Food and Agriculture Organization of the United Nations

FOOD SAFETY FORESIGHT TECHNICAL MEETING

13 - 17 NOVEMBER 2023

Food Safety Foresight Technical Meeting on New Food Sources and Production Systems

FAO, HQ, Rome, Italy: 13 – 17 November 2023

SUMMARY AND CONCLUSIONS

Issued in November 2023

The Food Safety Foresight Technical Meeting on New Food Sources and Production Systems was organized by the Food Systems and Food Safety Division of FAO as part of the activities of the Food Safety Foresight Programme. The main objective of the meeting was to evaluate the food safety issues associated with *i)* plant-based food products, *ii)* new applications of precision fermentation, and *iii)* 3D food printing. The meeting also aimed to illustrate, through a foresight exercise, how the future landscape of new foods and production systems may look like.

The meeting was attended by 17 experts who came from different geographic regions and brought a wide range of expertise pertaining to the subject of the meeting. The experts were supported by resource persons who provided additional knowledge and technical inputs.

This document summarizes the key conclusions of the meeting and outlines some data gaps and research needs pertaining to the three focus areas. The full report, including the deliberations at the meeting, will be published in the coming months.

The meeting participants are listed in Annex 1 of this summary report. Dr Cormac McElhinney served as Chairperson and Dr Lynne McLandsborough as Rapporteur.

More information on FAO's work on foresight in food safety and the area of new food sources is available at:
https://www.fao.org/food-safety/scientific-advice/foresight/en/

Background

New food sources and production systems (NFPS) can play a critical role in the transformation of our agrifood systems by diversifying our current ways of producing food. Therefore, it is important that FAO monitors this space, keeps gathering relevant information and disseminates sound technical advice on NFPS, particularly in the context of the food safety aspects of NFPS. Based on this objective and aiming to also build on the previous work of FAO in the area (FAO, 2022), the Food Safety Foresight Programme of the Food Systems and Food Safety Division of FAO organized a meeting to discuss the food safety aspects of a few select NFPS. At the meeting foresight approaches were used to explore the possible future landscape of NFPS. Applying foresight approaches in agrifood systems, and particularly in food safety, will allow FAO and its members to prepare for potential emerging threats, disruptions, and challenges, while also being ready to optimize opportunities that may arise in the medium- to long-term future.

NFPS is a fast-expanding, innovative sector that covers a range of areas (FAO, 2022). With promising potential, the NFPS sector is here to stay with certain products already on some supermarket shelves. However, as the term 'new' implies the sector will be subject to constant evolution and development, making it important for FAO to proactively take stock of the emerging areas and evaluate their associated opportunities and challenges.

One of the key challenges is the identification of food safety hazards linked to various areas under NFPS, which underpins food safety risk assessments, and can subsequently guide the development of relevant standards and/or other management measures needed to propel the sector forward. FAO has previously looked at the food safety implications of some of the different areas under NFPS, for example edible insects (FAO, 2021), seaweeds (FAO and WHO, 2022a) and technological innovations such as cell-based food production (FAO and WHO, 2023a); and as such these areas were not discussed in this meeting.

With strong momentum likely foreseen for the sector, timely evaluation of food safety issues will enable the sector to reach full potential while protecting consumer health and ensuring fair trade. In fact, the NFPS sector is also receiving attention from the Codex Alimentarius Commission (CAC) (FAO and WHO, 2021; 2023b). As this sector evolves, other emerging areas within NFPS may be addressed in the future work of FAO.

Scope and objectives

The scope of the meeting was to discuss the food safety issues of three areas in the NFPS space – plant-based food products, new applications of precision fermentation and 3D food printing. These areas were chosen based on their current popularity, and their relevance to food safety. While it is acknowledged that the focus areas are currently not at parity in terms of their adoption globally, these areas were chosen also considering their future potential for growth. Deliberations around the definitions and terminologies associated with these three areas were outside the scope of this meeting. However, some working explanations of certain terminologies, as utilized in the meeting, are provided below to give relevant context.

In addition to food safety, the impacts of such NFPS on the current agrifood systems can be felt at multiple levels, including economic, environmental, social, and nutritional. As these other considerations are relevant, they were briefly covered at the meeting, but detailed discussions around these aspects were beyond the scope of this meeting.

Through a foresight exercise, the meeting also aimed to *i)* identify emerging innovations in the NFPS space; *ii)* describe their opportunities and challenges (including the feasibility and impacts); *iii)* and broadly explore the various steps needed to optimize opportunities and circumvent the challenges identified. The foresight exercise was conducted in two phases, via a Delphi survey held virtually in advance to the meeting, and through interactive in-person sessions where the responses from the Delphi survey were described and discussed in more details.

Conclusions and way forward

Overarching conclusions

- In general, the food safety hazards associated with the NFPS under consideration are similar to those linked with conventional foods. However, new production and processing technologies may introduce conditions that are unique to a particular NFPS and may require close attention from a food safety perspective.
- When conducting safety assessments on new food sources, the intended uses of final products should be a key consideration.
- Provisions contained in the Codex standards are applicable to new food sources and new production systems. Codex Alimentarius has developed and continuously works on standards for all types of foods, whether processed, semi-processed or raw. The standards include provisions on food hygiene, food additives, residues of pesticides and veterinary drugs, contaminants, labelling and presentation, methods of analysis and sampling, and import and export inspection and certification. However, there may be some unique food safety aspects and impacts of NFPS which may need further risk analysis and could lead to revision of existing standards and/or the drafting of new ones.
- The foresight exercise conducted at the meeting highlighted the importance of applying forward-thinking approaches to stay abreast of emerging areas with food safety implications, such as within the sector of NFPS.
    - Such foresight approaches promote strategic preparedness among the food safety community to not only proactively address challenges but also to optimize opportunities that such emerging areas may bring.

Plant-based food products[1]

- Food safety implications for plant-based food products depend on how the plants are grown, harvested, stored, transported, and processed to obtain the functional ingredients.
- While new plant-based food ingredients can provide sustainability benefits, new hazards may be introduced if food products are based on plants not traditionally used for food purposes, especially if the plant is a primary component, and increased exposure of consumers to known hazards may also occur.
    - Of concern is the potential for increased consumer exposure to toxins, agrochemicals, and heavy metals, due to the nature of plant production. Allergenicity resulting from the consumption of new proteins or increased consumption of proteins from plant-based sources may also require specific assessment.

[1] For the purpose of this meeting, plant-derived products that generally mimic animal-derived foods such as meat, seafood, fish, eggs and dairy products are collectively called plant-based food products.

- Consumers may perceive plant-based food products as microbiologically safer than their conventional animal-derived counterparts, and so may not appropriately handle the products to the same extent, including cooking and storage. This may lead to additional food safety risks which could be mitigated by proper labeling and consumer education.

Precision fermentation[2]

- Precision fermentation is not a new technology and has been used to produce various food ingredients for decades. Nonetheless, this field is rapidly evolving, and novel technologies and applications may introduce food safety challenges which require ongoing risk assessment from the food safety community.
- Safety considerations around new applications of precision fermentation include allergenic risks of proteins that either mimic existing allergens, are altered in a way that may be allergenic, or may not previously have been identified as allergens. Appropriate safety assessments, labelling and consumer messaging will continue to be important tools in addressing allergen risks.
- The variability in purification steps and varying target purity of final products may introduce food safety challenges.
- Moving from laboratory to industrial scale is required during the commercialization of precision fermentation produced ingredients. This scale-up may introduce challenges that are relevant to food safety, particularly when sourcing alternative raw materials for feedstock, ensuring strain stability, and developing scale-appropriate hazard control measures.
- Effective monitoring of precision fermentation manufacturing in line with established safety management guidelines is an important component in preventing contamination during manufacturing.

3D food printing[3]

- Although 3D food printing (3DFP) is a new food production method, most of the potential hazards associated with it are common to other food production processes and can be addressed by existing food safety risk assessments and following appropriate hygiene protocols.
- 3DFP can be an enabling technology for other food innovations, which themselves may have food safety implications.
- As with other food processing equipment:
    - hygienic design principles should be used in the development process of the machine and associated consumables. This will help to prevent potential food safety issues.
    - consumer education around hygienic use of at-home 3D food printers is important to minimize potential food safety risks.

[2] Precision fermentation does not have an internationally agreed definition and therefore the working definition has been set for the purpose of this meeting as the controlled cultivation of modified microbial cells to produce specific food products and ingredients.

[3] Additive manufacturing (AM) is a process of building three-dimensional objects from pre-programmed 3D digital models by adding materials in a layer-by-layer fashion using various techniques that allow a precise spatial arrangement. This process may include extrusion or 3D printing with food ingredients.

Data gaps and research needs

Plant-based food products

- Research on the safety of animal-derived food products may not always fully translate to plant-based food products which may need to be assessed further. For example, there is limited microbiological research specific to plant-based food products, such as on the types and sources of spores and the potential for pathogenic bacteria survival and growth, dependent upon packaging conditions and holding temperatures throughout the distribution chain.
- Gaps in allergenicity research include food safety risks from increasing exposure to plant-based proteins and potential for food allergies when plants not traditionally used for food purposes are utilized in plant-based food products.
- There is research on mycotoxins in plant-based food products, but limited knowledge in the area of the presence of masked and emerging mycotoxins in these foods.
- Environmental contaminants, like per- and polyfluorinated substances (PFAS), residues of pharmaceutical or veterinary drugs, heavy metals, and/or micro- and nanoplastics, in plant-based food products may need further research.
- The toxicology of plant secondary metabolites (particularly of plants not traditionally used for food purposes) is an area where further research will be important.

Precision fermentation

- Lack of detection techniques for real-time, cost-effective appropriate monitoring of specific contaminants during precision fermentation remains an important gap.
- Additional research on allergenicity to inform safety assessment could be valuable in evaluating products produced via precision fermentation.

3D food printing

- There is limited information on the impact that some new post-printing methods, such as laser cooking, applied to provide structure stability to 3D printed foods, may have on food safety.
- Gap exists in our understanding of how consumers are likely to interact with 3D food printing devices intended for home use, related consumables, and their products, and how they will maintain required hygienic practices.

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Annex 1: List of participants

EXPERTS

Luciana Pimenta Ambrozevicius, Ministry of Agriculture and Livestock, Brazil

Sampathkumar Balamurugan, Agriculture and Agri-Food Canada, Canada

Bernard Bottex, European Food Safety Authority (EFSA), Italy

Wei Ning (William) Chen, Singapore Future Ready Food Safety Hub and Nanyang Technological University, Singapore

Antonio Derossi, University of Foggia, Italy

Jason Dietz, US Food and Drug Administration (FDA), United States of America

Gijs Kleter, Wageningen Food Safety Research, Netherlands (Kingdom of the)

Angela Parry-Hanson Kunadu, University of Ghana, Legon, Ghana

Cormac McElhinney, The Food Safety Authority of Ireland (FSAI), Ireland

Lynne McLandsborough, University of Massachusetts Amherst, United States of America

Milena von und zur Muhlen, Food Standards Agency (FSA), United Kingdom of Great Britain and Northern Ireland

Raffael Osen, Singapore Institute of Food and Biotechnology Innovation (SIFBI), Singapore

Katie Overbey, US Food and Drug Administration (FDA), United States of America

Simone Moraes Raszl, World Health Organization (WHO), Switzerland

Yong Quan Tan, Singapore Food Agency (SFA), Singapore

Diego Varela, Chilean Food Safety and Quality Agency (ACHIPIA), Chile

Wu Yongning, China National Center for Food Safety Risk Assessment (CFSA), China

RESOURCE PERSONS

David Crean, Global Food Safety Initiative, United Kingdom of Great Britain and Northern Ireland

Anne Gerardi, Global Food Safety Initiative, France

Graziele Grossi Bovi Karatay, Good Food Institute (GFI), Brazil

Ludovica Verzegnassi, SSAFE, Switzerland

SECRETARIAT

Vittorio Fattori, Food and Agriculture Organization of the United Nations, Italy

Markus Lipp, Food and Agriculture Organization of the United Nations, Italy

Keya Mukherjee, Food and Agriculture Organization of the United Nations, Italy

Magdalena Niegowska Conforti, Food and Agriculture Organization of the United Nations, Italy