Abstracts

International Scientific Conference on “Global commodity chains from a risk assessment perspective”

27–29 May 2024, Berlin

BfR
German Federal Institute for Risk Assessment

Preface

Dear guests and experts in the field of agri-food chains, related disciplines and regulatory areas.

It is an honour for me to welcome you at the German Federal Institute for Risk Assessment (BfR) in Berlin to the International Conference on “Global commodity chains from a risk assessment perspective”.

In a globalised world, the complexity and vulnerability of global commodity chains has become apparent, in particular in relation to feed and food safety risks. At the same time, advances in digitalisation are enabling a more comprehensive assessment of these risks. As food safety experts, we have developed strategies to address the challenges of globalised trade, the potential hazards and the impact on consumer health protection. We recognise the critical role of a thorough understanding of hazards, the need to integrate concepts from different disciplines and the importance of advanced technologies and accurate data to develop powerful tools for a comprehensive and holistic evaluation of risks. The work of food authorities and food safety experts around the world, some of which will be presented at this conference, highlights this point.

The challenges for risk assessment and consumer health protection posed by global agri-food trade can only be met through interdisciplinary collaboration between experts. Identifying, implementing and further developing existing procedures, concepts and technologies and closing existing knowledge and data gaps is an important part of this. The BfR is particularly committed to scientific challenges in the field of risk assessment and the development of software solutions that also serve to support crisis preparedness. This collaborative endeavour extends to partnerships with experts from regional, national as well as European food safety authorities and beyond, recognising that effective risk assessment and management requires collective action. In line with the EU Green Deal and the “One Health” approach, further collaboration and cooperation to implement holistic approaches in response to future challenges is paramount in modern risk assessment. Given the complex challenges facing our society such as climate change, population growth, economic and political instability as well as digital and technological innovation, including artificial intelligence, we need to bring together experts from diverse professional and cultural backgrounds dealing with global commodity chains.

I am very confident that this conference will offer a valuable opportunity to discuss the relevance of both existing and new concepts, approaches, methods and priorities. I would like to express my gratitude to all speakers, authors, poster and software contributors and all participants for their valuable contributions that will make this conference a success. I am convinced that the conference and the vibrant and dynamic city of Berlin will inspire you to build bridges, push boundaries and encourage collaboration as well as innovation in the pivotal field of global agri-food chains. I wish you a fruitful conference and an enjoyable time with your colleagues.

Professor Dr Dr Dr h.c. Andreas Hensel

President of the German Federal Institute for Risk Assessment (BfR)

International Scientific Conference on “Global commodity chains from a risk assessment perspective”

The conference will bring together national and international experts in feed and food chains, digitalisation and consumer health protection to exchange and transfer knowledge on concepts, data and tools for a holistic evaluation of risks in global commodity chains. The focus will be on innovative techniques and digital solutions to integrate data and knowledge about hazards, exposure and technologies for improved risk assessment along feed and food chains.

Sessions

- Guest perspective
- Setting the scene
- Traceability systems and commodity chain information
- Early warning, predictive models and prevention strategies
- Software solutions supporting outbreak investigations and risk assessments
- Interactive session (workshop, poster, software fair)
- Innovative analytical approaches
- Data and knowledge integration
- Integrated food and feed systems

Contents

1 Programme

Monday, 27 May 2024	
11:30–12:30	**Registration** Lunch snack will be provided
Opening Ceremony	
12:30–12:45	**Welcome and symposium opening** Andreas Hensel, President of the German Federal Institute for Risk Assessment (BfR), Germany
Guest perspective Session Chair: Benoît Vallet, Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail (Anses), France	
12:45–13:05	**From data to decision: Leveraging WGS as a tool for precision risk assessment along the food production chain up to consumption** Laurent Guillier, Anses, France
13:05–13:25	**New approach for antimicrobial resistance monitoring & surveillance using NGS** Hyochin Kim, National Institute of Food and Drug Safety Evaluation, South Korea
13:25–13:55	**Coffee break**
Setting the scene Session Chair: Carsten Fauhl-Hassek, BfR	
13:55–14:25	**History of traceability and global regulatory systems** Sylvain Charlebois, Dalhousie University, Canada
14:25–14:55	**What information do we need about European food chains to trace in outbreak investigations and to carry out risk assessments** Olaf Mosbach-Schulz, European Food Safety Agency (EFSA), Italy
14:55–15:25	**The New Modernization of the U.S. FDA Human Foods Program** Donald A. Prater, U.S. Food and Drug Administration (FDA), USA
15:25–15:55	**Coffee break**

Session I: Traceability systems and commodity chain information Session Chair: Matthias Filter, BfR	
15:55–16:20	**Should traceability systems in the food industry be based on blockchain technology?** Petter Olsen, Nofima, Norway
16:20–16:45	**GS1 based standards and data ecosystems** Tim Bartram, GS1, Germany
16:45–17:10	**Using transport and logistics data for food safety and food security analysis** Hanno Friedrich, Kühne Logistics University, Germany

Tuesday, 28 May 2024

Session II: Early warning, predictive models and prevention strategies Session Chair: Marion Gottschald, BfR	
09:00–09:25	**The EU Alert and Cooperation Network: in (need of re-)shape?** Jan Baele, European Commission, Belgium
09:25–09:50	**ISAR – Assessing the impact of the Ukraine war on the agri-food chain** Britta Müller, Bayerisches Landesamt für Gesundheit und Lebensmittelsicherheit, Germany
09:50–10:15	**The importance of the moral compass in food fraud vulnerability: Business culture and personal integrity** Saskia van Ruth, University College Dublin, Ireland
10:15–10:40	**Enhancing Public Health: Harnessing the Power of AI in Ensuring Food Safety** Maria Eleni Dimitrakopoulou, Agroknow, Greece
10:40–11:10	**Coffee break**

Session III: Software solutions supporting outbreak investigations and risk assessments Session Chair: Anneluise Mader, BfR	
11:10–11:35	**Food Defense: more than secure supply chains** Paul Elsinghorst, Bundeswehr Medical Academy, Germany
11:35–12:00	**Interoperable software tools for efficient supply chain tracing during foodborne incident investigations** Marion Gottschald, BfR, Germany Adam Friedlander, FDA, USA
12:00–12:25	**Over Twenty years of International Foodborne Outbreak Data: How PAIFOD Continues to Support Activities Against Foodborne Illness in Canada** Austyn Baumeister, Public Health Agency of Canada
12:25–14:00	**Lunch break**
Interactive Session (in parallel)	
14:00–15:00	**Watson Workshop: Solutions for Transparency and Integrity in the EU Food System** Session Chair: Dagmar Mithöfer and Claudia Coral, Humboldt-University of Berlin, Germany
14:00–15:30	**Poster session and software fair**
15:30–16:00	**Coffee break**
Session IV: Innovative analytical approaches Session Chair: Janet Riedl, BfR	
16:00–16:25	**Global initiatives in the implementation of whole genome sequencing for food safety** Eric Stevens, FDA, USA
16:25–16:50	**Spectroscopic analysis for feed quality and safety control at site and in lab** Vincent Baeten, Walloon Agricultural Research Center, Belgium
16:50–17:15	**Routine detection and interpretation of anomalies using multivariate and non-targeted methods** Eric Jamin, Eurofins Analytics, France
17:15–17:40	**Innovations in the detection of unknown contaminants by non-targeted MS** Chiara Dall'Asta, University of Parma, Italy
18:00	**Evening Event**

Wednesday, 29 May 2024	
Session V: Data and Knowledge Integration Session Chair: Marc Lorenzen, BfR	
09:00–09:25	**Prerequisites for data analysis and AI** Ákos Jóźwiak, Digital Food Institute, Hungary
09:25–09:50	**The RAKIP Initiative and it's solutions** Matthias Filter, BfR, Germany
09:50–10:15	**Towards AI-Driven Food science and society: Opportunities and challenges** Tome Eftimov, Jozef Stefan Institute, Slovenia
10:15–10:45	**Coffee break**
Session VI: Integrated food and feed systems Session Chair: Anja Buschulte, BfR	
10:45–11:10	**Risk Negotiation - Integrated Risk Analysis for One Health** Sophia Johler, University of Zurich, Switzerland
11:10–11:35	**FoodEx2: EFSA's food classification system and the Smart Coding App** Anastasia Livaniou, EFSA, Italy
11:35–12:00	**New advances in Risk Benefit Assessments** Sara Pires, Technical University of Denmark, Denmark
12:00–12:15	**Summary and final remarks**

2 Abstracts – oral presentations

2.1 **From data to decision: Leveraging WGS as a tool for precision risk assessment along the food production chain up to consumption**

Laurent Guillier

French Agency for Food, Environmental and Occupational Health & Safety (Anses), Maisons-Alfort Cedex, France

In the not-so-distant past, the introduction of whole genome sequencing (WGS) sparked high expectations within the scientific community. These hopes centered around the promise of more accurate risk assessments, improved source attribution performance, and heightened sensitivity in the realm of epidemiological investigations. Today, after several years of practical implementation, we find ourselves in a position to provide a preliminary assessment of the profound impact of genomics in these three crucial areas. The most significant improvement that we can attribute to WGS lies in the realm of epidemiological investigations. In recent years, numerous foodborne infection outbreaks have been successfully identified. For source attribution, we encounter a multitude of methodological innovations that have emerged to harness the power of sequencing data. These innovations encompass the application of population genetics models and machine learning techniques. However, it is important to note that the performance of these advanced models does not exhibit a significant departure from the outcomes derived from simpler subtyping methods. In the context of risk assessment, we find ourselves at a crucial crossroads. The availability of genomic data now empowers us to conduct more comprehensive characterizations of virulence. For several pathogens, markers that allow for a relative assessment of virulence between different strains have become accessible. These breakthroughs invite consideration of the adoption of more specific and targeted control measures. However, it is imperative that microbiological methodologies evolve in tandem with these progressions to ensure that public health stakeholders can fully exploit the knowledge that is continually advancing in this field.

2.2 **New approach for antimicrobial resistance monitoring and surveillance using NGS**

Hyochin Kim

National Institute of Food and Drug Safety Evaluation (NIFDS), Chungcheongbuk-do, South Korea

In recognition of antimicrobial resistance (AMR) as a major global public health threat, many countries established “National action plan to combat AMR”. With collaboration among human health, environment, and food production sector, Korean governments have tried to control AMR by “National Action Plan” since 2016 following by “National Antimicrobial Resistance Management Program” since 2003. As the control tower of food production sector, Ministry of Food and Drug Safety has been charged AMR surveillance and monitoring in whole food chain.

Rapid detection of AMR in surveillance and monitoring is a major challenge, compounded by the rapid evolution of AMR mechanism. Next-generation Genome Sequencing (NGS) has been considered as a robust bioinformatics tool to analyze AMR genes and their genetic context. Still, there are some limitations to adopt NGS as a routine method in laboratory.

In this presentation, we will show how MFDS utilizes NGS as a powerful tool for outbreak investigation, characteristics analysis, and comparative genomic analysis. In addition, current and future work regarding NGS implement to AMR surveillance and monitoring will be introduced.

2.3 **History of traceability and global regulatory systems**

Sylvain Charlebois, Noor Latif, Ibrahim Ilahi, Janele Vezeau

Agri-Food Analytics Lab, Dalhousie University, Canada

In an era characterized by globalization and rapid technological advancements, the agri-food sector faces unprecedented challenges and opportunities. Digital traceability systems have emerged as crucial tools for enhancing operational efficiencies, ensuring food safety, and promoting supply chain transparency. This study presents a comparative analysis of digital traceability adoption and its impact across OECD member countries. Using a multidimensional analytical framework, the research explores national regulations, legal frameworks, and key food commodities affected by digital traceability implementations. It systematically evaluates the effectiveness of these systems in meeting consumer transparency expectations, regulatory requirements, and the overarching goal of sustainable agri-food supply chains. Through case studies and empirical evidence, the paper highlights the complex interplay between technological innovation and regulatory environments, offering insights into best practices and potential integration barriers. This comprehensive investigation contributes to the scholarly discourse on digital traceability, providing actionable recommendations for policymakers, industry stakeholders, and academia to navigate the complexities of modern agri-food systems.

2.4 **What information do we need about European food chains outbreak investigations and to carry out risk assessments**

Olaf Mosbach-Schulz

European Food Safety Agency (EFSA), Parma, Italy

With the increased capabilities to exchange and assess structured data on the commodity supply chains the risk assessment of marketed products is enabled to look to more risks: risk to the human, animal, plant health, to the environmental integrity, and to refine the spatial and temporal granularity.

The food law is designed to investigate single incidents in the food supply chain, but more data are available or could be explored to extend the risk assessment to other areas. The talk will show examples, where improved knowledge on the commodity chains is used to support the risk managers in their decision making. These include investigations of incidents, risk assessments of imported commodities, and the identification of populations under risk.

2.5 **The New Modernization of the U.S. FDA Human Foods Program**

Donald Prater

U.S. Food and Drug Administration (FDA), USA

The FDA is focused on transforming the agency to be more efficient, nimble and ready for the future with the ever-changing and complex industries we regulate, including the emergence of new food technologies, the impacts of globalization, climate change and other factors that require the FDA to quickly adapt to an evolving world. The FDA completed its proposed reorganization package in December 2023. It is currently undergoing a formal external review process required for all federal reorganizations, and The FDA is hopeful implementation will occur sometime in calendar year 2024. Fundamentally, this reorganization centers on structural changes so that we can better optimize the talent we have across the food's programs under a single decision maker that can streamline and expedite our decision making. This talk will highlight some of the proposed changes to our structure and where our key priorities will be represented, including: preventing foodborne illness, raising the profile and work around nutrition, and enhancing chemical safety through both pre and post-market review. Fundamental to our efforts will be on better utilizing risk prioritization that recognizes that different foods, food processing, geographies, and supply chains all have different risks, and that data can help determine where our energies should be directed.

2.6 **Should traceability systems in the food industry be based on blockchain technology?**

Petter Olsen

Nofima, Norway

Transparency and traceability are key issues for food products, and there are various reasons why the importance of traceability is increasing. Partly it relates to the internal need for internal documentation and industrial statistics, and partly it is to meet customer and consumer requirements and preferences both in relation to product characteristics (origin, ingredients, processes and transformations undergone, etc.) and in relation to so-called secondary characteristics (sustainability attributes, emissions, food miles, eco-label status, ethics, fair trade, etc.). Traditionally these characteristics are recorded, stored in relational databases, and transmitted in the supply chain using some form of Electronic Data Interchange (EDI). In recent years building a traceability system on blockchain technology has become a viable alternative, and this presentation attempts to highlight the strengths and weaknesses associated with each option, and in particular to evaluate to what degree and under what circumstances a blockchain based traceability system is suitable for the food industry.

This presentation outlines applications, limitations, costs, and benefits related to the use of blockchain technology, and in particular evaluates the pros and cons of having a blockchain-based traceability system compared to a traditional electronic traceability system. The core principles of blockchain technology are outlined, as well as the fundamental requirements and drivers relating to an electronic traceability system. The presentation compares traditional vs. blockchain-based food traceability systems in terms of database structure, data quality and veracity, immutability, integrity, transparency, confidentiality, trust, robustness, speed, efficiency, and interoperability.

2.7 **GS1 Based Standards and Data Ecosystems**

Tim Bartram

GS1 Germany

Traceability systems and commodity chain information can be supported by the GS1 System in favor of different stakeholders in digitalized trade. As industry is working to adapt their companies in times of transformational change, technological push and societal challenges, three operational requirements for success, come into focus: Increasing TRANSPARENCY; Increasing SPEED and Increasing TRUST between supply chain partners and consumers.

50 years ago, GS1 started enabling businesses to: 1. Give things unique identity; 2. Connect that identity to trusted data; 3. Use that trusted data to power businesses and 4. Connect that trusted data to the world. Challenges further exist, new come up or can be foreseen already: All can be handled easier with the help of GS1 Standards like Identification, GS1 Digital Link, Links to other sources of Data, Resolver, ESG information, certificates and data sourced from GDSN.

Other key evolutions to be taken into consideration with the GS1 System today are: Beginning of digitalisation of trade documents, e.g. eBOL (Bills of Lading); Rise of “Single Windows” and electronic customs clearance where harmonisation of regulation will be difficult; Advent of digital negotiable instruments, as legal changes is tech development; Trade data platforms and networks where aggregation and analysis of trade data happens; Global digital identification schemes requiring extensive international cooperation. There is even more to comply with in the future: Simplification of trade documents, also partially; Models for data sharing and security, especially under decentralised conditions; Developing digital trust at scale via signatures or VCs, and Globally interoperable standards.

2.8 **Using transport and logistics data for food safety and food security analysis**

Hanno Friedrich

Kühne Logistics University (KLU), Hamburg, Germany

For many analysis in the context of food safety (and food security) logistics data can be helpful (sometimes even central). A good example is the trace back of food borne diseases after an outbreak (take for example the EHEC outbreak): which products where consumed, where were these products produced and how were they distributed? Logistics and supply chain management covers the whole process from raw material to consumption, the resulting knowledge and data is obviously useful for food safety and security analysis. This contribution outlines categories of logistics data and gives examples how to use the data for food safety and food security analysis.

Following data categories can be differentiated: production data, employment data, population data, sales/cash-out data, trade data, transport data, inventory data, tracing data, location data, and mobility data.

We used much of this data to develop a Dynamic Multi Regional Input Output Model for food supply in Germany and analyzed supply chain disruptions. We also run a trace-back algorithm for food-borne disease outbreaks using this data. Later, we estimated the connection between point of sales and consumers and regional food inventories for food security preparedness. Currently, we are working on methodologies to identify sources of food outbreaks using logistics location patterns (POS or warehouses) and trade data.

2.9 **The EU Alert and Cooperation Network: in (need of re-)shape?**

Jan Baele

European Commission - DG Health and Food Safety, Belgium

iRASFF is the online platform for the Alert and Cooperation Network, joining two pre-existing networks: the Rapid Alert System for Food and Feed and the Administrative Assistance and Cooperation Network.

“Notifications” in iRASFF report issues found with agri-food commodities that require assistance, attention or cooperation from other network members. Networks in iRASFF can work together on these notifications, but the useful data in these notifications are not sufficiently structured and are “locked up” inside the notifications.

These data inside the notifications should be made available to the network members for analysing possible patterns, for linking their own data or for setting priorities in their controls. In this way, the data will drive the “notifications”. In other words, based on the data provided, certain “actors” in the system will be notified and prompted to add information where needed.

For this to really work, a lot of data from various sources should be made available to the system as potential signals to identify events that need further investigation or cooperation. To exchange such large volumes of data on e.g. traceability or sampling and analysis, common standards are essential.

A new generation iRASFF should, through implementing data collections standards, be able to exploit a variety of data sources. Thereby iRASFF will focus on managing incidents in the agri-food chain, from minor non-compliances to full-blown crises, in which multi-disciplinary teams cooperate across national borders.

2.10 **ISAR – Assessing the impact of the Ukraine war on the agri-food chain**

Britta Müller

Bavarian Health and Food Safety Authority, Germany

The war in Ukraine can also have a negative impact on food safety and food authenticity. The potential for fraud may increase and food-related health risks may rise. In order to anticipate those risks, the LGL analysed food imports from Ukraine and Russia using the software ISAR (Import Screening for the Anticipation of Food Risks).

Ukraine has a significant share in the production of agricultural goods such as oilseeds and grain. Amongst others, the harvest, processing, storage and transport of food can be severely affected by the war. Mycotoxins, microbial contamination and an increased use of pesticides can be the result. The scarcity of food produced in Ukraine and Russia and the rising prices of animal feed, fertilisers and energy could also lead to higher food prices. This is a strong incentive to counterfeit or substitute expensive ingredients. The LGL initiated a multidisciplinary project with eight regional, national and European food safety authorities in order to assess the impact of the Ukraine war on the agri-food chain.

Vulnerable foods were identified and following specific investigations were initiated regarding health risks, for example pathogenic microorganisms, pesticide residues, mycotoxins, heavy metals, and as well adulteration.

Russia and Ukraine account for almost 80 % of mustard seed imports to Germany. In 2022 the import volumes from these two countries marked down, whereas the imports from Canada increased. Mustard seeds from Canada may exceed the maximum levels for Cadmium. Based on findings of the LGL, national control programmes were initiated.

2.11 **Fraudulent Activities and Corporate Business Culture in Food Supply Chains**

Saskia van Ruth

University College Dublin, School of Agriculture and Food Science, Dublin, Ireland

The issue of food fraud primarily stems directly from human actions in contrary to other common food quality and safety concerns. It involves individuals consciously choosing to violate ethical norms, motivated either by personal gain or on behalf of their employers. These individuals can be categorised as loyal employees, crisis responders, opportunity takers, opportunity seekers, or criminal professionals. While personal integrity plays a role, the corporate culture within food businesses and across supply chains is also crucial, as it can either deter or facilitate illicit activities. Research has shown a clear link between unethical business cultures and criminal activities within food supply chains. Intriguingly, our studies also revealed a connection between personal and corporate integrity levels. Moreover, individuals with low personal integrity often exhibit personality traits akin to those observed in white-collar criminals. They show low responsibility, like to manipulate, tend to break rules, are impulsive, lack behavioural self-control, and lack empathy. Control measures, including technological solutions like fraud monitoring and track-and-trace systems, are important in combating food fraud threats. However, managerial controls are equally essential to address the underlying motivational factors driving fraudulent behaviour.

2.12 **Enhancing Public Health: Harnessing the Power of AI in Ensuring Food Safety**

Maria Eleni Dimitrakopoulou, Manos Karvounis

Agroknow, Greece

In an era where foodborne illnesses pose significant threats to global well-being, the integration of AI technologies offers unprecedented opportunities to revolutionize traditional food safety protocols. Through the utilization of machine learning, computer vision, and predictive analytics, AI enables real-time monitoring, early detection of contaminants, and predictive modeling of potential hazards across the food supply chain. From farm to fork, AI-driven solutions empower stakeholders to proactively identify risks, implement targeted interventions, and mitigate the spread of foodborne diseases. Moreover, AI facilitates the enhancement of regulatory frameworks and policy-making processes by providing data-driven insights and risk assessments. FOODAKAI stands as a paradigm-shifting solution, harnessing the power of AI to analyze vast volumes of heterogeneous data sources, including announcements from food safety authorities, scientific literature, real-time monitoring data, and industry-specific information. Collaborative efforts between governmental agencies, industry stakeholders, and academic researchers are paramount in harnessing AI's full potential to establish robust food safety standards and ensure compliance with regulatory requirements. Additionally, by facilitating secure and transparent data sharing mechanisms, AI-driven approaches not only enable more effective risk management but also foster a culture of collaboration and trust within the food safety ecosystem.

2.13 **Food Defense: more than secure supply chains**

Paul Elsinghorst

Bundeswehr Medical Academy, Munich, Germany

Many years of peace and prosperity have made us take many things for granted: worldwide mobility and real-time communications as well as safe and sufficient energy, food and water supplies. Yet, international conflicts, crises and hybrid warfare have revealed our elusive perception of security and how interdependencies and secure supply chains have a critical impact on everyday life. Resilience has become a key term for the future of our society.

Looking at safety of food and drinking water, microorganisms, heavy metals, mycotoxins and pesticide residues have been the main focus of monitoring for decades – contaminants we know and specifically look for. But what about more uncommon or still unrecognized poisons, like biotoxins, superwarfarins or synthetic opioids? How will we recognize a contamination of food and water supplies with malicious intent? Reintroducing medieval tasters is obviously not an option, but there are strategies providing at least some layers of security.

Current food defense actions take a focus on preventive measures trying to protect the underlying logistics from a food defense event occurring in the first place. However, these actions primarily address the food industries, not governmental institutions, and suitable methods for a preventive or at least timely detection of a food defense event are, if at all, in their early stages. The presentation aims to provide an overview of the status quo of food defense and to highlight the urgent need for appropriate detection techniques.

2.14 **Interoperable Software Tools for Efficient Supply Chain Tracing during Foodborne Incident Investigations**

Adam Friedlander

U.S. Food and Drug Administration (FDA), USA

In November 2022, the FDA finalized its Food Traceability Final Rule that established recordkeeping requirements for persons who manufacture, process, pack, or hold foods on the Food Traceability List. At the core of this rule is a requirement that persons subject to the rule maintain records containing Key Data Elements (KDEs) associated with specific Critical Tracking Events (CTEs); and provide information to the FDA within 24 hours or within some reasonable time to which the FDA has agreed. The FDA is currently developing an internal Product Tracing System (PTS) to receive and analyze industry's food traceability data and more effectively and rapidly trace food within the United States. The PTS will enhance existing foodborne outbreak response processes – especially those by the FDA Coordinated Outbreak Response and Evaluation (CORE) Network – and will enable faster identification and rapid removal of potentially contaminated food from the market, resulting in fewer foodborne illnesses and/or deaths. This presentation will provide a brief overview of the Food Traceability Rule, as well as introduce some of the open-source and interoperable components of the internal PTS. It will conclude by addressing how these tools can lead to more efficient supply chain tracing during foodborne illness investigations.

Marion Gottschald

German Federal Institute for Risk Assessment, Berlin, Germany

The second part of this joint presentation will delve into the collaborative traceability projects led by the European Food Safety Authority and the German Federal Institute for Risk Assessment. These projects harness synergies among tracing initiatives and software tools across the EU and its Member States. The cornerstone of these projects involves consolidating tracing data collection, analysis and reporting software into an interoperable tracing software ecosystem. This ecosystem will be underpinned by a standardized data format for tracing known as the Universal Traceability Data Exchange format (UTX). The UTX format will offer adaptable, comprehensive solutions for various tracing scenarios, featuring standardized data blocks and the flexibility to incorporate data specific to certain tools. Both, the ecosystem and the UTX format will be tailored to meets the requirements of the local, Member State and EU authorities and allow for the integration of their existing tracing solutions. Sharing UTX data files will streamline efforts and avoid duplication of work during crises, while also facilitating potential global partnerships, such as with the U.S. Food and Drug Administration. Ultimately, the collaborative efforts through interoperable tracing software systems will enhance tracing investigations amid complex foodborne crises in the context of globalized food and feed trade.

2.15 **Over Twenty years of International Foodborne Outbreak Data: How PAIFOD Continues to Support Activities Against Foodborne Illness in Canada**

Austyn Baumeister

Public Health Agency of Canada

The Publicly Available International Foodborne Outbreak Database (PAIFOD) was initiated in 2000 with the goal of providing policy makers and other stakeholders with information to support a variety of activities to minimize the risk of human illness from food sources. To this end a database was designed to capture global publicly available outbreak data in a uniform way to aid analysis of outbreaks that inform on-going outbreak investigations on commodities or sources of similar outbreaks, review trends, and inform qualitative and quantitative risk assessments, all which support decision-making. Data extracted from outbreaks includes a wide range of key information, such as the type of microorganism or toxin, the contaminated food, the setting, the country, the year and month when the illness onset, the number of hospitalizations and deaths, major sequelae, causative reasons, the concentration of the organism, and the source of the outbreak information. Recent modernization efforts have increased avenues for exploring this data including developing a hierarchical food categorization strategy, developing a tool to capture the details of microorganisms down to serovar, data tags to indicate the availability of antimicrobial information, popular food attributes such as frozen, fermented, imported, and capturing outbreak investigation methods used during investigations. While PAIFOD has publicly available information that can be freely shared the database itself is not publicly available to query and future efforts include improving accessibility.

2.16 **Watson Workshop: Solutions for Transparency and Integrity in the EU Food System**

Dagmar Mithöfer, Claudia Coral

Humboldt-University of Berlin, Germany

This workshop is organised by the Humboldt Universität zu Berlin, Agrifood Chain Management Group and the Max Rubner-Institut, Department of Safety and Quality of Meat as part of the EU Watson project. Watson is a Horizon Europe project that aims to develop a methodological framework, combined with a set of tools and systems, to detect and prevent food fraud throughout the chain, thus accelerating the deployment of transparency solutions in the EU food system. In this workshop, participants will discuss three main questions through case studies and engaging discussions.

1) What are the main gaps in understanding food fraud and its vulnerabilities within the food system?

2) What are the different approaches for traceability and authenticity across the supply chain and how do they differ in their effectiveness and applicability in different supply chains?

3) What are the digital technology solutions within the food system to address food fraud issues and how do these solutions contribute to improving supply chain transparency and integrity?

Speakers and discutants

- Dr. Zhijun Wang, Researcher, University College Dublin “The Watson approach to transparency and integrity”
- Dr. Eleni Chatzidimitriou, Project Manager, Foodscale Hub “A methodological framework for improving traceability & integrity throughout food value chains”
- Dr. Claudia Coral, Researcher, Humboldt-Universität zu Berlin “Highlighting gaps in the food fraud vulnerability assessment: An Example of the meat supply chain”
- Dr. Paraskevas Bourgos, Research and Innovation Specialist, Netcompany-Intrasoft “The role of blockchain on food value to assure data integrity”
- Dr. Stelios Arhondakis, Founder/CEO, BioCoS “DNA traceability in the olive oil value chain: ensuring product integrity and enhancing sustainability”

Join us for an insightful discussion and valuable perspectives on how to strengthen transparency and integrity in the EU food system.

2.17 **Global initiatives in the implementation of whole-genome sequencing for food safety**

Eric Stevens

U.S. Food and Drug Administration (FDA), USA

Whole-genome sequencing (WGS) approaches have been broadly used in Food Safety to characterize foodborne pathogens. WGS has been applied to both identifying and better defining the scope of foodborne outbreaks to improving outbreak response with the linking between an isolate from a clinical patient and a food/environmental sample. Additional applications of WGS in food safety include a One Health Approach, source tracking, determining the root cause of a contamination event (e.g., transient versus resident pathogen), virulence and pathogenicity profiling, antimicrobial resistance monitoring, quality assurance of microbial testing, and its use within metagenomic studies. Aside from the generated sequences of pathogens, the corresponding metadata (e.g. data of collection, geographic location, isolate source, etc) is particularly useful in providing relevant context about a single pathogen or in constructing a trend about a group of related pathogens over time. Since 2011 the application of WGS within Food Safety has been transformative to how we think about pathogens and their relationship to the food we eat. This talk will highlight some of the recent developments of WGS within FDA's GenomeTrakr and NCBI's Pathogen Detection platform, other international sequencing efforts, the introduction of guidance and landscape documents on implementing WGS for foodborne disease surveillance, and where we stand on how to make the best use out of the data generated with respect to various data sharing options. Additionally, this presentation will offer a preview as to what the next 10 years might look like.

2.18 **Spectroscopic analysis for feed quality and safety control at site and in lab**

Vincent Baeten

Walloon Agricultural Research Centre (CRA-W), Belgium

There is an increasing demand for rapid and reliable techniques to address food quality control issues both on-site and in the laboratory. As a result, recent advancements have led to the development of handheld and near-infrared hyperspectral imaging (NIR-HSI) devices. These techniques have demonstrated promising results in determining quality parameters for complex matrices and checking the safety of products. They enable the simultaneous acquisition of in-situ, spatial, and spectral (and therefore chemical) information characterizing the samples. NIR-HSI instruments can collect several thousand spectra per sample simultaneously, which are then compiled to generate a hypercube containing frequency, absorbance values, and spatial information.

For decades, NIR-HSI systems and handheld devices have been utilized at CRA-W for food and feed laboratory analysis. It has been demonstrated that handheld NIR and NIR hyperspectral imaging devices are elegant solutions to address challenges in feed analysis. The characterization of feed products, as well as the detection of animal particles from different species or the comprehensive screening of ingredients in compound feed, has been successfully accomplished. The potential of NIR spectroscopy (NIRS) and NIR-HSI devices has been demonstrated in detecting chemical contaminants (e.g., non-protein nitrogen such as melamine) and botanical contaminants (e.g., ergot bodies in cereals), botanical impurities, animal contaminants (e.g., processed animal proteins or insects), and industrial contaminants (e.g., plastic particles). This lecture aims to provide an overview of the applications of NIR handheld and NIR hyperspectral imaging for effective quality control of various agro-food products.

2.19 **Routine detection and interpretation of anomalies using multivariate and non-targeted methods**

Eric, Jamin

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Checking the authenticity of a global commodity covers a wide range of potential frauds, and usually requires the combination of several analytical approaches. The most recent developments in the field concern the use of “holistic” approaches including targeted and-non targeted methods and exploiting the large amount of generated data via some statistical or artificial intelligence tools.

A combination of techniques, including Nuclear Magnetic Resonance (NMR), Liquid Chromatography - High Resolution Mass Spectrometry (LC-HRMS) and Isotope Ratio Mass Spectrometry (IRMS) are routinely used in our laboratory to detect alteration and confirm geographic origin of many food / natural commodities. A recent development concerns the characterization of organic versus conventional agricultural practices. Some models have been established for UHT milk, tomatoes, apples and apple juice, which correctly assign more than 90% of samples or even better.

Along with traceability tools, these new tools will better guarantee that only authorized practices have been used along the supply chain, thus increasing trust among consumers. In the move from a best-efforts obligation towards a performance requirement, they will become valuable tools for demonstrating, with science based-evidence, that integrity specifications are met.

2.20 **Innovations in the detection of unknown contaminants by non-targeted MS**

Guillem Campmajò Galvan, Hilva Gjoni, Chiara Dall'Asta

University of Parma, Italy

The increasing popularity of HRMS in the field of food contaminants is mainly due to the advantages of using the full-scan acquisition mode with high sensitivity, combined with high resolving power and accurate mass measurement. This opens to retrospective analysis, thus enabling the possibility to reconsider analytical results for stored data.

In a general meaning, a "non-targeted" analysis could be described as a screening against a large database of compounds, or a retrospective analysis of a dataset for compounds not specifically anticipated. This approach usually leads to a list of potential contaminants occurring in a sample that should be further confirmed by targeted analysis. The applicability of HRMS as a non-targeted approach indeed is based on the screening of an accurate mass of both precursor and fragments ions in one single run, by using data-independent analysis (DIA), without monitoring any preselected parent ions and based on general settings.

The potential of HRMS in the elucidation of unexpected contaminants can be further improved by coupling with ion mobility (IMS), adding a third dimension of separation based on size, shape, and charge of ions.

Therefore, HR-IMS can be successfully applied to the detection of unknown or unexpected contaminants in food as well as in the identification of potential adulterants in complex matrices.

Among the most challenging matrices to investigate, herbal supplements and botanicals may present several safety issues related to adulteration (i.e. addition of undeclared compounds or ingredients), dilution or substitution as well as general standardization in the composition. The inconsistency of the regulatory framework, the unprecedented market demand and the complexity of the supply chain make the monitoring of herbal supplements and botanicals even more difficult.

In this framework, the use of HR-IMS may offer a support in the detection of adulterants and possible addition of non-declared material.

This talk will bring some examples of the application of non-targeted mass spectrometry to the analysis of food supplements, leading to the identification of unexpected compounds or ingredients. Both fully untargeted and suspect screening approaches will be described, and the advantage provided by ion mobility will be discussed.

2.21 **Prerequisites for data analysis and AI**

Ákos Jóźwiak

University of Veterinary Medicine Budapest, Institute of Food Chain Science, Budapest, Hungary

As food systems exhibit complex behaviour, food safety regulatory science shall constantly evolve along these changes. Integration of AI and advanced data analytics in risk analysis processes present both novel opportunities and challenges. The presentation explores the foundational prerequisites necessary for leveraging data analytics to enhance safety of food systems. Key aspects include stringent requirements for data quality and the critical need for substantial data quantities, granular detail, representativeness, and interoperability.

Additional enabler of readiness for AI is the role of entities like the EFSA Advisory Group on Data, which not only provides strategic oversight but also acts as a think tank and a conduit for knowledge and expertise across Member States. Challenges such as the absence of universal standards for data, misalignment in existing data models, and the non-uniformity in sampling strategies underlines the complexities in creating a cohesive framework for data utilization in regulatory contexts.

There is a pressing need for machine-readable and FAIR-compliant data to support the construction of robust data lakes for research and control purposes. Additionally, the human element in data analytics shall be addressed, stressing the necessity for expertise in both food and data sciences to ensure effective data interpretation and validation.

The presentation calls for a concerted effort towards investing in data generation, developing standardized ontologies, promoting open data practices, and enhancing educational curricula to prepare future experts. By addressing these prerequisites, we can pave the way for more informed decision-making processes in food safety regulatory science, thereby safeguarding public health.

2.22 **The RAKIP Initiative and it's solutions**

Matthias Filter

German Federal Institute for Risk Assessment, Berlin, Germany

The RAKIP Initiative is a community-driven effort supported by 11 European risk assessment and research institutions that aims at enabling efficient exchange and re-use of predictive models (and underlying data). It addresses the need of researchers to find, apply and customize existing models irrespective of the programming language or software used for model generation. With this the RAKIP Initiative also supports general knowledge exchange, transparency and reproducibility in the risk assessment domain, as currently the exchange of predictive models (and underlying data) is difficult and time consuming.

The foundation of the solutions developed by RAKIP partners is the open FAIR Scientific Knowledge eXchange format (FSKX) that can be applied to a broad range of model classes and data. Based on FSKX a number of services and tools to search, download, apply, modify, create, combine, execute and share models online or with desktop software tools were developed.

This presentation will explain the underlying principles of RAKIP, introduce the RAKIP-Web model repository and showcase open-source software tools that support FSKX. It will also present recent achievements from currently ongoing software and content development projects. As the RAKIP Initiative is designed as a community-driven effort this presentation will conclude with recommendations on how to support or contribute.

2.23 **Towards AI-driven Food Science and Society: Opportunities and Challenges**

Tome Eftimov

Computer Systems Department, Jožef Stefan Institute, Ljubljana, Slovenia

In the last decades, a great amount of work has been done in the predictive modeling of issues related to human and environmental health. Resolution of issues related to healthcare is made possible by the existence of several available biomedical vocabularies and standards, which play a crucial role in understanding health information, together with a large amount of health data. However, focusing solely on healthcare data limits the potential benefits that our lives and societies could have from the rapid development of artificial intelligence (AI) and its enormous capabilities. As such, Lancet Planetary Health in 2019 noted that the focus of future improvements in our well-being and societies will depend on investigating the links between food systems, human health, and the environment. However, despite a large number of available resources and work done in the health and environmental domains, there is a lack of resources that can be utilized in the food and nutrition domains, as well as their interconnections.

Fostering trust within the food and nutrition industry remains an enduring and critical challenge that profoundly influences its growth trajectory and the overall health of the public. Despite the potential of technology to simplify the processing of food data, the digital landscape's unpredictability introduces additional layers of trust concerns. Persistent scepticism arises from apprehensions regarding data quality, biased artificial intelligence (AI) decision-making, and identity theft. Establishing trustworthy technology necessitates anchoring the entire process in fundamental values like responsibility, privacy, and user autonomy, especially when handling sensitive food-related data. This involves explaining how AI makes decisions and addressing biases at various technological levels.

To attain human and societal well-being through advances in the field of trustworthy AI, the talk will focus on opportunities for utilizing big data from food and nutrition and their interrelations with biomedicine and the environment. Huge amounts of data containing valuable information are now available in various datasets, registries, and scientific and grey literature, which makes it possible to use advanced Artificial Intelligence (AI) methods. However, before applying AI methods to real-life data, that is heterogeneous, unstructured (textual) data needs to be structured and normalized with other structured data. In this talk, we will explain AI methods and resources that can be used on different levels in the modeling process, starting from raw data to discovered knowledge. Finally, the existence of such methods and resources will be linked to several application scenarios of nutrient value predictions, missing nutrient value imputation, nutritional and sustainability labeling of food products, food-health relations discovery, and food chain traceability.

2.24 **Risk Negotiation - Integrated Risk Analysis for One Health**

Monika Ehling-Schulz[1], Matthias Filter[2], Jakob Zinsstag[3], Konstantinos Koutsoumanis[4], Mariem Ellouze[5], Josef Teichmann[6], Angelika Hilbeck[7], Mauro Tonolla[8], Danai Etter[9], Katharina Stärk[10], Martin Wiedmann[11], Sophia Johler[9]

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We are faced with a multitude of pressing global health risks with complex interdependencies that can only be effectively addressed in an integrated, participatory effort. Although risk analysis is a crucial tool to support decision-making, the compartmentalized nature of its current frameworks does not account for the complexity of multi-faceted systems. We propose the participatory and interdisciplinary concept of Risk Negotiation to transform the way we tackle global health challenges, such as pandemics, physical and mental health inequities, environmental problems, and food security. To allow integrated, participatory risk analysis, we need to valorize risks and trade-offs and negotiate them with stakeholder groups that represent different disciplines and sectors. This game theoretic approach becomes feasible through recent technological breakthroughs, such as artificial intelligence (AI)-assisted multi-agent negotiations or large language models (LLMs) in general. These are accessible, hold great promise in negotiating agreements and can be used to accommodate the complexity of real-world decision-making. Risk Negotiation-based risk analysis could disrupt compartmentalized, silo oriented risk analysis processes, and thereby increase global health security, equity, and sustainability.

2.25 **FoodEx2: EFSA's food classification system and the Smart Coding App**

Anastasia Livaniou, Sofia Ioannidou

European Food Safety Authority, Parma, Italy

The ability to capture all the useful details of food groups in exposure assessments by EFSA is a crucial requirement for the process of risk assessment. For this reason EFSA developed a food classification and description system, named FoodEx2 (1). This system is a standardized terminology backbone for representing and interpreting samples across the entire food safety risk assessment lifecycle, for data collections across different food and feed safety domains. At European level, FoodEx2 is used by all Member States for the purposes of the EFSA data collections but is used also by international organisations like the FAO and the WHO for encoding food consumption and food composition data. To keep this terminology and sample coding framework fit-for-purpose FoodEx2 is maintained with 1 major and 2-3 minor releases every year.

The EFSA Catalogue Browser is a Java software used to improve and facilitate the use of FoodEx2, and it is open source and freely available (2,3). FoodEx2 Catalogue is a flexible combination of base terms and facets, including different hierarchies for different food safety domains (i.e. Exposure hierarchy for food consumption, Reporting for chemical monitoring etc.), all structured in a parent-child relationship. Base terms can be of different types: Raw primary commodity (RPC), RPC derivative, Composite food simple, or Composite food aggregated (recipes). For each base terms, a scope note and different implicit attributes are defined (e.g. Scientific name, Common name, Matrix code etc.) to help users identify the correct code. Facets are descriptors providing additional information for a particular property or aspect of a food, and there are 29 facet categories in total.

The EFSA FoodEx2 Smart Coding Application (4) is a tool aiming to simplify the coding process by making use of artificial intelligence techniques capable of suggesting a series of complex FoodEx2 terms (combination of base term and facets) starting from a free text food description given as input by the user. The function of suggesting FoodEx2 terms, is achieved through various machine learning models which have been trained using historical food consumption data collected by EFSA in recent years, that have been submitted by data providers, and that have been reviewed and validated by EFSA prior to the model training phase (5). The application is hosted in the R4EU platform and can be customised in terms of language input and accuracy of proposed terms.

2.26 **New advances in risk-benefit assessments**

Sara Monteiro Pires

National Food Institute, Technical University of Denmark

Food systems and their impacts are high on the political agenda globally. The multiple impacts of diets and food systems on the health of populations and the planet are acknowledged but not always fully understood. Risk-Benefit Assessment (RBA) of foods has emerged as a decision-support tool that quantifies the trade-offs between negative and positive health impacts of foods and diets on human health, considering both nutritional risks and benefits, and microbiological and toxicological risks. This presentation will describe the main principles and applications of the RBA framework, the developments of methodologies within RBA over time, and its expanding scope to address sustainability impacts within food systems.

In the first two decades after its emergence, RBA research has mainly concentrated on methodological advancements, through the application of case studies across various populations. These case studies predominantly assessed the health impacts of scenarios of consumption of specific foods (e.g. fish and seafood; nuts; rice); of food substitutions (e.g. meat for fish; meat for pulses); or individual food components (e.g. iodine; folic acid). While various methodologies were applied, health metrics like the “Disability Adjusted Life Year” gained prominence. The increased number of published studies, international collaborations, and capacity-building efforts have contributed to harmonization of RBA methods across studies. Furthermore, ongoing research in selected European countries is addressing the challenges of assessing the health impacts of overall dietary patterns, which is particularly important when assessing the impacts of dietary shifts towards sustainability and health.

Recently, the need to consider other sustainability indicators, such as environmental and socioeconomic impacts, has promoted further development of methods and applications. The public health focus on dietary risk factors and food safety has expanded to encompass concerns about the sustainability of food systems, including their negative environmental impacts throughout food production, distribution, and consumption. These impacts are assessed using diverse metrics, from economic indicators to environmental factors like greenhouse gas emissions, land and water use, biodiversity, and even social and cultural considerations. Integrating all these impacts into a single assessment poses challenges. Recent projects have explored the application of multi-criteria decision analysis approaches, mathematical optimization, or visual representation for holistic assessments.

Methodological advancements and capacity-building efforts at the European level have increased the interest in RBA and underscored its utility for informing public health policies. However, widespread integration of RBA results in decision-making processes requires more effective communication with stakeholders. Ongoing international initiatives led by organizations like the WHO and EFSA are crucial for embedding RBA in integrated public health and environmental policies relevant to food systems. These efforts must be complemented by improved communication tools to disseminate RBA findings to the public, policymakers, and industries effectively.

The future of RBA will see a combination of research, stakeholder involvement, and international collaboration, which is key to promote knowledge translation and support international activities within RBA.

3 Abstracts – poster presentations

3.1 **Exposure Estimation Using the Physiologically Based Toxicokinetic Model with Human Biomonitoring and Comparison with Scenario-Based Exposure: A Case Study with Lead for Korean Adults**

Yong-Kook Kwon, Min-Ju Kim, Yun Ju Choi, Sang hyeon Yoon, Keum-soon Oh, Yeong Min Shin

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Lead (Pb) is a hazardous substance derived from diversty routes, with toxicity related to cardiovascular and nephrotoxicity issues. This study aims to evaluate Pb exposure in Korean adults by applying a physiologically-based toxicokinetic (PBTK) model to assess health risk. The human biomonitoring for blood Pb concentration was obtained from the Korean National Environmental Health Survey (KoNEHS) Cycle 4. For reverse dosimetry analysis, we adopted previously reported PBTK model (Dede, 2018), implemented and validated identically before undertaking the study. As a result, the average Pb exposure of Korean adults was 0.520 µg/kg bw/day (male: 0.594 µg/kg bw/day, female: 0.469 µg/kg bw/day). Afterwards, the PBTK results were compared with the scenario-based results in the risk assessment report for five heavy metals (Pb, Hg, Cd, As, Cr) conducted by the MFDS in 2021. Exposure from reverse dosimetry were approximately two times higher than scenario-based exposure for Korean adults (0.264 µg/kg bw/day). And the higher exposure levels determined through PBTK analysis may result from sustained exposure within historically more contaminated living environments, along with the long half-life Pb, as evidenced by the findings. These findings suggest that the PBTK-based method, capable of quantifying aggregated exposure levels in the body over time, can serve as a complementary tool addressing the constraint of scenario-based assessment method, which are confined to evaluating exposure levels within specific time frames. Moreover, in comparison to scenario-based exposure estimation, applicating the PBTK model is relatively convenient and cost-effective. Once constructed, the model will become a useful tool for tracking continuous national changes in hazardous substances. Therefore, based on the findings of this study, we propose the PBTK model as a complementary assessment tool to overcome several limitations in traditional scenario-based exposure evaluation for integrated risk assessment.

3.2 **An interoperable multi-actor software ecosystem for food and feed tracing and the Universal Traceability data eXchange (UTX) format**

Marco Rügen[1], Alexander Falenski[1], Olaf Mosbach-Schulz[2], Annemarie Käsbohrer[1], Bernd-Alois Tenhagen[1], Marc Lorenzen[1], Marion Gottschald[1]

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As agri-food chains have become more and more globalised and complex, powerful interoperable tracing software tools and active tracing data exchange via harmonised data structures are essential to resolve foodborne incidents quickly and reliably. Hence, a research project between the European Food Safety Authority (EFSA) and the German Federal Institute for Risk Assessment (BfR) is developing a tracing data exchange workflow and the Universal Traceability data eXchange (UTX) format to achieve interoperability between regional, national and European tracing tools. The workflow for collecting and curating tracing data involves several separate software tools which have been or are being designed for tracing and data extraction. Via the UTX portal, manual extraction of unstructured data from notifications of the Rapid Alert System for Food and Feed (RASFF) will be enabled in a guided and structured way. Complementing this, the Rapid Alert Supply Network Extractor (RASNEX) tool utilises artificial intelligence methods to automatically extract pertinent tracing information from RASFF notifications. At the local level, data will be collected using the Advanced Trace and Solve Tool (ATAST) through a web-based interface tailored for local food safety officers, featuring on-site plausibility checks and access to curated data. FoodChain-Lab Web (FCL Web) serves as the platform for visualising and analysing tracing data collected by the aforementioned tools, and also includes a reporting module. Acting as the interface between different tools (e.g., the tracing software FoodChain-Lab and the UTX portal), the UTX format will allow for the integration of their respective advantages, offering flexible and comprehensive solutions for diverse tracing scenarios. While providing standardised components for essential tracing information (core data), the UTX format will also accommodate data specific to individual tools (additional data). In the future, UTX data files might be shared via the RASFF system, minimising redundancy in manual data extraction from RASFF notifications during crises. Overall, this development is anticipated to enhance the quality, timeliness and completeness of tracing data, facilitating immediate analysis and enabling a more efficient resolution of complex foodborne crises.

3.3 **Rapid Alert Supply Network Extractor (RASNEX) tool to mine unstructured supply chain information from food and feed contamination notifications**

Marc Lorenzen, Matthew Salewski, Daria Savvateeva

German Federal Institute for Risk Assessment, Berlin, Germany

Background:

National competent authorities of member countries use the Rapid Alert System for Food and Feed (RASFF) to report information on (i) any direct or indirect human health risk arising from food or feed, (ii) serious risk to animal health or the environment in relation to feed. Particularly for foodborne disease outbreaks, it is of utmost importance to rapidly identify the involved supply chain actors and withdraw causative products, since the impacts on human and/or animal health and economic damages grow with time. The RASFF system collects information for a systematic mapping of relevant supply flows which allows the identification sources and transfers of contaminated goods, thereby enabling a fast response.

A major challenge for risk managers and risk assessors is to gain and maintain an overview over currently ongoing contamination events, as relevant information is continuously provided and updated by member countries. Recent feed related incidences in Europe illustrated that there is a need for a software system capable of supporting realtime investigations on supply chains as well as exposure assessments in crisis situations. To address these needs, the Rapid Alert Supply Network Extractor (RASNEX), an open-source tool, was developed to scan the information and identify actors, their locations and products using the AI-supported data/text mining techniques

Methods:

RASNEX was developed in Python as a browser-based app according to open-source principles. The primary engine supporting the textual analysis is large language model (LLM), which are currently enjoying popularity due to their successes in handling tasks in analyzing and reproducing natural speech.

Results:

RASNEX is able to extract actors involved in ongoing or past chemical contamination events or biological agent outbreaks from the structured and unstructured parts of RASFF notifications, as well as some formats of attached documents. The extracted information is presented alongside their source documents in a user-oriented dashboard for validation and editing. The verified information is then aggregated from all documents related to a single RASFF notification and exported using a UTX-conform output for further analysis with other tools (e.g. Excel, RACE [5], FoodChain-Lab and others). An additional feature currently in development for the dashboard is a chat interface which enables users to interact with the document.

Conclusion:

RASNEX is a user-friendly tool that utilizes the recent advances in text-based analysis from LLMs to perform assisted data mining from the RASFF notifications thus facilitating and accelerating extraction of the relevant crises and outbreak information. RASNEX is a collaborative project between BfR and the European Food Safety Agency (EFSA).

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3.4 **The Advanced Trace And Solve Tool: A regional management tool for collaboration in tracing investigations**

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North Rhine-Westphalia stands as one of Germany's leading Federal States in terms of integrated data systems. In times of increasing speed and volume of food and feed trade, efficient tracing approaches are crucial to facilitate efficient handling of foodborne incidents at the regional level. This sparked the development of the Advanced Trace And Solve Tool (ATAST), comprising several components tailored to the requirements of incident investigation at the regional and local level. The ATAST management tool serves as a central platform utilized by regional authorities to manage ongoing foodborne incident investigations. It provides a dashboard for monitoring the status of active investigations and lists foodborne incidents, with all incident-related data such as incident descriptions, involved companies, products and sample data accessible in one location. Through a JSON-based data exchange, the ATAST management tool enables the direct dispatch of investigation orders to local authorities, facilitating a seamless retrieval of collected data. Local food safety inspectors utilize the browser-based ATAST data collection tool to gather traceability data from food business operators. This tool streamlines the process with guided and structured data assessment, complemented by on-site plausibility checks. Additionally, it offers interfaces to catalogues and registers to retrieve curated master data. It is also possible to use the ATAST template upload portal in case larger amounts of traceability data need to be uploaded. All those features enhance the quality and swiftness of data collection in tracing investigations. The ATAST management tool extends its functionality by integrating with external software tools for advanced analysis, visualization, and automated reporting of collected traceability data. Through all these integrated components, the ATAST system supports regional and local authorities in North Rhine-Westphalia in promptly and reliably resolving foodborne incidents.

3.5 **Differences between local and global food supply chains**

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Food moves systematically from the producer to the consumer through different intermediaries, encountering issues such as biological and chemical contamination, and food fraud along the way. These issues vary in magnitude and frequency depending on the nature of the food supply chain, being local food supply chains perceived as performing better than global food supply chains. Hence, a review was conducted within the FoodSafeR project providing an overview of determinants in both, local and global food supply chains. An analysis was conducted using a drivers' approach to examine the drivers contributing to the emergence of food safety risk. This included a qualitative review of scientific and grey literature focussing on eight determinants: food security, food safety, technology, environmental protection, economic growth, sustainability, traceability, and data management. The goal was to identify distinctions between local and global food chains. Performance of each determinant was qualitatively assessed based on comprehensive information found in the literature, revealing that products in local food chains were perceived more sustainable and environmentally friendlier than products in global food chains. In contrast, global food supply chains were considered to provide greater food security, enhanced safety measures, adoption of advanced technology, significant contributions to economic growth, higher levels of traceability, and integration of more sophisticated data management systems throughout their supply chain compared to local food supply chains. The evidence suggests that local food supply chains encounter greater challenges, mainly regarding traceability and data management, than global food supply chains. Therefore, further research on the needs of local food supply chains could be pivotal to provide evidence-based support in optimising their supply chain processes e.g. via harmonised data structures or software systems tailored to the needs of local food supply chains.

3.6 **Horizon scanning to inform risk assessment**

Adrian Charlton, Jordina Farrus Gubern, Richard Millan

Fera Science Ltd, Sand Hutton, York, UK

HorizonScan is a web-based information service that pro-actively monitors food supply chain issues on a global scale.

Provided by Fera Science Ltd, HorizonScan is an established tool used by industry, governments and academia for over 10 years. The system tracks more than 500 commodities exported from 180 countries. Food integrity reports are collected and standardised daily by a team of experts to give users 24/7 access to real-time data concerning pesticide and drug residues, mycotoxins, microbiological contamination, heavy metals, dioxins, allergens, food fraud issues and many more.

HorizonScan features allow the user to search by commodity, country of origin, type of threat and suppliers; as well as set up automatic alerts for the raw materials and issues most important to them. HorizonScan helps users to identify emerging and increasing issues, rank analytical priorities, research suppliers worldwide and also aids with the data needed to complete vulnerability assessments.

3.7 **Effects of precursors and antioxidants on the formation of furan and its derivatives during heat treatment of perilla oil**

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Perilla oil (Perilla frutescens L.; PO) is widely used in various Asian dishes mainly due to its unique flavor characteristics. However, its physical and chemical properties can change during the heating process, leading to the formation of furan and its derivatives. This study investigated the formation of furan and its derivatives in PO after heat treatment (140, 160, and 180°C), including precursor and antioxidant effects.

The furan contents increased as the heating temperature elevated. PO enriched with linolenic acid (LN) produced the highest furan levels under all temperatures, indicating LN as the major precursor for furan in PO. Quercetin (QC) and sesamol exhibited furan reduction effects of 30.90% and 19.28%, respectively. As the temperature rose, the peroxide value also increased, mirroring the furan content pattern. This correlation implies that the increase in furan levels might result from the lipid oxidation of PO. Furthermore, the 2,2-diphenyl-1-picrylhydrazyl (DPPH) loss assay revealed that QC is efficient in scavenging free radicals. Also, the addition of QC effectively reduced the contents of furan and its derivatives, attributed to its radical scavenging ability.

All of 11 furan derivatives, including 2-methylfuran, 2-ethylfuran, and furan-2-carbaldehyde, were identified in PO. These compounds can be formed by various temperature-dependent processes, including lipid oxidation, Maillard reaction, and thermal degradation of ascorbic acid (AA). Overall, their levels increased with the addition of LN, AA, and also heat treatment. This study demonstrated that thermal cooking of PO promotes lipid oxidation and degradation of AA, significantly increasing the formation of furan and its derivatives.

3.8 **A Framework for Attributing Probabilities to Food Items in a Foodborne Disease Outbreak**

Sandra Rudeloff, Hanno Friedrich

Kühne Logistics University (KLU), Hamburg, Germany

Unsafe food poses a significant health and economic challenge globally, resulting in 600 million cases of foodborne illnesses and 420,000 deaths annually and an economic burden estimated at US$15.5 billion in the United States alone. The limitations of traditional outbreak investigations, primarily based on patient interviews, have prompted the development of complementary data-driven tools utilizing diverse data streams. Despite these advancements a significant gap in systematically and efficiently integrating all available information persists.

This research presents a framework that formalizes the integration of diverse data sources to bridge this gap. Central to this framework is the proactive collection and analysis of critical information prior to an outbreak, setting a foundational basis for the rapid calculation of contamination probabilities for various food items when an outbreak occurs. It specifies three essential data types: (1) historical food-pathogen pairs; (2) pathogen preferences which assess the likelihood of specific foods being contaminated based on intrinsic and extrinsic food characteristics; and (3) descriptive data on outbreak patterns, capturing variations in food preferences influenced by demographics and seasonal factors.

Upon the onset of an outbreak, once the responsible pathogen and affected demographics are identified, the framework leverages the pre-gathered data to construct a probability distribution for potential food item contaminants. This process aims to prioritize investigation efforts towards food items with higher probabilities of contamination given the specific conditions of the outbreak. Designed to supplement traditional methods and existing data-driven models, this framework seeks to enhance the speed and accuracy of pinpointing contamination sources.

3.9 **Re-conceptualising food fraud vulnerability within a social justice frame: Preserving the authenticity of Spanish honey**

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The European honey sector faces significant regulatory changes, especially in labeling and increased controls, due to concerns about food fraud. Since the early 2010s, food fraud has become a priority in the EU due to serious incidents and the complex, cross-border nature of the food system. The vulnerability approach has been at the heart of the EU food fraud prevention system since its inception. Research on food fraud vulnerability has drawn mainly from criminological and behavioral science theories, shedding light on fraud opportunities, motivations, and responses to control measures. However, social justice considerations have often been overlooked. This article contributes to a reconceptualization of food fraud vulnerability by considering social and environmental justice considerations regarding participation and impacts, especially for vulnerable actors of the chain. Based on narratives extracted from interviews with actors and experts in the Spanish honey supply chain, this study focuses on understanding food fraud vulnerability, exploring different aspects such as factors that increase vulnerability, stakeholders' perceptions, and the responses of various actors in the chain. This study highlights factors such as climate change, pests and diseases, and international trade dynamics that threaten the viability of traditional beekeeping. Other vulnerabilities include methodological limitations, regulatory gaps, power inequalities, and unequal participation in decision-making. Proposed solutions include implementing geographical indication schemes and direct producer-consumer interactions, promoting transparency measures, and improving data and information-sharing practices. Overall, this study contributes to a more comprehensive understanding of food fraud vulnerability and advocates for inclusive risk management approaches.

3.10 **Advancing Early Alerting and Decision Support in Supply Chains with OpenEPCIS and EPCIS 2.0 Subscriptions**

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As global supply chains grow more complex, benelog GmbH & Co. KG unveils OpenEPCIS, leveraging EPCIS 2.0 subscriptions for improved supply chain visibility and agility. This innovative tool enables real-time, data-driven decisions, aligning with the latest GS1 standards for seamless communication.

Our objective is to transform supply chain management by integrating OpenEPCIS with proactive risk management and operational optimization, fostering a transparent, efficient, and resilient ecosystem.

Implementation leverages strategic EPCIS 2.0 subscriptions within OpenEPCIS, providing real-time event notifications for dynamic supply chain monitoring and management. This cloud-based, scalable platform integrates smoothly with existing systems, enhancing flexibility.

In conclusion, OpenEPCIS with EPCIS 2.0 subscriptions significantly advances supply chain management, improving early alerting and decision support. With benelog GmbH & Co. KG's expertise in GS1 standards, OpenEPCIS is poised to redefine supply chain visibility and responsiveness, equipping businesses to effectively address modern challenges.

Keywords: Supply Chain Management, Early Alerting, Decision Support, OpenEPCIS, EPCIS 2.0, GS1 Standards, Real-Time Notifications, Interoperability, Cloud Computing.

3.11 **Empowering Agent-based AI: An Innovative Framework for Model Execution and Interoperability**

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Introduction: The growing dependence on predictive modeling across various sectors including research, product development, and risk assessment highlights the need for an infrastructure that supports consistent execution across diverse operating systems and computational settings. We introduce an advanced framework that integrates the FAIR Scientific Knowledge eXchange (FSKX) standard with prevalent open-source communication protocols and an innovative encapsulation strategy.

Goals: Our project is focused on developing a flexible, cloud-based infrastructure for running FSKX models, resolving dependency issues by creating custom encapsulated environments unique to each model's needs. Through the adoption of the EPCIS 2.0 (Electronic Product Code Information Services) standard, our system promotes effective interaction between discrete application programming interfaces (APIs) within this ecosystem.

Encapsulation of FSKX Models: Traditional methods of managing compute environments often struggled with meeting their specific requirements, which limited their cross-platform functionality. Our strategy creates a series of encapsulated environments, each corresponding to a single model, hence providing the specific computational context required.

Communication via EPCIS API: At the heart of our architecture is a flexible framework that connects to any FSKX model repository, enabling access to and deployment of models via standard APIs. This design allows service providers and research groups to develop tailored user interfaces while maintaining a consistent core infrastructure.

Conclusion: Our method is set to enhance the potential of community-supported model repositories by providing well-defined, conflict-free computational environments for a wide range of model applications. In addition, the API framework we've developed can also serve as a valuable tool for agent-based AI and large language model (LLM) technology, offering a robust, secure, and adaptable foundation for model execution across supply chain networks.

This research has been funded by the German Federal Ministry of Food and Agriculture (BMEL) in the research project “KI- & Daten-Akzelerator (KIDA)” with project number 28KIDA004.

3.12 **Zukunftslabor2030: Pioneering AI and novel technologies for advanced food freshness monitoring and spoilage predictio**

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Introduction: Safety and quality are essential for enjoying food without hesitation, but they depend on dynamic physiochemical and microbial changes of the products.

Real-time assessment of food freshness requires continuous monitoring throughout the entire process chain from production, storage and distribution to sale.

Goals: The objective of the research project "Zukunftslabor2030" (Future lab 2030), which is funded by the German Federal Ministry for Food and Agriculture (project number 28DK126F20), is to employ artificial intelligence and novel technologies to develop an efficient and sustainable system for monitoring food products in order to achieve improvements regarding food quality and safety, consumer protection and food waste reduction.

Platform architecture and standards: A fundamental component of the Zukunftslabor2030 project are digital twins which serve as digital representations of the properties of food products.

Using measurement data and modelling algorithms, the digital twins enable a dynamic assessment and prediction of food spoilage depending on environmental parameters such as temperature.

Communication between the individual modules of the Zukunftslabor2030 application, such as the data platforms, the predictive models and the digital twins, takes place via an EPCIS 2.0 service (EPCIS = Electronic Product Code Information Services), an exchange format for event-based product tracking and process documentation in the food trade.

Assessment and prediction of food spoilage are generated by predictive models developed within the project and provided in the harmonised exchange format FSKX (FSKX = FAIR Scientific Knowledge eXchange).

Conclusion: The Zukunftslabor2030 project aims to enhance food safety and quality by integrating artificial intelligence and new technologies for real-time food freshness monitoring and spoilage prediction, leveraging digital twins, predictive modeling, and the EPCIS standard for data exchange.

Keywords: Zukunftslabor2030, food supply chain, food freshness monitoring, food spoilage prediction, digital twin, EPCIS, FSKX

3.13 **Linking the Chain: Linked Data and Knowledge Graphs in commodity chains**

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Globalization increases the interconnection of markets, resulting in longer and more internationalized supply chains and thus higher complexity, making tracing products and their components challenging. For proper risk assessment, products and their components need to be reliably identifiable and traceable. Due to the number of partners and methods involved, collected data will occur in different formats, both as structured and unstructured data, making it difficult to utilize the full potential of the data available. Linked Data can help integrate data from different sources, interlinking and storing relations between data points and therefore, simplify the analysis of this complex and interconnected information. The developments in large language models have made it possible to at least partially automate the task of transforming data into Linked Data. We will show the process of generating Linked Data with an example data set, including triple generation and matching of terms to existing ontologies. Especially commodity chains can benefit from Linked Data in Knowledge Graphs as information across different stages in the supply chain can be related, seamlessly processed and analyzed. Knowledge Graphs allow discovering hidden relationships and therefore help getting a holistic view on commodity chains, avoiding data silos. This bears the possibility to consider additional factors for risk assessment and to act proactively, for example when it comes to product recall scenarios. To conclude, Linked Data and Knowledge Graphs can facilitate getting a holistic view on complex data and by doing so can help to identify risk factors along the commodity chain.

3.14 **Optimizing the Montenegrin Milk Supply Chain: A Data Visualization Approach**

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INTRODUCTION: This study provides an overview of Montenegro's milk supply chain, emphasizing food security and safety through the analysis of milk production, processing, distribution, and consumption. It identifies key gaps and opportunities for optimization, offering insights to enhance the entire system.

MATERIALS AND METHODS: A comprehensive database of dairy producers was compiled from the Register of Food Business Operators (FBOs) in Montenegro, enriched with detailed information on production capacity and employee count. Data on production, consumption, and trade were collected and analyzed from national (MONSTAT) and international databases (FAOSTAT, EUROSTAT, UN COMTRADE), with HTS codes used for product categorization. Python’s libraries, such as NetworkX, Pandas, and Matplotlib, were instrumental in calculating data and visualizing the milk flow network.

RESULTS: Data categorized by stages of milk production and consumption revealed significant discrepancies: production and import amounted to 103,742,010 kg, whereas consumption and export of raw and processed milk totaled only 44,090,156 kg. This imbalance primarily stems from the production of cheese and other milk derivatives. Visualization of milk production and consumption is detailed by municipalities, providing a clear geographic distribution of the data.

CONCLUSION: The study aims to assist decision-makers identify municipalities for increasing milk production, boosting producer incentives, and strategically positioning collectors and processors to reduce costs and time from production to the final product. By leveraging data visualization, stakeholders can better understand the dynamics of milk flow, supporting strategies to enhance food security and supply chain efficiency.

3.15 **Enhanced Early Detection of Food and Feed Risks Through AI-Based Weak Signal Mining**

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New and changing influences make the early detection of food and feed risks more important than ever. These influences arise from novel food and nutrition trends, changes in the supply chain or production processes, as well as a variety of impacts resulting from, for example, climate change and demographic change. Only through the early identification of potential risks is it possible to respond preventively and strategically to food and feed hazards and communicate them appropriately.

Although text data is abundant, the precision of a text based early risk detection system remains inadequate in various risk assessment processes. Weak signals are an important concept in early risk detection. The concept of weak signals, crucial for early risk detection, has become outdated with the conventional methodologies used. However, recent advancements in artificial intelligence provide opportunities for more accurate, context-sensitive analysis and interpretation of these signals.

This poster presents an AI-enhanced approach to weak signal detection that offers significant improvements over traditional techniques. By leveraging this novel method of weak signal mining, risk assessors can more effectively identify and monitor potential risks at their nascent stages, ensuring timely and informed responses.

3.16 **Does imported food pose an increased microbiological risk to consumer health?**

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Global food trade has revolutionized consumer access to a wide array of food products from around the world. However, the complexity of the globalized supply chains increases the risk of microbial food contamination, posing potential threats to consumer health.

Since 2009, Germany has conducted the Zoonoses Monitoring under Directive 2003/99/EC to track trends and sources of zoonotic agents. Over the years, several monitoring programs have included imported products, revealing concerning findings, such as the presence of Listeria monocytogenes and methicillin-resistant Staphylococcus aureus (MRSA) in about 30 % of imported fish samples. In 2021, according to Commission Implementing Decision (CID) 2020/1729/EU, the requirement to analyse poultry, pig and bovine meat at border control posts was established. Very few batches of turkey and pork meat were imported into Germany. No significant differences were found between bovine meat obtained at border control posts and at retail. For chicken meat, although there were no significant differences in prevalence for most of the analysed microorganisms, all isolates obtained at border control posts showed higher resistance rates than isolates obtained at retail. Particularly alarming was the prevalence of ESBL/AmpC-producing E. coli in imported chicken meat, with 91.8 % of samples testing positive compared to 33 % in retail samples. Genetic characterisation of these ESBL/AmpC-producing E. coli isolates also showed high diversity in the genes found not only between the two sources but also within them. These findings underscore the critical need for further investigation of imported food, as it may pose an increased risk to consumer health.

3.17 **ZooNotify - New online portal provides data on the occurrence of zoonotic agents and their antimicrobial resistances along the food chain in Germany**

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Zoonoses data from the food chain in Germany are primarily available in reports. This results in limited accessibility and re-usability of this data in science and risk assessment. With ZooNotify, the Federal Institute for Risk Assessment and the Federal Ministry of Food and Agriculture aim at making existing zoonoses data findable, accessible, interoperable and re-usable (FAIR).

The ZooNotify data base comprises data from 2012 to 2021 collected under the framework of the zoonoses monitoring and the Salmonella control programmes in poultry, according to Directive 2003/99/EC and Regulation (EC) No 2160/2003, respectively. Currently, aggregated antimicrobial resistance data for Germany are available, which will be complemented with non-aggregated data on resistance and occurrence soon.

Users can filter the ZooNotify data base according to individual interests. ZooNotify further offers different pre-defined graphs for easy and quick data visualization. For example, “temporal trend graphs” visualizing the development of resistance rates of microbiological isolates to antimicrobial substances over time. Additionally, the filtered data and associated metadata can be downloaded in csv-format. ZooNotify also provides explanations for the available graphs and the methods for resistance testing as well as isolate collection and characterization. Moreover, ZooNotify supplies an application programming interface in JSON-format for improved interoperability.

Overall, ZooNotify offers a digital solution to integrate data about zoonotic agents and their antimicrobial resistance along the food chain. The continuous development of functionalities and data expansion of ZooNotify supports the EU “open data” strategy and forms an important basis for improved risk assessment and animal and consumer health protection.

3.18 **Risk Assessment of 3-MCPD in Koreans through Soy Sauce Consumption**

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Background: 3-Monochloropropane-1,2-diol (3-MCPD) is a compound of chloropropane produced during the manufacturing process of food. This chemical contaminant has been classified as Group 2B (probably carcinogenic to humans) by the International Agency for Research on Cancer (IARC). In Korea, food standards of 3-MCPD are applied to acid-hydrolyzed and blended soy sauce. Soy sauce is usually consumed daily by the Korean population. The aim of this study is to safety management of 3-MCPD in foods by risk assessment through the food intake of the Korean population.

Methods: A total of 231 food items (7,438 samples) were monitored for 5-years (2019-2023) to analyze concentrations of 3-MCPD. For risk assessment, only data from soy sauce (4 items, 136 samples) were used. Exposure level and risk index were calculated by the data of contaminant degree and the amount of food consumption. The 7-9th (2017-2022) Base data and 24-hour recall data from the Korea National Health and Nutrition Examination Survey (KNHANES) were used to extract the dietary intake and body weight of the Korean population. We used R (ver. 4.3.1) for statistical analyses.

Results: The concentration of 3-MCPD was 0.004 mg/kg in the 136 soy sauce samples. The results of exposure level and percentage of tolerable daily intake (TDI%) about the TDI of 3-MCPD (2.7 μg/kg b.w./day) in Korea were 0.39 μg/kg b.w./day and 14.6%, respectively.

Discussion & conclusion: Exposure to 3-MCPD by consumption of soy sauce is considered safe. The reason is that the result of the risk index in this study was lower (60.8%p) than the risk index of 75.4% (TDI%) based on our food intake (6.3 g/day, soy sauce) with the Korean standard regulation for 3-MCPD (0.02 mg/kg).

3.19 **Leveraging Large Language Models for Risk Assessment in Commodity Chains**

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The integration of Large Language Models (LLMs) into global commodity chain management for risk assessment presents both promising advantages and notable challenges. LLMs offer advanced analytical capabilities, leveraging vast amounts of data to enhance decision-making processes and identify potential risks. By processing diverse data sources, including unstructured data such as news feeds and market reports, LLMs can provide early warnings of supply chain disruptions, forecast market trends, and suggest mitigation strategies.

However, the application of LLMs also introduces several challenges. Dependence on data quality and the breadth of data available can significantly influence the accuracy of risk assessments. Misinterpretations or biases in the models due to skewed data inputs or algorithmic limitations pose additional concerns, potentially leading to flawed decision-making. Furthermore, the complexity of LLMs requires specialized knowledge and significant computational resources. Moreover, the deployment of LLMs raises concerns regarding data protection and privacy. Ensuring robust data protection measures and compliance with privacy regulations is paramount to mitigate such risks and maintain trust in LLM applications within commodity chains. Additionally, there is the risk of over-reliance on automated systems, which might lead organizations to undervalue human expertise and intuition in risk assessment processes.

In conclusion, while LLMs have the potential to transform risk assessment practices in global commodity chains by providing detailed insights and proactive management tools, their effectiveness is heavily contingent upon the integrity of the data and the design of the algorithms.

3.20 **Practical implementation of AI-assisted risk negotiation**

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Global communities encounter various risks ranging from ecological challenges to economical and geopolitical conflicts. To mitigate these risks, a rapid and efficient risk analysis is critical. Efficient risk analysis involves (i) identifying potential threats, (ii) assessing their severity and likelihood, and (iii) determining the best course of actions. In our recent work we proposed a risk analysis framework centred around AI-assisted risk negotiation between relevant stakeholders and suggested how large language models (e.g. LLMs) and multi-agent modelling approaches can assist stakeholders at all stages of the risk analysis (Ehling-Schulz et al., 2024). The present work demonstrates the practical implementation of the above-described principle.

Each stakeholder is represented by an LLM-based autonomous agent and together all agents are involved in the risk negotiation process (e.g. multi-agent simulation) simulating negotiations between stakeholders. Firstly, with the assistance of retrieval augmented generation (RAG) concept (Guu, Lee, Tung, Pasupat, & Chang, 2020) and LLMs we extract relevant information about the stakeholders (i.e. agents) and discussed topic. Then the agents are involved in the preliminary discussion to define the list of concrete topic-related issues to be debated. Finally, agents negotiate over these issues and search for a solution within a scorable role-playing negotiation game setup (Abdelnabi, Gomaa, Sivaprasad, Schönherr, & Fritz, 2023).

We argue that AI-assited risk-negotiation pipelines help to mitigate time and information constraints stakeholders experience during the roundtables. At the same time, having human supervision at all principal preparatory stages enables to account for potential data inherent biases and to align with ethical principles.

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3.21 **Optimizing Quality Assurance: Multivariate Evaluation of Quality Control Samples in Spectroscopic Authentication of Food and Feed using KNIME**

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As supply chains become more complex, the potential for food and feed fraud increases. In this context, analytical authentication of these products is becoming increasingly important. Non-targeted screening has the potential to detect unknown adulterants in the products and thus provide an indication of possible fraud.

Non-targeted chemical analysis based on 1H-NMR spectroscopy is a powerful tool for the authentication of food or feed. In this strategy, every 1H-NMR spectrum is converted into a set of multiple variables, representing a chemical fingerprint of the sample. The measurement and evaluation of 1H-NMR spectra of proper quality control (QC) samples is crucial for the correct interpretation of results produced with this method. When food or feed samples are analyzed over a long period of time (from weeks to years) QC samples must also be analyzed each measurement day. Different strategies exist for the statistical evaluation of QC samples measured over a period of time. Among these strategies, a control chart is particularly useful as it allows to visually evaluate if a process changes over time or if a recently measured sample must be considered as an outlier. This requires that a sufficient number of QC samples is measured to enable the calculation of the corresponding limit values of the control chart. The regular measurement and processing of non-targeted 1H-NMR QC samples produce an array (table) with multiple samples and variables. The computational processing of this data array can be executed using open source, free software like R. This approach commonly requires the sequential, command-based execution of different functions provided by R packages. In order to streamline and make the assessment of QC samples more comfortable for end users, we present an automated, user-friendly application for the evaluation of 1H-NMR QC samples. The application is implemented in the data analytics, reporting and integration platform KNIME.

We introduce the conceptualization of the KNIME tool alongside an overview of the data analysis steps in each section of the workflow. We foresee that food chemists in particular and analytical chemists in general can benefit from using our software tool. In order to accommodate user specific needs, we are open to discuss potential collaborations with other researchers.

3.22 **Predictive Models for the Growth of Cronobacter sakazakii in Foods for People with Weakened Immune Systems**

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Cronobacter sakazakii (C. sakazakii) is commonly found in contaminated powdered infant formula, but also found in various foods such as cheese, nuts, and meat products. As the Cronobacter infection is known to be serious among people with weakened immune systems such as infant and the elderly, monitoring and management of C. sakazakii are necessary. The aim of this study is to develop predictive models of C. sakazakii in foods for vulnerable populations: infants and the elderly. We selected cheese as the sample for infant food and processed-meat product as the sample for the elderly food, considering risk ranking, production, and consumption. Each sample was inoculated with a mixture of two C. sakazakii strains and stored at 10, 15, 25, 30, 37°C in cheese and 22, 30, 37°C in processed-meat product to observe the kinetic behavior of C. sakazakii. To fit the growth data of C. sakazakii in each sample, Baranyi model was used as the primary model. The results indicated that the primary models fitted the growth data well ($R^2>0.96$). The secondary models were developed with lag phase duration (LPD) and maximum specific growth rate (μmax) as the function of temperature. In cheese and processed-meat product, the bias factor and accuracy factor were calculated close to 1 (Bf; 0.943 and 1.020, Af;1.068 and 1.072, respectively) and the RMSE value was also approaching to 0 (0.495 and 0.399, respectively). Therefore, these models could provide useful tool as an input model for microbial risk assessment in cheese for infants and processed-meat product.

3.23 **Novel Next Generation Sequencing Panel method for the Multiple Detection and Identification of Foodborne Pathogens**

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Next Generation Sequencing (NGS) is the latest technology that can analyze the genetic material of organisms and is used for various basic research, but it is not used as a standard test method for analyzing the cause of food poisoning. In order to more accurately identify the causative agents of food poisoning, we developed a technology that can simultaneously detect 17 target pathogens by laboratory NGS(S5). Although we have developed NGS for detecting 17 target pathogens, we wanted to apply the latest technology to see if it is possible to detect foodborne pathogens more accurately. 138 strains of the 17 target pathogens were analyzed. The strains were grown and genomic DNA was extracted using DNeasy Blood and Tissue kit. A DNA library was constructed from the extracted DNA, and specific regions were amplified. After the last step, the concentration was measured after purification and diluted for sequencing, and the sequence information was analyzed using FDG-NGS. The foodborne bacteria panel result using S5 instrument was identical to the in silico results, confirming that all 146 genes/692 amplicons were detected. However, when applied in nanopores instrument, 117 genes/314 amplification were found to be the optimal detection sites. The minimum detection limit analysis using each strain confirmed a minimum detection concentration of 3 pg. Based on the minimum detection limit analysis, we identified the need for further analysis of data output and analysis time.

3.24 **CATALYSE: Catalysing scientific innovation into food safety action**

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Introduction: Since the year 2000, Europe acts to maintain the highest levels of food safety in all Member States and to continuously improve food safety measures through research & innovation. Continuous advances in the industrial processes and control measures, pose new challenges in sharing knowledge on innovations among all food system actors. Research in recent years has driven immense advances, but barriers exist that can impede knowledge sharing among food system actors, hindering innovation in food safety.

Purpose: The ambition of CATALYSE is to promote the creation of a more resilient, sustainable, and equitable community, both online and in practice, to meet the needs of all stakeholders, from Farm2Fork, with the common goal to ensure food safety.

Methods: Catalyse will not generate science by itself or promote specific proprietary solutions: It will be a common place where all the actors of the food chain can meet, innovators, regulators, academia, industries, non-governmental organisations and define together the needs and possibilities that innovation can either answer and/or offer. By linking all these actors, we will foster tailor made and co-created innovation with an identified market for implementation, providing win-win solutions.

Results: The CATALYSE concept is based on the theory that, to be a catalyst for change, an interconnected system must be in place, and information of high quality is essential. This information must be translated in a way that all relevant stakeholders involved understand and commit for change, and widely shared. Education and training is essential as a pillar of change, to ensure that all system actors are aware of the latest developments.

Significance: Food safety, nutrition and food security are closely linked. Unsafe food creates a vicious cycle of disease and malnutrition. In addition to contributing to food and nutrition security, a safe food supply also supports national economies, trade and tourism, stimulating sustainable development.

3.25 **TITAN: Supply chain transparency for food safety**

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Introduction: TITAN aims to support consumers, including kids, to make informed healthy and sustainable food choices. Healthy meaning: safe, authentic, and in line with dietary recommendations. Sustainable meaning: good for the planet, the people and the economy.

Purpose: Food supply chains that are safe and traceable are essential for protecting consumer health and preserving the quality of the final product. Contamination or fraud risks can be reduced by tracking products through each step of production, processing, and distribution.

Methods: We will present a novel modular approach for the different steps of DNA analysis in two different use cases to ensure both authenticity and traceability on the olive oil value chain in combination with Blockchain, and with AI to prevent the presence of unintentional allergenic ingredients on the bakery value chain. Next-Generation sequencing technologies will be exploited for the rapid characterization of the microbial ecology in fermenting foods, the monitoring of multi-strain cultures applied to food for fermentation, ripening and bio-preservation and the composition food supplements based on live microorganisms.

Results: We are developing and integrating DNA-based methods for the specific detection of autochthonous olive varieties on miniaturized devices icw blockchain to ensure the full traceability of this product. A similar approach is being developed for the detection of the main allergenic ingredients that can contaminate the bakery value chain, and its combination with AI to better control the safety of these products. We are developing solutions for rapid NGS protocols for fermented food products benefiting from the following advantages: high resolution identification markers HPME, quantification of live/dead microbial cells, and optimized DNA extraction and concentration for contaminants.

Significance: TITAN explores how innovative solutions are reshaping the food industry to promote supply chain transparency to ensuring food safety.

3.26 **Predictive Microbiology in Official Food Control: status and future perspectives in Spain**

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Predictive Microbiology benefits food Official Control activities by providing valuable information for decision-making, microbial risk assessments, resource optimization and compliance monitoring. However, the adoption of software tools and models for assessing microbial responses in foods by Official Control agents is still limited. A survey, encompassing questions on the adoption, limitations and understanding of predictive microbiology concepts and software tools, was conducted among Official Control agents in Spain from June-September 2023. A total of 305 responses were obtained. Among the respondents, 93.8% perceive predictive microbiology tools as valuable as they offer quick and cost-effective results. The complexity of tools, lack of knowledge and protocols for their application and lack of suitable models, were indicated as the main reasons limiting the use of predictive microbiology. Moreover, only 33.2% of respondents uses predictive tools by their own choice, while 73.6% believes that there is a lack of user-friendly tools available, being ComBase and MicroHibro the most used ones. The primary area of interest for respondents regarding predictive modelling is in shelf-life estimation, alongside the production and distribution chains. Additionally, 84.3% of the respondents claim that Official Control would benefit from the integration of predictive models into traceability systems and logistics management. Survey results highlight the need to improve the accessibility and availability of Official Control agents to predictive microbiology resources, as well as the need to increase the interoperability between the available tools. This study is valuable for policymakers, researchers, and industry professionals seeking to enhance food safety and quality through predictive microbiology.

3.27 **Biomedical Event Extraction for Chemical Risk Assessment**

Kerstin Neubert, Julia Golz

German Federal Institute for Risk Assessment, Berlin, Germany

European agriculture makes widespread use of chemical pesticides to optimise crop yields, with pesticides sales around 350,000 tonnes per year (from 2011 to 2020). Exposure to pesticides has been linked to severe health issues in humans including cancer, heart, respiratory and neurological diseases. Moreover, they are known to reduce biodiversity in insect species and impact ecosystem health, putting food production at risk in the future [1].

Chemical risk assessment aims to characterise potential effects of a hazard on biological and ecological systems. Crucial effects, so-called key events (KE) of a substance, that are observed on molecular, cellular and organ level and subsequent negative overall impact on the organism (e.g. cancer) are modelled in Adverse Outcome Pathways (AOPs) in the AOPwiki [2]. New Approach Methodologies (NAMs), a wide range of animal-free approaches, provide very large amount of data for these events. For a specific risk assessment question experimental evidences, that are stored in various data sources have to be evaluated in an elaborate review process. Therefore we aim to automatically extract key event components consisting of the biological process (e.g. gene expression), a biological object (e.g. a gene), and the direction of the perturbation of the system (increased or decreased) from publications. Event extraction is a popular approach to resolve the complex interactions of biomedical entities in texts. We detect entities and events across multiple levels of biological organisation from molecular to the organ system level in a dataset with focus on toxicity of polychlorinated Dibenzodioxins and Dibenzofurans (PCDD/PCDF) from the AI4NAM project [3].

This research has been funded by the German Federal Ministry of Food and Agriculture (BMEL) in the research project “KI- & Daten-Akzelerator (KIDA)” with project number 28KIDA004.

[1] Briefing no. 06/2023 Title: How pesticides impact human health and ecosystems in Europe EN HTML: TH-AM-23-007-EN-Q - ISBN: 978-92-9480-559-1 - ISSN: 2467-3196 - doi: 10.2800/760240

[2] https://aopwiki.org/

[3] Blümmel, Tilmann, et al. "Exploring the use of Artificial Intelligence (AI) for extracting and integrating data obtained through New Approach Methodologies (NAMs) for chemical risk assessment." EFSA Supporting Publications 21.1 (2024): 8567E.

3.28 **Improving Global Commodity Chains: A Technological Framework for Enhanced Food Quality Control and Transparency**

Paraskevas Bourgos, Amalia Ntemou, Ioanna Drigkopoulou, Pantelis Lappas, Spyros Evangelatos

Netcompany-Intrasoft

This poster presents a novel technological framework developed by Netcompany-Intrasoft (NCIS) to tackle challenges in global food supply chains, including food fraud and security, sustainability, traceability, and transparency issues. It integrates advanced blockchain technology, a digital food product passport as well as fosters evidence-based decision making through AI and ML for preventative interventions and actionable planning.

Central to this initiative is the deployment of blockchain solutions that ensure data integrity and traceability across the supply chain. This infrastructure supports real-time data accessibility and fraud prevention, establishing a trustworthy environment for all supply chain participants. Additionally, the framework includes the development of a digital food product passport technology and interface. This technology is essential for documenting and communicating detailed, tamper-proof information about food products throughout their journey from farm to table. Furthermore, an AI-enabled Early Warning and Decision Support System leverages predictive analytics to preemptively identify and mitigate risks of food fraud, enhancing decision-making processes and ensuring the reliability of food quality and safety.

The efficacy and adaptability of this technological framework are exemplified through its application in several Horizon Europe projects—FOODGUARD (GA No 101136542), WATSON (GA No 101084265), and ALLIANCE (GA No 101084188). These projects demonstrate how the framework's innovations are tailored to meet specific challenges within the food industry. NCIS has played a key role in deploying these technologies, showcasing its commitment to leveraging IT solutions to enhance global commodity chains and ensure a safer, more transparent global food system.

3.29 **Digitizing One Health through Food Traceability**

Thomas Art Burke, Gabriel Armas-Cardona, Antje Risius

University of Göttingen, Germany

Advancements in food traceability regulations, such as the US FDA's Food Traceability Rule, are spurring supply chain digitalization and novel food safety informatics techniques. To work collaboratively across administrative and disciplinary silos in public health regulatory programs, One Health (OH) approaches are increasingly relevant. For example, livestock-contaminated agricultural water was likely, but not definitively, a source in romaine lettuce-implicated Escherichia coli O157:H7 outbreaks. Additionally, antimicrobial use in livestock production promotes resistant pathogens, but human exposures through food, water, and other environmental sources needs further elucidation. One Health, though an excellent collaborative framework, has yet to be successfully operationalized within public health authorities to its fullest extent, especially in finding underlying health determinants that lead to interventions. Institutional OH programs will need to channel and connect disciplinary stakeholders to digital supply chain information productively. Herein, we have designed an OH framework for the usage of standardized data carriers (2D barcodes), data standards (Electronic Product Code Information Services (EPCIS) and GS1 Digital Link), animal identifiers, geospatial data, and traceability data elements to empower investigative pathways for exposure assessment. As OH is increasingly employed by food systems regulatory authorities for both surveillance and foodborne illness investigations, we suggest adopting data science infrastructure, development, and documentation strategies (such as Agile) as collaborative scientific working processes within multidisciplinary teams. Advances in open source software, data standardization, and other multi-stakeholder technology consensus processes can further benefit OH-traceability programming.

3.30 **Rapid detection of honey adulteration – An on-field approach**

Bettina Haack, Janet Riedl, Carsten Fauhl-Hassek

German Federal Institute for Risk Assessment, Berlin, Germany

Honey is a popular food commodity to consumers and achieves high sales prices. From the consumer perspective, the quality and safety of the product is related to its authenticity. In recent years, a growing number of fraud incidents has been identified raising concerns about the authenticity of honey products. Testing for authenticity is important for both regulatory and commercial reasons to reduce common honey fraud, such as mislabeling by masking the true variety or origin, dilution with less expensive syrups and intensive supplemental feeding of honey bees. There are analytical approaches available that are established for honey authentication, but these methods are often time-consuming, expensive and not sufficient to meet the broad range of practices with regard to honey fraud.

A lot of effort has been put into the development of non-targeted approaches for food authentication. Beside general benefits, such as short acquisition time and simple sample preparation, their main advantage is the potential ability to detect any anomalies in a food sample. In the present study, Mediterranean honey samples were analyzed both pure and artificially adulterated with sugar syrups using a handheld Near Infrared (NIR) spectrometer. The results of the multivariate data analysis demonstrate the potential of handheld NIR spectroscopy for a rapid and low-cost broad anomaly testing.

Acknowledgement

This work is supported by the PRIMA programme under grant agreement No 1932, project MEDIFIT.

4 Abstracts – software fair

4.1 **The FoodChain-Lab web application: A comprehensive software for visualizing and analysing complex global food supply chain networks**

Alexander Falenski[1], Marco Rügen[1], Birgit Lewicki[1], Armin A. Weiser[2], Annemarie Käsbohrer[1], Bernd-Alois Tenhagen[1], Marion Gottschald[1]

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In the era of globalized food and feed trade, innovative software tools are crucial for swiftly and reliably resolving foodborne crises. FoodChain-Lab Web (FCL Web; https://fcl-portal.bfr.berlin/) serves as such a tool. FCL Web is free and open-source software designed to facilitate the tracing of food along complex global supply chains during foodborne disease outbreaks or other food-related incidents. FCL Web integrates interactive tracing data visualization, analysis and reporting into a single modular tracing platform. The interactive analysis module, developed in collaboration with EFSA, provides automated visualization of supply chains tailored to user needs. A data table presents key information on involved food business operators and food items, featuring comprehensive filter functions for detailed analysis. Moreover, the analysis module facilitates simulations of hypothetical cross-contamination or geographic clustering events during outbreaks through a scoring algorithm for deliveries and food business operators. A pilot version of a reporting module has been integrated into FCL Web as well to present tracing and case information in a format suitable for publishing tracing results in outbreak reports.

During the Software Fair, a demo will introduce the key functionalities of FCL Web to interested users. It will also be possible to try out the tool within a realistic scenario of a foodborne incident.

4.2 **The Ontology Recommender and Linked Data Extractor: Turning trade related texts to structured insights**

Uzair Jamil Khan, Julia C. Golz, Taras Günther

German Federal Institute for Risk Assessment, Berlin, Germany

Commodities traded in global markets are a result of a complex interaction between different industries, processes, and sectors. Ranging from the extraction and harvest of raw materials to sophisticated processing networks of goods. This results in various data formats and terminologies being used along the commodity chain. Thus, makes it challenging to warrant the interoperability and accessibility of commodity trade data. One solution could be the resource description framework (RDF) which translates different data sources into linked data. However, the process of generating linked data especially from unstructured data is labour intensive.

Therefore, we present our Software Tools as a Proof of Concept for creating linked data from unstructured sources such as trade related documents or regulatory texts. Our services, the Ontology Recommender and the Linked Data (LD) Extractor, integrate Large Language Models (LLMS) and ontology lookup services in a Human in the Loop Process. This process involves extracting named entities, matching the entities with external ontologies and structuring them systematically as RDF. Thereby, our services scan effectively unstructured texts, organizing the information according to ontologies specified in a YAML file. This file acts as a blueprint, outlining the entities and relationships that are transformed into RDF triples. Once the files are transformed, they can be uploaded in a graph data base to retrieve relationships across the different documents and data.

Our services address the challenges of data management along with data interoperability and compliance. This is essential for organizations looking to enhance operational efficiency and meet regulatory standards.

4.3 **HoneyChain: Enhancing Honey Production Monitoring System**

Luka Filipovic, Andrea Milacic, Amil Orahovac, Aleksandra Martinovic

University of Donja Gorica, Centre of Excellence for Digitalisation of Microbial Food Safety Risk Assessment and Quality Parameters for Accurate Food Authenticity Certification – FoodHub, Podgorica, Montenegro

The HoneyChain application aims to support the honey production monitoring system by accommodating a large number of users and producers through a series-based approach. This initiative integrates cutting-edge blockchain technology to ensure data integrity and traceability from production to consumption.

The application is built using Laravel, a PHP-based framework, with MySQL database. It includes additional modules for QR codes generation, blockchain technology and user and group management, allowing users to be assigned as honey producers, laboratory or system administrators. The application offers a transparent pathway for each jar of honey, allowing consumers to trace the product back to its producer and see all actions from production stage. Each production series is assigned a unique QR code, printed on the jar labels, enhancing user engagement and system efficiency.

The HoneyChain offers significant advantages. For producers, it enhances brand integrity and market value by demonstrating a commitment to quality and transparency. It also simplifies record-keeping and production management. For users, it serves as a source that provides detailed information about the product they are purchasing, including where and how it was produced, and its laboratory analysis results. Governmental agencies benefit from improved monitoring and regulation capabilities, ensuring adherence to production and safety standards. Moreover, the application supports Montenegrin tourism by promoting high-quality, authentic local honey products to tourists, showcasing the role of technology in supporting local industries.

URL: http://honeychain.foodhub.udg.edu.me

4.4 **New approach for Antimicrobial resistance monitoring and surveillance using NGS**

Hyochin Kim

National Institute of Food and Drug Safety Evaluation, Ministry of Food and Drug Safety, Chungcheongbuk-do, Republic of Korea

In recoginition of Antimicrobial resistance (AMR) as a major global public health threat, many countries established "National Action Plan to combat AMR". With the collaboration among human health, enviorment health, and food production sector, Korean governments has tired to control AMR under "National Action Plan" since 2016 following by "National Antimicrobial Resistance Management Program" since 2003. As the controltower of food production sector, Ministry of Food and Drug Safety has been charged AMR surveillance and monitoring in whole food chain.

Rapid detection of AMR in surveillance and monitoring isa majot challenge, compounded by the rapid evolutionof AMR mechanism. Next-generation Genome Sequencing (NGS) has been consideres as a robust bioinformatics tool to analyze AMR genes and thier genetic context. Still, there are some limitations to adopt NGS as a routine method in laboratory.

In this presentaion we will show how MFDS untilizes NGS as apowerful tool for outbreak investigation, characteristics analysis, and comparative genomic analysis. In addition, current and future work regarding NGS application to AMR surveillance and monitoring will be introduced.

4.5 **An approach to Risk Categorization of Products of Animal Origin Imported into the United Kingdom**

Elli Amanatidou, Helen Graham, J. Andrew Hudson, Chloe L. Thomas, Arif Ali, James Donarski

Food Standards Agency, London, UK

There are thousands of potential hazards associated with imported foods and to achieve an excellent food safety record, resources need to be focused on higher-risk foods and preventive mechanisms. We were tasked to develop an automated tool to assess public health risks from imported foods across multiple countries of origin, hazards and product types to replace manually conducted single product-hazard qualitative import assessments. A risk categorization approach was developed to assess the risk to consumers from importing foodborne microbiological hazards into the UK, to identify those higher-risk foods. The approach was aligned with international standards laid out in the CODEX principles and guidance by FAO and WHO on food control. The risk factors chosen were: an assessment of the inherent risk of the commodity (product characteristics), any hazard mitigation or control measures undertaken in the producing country (control characteristics) and real-world global data relating to food safety incidents over a three-year time window (compliance) for that product. Results by exporting country were generated for 16 selected public health hazards identified from global food safety incident data using expert elicitation. The results support risk managers in their reassessment of the controls that should be placed on foodstuffs imported into the UK.

4.6 KIDA-Chat: a prototype of an AI-Assistant to interact with scientific models

Racem Ben Romdhane[1], Thomas Schüler[1], Ahmad Swaid[2]

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Predictive models are helpful tools for research and decision-making in different fields, including food production and safety. Over years, numerous predictive models have been published. However, their effective use is often limited by the lack of documentation, code availability and repositories to access them. Recently, a standard format (FSKX: FAIR Scientific Knowledge eXchange) has been developed to reference and exchange predictive models.

The KIDA-Chat is a proof-of-concept software to interact with predictive models available in FSKX format via a chatbot user interface (UI) making use of a Large Language Model (LLM). It takes advantage of an agent-based architecture that has access to a model service API. On request, an LLM-agent queries the FSKX model repository for relevant models. If the request is about creating a model-based prediction, a specific agent provides the proper UI elements inside the chatbot to allow the user to define the input parameter values for the desired simulation scenario. This information is then captured, and another agent triggers the model execution. The generated results are then provided back to the user inside the chatbot UI.

The KIDA-Chat can enhance the usability of predictive models. It allows interacting with FSKX models using natural language. It can capture the chat session context to select the appropriate predictive model for the user's needs. Combined with the LLM access to knowledge not directly contained in the model simulations results, this context-capturing ability can assist in understanding and interpreting simulation results, which in turn might help to form an informed decision.

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4.7 **Rapid Alert Supply Network Extractor (RASNEX) tool to mine unstructured supply chain information from food and feed contamination notifications**

Marc Lorenzen, Matthew Salewski, Daria Savvateeva

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RASNEX is a web-based tool presented for potential users to collect feedback during the software fair.

Background:

National competent authorities of member countries use the Rapid Alert System for Food and Feed (RASFF) to report information on (i) any direct or indirect human health risk arising from food or feed, (ii) serious risk to animal health or the environment in relation to feed. Particularly for foodborne disease outbreaks, it is of utmost importance to rapidly identify the involved supply chain actors and withdraw causative products, since the impacts on human and/or animal health and economic damages grow with time. The RASFF system collects information for a systematic mapping of relevant supply flows which allows the identification sources and transfers of contaminated goods, thereby enabling a fast response.

A major challenge for risk managers and risk assessors is to gain and maintain an overview over currently ongoing contamination events, as relevant information is continuously provided and updated by member countries. Recent feed related incidences in Europe illustrated that there is a need for a software system capable of supporting realtime investigations on supply chains as well as exposure assessments in crisis situations. To address these needs, the Rapid Alert Supply Network Extractor (RASNEX), an open-source tool, was developed to scan the information and identify actors, their locations and products using the AI-supported data/text mining techniques

Methods:

RASNEX was developed in Python as a browser-based app according to open-source principles. The primary engine supporting the textual analysis is large language model (LLM), which are currently enjoying popularity due to their successes in handling tasks in analyzing and reproducing natural speech.

Results:

RASNEX is able to extract actors involved in ongoing or past chemical contamination events or biological agent outbreaks from the structured and unstructured parts of RASFF notifications, as well as some formats of attached documents. The extracted information is presented alongside their source documents in a user-oriented dashboard for validation and editing. The verified information is then aggregated from all documents related to a single RASFF notification and exported using a UTX-conform output for further analysis with other tools (e.g. Excel, RACE [5], FoodChain-Lab and others). An additional feature currently in development for the dashboard is a chat interface which enables users to interact with the document.

Conclusion:

RASNEX is a user-friendly tool that utilizes the recent advances in text-based analysis from LLMs to perform assisted data mining from the RASFF notifications thus facilitating

and accelerating extraction of the relevant crises and outbreak information. RASNEX is a collaborative project between BfR and the European Food Safety Agency (EFSA).

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4.8 **MicroHibro software for microbial risk assessment: bridging academia, food industry and regulatory authorities**

Arícia Possas, Cristina Díaz-Martínez, Fernando Pérez-Rodríguez,

UIC Zoonosis y Enfermedades Emergentes ENZOEM, Universidad de Córdoba, Spain

MicroHibro (www.microhibro.com) is a software for predictive microbiology and Quantitative Microbial Risk Assessment (QMRA) in foods, freely available online. The tool comprises a substantial database which contains diverse predictive models developed based on data obtained in various food matrices and environmental conditions. Besides allowing the estimation of microbial responses in foods and the performance of QMRA from farm to fork, MicroHibro features allow the design of sampling plans, shelf-life estimation, and model validation, providing assistance to industries, researchers, and official food control agents. Beyond its practical applications, the tool serves as an educational resource, simplifying the dissemination of fundamental concepts in predictive microbiology and QMRA. MicroHibro models are accessible to different users, addressing a key challenge faced by the food industry and control agents—ensuring access and verification of information related to these models. To tackle this challenge, models and predictions obtained using the software are sent as standardized events to the EPCIS repository in the FSKX format. This approach ensures transparency, accessibility, and provides actionable insights for authorized food control agents. Therefore, MicroHibro act as a bridge between the food industry and regulatory authorities. Its integration with the EPCIS repository, coupled with advanced search and modelling capabilities, revolutionizes the approach to food safety and quality control addressing entire food supply chains.

4.9 **ConTrans: A Web Tool to Estimate Feed-to-Food Chemical Contaminant Transfer in Farm Animals**

Jorge Numata, Matthew Salewski, Jan-Louis Moenning, Robert Pieper

German Federal Institute for Risk Assessment, Berlin, Germany

The presence of chemical and biochemical contaminants in the global agri-food commodity chain results in human exposure to potentially toxic substances. Animal products are often either the main exposure route or a large contributor to it. Farm animals exposed to contaminants can transfer them to eggs, milk and meat. Farm animals are the interface between the feed and food commodity chains. Predictive toxicokinetic models are mathematical tools that integrate quantitative knowledge on the transfer of contaminants in farm animals. They are based on in vivo, ex vivo and in vitro experimental studies, and other in silico tools, and can be used to simulate the absorption, distribution, metabolism and excretion of undesirable substances such as “dioxins”, per- and polyfluoroalkyl substances (PFAS), plant toxins [e.g. quinolizidine alkaloids (QAs)] or heavy metals in farm animals. The existence of a published model does not directly benefit risk assessment or management, as it consists of abstract algorithms. To mitigate this problem, we have developed ConTrans as an easy-to-use web-based graphical tool to empower risk analysis specialists to perform feed-to-food contaminant transfer estimates based on such models. ConTrans is designed to estimate transfer into a wide variety of substance-animal-product combinations using a single interface. The user can configure exposure scenarios with contaminated feed, soil and/or drinking water, as well as depuration periods. ConTrans helps risk analysts make quantitative predictions, thus linking the feed and food commodity chains in terms of chemical risks.

4.10 **Practical implementation of AI-assisted risk negotiation**

Iurii Savvateev, Racem Ben Romdhane, Matthias Filter

German Federal Institute for Risk Assessment, Berlin, Germany

Global communities encounter various risks ranging from ecological challenges to economical and geopolitical conflicts. To mitigate these risks, a rapid and efficient risk analysis is critical. Efficient risk analysis involves (i) identifying potential threats, (ii) assessing their severity and likelihood, and (iii) determining the best course of actions. In our recent work we proposed a risk analysis framework centred around AI-assisted risk negotiation between relevant stakeholders and suggested how large language models (e.g. LLMs) and multi-agent modelling approaches can assist stakeholders at all stages of the risk analysis (Ehling-Schulz et al., 2024). The present work demonstrates the practical implementation of the above-described principle.

Each stakeholder is represented by an LLM-based autonomous agent and together all agents are involved in the risk negotiation process (e.g. multi-agent simulation) simulating negotiations between stakeholders. Firstly, with the assistance of retrieval augmented generation (RAG) concept (Guu, Lee, Tung, Pasupat, & Chang, 2020) and LLMs we extract relevant information about the stakeholders (i.e. agents) and discussed topic. Then the agents are involved in the preliminary discussion to define the list of concrete topic-related issues to be debated. Finally, agents negotiate over these issues and search for a solution within a scorable role-playing negotiation game setup (Abdelnabi, Gomaa, Sivaprasad, Schönherr, & Fritz, 2023).

We argue that AI-assited risk-negotiation pipelines help to mitigate time and information constraints stakeholders experience during the roundtables. At the same time, having human supervision at all principal preparatory stages enables to account for potential data inherent biases and to align with ethical principles.

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