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Editorial: The future of foods

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Editorial on the Research Topic The future of foods

Food production systems are currently facing a redefining moment filled with challenges and opportunities with the potential of rendering them more wholesome and sustainable. Thus, the future of foods can take many paths, from the product itself through the expanded use of new ingredient sources (e.g., grass, microalgae, acorns, insects, etc.) or by-products of the food industry (e.g., fruit pomace or brewer's spent grains), the development and optimization of novel processing technologies (e.g., additive manufacturing, precision fermentation, cell cultures and emerging processes) and the advancement of disruptive techniques for data management, integration, and food systems virtualization (e.g., machine learning, Generative AI (gen AI), large language models (LLMs) and digital twins).

Looking at the future of foods in a way that allows overcoming current challenges, and taking advantage of its opportunities, requires many considerations, such as factoring in customisation, security, extensive digitalization, and social, environmental, economic and health impacts of innovations. In particular, the development of new foods with sustainability in mind (e.g., alternative proteins) must consider health benefits as well as indulgence and sensory appeal, and these factors must be weighed against the cost of production processes and the ultimate cost to the consumer.

Contributing articles to this timely Research Topic explored the future of our food production systems, addressing key challenges ranging from food security affected by war and the political climate in grain-producing countries, or the impact of science and technology on food security in Ukraine, a hub for food and grain production. They also tackled concerns raising in other developing countries, specifically related to food safety practices in elderly facilities and the impact on foodborne disease outbreaks in South Africa (Tshegofatso and Ntsoaki) which can be generalised and extended worldwide as ageing populations are becoming a reality in many countries.

New unusual and disruptive food sources, such as cell-cultured or cultured meat, are considered from the point of view of increasing the sustainability of the process by using agricultural waste as low-cost scaffolds for cultured meat (Perreault et al.), to the detail of the molecular scale in a review by Azhar et al. and specificities, such as the impact of microplastics on fish muscle cell proliferation and differentiation (Sun et al.).

Other alternative soilless cultures and carbon fixers, such as spirulina and chlorella microalgae as food ingredients with high nutritional value, and proven sustainability, are covered in detail. In the study of [Fratelli et al.](#), the incorporation of spirulina biomass (SB) and spirulina residual biomass (RB) into wheat bread after extraction of C-phycoerythrin was explored. They replaced 3% of wheat flour with either SB or RB to produce wheat bread with improved volume, high antioxidant capacity while also reducing the risk/presence of chemical contaminants (i.e., heavy metals). Baking with these novel ingredients also improved the digestibility of spirulina protein. [Melcher et al.](#) analysed and compared eight different commercial Chlorella products from distinct EU suppliers based on the identity of the production strain, macro- and micronutrient profiles, sensory properties, as well as microbial loads. The authors observed significant variations between white, yellow and green Chlorella products and concluded that advancing nutrient- and sensory comparative data sets could be helpful in the development of innovative foods.

From a microbiological perspective, the novelty of screening natural compounds for prophage induction in the control of pathogenic bacteria in food is extensively covered by the contribution of [Tompkins et al.](#) The authors emphasized the need to find natural approaches to combat pathogenic bacteria in food, rooted on the drive for clean-labels and the urge to maintain food safety. They proposed a high-throughput luminescent prophage induction assay as a valuable tool for the initial screening of natural bioactive compounds that have the potential to improve food safety and quality by inducing prophages. However, they recognised that further research is needed to understand the mechanism of bacterial cell death and to establish optimal concentrations for prophage induction in the context of food preservation.

The manuscript of [Bazhal and Koutchma](#) discussed the Impact of science and technology development in Ukraine on food security in the world. The solutions to enhance the stability of the grain and food supply are reviewed while aiding in reducing food and grain losses, improving food safety, and developing novel processing technologies. Another manuscript by [Mottaleb and Govindan](#) applied an ex-ante impact assessment procedure to examine the potential repercussions of the Russia-Ukraine conflict on the consumption and wheat trade and food security. In order to avoid hunger and supply shock from related disasters in the future, this study urges to search for alternative sources of grains, including wheat, particularly in import-dependent, resource-poor countries.

All these contributions to the Future of Foods Research Topic are novel and thought-provoking enough to attract your attention. Still, one manuscript, in the digital area remains, that will definitely convince you that this Research Topic gathers most of the key issues about the future of our food - Virtualisation of food: applications and perspectives towards optimising food systems. In this mini-review, [Chen et al.](#) discussed digital objects (models, ghosts and

twins) as monitoring and improvement tools for food systems. By dissecting virtualisation requirements, including data collection and analysis using complementary techniques reaching from Machine Learning to physical models, the authors shed light on the applicability of digital objects at several levels, from product to distribution channels and their dynamic, economical and effective roles to inform the design and performance of food products, manufacturing processes and supply chain logistics to achieve healthy and sustainable food systems.

The editors are certain that this Research Topic of articles is a must-read for any aspiring or established food scientist/technologist/engineer.

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