Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Food & Environmental Protection Newsletter

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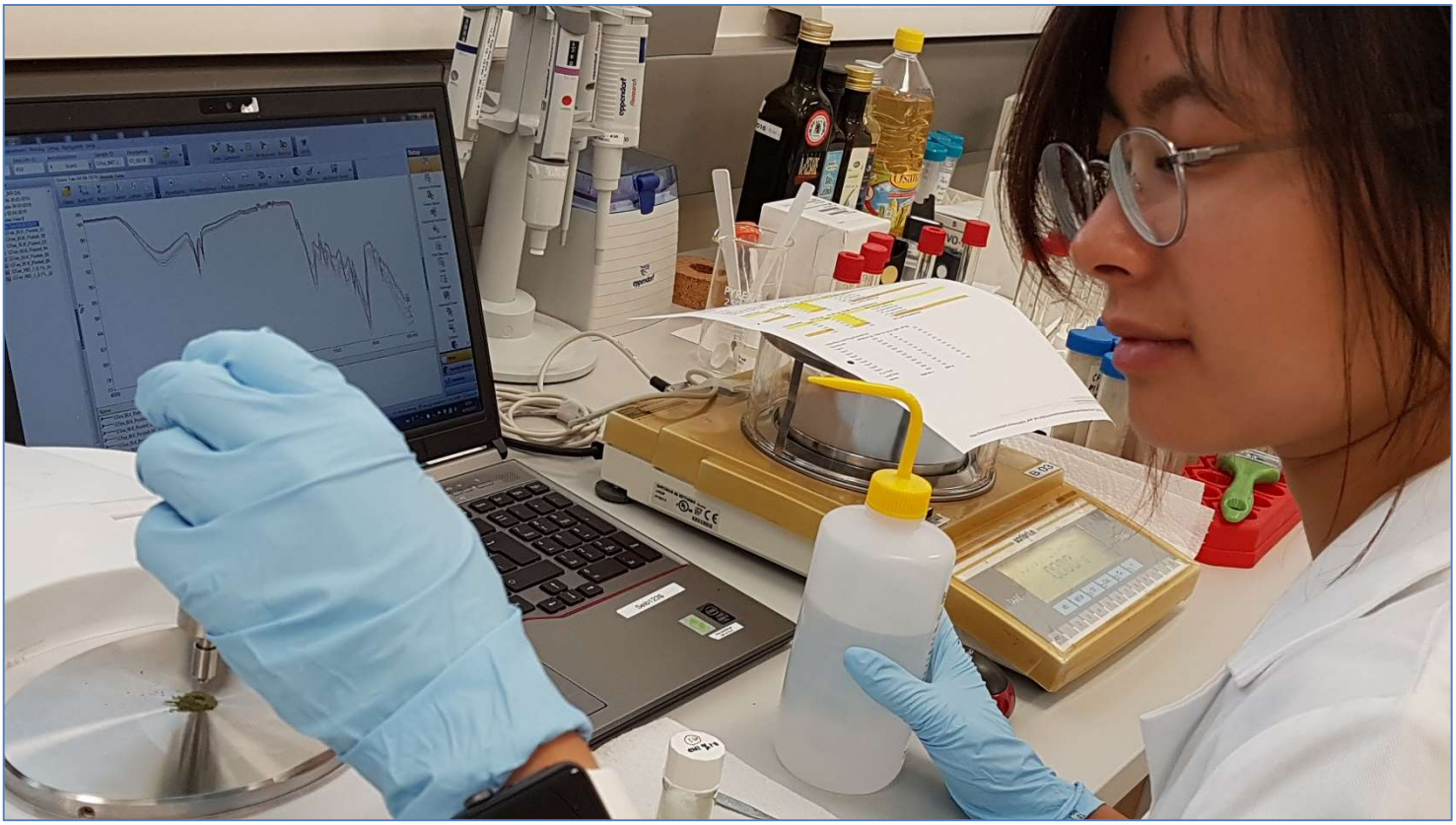
To Our Readers



FTIR-ATR analysis of green tea by scientists at the Food and Environmental Protection Laboratory, Seibersdorf, Austria.

It is my pleasure to write to you for the first time as Head of the Food and Environmental Protection (FEP) Section. I took up the post of Section Head in July 2021, but many of you may know me from my previous roles as head of our Food and Environmental Protection Laboratory, where I served from July 2004 to 2021, and as a technical officer in the Animal Production and Health section before that. In taking up my new position, I thank my colleagues, James Sasanya and Carl Blackburn for their capable leadership of the section since August 2020. Thanks also to Simon Kelly, who has taken on the added responsibility of leadership of the laboratory team, pending the appointment of a new Laboratory Head.

It is opportune to record my appreciation of all my colleagues in the Food and Environmental Protection subprogramme for the excellent job they have done in

maintaining outputs in support of food safety and quality in our Member States under the difficult times we live in, with the mental stress and increased workload due to the organizational, practical, health and social difficulties imposed by COVID-19 related safeguards and restrictions. Appreciation is also due to the counterparts in our many projects who maintain successful collaboration and cooperation under the same, and often more drastic, conditions.

One of the key mechanisms for supporting Member States is technology transfer, mainly through training courses and workshops, and this is one of the areas that has been disrupted most by restrictions on travel and meetings. Nevertheless, we have tried to adjust to the limitations and have delivered training in a number of virtual and hybrid events, both through the technical cooperation projects and through courses developed with extrabudgetary funding and led by the Food and Environmental Protection Laboratory at Seibersdorf. These events covered topics such as risk analysis, quality standards, food irradiation and laboratory methods for food safety and authenticity. Although it is well recognized that virtual training on analytical methods is no substitute for hands-on training and interaction in the laboratory, feedback has indicated that the sessions held were well appreciated. Support to the technical cooperation programme has continued to produce significant results, including the establishment of screening capabilities for chemical residues and contaminants in several countries, including Burundi, Cote d'Ivoire, Georgia and Myanmar.

Another key activity is coordinated research. During this period, virtual research coordination meetings were held for three of our five active coordinated research projects (CRPs) and two new CRPs were initiated focusing on risk assessment of biotoxins and food pathogens, and on novel irradiation technology for phytosanitary treatment of food commodities and promotion of trade. We are happy to report that we received funding from the United States of America for a Peaceful Uses Initiative project on the development of a food authenticity laboratory network (FALNET), which expands our coordinated research project on the authentication of foods with high value labelling claims.

FEP staff actively engage with the global community, contributing to matters related to food safety and control. Recent examples include participation in several international meetings and conferences, including the Latin America Risk Assessment Symposium, the African Food Safety Workshop, side events at the Pre-Summit of the UN Food Safety Systems Summit and COP26 Climate Summit, and a decade of progress after Fukushima-Daiichi. We also contributed to an international conference on the development of preparedness for emergency response and participated in a successful international exercise to test and rehearse procedures under the nuclear accident conventions at level three (ConvEx-3), the top-most level of nuclear emergency exercise. Involvement in the development of international standards included contributions to the CODEX Committees on Pesticide Residues and Residues of Veterinary Drugs in Food and a technical meeting on radionuclides in food and drinking water in non-emergency situations.

Applied and adaptive research in the Food and Environmental Protection Laboratory resulted in the development of methods for the determination of aflatoxins in pistachio, the determination of pesticide metabolites in biobeds and the discrimination of mandarins of different botanical origins.

With regard to staff, our thanks and best wishes go to two PhD consultants who have completed their work in our laboratory, Ms Sofia Rezende and Mr Ignacio Migues, both from the University of the Republic, Uruguay, and to Ms Beatrix Liebisch who completed a one-year internship in the laboratory. We welcome Mr Vamsi Golla, who has joined the laboratory team as an intern.

In closing, I wish you and your families a happy and healthy 2022, and hope for less trying times in the near future.

Andrew Cannavan

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Feature Article

Looking Ahead–the Food and Environmental Protection Sub-programme in the Next Biennium

Andrew Cannavan

The Food and Environmental Protection subprogramme (FEP) maintains a dynamic work plan, which is constantly evolving in response to the needs of Member States. Work is planned on a biennial cycle, and it is timely in this issue of the newsletter to outline our plans for addressing ongoing and emerging challenges to food safety, quality and security in 2022–2023 and beyond.

Member States face many challenges in ensuring a sustainable, safe and nutritious food supply for the growing global population, with the necessary controls to enable domestic and international trade. Intensified food production has led to increased use of agrochemicals, which may result in harmful chemical residues in foods. Emerging contaminants such as microplastics, multiple endocrine disruptors and zoonotic or other pathogenic microbes affect food safety. Market competition and the demand for added value products have resulted in an increase in food counterfeiting and adulteration. Climate change has far-reaching impacts on food safety both pre- and post-production, including changes in the prevalence and geographical distribution of pests and natural toxins. The food supply is vulnerable to systemic shocks such as pandemics, extreme weather events, conflicts, and natural disasters, which can lead to food shortages, disrupt food inspection and testing and provide increased opportunities for adventitious contamination, the misuse of agrochemicals, food fraud and food processing shortcuts, posing additional food safety risks. Member States require assistance in building resilient, integrated food control systems to meet these challenges and ensure a safe food supply under normal conditions and in stress situations or emergencies.

Nuclear technologies offer advantages for food testing to control contaminants and to provide information on authenticity and origin, and for food processing. These are essential elements of effective food control systems. Our activities focus on the integration of nuclear and related food testing methods into food control systems, and the application of novel food irradiation methods for improving food safety, combating pests, reducing post-harvest spoilage and preventing losses.

Activities in 2022–2023 will focus on several key topics. The development and transfer of analytical methodology packages to help Member States to tackle the rapidly growing problem of food fraud will remain a priority area, as will analytical methods to control food residues and contaminants. Cost-effective screening methods that can be rapidly deployed in food crisis situations to provide information vital for decision making and to support rapid interventions has become a priority area. Linked to these topics is the generation and transfer of data packages to facilitate standard setting and risk assessment. Food irradiation research will focus on new uses of machine-generated irradiation technologies to provide effective means to ensure food quality and minimize losses due to spoilage without relying on radionuclide sources.

Control of food residues and contaminants and food authenticity

There is an increasing need for the generation of data to support national authorities in the management of agricultural inputs, enabling farmers to produce sufficient, safe, good quality food for domestic consumption and trade. FEP will help to develop the capacity in Member States to generate information on risks posed by contaminants and residues in food and the environment, data to monitor the use of antimicrobials in relation to antimicrobial resistance, and databases to combat food fraud. In addition to support for technical cooperation projects, activities in this field will include a new coordinated research project (CRP) on isotopic techniques to support risk assessment for biotoxins, which also incorporates a new research topic on novel analytical methodology for the detection and control of pathogens. Three current CRPs on food authenticity and chemical residues/contaminant control will continue. All projects will be underpinned by targeted, applied research and development in the Food and Environmental Protection Laboratory (FEPL), now with much improved capabilities in the new Yukiya Amano Laboratories building. Capacity building will continue to be enhanced through networking, with current networks being supported and expanded in Latin America (Red Analitica de Latino America y el Caribe, RALACA), Africa (the African Food Safety Network, AfoSaN) and Asia (Food Safety Asia network, FSA).

Responding to crises affecting the food supply

The COVID-19 pandemic has highlighted the vulnerability of the food supply to crisis situations. A new FEP project in 2022–2023 will help Member States to prepare for and respond to food contamination incidents and crises. The focus will be on the development and transfer of cost-effective nuclear, isotopic and related screening methods that can be rapidly deployed to provide information vital for fast decision making and the mitigation of disruptive effects on food and supply systems. Easy to use screening methods can be applied at different points along the food supply chain and will reduce reliance on sophisticated and labour-intensive laboratory testing during a critical period, allowing available resources to be targeted only to those high-end

techniques essential for crisis control and management. In addition to food contamination incidents, portable screening methodologies will be applicable where food safety testing is compromised indirectly, for example disruption caused by phenomena such as pandemics, extreme weather events, earthquakes etc., so that food safety can be assured as much as possible when laboratory-based resources are constrained.

Planned activities include applied research and development and technology transfer in FEPL under an ongoing extrabudgetary project, 'Enhancing Capacity in Member States for Rapid Response to Food Safety Incidents and Emergencies', and a new CRP on the development and implementation of rapid screening methods for safe food, which will commence in 2023. This work will be supported by the development of laboratory networks capable of fast response on a national or regional basis.

New uses of machine generated irradiation technologies

More widespread use of food irradiation could help to mitigate many of the negative impacts on food security brought about by external shocks to food systems. Climate change, for example, is already implicated in more frequent 'extreme weather events', changes in food production patterns and increased food losses and wastage. The need to maintain food safety, reduce food losses, facilitate trade and adopt more sustainable food processes is expected to favour a steady increase in volumes of irradiated food in the long term. Current barriers to the adoption of food irradiation include the difficulty in acquiring, transporting, and maintaining cobalt-60 sources, and the logistics of moving large volumes of food to specialist irradiation centres. Machine source irradiation, using electricity to generate electron beams and X-rays, avoids the difficulties associated with isotope source safeguards. Electron accelerators can potentially provide sustainable food industry solutions to ensure food safety and address environmental impacts, with more efficient energy consumption, lower water use and fewer chemical inputs. Increased use of these techniques will improve access to irradiated food, and this should be further enhanced by the development of capabilities to irradiate food in factories or on packing lines using low energy (keV) beams as part of a normal food business.

The FEP will provide support to improve Member State capabilities in the development, expansion and implementation of food irradiation applications to control pests, reduce microbial contamination and extend the shelf-life of foodstuffs. Research in the coming biennium will focus on low energy electron beam and X-ray techniques and generic phytosanitary treatments to enable fresh food trade across quarantine boundaries. It is expected that this work will help develop international standards, guidelines and protocols that will help Member States in the adoption and use of food irradiation applications.

Although the work plan for 2022–2023 has been formulated, refined and approved as summarised here, there is no doubt that new challenges to food integrity will emerge during the biennium. We will, as always, be continually scanning the horizon for such challenges and will retain the flexibility to incorporate appropriate responses into our work to continue assisting our Member States in maintaining a safe, secure food supply.

Forthcoming Events

Research Coordination Meetings and Training Courses

Second Research Coordination Meeting on Depletion of Veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices (D52043-CR-2), Vienna, Austria, 28 February–4 March 2022.

First Research Coordination Meeting on Irradiation Technology for Phytosanitary Treatment of Food Commodities and Promotion of Trade (D61026-CR-1), virtual, 7–11 March 2022.

Training Course on Analytical Methods to Detect and Control Organic Contaminants in Food, Seibersdorf, Austria, 16–27 May 2022.

Fourth Research Coordination Meeting on Field-deployable Analytical Methods to Assess the Authenticity, Safety and Quality of Food (D52040-CR-4 & G42007-CR-4), Vienna, Austria, 20–24 June 2022.

Second Africa Food Safety Technical Meeting, Johannesburg, South Africa, 27 June–1 July 2022.

First Research Coordination Meeting on Nuclear Techniques to Support Risk Assessment of Biotoxins and Pathogen Detection in Food and Related Matrices (D52044- CR-1), Vienna, Austria, 22–26 August 2022.

Training Course on the Use of Rapid Profiling/Fingerprinting Techniques to Determinate Food Origin and Verify Food Authenticity, Seibersdorf, Austria, 22 August–2 September 2022.

Consultants' meeting on Rapid Screening for Safe Food Vienna, Austria, 26–30 September 2022.

Second Research Coordination Meeting on Innovating Radiation Processing of Food with Low Energy Beams from Machine Sources (D61025-CR-2), Vienna, Austria, 10–21 October 2022.

Third Research Coordination Meeting on Implementation of Nuclear Techniques for Authentication of Foods with High-Value Labelling Claims (INTACT Food) (D52042-CR-2), Vienna, Austria, 31 October–4 November 2022.

International Meetings/Conferences

EuroResidue IX, Current issues and emerging trends in residue control, St. Michielsgestel, The Netherlands, 23–25 May 2022.

Second International Conference on Applications of Radiation Science and Technology (ICARST-2022), Vienna, Austria, 22–26 August 2022.

The 20th International Meeting on Radiation Processing (IMPRP20), Bangkok, Thailand 7–11 November 2022.

Past Events

Presentation on Honey Authenticity to Tajikistan Government Officials

Simon Kelly

Tajikistan is a landlocked country with a population of about 8 million. About three-quarters of population is living in rural areas. The country's climatic diversity, fertile soil and favourable water conditions enable the production of a variety of fruits and vegetables known for their special flavour and nutritional value. Despite these favourable conditions the agricultural sector in Tajikistan faces market access barriers related to food safety issues. According to a private sector-survey carried out by OECD in Tajikistan, whilst the basic legal framework for technical and sanitary standards is in place, due to lack of funds, capacity and organisation, Tajikistan's agricultural products are often not in compliance with international standards. This is a major barrier to exporting through formal channels and also leads to challenges of getting "trusted trader" status for Tajikistan.

During a Standards and Trade Development Facility (STDF) working group meeting, a roadmap was proposed to improve veterinary, sanitary and phytosanitary safety in Tajikistan. This resulted in the FAO project 'Enabling market access for Tajik agricultural products through an improved food safety system', which aims to remove technical and market infrastructure barriers for small scale producers and processors and assist them to reach higher value markets. This will result in supporting poverty reduction in the most remote areas of Tajikistan, due to the concentration of agricultural production in these areas. In addition, the project aims to introduce sustainable agrochemical use that will have positive impact on the environment and contribute to the related Sustainable Development Goals (SDGs). The project also contributes to the harmonisation and adoption of international standards, in particular maximum residue limits (MRLs) for veterinary and agrochemical residues. The project is designed to facilitate interaction with neighbouring countries and regional trading partners towards regional harmonisation for the purpose of trade facilitation.

Mr Simon Kelly was invited to give an online synchronous presentation to Tajikistan government officials on honey authenticity on the 14 April 2021. Mr Kelly's presentation covered the broader context of food fraud and its impact on attainment of the SDGs and definitions of food fraud given in the European Committee for Standardization's Workshop Agreement 17369 'Authenticity and fraud in the feed and food chain – Concepts, terms and definitions'. He went on to explain; EU and Codex standards and regulations relating to honey; compositional aspects of honey; the size of global markets for honey; issues related to adulteration; the availability of adulterant sugar syrups in the global market place; general analytical quality control of honey and finally the specifics of stable carbon isotope analysis of honey to detect C4-plant sugar addition (AOAC method 998.12). The presentation was well received and most of the questions related to the acceptable processing treatments of honey and its effect on the enzyme (diastase) activity as this is the basis of evaluating the quality of honey.

Mr Simon Kelly giving an online presentation on honey authenticity to Tajikistan Government officials.

Virtual Training Course on the Detection and Control of Organic Contaminants in Food

Britt Maestroni and Andrew Cannavan

Although COVID-19 is not a food-borne disease to any great extent, the pandemic has had serious effects on the integrity of our food supplies. The global food sector has been impacted across the entire food chain, in relation to factors such as human resources; disruptions to supply chains of ingredients, packaging, finished products and equipment; and transportation of people, materials and goods. National Food Safety Control Systems, as described in the Codex Guidelines for the Validation of Food Safety Control Measures (CAC/GL 69-2008), have been compromised. The reduction of controls and inspection has presented opportunities for food fraud, and for misuse of agrochemicals, potentially giving rise to harmful residue levels of both authorised and illegal compounds in food.

To maintain assistance to Member States during the COVID-19 pandemic, a FAO/IAEA Training Course on the Detection and Control of Organic Contaminants in Food was implemented virtually from 7–11 June 2021 and was attended by 22 participants from Algeria, Argentina, Bangladesh, Brazil, Chad, Ecuador, Ethiopia, Ghana, India, Lao People's Democratic Republic, Lebanon, Namibia, Oman, Pakistan, Paraguay, Seychelles, Sri Lanka, Thailand, Tunisia, Uruguay, Uzbekistan and Viet Nam. The training was provided under a project funded by the Japanese Government under the Peaceful Uses Initiative, 'Enhancing Capacity in Member States for Rapid Response to Food Safety Incidents and Emergencies'. The course was intended

to be hands-on, in the laboratory, to complement the more theoretical course held in December 2020, but due to the ongoing COVID-19 pandemic, had to be redesigned as a virtual course. The training was intended to impart knowledge on the general principles and application of selected analytical techniques and to provide participants with the ability to transfer the techniques and methods to their own environment and infrastructure. Several external experts (Ms Veronica Cesio, Ms Lucia Pareja, Ms Maria Rosa Repetti, Ms Susanne Ekroth) and FEPL collaborators provided expertise and training materials for the course in the form of videos. The methods and laboratory demonstration videos involved the use of equipment and instrumentation from a variety of different manufacturers, and various software applications for instrument operation, data acquisition and processing and statistical analysis. The training focused on examples of sample preparation methods for different organic contaminants, such as a SweEt method for pesticide residues in low fat animal products, an orange juice sample preparation method for analysis of pesticides, a turmeric sample preparation method for analysis of organic contaminants, a honey sample preparation method for organic contaminants testing, a milk sample preparation method for veterinary drug residue testing and a sample preparation method for testing for mycotoxins in cereal. The course also included an overview of analytical instrumentation for targeted detection and control of organic contaminants in food such as liquid- and gas-chromatography tandem mass spectrometry instruments (LC-MS, GC-MS), a section on stable isotope dilution assays as well as a section on experimental design for LC-MS and GC-MS applications. The complete training course is avaible online via the IAEA Nucleus portal Virtual Laboratory Training on the Detection and Control of Organic Contaminants in Food - Thumbnails (iaea.org).The participants of the training course had one week to access the video materials, before being invited to participate in live question and answer (Q&A) sessions, to clarify any details in the training materials and receive advice from the experts and collaborators. Although there were limited opportunities for interaction with the FEPL staff or the external experts providing demonstrations, the participants rated the Q&A sessions as very valuable.

Demonstrating laboratory operations and the application of instrumental methods of analysis via e-learning, without in-person real-time interaction, was a new challenge for the FEPL. Nevertheless, the feedback from the participants was encouraging. As shown in Figure 1, 75% of the respondents evaluated the training course as good or very good. Feedback indicated that the first part of the training course, the theoretical component held in December 2020, was very useful even as a virtual event; the laboratory component was well appreciated as a necessary compromise, but it is recognised that physical presence at the laboratory is essential for a laboratory component to be fully effective. Nevertheless, 95% of the respondents also indicated that the information obtained during the virtual training will be implemented into the daily activities and experimental work at their home organisations. This is a very encouraging result for the FEPL.

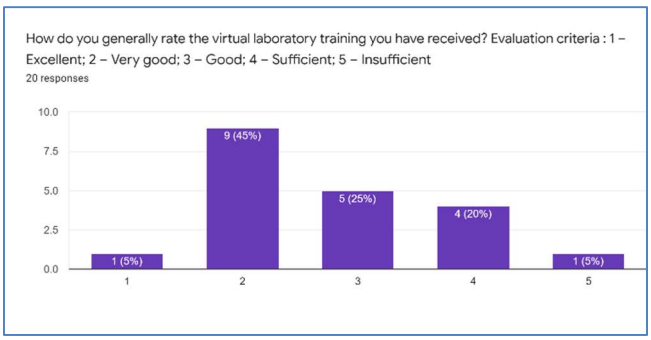


FIG. 1. Participants' evaluation of the Virtual Training Course.

The FEPL is looking forward to hosting an in-person training course on 'Analytical Methods to Detect and Control Organic Contaminants in Food' at its new facilities in the Yukiya Amano building in Seibersdorf from 16–27 May 2022, assuming circumstances allow travel and physical interaction by then.

Participation in a Virtual Consultative Meeting to Develop a Food Safety Strategy for Africa

James Sasanya

Mr James Sasnaya represented the Joint FAO/IAEA Centre in this online continental consultative meeting on the development of a food safety strategy for Africa at the invitation of H.E. Amb. Josefa Sacko, the Commissioner of Agriculture, Rural Development, Blue Economy and Sustainable Environment (ARBE) of the African Union Commission. The objectives of the meeting, which took place from 8–11 June 2021, were to: 1) articulate the vision, mission and objectives of the African Food Safety Strategy; 2) identify the guiding principles, strategic thematic areas and expected outcomes; 3) identify strategic actions to achieving the objectives of the strategy; 4) discuss coordination mechanism for implementation of food safety activities at the continental and regional levels.

Virtual Consultative Meeting organized by the African Union.

Mr Sasanya joined various breakout and plenary discussions to address themes including food safety in Africa: continental and other initiatives, and food safety systems in specific regions – evaluating strengths, weakness, opportunities and threats as well as current and future trends.

The scope, vision, goal and guiding principles of the continental food safety strategy for Africa were also covered, as were strategic objectives and priority areas. Mr Sasanya also made contributions to discussions on the continental infrastructures needed to strengthen the food control system and plans to establish an African Food Safety Agency.

UK Government Chemist Conference: Safe Food for Tomorrow's World

Simon Kelly

The UK Government Chemist Conference was originally scheduled to take place in June 2020 but was postponed due to the COVID-19 pandemic. The conference was held as an online event on the 23 and 24 June 2021. The conference was opened by Professor Gideon Henderson, Chief Scientific Advisor to the UK's department for Environment, Food and Rural Affairs after a brief introduction by Dr Julian Braybrook, the UK's Government Chemist. The programme included both national and international perspectives on food safety and food integrity and the use of science for improved consumer protection and developing consumer trust in the manufacturing, packaging, retailing and testing of food. The conference was aimed at policy makers, regulators, enforcement agencies, researchers and industry technical officers. Contributions were made by both international researchers and food industry representatives on:

- Official food control systems;
- Regulation for global food markets;
- Science for improved health outcomes;
- Novel solutions for food authenticity and sustainability.

Mr Simon Kelly was invited to give a pre-recorded lecture on 'Nuclear and complementary field-deployable technologies to build food authenticity capability' and then participate in live questions and answers during the session 'Novel solutions for food authenticity and sustainability'. Mr Kelly presented an overview of the activities of the FAO/IAEA Joint Centre's Food and Environmental Protection Laboratory (FEPL) and reported specifically on some successful outcomes of the Coordinated Research Project (D52040) 'Field-deployable analytical methods to assess the authenticity, safety and quality of food'. The presentation was well received and gave rise to several questions from the meeting participants, relating mainly to the use and reliability of hand-held screening devices and the databases and multivariate analysis needed to deploy them effectively.

The conference also held a workshop on 'Consumer confidence in food integrity and authenticity beyond composition'. Participants discussed the potential impacts of climate change, achieving decarbonisation (net zero) and its effect on global supply chains, and sustainable agricultural production on food integrity. The workshop also covered current and future scientific challenges and potential solutions to ensure food authenticity when related to claims of food origin, provenance and protected food names.

Presentation: Food Safety & Quality for Consumer Protection, Trade & Food Security, Pre-Summit of the UN Food Systems Summit Side Event

James Sasanya

On 5th July 2021 a side event was organized under the theme 'Science, Technology and Innovation for Food Systems Transformation - The role of nuclear and related technologies' in a preparation event for the 2021 UN Food Systems Summit (UNFSS). The side event was organized by the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture in cooperation with five partner national ministries/institutions in Members States. The objective was to showcase how food systems innovation, through the lenses of nuclear science, technology and innovation, contributes to food systems transformation. The IAEA's Deputy Director General and Head of the Department of Nuclear Sciences and Applications, Ms Najat Mokhtar moderated the event and Ms Ismahane Elouafi, Chief Scientist, FAO, provided key remarks.

Five broad topics were covered, namely: animal production and health practices to enhance food security; climate-smart agricultural practices for sustaining agricultural production; integrated pest management in agriculture and human health; crop improvement in support of food and nutrition security and biodiversity; and food safety and quality for consumer protection, trade and food security. Mr Sasanya and a representative of the Ministry of Agriculture Animal Industry and Fisheries, Uganda, jointly presented on the contributions of nuclear science to a functional food safety control system, focusing on: 1) applications for the control of a wide range of chemical residues and contaminants; 2) food irradiation for post-harvest and industrial purposes; and 3) technology to ensure food authenticity. Examples of the application of nuclear/isotopic technologies in several Member States were given. For instance, in Costa Rica, exports of animal products have been enhanced and new markets accessed, thanks to laboratory testing utilizing nuclear techniques. Resources are saved annually by testing foods locally instead of outsourcing. Exports of foodstuffs such as pineapple, cashew nuts and honey from Benin, and animal products from Thailand, have also been enhanced, and many laboratories have attained accreditation. Technologies for food authenticity have been developed and applied to address economically motivated fraud, while food irradiation has helped secure Viet Nam's fruit exports. Finally, the presentation shared the experience of Uganda in applying nuclear technology to strengthen food safety, initiating a mobile laboratory system, conducting systematic

monitoring of residues and contaminants as well as building national and international food safety partnerships. The strengthening of at least three competent laboratories capable of training scientists from other African countries was also highlighted.

Participation at a side event of the food systems pre-summit.

25th Session of the Codex Committee on Residues of Veterinary Drugs in Food (CCRVDF)

James Sasanya

Mr James Sasanya represented the Joint FAO/IAEA Centre at the 25th CCRVDF meeting, which was held virtually from 12–20 July 2021 and attended by 80 Member countries, one member organization (the European Union), 11 observer organizations, and representatives of the FAO and WHO.

Mr Sasanya delivered a presentation to highlight recent and ongoing activities implemented by the Joint Centre in collaboration with Member States, under Agenda Item 3.3: Matters of interest arising from the Joint FAO/IAEA Centre. He highlighted relevant coordinated research and technical cooperation projects, the Joint Centre's work on capacity building, supporting food safety networks and enhancing active participation of developing countries in Codex matters. This included research involving the use of radiolabelled materials which could provide data to support JECFA evaluations and the process of elaborating prioritized Codex MRLs. Mr Sasanya provided an example of coordinated research on depletion studies for a wide range of veterinary pharmaceuticals and related compounds and called on CCRVDF's support for the participating countries. Suggested support could include donation or synthesis of radiolabelled material, offering of specialized training and hosting short-term visits to facilities with extensive experience in radiolabelled studies. He also asked for increased public-private partnership engagement and that risk managers/national codex teams in respective Member States should consider extending support to research institutions involved in the depletion studies in their countries. Mr Sasanya also encouraged analytical laboratories to consider sharing their methods of analysis for publication on the Food Contaminant and Residues Information System, hosted by the IAEA for Member States.

A number of countries/delegations reported that IAEA's support has made significant contributions to their food control systems and Codex work and requested continued cooperation. This appreciation was also recorded in, for example, conference room documents (CRD) CRD 9 (Nigeria), CRD 10 (Kenya), CRD 11 (Uganda) and CRD 15 (Argentina, Brazil, Chile, Costa Rica, Cuba, Dominican Republic, Ecuador, Mexico, Panama, Uruguay).

Presentation at the 25th CCRVDF.

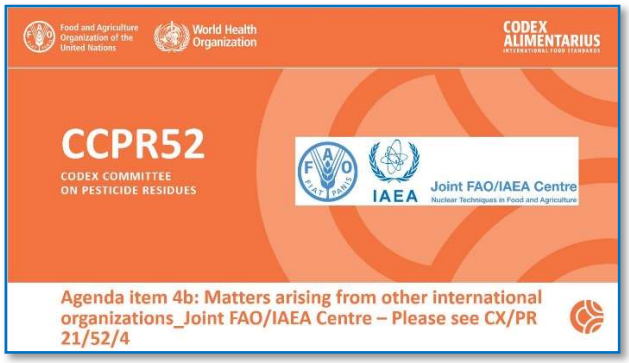
52nd Session of the Codex Committee on Pesticide Residues (CCPR)

James Sasanya

Mr James Sasanya represented the Joint Centre at the 52nd CCPR, which was held virtually, 26–30 July 2021 and 3 August 2021 and attended by 82 Member countries, one member organization, and 15 observer organizations. Mr Sasanya delivered a report highlighting the activities of the Joint FAO/IAEA Centre relevant to CCPR under Agenda Item 4b: Matters arising from other international organizations. He informed the delegates about three coordinated research projects and thirty six technical cooperation projects of interest, focusing on the Joint Centre's work on capacity building, supporting food safety networks and enhancing the active participation of developing countries in Codex matters. Activities presented included research involving the use of radio-labelled materials to produce data that could support JMPR evaluations and the process of elaborating prioritized Codex MRLs, including dual use compounds, and the development of analytical methods for monitoring mixed chemical hazards including pesticide residues.

Several delegations, in particular those from developing countries, referring to their written comments in conference room documents (CRDs) such as CRD 5 (Kenya) and CRD 10 (Uganda), expressed appreciation of the Joint Centre for their support and cooperation in strengthening laboratory capacities and development of laboratory networks, which have made significant contributions to improving their food control systems and participation in Codex work. They anticipated continuous and increased collaboration with the Joint Centre. The Committee thanked the Joint FAO/IAEA Centre for its support to CCPR Members, especially the capacity building in developing countries, and noted the information provided and comments made by delegations. Some of the ongoing and future work that requires contribution includes harmonizing the

definition of offal and efforts to establish MRLs based on those definitions, and the development of a discussion paper on monitoring the purity and stability of certified reference material of multi-class pesticides during prolonged storage, for consideration by CCPR53. This work is led by Argentina and India, with previous contributions of the Joint Centre to the draft.



CCPR52 Codex Committed on Psesticide Residues.

Virtual African Food Safety Workshop

James Sasanya

A one-day virtual African Food Safety Workshop was held on 4 August 2021 under the framework of the African Food Safety Network (AFoSaN), attracting nearly 500 participants interested in food safety in Africa. The meeting was organized in cooperation with the National Metrology Institute of South Africa (NMISA). AFoSaN's committee on conferences and meetings played an important role in the planning, dissemination and moderation of the event. This was a prelude to an in-person workshop due to be held from 27 June to 1 July 2022 in Johannesburg, South Africa, a continuation of the biennial Africa-wide food safety workshops launched in 2018 in Pretoria, South Africa.

The workshop focused on food safety programmes relevant to the African Continental Free Trade Area (AfCFTA) – a market of 1.3 billion people and worth USD 2.5 trillion – and included deliberations on: Africa's food safety regulatory framework; sanitary and phytosanitary (SPS) measures; food safety standards and guidelines within the AfCFTA; regional efforts in contributing to setting standards and tolerance levels/limits; intra-/extra-regional trade challenges; reliable food safety laboratory testing services; and the African Food Safety Index.

The event was attended by staff of the African Union Commission (AUC) including the Director of the Department of Agriculture, Rural Development, Blue Economy and Sustainable Environment (DARBE), Dr Godfrey Bahiigwa, as well as Ms Diana Akullo, Senior Policy Officer SPS, AUC and Ms Wezi Chunga-Sambo, Programme Manager of the Partnership for Aflatoxin Control in Africa, among others. The Chief Executive Officer (CEO), NMISA, Mr Ndwakhulu Mukhufhi and a number of his staff also attended and worked closely with Technical Officer in moderating the event.

The meeting observed that Africa is disproportionately affected by foodborne diseases compared to the rest of the world and that there is a need for a united front, given the multifaceted nature and importance of food safety. As a predominantly agricultural region, trade in Africa's food products and food security are impacted by unsafe food, including export rejections. Participants highlighted the need for greater involvement as active participants in setting Codex standards. In this context, CRPs such as D52043, 'Depletion of Veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices', that involves use of radiolabelled material to generate data needed to elaborate maximum residue limits, can contribute significantly. Four African countries Burkina Faso, Morocco, Sudan and Uganda are involved in the CRP.

Virtual Training Course on the Use of Profiling/Fingerprinting Techniques to Determine Food Origin and Verify Food Authenticity

Alina Mihailova and Andrew Cannavan

A virtual training course on 'the Use of Profiling/Fingerprinting Techniques to Determine Food Origin and Verify Food Authenticity' was held from 16–27 August 2021 under the Peaceful Uses Initiative (PUI) project 'Enhancing Capacity in Member States for Rapid Response to Food Safety Incidents and Emergencies', which is funded by the Japanese Government. The objective of the training was to enhance the capabilities of laboratory personnel in Member State institutions in the application of rapid, untargeted screening methods, enabling Member States to respond to food safety-related incidents and emergencies and to improve their food control systems.

The course covered the following techniques:

- Benchtop nuclear magnetic resonance (NMR) spectroscopy;
- Ion mobility spectrometry (IMS);
- Fourier transform infrared (FTIR) spectroscopy, including attenuated total reflectance (FTIR-ATR);
- Near-infrared spectroscopy (NIR);
- Multi-spectral imaging (MSI);
- Spectral data processing and chemometrics to enable interpretation of the data.

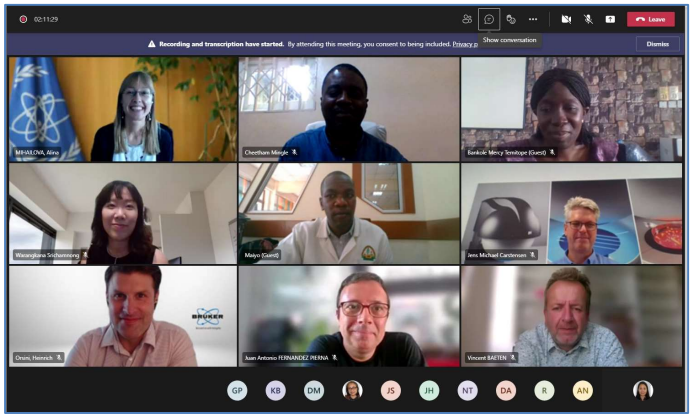
The virtual training employed recorded lectures, video presentations of laboratory procedures (sample preparation, instrumental analysis, data processing, multivariate statistics) and 'live' online question-and-answer sessions. In addition, examples of standard operating procedures and method protocols were provided to course participants, to foster adoption of the demonstrated methods in their own

laboratories. Course materials were made available to participants via the NUCLEUS SharePoint site.

The course was attended by 31 scientists from institutes in 24 countries: Australia, Bolivia, Chile, Denmark, Ecuador, Egypt, Ghana, Indonesia, Jordan, Kenia, Nigeria, Myanmar, Oman, Pakistan, Qatar, Russian Federation, Saudi Arabia, Senegal, Seychelles, Singapore, Sri Lanka, Thailand, Tajikistan and Uruguay.

In addition to the FEPL staff, this training was delivered by external experts from the United Kingdom (Ms Kate Kemsley, Quadram Institute) and Belgium (Mr Vincent Baeten, Mr Juan-Antonio Fernandez Pierna, Walloon Agricultural Research Centre), and contributors from Magritek, Perkin Elmer, Bruker Optics, Bruker BioSpin, Videometer, G.A.S. Dortmund, and Imprint Analytics.

The training course was very well received. Of the participants who completed an anonymous online feedback questionnaire, 94.1% reported that 75-100% of course material was useful to their work, and all respondents indicated that the information provided during the course would be implemented in their activities/laboratory work at their home institution. A follow-up training course on 'the Use of Profiling/Fingerprinting Techniques to Determine Food Origin and Verify Food Authenticity' will be held at the FEPL laboratories in 2022.



Ms Alina Mihailova moderating a Q&A session on infrared spectroscopy and multispectral imaging.

Virtual Technical Meeting on Radionuclides in Food and Drinking - Water in Non-Emergency Situations

Carl Blackburn

This technical meeting was held online from 6–10 September 2021, with 129 participants from 50 countries, FAO, IAEA and the World Health Organization (WHO). Participants contributed to the development of a technical document (TECDOC) that proposes practical approaches for use in science-based guidance on radioactivity in food.

Until relatively recently, radiation safety standards only directly addressed criteria for controlling public exposure to radiation from radionuclides in food in the context of nuclear or radiological emergencies. However, this changed in 2014 when revised basic safety standards Requirement 51 of EC (EC/Euratom), FAO, IAEA, ILO, OECD/NEA, PAHO, UNEP and WHO, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements, 2014 included a requirement for radionuclides in food in normal, everyday situations ('existing exposure situations'). A 2016 technical document IAEA, Joint FAO/IAEA Programme, WHO. TECDOC1788 Criteria for Radionuclide Activity Concentrations for Food and Drinking Water, TECDOC Series, 2016 summarized and presented a review of international standards and guidance related to radionuclides in food and drinking water. It identified a gap in the provision of practical guidance on radionuclides in existing exposure situations and a need for food related guidance to be consistent with extant Codex standards and also WHO guidance on radioactivity in drinking water. The FAO, through the Joint FAO/IAEA Centre, subsequently worked in collaboration with the IAEA and WHO in a project to:

a. provide technical information that can be used by Member States as a basis for their assessment and, if necessary, management of radionuclides in food in existing exposure situations, and;
b. develop science-based guidance to assist national authorities in their management of radiation doses from the consumption of food in existing exposure situations, consistent with Codex standards and also the WHO guidelines for drinking-water quality.

A safety report is already in press to publish the technical information generated by the project. This document includes information on both natural and human-made radionuclides in food, the observed distributions of concentrations of natural radionuclides in various food products, the use of dietary surveys to assess ingestion doses, and radionuclide concentrations in specific sectors such as natural mineral waters that are sold as food products and foods collected from the wild. A draft TECDOC has also been prepared for publication to disseminate the proposed assessment approaches that could be used as guidance.

The meeting provided an opportunity for the FAO, IAEA and WHO to receive feedback from technical experts and to facilitate a common understanding of the project. In general, participants agreed with the approaches outlined and recommended further development of the TECDOC. Key recommendations were made to help refine the publication and clarify the approaches. The draft TECDOC is being updated and it is envisaged that the resulting publication will be used as the basis for guidance in international radiation safety standards and possibly in food standards.

Proposal to Establish an International Food Irradiation Network (Ifine)

Carl Blackburn

The idea for a new food irradiation network came from the discussions during the recent international symposium on food irradiation organized by Aerial (an IAEA collaborating centre for food irradiation) and provided in partnership with the Joint FAO/IAEA Centre, IBA and Buhler (see the report in the previous newsletter). On 5th October 2021, an online meeting of experts was convened to discuss if and how a small international group could be formed with a view to giving new impetus to food irradiation.

The participants at this first meeting were Mr Cherin Balt (South Africa), Mr Carl Blackburn (Joint FAO/IAEA), Mr Yves Henon (iia), Mr Florent Kuntz (France), Ms Monique Lacroix (Canada), Ms Gao Mei Xu (China), Mr Suresh Pillai (USA), Mr Peter Roberts (New Zealand), and Mr Alain Strasser (France). To introduce the topic, Mr Roberts gave a presentation on the former International Consultative Group on Food Irradiation (ICGFI) which was given its mandate and first met in 1984. Under the IAEA, FAO and WHO this network produced useful documents and arranged activities to advance food irradiation, but it was disbanded in 2004 when its mandate was not renewed. The ICGFI network could rely on an annual budget from participating countries who made payments to support its activities. Although this type of network cannot be formed at this time, it could be feasible to form a less formal group and network, if participants were available to volunteer and make their contributions in-kind.

The group felt that a small, informal network should be formed as an initial step and that a limited workplan should be agreed at a future meeting. A successful network would be one that would produce outputs such as useful documents and collaborations to target important issues. If a small network could demonstrate its usefulness it would evolve and grow in membership. Most agreed that research activities would be within the scope of the network, but not its sole purpose. All agreed that it would be desirable to recruit some younger professionals. Mr Blackburn volunteered his services and support in-kind from the Joint FAO/IAEA centre. He agreed to produce a note of this meeting, an initial list of possible future work items and put forward arrangements for a second virtual meeting.

International Conference on the Development of Preparedness for National and International Emergency Response (EPR2021)

Carl Blackburn

An IAEA Emergency Preparation and Response Conference is held every three or four years as an international forum to exchange information on nuclear emergency planning topics. Over the course of this 2021 conference which was held from 11–15 October, information was exchanged on a wide range of emergency activities. These include emergency planning, management, protection strategies, communication, public health and ethical considerations, the provision of assistance, education and training. Some contributions also focused on the experience gained from dealing with past incidents and the lessons learned.

Holding the conference in a hybrid format, with at least 90 participants in-person at the IAEA and many more virtually by internet, allowed a wide and diverse audience to participate. There were 536 participants registered to take part, including nine from international organizations. The FAO participated through the Joint FAO/IAEA Centre.

Online Training Course – The Use of Stable Isotope and Trace Element (SITE) Profiling to Determine Food Origin and Verify Food Authenticity

Simon Kelly and Alina Mihailova

The Peaceful Uses Initiative (PUI) project 'Enhancing Capacity in Member States for Rapid Response to Food Safety Incidents and Emergencies', held its fourth training course through blended E-learning via the IAEA Nucleus SharePoint platform and the IAEA's E-Learning CLP4NET portal from 11–22 October 2021. The purpose of the training was to strengthen Member States' surveillance and research laboratory capacities in using the nuclear techniques, isotope ratio mass spectrometry (IRMS) and energy dispersive X-ray fluorescence (EDXRF) spectrometry to verify labelling claims related to the origin and authenticity of food products. The training also included an introduction to multivariate analysis of stable isotope and trace element (SITE) data using the Chemometric Add-in for Excel (CAFE) software.

This training was designed to underpin effective control measures to protect consumers from fraud, including any associated unintended safety issues, mitigate the disruptive impact of emergencies affecting the food chain, and minimize disruption to trade in agricultural commodities. 108 scientists registered for the online training course from 31 countries; Albania, Algeria, Argentina, Australia, Austria, Brunei Darussalam, Burkina Faso, Chile, Costa Rica, Egypt, India, Indonesia, Italy, Lebanon, Mongolia, Morocco, Myanmar, Oman, Pakistan, Paraguay, Philippines, Qatar, Romania, Russian Federation, Slovenia, Sri Lanka, Sudan, Thailand, Turkey, United States of America and Uruguay. The 10-day course included pre-recorded theoretical lectures that could be accessed on-demand, videos of practical laboratory procedures such as sample preparation and analysis, multivariate assignments with CAFE software and multiple live question-and-answer (Q&A) sessions with the expert trainers.

The first week of online training focused on an introduction to food authentication and the application of IRMS coupled with elemental analysis (EA) and gas chromatography (GC). The pre-recorded lectures were prepared by external experts from the United Kingdom, Mr Gareth Rees and Mr Christopher Brodie and made available 'on-demand' from the IAEA Nucleus SharePoint site. The two external experts participated in live Q&A sessions, which were moderated by Mr Simon Kelly with support Ms Alina Mihailova. Video materials covering the new rapid method developed by FEPL for compound-specific hydrogen isotope analysis of sugars in fruit juice by GC-IRMS, were prepared with technical support from Mr Aiman Abrahim and also made available on-demand through the SharePoint site.

The first half of the second week of training focused on an introduction to X-ray emission spectrometry with emphasis on EDXRF. This part of the course was supported by nuclear instrumentation physicist, Mr Roman Padilla Alvarez (IAEA Division of Physical and Chemical Sciences. The second half of week two was dedicated to the CAFE software. The CAFE software, tutorial videos and assignments were developed and delivered by external experts from the Russian Federation, Ms Oxana Rodionova and Mr Alexey Pomeranstev, who also participated in live Q&A sessions.

Live Q&A session on the application of the CAFE software to SITE data to determine food origin and verify food authenticity.

Assessment of the knowledge gained by participants was made through online multiple-choice questionnaires and assignments in Excel covering the multivariate analysis techniques. The training was generally well received by the participants and anonymously assessed by 46 respondents with 53% rating the training as 'excellent' or 'very good'. Importantly, 91% of respondents to the questionnaire would recommend the training to other colleagues and 98% would like to be informed of future similar training events under the PUI project.

The content from the Training course can be access here: IAEA, Joint FAO/IAEA Programme, WHO. TECDOC1788 Criteria for Radionuclide Activity Concentrations for Food and Drinking Water, TECDOC Series, 2016 and https://elearning.iaea.org/m2/enrol/index.php?id=607 by the registered IAEA Nucleus account holders.

FAO, IAEA and RALACA Workshop on Food Contaminant Testing and Risk Assessment Programmes

Britt Maestroni

Effective food control systems are needed to ensure a safe and wholesome food supply on a global basis. One key element of such a system is the provision of feedback on the effectiveness of agricultural practices in producing food that is safe and meets requirements for international trade. Data on the concentrations of chemical residues and contaminants in food are required to enable the estimation of population exposure to those chemicals. Implementing monitoring schemes is challenging, especially for developing countries, and requires strong networking, research, human resource development and capacity building in the field of food control systems and risk assessment, and an efficient food testing infrastructure. To help Member States in this regard the Joint FAO/IAEA Centre, in collaboration with the Latin America and the Caribbean Food safety Analytical Network (RALACA) hosted a virtual workshop on food contaminant testing and risk assessment programmes, from 12–14 October 2021. Thirty participants from Argentina, Bolivia, Chile, Costa Rica, Guyana, Italy, Jamaica, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Spain, Uruguay attended the 3 days of the workshop.

The purpose of the workshop was to share scientific and technological developments in the sample preparation and analysis of residues and contaminants such as pesticides, mycotoxins and veterinary drugs, to identify gaps in knowledge and to discuss ways in which nuclear and isotopic methodologies can improve food safety testing and risk assessment programmes. The workshop focused on rapid food contaminant testing techniques applied to mycotoxin analysis, and the contribution of analytical data to risk assessment. Experts accompanied the participants through a virtual food safety journey covering a range of important topics such as sharing of knowledge, data and technological developments, networking, the IAEA collaborating centre scheme, the role of nuclear technology in analytical testing and monitoring programs for food safety, screen-printed electrodes and electrochemical sensors for rapid food and environmental contaminant testing, and risk assessment. Video presentations demonstrated various laboratory techniques question and answer sessions were held to discuss relevant issues and provide advice to facilitate the implementation of relevant guidelines and programs in participants' laboratories.

The workshop represented a forum for networking. Though limited in its effectiveness due to the inherent difficulties of the virtual modality, responses to a feedback questionnaire indicated that the workshop was well received and that the participants rated the training workshop very highly. All of the respondents confirmed that they will be implementing

information received during the workshop in their future activities.

Virtual classroom with participants from Argentina, Bolivia, Chile, Costa Rica, Guyana, Italy, Jamaica, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Spain, Uruguay (in total 30 participants).

Latin American Risk Assessment Symposium (LARAS 2021)

Britt Maestroni, Simon Kelly and Andrew Cannavan

The second Risk Assessment Symposium for Latin America and the Caribbean (LARAS 2021), co-sponsored by the IAEA among other international organizations, was held virtually, jointly hosted by the Chilean Agency for Food Safety and Quality (ACHIPIA) and the German Federal Institute for Risk Assessment (BfR) on 14, 18, 19 and 25 October 2021. The symposium aimed to contribute to risk assessment as an official approach to food safety, rooted in cooperation, state-of-the-art science, and trust. The Food and Environmental Protection Laboratory (FEPL) actively contributed to the agenda, providing two speakers and moderating the event on 18th October. The events were broadcast simultaneously by two virtual platforms (Zoom and YouTube). On 14th October, the inauguration and risk assessment in food integrity day, Mr Andrew Cannavan, Head of the Food and Environmental Protection Section, contributed an opening speech emphasising that the FAO/IAEA Centre is a strong partner in relation to the scope of LARAS. Mr Cannavan wished the LARAS 2021 symposium great success and looked forward to strengthening the partnership with the regional and international organizations present at this event (Achipia, Bfr, FAO, IICA, PAHO).

Mr. Kelly presenting 'General and methodological framework, use of nuclear technologies - SITE profiling'.

Mr Simon Kelly, acting Head of the FEPL, gave a keynote speech on the general and methodological framework for the use of nuclear technologies, 'Stable isotope and trace element (SITE) profiling'. Mr Kelly emphasized that SITE analysis is a comparative technique that requires extensive databases composed of authentic products in order to conduct meaningful comparisons with suspect samples of unknown origin.

On the same day the first IAEA nominated speaker, Ms Brenda Checa gave her presentation on Panama's experience using rapid technology for the detection of pesticides in fruits and vegetables.

On 18th October Ms Britt Maestroni acted as a moderator for the event. The theme of the day was on novel risks and foods. The presentations provided an insight into; new foods such as edible insects; the evaluation of the risk of human exposure to the contaminant deoxynivalenol (DON) through the diet in Brazil; human exposure to microplastics from the diet; epigenetic analysis and endocrine disruption: applicability in risk assessment; and cannabidiol-based foods. The LARAS 2021 continued on 19th October with collaborative experiences in risk assessment. The IAEA nominated speakers were Mr Daniel Kerekes, who presented the RALACA network, and Mr Darío Maggioni, who focused on the results obtained from a probabilistic dietary risk assessment study for pesticide residues in Argentina.

Ms Maestroni moderating LARAS 2021 on 18 October 2021.

On the last day of LARAS 2021, risk assessment collaboration experiences were discussed and the second LARAS event was officially closed. The LARAS 2021 successfully contributed to strengthening risk analysis in the Latin American and Caribbean Region as an official approach to food safety, based on mutual trust,

multidisciplinarity and cutting-edge science, while encouraging knowledge sharing and networking.

After the event, Ms Nuri Gras, head of ACHIPIA, Chile, commented, "LARAS 2021 was an extremely enriching experience in which we were able to see the importance of working together in a coordinated way to strengthen science in the food area, specifically risk assessment in the countries of the Latin America and the Caribbean region".

The videos of LARAS 2021 can be accessed online https://www.fao.org/americas/eventos/ver/en/c/1442636/.

The Food and Agriculture Working Group of the Technical Meeting on Artificial Intelligence for Nuclear Technology and Applications (AI4Atoms)

Simon Kelly and Gerd Dercon

Artificial Intelligence (AI), also known as 'machine learning', generally refers to the use of algorithms with computing to deal with large data sets, to solve complex and challenging problems, in a way that simulates human logic and reasoning. In unison with the rapid development of computer technology and computing power AI is advancing at an unprecedented rate and is already being applied to tackle many global challenges. For example, AI will be an integral part of the Agency's new ZODIAC project helping to identify and contain future zoonotic disease outbreaks. However, the enormous power of AI is accompanied by ethical concerns around security, trust and issues of transparency and 'explainability'. The IAEA, as the global focal point for nuclear cooperation, is backing AI and its enormous potential to help accelerate the safe, secure and peaceful uses of nuclear technologies and facilitate progress towards the United Nations' Sustainable Development Goals. Consequently, the IAEA organised the first ever Technical Meeting (TM) on AI for Nuclear Technology and Applications as a virtual event from 25–29 October 2021.

The TM provided an international, cross-cutting forum to discuss and foster cooperation on AI applications, methodologies, tools and enabling infrastructure that have the potential to advance nuclear technology and applications, while taking into account existing mandates and programmatic priorities. There were over 300 participants from 67 Member States, intergovernmental organizations and non-governmental organizations. The event was coordinated by Mr Matteo Barbarino (Nuclear Plasma Fusion Specialist, NAPC) who brought together representatives from the departments of Nuclear Applications, Nuclear Energy, Nuclear Safety and Security, and Safeguards, 11 working groups on different topics. Mr Simon Kelly (FEPL) and Mr Gerd Dercon (Head of the Soil and Water Management and Crop Nutrition Laboratory) organised the Food and Agriculture plenary lecture and the parallel sessions of the Food and Agriculture Working Group (FAWG). The Food and Agriculture plenary speaker was Dr Hans Marvin (Wageningen Food Safety Research, The Netherlands) who gave a presentation on 'The Use of AI in Food Safety and Food Fraud: Early Warning Systems'. His presentation described the value of using a Bayesian Network (BN) approach to model possible links between food fraud cases retrieved from the Rapid Alert System for Food and Feed (RASFF, EU) and Economically Motivated Adulteration databases (EMA, USA).

The parallel FAWG sessions had 25 participants and included presentations from Mr Frank Albinet (independent statistics and AI consultant, France) on 'Optimizing the remediation of radioactive contamination in agriculture using Deep Learning'; Ms Kate Kemsley (Quadram Institute Bioscience, UK) on 'AI applied to NMR spectral data processing for food authentication'; Mr Yamine Bouzembrak (Wageningen Food Safety Research, The Netherlands) on 'Machine learning applied to prediction of Food Fraud events'; Mr Modou Mbaye (Institut Senegalais de Recherche Agricole, Senegal) on 'Deep Learning Approach for Calibrating Cosmic-Ray Neutron Sensors (CRNS) in Area-Wide Soil Moisture Monitoring'; and Ms Anne Gobin (VITO/KULeuven, Belgium) on 'Remote sensing data for agricultural soil management using machine learning algorithms'.

The cross cutting conclusions and recommendations of the FAWG were presented by Mr Dercon to the plenary on the final day of the main AI4Atoms TM. The expected outcomes of the IAEA's activities in accelerating the use of AI in Food and Agriculture were that AI would: help to fuse and integrate data and datasets from a local to global scale; innovate model development for enhanced decision support and enforcement in a scientific and ethical way; become a mainstream tool for better use of nuclear and isotope data; and AI will be integrated in education programmes at all levels.

The virtual TM will result in a final report that will serve as a roadmap of ideas and opportunities where IAEA can have a supporting and transformative role in aiding progress towards the realization of the transformative impacts of AI in nuclear science, technology, and applications. There is a link to the virtual TM website and content available here: https://conferences.iaea.org/event/245/overview.

International Emergency Exercise ConvEx-3

Carl Blackburn

The Food and Agriculture Organization (FAO) of the United Nations is a party to the nuclear emergency conventions and member of the Joint Plan of the International Organizations (JPLAN). In the event of a nuclear or radiological accident and as part of the JPLAN, the FAO assigns staff to the IAEA Incident and Emergency Centre. The FAO, through its Joint

FAO/IAEA Centre located in Vienna, Austria, ensures implementation, coordination, and the dissemination of information on nuclear issues related to food and agriculture. Exercises to test the operational arrangements of the two nuclear emergency conventions are held regularly. However, level 3 exercises (ConvEx-3) only take place every three to five years. They are the highest level, designed to evaluate international emergency response arrangements to a severe accident. The 2021 ConvEx-3, held on 26–27 October, involved authorities in 75 countries and 12 international organizations working over two days to address a simulated accident at a nuclear power plant in the United Arab Emirates (UAE).

The accident scenario involved the Barakah Nuclear Power Plant and simulated a significant release of radioactive materials into the atmosphere. Food and agricultural trade were exercise issues. However, the UAE is not a major food producing country and food production was not affected in the exercise. In addition to the common exercise objectives of international coordination and communications, FAO objectives included testing the initial call out procedures, staffing the IAEA Incident and Emergency Centre by representatives from the Joint FAO/IAEA Centre, and the exchange of information within FAO.

We would like to thank those in the Joint FAO/IAEA Centre who participated and also our FAO colleagues especially Mr Ludovic Plée of the Emergency Management Centre for Animal Health in Rome, Mr Peter Mayer of the Office of Corporate Communications, Ms Diana Gutierrez Mendez of the New York Liaison Office and Ms Rachele Oriente of the Regional Office for Asia and the Pacific.

Food Irradiation, Nuclear Technology and Climate Change Adaptation at COP26, 6 November 2021

Carl Blackburn

The IAEA staged several events during the UN Climate Change Conference, COP26. One of these was a side-event that included food irradiation. This online occasion focused on the contribution of nuclear science and technology to climate change adaptation. It aimed to make people more aware about climate adaptation in food and agriculture and the role of nuclear based innovations. The event featured several international experts and highlighted the support that the Joint FAO/IAEA Centre gives to countries. After a short video that introduced the topic, Dr Ilmi Hewajulige of the Industrial Technology Institute, Sri Lanka took part in a question-and-answer session concerning food irradiation, food safety and trade. We would like to thank Dr Hewajulige for agreeing to take part as an expert contributor at short notice and for helping to make this side event a success. A recording of the full event is available online https://www.youtube.com/watch?app=desktop&v=0990EfZh7Lk&feature=youtu.be and the session that dealt with food irradiation can be viewed from here Contribution of Nuclear Science and Technology to Climate Change Adaptation: Part 1 - YouTube.

Dr Ilmi Hewajulige, Industrial Technology Institute, Sri Lanka.

International Conference on a Decade of Progress after Fukushima-Daiichi: Building on the Lessons Learned to Further Strengthen Nuclear Safety

Carl Blackburn

The 11 March 2021 marked ten years since the Fukushima-Daiichi nuclear power plant accident. The IAEA convened an international conference from 8–12 November 2021 to look back on lessons learned and actions taken, as well as to identify ways to further strengthen nuclear safety. The conference was divided into three parts: international organizations' perspectives, learning lessons and the path forward. In the first session, Joint FAO/IAEA Centre representatives gave opening remarks and a presentation on food and agriculture related activities.

From March 2011 onwards, the FAO worked in collaboration with its member countries, the IAEA and other international organizations through the Joint FAO/IAEA Centre. Standards and guidance related to radionuclides in food received considerable scrutiny. A set of comprehensive standards and norms are available for emergency exposure situations. However, the improvements that were identified related to a need to promote a greater understanding of and development of international guidance for both natural and human-made radioactivity in foods in non-emergency (existing exposure) situations.

IAEA Director General Rafael Mariano Grossi, opening of the Conference.

The Joint FAO/IAEA Centre also determined that it could do more to support agricultural departments in member states, for example, by helping to develop technology to aid the collection, dissemination, and visualization of food monitoring data and to support decision making on agricultural controls. Further, international technical workshops were convened in October 2016 and 2021 to promote and share knowledge and experience related to remediation of radioactive contamination in agriculture.

The Joint FAO/IAEA Centre also commissioned an international research project to combine experimental studies with field monitoring and modelling. This research aims to better understand and predict the role of environmental conditions on radiocaesium and radiostrontium transfer in food chains and their dynamics. One of the research objectives is to customise the remedial options in agriculture to suit less-well-studied agricultural production systems and to adapt and develop innovative decision support systems for optimizing remediation of agricultural lands, based on machine learning and operations research techniques.

Mr Gerd Dercon (left) and Mr Carl Blackburn (right) presenting FAO activities at the opening session

The conference was organized by the IAEA in cooperation with the International Labour Organization (ILO), the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), the World Meteorological Organisation (WMO), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the OECD Nuclear Energy Agency (NEA) and the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). Approximately 200 people participated in-person at the IAEA headquarters with an additional 400 taking part online.

Achievements of the CICA-UCR as an IAEA Collaborating Centre in 2021

Mario Masis, Cristina Chinchilla Soto, Laura Brenes and Britt Maestroni

Since 2020, the world began to experience a very different reality, a reality that has caused many unexpected changes and to which everyone had to adapt. The dynamics of training and collaborative work have also been affected. The Environmental Pollution Research Centre for the University of Costa Rica (CICA-UCR) was redesignated in 2021 as the IAEA Collaborating Centre for the period 2021–2025 tasked with the challenge of being a reference centre for accelerated capacity building, thus supporting the implementation of peaceful uses of nuclear techniques in the Latin American and Caribbean (LAC) region. In July 2021, a small ceremony was held at CICA-UCR celebrate the recognition of the institute by the IAEA and to renew the commitment to continue with the work plan and the specific objectives set, among which are:

- Carry out research and development on contaminants in food in the LAC region;
- Provide advisory services on food integrity to the RALACA laboratory network;
- Contribute to promoting the activities and growth of the RALACA network;
- Organize meetings to build awareness of key issues for decision makers and private sector stakeholders;
- Act as a technical centre for food safety in the region: create and make available short online training courses;
- Provide training to transfer technology and build capacity in the LAC region.

Ceremony commemorating the recognition as IAEA Collaboration Centre. From left to right: PhD Federico Torres Carballo (Costa Rica NLO-IAEA), PhD Gustavo Gutiérrez Espeleta (Rector of University of Costa Rica), MSc María Laura Arias Echandi (Research Vice-rector of University of Costa Rica) and PhD Cristina Chinchilla Soto (Director of CICA-UCR).

Many of these activities were planned with the FAO/IAEA liaison officer as in-person laboratory training. The COVID-19 pandemic prevented this from happening and it has been necessary to implement new strategies to achieve results. Virtual platforms made it possible to continue with raising awareness about the CICA-UCR research projects and training activities. Throughout 2021, the CICA-UCR, through the RALACA and the CICA social networks, increased the number of webinars, reaching a frequency of two per month, with topics related to food safety and environment pollution. CICA-UCR has also implemented virtual training on QuEChERS methods for determination of pesticide residues in food, focusing on reference materials

management, validation of analytical methods, use and basic maintenance of the liquid and gas chromatography equipment coupled to mass spectrometry, among other topics. The delivery of the virtual training was carried out through live seminars and offline videos. The joint work between the executive committee of the RALACA Network and the IAEA Collaboration Center has been developed with the use of different virtual for the delivery of webinars, meetings, participation in international congresses and workshops. The essence of the collaboration work with the IAEA became evident in the "only one 2021" face-to-face training implemented at the CICA-UCR facilities. Through the collaboration of the IAEA that supplied reagent kits, the Spanish Cooperation Agency and governments of Costa Rica and Ecuador, it was possible to arrange the visit of two scientists from Agrocalidad, Ecuador, to the CICA-UCR and carry out laboratory training on the analysis of pesticide residues in plant matrices.

Presentation to the 'Sure Global Fair' Technical Working Group: FEPL Food Authenticity Activities in Fruit Juice and Other Foods

Simon Kelly

The Schutzgemeinschaft der Fruchtsaft-Industrie e.V. (SGF) was founded in Germany in 1974 as body of industrial self-regulation and control, re-establishing free and fair market conditions in the fruit juice industry. Since then it has been successfully fighting fraud in the fruit juice industry. The SGF now stands for "Sure-Global-Fair"; is an independent non-profit organisation and has developed into the acknowledged global system for fruit juices that serves the industry regarding all aspects of production, quality, authenticity, safety and sustainability. Dr Peter Rinke, Head of research and development at SGF International e.V., has collaborated with the Food and Environmental Protection Laboratory (FEPL) by providing authentic industrial fruit juice and whole fruit samples for a study on the detection of exogenous sugars to pineapple juice and differentiating organic and conventional orange juice and strawberries.

The SGF Technical Working Group (TWG) met online on the 10 June 2021 and Mr Simon Kelly was invited to give a scientific lecture on a new rapid method, developed in FEPL, using hydrogen stable isotope analysis to detect undeclared addition of exogenous sugar to fruit juice. The new procedure has advantages over methods using nitro-sugar derivatives, sugar degradation products and fermentation in terms of ease of use, analysis time and sensitivity. The potential of the technique for detecting economically motivated adulteration of foods and beverages was discussed with illustrations of the differences between the isotope abundance of the non-exchangeable hydrogen in sugars from authentic pineapple juice and those of beet and cane sugars/syrups, which permits the presence of these potential adulterants to be rapidly detected. Other speakers in the webinar covered topics such as quality and authenticity observations in the juice market, new analytical insights for lemon and lime juice analysis and other new isotopic techniques for the analysis of pineapple juice.

Mr Kelly giving an invited lecture at the SGF Technical Working Group 10 June 2021.

Mr Kelly then participated in a 15-minute question and answer session in which TWG members asked questions related to his presentation regarding the comparability of measurements from the new rapid method to measurements using the previously described offline methods. Mr Kelly referred to the findings of the FEPL study published in Nature partner journal, the Science of Food (2021), which demonstrated the comparability of results from the new method, using trifluoroacetate-sugar derivatives, for the hydrogen isotope analysis of carbon-bound non-exchangeable hydrogen on saccharides with that obtained with nitro-sugar derivatives.

Coordinated Research Projects

CRP Reference Number	Ongoing CRPs	Project Officer
D52040	Field-deployable Analytical Methods to Assess the Authenticity, Safety and Quality of Food	S. Kelly A. Cannavan
D52041	Integrated Radiometric and Complementary Techniques for Mixed Contaminants and Residues in Foods	J.J. Sasanya
D52042	Implementation of Nuclear Techniques for Authentication of Foods with High-Value Labelling Claims (INTACT Food)	S. Kelly A. Cannavan
D52043	Depletion of Veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices	J.J. Sasanya
D61025	Innovation of Irradiation Technologies on Surface Treatment of Food Commodities	C.M. Blackburn
D61026	Irradiation Technology for Phytosanitary Treatment of Food Commodities and Promotion of Trade	C.M. Blackburn

Third Research Coordination Meeting on Field-Deployable Analytical Methods to Assess the Authenticity, Safety and Quality of Food (D52040)

Simon Kelly

The Joint FAO/IAEA Centre held the third Research Coordination Meeting (RCM) for the international coordinated research project (CRP) to exploit and adapt bench-top, portable and hand-held nuclear and molecular spectroscopic screening technologies, for front-line food fraud detection, as an online event from the 7–18 June 2021. The third RCM was originally scheduled to take place from 23–27 November 2020 in the University of Science, Penang campus, Malaysia but was postponed due to the COVID-19 pandemic and eventually rescheduled as a series of video-conferences over a 10-day period. The meeting participants comprised eight contract holders from China, India, Malaysia, Morocco, Russian Federation, Singapore, Sri Lanka and Uganda; eight agreement holders from Austria, Belgium, Germany, Sweden, United Kingdom (x 3), and the United States of America; and five observers representing Barilla G.R. F.lli SpA (Italy), the Institute of Chemical Physics RAS (Russian Federation) and the Laboratory of the Government Chemist (UK). In addition, there was one attendee in an individual capacity from the Walloon Agricultural Research Centre (Belgium).

Mr Simon Kelly, the Scientific Secretary, reintroduced the background, scope and objectives of the CRP to the participants as a pre-recorded lecture. The presentation also summarized the expected outcomes of the project and the main aims of the 3rd RCM. The format of the daily on-line 'Teams' meetings included presentation of each contract holders' project progress, including outputs and success stories, questions and answers and a presentation of the proposed workplan for the next 12-months of the project. The proposed workplans for the final phase of the project were discussed, refined and redrafted to improve their planning and progression when required.

Despite the challenges of the COVID-19 pandemic and the detrimental effects of lock-down periods on access to laboratories and the opportunities for authentic sample collection, good progress has been made by the project consortium. Major achievements include 1) the establishment of the IAEA Shared Analytical Data Library Upload Tool, established through a technical contract with the Walloon Agricultural Research Centre (Belgium) as a repository for spectra for authentic vegetable oil and milk powder samples; 2) The distribution of sealed calibration units of vegetable oil and milk powder to ensure inter-comparability of spectra between different laboratories and equipment 3) The finalization of the Chemometrics Add-in For Excel (CAFE) software and E-Learning package; 4) significant scientific output as evidenced by ten papers published in peer-reviewed journals since the second RCM in 2019.

The focus of the final phase of the project is to ensure, consistency of spectral acquisition and data quality between participants so that the ultimate goal of generating a sustainable database of authentic vegetable oil and milk powder atomic and molecular spectroscopic parameters can be achieved. All participants emphasized the need to continue to communicate regularly and recommended that the IAEA and the FAO should support raising awareness of the CRP activities through appropriate channels and place extra resources into funding these activities where available.

Consultancy Meeting Develops a New CRP: Nuclear Techniques to Support Risk Assessment of Biotoxins and Pathogen Detection in Food and Related Matrices

James Sasanya

A virtual meeting was held from 16–20 August 2021 to discuss a concept for a new CRP, 'Nuclear Techniques to Support Risk Assessment of Biotoxins in Food & Related Matrices as well as Isotope-Assisted Pathogen Detection', develop a project proposal and provide recommendations and strategies for effective implementation. Eleven participants were involved, including staff of the Food and Environmental Protection Subprogramme and 8 experts from Argentina, China PR, India, Indonesia, Pakistan, South Africa, Uganda and the USA. The specific objectives were: 1) a critical review of the concept and its development into a proposal; 2) identification of any additional nuclear and related technologies suitable for undertaking research studies on biotoxins and pathogens; 3) identification of priority analytes and pathogens and proposal of a suitable research program; and 4) identification of competent research agreement- and contract- holders with suitable laboratories and resources. Mr Sasanya was scientific secretary and meeting-moderator.

At the end of the meeting, the new CRP proposal was developed, a report prepared, and a list of potential participants and strategies for selection and implementation proposed. The participants concluded that there is an urgent need to establish this new CRP to equip Member States through research so that they are better prepared to control biotoxins and foodborne pathogens (including zoonoses) and contribute to effective disease-outbreak investigations. They also noted that the CRP is a very good example of a 'One Health' approach to addressing public and environmental health issues and should therefore promote the collaboration among Member State institutions in the food, chemistry, veterinary and clinical settings.

The meeting recommended that the project should cover both biotoxins and pathogens, with food-borne zoonotic pathogens being an integral component. The biotoxins would primarily include cyanotoxins (with greater focus on fresh-water settings) and some targeted mycotoxins, as well as biotoxins elaborated by foodborne or related pathogens. The importance of research on biomarkers as well as the use of tools such as matrix assisted laser desorption ionization mass spectrometry were highlighted. The consultancy report and proposal were subsequently approved and the CRP is now receiving proposals from Member States as announced on the website https://www.iaea.org/newscenter/news/new-crp-nuclear-techniques-to-support-risk-assessment-of-biotoxins-and-pathogen-detection-in-food-and-related-matrices-d52044.

First Research Coordination Meeting of CRP D61025: Innovating Radiation Processing of Food with Low Energy Beams from Machine Sources

Carl Blackburn

This research coordination meeting was held virtually on 2–3 and 9–10 September 2021 and attended by representatives from 14 countries. The meeting was held as four sessions each of approximately three hours duration. The purpose of the meeting was to initiate this new IAEA coordinated research project, review discuss and agree on each participant's research plans and promote collaborative work. The relationship of each of the participants' research activities to the overall CRP objectives was discussed and this also served to promote collaborative work.

The participants research workplans include:

- Developing dosimetry tools and techniques for low energy beams and for specific food items;
- Modelling and simulation of low energy beam process;
- Identifying minimum and maximum target doses to achieve specific end-points on specific products;
- Understanding the quality effects (sensory, nutritional and chemicals) on specific foods when exposed to low energy beams;
- Delineating D_{10} values and mechanisms of inactivation of microorganisms and insects during low energy beam irradiation;
- Optimizing low energy beam sources and method(s) of product presentation to the beam(s) of ionizing rays.

The research in this CRP will prepare a solid technical and scientific foundation for the expansion of low energy electron beam and low energy X-ray irradiation of food. In many instances, the irradiation of food using low energy beams may be sufficient to eliminate pathogens, insects, and spoilage organisms. Previous research has indicated that beams with energies of 300 keV or even less can improve the quality of some foods and researchers have also proposed the technology as a method of microbiological decontamination. Low energy beam systems are being used in some non-food applications (e.g., blood irradiation programs) and their potential in food applications is being explored further. One of the advantages is that low energy beam machines do not require heavy shielding and in contrast to conventional high energy (MeV) irradiation these types of machines can be fitted into food factories or packing houses as part of the normal operations of a food business.

Under CRP D61025, low energy beam irradiation of insect derived protein as a sustainable future food source is being studied by the Philippine Nuclear Research Institute (PNRI) in collaboration with Mindanao State Universit. Photo curtesy of Dr Custer C. Deocaris (PNRI).

Second Research Coordination Meeting on the Implementation of Nuclear Techniques for Authentication of Foods with High-Value Labelling Claims (D52042)

Simon Kelly

The second RCM of this 5-year Coordinated Research Project (CRP) was held as an online event from 1–12 November 2021. The participants comprised 12 contract holders (from China, Costa Rica, India, Indonesia, Jamaica, Malaysia, Morocco, Myanmar, Slovenia, Thailand and Uruguay), eight agreement holders (from China, Denmark, Germany, Italy, Japan, New Zealand, Spain and USA) and five observers representing the University of Cordoba (Argentina), the Chilean Food Safety Agency, the Oil Crops Research Institute (China), the European DG Joint Research Centre (Belgium), and the National Institute of Standards and Technology (NIST, USA).

The main objective of the CRP is to conduct applied and adaptive research with nuclear and complementary methods to verify the authenticity and origin of premium foods with labelling claims that add value e.g. Geographical Indications, organic food and natural rather than synthetic food components. This will enable developing countries to protect and promote food products with high-value labelling claims, that are often targets for economically motivated adulteration. The project thereby aims to safeguard consumers and reputable producers; ensure regulatory and ethical compliance; stimulate domestic markets and reduce barriers to international trade.

Through the online 'Teams' presentations of research and agreement holders and the associated discussions, the contract holders' workplans for the next phase of the project were reformulated.

Participants in the online 'Teams' sessions for the second RCM of CRP D52042.

The focus of the next phase of the project is to ensure that any delays due to the COVID-19 pandemic can be rectified as soon as practicable to ensure sufficient sampling, consistency of methods and data quality between participants so that the ultimate goal of generating a sustainable database can be achieved. To this end the addition of the new zero-cost Agreement Holder, NIST, and their contribution of an open access database with in-built chemometric and artificial intelligence interpretation tools is a major step forward for the CRP. Furthermore, supplementary fundingfrom for the project was received from the U.S. State Department to support an additional five research contracts from Latin America and the Caribbean (LAC), and observer presentations from Argentina and Chile were invited in order to present their ideas for joining the project. The USA funding will also be used to support the formation of a food authenticity laboratory network in the LAC region; and finally, to support the construction of the open-access database.

At the conclusion of the second RCM all participants emphasized their ongoing commitment to the project and to communicate regularly and recommended that the IAEA and the FAO should continue to support raising awarenessof the CRP activities through appropriate channels.

Technical Cooperation Projects

Country/Region	Project No.	Title	Technical Officer
Burundi	BDI5003	Strengthening National Capacities for Monitoring and Testing Veterinary Drug Residues in Food	J.J. Sasanya
Burundi	BDI5004	Enhancing Control of Chemical Residues and Related Contaminants in Food	J.J. Sasanya
Benin	BEN5013	Expanding Analytical Capabilities for Systematic Control of Veterinary Drug Residues and Related Contaminants in Foodstuff	J.J. Sasanya
Bangladesh	BGD5032	Building Capacity in Improving Food Safety Using Nuclear and Other Complementary Analytical Techniques	S.D. Kelly
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	BHA5001	Developing laboratory capacity for testing contaminants in animal and related products including fish in Bahamas	J.J. Sasanya
Bahrain	BAH5002	Establishing a National Quality Control Standard for Foodstuffs and Fishery 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	A. Cannavan
Botswana	BOT5020	Enhancing Capabilities for a Holistic Approach to Testing Food Hazards in Poultry Production and Products	J.J. Sasanya
Botswana	BOT5023	Enhancing Control of Food Hazards in Poultry Production and Products	J.J. Sasanya
Belize	BZE5011	Strengthening Laboratory Capabilities to Monitor Contaminants in Fisheries Products	B.M. Maestroni
Cameroon	CMR5025	Improving Laboratory Testing Capabilities to Enhance the Safety and Competitiveness of Agricultural Products - Phase I	J.J. Sasanya
Chile	CHI0021	Building General Capacity for Nuclear Science and Technology Applications in Key Sectors	S.D. Kelly J.J. Sasanya
Chile	CHI5053	National Reference System for Verification of Authenticity and Determination of Origin of Food using Nuclear Isotopic Techniques	S.D. Kelly
Costa Rica	COS5037	Strengthening Capabilities to Analyse and Monitor Toxic Metals in Animal Products	J.J. Sasanya
Cuba	CUB5022	Promoting Food Safety through the Mitigation of Contaminants in Fruits for Human Consumption	C.M. Blackburn J.J. Sasanya

Country/Region	Project No.	Title	Technical Officer
Djibouti	DJI5001	Developing Nuclear/Isotopic and Complementary Food Safety Testing Capabilities	J.J. Sasanya
Dominica	DMI5002	Enhancing Capacity to Monitor Agrochemical Residues in Foods and Related Matrices	J.J. Sasanya
Dominica	DMI5003	Strengthening a Nuclear Isotopic Laboratory and Complimentary Field Food Safety Surveillance Capabilities	J.J. Sasanya
Dominican Republic	DOM5005	Strengthening National Capabilities to Ensure Food Authenticity	S.D. Kelly
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	ERI5012	Developing Analytical Capabilities for Food Safety	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 J.J. Sasanya
Georgia	GEO5001	Enhancing National Programmes for Testing and Monitoring Food Contaminants and Residues	J.J. Sasanya
Haiti	HAI5009	Strengthening Laboratory Capacity to Test and Monitor Food Contaminants	J.J. Sasanya
Honduras	HON0003	Improving National Capabilities in the Use of Nuclear Technologies for the Promotion of Sustainable Development Goals	Mr P.D.M. Brisset Ms T. Jevremovic Ms I.T.Bertral J.J. Sasanya
Indonesia	INS5045	Strengthening Food Security Through Improvement of Food Safety for Exports Using Gamma Irradiators and Electron Beams	C.M. Blackburn B. S. Han
Cote d'Ivoire	IVC5042	Improving Testing and Monitoring of Food Hazards Using Nuclear and Isotopic Techniques	J.J. Sasanya
Cambodia	KAM5004	Strengthening National Capability for Food and Feed Safety	J.J. Sasanya
Kazakhstan	KAZ5005	Building Capacities in Effectively Irradiating Food	C.M. Blackburn

Country/Region	Project No.	Title	Technical Officer
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	LEB1010	Establishing an Isotopic Ratio Mass Spectrometry Laboratory Dedicated to Authentication and Provenance for Supporting the National Fraud Repression Scheme	S. D. Kelly M. Groening
Lebanon	LEB5016	Strengthening Capacity for Exposure Assessment of Residues and Contaminants in the National Diet	J.J. Sasanya
Lebanon	LEB5017	Strengthening Technical Capabilities by Introducing Metal Speciation Techniques to Support Health and Environmental Safety	S. D. Kelly
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	A. Cannavan 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	Mihailova S.D. Kelly J. J. Adu-Gyamfi E. Fulajtar C. Zorrilla
Mauritius	MAR5027	Building Capacity to Analyse Veterinary Drug Residues and Related Chemical Contaminants in Animal Products	J.J. Sasanya
Mauritania	MAU5008	Strengthening Laboratory Capacity to Analyse and Monitor Residues and Contaminants in Foods	J.J. Sasanya
Marshall Islands	MHL5002	Building Core Capacities to Control Contaminants and Other Residues in Food — Phase I	J.J. Sasanya
Mali	MLI5032	Improving Laboratory and Monitoring Capabilities for Contaminants in Cereals and Nuts	J.J. Sasanya
Mongolia	MON5024	Enhancing Food Safety Analytical Capabilities for Veterinary Drug Residues and Related Contaminants Using Isotopic Techniques	J.J. Sasanya

Country/Region	Project No.	Title	Technical Officer
Mozambique	MOZ5010	Strengthening Confirmatory Analytical Capabilities for Veterinary Drug Residues and Related Contaminants in Animal Products	J.J. Sasanya
Mozambique	MOZ5012	Enhancing Food Safety Testing and Monitoring of Hazards Using Nuclear and Related Techniques	J.J. Sasanya
Namibia	NAM5018	Strengthening Animal Health and Food Safety Control Systems	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
Nepal	NEP5007	Supporting Analysis of Pesticide Residues in Agricultural Products	B.M. Maestroni
Niger	NER5023	Strengthening Capacity of the Public Health Laboratory to Monitor Food Contaminants	J.J. Sasanya
Niger	NER5025	Improving Food and Biological Hazard Detection, Food Preservation and Mutation Breeding	J.J. Sasanya C.M. Blackburn S. Sivasankar
Nicaragua	NIC5012	Strengthening the Monitoring and Control System for Food Contaminants	J.J. Sasanya
Oman	OMA5008	Enhancing National Capabilities in Food Safety and Traceability	S.D. Kelly
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	PAN5027	Strengthening Analytical Capabilities for Risk-based Monitoring of Agricultural Products for Internal Consumption	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
Philippines	PHI5035	Advancing Laboratory Capabilities to Monitor Veterinary Drug Residues and Related Contaminants in Foods	J.J. Sasanya
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
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

Country/Region	Project No.	Title	Technical Officer
South Africa	SAF5018	Establishing National Capacities for Monitoring and Control of Pesticide Residues in Agricultural Produce	B.M. Maestroni
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
Singapore	SIN5001	Enhancing Food Safety	C.M. Blackburn J.J. Sasanya
Sri Lanka	SRL5048	Strengthening National Capability for Food and Feed Safety	A. Cannavan A. Mihailova
Sudan	SUD5040	Strengthening the Evaluation of Quality, Monitoring and Control Programmes for Food Contaminants	J.J. Sasanya
Uganda	UGA5042	Strengthening Capabilities of Two Central Food Safety Laboratories and Selected Regional Veterinary Centres of Public Health	J.J. Sasanya
Vanuatu	NHE5004	Strengthening Agro-Food Laboratory Quality Infrastructure — Phase II	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
Africa	RAF0050	Promoting Institutional Capacity Building Through Triangular Partnerships (AFRA)	V. Gershan J.J. Sasanya
Africa	RAF5084	Strengthening Food Contaminant Monitoring and Control Systems and Enhancing Competitiveness of Agricultural Exports using Nuclear and Isotopic Techniques (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 C.I. Horak
Asia/ Pacific	RAS5081	Enhancing Food Safety and Supporting Regional Authentication of Foodstuffs through Implementation of Nuclear Techniques (RCA)	S.D. Kelly
Asia/ Pacific	RAS5087	Promoting Food Irradiation by Electron Beam and X Ray Technology to Enhance Food Safety, Security and Trade (RCA)	C.M. Blackburn
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

Country/Region	Project No.	Title	Technical Officer
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
Latin America/ Caribbean	RLA5069	Improving Pollution Management by Persistent Organic Pollutants to Reduce Impact on People and the Environment (ARCAL CXLII)	B.M. Maestroni
Latin America/ Caribbean	RLA5079	Applying Radio-Analytical and Complementary Techniques to Monitor Contaminants in Aquaculture (ARCAL CLXXI)	J.J. Sasanya
Latin America/ Caribbean	RLA5080	Strengthening the Regional Collaboration of Official Laboratories to Address Emerging Challenges for Food Safety (ARCAL CLXV)	B.M. Maestroni A. Cannavan
Latin America/ Caribbean	RLA5081	Improving Regional Testing Capabilities and Monitoring Programmes for Residues/Contaminants in Foods Using Nuclear/Isotopic and Complementary Techniques (ARCAL CLXX)	J.J. Sasanya
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

Radio Receptor Assay Residue & Contaminant Screening Capabilities Established in Myanmar, Georgia, Cote D'Ivoire, Burundi and Lesotho

James Sasanya

Controlling chemical hazards in food to meet public health and trade demands requires cost-effective analytical techniques so that the laboratories can have quick-turn around times and remain sustainable. Radio receptor assay techniques that use tritium (3H) or carbon-14 (14C) labelled analytes offer a solution. They are easy-to-perform and accurate tests that can analyse a range of of veterinary antimicrobials and pesticide residues, as well as mycotoxins.

COVID-19 challenges notwithstanding, these capabilities have recently been established and are being used at the National Centre of Food Technology in Burundi; The National Laboratory of Quality Tests in Metrology and Analysis (LANEMA) in Cote D'Ivoire; State Laboratory of Agriculture (SLA) in Georgia; Central Veterinary Laboratory (CVL) Lesotho and Veterinary Assay Laboratory, Myanmar. The counterpart in Myanmar is now screening food and animal feed for the presence of residues and mycotoxins for the first time. In the CVL, Lesotho, this is also the first time screening of residues in animal products has been performed. The institute is looking forward to establishing confirmatory analytical techniques. The same applies to LANEMA who are also collaborating with two other institutions, the National Public Health Laboratory and the National Agricultural Development Support Laboratory to address food safety concerns. In Burundi, a foundation is now in place for regular screening of chemical residues through the National Centre of Food Technology, which will also collaborate with a sister institution, the Burundi Bureau of Standards and Quality Control. Efforts are underway to enhance the analytical capabilities and residue testing/monitoring programmes (as applicable).

Group Training on Quality Standards to Facilitate Reliable Testing of Food Contaminants in Africa

James Sasanya

A group training event was organized under a regional technical cooperation project (TCP) RAF5084 in Cairo, Egypt in June 2021. The training covered the following scope: introduction to laboratory accreditation and international dimension of accreditation; introduction to ISO

17011:2017; history and evolution of ISO/IEC 17043:2010; scope, normative references, terms and definitions; data analysis and evaluation of proficiency testing scheme results; reports, communication with participants and confidentiality; management requirements; cases study; design of proficiency testing schemes; sample preparation and assessing the homogeneity and stability tests for some chemicals in food samples; sample preparation and assessing the homogeneity and stability tests for some microbiological food samples; and statistical analysis and evaluation of participants.

Five participants from Kenya, Malawi, Mali, Rwanda and Uganda benefited from the training. According to one of the fellows from Kenya "The training has provided me with new skills in the area of management of proficiency testing". "I will implement what I have learnt, which includes improvement in documentation, and align them according to ISO/IEC 17043 requirement, skills in the evaluation of participants' PT results, homogeneity and stability study, and will also transfer the knowledge acquired to my colleagues", added the participant.

According to another fellow (from Mali), "This training allowed us to better understand these two standards which are essential for the accreditation process of a laboratory as well as inter-laboratory tests".

Group trainees on ISO/IEC 17011:2017 and ISO/IEC 17043 in Cairo, Egypt.

Regional Food Safety Meeting/ Training on Risk Analysis

James Sasanya

A regional event was hosted by Kenya Bureau of Standards in Nairobi, 4–8 October 2021, under the framework of the regional technical cooperation project (TCP) RAF5084. The event was attended by 18 delegates from 14 African Member States: Botswana, Burkina Faso, Burundi, Cameroon, Egypt, Kenya, Malawi, Mauritania, Mozambique, Rwanda, Senegal, Sudan, Uganda and Zimbabwe.

A wide range of topics was covered, including risk analysis, changing global factors that affect national food safety systems, and evolution of food safety risk analysis as a discipline. The factors driving changes in food safety and benefits for governments to use food safety risk analysis were also covered.

Participants at the risk analysis meeting in Nairobi, October 2021.

Training was provided on the details of food microbiological risk assessment, chemical risk assessment and risk management. Further work was conducted using case studies such as a study of *Listeria monocytogenes* in ready-to-eat foods in the USA, risk assessment of chemicals in food - a study of methylmercury in fish in the USA and risk assessment of *Mycobacterium bovis* in milk in pastoral communities in Kenya. These studies and individual country experiences were discussed in plenary. The meeting noted that risk analysis is an evolving discipline, requiring frequent refresher training and that Member States should institutionalize risk analysis in undergraduate and graduate curricula.

Regional Training Course on Electron Beam/X-Ray Technology and Food Irradiation in Asia and the Pacific

Carl Blackburn

This online regional training course was held from 30 August–1 September 2021 under regional technical cooperation project RAS5087. The wider objective of this project is to encourage more widespread use of food irradiation by beams generated from electricity (electron beam and X-ray technology) to compliment technology that uses ^{60}Co radionuclide source gamma irradiation. The training course was requested to give a global context for food irradiation, provide information that would assist in choosing gamma, electron beam or X-ray technology, give a briefing on the harmonization of standards and therefore legislation relating to the maximum energy for the X-ray irradiation of food, provide information on the different types of technologies available and to give expert guidance on electron beam and X-ray dosimetry. A three-day course was designed and implemented by Mr Peter Roberts of Radiation Advisory Services in New Zealand,

Mr Tran Minh Quynh of the Hanoi Irradiation Centre in Viet Nam and Mr Blackburn of the Joint FAO/IAEA Centre.

Day one of the course dealt with regulations and standards for food irradiation, including details of current and possible future applications of the technology. Two documents were presented and discussed. One dealt with comparisons between gamma, electron beam or X-ray irradiators, the three different modes of radiation permitted for food irradiation under international standards. Participants agreed that this document should be published as an IAEA Technical Document because it would be of interest to many others. The second document concerned the maximum permitted energy for the X-ray irradiation of food. It was agreed that this document should be circulated more widely so that it may be used to encourage more harmony.

Day two focused on different accelerator systems. Presentations were given on the CORAD linear accelerator and the IBA rhodotron accelerator. Details were also provided on the new Steritech irradiation facility in Australia where the Mevex linear accelerator is used to generate X-rays for phytosanitary irradiation. A presentation from Viet Nam also gave details on the electon beam facility at Vinagamma. With a look to the future, a technical presentation on the development of low energy electron beams for food irradiation focused on fundamental research undertaken in Japan. A follow-up presentation from Buhler, a food engineering company, detailed the Laatu soft electron machine that is a new commercial product that uses low energy electrons to process dried ingredients such as nuts, seeds, grains, herbs and spices in food factories. At the end of the session, course participants from China, Pakistan, The Republic of Korea and Thailand also gave short presentations on their accelerator systems used in commercial scale food irradiation in this region.

Day three of the course focused on dosimetry. Mr Florent Kuntz, of the IAEA collaborating Centre at Aerial in France, provided several videos and presentations which introduced key aspects of dosimetry. Participants took the opportunity to raise questions on dosimetry and to discuss dosimetry systems used in the region. Several participants agreed that a dosimetry inter-comparison exercise would be useful as part of the project.

Agaram Technologies, India, Donates Laboratory Information Management System to the Food Safety & Technology Laboratories, Bahamas

James Sasanya

The Joint FAO/IAEA Centre supports food safety testing and related laboratories in Member States through human resource development, technology transfer and the establishment or improvement of analytical instrumentation. One of the goals is to ensure that the laboratories are fit-for-purpose and credible/competent enough to render services that truly help protect consumers and meet food export or import requirements. These efforts require improvement of laboratory quality management, with the goal of accreditation. An important tool in this respect is a Laboratory Information Management System (LIMS). The IAEA typically procures the LIMS (hardware and software) and associated services at costs between about €60,000 and €200,000. As part of its corporate social responsibility, Agaram Technologies recently donated LIMS software and related services worth €50,000 to the Food Safety & Technology Laboratories, Bahamas through the Joint FAO/IAEA Centre. Agaram Technologies is a global organization with headquarters in Chennai, India, focusing exclusively on laboratory informatics software. Founded in 1998, it is an ISO 900: 2015 certified organization. Agaram Technologies has previously won competitive bids to supply nine IAEA Member States with LIMS, with successful implementation in each case. This donation to Bahama was most appreciated and compliments work already done to establish state-of-the-art screening and confirmatory analytical capabilities under the TCP BHA5001, 'Developing laboratory capacity for testing contaminants in animal and related products including fish in Bahamas'.

Food Safety Lab in Bahamas receiving the LIMS.

Updates on RLA5080: Strengthening the Regional Collaboration of Official Laboratories to Address Emerging Challenges for Food Safety

Britt Maestroni and Nicola Schloegl

Risk analysis, consisting of the three components risk assessment, risk management and risk communication, is a systematic methodology for making decisions about food safety and is carried out to maintain confidence in the food supply system from farm to fork. Changes in food production patterns, the globalisation of the food supply chain and exposure to new and emerging risks require increasing sanitary protection and strengthened food monitoring programmes that are risk based.

In the frame of the IAEA´s regional technical cooperation project (TCP) RLA5080, 'Strengthening regional collaboration between official laboratories to face new challenges related to food safety' (ARCAL CLXV), the need for training on science-based risk assessment, as the basis for a systematic management approach to food safety, was identified.

In this context, an e-learning course on *Food Safety Risk Assessment* was created to transfer basic to intermediate knowledge on dietary risk assessment and to familiarize participants with practical applications using a dedicated '*@Risk'* software package. The course is currently in a testing phase and will be and will be available online IAEA CPL4 net. Registration on Nucleus Nucleus is mandatory.

An e-learning course on Food Safety Risk Assessment will be soon available at IAEA CPL4 net.

For national food safety authorities to be able to apply risk assessment tools, the access to high-quality and current data sets is essential. For this purpose, RALACA has been focusing its work since 2019 on the concept of data-sharing, including the establishment of monitoring programmes considering risk-based evidence and assessments. The regional TCP RLA5080 provided support for the establishment of the RALACA Data-Sharing Committee (RALACA-DSC). During 2020–2021, the official framework document of RALACA-DSC was developed, including provisions for data exchange, collection, verification and the use of data, which will be coordinated by representatives of official analytical food safety laboratories in the framework of RALACA-DSC. The IAEA also supports the establishment of a regional food safety database for Latin America and the Caribbean (LAC) which will be hosted on the IAEA´s Nucleus pages. The database will be used by RALACA-DSC to carry out ad hoc risk-based decision-making and policy-formulation on food safety in the LAC region. Data reporting modules are currently being developed and will be connected to the regional (RALACA) database. The final deliverable, expected in early 2022, is a user-friendly data portal and data base in line with RALACA-DSC provisions and in compliance with IAEA data-security standards. As of November 2021, twelve countries in LAC have already assigned RALACA-DSC representatives. The official endorsement of the framework document and the launch of RALACA-DSC are envisaged for March 2022.

The establishment of a regional data-sharing network will promote cooperation among official reference laboratories in the region in the use of scientific evidence for agriculture and food safety management and will contribute to improving food safety through the development of risk-based policies to ensure public health and environmental protection.

Final Coordination Meeting of RLA5069: Improving Pollution Management by Persistent Organic Pollutants to Reduce Impact on People and the Environment

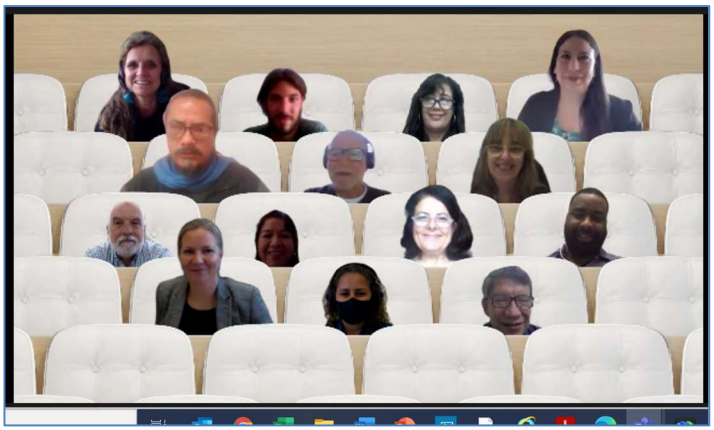
Patricia Gatti, Britt Maestroni and Dominika Zahrer

In the past two decades, the toxicity of organochlorines to humans and the environment has been the subject of many studies worldwide. The organochlorine pesticides are part of a group of compounds known as persistent organic contaminants (POCs) or persistent organic pollutants (POPs), synthetic organic chemicals that can be either intentionally or unintentionally produced and/or released. They are persistent in the environment and their long-range transport leads to global pollution. They bioaccumulate in food chain and, being lipophilic, have a tendency to remain in fat-rich tissues, such as milk and are likely to accumulate, persist and bioconcentrate and could, eventually, achieve toxicologically relevant concentrations, even though exposure episodes may appear limited. Because of their persistence in the environment and long half-lives, they continue to be transferred to humans via food and water, among other pathways for human exposure. Once absorbed by the body, they are concentrated in the central nerve ganglia, adrenals and adipose tissue in the nervous system. In lactation, milk is a major route of elimination of organochlorine pesticides but is also an important route of exposure for infants.

In Latin America, there are large geographic areas where agricultural and industrial activity are conducted, situated near residential and recreational areas with many people. The IAEA is currently closing a 6-year project on 'Improving Pollution Management by Persistent Organic Pollutants to Reduce Impact on People and the Environment' (RLA5069). This regional project involves 10 countries from the Latin American and Caribbean (LAC) Region; Argentina, Bolivia, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Mexico, Paraguay and Uruguay. It is the first time that a regional assessment is being carried out for the presence and concentration of POPs in human milk, cow's milk, water and soil samples, and the exposure to humans via these routes. The final coordination

meeting of the project was held in November 2021. Countries presented their national results, produced concentration maps and carried out risk assessment using deterministic and probabilistic approaches. All countries shared their data in a regional database. The results obtained were assessed along with an evaluation of the outcomes and impact of the project for the participating countries. The training courses and workshops carried out have made it possible to strengthen fundamental knowledge related to the sources of contamination of POPs and their routes of exposure, which will help to establish adequate sampling criteria in potentially exposed populations. It has also been possible to harmonize sampling criteria, criteria for ensuring the quality of the measurements in the different matrices, and the treatment of results. The participating countries have defined the sampling areas and have made strategic alliances to carry out the sampling. They have also negotiated authorizations with the national Ethics Committees according to WHO recommendations to enable studies on biological material (mother's milk). Several new analytical methods were developed by the laboratories and validated for the determination of POPs in human and cow milk, soil and water samples. All participants reported an expansion of the analytical capacity of the laboratories for the analysis of POPs, especially after the participation in the interlaboratory comparison implemented during the project.

Despite the many challenges presented by COVID-19, the final coordination meeting was very successful and all planned activities and expected results were achieved. It is expected that, under the regional framework of RALACA, monitoring of POPs in the LAC region will continue and more laboratories will be able to join the newly formed RALACA-POPs committee. We wish the participants a successful continuation of these important monitoring activities.



Participants of the final coordination meeting of project RLA5069.

Developments at the Food and Environmental Protection Laboratory

Discrimination of Mandarins of Different Botanical Origins Using FTIR Spectroscopy

Ignacio Migues, Alina Mihailova, Beatrix Liebisch and Marivil Islam

A wide range of analytical approaches, based on high-field nuclear magnetic resonance spectroscopy and high-resolution mass spectrometry, have been applied for the assessment of metabolic differences between fruit varieties and the authentication of the botanical origin of fruits. The above methods are sophisticated and costly from the point of view of analysis time, equipment, infrastructure and maintenance. In addition, they techniques require lengthy sample preparation, which introduces a substantial delay between sampling and the generation of the results. More rapid and cost-effective methods, which can be applied to screen samples both in the laboratory and directly in the field, are required for the verification of botanical origin of fruits.

Infrared (IR) spectroscopy is a rapid, non-destructive technique that requires little or no sample preparation and does not involve the use of chemicals or specialized laboratory facilities. Several studies have shown the potential of IR spectroscopy combined with chemometrics for the differentiation of the botanical origin of various plant-based foods, e.g. honey, almonds, apricots, figs and citrus juices.

In this study, Fourier Transform Infrared with Attenuatued Total Reflectance (FTIR-ATR) spectroscopy, coupled with principal component analysis (PCA) and orthogonal projections to latent structures discriminant analysis (OPLS-DA), was applied for the differentiation of two varieties of mandarins cultivated in Uruguay: 'B475', which has a superior taste and is highly valued by consumers, and 'M16', which is characterised by a sour taste and is palatable to consumers. This work has contributed to the development of analytical approaches under coordination research project (CRP) D52042, 'Implementation of Nuclear Techniques for Authentication of Foods with High-Value Labelling Claims' and to the PhD research of the FEPL consultant, Mr Ignacio Migues.

Spectra were acquired in the range 450 to 4000 cm^{-1} using a Perkin Elmer Spectrum 2 FTIR spectrometer fitted with an ATR sampler. Data were centred and pre-processed using the multiplicative scatter correction (MSC) function. The FTIR absorbance spectra obtained from 'B475' and 'M16' varieties are displayed in Figure1. The main region of interest lies in 'fingerprint' region between 1800 and 900 cm^{-1}. The major differences in absorbance bands between the two varieties were observed around 1722 (C=O stretching) and 1226cm^{-1} (C–O stretching), which is associated with the presence of carboxylic acids, as well as around 1054 and 998 cm^{-1}, which is indicative of the stretching and bending modes in sugars.

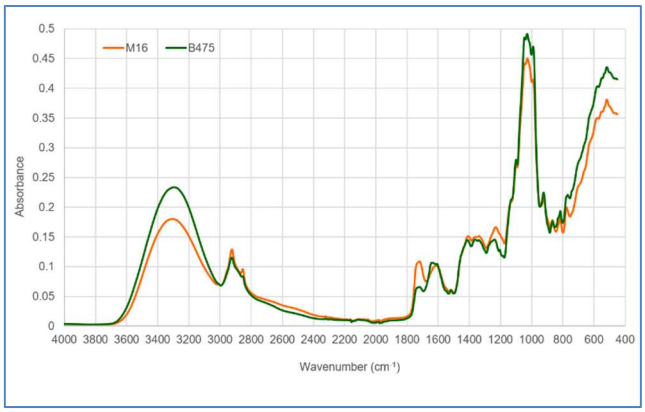


FIG. 1. Mean raw FTIR-ATR spectra of "M16" and "B475" mandarin varieties.

An unsupervised chemometric approach using PCA was applied to assess initial sample groupings. The PCA model showed a distinct separation between the samples of the 'M16' and 'B475' varieties. The goodness of fit and predictability values of the PCA model were 0.998 and 0.996, respectively.

In addition, a supervised chemometric approach, OPLS-DA, was applied to discriminate the two varieties. The OPLS-DA model permitted good discrimination of 'M16' and 'B475' mandarin varieties. The goodness of fit (R2X(cum), R2Y(cum)) and the predictive ability (Q2(cum)) values of the 7-fold cross-validated OPLS-DA model were 0.951, 0.994 and 0.994, respectively (Figure 2).

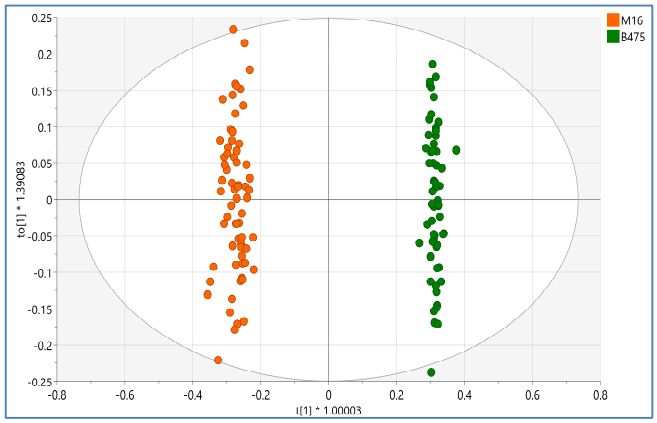


FIG. 2. OPLS-DA model of the training dataset ("B475" variety, n = 58 and "M16" variety, n= 66).

External validation of the OPLS-DA model was performed using the test dataset ("M16", n=32 and "B475", n=29)

comprising mandarin samples that were not used in the construction of the model. The model was able to correctly predict the mandarin variety of all the samples in the test dataset, i.e. a 100% correct classification rate was achieved for both 'M16' and 'B475' varieties.

This study has demonstrated that FTIR-ATR spectroscopy, combined with PCA and OPLS-DA, is a promising analytical tool for the differentiation of mandarin varieties. The main advantages of these technique over the high-resolution metabolomics methods are the rapidity and the ease of use in routine analysis, low cost, the non-destructive nature of the techniques and minimal sample preparation. Further studies using a wider range of authentic mandarin samples, from multiple regions and production years, are required to assess the robustness of this approach.

Method Development for Determination of Pesticide Metabolites in Uruguayan Biomixture for Use in Biobeds

Sofia Rezende, Veronica Cesio, Natalia Besil, Shuichi Nakaya and Britt Maestroni

The FEPL, through the work of the RALACA food safety laboratory network, continues to support research studies on agricultural pollution sources, as it is important to simultaneously ensure the safety of food products and a sustainable agricultural environment whenever possible. The Group for the Analysis of Trace Compounds (GACT) of the Universidad de la República in Uruguay and the team in the Centro de Investigación en Contaminación Ambiental (CICA) of the University of Costa Rica are working on accelerating the degradation of pesticides in industrial and horticultural wastewater using 'biobeds' technology. Under this framework, a study was initiated in FEPL, in collaboration with GACT, to contribute to the development of chromatographic and mass spectrometry methods to detect pesticide metabolites and transformation products (M & TP), that are the result of degradation processes of pesticides in biobed reactors. The active ingredients degrade totally or partially into smaller molecules by biological, physical and chemical processes such as enzyme degradation, photodegradation or hydrolysis. Residues of M & TP can be found in environmental and food matrices along with the parent compounds. They have become a matter of concern during the last few years due to their toxicity to humans and animals, and to the environment. In certain cases, toxicity of these compounds can surpass that of the corresponding parent compounds.

The determination of pesticide metabolites can be carried out by targeted analysis using either gas or liquid chromatography coupled to tandem mass spectrometry (GC-MS/MS) or (LC-MS/MS). Each of these methods is applicable depending on the analytes' volatility, which is a function of the compounds' molecular mass and polarity. Volatile analytes are most easily analyzed by GC-MS, whereas non-volatiles are typically analyzed by LC-MS, provided they can be ionized for mass spectrometric detection.

In the second part of 2021 and in the context of a PhD consultancy from Uruguay, the FEPL validated a sample preparation method, previously developed and optimized in Uruguay, for the determination of pesticide metabolites in the biomixture used in biobeds in Uruguay. These biobeds were established in Uruguayan agricultural farms to evaluate the degradation of the active ingredients (pesticides) used in field applications (see article in Newsletter Vol 24 No. 1, January 2021).

Lyophilized biomixture samples were obtained from Uruguay and used as blank materials for recovery studies. Before use, they were thoroughly homogenized using a ball mill, and their final homogeneity was verified by ion mobility spectrometry (IMS) using an application developed for their volatile component.

After evaluating different sample preparation procedures, the final method consisted of an extraction using acetonitrile with magnesium sulphate and sodium chloride to increase the salinity of the aqueous phase and promote the extraction of the pesticides into the organic phase. After strong agitation, the mixture was centrifuged and an aliquot of the supernatant carefully dried over magnesium sulphate, centrifuged again and filtered for injection into the LC-MS/MS and GC-MS/MS.

Thirty-five analytes were anaysed by LC-MS/MS and/or GC-MS/MS in multiple reaction monitoring mode (MRM). The target list was based on metabolites that are included in the residue definition of the parent species, and for which standards were available at FEPL. A considerable amount of time was spent on optimization of the instrumental conditions for the metabolite standards, specifically to identify the best precursor and product ion transitions, the collision energies, the source voltages and all MS conditions under multiple reaction monitoring mode. Of particular importance was the optimization of the injection conditions in the case of the GC-MS/MS system due to the use of acetonitrile as solvent for the injection, which is known to be detrimental to the lifetime of GC columns. The multi-mode inlet was temperature-programmed to minimise the injected solvent volume. In addition, the injected amount was reduced to take into account the relatively large expanded vapour volume of the acetonitrile solvent compared to other GC compatible solvents. The method was validated in terms of linearity, recovery, repeatability, within-laboratory reproducibility , limits of quantitation and limits of detection. Solvent and matrix matched calibration curves were compared, and matrix effects were quantified. Figure 1 shows the within laboratory reproducibility of the method by LC-MS/MS and GC-MS/MS.

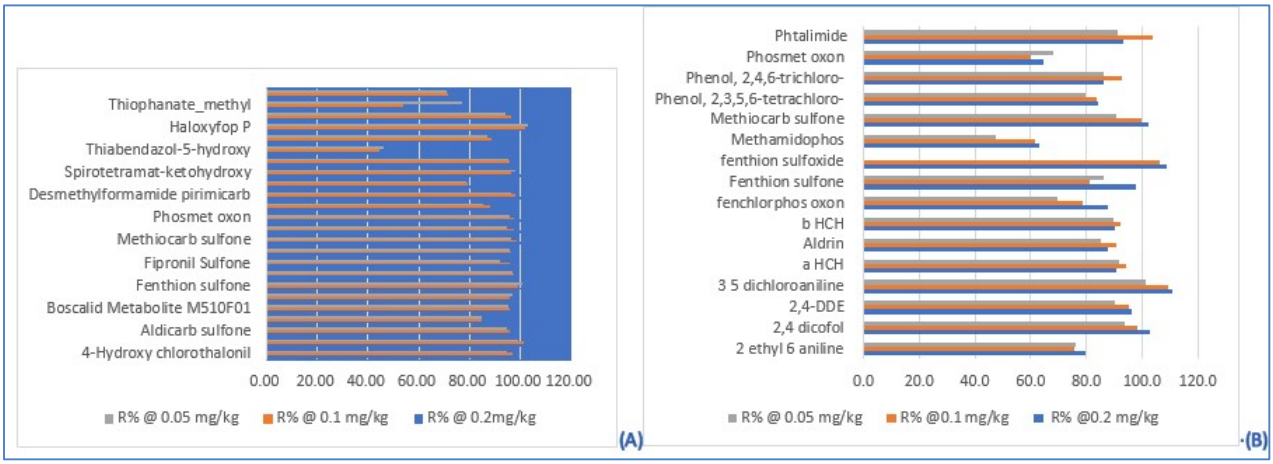


FIG 1. Within laboratory reproducibility for the metabolite method (recovery of analyte from fortified samples) using LC-MS/MS (A), GC-MS/MS (B).

An interlaboratory comparison is currently underway with the GACT laboratory and the results will be presented in the next newsletter.

Future work will include an expansion of the method to additional parent/metabolite combinations. Furthermore, a specific study is being planned to understand the possible degradation of parent compounds in the injector port of the GC-MS/MS and in the ESI source of the LC-MS/MS.

Screening and Confirmation of Aflatoxins in Food

Britt Maestroni and Shuichi Nakaya

Climate change has led to an increased risk of aflatoxin contamination in food products in regions of the world that were previously not exposed to such food contaminants. This is a direct consequence of modified meteorological conditions, with persistent humid conditions and increased average temperatures. Ingestion of even low amounts of aflatoxins can generate severe adverse effects in humans, so their levels in food commodities must be strictly regulated.It is, therefore, very important to be able to quickly identify contaminated commodities to protect the health of consumers.

A collaborative study between the FEPL and the University of Oviedo has started, involving the preparation of pistachio sample extracts and their analysis by the laboratory in Oviedo using a rapid screen-printed carbon electrode (SPCE) screening method and by FEPL using ultra high-performance liquid chromatography coupled to tandem mass spectrometry (LC-MSMS), as a confirmatory method.

Development of a competitive immunoassay for total aflatoxins using screen-printed carbon electrodes

Screen printing technology is a well-developed method widely used to fabricate disposable and economical electrochemical sensors. Screen printed carbon electrodes (SPCEs) can provide highly reproducible, sensitive and cost-effective detection methods. Their adaptability and ease of modification are of great importance and allow for detection of specific targets, such as total in pistachio and peanut butter. The Nanobioanalysis Group of the Department of Physical and Analytical Chemistry, University of Oviedo, Spain, developed an immunosensor for the electrochemical detection of total aflatoxins (AFB1, AFB2, AFG1, AFG2) under a technical contract financed by the IAEA technical cooperation project VIE5022. The scheme of the competitive immunoassay is shown in Figure 1.

The bovine serum albumin (BSA)-labelled antigen, in this case aflatoxins (BSA-AF) immobilized on the SPCE surface, and the free AF analyte compete for the specific monoclonal antibody (mAb-AF). The horse radish peroxidase (HRP) enzyme is labelled to the electrode through a polyclonal secondary antibody (anti-IgG-HRP). After that, the added 3,3',5,5'-Tetramethylbenzidine (TMB) reagent is enzymatically oxidized by the HRP molecules. The oxidized TMB is reduced on the surface of the SPCE by applying a constant potential of −0.2 V for 60 seconds, producing an associated catalytic current (analytical signal) that is proportional to the initial AF amount

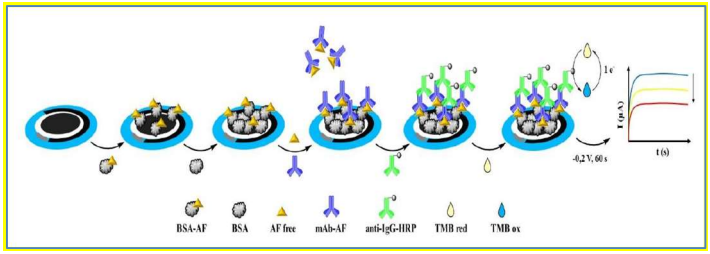


FIG 1. Scheme of the competitive immunoassay for total aflatoxins performed on the surface of screen-printed carbon electrodes (SPCEs).

Ms Britt Maestroni received hands on training on the preparation of the immunosensor and its application to the routine screening of pistachio and peanut butter samples. The training took place at the analytical facilities of the University of Oviedo, under the guidance of Dr Alfredo de la Escosura and the laboratory demonstration of Ms Beatriz Perez. A standard operating procedure was drafted for the preparation of the SPCE for the electrochemical detection of total aflatoxins (AFB1, AFB2, AFG1, AFG2) and its application to the routine screening of pistachio samples.

The developed SPCE immunosensor is simple, rapid, sensitive and makes use of low-cost instrumentation. The excellent performance observed in pistachio samples together with a detection limit below the Codex legal maximum level of total AFs, makes this approach a promising tool for the determination of total aflatoxins at the point-of-need, using a Smartphone interface. This approach also offers a rapid development stage for emerging challenges, i.e. other food contaminants, as the sensor development is simple and straightforward.

Method optimization for determination of aflatoxins in pistachio samples by LC-MSMS

Three prospective methods were evaluated for the determination of aflatoxins in pistachio samples. Samples of blank organic pistachios from a supermarket were homogenised in an automatic pestle and mortar mill using liquid nitrogen. Individual aliquots of pistachio paste were fortified and analysed to compare the methods, which differed in the extraction solvent used, the use of C18 clean-up columns and the fractionation solvent used and the amount. The aflatoxins were individually analysed, and the method that provided the best recovery values for all the aflatoxins (B1, B2, G1 and G2) and had the lowest number of analytical steps was selected. In the selected method, pistachio samples are extracted with methanol in the presence of a saturating salt, with thorough mixing and centrifugation steps. The upper layer of organic solvent is diluted with Milli Q water and applied to an immunoaffinity column, washed with water and eluted in methanol. The filtered extract is injected into a LC-MS/MS instrument programmed for the MRM transitions shown in Table 1.

The method is currently being validated, and sample extracts will be prepared and sent to the Oviedo laboratory for the intercomparison study using two different detection technologies. Future work will include the incorporation of additional mycotoxins and the validation of the method for peanut samples.

TABLE 1. OPTIMIZED MRM TRANSITIONS FOR THE DETECTION OF AFLATOXINS BY LC-MS/MS.

Name	RT (min)	Polarity	Transition1 (*m/z*)	CE	Transition2 (*m/z*)	CE	Transition3 (*m/z*)	CE
Aflatoxin B1	4.67	+	313.1>241.1	-28.0	313.1>285.1	-34.0	313.1>269.1	-22.0
Aflatoxin B2	4.28	+	315.1>259.2	-22.0	315.1>287.2	-22.0	315.1>243	-20.0
Aflatoxin G1	3.81	+	329.1>243.1	-20.0	329.1>311.2	-26.0	329.1>200.2	-24.0
Aflatoxin G2	3.40	+	331.1>313.05	-23.0	331.1>245.2	-32.0	331.1>189.05	-41.0

FEPL Staff

Ms Maria Sofia Rezende, from the University of the Republic of Uruguay, finished her PhD consultancy in September 2021. Sofia contributed to several outputs for the Food and Environmental protection Laboratory (FEPL) in the field of analytical methods for the control of chemical contaminants and residues in food. Under her PhD she developed and optimized a multi residue method for pesticide metabolites and transformation products in biobeds using LC-MS/MS and GC-MS/MS. Additionally, she provided support to FEPL staff in the preparation of virtual training materials for capacity building activities. Sofia was a real asset to FEPL. In her time in the laboratory Sofia not only acquired additional professional skills, but also contributed to team building with her positive attitude to work. We wish Sofia great success back at her Institution in Uruguay and look forward to future collaborations.

Mr Ignacio Migues Borghini, from the University of the Republic of Uruguay, concluded his PhD consultancy in FEPL in August 2021. During his consultancy he played an important role in the successful commissioning of the new bench-top low-field (60 MHz) magnetic resonance spectroscopy system (BT-NMR) in FEPL. He brought to bear his experience from his high-field NMR studies during his PhD programme in Uruguay, allowing him to rapidly develop robust standard operating procedures for the analysis and data processing stages, which had great value for the other FEPL staff members and for Member States. His applied and adaptive research on the BT-NMR system covered the differentiation of Arabica and Robusta coffees to detect economically motivated adulteration; a study of the correlation between BT-NMR profiles of mandarin and desirable quality attributes; and a feasibility study into the use of rapid BT-NMR screening to distinguish fish species based on triacylglycerol profiles. Over the 12-months Mr Borghini was in FEPL his drive and enthusiasm had a significant impact on the work programme for which he should be thoroughly commended. He will be missed by all the staff. We wish Ignacio all the best in his continued research and studies, and we hope that we can continue to have a fruitful collaboration in the future through CRP D52042 in which his institute is a contract holder.

Ms Beatrix Liebisch completed a one-year internship in FEPL in August 2021. Beatrix contributed to many aspects of the FEPL work during her internship, including measurements using bench-top spectroscopy instrumentation to assist FEPL staff in the development and validation of food authentication methods. She also made a substantial contribution to the preparation of virtual training materials and videos for the virtual training courses held by FEPL during the period of her internship. We wish Beatrix all the very best for her continued studies and future career.

Announcements

Second International Conference on Applications of Radiation Science and Technology (ICARST-2022)

Carl Blackburn

The International Atomic Energy Agency is organizing the ICARST-2022 for new dates in 2022. The conference will take a comprehensive look at the status of radiation science in academia and industry, as well as its ability to meet future challenges. Due to the continuing global response to the COVID-19 pandemic, the conference has been rescheduled and is now due to be held in Vienna, at the IAEA Headquarters from 22–26 August 2022. Further information can be found online Home: Second International Conference on Applications of Radiation Science and Technology (ICARST-2021) | IAEA.

The 20th International Meeting on Radiation Processing (IMRP20)

Carl Blackburn

COVID-19 has caused many events to be delayed and this includes the IMRP20. This international conference is held every two or three years and is one of the leading international events concerning the science and commercial application of radiation processing. The International Irradiation Association has rescheduled the dates for this international conference. For the first time, it will also include a meeting of the Phytosanitary Irradiation Forum. The meeting will be hosted in Bangkok from 7–11 November 2022 by the Thailand Institute of Nuclear Technology. Further information is available online IMRP 20 – Where Business and Science Connect (imrp-iia.com).

The International Meeting on Radiation Processing (IMRP), Bangkok, Thailand, 7–11 November 2022.

Publications

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