinants, advocating for systemic solutions that tackle climate change, biodiversity loss, and nutritional inequalities concurrently [3].

Novel food biotechnologies are emerging with the goal of beneficially modulating the human gut microbiome, presenting implications for health promotion and disease prevention. Strategies like engineered probiotics, prebiotics, and postbiotics demonstrate how precision nutrition, guided by biotechnology, can optimize gut health and improve systemic well-being [4].

Food environments, encompassing everything from retail practices to policy, significantly influence health and sustainability outcomes. Nutritional epidemiology plays a vital role in analyzing these intricate interactions, underscoring the need for multi-faceted interventions. Such efforts aim to create equitable access to healthy and sustainable food choices, thereby reducing diet-related health disparities [5].

Mycoprotein production represents a promising area of development as a sustainable and nutritious alternative protein source within evolving food systems. Advances in fermentation processes, its nutritional advantages, and its environmental footprint position

mycoprotein as a key component for addressing future food security and facilitating dietary shifts [6].

Ultra-processed foods (UPFs) have been linked to an increased risk of multimorbidity, a connection explored through systematic review and meta-analysis, with insights from nutritional epidemiology. The significant public health implications of high UPF intake highlight the urgent need for dietary interventions and changes within food systems to lessen their adverse effects on the chronic disease burden [7].

Food waste valorization is essential for fostering a circular economy within food systems. This review outlines current trends and challenges, showcasing innovative biotechnological approaches to transform food waste into valuable products, yielding both environmental and economic benefits by enhancing resource efficiency and sustainability [8].

Biofortification stands as a critical food biotechnology strategy addressing micronutrient deficiencies, known as "hidden hunger," on a global scale. Genetic engineering and conventional breeding are detailed as methods for enhancing the nutritional content of staple crops, emphasizing biofortification's role in improving public health outcomes and strengthening nutritional security within diverse food systems [9].

Developing dietary guidelines for planetary health requires critical examination of various methodologies, where nutritional epidemiology offers crucial insights to balance human health and environmental sustainability. Policy implications for transforming global food systems are discussed, aiming to promote diets that are both nourishing and environmentally responsible, advocating for integrated approaches to food and health policy [10].

Conclusion

The global challenge of food security and human nutrition is being addressed through innovative approaches spanning biotechnology, public health, and environmental sustainability. Genomic selection and gene editing, including CRISPR-Cas technology, offer potential for creating resilient, nutrient-dense crops, crucial for sus-

*Correspondence to: Alexander Schmidt, Institute of Food Science, Berlin University, Germany. E-mail: alexander.schmidt@berlinuniv.de

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tainable food systems. Mycoprotein production and biofortification further contribute as alternative protein sources and strategies to combat hidden hunger. Concurrently, understanding dietary patterns, particularly the impact of Ultra-processed Foods (UPFs) on multimorbidity, is critical. Nutritional epidemiology plays a vital role in developing dietary guidelines that balance human health with environmental impacts. Efforts extend to transforming food environments and valorizing food waste, fostering a circular economy. Achieving a healthier, more equitable, and sustainable future requires systemic changes that integrate food and health policies, addressing climate change, biodiversity loss, and nutritional inequalities.

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