Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Food Safety and Control Newsletter

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To Our Readers

Ensuring food safety in Natal, Brazil (Photo courtesy of Mr J. Sasanya, IAEA)

"Food safety: Science in Action" is the slogan for the world food safety day for the year 2025. The theme recognizes the key role played by sciences in ensuring the credibility and accuracy of data produced related to food safety, that decision makers e.g. governments, food businesses, consumers have to consider.

The Food Safety and Control (FSC) Subprogramme under the Joint FAO/IAEA Centre commemorated the World Food Safety Day by organizing an international webinar titled "Nuclear Applications for Safe Food". The event aimed to promote the use of nuclear techniques and to highlight the support provided by FAO and IAEA to Member States in terms of capacity building relevant to food safety and control activities

Several other events took place in June 2025 where the FSC Subprogramme participated in presenting the subprogramme at international forums. Notable engagements included the "Vienna Food Safety Forum 2025: The potential of digitalization" held from 10-12 June at the Vienna International Centre and the "African Food and Beverage Value Chain Summit" held in Cairo, Egypt, during 2-4 June 2025. Both events were organized by UNIDO in collaboration with other international organizations.

During the first two quarters of 2025, the FSC Subprogramme made significant contributions by leveraging its technical expertise to guide researchers in Member States in applying appropriate and targeted technologies through Coordinated Research Projects and

Technical Cooperation (TC) Projects. These efforts supported the generation of data for use in risk assessment studies and the development of food safety standards.

As the implementation of food safety programmes in Member States is primarily based on international standards and guidelines, the FSC, in collaboration with the TC Department, organized two training courses for Africa. These courses aimed to build capacity in understanding and applying the basic principles of Good Laboratory Practice (GLP), particularly in conducting studies for the establishment of maximum residue levels of antimicrobials in food and in carrying out supervised field trials.

A new Coordinated Research Project on seafood authenticity will be launched in January 2026. In preparation, a consultancy meeting was held from 10-14 February 2025, bringing together experts in food authenticity, marine science, and representatives from technical companies for three days of discussion. The meeting outcomes contributed to shaping the framework of the research contracts to be supported. The Food Safety and Control laboratory (FSCL) has taken a proactive step in this field by anticipating Member States' needs in applying handheld near-infrared spectroscopy and chemometric tools to determine the origin of seafood products as Chilean mussels and white fish species.

Within the same context, a hands-on training course was organized by FSCL in collaboration with the TC Department for Latin America. The course brought together 20 participants from Caribbean countries. Over the span of five days, participants were introduced to state-of-the-art technologies used in food authentication studies. The training underscored the importance of this emerging discipline, and participants expressed their intention to advocate for its adoption within their respective governments to combat food fraud and protect consumers.

The FSC Subprogramme has participated in several activities organized in Member States during which the discussion was mainly focusing on the use of nuclear techniques in addition to other non-nuclear applications to measure the contaminants and residues in food samples. The "10th Latin America Pesticide Residue Workshop" held in Argentina during 4-8 May 2025 discussed the development brought by Latin American countries related to the detection and measurement of residues of pesticides in food matrices; noting the training course as well organized in Columbia during March 2025 on the isotopic dilution methods for the measurement of food contaminants.

Staff from the FSC Subprogramme also participated in the "15th Conference of the World Mycotoxin Forum", where it delivered a presentation titled *"Advances in Analysis and Detection of Mycotoxins in Dryland Crops at the Joint FAO/IAEA Centre's Food Safety and Control Laboratory"*. This was part of the session on *"Smart Approaches for Mycotoxin Analysis"*. The presentation provided an overview of the Joint FAO/IAEA Centre's ongoing activities and highlighted the Peaceful Uses Initiative (PUI) project, *"Ensuring Food Security and Safety by Future-Proofing Dryland Crops under Climate Change"*. Through this initiative, the FSCL is developing and transferring to Member States rapid screening and confirmatory methods for monitoring mycotoxins—considered priority climate-related hazards in dryland crops—using portable electrochemical immunosensors and confirmatory isotope dilution LC-MS/MS and SFC-MS/MS techniques.

In line with efforts to expand the technical expertise of the FSCL team to address a broader range of food hazards, a new Inductively Coupled Plasma Mass Spectrometry (ICP-MS) instrument has been acquired. This system allows for the detection of trace and toxic elements at ultra-trace levels in food matrices. Additionally, a Liquid Chromatography (LC) system will be coupled to the ICP-MS to enable speciation analysis of toxic compounds such as methylmercury, selenate, and others. These advanced analytical techniques will be made accessible to scientists from Member States for training and knowledge transfer to support national food safety programmes.

Recognizing the critical role played by IAEA Collaborating Centres in advancing research and development across regions, a visit of the Collaborating Centre Aerial, France was conducted from 23–25 February 2025. The delegation was led by the IAEA Deputy Director General and head of the Department of Nuclear Sciences and Applications. This visit provided an excellent opportunity to deepen engagement with the Aerial Collaborating Centre, explore its expertise in food irradiation, and discuss areas for further collaboration in related technical fields to be considered under the renewal of their assignment.

Lastly, Ms. Alina Mihailova, Mr. Islam Hamed, and Ms. Martina Domanik have concluded their contracts at the FSCL. We warmly thank our three colleagues for their outstanding dedication, professionalism, and enthusiasm, which have greatly contributed to the work of the Section. Their commitment and positive spirit will be missed, and we wish them every success in their future endeavors.

Rola Bou Khozam
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Feature Article

Exploring the Potential of AI and Machine Learning to Better Support Member States in Fighting Food Fraud

Christina Vlachou, Alina Mihailova, Rina Ahmed, Hemavarshini Bhaskar, Clinton Tak, Muhammed Tayyab

Food fraud is a complex issue that poses serious threats to food systems. Fraudulent activities can vary from intentional mixing of food with adulterants or substitution of ingredients with cheaper alternatives to mislabelling of the origin or misbranding to make economic gain, and they are often part of wider criminal activity. The consequences range from consumer deception and loss of trust to the control system to serious health risks and can have significant financial implications for both the legitimate food industry, which is forced to compete with businesses that do not comply with the law, and for governments. With increasing attention being paid to the detection of food fraud, efficient analytical approaches are crucial for safeguarding public health, facilitating trade and improving public trust in food.

To support Member States in addressing food fraud challenges, the Food Safety and Control Laboratory (FSCL) conducts research on nuclear and related techniques applicable for food authenticity verification as one of its core activities. Food authentication studies at FSCL are based on a combination of appropriate state-of-the-art analytical techniques and chemometrics. Chemometrics is the science of extracting information from chemical systems by data-driven means using multivariate statistics, applied mathematics and computer technology with the intent of learning and describing the underlying relationships and structure of the data (exploratory data analysis), or for discrimination, classification, pattern recognition, clustering, or prediction purposes. The use of advanced chemometrics in food authentication is crucial for managing the huge amount of data that is generated by applying advanced analytical methods. The datasets are often large and complex, involving hundreds to thousands of variables, and hundreds to thousands of cases or observations. Discrimination and classification are performed to predict whether a food sample belongs to the category of the authentic product, based on its characteristics. For this purpose, a model representing a "fingerprint" of the authentic food is first built using a training set, which is composed of a set of authentic samples with characteristics known a priori. Then, the model is applied to predict the category of new samples, i.e., analytical results of samples that are suspicious for fraud are checked against this fingerprint using the same software.

Model performance and predictability are critical and can be improved with Artificial Intelligence (AI) and Machine Learning (ML) tools. AI generates models from datasets or logic-based algorithms capable of tracking complex problems in ways like human logic and reasoning. ML belongs to the "Data-driven AI". ML learns how to complete tasks based on large amounts of data and can thrive in the "big data era" to find patterns in data. As AI and ML techniques evolve and mature, the opportunities to employ them to address global challenges in the food sector increase.

FSCL collaborates with the IAEA MTIT/BSS (Business Solutions Section) Innovation Team on the project "*Exploring the potential of AI and ML tools to better support Member States in fighting food fraud*". Based on the chemometric approaches most frequently used in food authentication studies, which are based on licensed software, and the ML tools that could be explored, a workplan was identified to: (a) Explore ML and Deep Learning (DL) tools that can be used in multivariate data analysis for food safety and food authenticity applications; (b) Assess whether ML and DL could improve the performance of the chemometric models that are currently used for FSCL's applications (e.g., PCA, OPLS-DA, OPLS, HCA, DD-SIMCA) (c) Explore the most cost-effective ways to use ML and DL approaches for multivariate data analysis and their applicability to be transferred to the Member States. The focus would be on cost-free, open access, if possible non-coding software options, transferrable through knowledge sharing and training options. The importance of identifying open-source software options was highlighted, so that the Member States can have the benefit of accessing effective tools, avoiding software license costs.

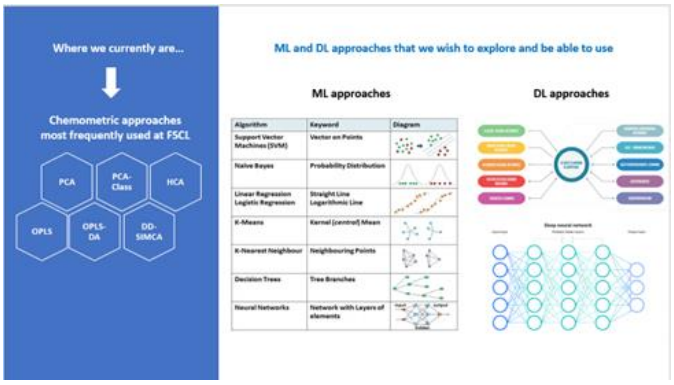


FIG. 1 Collaboration between FSCL and the IAEA MTIT Innovation Team: Topics discussed during the inception meeting of the project

During the first phase of the project, the potential of open-source frameworks on the Microsoft *Azure* AI ML platform was explored by the BSS Innovation Team. The Microsoft *Azure* AI ML platform offers strong potential for enhancing chemometric models in food safety and authenticity, thanks to its scalability, advanced ML tools, and integration with diverse data sources.

A benchmarking study was implemented, based on an existing scenario and employing an extensive dataset of

analytical results of samples of grain and ground rice collected from 2020 to 2022, already used in the project "*Geographical discrimination of Paw San rice cultivated in different regions of Myanmar using near-infrared spectroscopy, headspace-gas chromatography-ion mobility spectrometry and chemometrics*". This approach gave the opportunity for comparing the results from the chemometrics and the ML processing. After appropriate data preparation, several ML features of the of the *Azure* AI platform were used: Logistic Regression; K-Nearest Neighbours (KNN); Support Vector Machine (SVM); Random Forest Classifier; Decision Tree Classifier; Gradient Boost; Neural Networks. The first results show that the Decision Tree Classifier tool resulted in a substantial improvement of the accuracy scores and prediction of the geographical origin of Paw San grain rice, which is very important, as minimal or no sample preparation are added advantages regarding the easiness, the rapidity and the cost-efficiency of the authentication process.

Decision Trees are highly interpretable, fast to train, and capable of handling both numerical and categorical data with minimal preprocessing. These characteristics make them well-suited for practical applications like rice authentication, where simplicity, speed, and cost-efficiency are crucial, and minimal or no sample preparation is preferred. However, one limitation of Decision Trees is their tendency to overfit, especially with complex or noisy datasets, or in cases with a low dataset, which can lead to less robust predictions when generalized to unseen data. Additionally, while the model is interpretable, its performance can be affected by hyperparameter tuning, requiring careful adjustment to achieve optimal results.

The next steps of the project include identification and evaluation of further appropriate AI and ML platforms, focusing on no-/low-cost and no-/low-code friendly tools, with emphasis on transferability. Multiple other frameworks and platforms were also evaluated for this project. While it is challenging to find a platform that accommodates all requirements, several options were evaluated and compared against given requirements. Free open-source frameworks were leveraged and assessed for the cost-free development setup on local devices as well as scalable and easy to use cloud-based Machine Learning platforms were highlighted from various vendors including Microsoft, Amazon, Snowflake and Google.

In March 2025, the project was presented to scientists from CARICOM Member States who participated in the "TC Training on the Use of Nuclear, Isotopic and Complementary Techniques in Assessing Food Authenticity and Origin" that was hosted by FSCL. Ms Rina Ahmed and Mr Clinton Tak (IAEA MTIT/BSS) presented an introduction to Artificial Intelligence (AI) and Machine Learning (ML) and application for food authentication cases.

Ms Rina Ahmed and Mr Clinton Tak (IAEA MTIT/BSS) presenting an introduction to Artificial Intelligence (AI) and Machine Learning (ML) and application for food authentication cases during the training of scientists from CARICOM Member States held in FSCL (Photo courtesy of Ms Christina Vlachou, IAEA).

Forthcoming Events

Consultancy Meetings and Training Workshops

Virtual Consultancy Meeting on Antimicrobial Residues, Antimicrobial Resistance and Aquaculture Products Safety, with Focus on West Africa, 2, 3 and 7 July 2025.

Virtual Consultancy Meeting on Advances and Challenges in Monitoring and Controlling Microplastics in Food and Agriculture, 29 September – 1 October 2025.

Consultancy Meeting on Novel Food, Edible Insects and Hazards Arising from Food Processing, Preparation and Handling Practices, Vienna, Austria, 6–10 October 2025.

International Workshop on Radiation Safety in food in non-emergency situations, Seibersdorf, Austria, 21–23 October 2025.

Consultancy Meeting on Radioisotope Production, Radiolabeling of Chemicals and Their Use in Food Animal Depletion Research, Vienna, Austria, 3–7 November 2025.

Virtual Training Workshop on Monitoring and Controlling Microplastics Contamination in Food and Agriculture, 25– 28 November 2025.

Consultancy Meeting on Modelling in Food Irradiation, Vienna, Austria, 1–5 December 2025.

Past Events

Strengthening the IAEA – AERIAL Collaboration on Food Irradiation

Rola Bou Khozam

AERIAL is one of the IAEA's designated Collaborating Centres, working closely with the Food Safety and Control (FSC) subprogramme on food irradiation, as well as with other IAEA sections on materials irradiation. This collaboration began in 2016, based on the complementary expertise that AERIAL offers in the field of food irradiation, among other areas.

Equipped with state-of-the-art infrastructure—including the Rhodotron TT300 accelerator and advanced laboratories spanning microbiology (including BSL-3), physico-chemistry, sensory analysis, and lyophilisation—AERIAL plays a pivotal role in supporting FSC activities. This support is especially vital as food irradiation is not currently within the technical capacity of the Food Safety and Control Laboratory (FSCL).

Since its original designation in 2016, Aerial has diligently responded to IAEA requests for support both in research and innovation as well as in the transfer of skills and knowhow through technical cooperation. Achievements of past collaboration include new and improved dosimetry techniques and practices, studies into food irradiation using low energy beams, work on the detection of irradiated food and evaluations of foods irradiated with high energy X rays, radiation processing

As a result of its Faisceau d'Electrons Et Rayonnement Ionisants X (FEERIX) project, Aerial has extended its capabilities. The FEERIX involves new state-of-the-art rhodotron electron accelerator with two beam lines that can operate at high energies of up to 10 MeV for electrons and 5 or 7 MV for X rays. At the other end of the energy scale, new equipment now includes low energy electron lamp irradiators. The institute has a compliment of irradiation facilities that span low, medium and high energy beam irradiation and being an IAEA Collaborating Centre means that these facilities may be used to support both food and non-food activities to reinforce capabilities for research, training and technology transfer to IAEA Member States.

Over the years, AERIAL has been actively involved in Coordinated Research Projects (CRPs), offering guidance to contract holders from Member States on research activities related to food irradiation, hosting fellows and offering irradiation services when needed. A notable contribution was the organization of an intercomparison test for participating CRP researchers, which allowed them to verify the accuracy of dosimetry measurements used in food irradiation procedures, with results meeting the accepted ±5% criteria.

In recognition of the strong and evolving partnership, a high-level IAEA delegation—including the Deputy Director General (DDG) and the Programme Coordinator of the Department of Nuclear Applications, accompanied by the Head of the FSC Section—visited AERIAL on 24 – 25 February 2025. The visit provided an excellent opportunity to explore AERIAL's extensive technical capabilities and to discuss strategies to further strengthen the collaboration. Topics included the development of joint projects and resource mobilization in fields such as physical and chemical sciences, food and agriculture, and marine environment applications.

As AERIAL concludes its third cycle as an IAEA Collaborating Centre by the end of 2025, both parties have agreed to renew the Collaborating Centre agreement. The renewal is scheduled to be formalized during the 69th IAEA General Conference.

Group photo of the IAEA and AERIAL staff, Strasbourg, 24 February 2025 (Photo courtesy of AERIAL)

Vienna Food Safety Forum 2025: The Potential of Digitalization

Rola Bou Khozam

The Vienna Food Safety Forum 2025 (VFSF), organized by UNIDO, took place from 10 to 12 June 2025 at the Vienna International Centre. Held biennially, the forum provides a global platform for innovation, collaboration, and knowledge exchange aimed at transforming agri-food systems. This year's edition was held under the theme "The Potential of Digitalization in the Food Safety Area," focusing on how data-driven technologies can reshape food safety practices, facilitate trade, and improve public health outcomes.

VFSF 2025 brought together a diverse range of stakeholders, including practitioners, policymakers, industry leaders, and subject-matter experts. Discussions highlighted the critical need to develop digitalized and traceable systems, steered by effective government frameworks and supported by

comprehensive regulations. One of the key themes was the importance of harmonizing data collected from various actors within the national food safety ecosystem to ensure effective traceability. Considering the global nature of the food trade, participants also stressed the need for international alignment in traceability systems.

The forum underlined the essential role of public-private partnerships in fostering collaborative models that integrate technological advances with food industry practices to strengthen safe trade. Issues of data confidentiality and the significance of food safety management systems in supporting traceability efforts were discussed in depth. Multiple interventions from stakeholders illustrated the practical challenges and opportunities in adopting digital traceability systems. The agenda further explored emerging technologies, such as artificial intelligence, machine learning, electronic certification, and remote audits, as powerful tools to enhance food safety systems globally. A recurring concern was the digital divide between low- and middle-income countries and industrialized nations, underscoring the urgent need for inclusive strategies to ensure equitable access to technological advancements.

The Food Safety and Control Section (FSC) under the Joint FAO/IAEA Centre actively contributed to the forum. Ms Rola Bou Khozam, Head of the FSC Section, was a panellist in the session titled "The Role of Digital Traceability to Address Challenges in Food Safety Systems." In her intervention, she highlighted the IAEA's role in supporting Member States to develop capacity for generating credible, high-precision data, which is essential for informed policy-making and effective food safety governance. Ms Bou Khozam emphasized the value of digital tools for creating product fingerprints, which are instrumental in detecting food fraud and verifying authenticity throughout the value chain. She also presented the IAEA's work in organizing proficiency testing schemes for Member States' laboratories, ensuring the sustainability and reliability of advanced analytical practices. Additionally, she introduced new protocols developed at the Food Safety and Control Laboratory (FSCL) for rapid screening of food contaminants using handheld, digital-based devices.

The FSC further participated in a "Lighthouse Session" organized by UNIDO, which focused on supporting food safety authorities in Africa and Asia in their efforts to develop data hubs related to food hazard monitoring. This session served as a platform to identify technical needs and future avenues for cooperation.

In another key session, the IAEA's MTIT/BSS Innovation Team, represented by Ms. Rena Ahmad, contributed to the panel "Machine Learning for Improved Food Safety Practices – Enhancing Surveillance and Regulatory Oversight." Ms Ahmad presented an IAEA initiative on exploring the use of AI and machine learning tools to assist Member States in combating food fraud. Her intervention emphasized the potential of these technologies to strengthen surveillance systems and enhance regulatory oversight, thereby improving food safety outcomes across various contexts.

The FSCL also hosted a booth exhibition within the VFSF activities with the participation of Ms Chritina Vlachou, Head of FSCL, Ms Britt Maestroni, Food Safety Officer and Ms. Marivil Islam Food Safety Technician, showcasing handheld equipment used for the rapid screening of contaminants and detection of food fraud. Demonstrations at the booth illustrated how such digital tools could be used as emergency-response instruments, offering faster alternatives or complements to conventional laboratory methods.

On 13 June, after the main forum sessions, participants visited the IAEA laboratories in Seibersdorf. During the visit, they were introduced to the nuclear and related analytical techniques used at the FSCL for measuring contaminants and residues and for conducting food authenticity testing and fraud detection. The visit provided a valuable opportunity for participants to observe firsthand how these scientific techniques are applied in real-world food safety scenarios.

It is worth noting that IAEA Deputy Director General for Nuclear Sciences and Applications, Ms Najat Mokhtar, was one of the keynote speakers during the opening session. In her speech, Ms Mokhtar emphasized the IAEA's commitment to promoting nuclear applications as vital tools for improving food safety in Member States. She also underscored the importance of digital technologies as a driving force for ensuring both the safety and authenticity of food.

The Vienna Food Safety Forum 2025 successfully underscored the transformative power of digital technologies in building resilient and transparent food safety systems. It also reaffirmed the IAEA's leadership in providing scientific and technical support to its Member States and in fostering global cooperation to tackle emerging food safety challenges through innovation, capacity-building, and data-driven solutions.

Vienna Food Safety Forum 2025: The potential of Digitalization (Photo courtesy of Ms B. Maestroni, IAEA)

Supporting Food Safety and Control Capabilities in Mauritania and Organization of a National Stakeholder Workshop on Atoms4Food Initiative – Food Safety and Control

James Sasanya

Mauritania's food safety and control system that involves a number of institutions and Ministries, continues to face significant capacity challenges. In response, the IAEA—through its Technical Cooperation (TC) Programme and the Atoms4Food Initiative—is playing a key role in supporting the country's efforts to strengthen its food safety frameworFrom 24–28 February 2025, Mr Sasanya, a Technical Officer on food safety, conducted an in-country mission to assess current capacities and deliver technical assistance. Visits were made to key Food safety related institutions receiving IAEA support, includingThe Office National de Recherches et Développement d'Elevage et du Pastoralisme (ONARDEP) and the National Institute for Public Health Research (INRSP. Both institutions received tailored training and technical support. Mr. Sasanya also assessed the needs of other critical agencies such as the *Agence Mauritanienne de Sécurité Sanitaire des Aliments* (AMSSA), *Office National d'Inspection Sanitaire des Produits de la Pêche et de l'Aquaculture* (ONISPA), and the *Office National de Normalisation et de Métrologie* (ONANOR). Thanks to support under the Atoms4Food Initiative—funded by the Government of Japan—three procurements for ONISPA, two for AMSSA, two for ONARDEP, and one for INRSP have been completed or are in progress, pending delivery or installation. Additionally, laboratory personnel have received training, further strengthening national technical capabilities.

A key highlight of the mission was a two-day national food safety workshop organized with financial contributions from ONARDEP. The event gathered 27 participants from 12 institutions, including AMSSA, the Department of Veterinary Services, Mauritanian Animal Products, the Faculty of Science and Technology, and the Plant Protection Directorate. The National Liaison Officer and heads of key institutions participated, particularly during the opening session.

Mr Sasanya led technical sessions on the role of multi-institutional coordination in food safety systems, the importance of robust food safety legislation, and stakeholder engagement including regulators and inspectors. Participating institutions presented on their mandates, current capabilities, and the challenges they face. Two invited experts from Egypt and Benin enriched the workshop by sharing best practices in setting up and operating national food safety agencies—experiences highly relevant to Mauritania.

The event also enabled the Mauritanian institutions to discuss the current food safety and control systems, share information and explore coordination mechanisms. They highlighted that there are still laboratory capacity and routine surveillance (of hazards) limitations; that the food safety legislation is still very weak requiring urgent attention from national authorities; and that equipment maintenance and troubleshooting support is a bottleneck, impacting the laboratories' operations. The institutions also noted that further support is needed in establishing a national Codex committee and asked for assistance to organize another national workshop.

Some of the gaps identified are being addressed through a technical cooperation project and additional support under the Atoms4Food Initiative. Further expert missions are recommended for the INSRP, ONISPA and ONARDEP etc to strengthen laboratory analytical capabilities. subject to funds-permitting, a workshop is also recommended to finalize the establishment of their national codex committee and to provide training to non-laboratory personnel such as food inspectors.

The mission also initiated valuable partnerships. Collaboration with the World Food Programme (WFP) began with WFP participation in the workshop and continued through a follow-up meeting at the WFP country office. This partnership is expected to open opportunities for IAEA-supported laboratories to offer food testing services, contributing to financial sustainability.

In addition, Mr Sasanya and ONARDEP counterparts met with the FAO country office, which is developing a new food safety project with the Plant Protection Directorate under the Standards and Trade Development Facility (STDF). FAO also expressed interest in collaboration on animal production and health, linking with ONARDEP's animal health experts.

Participants at an Atoms4Food Workshop in Mauritania, Feb 2025, Nouakchott (Photo courtesy of Mr J. Sasanya, IAEA)

Mr Sasanya provided hands-on training to ONARDEP and INRSP in use of instrumentation for certain chemical hazard analysis, instrument and analytical method troubleshooting as well as data analysis/interpretation and reporting. He also noted that there is management support for food safety capacity development at the relevant institutions such as AMSSA and ONARDEP. This was noted following meetings with the respective Directors General who assured their commitment to drawing attention of higher national

authorities including Ministers; and resource-mobilization. The managers thanked the IAEA for the support rendered thus far and called for further cooperation.

Inter-Agency Committee on Radiation Safety, ILO Headquarters Geneva, Switzerland

Carl Blackburn

This Inter-Agency Committee on Radiation Safety (IACRS) consists of eight intergovernmental organizations (including the FAO, through the Joint FAO/IAEA Centre) and five non-governmental bodies and provides a forum for liaison and coordination on radiation safety matters between relevant international bodies. The committee members met from 30–31 January 2025 at the headquarters of the International Labour Organization (ILO) in Geneva where the role of Chair formally passed from IAEA to the ILO for a term of about 18 months. The Inter-Agency Committee on Radiation Safety.

Exposure due to radionuclides in food in existing exposure situations (not in emergencies) was discussed as was collaboration in producing a possible future Joint FAO/IAEA Centre information document on natural radionuclides. In addition, there was an update from the World Health Organization on their planned revision to the chapter in the Guidelines on Drinking Water Quality that deals with radionuclides.

One of the key areas of success for the IACRS is the coordinated development and implementation of general safety requirements that underpin international standards and were last revised in 2014 as the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (GSR Part 3). However, the ICRP review of estimates of lung cancer from the inhalation of radon and its progeny and the subsequent revised dose coefficients for exposure to radon in workplaces has served to highlight that there are important dose coefficients that are reproduced in high-level radiation safety standards (e.g. Schedule III of GSR Part 3). One of the topics for discussion was therefore the updating of dose coefficients that are explicitly given in international standards. The meeting also discussed the ICRU report-95 and the proposed new definition of "operational quantities: (e.g. Ambient dose equivalent, Directional dose equivalent, and Personal dose equivalent) for external exposure to ionizing radiation. Discussions centered around the implications of defining conversion coefficients based on anthropomorphic phantoms. This would give the operational quantities the same fundamental basis as the protection quantities (e.g. effective dose) that are already based on anthropomorphic phantoms.

Entrance hall of the International Labour Organization Headquarters (Photo courtesy of Mr C. Blackburn, IAEA)

Inter-Agency Committee on Radiological and Nuclear Emergencies, European Commission, Luxembourg

Carl Blackburn

The meeting was hosted by the European Commission in Luxembourg from 5 to 7 March 2025. The committee, established in 1986 following the Chernobyl accident, plays a key role in facilitating and coordinating inter-agency cooperation at the international level in the area of nuclear emergency preparedness and response.

During the meeting, discussions with representatives of international organizations focused on administrative and logistical preparations for the upcoming ConvEx-3 exercise, now rescheduled for June 2025. Participants also exchanged updates on emergency preparedness and response activities across their respective organizations.

A presentation was delivered on the Joint FAO/IAEA Programme, highlighting activities relevant to the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE). The FAO, as a full party to the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, contributes to emergency response under the Joint Radiation Emergency Management Plan of the International Organizations (JPLAN).

Under this framework, the Joint FAO/IAEA Centre assigns liaison officers to the IAEA Incident and Emergency Centre (IEC) in Vienna to facilitate coordination and the exchange of information between the two organizations — particularly in areas related to food safety, agricultural production, distribution, and trade.

Online Webinars: Exposure Due to Radionuclides in Food in Non-Emergency Situations

Carl Blackburn

A series of webinar events were streamed and recorded in April, bringing together experts from FAO, IAEA, and WHO to provide an overview of current international guidance that supports countries in measuring, controlling, and communicating the implications of radionuclides in food and diet. The webinars, available as a series of five recordings link. focus on "normal situations" — that is, scenarios outside of nuclear emergencies, which are governed by different but complementary safety standards for food and agricultural products.

Featuring a technical expert from Ireland, the series was developed using data and information from the three international organizations, along with input from experts from Member Countries. These groups collaborated to review and summarize criteria for radionuclide activity concentrations in food and drinking water, as published in IAEA TECDOC-1788. The webinars also present outcomes from a joint project that proposed approaches and supporting materials to assist national authorities in managing exposure to radiation through ingestion in non-emergency contexts. Key reference materials include: TECDOC-2011 which provides practical guidance and Safety Report Series No. 114) which offers the technical background to support national assessments and, where necessary, the management of radionuclide ingestion risks.

Both publications were co-sponsored by FAO, IAEA, and WHO, reflecting strong inter-agency collaboration on food safety and radiological protection.

Consultancy Meeting on a New Coordinated Research Project on "Seafood Origin and Authenticity Using Nuclear and Related Technologies"

Christina Vlachou, Alina Mihailova

From 10–14 February 2025, a consultancy meeting on a new Coordinated Research Project (CRP) titled "Seafood Origin and Authenticity Using Nuclear and Related Technologies" was held in a hybrid format at the IAEA Headquarters in Vienna and virtually via Microsoft Teams. The meeting, organized under the Food Safety and Control subprogramme, brought together experts from Australia, Austria, Cambodia, Chile, China, Germany, Japan, Morocco, Norway, the United Kingdom, the Food and Agriculture Organization of the United Nations (FAO), and the European Commission's Joint Research Centre (EU-JRC).

Experts participating in the consultancy meeting on a new Coordinated Research Project on "Seafood Origin and Authenticity Using Nuclear and Related Technologies". Vienna, Austria (Photo courtesy of IAEA)

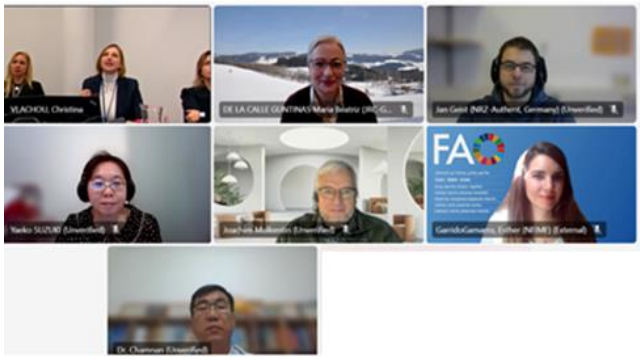
Fisheries and aquaculture products are among the most internationally traded food commodities, playing a vital role in global food security and livelihoods. As key sources of high-quality proteins, omega-3 fatty acids, vitamins, and minerals, their importance is undeniable. However, fraud in this sector remains a significant global challenge. It compromises food safety, distorts economic value chains, harms the environment and society, erodes consumer trust, and slows progress towards the Sustainable Development Goals (SDGs). The seafood supply chain is particularly vulnerable to fraud due to globalization, the increasing complexity and diversification of food systems, the competitiveness of the fisheries industry, and the rapid growth of online trade. Common fraudulent practices include species substitution and the mislabelling of origin, fishing or harvesting area, and production or processing methods. While many of these practices are economically motivated, they can also present serious food safety risks to consumers.

Weak regulatory frameworks and inadequate traceability systems further exacerbate these challenges, highlighting the need for more robust verification mechanisms. Nuclear and related analytical techniques, such as stable isotope ratio analysis, trace element profiling, and radionuclide detection, offer powerful tools to identify and prevent fraud. These methods provide scientifically sound and traceable means to verify the authenticity of seafood products, thereby protecting consumers and supporting legitimate producers while safeguarding public health.

During the meeting, the experts provided guidance on the CRP's scope and objectives and reviewed the types of seafood fraud most encountered. They examined relevant international, regional, and national regulatory frameworks and assessed available analytical methods applicable to seafood authentication. Discussions also focused on identifying research gaps, setting selection criteria for participating institutions, and recommending countries and laboratories with relevant expertise and infrastructure. Opportunities to access or develop data sources and

databases were explored, alongside potential partnerships and extra-budgetary funding sources. The group worked collaboratively to draft the CRP proposal and meeting report, outlining future activities and research directions.

The proposed CRP will contribute to building technical capacity for seafood authentication using nuclear and related technologies, supporting national and international food control systems, enhancing consumer protection, and promoting fair trade. It is closely aligned with the IAEA's broader efforts under the Atoms4Food initiative, aimed at applying nuclear science and innovation to strengthen global food safety and security.



Experts participating in the consultancy meeting on a new Coordinated Research Project on "Seafood Origin and Authenticity Using Nuclear and Related Technologies". Vienna, Austria and virtually, 10-14 February 2025 (Photo courtesy of IAEA)

The experts expressed strong support for the CRP and emphasized its potential to significantly enhance food safety and traceability to the sea food industry, bolster consumer trust, strengthen partnerships among stakeholders, including policy makers, and enhance collaborative research efforts to combat food fraud through scientific methods.

Participation in the International Conference on "Cooperation in the Field of Food Security in the Context of Climate Change"

Christina Vlachou

Organized by the Ministry of Agriculture and the Ministry of Environmental Protection of Turkmenistan, with the support of the Food and Agriculture Organization of the United Nations (FAO), the International Conference on "Cooperation in the Field of Food Security in the Context of Climate Change" was held in a hybrid format on 28 November 2024 in Ashgabat, Turkmenistan.

The conference served as a platform for dialogue on how to ensure food security in the face of climate change, promote cross-border collaboration, and strengthen national and regional commitments to sustainable food systems and climate action. Participants emphasized the importance of aligning efforts across food and climate agendas. By fostering coordinated action among governments and stakeholders, more resilient agricultural systems can be built to support health, well-being, and long-term food security.

The event aligned with the broader objectives of COP29 and brought together high-level representatives from relevant ministries and departments of Turkmenistan, international organizations, CAREC countries, academia, and the media.

As an invited speaker, Ms Christina Vlachou delivered a virtual presentation titled "Exploring Challenges and Advances in Addressing the Impact of Climate Change on Food Safety." Her talk focused on collaborative approaches to building agro-food system resilience for healthy diets in a changing climate. She highlighted the research and capacity-building activities of the Food Safety and Control Section and Laboratory to support the development of effective and resilient food control systems in Member States.

Ms Vlachou also shared insights from the Peaceful Uses Initiative (PUI) project "Ensuring Food Security and Safety by Future-Proofing Dryland Crops under Climate Change." This initiative brings together three laboratories of the Joint FAO/IAEA Centre and international experts from various disciplines. It showcases how nuclear technologies can help tackle climate-related challenges, improve food safety, and enhance nutritional security through innovative research and capacity-building achievements.

TC Training on the Use of Nuclear, Isotopic and Complementary Techniques in Assessing Food Authenticity and Origin, Hosted by FSCL

Christina Vlachou, Alina Mihailova, Marivil Islam, Aiman Abrahim, Florence Maxwell

From 17 to 28 March 2025, the Food Safety and Control Laboratory (FSCL) hosted an in-person laboratory training course on "Use of Nuclear, Isotopic and Complementary Techniques in Assessing Food Authenticity and Origin" under the regional Technical Cooperation Project RLA7027. The training aimed to enhance the capabilities of scientists from CARICOM Member States in applying rapid screening and confirmatory techniques for food authenticity and origin, thereby strengthening national responses to food safety and fraud-related incidents. Fifteen scientists from Antigua and Barbuda, Belize, Dominica, Grenada, Jamaica, Saint Kitts and Nevis, Saint Lucia, and Trinidad and Tobago participated in the event.

Participants received both theoretical and practical training, working on selected applications and food fraud case studies. The agenda included lectures and hands-on sessions covering techniques such as elemental analyzer–isotope ratio mass spectrometry (EA-IRMS), nuclear magnetic resonance (NMR), gas chromatography–ion mobility spectrometry (HS-GC-IMS), FTIR-ATR, FT-NIR and

portable NIR spectroscopy, and chemometrics. These tools were applied to detect fraud and verify the authenticity of products like honey, coffee, spirits, olive oil, and spices. Additional techniques such as Raman and SERS spectroscopy, energy dispersive X-ray fluorescence (ED-XRF), and cavity ring-down spectroscopy (CRDS) were also introduced. The Innovation Team from the IAEA's Division of Information Technology (MTIT/BSS) presented applications of Artificial Intelligence (AI) and Machine Learning (ML) for food authentication.

A final dialogue and brainstorming session allowed participants to reflect on the training and identify priority commodities and potential fraud challenges in their home countries. Despite their interest and commitment, participants acknowledged the absence of monitoring programs and limited laboratory infrastructure in the region. Most countries rely heavily on food imports, which makes fraud detection more difficult and highlights the need for better awareness, equipment, and technical capacity. The potential for regional application of the training outcomes was widely recognized, including possible collaboration with local universities.

The training prompted the Caribbean Agricultural Health and Food Safety Authority (CAHFSA) to initiate discussions on establishing a Regional Centre for Food Authenticity Testing. A related committee meeting was held on 13 May 2025, with FSCL's Lab Head providing strategic input. Other participants included representatives from FAO, CAHFSA, the University of the West Indies, CARICOM, IICA, CRFM, CARDI, and CARPHA.

A dedicated session on this initiative has also been included in the agenda of the Annual Meeting of the Caribbean Task Force on Food Safety scheduled for June 2025, where FSCL has been invited to participate.

Training on the Use of Nuclear, Isotopic and Complementary Techniques in Assessing Food Authenticity and Origin", under the RLA7027 TCP, hosted by FSCL in Seibersdorf, Austria, on 17-28 March 2025 (Photo courtesy of Ms C. Vlachou, IAEA)

Participation in the 15th Conference of the World Mycotoxin Forum

Christina Vlachou

The World Mycotoxin Forum is a leading international conference series focused on integrated strategies to ensure the safety and security of the food and feed supply chain with respect to mycotoxins. Its 15th edition was held in Salzburg from 7 to 9 April 2025, bringing together researchers, industry representatives, laboratories, policymakers, and regulatory authorities to address current challenges in mycotoxin monitoring and management. The event featured thematic sessions on topics including mycotoxins in the One Health framework; advanced analytical techniques; on-site detection methods; control strategies at the farm level; occurrence and mitigation approaches; societal impacts; and the role of digitalization and artificial intelligence in research and management.

Ms Christina Vlachou was invited as a keynote speaker in the session "Smart Approaches for Mycotoxin Analysis." Her presentation, titled *"Advances in Analysis and Detection of Mycotoxins in Dryland Crops at the Joint FAO/IAEA Centre's Food Safety and Control Laboratory"*, provided an overview of the Joint FAO/IAEA Centre's activities and highlighted the Peaceful Uses Initiative project "Ensuring food security and safety by future-proofing dryland crops under climate change." The talk focused on FSCL's development and transfer of rapid screening and confirmatory methodologies to laboratories in Member States. These include portable electrochemical immunosensors for on-site mycotoxin detection, as well as advanced analytical techniques such as isotope dilution liquid chromatography and supercritical fluid chromatography coupled with tandem mass spectrometry (LC-MS/MS and SFC-MS/MS).

Ms Christina Vlachou delivering a keynote presentation at the 15th Conference of the World Mycotoxin Forum. Salzburg, Austria, 9 April 2025 (Photo courtesy of Ms A. Petchkongkaew, Thammasat University Thailand)

The presentation was well received and generated significant interest in the FSCL's research and development efforts. Participation in the conference provided valuable outreach and networking opportunities, helping to raise

awareness of the potential of nuclear and complementary techniques to address climate-driven food safety challenges. The event also facilitated productive discussions with stakeholders on possible areas of collaboration to strengthen future joint activities.

R&D and Capacity Building Activities of FSCL within the Peaceful Uses Initiative Project "*Ensuring Food Security and Safety by Future-Proofing Dryland Crops under Climate Change*"

Christina Vlachou, Britt Maestroni

Dryland farming is a method of growing crops in regions with limited rainfall, relying on natural precipitation and soil moisture, and it is mainly practiced in arid and semi-arid areas, which constitute 70% of the global cultivated land, supporting livelihoods and food security. Climate change has profound impacts on dryland crops. Elevated temperatures together with increasing CO_2 levels not only adversely impact the crop yields posing threat to food security but also diminish the nutritional quality of the food and can create environments conducive to mycotoxin-producing fungi and to increased uptake of heavy metals into plants, presenting contamination risks and compromising food and feed safety and nutritional security.

As climate change is a complex challenge, which necessitates multifaceted and multidisciplinary collaboration, the Peaceful Uses Initiative (PUI) project "*Ensuring food security and safety by future-proofing dryland crops under climate change*" was jointly implemented in 2024 by the Food Safety and Control Laboratory (FSCL), the Plant Breeding and Genetics Laboratory (PBGL) and the Soil and Water Management and Crops Nutrition Laboratory (SWMCNL) of the Joint FAO/IAEA Centre. The project was financially supported by the Government of the United Kingdom of Great Britain and Northern Ireland via the Department for Energy Security and Net Zero and comprised research and capacity building components.

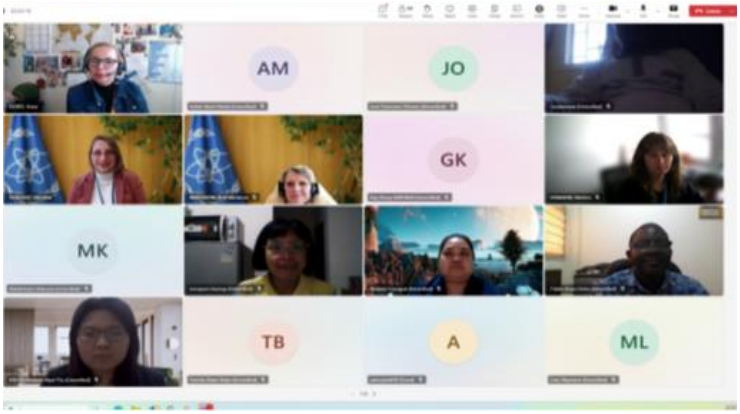
FSCL's research and development work focussed on developing rapid screening and confirmatory analytical methods to support Member States efforts to detect and monitor key climate change-related chemical hazards in food that threaten food safety and consequently food security: mycotoxins and heavy metals. Confirmatory methods for mycotoxin analysis, employing isotope dilution liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS) for the determination of aflatoxins and fumonisins B in millet and cassava, including appropriate easy-to-apply sample preparation method techniques, were validated. The method was also evaluated for recovery and reproducibility in groundnut samples. Samples of pearl millet from Ghana and of cassava flour from Thailand were tested for the presence of mycotoxins according to the validated methods. Supercritical fluid chromatography coupled to tandem mass spectrometry (SFC-MS/MS) technique was successfully applied for the analysis of pesticides and aflatoxins in millet and cassava. Additionally, a portable electrochemical immunosensor for screening fumonisins B in maize was optimized and provided a reliable miniaturized analytical system that can be used in the field and can be integrated in early warning or alert systems for mycotoxin contamination of crops. Rapid metal profiling was applied to millet and cassava using benchtop energy dispersive X ray fluorescence (ED-XRF). The feasibility of a portable XRF system was tested in collaboration with Queens University Belfast, which is an IAEA Collaborating Centre.

Additionally to the research component, a virtual training workshop on "*Integrated Nuclear and Complementary Approaches to Understanding the Nexus between Water and Nutrient Use Efficiency, Nutrition Security and Food Safety for Dryland Crops in a Changing Climate*" was jointly implemented by FSCL, PBGL and SWMCNL under the same PUI project from the 26th of November to the 3rd of December, highlighting how advancements in laboratory analysis and field experiments for the assessment of improved genetics, resource use efficiency, nutrition security and food safety can enable Member States to effectively respond to climate change-related challenges in drylands.

Her excellency the UK Ambassador and Permanent Representative to IAEA & CTBTO, Ms Corinne Kitsell, opened the event on the 26th of November, delivering opening remarks. The training workshop was attended by 118 participants from 51 Member States and provided an excellent platform for raising awareness and presenting the research undertaken, as well as for enhancing capabilities in the use of nuclear and complementary techniques for understanding the nexus between water and nutrient use efficiency, nutrition security and food safety for dryland crops in a changing climate. The discussion held during the course opened up the suggestions for new research topics complementing the work done.

FSCL's session on the 2*nd* & 3*rd* of December presented "*Challenges and Advances in Addressing the Impact of Climate Change on Food Safety*", including key climate change-related hazards in food, such as mycotoxins and heavy metals, and the potential of nuclear, isotopic and complementary techniques to support the Member States to address climate challenges. FSCL's contribution consisted of the following subjects: Challenges in Understanding and Addressing the Impact of Climate Change on Food Safety; Key Climate Change-Related Hazards in Crops and Food Products to be Monitored and Controlled; Analytical Approaches and Considerations for Monitoring Key Climate Change-Related Chemical Contaminants in Food: Mycotoxins and Heavy elements using Nuclear, Isotopic and Complementary Techniques (Liquid Chromatography –

Tandem Mass Spectrometry, Inductively Coupled Plasma Mass Spectrometry (ICP-MS)) including the Rapid Screening with Portable Electrochemical Immunosensors and Rapid Elemental Profiling in Food With Energy Dispersive X-Ray Fluorescence Spectroscopy (ED-XRF);; Regulatory Provisions and Safety Standards for Mycotoxin and Heavy Metal Contamination in Food; Sampling and sample preparation for Mycotoxin and heavy metals Analysis in Food were also part of the training course.



Virtual training workshop on "Integrated Nuclear and Complementary Approaches to Understanding the Nexus between Water and Nutrient Use Efficiency, Nutrition Security and Food Safety for Dryland Crops in a Changing Climate"- FSCL session (Photo courtesy of Ms H. Kenny, IAEA)

Insights into the 10th Latin American Pesticide Residue Workshop (LAPRW)

Britt Maestroni

At the 10th Latin American Pesticide Residue Workshop (LAPRW) held from 4–8 May 2025 in Buenos Aires, Argentina, the Food Safety and Control Laboratory (FSCL) of the Joint FAO/IAEA Centre joined over 280 scientists from Latin America, Europe, and the USA to share recent advancements in pesticide residue analysis. FSCL presented a poster on the use of supercritical fluid chromatography-mass spectrometry (SFC-MS) for multiresidue analysis in complex food matrices, such as maize, millet, and cassava. The study evaluated the technique's performance in terms of recovery, reproducibility, linearity, and matrix effects for 40 representative pesticides and 4 mycotoxins. The results confirmed SFC-MS as a robust and efficient technique with strong potential to complement traditional LC-MS/MS, especially for complex dryland crops.

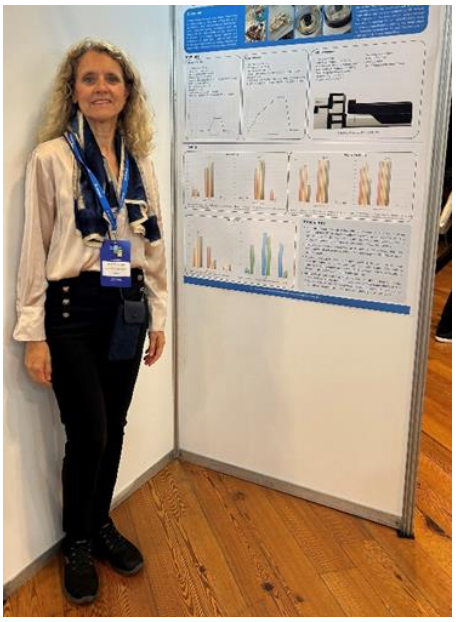
The workshop also explored innovations in sample preparation and detection, including green, miniaturized approaches such as micro-scale solid-phase extraction (micro-SPE) and microflow LC. These advancements are enhancing reproducibility, reducing environmental impact, and expanding access to high-quality testing—even in resource-limited settings. Detection of challenging pesticide classes like dithiocarbamates and polar compounds such as glyphosate is also improving with newer LC-MS/MS and ion chromatography-based methods.

Beyond technical innovations, the workshop addressed broader issues of environmental contamination, public health risks, and regulatory shifts. In Argentina, intensive pesticide use has led to concerning levels of contamination in water, soil, air, and dust. New research also suggests potential long-term and heritable effects of glyphosate exposure. Meanwhile, interactions between pesticides and microplastics are emerging as a new risk area, raising concerns for crop uptake and food safety.

Dietary risk assessment is evolving as well, with the transition from IEDI to the more refined Global Estimated Chronic Dietary Exposure (GECDE) model, which often yields higher exposure estimates due to its population-specific focus. This has regulatory implications, reinforcing the importance of high-quality, reliable analytical results supported by rigorous quality systems. Countries like Colombia are investing in laboratory infrastructure and metrological tools to meet international standards, as exemplified by ICA's implementation of ISO 17034 and ISO 17043 under regional IAEA projects.

The Forum underscored a global commitment to advancing food safety and pesticide residue monitoring. FSCL's participation showcased the value of nuclear and complementary techniques in strengthening analytical

capacities, fostering collaboration, and contributing to global efforts in food safety under changing environmental and regulatory conditions.



Ms B. Maestroni presented a poster on" The use of supercritical fluid chromatography coupled with mass spectrometry for multiresidue analysis in complex food matrices, specifically maize, millet, and cassava" at the 10th Latin American Pesticide Residue Workshop (Photo courtesy of Ms B. Maestroni, IAEA)

Regional Training Course on the Application of Isotopic Dilution in Certifying Reference Materials

Andres Sebastian Salinas Trujillo, Britt Maestroni

Under the regional technical cooperation project IAEA/RLA5091 'Strengthening the Monitoring Programmes of Pesticide Residues and Mycotoxins in Food Through the Establishment of a Proficiency Test Programme in Official Laboratories', which aims to strengthen pesticide and mycotoxin residue monitoring programmes in food through the establishment of proficiency testing in official laboratories, a regional training course on isotope dilution mass spectrometry (IDMS) was held in Bogotá, Colombia, from 25 to 28 March 2025. The course was designed for participants from institutions expected to become proficiency testing providers under the project in the near future.

The training focused on the application of IDMS, a highly accurate and traceable analytical technique widely recognized as a primary method of measurement and the preferred method for certifying reference materials (RMs). Following a brief overview of its historical background, the course explored core concepts such as isotopic labelling—introducing enriched isotopes like ^{2}H, ^{13}C, or ^{18}O into molecules for quantification—and isotopic enrichment, which involves increasing the abundance of specific isotopes, often through cryogenic distillation or chemical synthesis.

TABLE 1: IMPORTANT DEFINITIONS FOR THE ISOTOPE DILUTION ANALYTICAL TECHNIQUES

Isotopes	Atoms with the same number of protons but different numbers of neutrons
Relative Atomic Mass	Weighted average of the masses of an element's isotopes
Monoisotopic Mass:	Exact mass of the most abundant isotope of each element in a molecule
Mass Defect	Difference between the actual mass and the nearest whole number mass
Nominal Mass	Integer mass of the most abundant isotope

Participants learned that IDMS involves spiking a sample with a known quantity of an isotopically enriched compound (the "spike"). After achieving isotopic equilibrium, the isotopic ratio of the mixture is measured using mass spectrometry, allowing for accurate calculation of the analyte concentration in the original sample. The method is valued for its high accuracy and precision, minimal susceptibility to matrix effects, and direct traceability to the International System of Units (SI).

Various calibration strategies were discussed, including single IDMS, which uses certified spikes and known isotopic ratios to calculate concentrations; reverse IDMS, where the spike is characterized using a known standard if it is not certified; double IDMS, which combines standard and reverse methods to minimize bias; and exact matching, a technique that adjusts the sample and standard ratios until the isotopic ratios align, thus eliminating the need for mass bias correction.

Discussion session with the participants of the regional training course on isotopic dilution (Photo courtesy of Ms B. Maestroni, IAEA)

Mr Sebastián Salinas from the Colombian Metrology Institute (INM) provided a comprehensive overview of the metrological requirements for IDMS to qualify as a primary method. These include achieving complete isotopic equilibrium, ensuring matrix independence, controlling spectral interferences, and conducting rigorous contamination checks. Sample preparation techniques were also demonstrated in the laboratory, highlighting the superiority of the gravimetric spiking approach over the faster but less precise volumetric method.

A practical case study was conducted as part of the laboratory component, focusing on the characterization of a candidate reference material for the mycotoxins zearalenone and aflatoxins in maize. The exercise consisted of two parts: initial quantification using external calibration, followed by IDMS-based quantification. As part of the project, 54 units of this candidate reference material were prepared by INM and will be distributed to collaborating laboratories across the region for a preliminary characterization study, before final certification and distribution as an INM reference material. This effort directly supports one of the core goals of RLA5091—to address the limited availability of certified reference materials for mycotoxins in the Latin America and Caribbean region.

The training also introduced participants to uncertainty estimation and expression based on the ISO Guide to the Expression of Uncertainty in Measurement (GUM) and the Monte Carlo method. While the GUM involves analytical propagation of uncertainty, the Monte Carlo method uses probabilistic simulations to generate a distribution of possible outcomes. A dedicated website for running

simulations was shared, generating strong interest for further regional training in this area.

Overall, the workshop demonstrated a structured approach to producing reference materials, underscoring the importance of quality assurance, metrological traceability, and capacity building in food safety. Looking ahead, a dedicated training course on the application of IDMS in food safety testing, aligned with ISO/IEC 17025 requirements, will be held in the first semester of 2026 at the Joint FAO/IAEA Food Safety and Control Laboratory in Seibersdorf. A call for nominations will be issued at the end of 2025, and analytical laboratories are encouraged to apply.

The application of the gravimetric method for the Isotope Dilution Mass Spectrometry (IDMS) approach at the laboratory facilities of the Colombia Metrology Institute (INM) (Photo courtesy of Ms B. Maestroni, IAEA)

Webinar on "Nuclear Applications for Safe Food" in Commemoration of World Food Safety Day 2025: Science in Action

To mark World Food Safety Day 2025, the Food Safety and Control (FSC) Subprogramme under the Joint FAO/IAEA Centre hosted a webinar on 5 June, aligned with this year's theme: *"Science in Action."* The event, titled "Nuclear Applications for Safe Food," brought together participants from three regional food safety networks to showcase success stories and engage in discussions on how scientific knowledge and nuclear technologies are strengthening food safety systems around the world.

The webinar highlighted the pivotal role of the FSC Subprogramme in supporting Member States to integrate nuclear and related techniques into their national food safety and control systems. This support is delivered through technical cooperation and research coordination projects.

In her welcome remarks, Dongxin Feng, Director of the Joint FAO/IAEA Centre, underlined the importance of the event as a platform for food safety scientists to promote their efforts and to reflect the theme of *"Science in Action"* by showcasing the practical use of nuclear applications in food and agriculture.

The keynote presentation was delivered by Markus Lipp, Senior Food Safety Officer at FAO, who focused on strategies for building trust in food systems. He emphasized the role of *Science in Action* in ensuring data transparency, which is essential for achieving food safety goals. Dr. Lipp noted that trust "from farm to fork" is vital to both consumer satisfaction and public confidence.

Further illustrating the role of the FSC Subprogramme, Christina Vlachou, Head of the FSC Laboratory at Seibersdorf, presented on the development and transfer of technologies to Member States. She emphasized how the laboratory—one of five Joint FAO/IAEA research labs near Vienna, Austria—supports countries in adopting innovative tools and methodologies to enhance food safety.

Cutting edge highlights included presentations from national counterparts in the People's Republic of China, the Islamic Republic of Pakistan, and the Republic of Namibia, who showcased how technical support from the Joint Centre has contributed to tangible improvements in food safety in their respective countries.

Rola Bou Khozam, Head of the FSC Section, concluded the event by reaffirming the subprogramme's commitment to strengthening research and capacity-building efforts. "By helping Member States generate credible data, the FSC Subprogramme plays a critical role in safeguarding food safety," she stated. She further emphasized that building resilient food monitoring systems and enhancing technical capabilities are vital, and she closed by stressing that food safety is a shared responsibility. She urged continued investment in scientific advancements to protect lives, foster trust, and promote sustainable development.

To read more on the food safety day webinar From the Lab to Your Dining Table: How Nuclear Science Enhances Food Safety | IAEA

Coordinated Research Projects

Reference Number	Coordinated Research Project	Project Officer
D52043	Depletion of Veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices	J.J. Sasanya
D52044	Nuclear Techniques to Support Risk Assessment of Biotoxins and Pathogen Detection in Food and Related Matrices	J.J. Sasanya
D61025	Innovating Radiation Processing of Food with Low Energy Beams from Machine Sources	C.M. Blackburn
D61026	Novel Irradiation Technology for Phytosanitary Treatment of Food Commodities and Promotion of Trade	C.M. Blackburn
D60001	Ionizing Radiation to Mitigating Potential Food Related COVID-19 and Zoonosis Risks	C.M. Blackburn

Technical Cooperation Projects

Country/Region	Project No.	Title	Technical Officer
Barbados	BAF5001	Enhancing Capability for Food Safety and Surveillance through the Development of Nuclear, Isotopic and Complimentary Analytical Methods	J.J. Sasanya
Burundi	BDI5004	Enhancing Control of Chemical Residues and Related Contaminants in Food	J.J. Sasanya
Bangladesh	BGD5034	Enhancing Competence in Nuclear and Complementary Capabilities for Testing/Monitoring Veterinary Drug Residues and Other Contaminants in Foods	J.J. Sasanya A. M.V. M. Rodriguez y Baena
Bahamas	BHA5003	Strengthening Laboratory Capacity for Testing Microbial and Related Chemical Contaminants in Food Products	J.J. Sasanya
Bosnia and Herzegovina	BOH5003	Using Nuclear Technology in Enhancing Science Based Safety, Quality and Control Systems in Feed and Food Chains	J.J. Sasanya
Botswana	BOT5023	Enhancing Control of Food Hazards in Poultry Production and Products	J.J. Sasanya
Cameroon	CMR5025	Improving Laboratory Testing Capabilities to Enhance the Safety and Competitiveness of Agricultural Products - Phase I	J.J. Sasanya
Cameroon	CMR5028	Improving the Capacity for Food Safety Testing Using Nuclear and Complementary Techniques	J.J. Sasanya
Chad	CHD7003	Developing Laboratory Capacities to Control Water Quality	J.J. Sasanya Y. Vystavna
Chile	CHI5056	Strengthening of the National System for Verification of Authenticity and Determination of Origin of Food.	A. Mihailova

Country/Region	Project No.	Title	Technical Officer
Chile	CHI0023	Building Capacity for Nuclear Science and Technology Applications	A. Mihailova B.M. Maestroni
Comoros	COI5001	Building a Food Safety Laboratory Capacity in Comoros — Phase I	J.J. Sasanya
Cuba	CUB5022	Promoting Food Safety through the Mitigation of Contaminants in Fruits for Human Consumption	C.M. Blackburn J.J. Sasanya
Cuba	CUB5025	Establishment of a National System for the Verification of the Authenticity and Determination of Food Origin	A. Mihailova
Djibouti	DJI5001	Developing Nuclear/Isotopic and Complementary Food Safety Testing Capabilities	J.J. Sasanya
Dominica	DMI5003	Strengthening a Nuclear Isotopic Laboratory and Complimentary Field Food Safety Surveillance Capabilities	J.J. Sasanya
Dominica	DMI5004	Establishing a National Food Safety Monitoring Surveillance Programme	J.J. Sasanya
Ecuador	ECU5030	Reducing Post-Harvest Losses of Native Potatoes and other Fresh Foods by Irradiation	C.M. Blackburn
Ecuador	ECU5033	Strengthening Laboratory Capacities for Monitoring Residues of Neonicotinoid Pesticides in Honey Bees and Honey	B.M. Maestroni
Eritrea	ERI5016	Strengthening the Capabilities of the National Plant and Animal Health Laboratory and Collaborating Institution(s) for Food and Feed Safety and Quality Testing	J.J. Sasanya
Eritrea	ERI5014	Enhancing Food Safety Analytical and Monitoring Capabilities	J.J. Sasanya
Fiji	FIJ5002	Increasing Trade and Export Capacities of Selected Value Chains within the Agro-Food Sector through the Adoption of an Appropriate Quality Infrastructure	C.M. Blackburn
Fiji	FIJ5005	Establishing a Food Safety Laboratory for Analysis of Pesticide Residues in Fresh Fruits, Vegetables and Root Crops — Phase II	B.M. Maestroni
Fiji	FIJ5006	Supporting the Establishment of an Irradiation Facility for the Treatment of Food and Agricultural Commodities against Exotic Pests and Diseases — Phase II	C.M. Blackburn
Fiji	FIJ5008	Improving the Capabilities of the Food Safety Laboratory for Analysis and Control of Biological Contaminants	B.M. Maestroni
Georgia	GEO5001	Enhancing National Programmes for Testing and Monitoring Food Contaminants and Residues	J.J. Sasanya
Honduras	HON5012	Strengthening Analytical Capabilities for the Detection of Residues, Contaminants and Microbiological Hazards in Food and Feed	J.J. Sasanya

Country/Region	Project No.	Title	Technical Officer
Indonesia	INS5045	Strengthening Food Security Through Improvement of Food Safety for Exports Using Gamma Irradiators and Electron Beams	C.M. Blackburn B. S. Han
Indonesia	INS5046	Strengthening Food Security through the Improvement of Food Safety for Exports using Gamma Irradiators and Electron Beams	C.M. Blackburn
Iran, Islamic Republic of	IRA1011	Building Capacity for the Development of Stable Isotope Techniques in Medicine, the Environment, Agriculture, and Sciences	U.D. Sarvana Kumar O. Kracht J.A. Miller
Cote d'Ivoire	IVC5042	Improving Testing and Monitoring of Food Hazards Using Nuclear and Isotopic Techniques	J.J. Sasanya
Cote d'Ivoire	IVC5045	Strengthening National Analytical Capacities for Food Safety Testing and Assessing Micronutrient Bioavailability in Local Diets	J.J. Sasanya V.O. Owino
Cambodia	KAM5004	Strengthening National Capability for Food and Feed Safety	J.J. Sasanya
Kazakhstan	KAZ5005	Building Capacities in Effectively Irradiating Food	C.M. Blackburn
Kenya	KEN9007	Establishing a National Standard Laboratory for Individual Monitoring, Radioanalysis, and Calibration of Neutron and Surface Contamination Services	C.M. Blackburn J.J. Sasanya
Kyrgyzstan	KIG5001	Establishing Effective Testing and Systematic Monitoring of Residues and Food Contaminants and of Transboundary Animal Diseases	J.J. Sasanya I. Naletoski
Lebanon	LEB5017	Strengthening Technical Capabilities by Introducing Metal Speciation Techniques to Support Health and Environmental Safety	C. Vlachou
Lesotho	LES5011	Strengthening Nuclear and Related Food Safety Laboratory Capabilities to Control Veterinary Drug Residues and Related Contaminants	J.J. Sasanya
Madagascar	MAG5028	Developing Food Safety Laboratory Capabilities	J.J. Sasanya
North Macedonia	MAK5009	Enhancing National Capacities to Standardize Nuclear Based and Related Techniques for Food Safety and Detection of Irradiated Food	B. S. Han A. Mihailova C.I. Horak
Malaysia	MAL5032	Strengthening National Capacity in Improving the Production of Rice and Fodder Crops and Authenticity of Local Honey Using Nuclear and Related Technologies	A. Mihailova J. J. Adu-Gyamfi E. Fulajtar C. Zorrilla
Malaysia	MAL5033	Strengthening Analytical Capabilities for Food Safety and Food Security	J.J. Sasanya
Malaysia	MAL5035	Strengthening National Capacities in Nuclear and Related Techniques to Improve Halal Meat Authentication for Food Safety and Security	A.Mihailova
Mauritius	MAR5027	Building Capacity to Analyse Veterinary Drug Residues and Related Chemical Contaminants in Animal Products	J.J. Sasanya

Country/Region	Project No.	Title	Technical Officer
Mauritania	MAU5008	Strengthening Laboratory Capacity to Analyse and Monitor Residues and Contaminants in Foods	J.J. Sasanya
Mauritania	MAU5011	Enhancing Intersectoral Food Safety Testing and Surveillance of Chemical and Biological Hazards	J.J. Sasanya
Marshall Islands	MHL5002	Building Core Capacities to Control Contaminants and Other Residues in Food — Phase I	J.J. Sasanya
Marshall Islands	MHL5004	Strengthening Capacities for the Detection and Control of Contaminants and Residues in Food	J.J. Sasanya
Mali	MLI5032	Improving Laboratory and Monitoring Capabilities for Contaminants in Cereals and Nuts	J.J. Sasanya
Malawi	MLW5007	Enhancing Capabilities to Test, Monitor and Control Contaminants and Chemical Residues in Foods	J.J. Sasanya
Mozambique	MOZ5012	Enhancing Food Safety Testing and Monitoring of Hazards Using Nuclear and Related Techniques	J.J. Sasanya
Myanmar	MYA5031	Strengthening Food Safety Chemical Hazard Testing and Monitoring Capabilities	J.J. Sasanya
Namibia	NAM5019	Enhancing National Capacity for Contaminant and Adulteration Monitoring of Marine and Other Food Products for Consumer Protection	J.J. Sasanya A. Mihailova M. H. T. Metian
Namibia	NAM5021	Enhancing National Food Safety and Aquatic Contaminant Monitoring Programmes	B.M. Maestroni C.Vlachou
Nepal	NEP5007	Supporting Analysis of Pesticide Residues in Agricultural Products	B.M. Maestroni
Niger	NER5025	Improving Food and Biological Hazard Detection, Food Preservation and Mutation Breeding	J.J. Sasanya C.M. Blackburn S. Sivasankar
Niger	NER5026	Enhancing Food Production, Preservation, Safety and Quality	J.J. Sasanya C.M. Blackburn I.K.K. Bimpong
Oman	OMA5010	Building Capabilities in Food Safety and for Monitoring Irradiated and Contaminated Food and Consumer Products	C.M. Blackburn B.M. Maestroni
Vanuatu	NHE5004	Strengthening Agro-Food Laboratory Quality Infrastructure — Phase II	J.J. Sasanya
Vanuatu	NHE5005	Strengthening Food Safety Laboratory and Surveillance Capabilities of the Vanuatu Bureau of Standards — Phase III	J.J. Sasanya
Nicaragua	NIC5012	Strengthening the Monitoring and Control System for Food Contaminants	J.J. Sasanya

Country/Region	Project No.	Title	Technical Officer
Pakistan	PAK5053	Strengthening and Enhancing National Capabilities for the Development of Climate Smart Crops, Improvement in Animal Productivity and Management of Soil, Water, and Nutrient Resources Using Nuclear and Related Techniques	J.J. Sasanya
T.T.U.T.J. of T. Palestinian A.	PAL5010	Strengthening Capability to Monitor Contaminants in Food and Related Matrices through Nuclear and Complementary Analytical Techniques	J.J. Sasanya
Panama	PAN5030	Strengthening Laboratory Capacity in Monitoring Veterinary Drug Residues and Contaminants in Milk and Honey Using Nuclear/Isotopic Techniques	J.J. Sasanya
Panama	PAN5032	Strengthening Monitoring Capabilities for Chemical Residues and Contaminants in Aquaculture using Nuclear and Isotopic Techniques	J.J. Sasanya
Philippines	PHI5035	Advancing Laboratory Capabilities to Monitor Veterinary Drug Residues and Related Contaminants in Foods	J.J. Sasanya
Papua New Guinea	PAP5005	Strengthening National Infrastructure to Control Contaminants and Other Residues in Food — Phase I	J.J. Sasanya
Paraguay	PAR5013	Strengthening Analytical Capacities in the Control of Residues and Contaminants in Primary Foods for Human Consumption	B.M. Maestroni C.Vlachou
Palau	PLW5005	Building Core Capacities to Control Contaminants and Other Residues in Food — Phase I	J.J. Sasanya
Peru	PER5036	Assessing the Safety of Medicinal Plants for Consumption and Establishing a Genetic Improvement Programme of Medicinal Plants Using Ionizing Radiation – Phase I	J.J. Sasanya F. Sarsu
Qatar	QAT5009	Enhancing National Food Safety Capacity to Test and Monitor Residues/Contaminants Using Nuclear and Related Isotopic Techniques	J.J. Sasanya C.M. Blackburn B.M. Maestroni
Romania	ROM5010	Enhancing Food Safety and Quality of Consumer Protection	C.M. Blackburn J.J. Sasanya
Rwanda	RWA5003	Strengthening Laboratory Capacity of the Standards Board to Analyse and Monitor Chemicals (Veterinary Drug Residues and Related Contaminants) in Foods — Phase II	J.J. Sasanya A. M.V. M. Rodriguez y Baena
Saint Kitts and Nevis	STK7001	Building National Capacity for the Application of Nuclear Science and Technology	C. Zorrilla J.J. Sasanya

Country/Region	Project No.	Title	Technical Officer
Seychelles	SEY5014	Developing Toxicological Analytical Capability for Monitoring and Biomonitoring Exposure to Toxic Agents in Biological and Environmental, as well as Food and Water Matrices	J.J. Sasanya
Senegal	SEN5043	Developing Capacity to Conduct an Assessment of Exposure to Chemical Hazards in Food, and to Evaluate the Nutritional Composition of Local Dishes	J.J. Sasanya V.O. Owino
Singapore	SIN5001	Enhancing Food Safety	C.M. Blackburn J.J. Sasanya
Sri Lanka	SRL5048	Strengthening National Capability for Food and Feed Safety	A. Mihailova
Sudan	SUD5040	Strengthening the Evaluation of Quality, Monitoring and Control Programmes for Food Contaminants	J.J. Sasanya
Thailand	THA5058	Applying Nuclear Technology to Assure Food Quality and Safety	C.M. Blackburn J.J. Sasanya
Tanzania	URT5038	Developing Food Safety Laboratory Capabilities in Zanzibar	J.J. Sasanya
Togo	TOG5007	Developing Laboratory Capacities for the Quality Control of Food and Pharmaceutical Products	A. Mihailova J.J. Sasanya
Tunisia	TUN5033	Strengthening Food Safety Capabilities	J.J. Sasanya
Uganda	UGA5042	Strengthening Capabilities of Two Central Food Safety Laboratories and Selected Regional Veterinary Centres of Public Health	J.J. Sasanya
Venezuela	VEN5022	Enhancing National Capacities for the Control of Contaminants in Cocoa Beans using Ionizing Radiation	C. Blackburn J.J. Sasanya
Samoa	WSM5001	Building Core Laboratory Capacities to Control Chemical Contaminants and Residues in Food	J.J. Sasanya
Democratic Rep. of the Congo	ZAI5028	Controlling Food and Feed Contaminants in Fish Production	J.J. Sasanya
Zambia	ZAM5032	Strengthening and Expanding Analytical Capacity to Monitor Food Contaminants using Nuclear/Isotopic and Complementary Tools	J.J. Sasanya
Zambia	ZAM5034	Expanding the Scope of Food Safety Testing and Surveillance of Hazards in Foods and Related Matrices	J.J. Sasanya
Africa	RAF5091	Enhancing Human and Analytical Capacities for Food Safety Standards (AFRA)	J.J. Sasanya
Africa	RAF5088	Building Capacity for Food Irradiation by Facilitating the Commercial Application of Irradiation Technologies — Phase II (AFRA)	C.M. Blackburn B. S. Han
Asia/ Pacific	RAS5087	Promoting Food Irradiation by Electron Beam and X ray Technology to Enhance Food Safety, Security and Trade (RCA)	C.M. Blackburn

Country/Region	Project No.	Title	Technical Officer
Asia/ Pacific	RAS5096	Strengthening Multi-Stakeholder Food Safety Monitoring Programmes for Chemical Contaminants and Residues in Plant and Animal Products Using Nuclear/Isotopic Techniques	J.J. Sasanya
Asia/ Pacific	RAS5099	Developing Climate Smart Crop Production including Improvement and Enhancement of Crop Productivity, Soil and Irrigation Management, and Food Safety Using Nuclear Techniques (ARASIA)	J.J. Sasanya M. Zaman
Europe	RER5029	Improving Food Safety Through the Early Detection of Microbial Pathogens	J.J. Sasanya
Latin America/ Caribbean	RLA5091	Strengthening the Monitoring Programmes of Pesticide Residues and Mycotoxins in Food Through the Establishment of a Proficiency Test Programme in Official Laboratories (ARCAL CXCV)	B.M. Maestroni
Latin America/ Caribbean	RLA5084	Developing Human Resources and Building Capacity of Member States in the Application of Nuclear Technology to Agriculture	J. J. Adu-Gyamfi I. Naletoski W.R.E. Hoeflich C. Zorilla J.J. Sasanya A. Mihailova
Latin America/ Caribbean	RLA7027	Applying Nuclear Technology in Agriculture, Water Resource Management and the Environment in Caribbean Member States (CARICOM)	K.I. Bimpong M. Metian W.R. Enkerlin Hoeflich C. Vlachou A. Harjung C.M. Alonso Hernandez

Regional (African) Training Course on Good Laboratory Practice for Conduct of Supervised Field Trials – Crops to Facilitate Establishment of Codex Maximum Residue Limits (MRLs)

James Sasanya

A regional IAEA technical cooperation training course was held in Accra, Ghana, from 5 to 16 May 2025, in collaboration with the Ghana Standards Authority and the Ghana Atomic Energy Commission. The course aimed to enhance national capabilities in generating reliable pesticide residue data for use in standards setting, through the application of Good Laboratory Practices (GLP) in supervised field trials. Participants from 18 countries—Burkina Faso, Burundi, Congo, Egypt, Eswatini, Ethiopia, Ghana, Madagascar, Malawi, Morocco, Senegal, South Africa, Sudan, Togo, and Zimbabwe—took part in the training.

The course covered a wide range of topics, including the principles and implementation of GLP in supervised field trials, planning and conducting pesticide residue studies in minor crops, and the proper documentation and reporting of such studies. Participants were introduced to both national and international regulations governing GLP and pesticide research, particularly those established by the OECD. Emphasis was placed on ensuring data integrity and reliability, designing robust field experiments, following good experimental practices, and applying suitable analytical tools and quality assurance/control procedures.

The theoretical sessions were followed by practical, supervised field trials involving the application of the pesticide Afidopyropen on okra, used as a model crop for residue trials. In addition, field trials were conducted on chili pepper. The training included guidance on crop grouping for extrapolating maximum residue levels (MRLs), a practice that allows analytical laboratories to operate more efficiently and enables faster label approvals for growers. This approach also supports international harmonization efforts, facilitating trade and helping countries meet import tolerance requirements. Given the growing need for global harmonization, almost all crops cultivated worldwide are now incorporated into Codex crop groupings and standardized vocabularies.

Other key topics addressed included dietary risk assessment of pesticide residues, principles of residue definitions for both dietary risk and enforcement purposes, the use of the OECD calculator for MRL setting based on GLP field trial and monitoring data, and the critical role of national pesticide residue monitoring programmes in protecting consumer health.

The course also benefited from the experience of India's All India Network Project on Pesticide Residues, which was shared as a successful model of residue monitoring and data generation. The training helped build regional cooperation and fostered networking among countries, with the aim of positioning African nations to contribute actively to scientific data collection for both national and international food safety standards.

GLP-Crop training in Accra, Ghana, May 2025 (Photo courtesy of Mr P. Osei, GSA, Ghana)

Enhancing Food Safety Testing in the United Republic of Tanzania

James Sasanya

The IAEA is supporting the development and enhancement of food safety capabilities in the United Republic of Tanzania through cooperative arrangements with two key laboratories: the Zanzibar Food and Drug Agency (ZFDA) in Zanzibar and the Tanzania Veterinary Laboratories Agency (TVLA) on the mainland. Prior to this support, provided under an IAEA Technical Cooperation project, the ZFDA's food safety testing was limited to selected mycotoxins. With the IAEA's assistance, the laboratory has since expanded its scope to include a range of antimicrobials, additional mycotoxins, and pesticides, using screening techniques based on radio receptor assays. The ZFDA is also in the advanced stages of establishing capabilities for non-destructive testing of toxic metals in food and other matrices, and efforts are underway to develop confirmatory analytical methods.

During a recent mission, Mr. Sasanya provided on-site training to staff from both ZFDA and TVLA, focusing on screening and quantitative analysis of antimicrobials and mycotoxins. While at the ZFDA, he also helped troubleshoot and resolve a malfunction in one of the laboratory's key instruments—an HPLC-DAD/FLD system. His intervention restored the instrument to full functionality, saving the laboratory from prolonged downtime and potentially high repair costs.

The TVLA, under the Ministry of Livestock and Fisheries, plays a central role in animal disease control, diagnostics, feed and pesticide quality assurance, and vaccine production. However, its capacity for food and feed safety testing remains limited. In response, steps are being taken to

build up these capabilities, including the procurement of a radioreceptor assay system to complement existing methods such as acaricide testing using HPLC-DAD. During his visit to the TVLA, Mr. Sasanya identified several critical capacity gaps and worked directly with laboratory staff to optimize an existing analytical method, which has since proven to be more effective and fit for purpose. He also noted ongoing discussions between the ZFDA, Zanzibar Veterinary Services, and the TVLA to strengthen collaboration on food safety testing across the country.

Laboratory deliberations at ZFDA, March 2025, Zanzibar (Photo courtesy of Mr J. Sasanya, IAEA)

To address the broader capacity-building needs, both laboratories have requested further support through initiatives such as the Atoms4Food Initiative and the ongoing regional food safety project RAF5091 'Enhancing Human and Analytical Capacities for Food Safety Standards'. The IAEA responded promptly, and both institutions are now formal counterparts under the project. In addition, Mr. Sasanya and representatives from the two laboratories visited the FAO country office to raise awareness of the ongoing collaboration and explore opportunities for synergy. The FAO welcomed the initiative and has since continued engaging with the national institutions, with the possibility of providing additional support in the future.

Regional (African) Training Course on Good Laboratory Practices (GLP) for Animal Disposition Studies- Large Terrestrial Food Animals

James Sasanya

A regional training course was held in Rabat, Morocco from 31 March to 4 April 2025 in collaboration with the Office National de Sécurité Sanitaire des Produits Alimentaires. The event brought together 32 participants from 21 African countries: Benin, Botswana, Burkina Faso, Burundi, Congo, Djibouti, Egypt, Eswatini, Ethiopia, Kenya, Madagascar, Malawi, Mauritania, Morocco, Namibia, Nigeria, Rwanda, Senegal, Togo, Tunisia, Uganda, and Zimbabwe.

The training focused on the principles and application of Good Laboratory Practice (GLP) in food animal depletion and pharmacokinetic studies. Key topics included the design, conduct, and reporting of animal and agrochemical studies, as well as the interpretation of depletion data generated under both GLP and non-GLP conditions. Participants also learned how to prepare regulatory dossiers and reports, with emphasis on the organizational processes and conditions required to ensure compliance with GLP.

Further areas of focus included the roles and responsibilities of personnel in a GLP-compliant laboratory, the importance of qualified staff working in appropriately equipped facilities, and the correct use of test systems, apparatus, and reagents. Special attention was given to the management, handling, and disposal of test items, reference materials, and biological specimens, in accordance with required safety and quality protocols.

Participants received in-depth instruction on establishing a robust quality control system and understanding the role of Quality Assurance (QA), including national GLP compliance monitoring mechanisms and QA inspections. The training also covered when and how to appropriately use non-GLP studies in cases where GLP-compliant research is not feasible.

Guidelines and regulatory requirements for depletion studies, particularly those from the Organisation for Economic Co-operation and Development (OECD), were presented. These included associated guidance documents and areas of regulatory focus at both national and international levels. Acknowledging the common challenge of data interpretation among emerging researchers, the training provided practical sessions on analyzing and reporting findings from depletion and agrochemical studies conducted under varying conditions.

This training was conducted under an IAEA Technical Cooperation project that aims to address a critical gap in Africa's food safety system—the capacity to generate and interpret scientific data for the establishment of national, regional, and international standards and guidelines. These efforts are essential for protecting consumers, promoting responsible agricultural practices, and enabling fair trade in food and agricultural products.

Participants at training on GLP-Animal studies in Rabat, Morocco (Photo courtesy of Mr S. Darkaoui - RIP, Morocco)

Enhancing Food Safety Testing in Bangladesh

James Sasanya

The Institute of Food and Radiation Biology (IFRB) of the Bangladesh Atomic Energy Commission in Gonakbari, Savar continues to advance its scientific capabilities, positioning itself as a leading institution in the country for food safety testing and research. Among its notable efforts is the use of radiolabelled antimicrobials in Sonali chicken, contributing to the global process of setting food safety standards and guidelines. With the support of the IAEA, the Institute has successfully established specialized capabilities for conducting Carbon-14 (C-14) and Tritium (H-3) analysis using a sample oxidizer and a liquid scintillation counter (LSC).

The sample oxidizer is a fully automated, computer-controlled system designed to prepare solid organic samples, such as chicken tissue, by combusting them into homogenous and transparent liquid forms suitable for precise radioactivity measurement with the LSC. Depletion studies using both radiolabelled (H-3) and non-radiolabelled compounds have been carried out on antimicrobials such as doxycycline and amoxicillin. These studies require rigorous analytical protocols, prompting the development and validation of fit-for-purpose methods.

In the case of amoxicillin, the validated method includes its key metabolites—amoxycilloic acid sodium salt and amoxicillin diketopiperazine—as well as the use of deuterated amoxicillin to enhance analytical performance. Further research is underway on other veterinary drugs, including anthelmintics.

A recent mission to IFRB by Mr Sasanya (20–24 April 2025) provided critical support for method development and validation, addressing analytical challenges that had persisted for over a year. During his visit, he also conducted theoretical training for ten laboratory staff on Inductively Coupled Plasma Mass Spectrometry (ICP-MS), as the Institute prepares to broaden its analytical testing scope. The training covered both fundamental and advanced applications, with emphasis on best practices and practical guidance for achieving accurate results.

Additionally, the IFRB has initiated research on the detection of food and beverage pigments, some of which are suspected to be non-compliant with safety regulations. A preliminary method using HPLC-DAD/FLD has been developed to screen 17 pigments. Mr Sasanya provided technical input on optimizing this method and introduced automated data processing approaches, which will support future work in this area.

In a further effort to strengthen collaboration, Mr Sasanya and an IFRB counterpart visited the FAO office in Bangladesh to inform them of ongoing support to the Institute and to explore potential areas for joint cooperation. The meeting was well received, and several opportunities for synergy were identified, particularly in the areas of food safety, quality, and broader food and agriculture initiatives supported by the Joint FAO/IAEA Centre.

Lab staff conducting tests, April 2025, Gonakbari, Bangladesh (Photo courtesy of Mr J. Sasanya, IAEA)

Developments at the Food Safety and Control Laboratory (FSCL)

Supporting Member States in Using Nuclear and Related Techniques to Strengthen their Analytical and Monitoring Capabilities Regarding AMR-Related Antimicrobial Residues in Aquaculture Products and Associated Matrices

Christina Vlachou, James Sasanya, Britt Maestroni

Aquaculture—the farming of aquatic organisms under controlled conditions—is playing an increasingly important role in economic development, social well-being, and food security. The sector is expanding rapidly, and in 2022, for the first time, aquaculture production of animal species surpassed that of capture fisheries. However, this growth is being challenged by aquatic animal diseases and environmental stressors. The intensification of aquaculture has led to increased use of antimicrobials to manage disease outbreaks, contributing to the emergence of antimicrobial resistance (AMR)—a serious global health threat projected to cause up to 10 million deaths annually by 2050.

AMR endangers not only aquatic animal and human health but also food safety, food security, and environmental sustainability. Its emergence is driven by factors such as the misuse of antimicrobials, poor biosecurity practices, and insufficient regulatory frameworks. Residues of antimicrobials in aquatic food products can raise food safety concerns and lead to trade restrictions, with serious economic consequences. Moreover, other substances—including sanitizers, biocides, pesticides, and heavy metals—can worsen AMR. Resistance genes can also spread into pond water and sediments, which are sometimes reused as fertilizers, posing additional risks to environmental and public health.

At the global level, the Food and Agriculture Organization of the United Nations (FAO), along with other partners, plays a key role in tackling AMR in aquaculture by promoting responsible antimicrobial use, developing monitoring guidelines at the farm level, and assessing the risks associated with antimicrobial use.

In support of these global efforts, the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture is implementing two Peaceful Uses Initiative (PUI) projects. The first, titled *"Integrated Strategies for Managing Antimicrobial Resistance in Western and Central African Aquaculture"*, is funded by the Government of the United Kingdom through the Department for Energy Security and Net Zero (DESNZ). The second, *"Integrated Strategies for Managing Antimicrobial Resistance in Indo-Pacific Aquaculture"*, is funded under the Atoms4Food Initiative by the Government of Australia. Both projects take a cross-disciplinary approach to enhancing aquatic animal health, food safety, food security, environmental sustainability, and biodiversity, while applying nuclear and related technologies.

The projects will be jointly implemented by the Food Safety and Control Laboratory (FSCL), the Soil and Water Management and Crop Nutrition Laboratory (SWMCNL), and the Animal Production and Health Laboratory (APHL). Together, these laboratories will develop tools to detect aquatic pathogens and chemical residues, enhance biosecurity, and support sustainable aquaculture practices that are resilient to climate change.

The FSCL will lead the food safety component of the projects, focusing on research and development to improve analytical testing for antimicrobial residues in aquaculture products. This work will support the establishment of national food safety standards and help identify chemical drivers of AMR. FSCL will employ advanced analytical technologies such as radio receptor assays (e.g., Charm II), isotope dilution liquid chromatography-tandem mass spectrometry (LC-MS/MS), and rapid screening tools such as portable electrochemical immunosensors. The laboratory will also analyze heavy metals in aquaculture products using energy-dispersive X-ray fluorescence and its newly acquired liquid chromatography–inductively coupled plasma mass spectrometry (LC-ICP-MS) system.

Fish are sampled for implementing food safety monitoring programs in member states (Photo courtesy of Ms B. Maestroni, IAEA)

In the first year of implementation, FSCL will prioritize the development of rapid testing methods and validation of multi-analyte confirmatory techniques for antimicrobials and other chemical hazards. A virtual consultancy meeting is planned to facilitate knowledge exchange, synthesize recent advances in analytical techniques, perform gap analyses, and identify research priorities.

In addition to research and development, the projects will deliver targeted capacity-building activities. These include training workshops designed to transfer analytical methodologies and standard operating procedures to Member States, thereby strengthening their national capacities to monitor antimicrobial use in aquaculture and manage associated risks more effectively.

Enhancing R&D Capabilities to Monitor and Control Microplastics Contamination in Food and Agriculture

Christina Vlachou, Britt Maestroni

Microplastics (MPs), defined as plastic particles smaller than 5 mm, have become widespread in the environment due to human activities, particularly in agriculture and industry. These contaminants, entirely anthropogenic in origin, are now found even in remote areas, underscoring the urgent need for global action. MPs persist in both soil and aquatic ecosystems, where they can be taken up by plants and animals, entering the food chain. They often carry toxic additives and environmental pollutants such as phthalates, heavy metals, pesticides, dioxins, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

A recent lecture by Dr. María Dolores Hernando Guil from the Spanish National Research Council, presented at LAPRW2025 (see article above on "Insights into the 10th Latin American Pesticide Residue Workshop (LAPRW), emphasized the increasing presence of MPs, particularly from mulch films, in agricultural environments and their potential risks to plant health.

A comparative study of conventional polyethylene mulch films and biodegradable PBAT (polybutylene adipate terephthalate) films showed that pesticides—depending on their chemical properties, such as lipophilicity measured by the octanol-water partition coefficient (log Kow)—and environmental factors like ionic strength, can adsorb to these films. PBAT films were found to retain higher levels of pesticide residues and release them more slowly than polyethylene. The study also demonstrated that polystyrene nanoplastics (100 nm) could be absorbed by garden cress and accumulate in roots, stems, and leaves, with most particles remaining in the roots. At high concentrations (≥50 mg/L), nanoplastics significantly reduced germination, plant biomass, shoot and root growth, and lateral root development—posing a potential threat to food security.

From a human health perspective, exposure to MPs primarily occurs through food, either from contaminated crops and animals or through food processing and packaging. Ingested MPs can damage the gastrointestinal tract, disrupt hormonal systems, harm cells, and contribute to cardiovascular disease. As MPs degrade, they release harmful substances, increasing their toxicity. However, limited data on dietary intake and gaps in analytical methodologies hinder accurate risk assessments. More research is needed to detect MPs in various foods, trace their sources, and evaluate health impacts.

To address these research and development gaps, the Food Safety and Control Laboratory (FSCL), in collaboration with the Soil and Water Management and Crop Nutrition Laboratory (SWMCNL), is implementing a new Peaceful Uses Initiative (PUI) project titled *"Enhancing R&D Capabilities to Monitor and Control Microplastics Contamination in Food and Agriculture."* The project is funded by the Government of the United Kingdom through the Department for Energy Security and Net Zero (DESNZ). Building on the NUTEC Plastics initiative and the Joint FAO/IAEA Centre's research, the project contributes to the Atoms4Food initiative and supports the objectives of the UN Plastic Pollution Treaty. Its aims include identifying research gaps, supporting global food safety standards, and improving monitoring and risk assessment capacities.

FSCL is developing analytical methods to identify and quantify MPs in terrestrial food commodities and to investigate the adsorption of pollutants—both organic and inorganic—onto MPs, including phthalates and heavy metals. To support this work, the laboratory has recently acquired an FT-IR microscope for MP identification in food and beverages, as well as a liquid chromatography–inductively coupled plasma mass spectrometry (LC-ICP-MS) system. Other available technologies include a liquid chromatography–tandem mass spectrometry (LC-MS/MS) system with isotopic dilution for detecting organic contaminants and an energy-dispersive X-ray fluorescence (ED-XRF) system for elemental analysis and assessment of MPs' ability to adsorb heavy metals.

The project is expected to improve understanding and technical capabilities in using nuclear, isotopic, and related techniques to identify and monitor MPs in agricultural environments and food products, while enhancing awareness of the food safety and public health implications of MPs as vectors for toxic substances. A virtual consultancy meeting with leading experts is planned to synthesize current knowledge, review analytical advances, identify research gaps, and define future priorities.

In addition to its research component, the project includes capacity building. A virtual training workshop will be held jointly with SWMCNL in November 2025 to raise awareness about the food safety and health risks associated

with MPs in food, promote the development of analytical and monitoring capabilities for agricultural soils and food products, and gather feedback on existing technologies and research needs.

Plastics are used broadly across numerous applications. Is the food that we eat free of microplastics? (Photo courtesy of Ms B. Maestroni, IAEA).

Liquid Chromatography-Inductively Coupled Plasma Mass Spectrometry – a New Technique for Food Safety and Authenticity Testing at FSCL

Christina Vlachou, Britt Maestroni, Marivil Islam, Aiman Abrahim

The contamination of food with heavy metals such as cadmium, lead, arsenic, and mercury poses significant risks to human health, making it essential to have legislation that ensures consumer and environmental safety. International, European, and national standards set maximum allowable levels for these toxic metals and their species in food commodities. Member States must implement effective monitoring programs to ensure food safety, protect public health, and facilitate trade. Climate change is expected to increase heavy metal uptake by crops due to rising soil temperatures. Extreme weather events and permafrost thawing can release trapped heavy metals into the environment, while soil acidification from acid rain and fertilizer use may alter the bioavailability and mobilization of these metals, threatening crop safety. Besides safety concerns, testing for elements like iron, magnesium, and zinc is important to assess the nutritional value of foods. Additionally, elemental fingerprinting serves as a powerful tool to detect food fraud, adulteration, and to verify authenticity and origin.

Inductively coupled plasma mass spectrometry (ICP-MS) is a sensitive analytical technique used for trace element measurement in foods. It offers multi-element analysis, high sensitivity, broad analytical range, and high sample throughput. When coupled with liquid chromatography (LC), LC-ICP-MS enables heavy metal speciation, which is crucial since different oxidation states of elements such as chromium, tin, arsenic, and mercury have varying toxicities.

The Food Safety and Control Laboratory (FSCL) recently acquired and installed a Thermo Fisher Scientific iCAP RQplus ICP-MS system coupled with a Vanquish liquid chromatography system. This acquisition, partly funded by the Peaceful Uses Initiative (PUI) project "Ensuring food security and safety by future-proofing dryland crops under climate change," supported by the UK Government's Department for Energy Security and Net Zero, will strengthen FSCL's R&D in elemental profiling. This includes analyzing toxic and essential metals in dryland crops and supporting food authentication studies, complementing existing rapid screening methods like X-ray fluorescence and electrochemical sensors.

Recognizing the importance of sample preparation, FSCL has established a standard operating procedure for microwave-assisted acid digestion of food samples for elemental analysis. Method protocols and sample preparation procedures will be developed and shared with Member States' laboratories. Visiting scientists, fellows, and interns will have opportunities to train on the LC-ICP-MS system, thereby enhancing Member States' capacities to ensure compliance with regulatory limits for toxic metals and their species, detect food adulteration, and verify food authenticity and origin.

Inductively coupled plasma mass spectrometer coupled with liquid chromatography (LC-ICP-MS) at FSCL (Photo courtesy of Ms M. Islam, IAEA).

Discrimination of White Fish Species Using Near-Infrared Spectroscopy and Chemometrics

Alina Mihailova, Florence Maxwell

Fish and seafood are vital components of the global food system, providing high-quality protein, essential fatty acids, and micronutrients to billions worldwide. Since the 1950s, aquaculture (fish farming) has steadily expanded and now produces more seafood than capture fisheries. With increasing demand driven by population growth and shifting dietary preferences, the seafood supply chain faces growing pressure, making it vulnerable to food fraud. One of the most widespread fraudulent practices is species substitution, where lower-value fish are deliberately mislabelled as higher-value or more desirable species for economic gain.

Species substitution has significant implications: economically, it distorts market dynamics, creating unfair competition and financial losses for legitimate producers and distributors. For consumers, it undermines trust and causes them to pay premium prices for misrepresented products. Public health and safety concerns also arise since substituted species may trigger allergic reactions, introduce unexpected dietary components, or contain higher levels of environmental contaminants. Furthermore, this practice can mask the sale of endangered or overfished species as more sustainable alternatives, undermining conservation and traceability efforts. Thus, accurate species identification is critical for seafood authenticity, consumer protection, and sustainable fisheries management.

Cod (*Gadus spp*.) authenticity is particularly important due to its high economic value, global consumption, and central role in international seafood markets. Atlantic cod (*Gadus morhua*) is a premium species often targeted in fraud, commonly substituted with lower-cost or morphologically similar fish such as pollock, haddock, or pangasius. Such substitution is economically motivated and often difficult to detect visually, especially in processed products like fillets, fish fingers, or ready meals. Cod is among the most frequently mislabelled fish species worldwide, making it a priority for authenticity verification.

Various analytical techniques—DNA-based methods, gas and liquid chromatography coupled with mass spectrometry (GC-MS, LC-MS), nuclear magnetic resonance (NMR) spectroscopy, and vibrational spectroscopy—have been applied to fish speciation. Near-infrared (NIR) spectroscopy is a promising tool for non-targeted, multi-analyte screening and has proven effective for verifying fish authenticity, including species differentiation. NIR spectroscopy offers distinct advantages: it is rapid, cost-effective, non-destructive, requires minimal or no sample preparation, involves low operational costs, offers high throughput, and does not generate chemical waste or require specialized lab facilities. Combined with chemometric modelling, NIR generates fingerprints of authentic samples and enables rapid detection of atypical or fraudulent products. Moreover, handheld NIR sensors facilitate rapid, on-site screening throughout the supply chain.

To support the CRP proposal on Seafood Origin and Authenticity Using Nuclear and Related Technologies, the Food Safety and Control Laboratory (FSCL) has initiated development of rapid spectroscopic methods for white fish speciation. Frozen samples of six white fish species were sourced from local supermarkets for this feasibility study: Atlantic cod (*Gadus morhua*), European plaice (*Pleuronectes platessa*), pangasius (*Pangasianodon hypophthalmus*), European seabass (*Dicentrarchus labrax*), Northern rock sole (*Lepidopsetta polyxystra*), and gilt-head bream (*Sparus aurata*). Thawed minced fish samples were analyzed using benchtop MPA II FT-NIR (Bruker Optics, Germany) and handheld microNIR 1700ES (VIAVI Solutions, USA) spectrometers. Chemometric modeling techniques such as principal component analysis (PCA), orthogonal partial least squares discriminant analysis (OPLS-DA), and data-driven soft independent modelling of class analogy (DD-SIMCA) were applied to differentiate species.

FIG. 1: Analysis of white fish samples using FT-NIR and handheld NIR. (Photo courtesy of Ms A. Mihailova, IAEA).

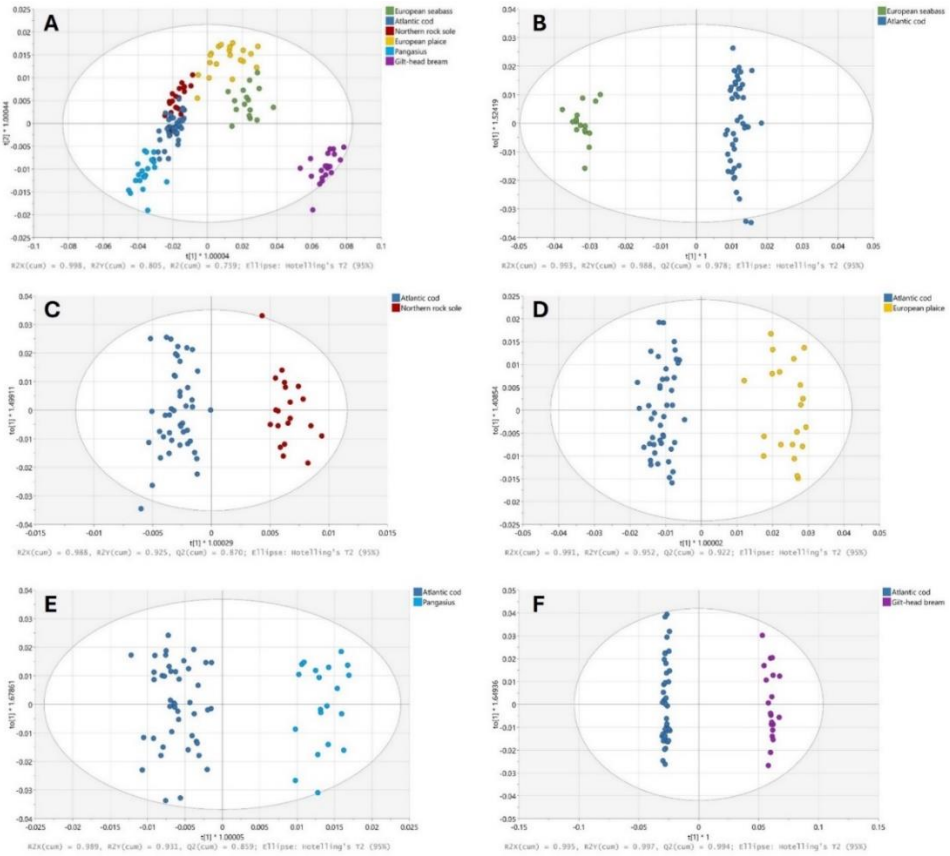


Figure 2: Shows the score plots of the 7-fold cross-validated OPLS-DA models for the discrimination of all six white fish species (A) as well as Atlantic cod versus each of the other five white fish species (B-F) using FT-NIR spectroscopy data

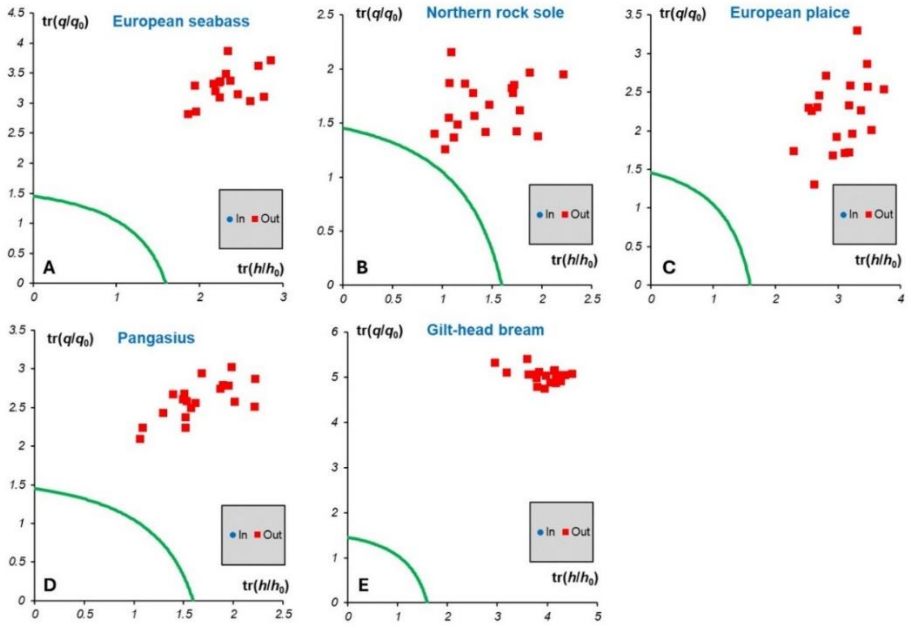


FIG. 3: The acceptance plots of the DD-SIMCA models for the discrimination of Atlantic cod and European seabass (A), Northern rock sole (B), European plaice (C), pangasius (D) and gilt-head bream (E) using FT-NIR spectroscopy data. The green line indicates the acceptance boundary (95% confidence) for the Atlantic cod class. The red squares are the samples from the other white fish species correctly classified as outliers.

Excellent separation between Atlantic cod and each of the other five white fish species was achieved using both benchtop FT-NIR and handheld NIR spectroscopy data. The predictive ability of the orthogonal partial least squares discriminant analysis (OPLS-DA) models, measured by Q^2 values, ranged from 0.859 (Atlantic cod vs. pangasius) to 0.994 (Atlantic cod vs. gilt-head bream) for FT-NIR data. For handheld NIR data, Q^2 values ranged from 0.801 (Atlantic cod vs. Northern rock sole) to 0.996 (Atlantic cod vs. gilt-head bream).

In addition to OPLS-DA, one-class classification modelling using data-driven soft independent modelling of class analogy (DD-SIMCA) was performed. Atlantic cod samples were designated as the target class, while samples from the other white fish species were assigned as the alternative class (see Figure 3). The DD-SIMCA models based on both FT-NIR and handheld NIR data achieved high classification performance, with 97% sensitivity and 100% specificity in distinguishing Atlantic cod from other white fish species.

This preliminary feasibility study, conducted with a limited sample set, demonstrates the promising potential of FT-NIR and handheld NIR spectroscopy combined with chemometric analysis for white fish species differentiation. However, due to the limited number of samples, external model validation was not performed at this stage. Further research including a larger sample size that covers multiple catchment years and geographical origins will be necessary to validate and refine the OPLS-DA and DD-SIMCA models. Updates on this work will be shared in future issues of the FSC Newsletter.

Geographical discrimination of mussels from Chile using near-infrared spectroscopy and chemometrics

Alina Mihailova, Marivil Islam

The authentication of the geographical origin of food products has become increasingly important amid globalized trade, heightened consumer awareness, and stronger regulatory demands. Among high-value and perishable commodities, seafood—particularly bivalve molluscs such as mussels—is highly vulnerable to food fraud practices. Mussels (e.g., *Mytilus edulis*, *Mytilus galloprovincialis*) are cultivated and harvested in diverse aquatic environments across Europe, Asia, and the Americas. Their regional reputation and quality often depend on specific environmental and ecological conditions. The geographic provenance of mussels influences their nutritional profile, contaminant levels, and organoleptic properties, thus affecting food safety, consumer perception, and market value.

Food fraud in seafood includes deceptive practices such as species substitution, undeclared treatments, and mislabeling of production or geographical origin. Misrepresentation of geographical origin is particularly common and difficult to detect. Mussels from regions with lower production inputs or less stringent environmental and quality regulations may be falsely marketed as originating from premium or protected designations of origin (PDO) or protected geographical indications (PGI). Such fraudulent labeling undermines consumer trust, harms legitimate producers, and creates unfair competition. Various studies and regulatory audits have identified discrepancies between label claims and analytical findings regarding seafood origin, revealing weaknesses in supply chains and documentation-based traceability.

The European Union and other regulatory bodies have recognized the importance of origin labeling in aquaculture and fisheries. For example, EU Regulation No. 1379/2013 mandates clear labeling of production methods and geographical origin. However, compliance is mostly verified through document checks, which alone cannot reliably detect fraudulent origin claims. This underscores the need for analytical tools that can independently verify provenance. Mussels' filter-feeding behavior and rapid incorporation of environmental elements make them well-suited for origin authentication based on their chemical and biochemical profiles.

Infrared (IR) spectroscopy has emerged as a promising tool in this area, offering rapid, non-destructive, and reagent-free analysis of food matrices. Both mid-infrared (MIR) and near-infrared (NIR) spectroscopy have been successfully applied to food authentication due to their sensitivity to molecular vibrations of water, proteins, lipids, and other organic compounds. When combined with chemometric techniques such as principal component analysis (PCA), orthogonal partial least squares-discriminant analysis (OPLS-DA), or machine learning classifiers, IR spectroscopy can detect subtle compositional differences related to geographic and environmental factors. Additionally, handheld NIR sensors enable rapid authenticity screening outside laboratory settings, facilitating use at multiple points along the supply chain.

To support TCP CHI5053 and the CRP proposal on Seafood Origin and Authenticity Using Nuclear and Related Technologies, the Food Safety and Control Laboratory (FSCL) has initiated development of rapid spectroscopic methods to verify the geographical origin of Chilean mussels. This study utilized 80 freeze-dried ground mussel samples from two Chilean locations—Huito Calbuco and Quellón Trincao—harvested over four seasons and two production years. The samples were provided by the Food Quality Research Centre at the University of Chile. Rapid screening analysis was performed using benchtop MPA II FT-NIR (Bruker Optics, Germany) and handheld microNIR 1700ES (VIAVI Solutions, USA) spectrometers. Chemometric modeling employed principal component analysis (PCA) and orthogonal partial least squares discriminant analysis (OPLS-DA).

The OPLS-DA model was validated using an independent test set (n = 24). The total correct classification rate of the mussels from the test set was 95.83% – all mussel samples from Huito Calbuco region were correctly classified (100%), while the classification accuracy of the mussel samples from Quellón Trincao region was 91.67% (Table 1)

Figure 1A shows the score plot of the 7-fold cross-validated OPLS-DA model for the discrimination of mussels from Huito Calbuco and Quellón Trincao regions using FT-NIR spectroscopy data. The goodness of fit (R2X(cum), R2Y(cum)) and the predictive ability (Q2(cum)) values of the OPLS-DA model built using FT-NIR data, were 0.902, 0.960 and 0.760, respectively.

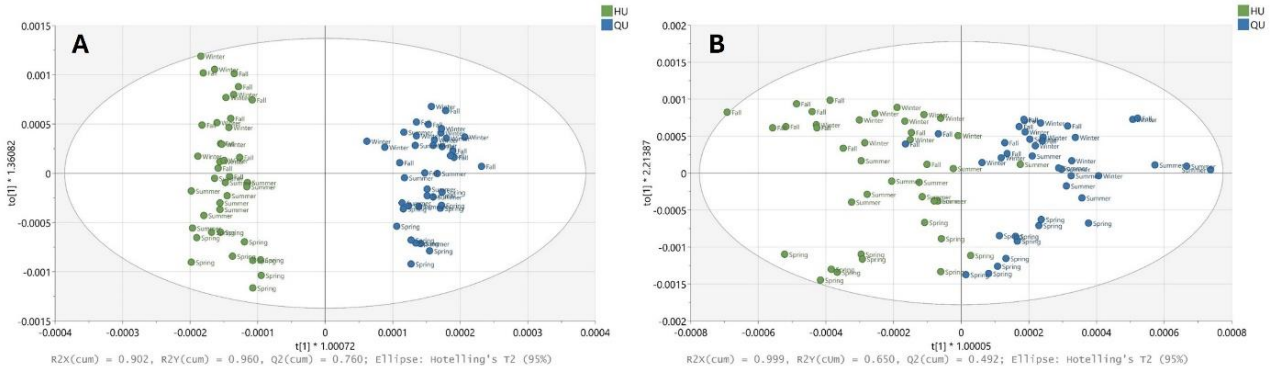


FIG. 1: The score plots of the OPLS-DA models for the discrimination of mussels from Huito Calbuco (HU) and Quellón Trincao (QU) regions using FT-NIR (A) and handheld NIR (B) spectroscopy data.

Handheld NIR spectrometer data also allowed the discrimination of mussel samples from the two geographical regions; however, the model performance was poorer in comparison to the FT-NIR data. Figure 1B shows the score plot of the 7-fold cross-validated OPLS-DA model for the discrimination of mussels from Huito Calbuco and Quellón Trincao regions using handheld NIR spectroscopy data. The goodness of fit (R2X(cum), R2Y(cum)) and the predictive ability (Q2(cum)) values of the OPLS-DA model built using handheld NIR data, were 0.999, 0.650 and 0.492, respectively.

TABLE 1: PERFORMANCE INDICATORS OF THE OPLS-DA MODELS FOR THE DISCRIMINATION OF MUSSELS FROM HUITO CALBUCO AND QUELLÓN TRINCAO REGIONS USING FT-NIR AND HANDHELD NIR SPECTROSCOPY DATA.

Analytical technique	**OPLS-DA model (training set, n = 56)**			**Classification accuracy of the test set (n = 24), %**		
	R2X	**R2Y**	**Q2**	***Huito Calbuco* (n = 12)**	**Quellón Trincao (n = 12)**	**Total (n=24)**
FT-NIR	0.902	0.960	0.760	100	91.67	**95.83**
Handheld NIR	0.999	0.650	0.492	83.33	91.67	**87.5**

The OPLS-DA model was validated using an independent test set (n = 24). The total correct classification rate of the mussels from the test set was 87.5% – the classification accuracy of the mussel samples from Huito Calbuco and Quellón Trincao regions was 83.33% and 91.67%, respectively (Table 1).

Even though the sample set was very small and a much larger number of samples from multiple production years is required to draw the conclusions about the model performance, both PCA and OPLS-DA score plots indicated that there was a pronounced seasonal effect. In each of the two regions, the sample distribution was in accordance with the seasons (spring, summer, winter and autumn).

To assess if it was possible to discriminate four seasons regardless of the two geographical regions, new OPLS-DA models were generated. Both FT-NIR and handheld NIR data allowed discrimination of the mussels from spring, summer, winter and autumn irrespective of the geographical location (Figure 2A and 2B, respectively).

The goodness of fit (R2X(cum), R2Y(cum)) and the predictive ability (Q2(cum)) values of the OPLS-DA model built using FT-NIR data, were 0.921, 0.811 and 0.641, respectively. While the goodness of fit (R2X(cum), R2Y(cum)) and the predictive ability (Q2(cum)) values of the OPLS-DA model built using handheld NIR data, were 0.999, 0.746 and 0.524, respectively. Validation of these models using an independent test set was not performed due to a very limited number of samples available.

This has been a small feasibility study with a limited number of mussel samples, however, the results show the potential of both FT-NIR and handheld NIR spectroscopy, coupled with chemometrics, for the differentiation of mussels from Huito Calbuco and Quellón Trincao regions. The strong seasonal effect that was observed would affect the performance of the OPLS-DA models for the separation of geographical regions. Therefore, a larger number of samples collected over four seasons during multiple production years, would need to be used to assess the suitability of this

analytical approach and for further validation of the OPLS-DA models. Further work will be conducted and reported in future issues of the FSC Newsletter.

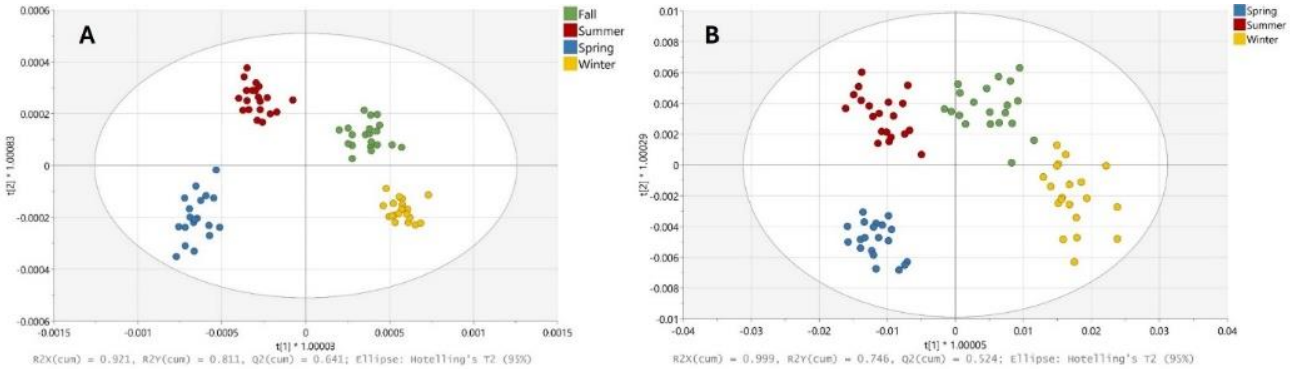


FIG. 2: The score plots of the OPLS-DA models for the discrimination of mussels collected in spring, summer, winter and autumn (fall) using FT-NIR (A) and handheld NIR (B) spectroscopy data.

FSCL Staff

In this newsletter, we take the opportunity to pay tribute and bid farewell to FSCL colleagues who recently left the agency.

Mr Simon Kelly, an expert in the field of stable isotope analysis for food authentication, completed his assignment in January 2025. Simon has served at the FSCL for 9 years with professionalism and dedication, making an excellent contribution to the laboratory achievements, delivering outstanding outputs in research, capacity building, standards setting, resource mobilisation and outreach activities. He developed innovative analytical methods, successfully managed several Coordinated Research Projects on topics of food authenticity and origin, supported Technical Cooperation Projects in the Member States and served as acting Laboratory Head.

After almost seven years at the FSCL, Ms Alina Mihailova completed her assignment as an analyst on food authenticity topics. With her enthusiasm and dedication, Alina was an inspirational team member, making invaluable contribution to many aspects of the FSCL research on analytical methods for food authenticity and origin assessments, using rapid benchtop and portable spectroscopic screening techniques, as well as untargeted analysis. She also served as a technical officer supporting capacity building in the Member States.

We thank Simon and Alina for all their efforts and support, we wish them all the very best for their future endeavours, and we look forward to future collaboration opportunities.

At the end of 2024, Mr Islam Hamed completed his temporary assignment as a laboratory technician. Islam had taken over the duties of Ms Florence Maxwell, who was in developmental reassignment in the Division of Physical and Chemical Sciences and who returned to FSCL as of the beginning of 2025. Islam made a great contribution to the FSCL's achievements, assisting in sample registration and preparation and to the day-to-day laboratory operations. We thank Islam, we wish him all the very best for his future career, and we welcome Florence back to FSCL.

After one year in the agency, Martina Domanik completed her temporary assignment as a team assistant in May 2025. Martina had taken over the duties of Ms Joanna Mletzko, who is in developmental reassignment in the Office of Procurement Services (MTPS). Being very well organized, always willing to learn, to improve administrative procedures and to take proactive steps, Martina has greatly supported the FSC and APH laboratories. We thank Martina for all her efforts, and we wish her all the very best for her future career.

Announcements

International Conference on Nuclear and Radiological Emergencies: Building the Future in an Evolving World 2025, 1–4 December, Riyadh, Saudi Arabia

The International Conference on Nuclear and Radiological Emergencies: Building the Future in an Evolving World, will be held from 1–4 December 2025, in Riyadh, Saudi Arabia. The Conference is being arranged by the IAEA Incident and Emergency Centre and hosted by the Government of the Kingdom of Saudi Arabia. It aims to foster information exchange and enhance global awareness of emergency preparedness and response topics, including the protection of food and agricultural products. A side-event dedicated to food and agriculture is being planned in cooperation with the Joint FAO/IAEA Centre.

Codex Alimentarius Commission, 10–14 November 2025, Rome, Italy

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