Deliverable **6.7**

FOODSAFER

Practice Abstracts batch 1

#EVERYBODY'S BUSINESS

Deliverable D6.7: Practice Abstracts – batch 1

Work package number and title	WP6: Project Management and Pathway to impact and participation
Lead-beneficiary	FFoQSI (GFRS)
Work package Leader	FFoQSI
Contributors to deliverable	IRIS (Cristina Fernandez)
Relevant Task	Related to all tasks
Participants	WU, AIT, UGent, QUB
Dissemination Level	Public
Due Date (month)	M18 – 31 March 2024

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1. Introduction

This deliverable target <u>10 practice abstracts</u> to allow checking the appropriateness of the content and text for end-users.

Communicating about projects, activities and results is much easier through the use of a common format. The EIP-AGRI common format facilitates knowledge flows on innovative and practice-oriented projects from the start till the end of the project. The use of this format also enables farmers, advisors, researchers and all other actors across the EU to contact each other.

The EIP-AGRI has been changed into the EU-CAP Network.

(https://eu-cap-network.ec.europa.eu/index_de)

The idea is to use a common format of presenting relevant (best) practices, project results, know-how a.m.m. to provide farmers, advisors, FBOs, food risk managers, etc. (target groups of FoodSafeR) with short and concise practical information (so-called practice abstracts). Links to audio-visual material (e.g. photos, films, etc.) can be included and linked.

Link to the Good Practice database: http://tinyurl.com/yu6vufdk

FoodSafeR will insert their practice abstracts into this database after the acception of this deliverable and make the best practice examples public.

The FoodSafeR practice "abstract" is structured into the following main parts:

1. Objective of the project in English considering what problems/opportunities are addressed in the project and are relevant for practitioners/end-users.
2. Short summary for practitioners
    a. Introduction
    b. Material and Methods
    c. Summary of the findings
3. Resources: References, Links, etc.

The first bath of practice abstracts gained within reporting period 1 (M1 – M18):

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Unpasteurized spontaneously fermented vegetables: A food safety perspective

Introduction

Fermentation is one of the oldest techniques used to preserve foods, incl. vegetables. Pasteurized fermented vegetables, produced by controlled fermentation, are preferred from a food safety perspective. However, considering the rising trend in fermented vegetable technology (food and beverages) of recent years, together with the trend to more local consumption, the interest in fermented vegetables (mainly unpasteurized, spontaneous lactic acid fermented vegetables) has increased. This research may support providing guidance on proper fermentation practices, ensuring food safety.

The Horizon Europe FoodSafeR project aims to establish a joined-up approach to the identification, assessment and management of emerging food safety hazards and associated risks. Within Work Package 2 (WP 2), the focus is mainly on microbiological risks in novel and alternative food networks and, in particular, those food processes or products or food distribution or commercialization routes that are innovative and often still lack knowledge on hazard identification or are a grey zone in food safety regulations. All case studies in WP2, including "unpasteurized fermented vegetables set available in restaurants, catering shops, popup or online shops", were selected within this context and are subject to interest by the consumer due to their perception as fancy, healthy, and sustainable.

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Materials and Methods

Unpasteurized spontaneously fermented vegetables were sampled in Ghent (Belgium) and Vienna (Austria), both in the local and through online shops. The samples were analysed for microbiological quality and food safety parameters (lactic acid bacteria as beneficial bacteria, Enterobacteriaceae and Escherichia coli as process hygiene indicators, Listeria monocytogenes as a foodborne pathogen etc.), both at the day of purchase and the end of the shelf-life. In addition, (i) data on intrinsic (acidity, water activity, etc.) and extrinsic characteristics (type of packaging, storage temperature) of the food product, and (ii) information on the label (the shelf life, reasonably foreseen handling, and health claims) were collected for all samples taken.

Resources:

FSAI. (2021). Guidance Note No. 37: Good Manufacturing Practices for the Production of Ready-to-eat Unpasteurised Fermented Plant-based Products. https://www.fsai.ie/publications/gn-37-good-manufacturing-practices-for-the-product

Battcock, M., & Azam-Ali, S. (1998). Fermented Fruits and Vegetables. A Global Perspective. In Fermented Fruits and vegetables.A Global perspective. Food and Agriculture Organization of United Nations. https://www.fao.org/3/x0560e/x0560e00.htm

Van Beeck, W., Verschueren, C., Wuyts, S., van den Broek, M. F. L., Uyttendaele, M., & Lebeer, S. (2020). Robustness of fermented carrot juice against Listeria monocytogenes, Salmonella Typhimurium and Escherichia coli O157:H7. International Journal of Food Microbiology, 335, 108854. https://doi.org/10.1016/J.IJFOODMICRO.2020.108854

Summary of the findings

When fermenting vegetables, often mentioned key factors which ensure the safety of the product are (i) the use of starter cultures, and (ii) a heat treatment. However, these control measures will affect the bacterial biodiversity and probiotic quality and may result in an altered lactofermentation. Therefore, spontaneous fermentation is often preferred. However, the reliance on indigenous microbiota can affect safety and predictability of the fermentation process because the microbial load and activity of naturally present lactic acid bacteria that reside on the (shredded/cut) vegetables can be variable. It has been observed in the FoodSafeR project experimental research work that during this phase it is crucial to follow up on the following factors. A good practice is to see that:

(i) Washed vegetables are completely submerged in (3-4%) saltwater brine until the jar is almost full and the jar is tightly closed

(ii) The acidification (pH drop) by the lactic acid bacteria should result in a pH < 4.2

(iii) The fermentation time should be at least 14 days (usually at 18-21°C under anaerobic conditions)

(iv) The sensory attributes are acceptable: check for off-odours or visual mould formation.

If one of these conditions has not been met, discard the product as not only the quality, but also the safety of the spontaneous fermented vegetable product cannot be guaranteed.

Furthermore, during the FoodSafeR project survey, most (but not all) market samples have shown to comply with a pH level lower than 4.2. On a few occasions, persisting Enterobacteriaceae indicated either a too slow pH-decrease with related favourable initial growth conditions or a too short fermentation time.

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Combating the illegal addition of toxic chemicals to food that poses unchecked food hazards

Introduction

Adulteration of turmeric for economic profit using the toxic "lead chromate" is an emerging global health concern. This study aims to provide a comparative evaluation of energy dispersive X-ray fluorescence spectroscopy with a focus on matrix optimised calibration approaches. Furthermore, the prevalence of lead chromate adulteration in turmeric powder sourced from the main supply chain categories, including branded, open/market/non-branded both within India and international products, was investigated. Three different analytical techniques were used to assess the adulteration in the turmeric samples using 3 different calibration approaches (Empirical, Fundamental Parameter and Matching Library). Results showed that handheld XRF using a generic geochemical calibration gave good results and can be used for sample screening as well as quantitative analysis for higher Pb values, having an analysis time of 90 seconds without any extensive sample preparation. Branded samples had the highest incidence of Pb enrichment, highlighting the supply chain's vulnerability for domestic branded products which is counter to the well documented situation in Bangladesh. Overall, this study presents a thorough, in-depth assessment of the effectiveness of different ED-XRF methods. By addressing both methodological optimization and real-world prevalence, the study contributes to the enhancement of analytical techniques and promoting a safer and more transparent turmeric market.

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Materials and Methods

Around 78% of the world's turmeric production originates from India. For this study, 12 different sites were selected with 9 of them being major producers (Minhas, 2022). 270 dried turmeric powdered samples were collected categorised as follows: (N-53) Open /Market samples, (N-199) branded samples and (N-18) international samples. We extended our analysis by including samples from 3 majorly used e-commerce platforms. Also, 124 international and and 80 branded samples samples were included, reaching the 474 samples in this study.

Analysis was carried out by placing sample cups on the nose of the portable XRF covered with an X-ray shielding lid using the empirical factory calibration settings.

Resources:

European Commission (EC), 2021. Commission Regulation (EU) 2021/1317 and 2021/1323 Has Amended Regulation (EC) No 1881/2006, as Regards Maximum Levels of Cadmium and Lead, Respectively, in Certain Foodstuffs (Text with EEA Relevance).

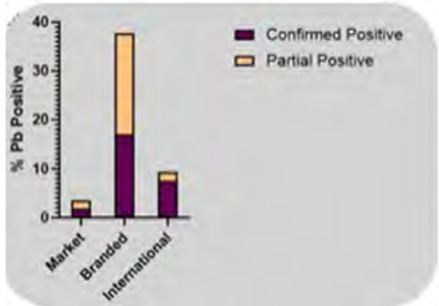
Food Safety and standards (FSSAI), 2011. Food Safety and Standards (Contaminants, Toxins and Residues) Regulations, 2011.

Minhas A., 2022. India: Turmeric production volume by state 2022, Statista.

Shaktawat, Y., 2018. Asia's largest ever wholesale spice market is right here in this city, Curly Tales.

Summary of the findings

The utilization of PXRF as both screening as well as quantitative technique revealed 53 positive results. These results were further categorized into two distinct classes: "partial positive," indicating results that were below the LOD of PXRF (2mg Pb /kg) marked as ND but still giving a Pb value during analysis and "confirmed positive," indicating results that showed a Pb value above specified regulatory limits of 1.5 mg/kg.



PXRF showed a rapid and reliable way for qualitative and semiquantitative analysis of toxic elements like Pb and Cr using inbuilt default calibration. However, despite its high LOD, PXRF holds the potential to be used for real-time analysis for low-resourced countries like India, where regulatory limits are higher (10 mg Pb/kg) as compared to EU (1.5 mg Pb/kg, EC, 2021) in turmeric for lead (FSSAI, 2011). While PXRF holds as a promising, efficient technique to be used for on-field screening of toxic metal adulteration in turmeric, BXRF showed a potential to become a 1st line of validation for PXRF results. However, these measures cannot entirely replace ICP-MS but can be able to decrease the frequency of its utilization.

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Holistic approach for identification of emerging food safety risks

Introduction

With the General Food Law (EC/178/2002), FBOs (Food Business Operators) are clearly responsible for food safety of the produce at their enterprises. Safe food is food that is produced, stored, and prepared in such a way that, upon consumption, consumers are not affected by either acute or chronic adverse health effects. Unsafe food means food contaminated with a microbiological or chemical (or physical) hazard that can result in negative effects for human and animal health.

Food producers and governmental agencies have a full packet of food safety procedures in place, consisting of -amongst others - regulations, food safety management systems and monitoring programs. While such systems function well under known stable circumstances, the food system and its environment are changing fast, and food safety risks can easily emerge and go out of control (become super risks).

Food safety risk management thus needs to be adapted to be able to cope with the multiple drivers of change, which may arise from within and outside the food supply chain. Examples include political changes, climate change, consumer trends (Figure 1).

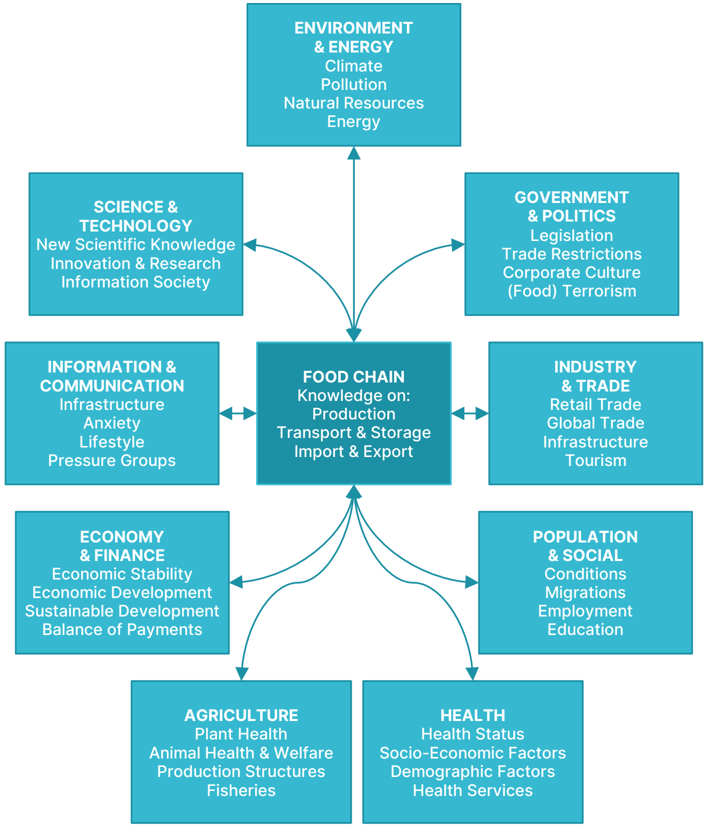

Figure 1. Holistic approach for identification of emerging risks in the feed or food supply chain, derived from [1]

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Emerging food safety risk identification

The drivers can lead to the emergence of food safety risks. Emerging food safety risk comprise 3 groups[2]:

1. Known hazard that has reemerged or reintroduced in the food chain, e.g., due to changes in practice or termination of certain preventive measures;
2. Relatively new or unknown hazard, e.g., discovered by new or more sensitive detection techniques
3. Changes in consumer diet that lead to increased exposure to certain hazards

Early identification of emerging hazards could provide risk management the opportunity to take measures to prevent the hazard from becoming an (emerging) risk.

One of the approaches to do so is the so-called "Holistic approach", which requires:

A. Identification of the drivers of changes [3]

B. Identification of one/more indicators, with data sources, for each driver of change

C. Following the indicator trends

D. When indicator values go out of the normal ranges of values, this may indicate the emergence of a food safety risk.

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Holistic approach for identification of emerging food safety risks

In FoodSafeR, this holistic view is taken (Figure 2). An Open Digital Hub is developed in which the indicator trends can be followed by end-users of the Hub, such as risk managers.

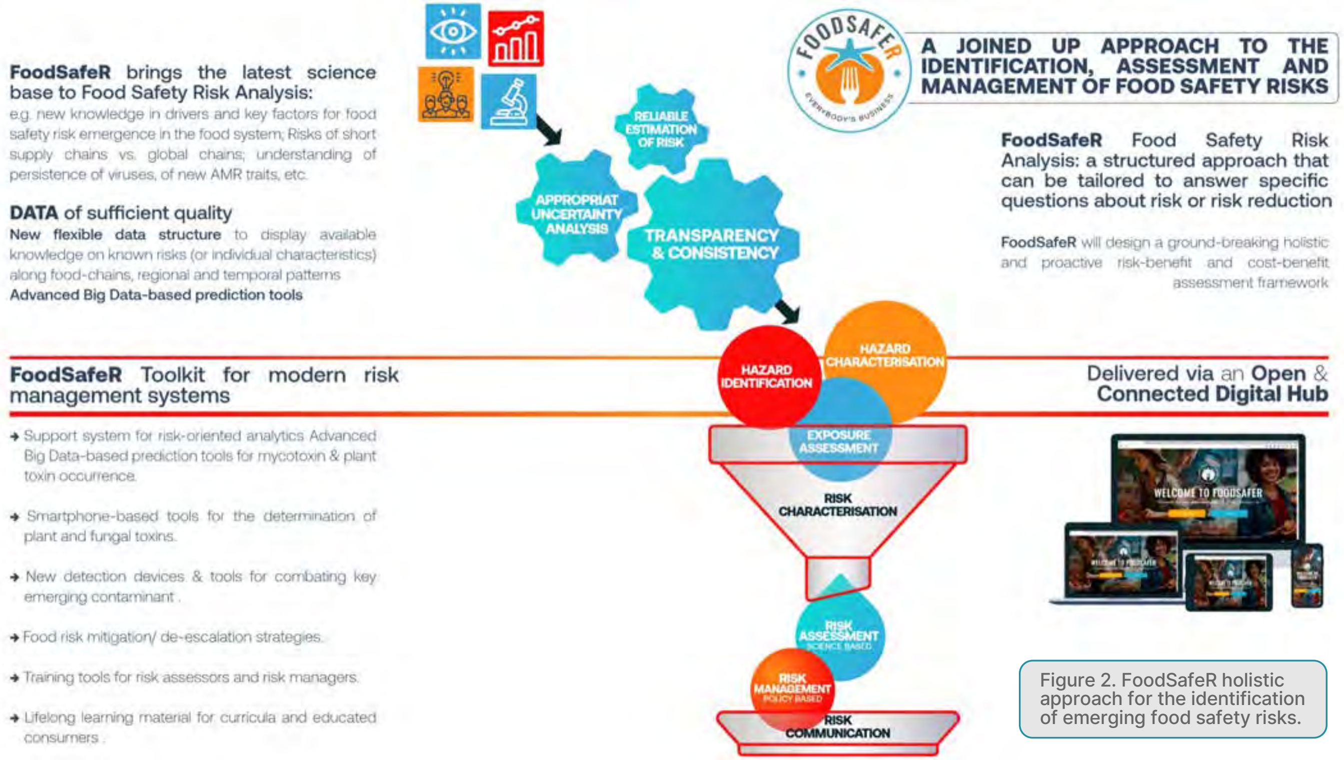

Figure 2. FoodSafeR holistic approach for the identification of emerging food safety risks.

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Resources:
1 Noteborn, H. P. J. M. et al. 2006. Report of the EFSA service contract EFSA/SC/tender/01/2004 “forming a global system for identifying food-related emerging risks—EMRISK”. EFSA Supporting Publications, 2, 224R. https://doi.org/10.2903/j.efsa.2005.224r
2 EFSA. Definition and description of “emerging risks” within the EFSA’s mandate, 2007. Available at: http://www.efsa.europa.eu/en/scdocs/doc/scdefinitionemergingrisksen.pdf,Accessed on July 16, 2010.
3 Kandhai MC, Booij CJH, Van der Fels-Klerx HJ. 2011. Expert study to select indicators of the occurrence of emerging mycotoxin hazards. Risk Analysis 31(1): 160-170. DOI: 10.1111/j.1539-6924.2010.01486.x

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Factors supporting persistence of *Listeria monocytogenes* in food processing environments

Introduction

Listeria monocytogenes is a bacterium capable of surviving in food processing environments for long periods of time, posing the threat of product contamination and a risk to public health. This so-called persistence of food-borne pathogens presents an immense challenge to food producers, as persistent strains remain difficult to eradicate even using rigorous cleaning and disinfection strategies. Despite decades of research on phenotypic and genotypic traits associated with persistence, no clear patterns have arisen to adequately explain this phenomenon.

In the Horizon Europe Project FoodSafeR WP2 (Task 2.3), we aim to not only identify key patterns in the genome of L. monocytogenes that make it well-adapted to food processing facilities, but also draw upon concepts from the ecology and evolution of this organism toward improvement of future monitoring and management strategies. To do so, we apply a combination of microbiological, culture-independent, and bioinformatic approaches. The results of this work form the foundation of the "Persisters Database", which will be hosted as a resource on the FoodSafeR DigitalHub for use by professionals in the food safety sector.

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Materials and Methods

We take a three-tiered approach toward understanding genetic and environmental factors that may underlie persistence, including:

(1) Meta-analysis of published studies to identify strain-type and gene-level patterns of persistence.

(2) Analysis of gene-level patterns across a database of whole genome sequences. Persistent strains are defined as identical isolates repeatedly sampled over at least two years with ≤20 whole genome SNP differences.

(3) Sampling food processing facilities across partner countries for L. monocytogenes isolates, co-occurring microbiota, and environmental data. Swab sampling and metadata collection (e.g., temperature, humidity) at three timepoints is ongoing in Austria (FFoQSI), Greece (AUA), and Spain (UBU). Isolates and the microbiome from swab samples will be sequenced and analyzed.

Summary

(1) Meta-analysis of 45 published studies revealed only weak associations between specific genes and persistence. Specifically, disinfectant resistance genes and mobile genetic elements (MGEs) exhibit stronger links to persistence. This work highlights the need for a more robust definition for persistence across studies, as well as a deeper understanding of the context in which L. monocytogenes survives.

(2) Analysis of ~3000 genome sequences from Austrian food producers indicates that a high diversity of sequence types are capable of persistence, including ST4, ST8, ST9, and ST37, among others. Gene-specific patterns are being investigated, with emphasis on disinfectant resistance, MGEs, and persistence.

(3) Ongoing facility sampling demonstrates high variability in the prevalence of L. monocytogenes across facility types. Analysis of isolates from Austria in the context of historical data supports their classification as persistent strains, with less than 7 whole genome SNP differences identified across all genomes.

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LEVERAGING A MULTI-ACTOR COCREATION APPROACH

The FoodSafeR Cocreation: Living Labs **Methodology**

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FoodSafeR is framed around Six Living labs to ensure we make addressing food safety #EverybodysBusiness

Food safety, nutrition and food security are closely linked. According to the World Health Organisation (WHO)[1], unsafe food leads to a vicious cycle of disease and malnutrition that particularly affects infants and young children, pregnant women, the elderly, and immunocompromised or sick people. The **FoodSafeR** project aims to make a significant contribution to making the food system safer.

The complexity of the factors leading to foodborne hazards requires improved information sharing in the international food system and the use of novel techniques - including big data processing - to facilitate future data-driven management by the stakeholders involved.

Under the mantra of #EveryBodysBusiness **FoodSafeR** is adopting a cocreation innovation approach to ensure that the diverse actors and stakeholders from across the food safety system have the opportunity to be involved in shaping the **FoodSafeR** developments.

As such, over the course of the project, six Living Labs are being organised as a series of collaborative or participatory workshops in which relevant stakeholders can come together to cocreate and contribute to the shaping the project's frameworks, tools, methods, strategies, models, guidance and training materials and their interface via the Digital Hub.

The goal of these workshops is to foster participation and collaboration and to stimulate innovation by bringing together different perspectives, skills, and expertise.

[1] https://www.who.int/news-room/fact-sheets/detail/food-safety

LL1
Living Lab 1
Consortium & Advisory Board
Digital Hub Cocreation

LL2
Living Lab 2
Cocreation with Food Safety Authorities, Risk Assessors & Risk Managers

LL3
Living Lab 3
Emerging food safety risk drivers and indicator analysis

LL4
Living Lab 4
Codesign of Risk-benefit and cost-benefit assessment framework

LL5
Living Lab 5
Learning pads

LL6
Living Lab 6
Participation in the Microbiological and Chemical Case Studies

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Living Lab 1. Cocreating the Open Digital Hub with the FoodSafeR Advisory Board

Living Lab 1 was held in Barcelona on 27th & 28th April 2023. It united the Work Package Leaders of FoodSafeR consortium with the members of the International Advisory Board. Over the course of a two-day hybrid Living Lab, two core working sessions were held.

Highlights from Working Session 1

The need for worldwide monitoring of emerging risks is underlined, with the COVID-19 pandemic serving as a critical example of how quickly local issues can become global.

The importance of passive monitoring, stakeholder engagement, and international collaboration in identifying and managing food safety risks.

The need for the integration of external data sources and digital platforms for a comprehensive approach to food safety.

Interest in connecting FoodSafeR's Open Digital Hub with existing data sources, platforms, and international networks to enhance food safety knowledge and risk management practices.

Working Session I: International perspectives on the status of current and emerging food safety and security hazards, with a focus on microbiological and chemical risks, from across Europe, USA, China, Africa (Nigeria and Kenya), Thailand, Singapore, Canada, and the different regions worldwide from representatives of the following organisations:

- European Food Safety Authority
- European Commission
- DG Health
- Codex Alimentarius Commission
- WHO
- FAO
- Federal Agency for the Safety of the Food Chain (Belgium)
- National Research Council of Italy
- Czech University of Life Sciences
- Test Aankoop Belgium
- USDA
- FDA
- Michigan State University
- Agriculture and Agri-Food Canada
- Health Canada
- Singapore Food Agency
- International Joint Research Center on Food Security (Thailand)
- Babcock University (Nigeria)
- University of Nairobi (Kenya)
- Academy of National Food and Strategic Reserves Administration (China)

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Defining the 'Minimum Viable Product' of the FoodSafeR Open Digital Hub

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Working Session II: Defining the MVP of the FoodSafeR Open Digital Hub

This working session reviewed and iterated on the first designs of the Open Digital Hub focussing on the first use cases, user requirements and desired user experience.

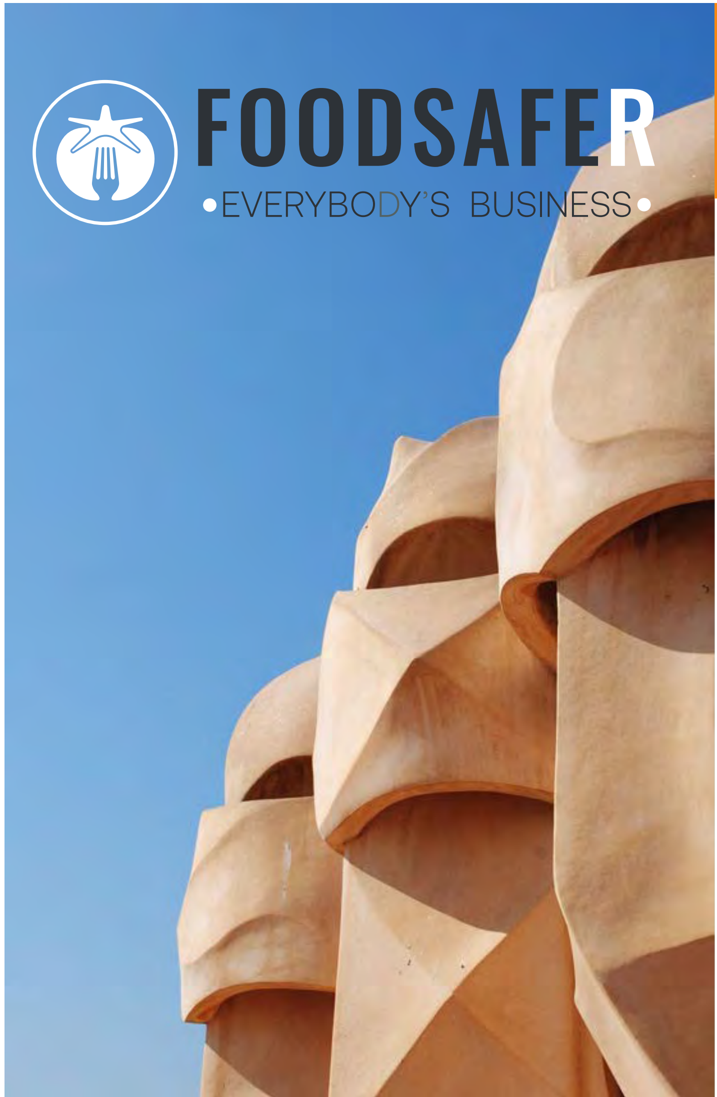
It was a unique opportunity for the FoodSafeR Digital team at IRIS Technology Solutions to consult the user requirements, specifications, and requests for the Open Digital Hub with the food safety and risk experts from within the Consortium and the Advisory Board.

This process enabled the delivery of a mock-up of the core functionality and features of the Hub for its future verification, modification and extension in the second living lab (LL2).

Driven by professionals.

Evidence-based.

Moderated by the scientific community.



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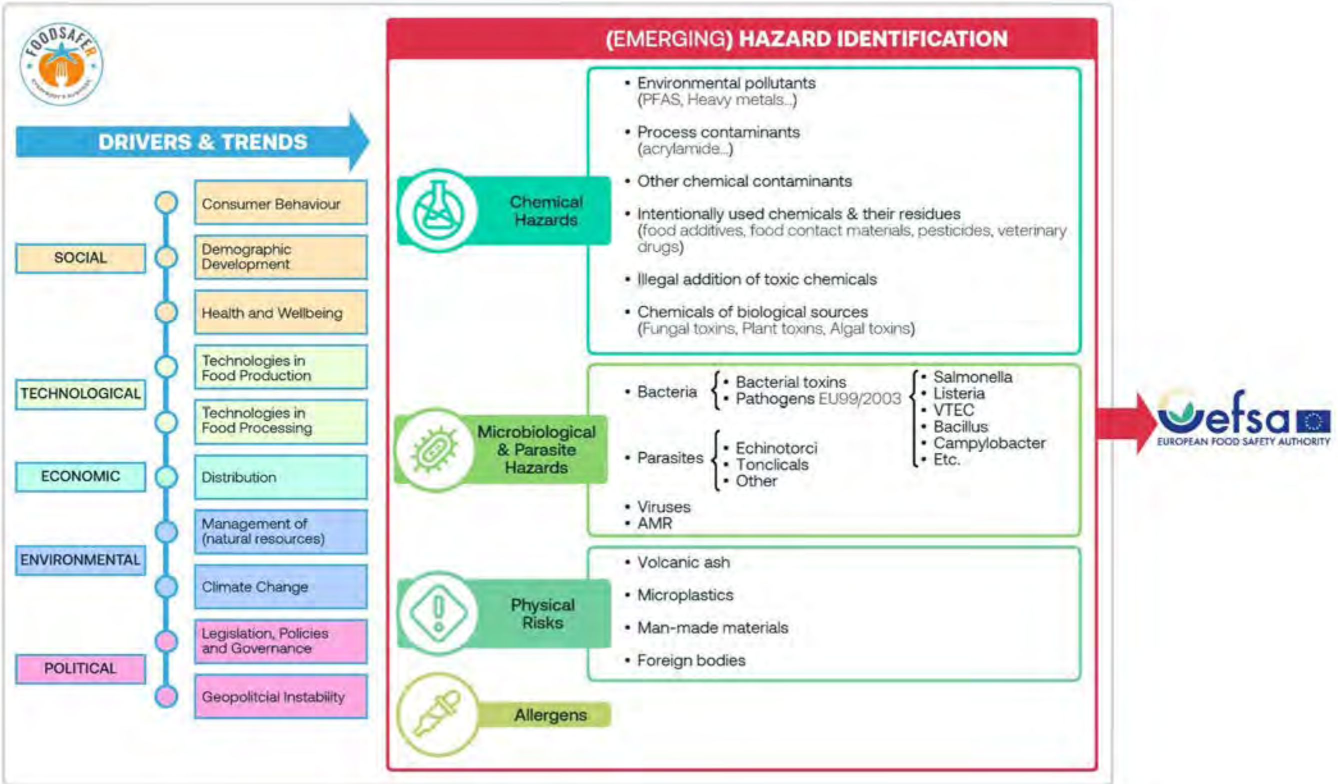
CoCreation for User Centric design and building end-user and stakeholder '*buy-in*'.

Working Session III: Defining a scalable framework for underpinning the digitalisation of the European food safety system.

The team worked on the mapping the core drivers and trends affecting (emerging) hazard identification. This will underpin a scalable framework for which information, tools, data, alerts will be built up and easily navigable for users.



Living Lab 2.
Design thinking with food safety professionals in EU & international government bodies

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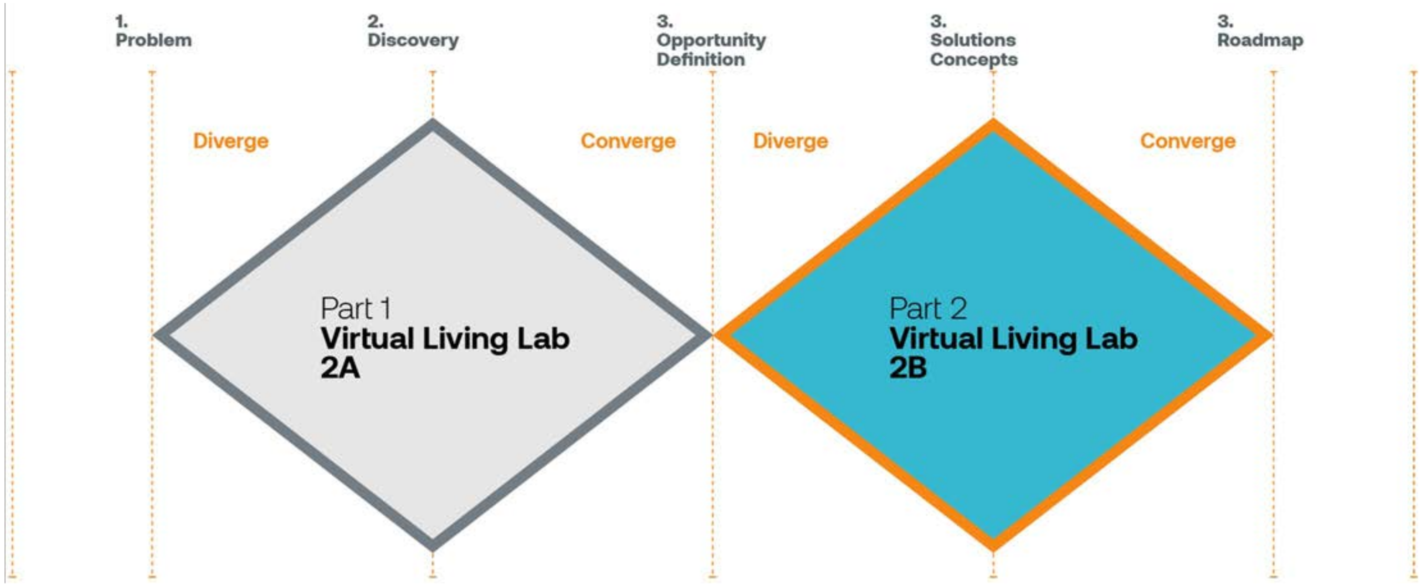
Living Lab 2 was hosted in October and November 2023 by the FSAI in Dublin, Ireland in collaboration with Accenture The Dock and supported by AGES (Austrian Food Safety Authority), IRIS Technology Solutions (Spain) and FOODREGSCI Europe.



The purpose of **Living Lab 2** was to gain a wide range of ideas from the perspective of food safety professionals in EU and international government bodies on the functionality and content that would drive wide and sustained adoption by users of the Open Digital Hub as an everyday tool.

Living Lab 2 consisted of a 2-part design thinking approach.

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Understanding the roles, priorities and problems that exist for the food safety experts to emerging food risk

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Living Lab 2A (LL2A) was a 2-hour virtual design thinking session held on 17th Oct. 2023 with 36 participants from across 13 different food safety agencies across the FoodSafeR network.

The primary objective was to understand the roles, the priorities and the problems that exist for the food safety experts when it comes to emerging food risk, and to begin ideating on how an Open Digital Hub might address or solve those problems and opportunities.

The MVP defined from **Living Lab 1 (LL1)** was presented to the LL2 participants as a starting point for discussions. This virtual session was facilitated by Accenture at the Dock, Dublin.

The process culminated in each of the 6 teams framing their ideation in terms of a Value Proposition Statement (simple summary outlining the problem to be solved, and the benefits to be realised through the Open Digital Hub).

The feedback and insights gathered from **LL2A** and the Value Prop Statements generated would be used to inform key themes, that would act as a starting point for Living Lab 2B.

Team 1

Creation of a **Risk Assessment Knowledge Management Network**, available for risk assessors and FBO's. Leverages experts collaboration and uses multi-language translation. Enables global learning, faster and more comprehensive risk assessments

Team 2

An initiative designated to **optimise data sharing** between all users of the Open Digital Hub. Enables efficient communication and opinion sharing, necessary for the success of the platform

Team 3

Solution ensuring compliance to GDPR regulations by design of the platform when is necessary when overseeing aspects of collaboration. Solution would require data lineages, decision trees and data sharing agreements between users.

Team 4

Mapping of different risk assessment / identification / management initiatives per National and Regional agencies to identify differences and harmonize and optimize approach to signaling.

Team 5

Solution aiming to **navigate large amounts of data and identify risks in isolation**. This can be by leveraging existing tools an AI pattern recognition and others to achieve a filter mechanism. This would improve accuracy, time and proof of principle for users.

Team 6

Creation of a filtering database tool to enhance open-source data, collaboration and risks and hazards prediction. The solution would be moderated by areas specific experts.

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Developing new valuable solution concepts for the Open Digital Hub that address the key user needs

Living Lab 2B was an in-person design thinking session held in Accenture The Dock offices in Dublin over two days (23rd & 24th Nov 2023) where a group of 16 participants from LL2A participants engaged in two sessions built around the research themes and innovation opportunities informed from Living Lab 2A.

The objective of LL2B was to build on the research and ideation from LL2A, and to develop new valuable solution concepts for the Open Digital Hub, that address the key user needs. The session also explored the factors that will influence user adoption, and an assessment of the feasibility and data landscape for the solution concepts, to help inform the future roadmap of the Open Digital Hub.

With emerging risks, there is often very limited information, but given the size of the EU, there are likely multiple signals of an emerging risks at various levels and to capture these signals from the 'jigsaw' the picture (scale, severity) may become clearer at an earlier opportunity

"Nobody here can do everything, but everybody here can do something."

Participant FoodSafeR Living Lab 2, Dublin, November 2023

Roadmap to guide the development of the Open Digital Hub & Value Feasibility matrix of the proposed solutions

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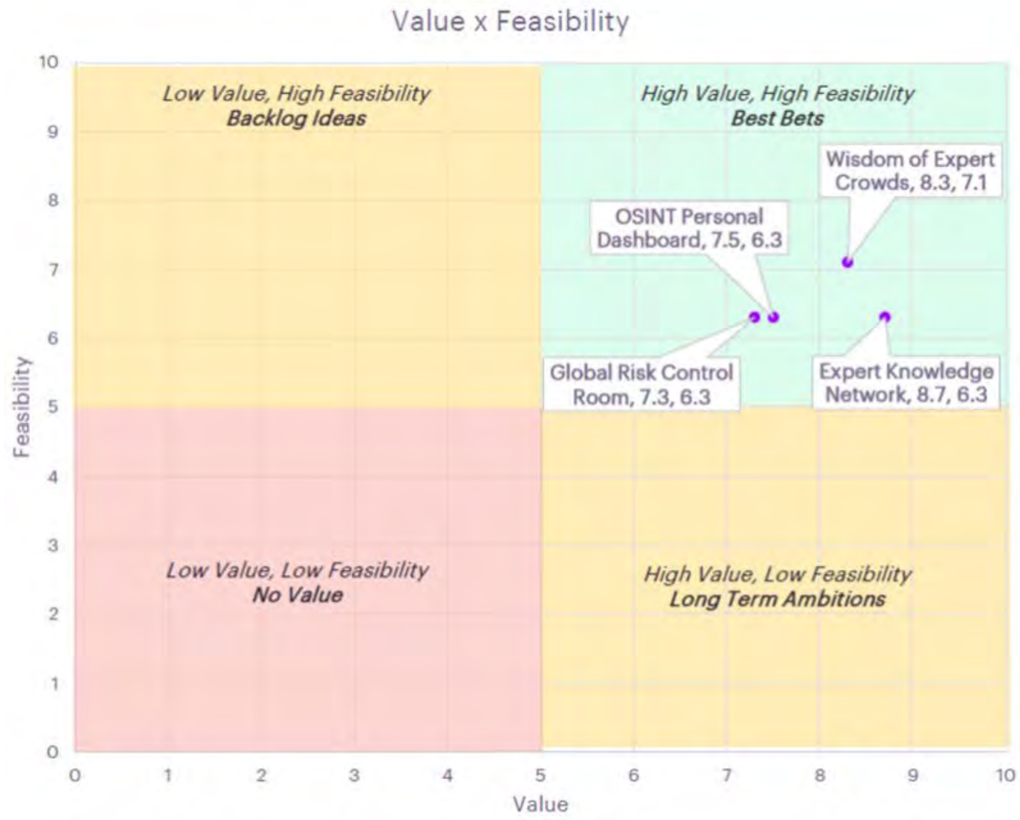

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FoodSafeR is a 4-year Horizon Europe funded research project that started in October 2022.

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Living Lab 3. Indicators for drivers of emerging food safety hazards

1.Drivers

- Are developments fostering change which affect or shape the future.
- Are shaping how a society, organisation, industry, research area, technology, etc. develops (EFSA, 2010).
- Can directly influence the food system and also extend beyond the food system into other aspects of society.

2.Indicator

- Is a measurable factor (with a unit e.g. temperature in Celsius)
- Indicates or is directly or indirectly related to the possibility of the occurrence of a (re)-emerging hazard or risk or in this project a driver (e.g., 'storage and transport conditions').
- Provides information on the nature of the hazard or driver and source of risk.
- Ideally it is reliable, sensitive and quantifiable, but can either be qualitative or quantitative in nature.

Living Lab 3 was designed to identify indicators for drivers of emerging food safety hazards and was held online on 31st January 2024 organized by AIT. Drivers of food safety risks were identified and sorted along STEEP categories: social, technological, economic, environment and political. **Participants:**

Highlights from Working Session

- AGES (Austria)
- Agriculture and Agri-Food Canada
- AIT (Austria)
- AUA (Greece)
- Barilla (Italy)
- BfR (Germany)
- BIGH (Belgium)
- Biomin (Austria)IRIS (Spain)
- Biosense (Serbia)
- BOKU (Austria)
- FaVV-AFSCA (Belgium)
- FDA (USA)
- FFoQSI (Austria)
- FSAI (Ireland)
- Health Canada's Food Research Division
- ISPA (Italy)
- Nestle (Switzerland)
- PIWET (Poland)
- QUB (United Kingdom)
- Singapore Food Agency (Singapore)
- Gent University (Belgium)
- WUR (The Netherlands)

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The Team

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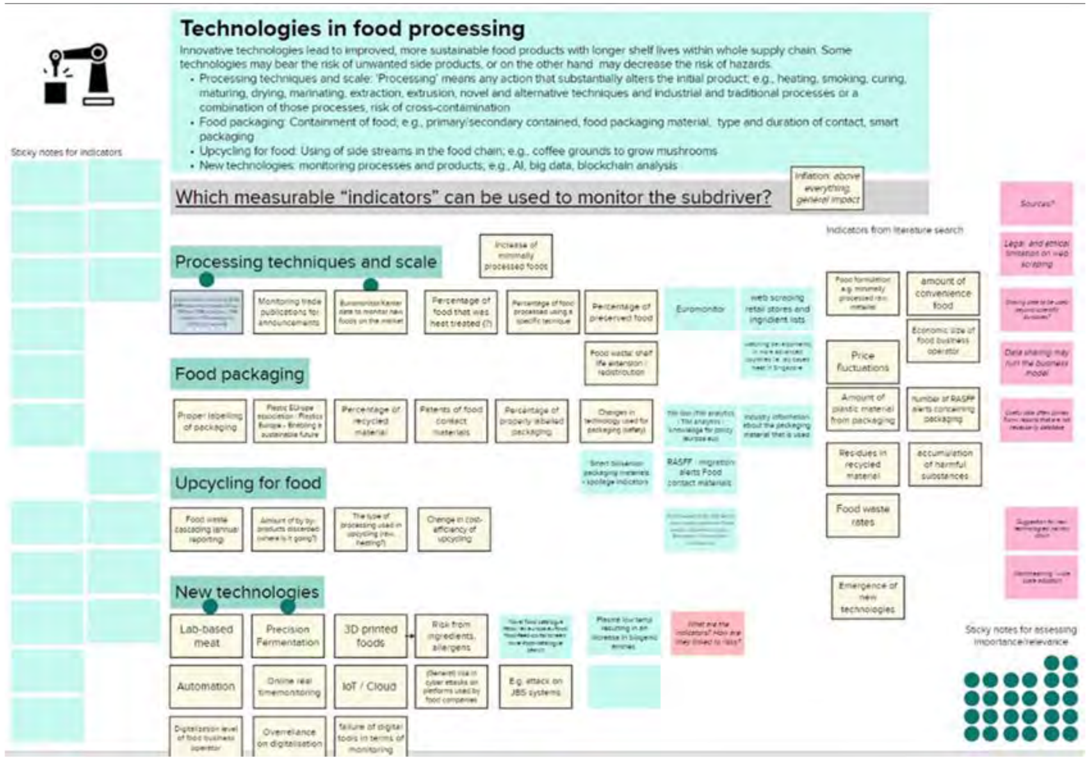
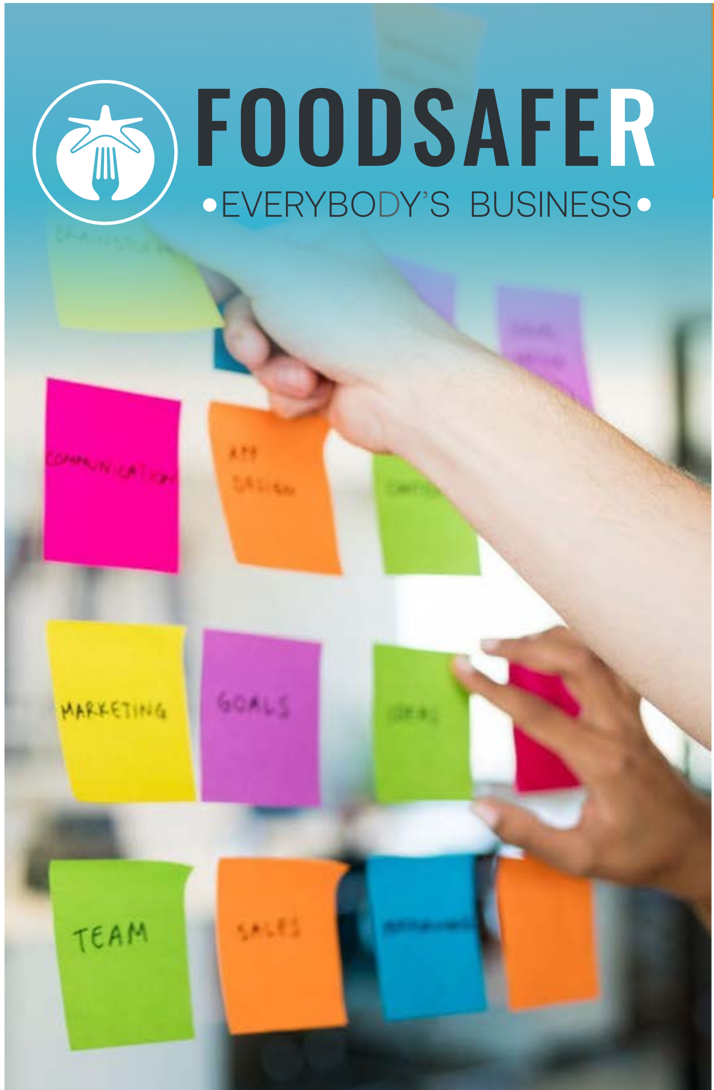
Understanding the roles, priorities and problems that exist for the food safety experts to emerging food risk

After a short introduction the participants were divided into 5 groups and sent into breakout rooms. Moderators awaited the participants in the breakout rooms and invited them to join the online whiteboard Mural. Each group used a pre-installed whiteboard template to discuss indicators for the subdrivers. The participants could write individual contributions, comment and add to other's contributions. The outcomes of the indicators for the subdrives of "Technologies in food processing"are presented below.





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Example for identified indicators

Working Session: The workshop outcomes were merged with the initial literature search conducted to arrive with a comprehensive list of the most relevant indicators and according databases. An example for technological drivers, their respective indicators and potential underlying databases is presented below. This list of indicators will be used as keywords in the open Digital Hub to search within a list of "DATABASES or WEBSITES".

Outlook: In the future, an alert system tool will be built in the open digital hub. This is a scalable tool that consists of an interactive dashboard that displays the real-time values of the indicators (based on the underlying data) so that users can follow the trends in the indicators via graphs. Users will also be able to set up the alerts feature so that they are notified if indicators move out of the normal range of values.

Driver	Subdriver	Indicator	Database
Technologies in food processing	Food packaging	Number of RASFF alerts concerning packaging	RASFF
	New digital technologies	Emergence of new technologies	
	Processing techniques & scale	Increase of minimally processed foods Amount of convenience food	
Technologies in food production	Bioengineering	Share of GMO cultivation / transfer of genetic traits	
	Cell-based food	Total cell-based food production / number of countries where cell-based food is approved for market entrance	
	Primary production	Total crop production: utilised agricultural area, harvested production	EUROSTAT
		Dairy food production	EUROSTAT
		Meat production	EUROSTAT
		Fishing & aquaculture production	EUROSTAT
		Indoor – outdoor production rates	
		Organic production: area, animal & crop production	EUROSTAT FAOSTAT
		Occurrence of dioxin and mycotoxins in feed	
	Products for food production	Veterinary drug use	EFSA reports
		Water use by agriculture	

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FoodSaferR's open digital HUB: Expert Knowledge expert.

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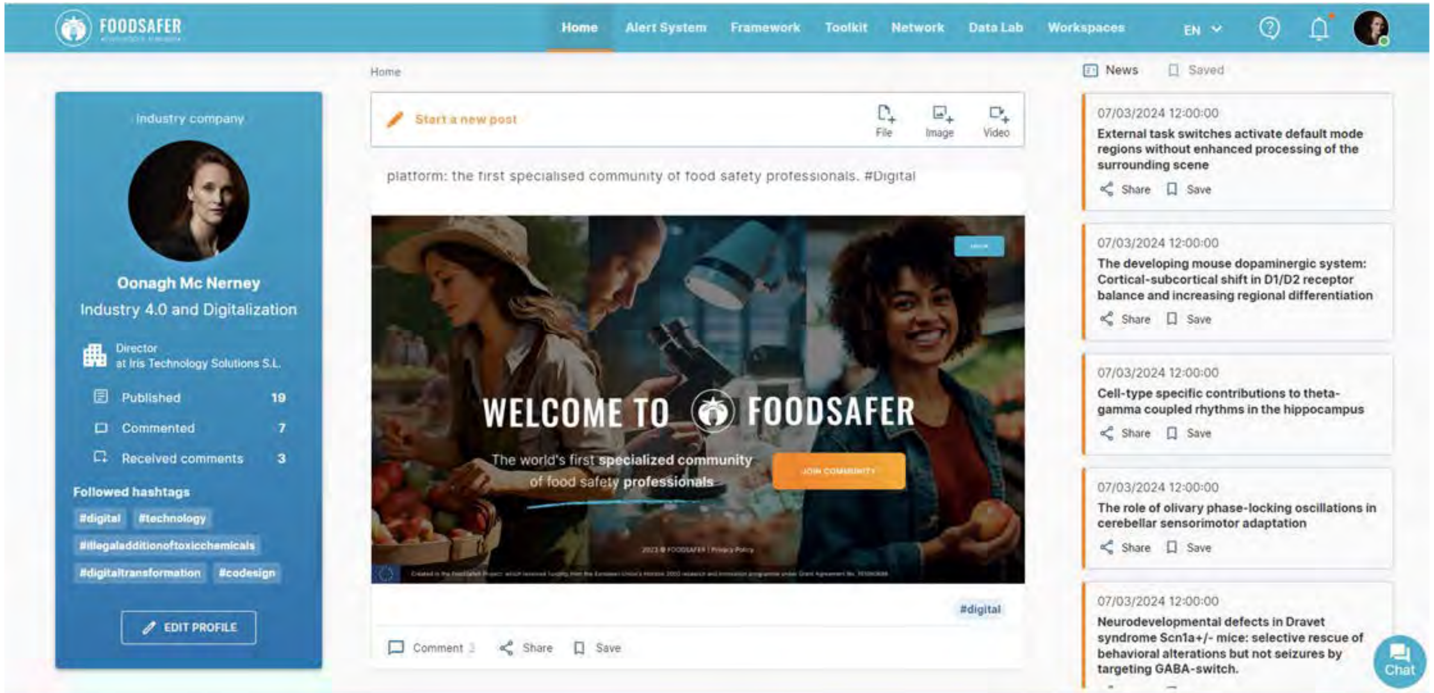
Funded by the European Union

FoodSafeR is developing an **'Open Digital Hub'** as a one-stop-shop for emerging food risk management, which will for the first time, connect and engage experts and stakeholders from across the food system. Curated by the scientific community, **FoodSafeR** aims to be a trusted source of information, guidelines, and advice in relation to emerging hazards that are posing a risk for food safety.



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A harmonized approach to risk management across the network – A LinkedIn for Food Safety

Who is its targeted at?

FoodSafeR is building a specialised community of European and international experts:

- Risk managers & Risk assessors from Government/Food competent authorities
- Scientific community
- Food Business Operators
- Policy Developers

What benefits will the FoodSafeR Open Hub bring to its users?

FoodSafeR is building a specialised community of European and international experts:

- Social knowledge network that helps experts communicate, collaborate and share early insights and weak signals among the community as the true opportunity for differentiation in emerging food risk.
- Food safety experts can post emerging risk early signals. The posts are prioritised by Positive Amplification to show which matter most.
- AI-powered summarisation, analysis and sharing of high priority insights from the most amplified emerging risk signals.
- 'One Stop Shop' with data available from a variety of food safety sources across an international eco-system.

Bridges a current gap in relation to a centralised and collaborative space for food safety experts and stakeholders.

Driven by professionals.

Evidence-based.

Moderated by the scientific community.

Sign up at:
my.foodsafer.com

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International Stakeholder Assessment of Emerging Microbiological and Chemical Food Safety Hazards and Associated Risks

Introduction

The interconnectedness of food markets has increased the risk of contamination and emerging foodborne illnesses, with microbiological hazards accounting for over 95% of food safety violations in Europe, and chemical contaminants also posing significant health risks. Climate change, the rise in consumption of alternative proteins, and the move towards a circular economy are likely to make sporadic occurrences like zoonotic diseases and carcinogenic mycotoxins more frequent. The global food system's vulnerability to shocks from zoonoses, conflicts, extreme weather, and pandemics like COVID-19 underscores the need for adaptive and resilient food safety management strategies.

The FoodSafeR project, funded by the European Commission, aims to enhance EU food safety and offer insights for global application through a collaborative approach to manage emerging food safey hazards and associated risks. This involves proactive risk management strategies, lessons from other industries, and innovative technologies like big data.

Stakeholder Workshop

To gather current stakeholder perspectives on emerging food safety hazards, a workshop was held within the Living Labs framework.

Members of the FoodSafeR Consortium and International Advisory Board identified new microbiological and chemical risks via a mini-survey, addressing a gap in data since the last major study over ten years ago.

The workshop aimed to inform EU and global food safety policies with updated insights.

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Insights on enhancing food safety knowledge and informing new policies within the EU and globally.

Materials & methods:

The FoodSafeR International Advisory Board, with 25 experts from 18 institutions across four continents, met for a workshop in Barcelona in April 2023. Participants, experts in food safety from various global institutions, focused on microbiological and chemical hazards and risk assessment. They completed pre-workshop surveys on food safety issues, which were analysed for discussion at the event, fostering peer-to-peer dialogue on food safety risk management.

Current and emerging microbiological hazards and risk factors

18 responses identified Salmonella and Listeria as primary microbial food safety hazards in North America and Europe, with a greater variety of pathogens recognized as high-risk in Africa and Asia due to less controlled food chains. Multi-drug resistant bacteria were also a concern across the study regions. These findings align with the World Health Organization's 2021 report on significant global foodborne pathogens[1]. Specific risks included Cronobacter in North American infant formula and Salmonella in vegetables globally, while Listeria was a risk in various foods like cheese and seafood. Other concerns involved toxigenic fungi, parasites, and viruses, with norovirus contamination noted in Singapore due to climate change. The study highlighted poor regulations, limited surveillance, climate change, and rising antimicrobial resistance as universal risk factors for microbial contamination, emphasizing the need for improved monitoring and regulation to prevent foodborne illnesses.

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1 World Health Organization 2021. https://www.who.int/news-room/fact-sheets/detail/food-safety#:~:text=are%20listed%20below.-,Bacteria,vomiting%2C%20abdominal%20pain%20and%20diarrhoea

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Materials and Methods

Unpasteurized spontaneously fermented vegetables were sampled in Ghent (Belgium) and Vienna (Austria), both in the local and through online shops. The samples were analysed for microbiological quality and food safety parameters (lactic acid bacteria as beneficial bacteria, Enterobacteriaceae and Escherichia coli as process hygiene indicators, Listeria monocytogenes as a foodborne pathogen etc.), both at the day of purchase and the end of the shelf-life. In addition, (i) data on intrinsic (acidity, water activity, etc.) and extrinsic characteristics (type of packaging, storage temperature) of the food product, and (ii) information on the label (the shelf life, reasonably foreseen handling, and health claims) were collected for all samples taken.

Resources:

FSAI. (2021). Guidance Note No. 37: Good Manufacturing Practices for the Production of Ready-to-eat Unpasteurised Fermented Plant-based Products. https://www.fsai.ie/publications/gn-37-good-manufacturing-practices-for-the-product

Battcock, M., & Azam-Ali, S. (1998). Fermented Fruits and Vegetables. A Global Perspective. In Fermented Fruits and vegetables.A Global perspective. Food and Agriculture Organization of United Nations. https://www.fao.org/3/x0560e/x0560e00.htm

Van Beeck, W., Verschueren, C., Wuyts, S., van den Broek, M. F. L., Uyttendaele, M., & Lebeer, S. (2020). Robustness of fermented carrot juice against Listeria monocytogenes, Salmonella Typhimurium and Escherichia coli O157:H7. International Journal of Food Microbiology, 335, 108854. https://doi.org/10.1016/J.IJFOODMICRO.2020.108854

Summary of the findings

When fermenting vegetables, often mentioned key factors which ensure the safety of the product are (i) the use of starter cultures, and (ii) a heat treatment. However, these control measures will affect the bacterial biodiversity and probiotic quality and may result in an altered lactofermentation. Therefore, spontaneous fermentation is often preferred. However, the reliance on indigenous microbiota can affect safety and predictability of the fermentation process because the microbial load and activity of naturally present lactic acid bacteria that reside on the (shredded/cut) vegetables can be variable. It has been observed in the FoodSafeR project experimental research work that during this phase it is crucial to follow up on the following factors. A good practice is to see that:

(i) Washed vegetables are completely submerged in (3-4%) saltwater brine until the jar is almost full and the jar is tightly closed

(ii) The acidification (pH drop) by the lactic acid bacteria should result in a pH < 4.2

(iii) The fermentation time should be at least 14 days (usually at 18-21°C under anaerobic conditions)

(iv) The sensory attributes are acceptable: check for off-odours or visual mould formation.

If one of these conditions has not been met, discard the product as not only the quality, but also the safety of the spontaneous fermented vegetable product cannot be guaranteed.

Furthermore, during the FoodSafeR project survey, most (but not all) market samples have shown to comply with a pH level lower than 4.2. On a few occasions, persisting Enterobacteriaceae indicated either a too slow pH-decrease with related favourable initial growth conditions or a too short fermentation time.