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Nuclear Techniques in Food and Agriculture

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To Our Readers

Samples for verifying authenticity of high-value edible oils at Oil Crops Research Institute, Chinese Academy of Agricultural Sciences, China. Photo courtesy of Mr Jiang Jun.

Over the past six months, the Food and Environmental Protection (FEP) Sub-programme has been busy with coordinated research projects, technical support to national, regional and interregional technical cooperation projects (TCPs); the organization of workshops and training courses; participation in international conferences and meetings; as well as R&D activities at the Food and Environmental Protection Laboratory (FEPL).

Currently the Sub-programme implements five Coordinated Research Projects (CRPs) in which two research coordination meetings (RCMs) were held in the first half of this year. Detailed reports of each RCM are included in this newsletter. Briefly, the first RCM of the new CRP D52042, on food authenticity, was held at the IAEA Headquarters in Vienna, Austria. It involved experts from 16 countries working together to refine methods to apply nuclear-derived

techniques to test for accuracy in food labels. The second RCM of the CRP D52041, on integrated radiometric and complementary techniques for mixed contaminants and residues in foods, was held in Gaborone, Botswana and is the subject of this newsletter's feature article.

We are currently providing support to 64 IAEA TCPs, including one interregional and nine regional projects, in collaboration with our colleagues in the IAEA Department of Technical Cooperation and counterparts in Member States. Some of the highlights in this important area of our work are also included in this issue. For example, we conducted field visits and on-site technical assistance and progress-evaluation of food safety and control activities in Benin and Rwanda; and pre-project planning for capacity building in food safety and food analysis in Georgia and Kyrgyzstan. Several regional and interregional technical training courses in the field of food safety have also been organized. Examples include training on: analysis of toxic metals in food and related matrices; establishment of maximum residue limits (pesticide and veterinary drugs) and risk assessment; antimicrobial resistance associated with food safety; and application of statistical principles to food safety laboratories and national monitoring plans/programmes. Also, a joint workshop was successfully held in collaboration with RALACA (Latin American and Caribbean Analytical Network) on "Quality Assurance and Quality Control Measures in Food Testing Laboratories" at Foz do Iguazu, Brazil, 5 May 2019. This workshop was appreciated by all participants and very positive feedback has been received. Meanwhile, technical support and inputs have also been provided to designing some forty new projects for the 2020–2021 TC cycle.

We have participated in key regional and international meetings concerning food safety and control issues. These include: the first FAO/WHO/AU International Conference on Food Safety held recently in Ethiopia; an International Forum on Food Safety and Trade, held in Switzerland; the first ISO-FOOD International Symposium on Isotopic and Other Techniques in Food Safety and Quality that took place in Slovenia; a workshop held in Astana, Kazakhstan on a prospective Asian Development Bank-IAEA Partnership for Strengthening International Standards in Agricultural Value Chains in Central Asian Countries; and the FAO/WHO Expert Meeting on carry-over of veterinary drug residues in feed and the transfer from feed to food.

Continued support has also been provided to the Codex Alimentarius Commission and its committees. A representative from our team participated in the 52nd Session of Codex Committee on Pesticide Residues and presented aspects of our recent work, including the implementation of 23 capacity building projects and two research projects concerning pesticide residues and dual use compounds (veterinary drug-pesticides). At the 13th meeting of the Codex Committee on Contaminants in Foods, we presented information on radioactivity in food in non-emergency situations, along with a request to establish an Electronic Working Group on this issue. Our contribution and proposal received positive feedback and support.

This newsletter also gives details of research and innovation at the FEPL. Recent work includes the optimization of a multi-contaminant and chemical analysis method. Herbs and spices are important commercial products used worldwide as ingredients in food, teas and medicines. Such spices may contain pesticides. Therefore, using turmeric as a representative spice, the FEPL has focused on the development of a method to detect several pesticide residues and other chemical contaminants and markers. The technique includes headspace gas chromatography - ion mobility spectrometry (GC-IMS) applied in combination with full scan GC-MS/MS, to characterize authenticity and the representativeness. Related work has included applications of GC-IMS and chemometric analysis, as a basis for a food authenticity screening test.

I am also pleased to announce that a new project on 'Enhancing Capacity in Member States for Rapid Response to Food Safety Incidents and Emergencies' has received funding from Japan under the Peaceful Uses Initiative. This two-year project will include method development for the detection of food contaminants, determination of food authenticity and geographical origin, and the transfer of the technology to Member States to strengthen laboratories and reliable testing frameworks.

As indicated in the announcement section of this newsletter, the newsletter will no longer be circulated as hard copies as the practice has been. Effective January 2020 (issue 23), our newsletter will only be available electronically and subscribers will be informed by Email of the link to the latest edition when it is posted on our website. This is part of our initiative to be more environmentally friendly and ensure that readers receive the newsletters in time.

In closing, I would like to thank our collaborators and counterparts for their continued support and express my appreciation to the staff of the FEP Section and Laboratory for their dedication and contribution to the Sub-programme and technical assistance to the Member States.

Sincerely,

Zhihua Ye
Head, Food and Environmental Protection Section

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Feature Article

International Technical Meeting to Review Progress for a Coordinated Research Project (CRP) "Integrated Radiometric and Complementary Techniques for Mixed Contaminants and Residues in Foods", Gaborone, Botswana, 25–29 March 2019

James Sasanya

Risk management of contaminants and residues in food is largely based on health risk assessments on individual hazards although consumers may be exposed simultaneously to mixtures of such contaminants or residues as veterinary drug and pesticide residues, mycotoxins among others. Therefore, to better safeguard consumers, assessing the risk of exposure and subsequent management and communication should depend on scientific information from the mixed contaminants/residues. The practice of testing and monitoring these hazards as a group is lacking and requires research for reliable analytical methods hence the need for the CRP "*Integrated Radiometric and Complementary Techniques for Mixed Contaminants and Residues in Foods"* initiated in June 2017 with the overall objective: To enhance Member States' food and environmental safety control systems and risk assessment programmes through improvement of laboratory capabilities needed to gather reliable data on mixed contaminants or residues in foods as well as antimicrobial use pertaining to the development of antimicrobial resistance.

CRP participants at the meeting.

Following up on the first technical meeting held to launch the project, from 19 to 23 June 2017, Vienna, Austria, the second meeting was organized in Gaborone, Botswana from 26 to 30 March 2019. This was to review work done during project phase I and plan for the next phase. The meeting was held at the Botswana National Veterinary Laboratory (BNVL) and attended by 35 visiting and local scientists from Benin, Botswana, China, Colombia, Ecuador, Northern Macedonia, Nicaragua, Pakistan, Peru and Uganda. Others included Italy, South Africa, Spain, the Netherlands and the United States of America as well as a member of the private sector (Perkin Elmer, South Africa) who shared their discovery and analytical solution as well as technologies relevant to the CRP.

The meeting was addressed by Dr Chandapiwa Marobela Raborokogwe, Director of the BNVL who welcomed the participants and highlighted the importance of food safety research to countries such as Botswana, a major beef exporter. She added that the research is timely due to the increasing demand for new and broad-spectrum techniques and capabilities for more comprehensive residue and contaminants testing and monitoring. She thanked the IAEA for choosing and trusting the BNVL as a host and encouraged participants to use this opportunity to strengthen relationships and share information and experiences among themselves.

CRP participants touring the BNVL and sharing research experience.

Prof Mathew Nindi (agreement holder, South Africa) and Ms Hiranthi Jayasuriya (USA) were nominated as meeting chair and rapporteur, respectively. The officer was the Scientific Secretary and guided meeting proceedings and reminded participants of work done under the CRP since the first RCM. Areas of improvement and meeting expectations were outlined.

The participants presented, discussed and fine-tuned the below (among others):

Work done included radiotracer studies to develop and validate multi-class analytical methods for multiple food contaminants. Studies were conducted to isolate receptors of interest for selected analytes (tetracycline, aflatoxins, chloramphenicol and gentamicin) from poultry liver tissues, without immunization applying different cell separation techniques (such as homogenization, cell straining, centrifugation and sonication) at varying experimental conditions. Tritium-labelled substances, supplied with standardized kits (Charm Sciences), were used as tracers. Receptors developed in-house were found successful and are useful for analysis of residues in milk samples. Further work

is ongoing on trueness; cross reactivity; bulk production and sustainability. Comparative studies (with chromatographic and spectrometric techniques); lyophilization and multi-analyte studies also planned.

Work has been done and was reported on development of analytical methods for polyaromatic hydrocarbons and mycotoxins in a range of products namely roasted coffee, smoked fish, dried fish and infant flours based on cereals, in the context of Total Diet Studies.

In a separate project, work was presented on validation and application of analytical methods for the identification and quantification of multi-class analytes in biological samples and associated animal products: a valuable tool for monitoring mixed contaminants in food producing animals.

In another research project, investigations were done to ascertain depletion of certain antimicrobials and compare their levels in biological and food samples. Broiler chicken were treated and samples evaluated and quantified. As a preliminary work, a multi-residue method for quantification and confirmation of 15 antimicrobial residues in broiler chickens also relevant to understanding antimicrobial resistance, has been published.

An isotopic method for screening mixed residues and contaminants including 240 pesticides in eggs has been expanded to include analytes such as fipronil and its three metabolites. Fipronil is a public health concern that was recently found eggs (though typically used in crop production) in a scandal that resulted in withdrawal of millions of eggs from markets in Europe and Asia.

Another piece work on "Development of Isotopic Techniques for the Determination of Residues of Pesticides and Veterinary Drugs in Samples of Livestock Origin" has so far included chloramphenicol, chloramphenicol D5, atrazine and atrazine D5, and is due for expansion followed by application to national testing programmes in one of the investigation countries.

Two presentations were shared on "Development and Application of a Multi-Class/Residue Method for the Determination of Mixed Veterinary Drug Residues and Contaminants in Meat by IL-DLLME and Isotope-based LC-MS/MS" as well as "Development of Multi Class Analytical Method for Mixed Contaminants including Hormones and Environmental Contaminants from Natural Sources, in Bovine Urine and Milk". Evaluation of risk factors associated with exposure to these hazards is also planned.

Work in ongoing on cost-effective techniques on pesticide and antimicrobial residues in shrimps and fish. In another study, a method for 132 compounds including pesticides and mycotoxins in quinoa was reported. This is important for Peru, the largest producer of quinoa. Trade rejections of quinoa from Peru because of pesticides has been reported and there is need for action to redress this problem. Quinoa can also have mycotoxins.

Research updates from agreement holders included: targeted and untargeted analysis and the work on the recent food safety crisis associated with fipronil in eggs in the Netherlands; high resolution/supercritical and spectrometric techniques for pesticide analysis; formulating validation criteria for mixed contaminant analysis; generic extraction method for detection of mixed contaminants in raw bovine milk by UPLC-HRMS where a method developed to detect 30 veterinary drugs in milk is now being extended by adding 46 more compounds including mycotoxins, pesticides and other challenging drugs e.g. aminoglycosides.

Presentations on performance evaluation of screening and confirmatory LC-MS/MS methods for multi-mycotoxin analysis as well as measurement uncertainty were also delivered and discussed. The officer guided discussions on validation criteria for mixed contaminants based on existing related guidelines for mycotoxin, vet drugs and pesticides as well as mycotoxins.

In conclusion, good progress has been made under the CRP where more than 10 analytical methods for over 300 different mixed contaminants/residues in at least five matrices have been developed and/or validated with some applied.

Successful in-house production of certain receptors to facilitate radio-receptor assays of food contaminants and residues has been recorded.

Nevertheless, further work is ongoing to expand the scope of methods, analytes and matrices as well as application and integration of the methods to routine testing and national monitoring programmes.

Continued and close interactions among the project participants has grown although more effort is encouraged. Knowledge-sharing mechanisms such as webinars were discussed, and action taken. A couple of weeks after the RCM, a webinar on measurement uncertainty and how to make decisions on foods with violative levels of contaminants and residues, was organized by the EU reference laboratory for pesticide residues and the University of Almeria where over 30 participants from Africa, Asia and Latin America, including none CRP participants benefited.

The possibility of organizing targeted training courses, including specialized practical sessions alongside RCMs was discussed and this has been planned for the next RCM in China, April 2020. The RCM provided an opportunity for CRP participants to interface with counterpart(s) of an ongoing technical cooperation project on food safety, and give expert advice.

Forthcoming Events

Consultancy Meetings (CMs) for Developing New Coodinated Research Projects (CRPs)

Consultancy Meeting on Depletion of Veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices, Vienna, Austria, 15–19 July 2019.

Consultancy Meeting on the Use of Low Energy Beams (LEB) and Related Nuclear Applications for Food Safety and Quality to Enhance Food Security (SDG2), Vienna, Austria, 7–11 October 2019.

Training Course on the Use of Stable Isotope Techniques to Determine Food Origin and Verify Food Authenticity, Seibersdorf, Austria, 7–18 October 2019.

International Meetings/Conferences

Inter-Agency Committee on Radiation Safety (IACRS), Geneva, Switzerland, 1–3 July 2019.

42nd Session of the Codex Alimentarius Commission, Geneva, Switzerland, 7–12 July 2019.

Feed Addittives 2019, Amsterdam, the Netherlands, 25–27 September 2019.

Annual Meeting of FAO with International Feed Industry Federation (IFIF), Rome, Italy, 3–4 October 2019.

9th International Symposium on Recent Advances in Food Analysis, Prague, Czech Republic, 5–8 November 2019.

Past Events

The 14th International IUPAC Congress on Crop Protection, Ghent, Belgium, 19–24 May 2019

Britt Maestroni

The FEPL participated in the planning of theme 6 on "Food Quality and Safety" of the 14th International IUPAC Congress on Crop Protection which was held in Ghent from 19 to 24 May 2019. Ms Britt Maestroni participated in the congress overseeing the implementation of theme 6 programme. She also chaired sessions, organized the poster award and promoted networking among participants.

A lively discussion on sample preparation for pesticide residue analysis during the analytical forum.

The IUPAC congress attracted around 1500 people, mainly from industry. Interesting debates held in plenary were on science-based facts and fact-based policies for crop protection; emerging food safety risks, precision agriculture and communication on agro-science to the general public. The theme 6 agenda was carefully planned to take into account availability of speakers, current scientific topics of interest, independence from parallel sessions and submitted abstracts. Theme 6 was attended at its highest point by about 80 people.

The program of theme 6 included the following main topics:

- International trends in food production, food trade, food fraud, food authenticity and novel foods.
- New approaches to sampling and monitoring.
- Modern analytical techniques to detect and control residues in food and feed.
- MRL and International guidelines / standards / regulations for consumer protection.
- Advances in dietary risk assessment and decision making.

Thirty-five invited speakers gave oral presentations on the topics above. The program also included a theme six analytical forum to give a chance to the audience to ask experts in the field about analytical issues and challenges. The session was very successful and attracted a lot of interest from the participants.

The IUPAC congress represented an excellent opportunity to exchange information about current crop protection technology, challenges and opportunities worldwide.

There was considerable interest in the work of the Agency in capacity building, including opportunities for potential collaboration with several partners. Participation in the IUPAC congress, including the preparatory work, was of direct benefit to the work of the Joint FAO/IAEA Food and

Environmental Protection Laboratory and, ultimately, to the Member States. More information about the congress can be found on the IUPAC web site[1].

RALACA third General Meeting, Foz Do Iguazu, Brazil, 6 May 2019

Britt Maestroni

RALACA is the Analytical Laboratory Network of Latin America and the Caribbean[2]. It is a non-profit network of laboratories and associated institutions that aims to improve technical capabilities and encourages cooperation between laboratories belonging to the network. Information sharing is key to enhancing regional opportunities. Meetings are held regularly either online, through webinars, or as side events of technical meetings and/or training events. The network held its third general meeting in Brazil on 6 May 2019 on the occasion of the 7th Latin American Pesticide Residue Workshops (5–9 May 2019). The meeting was attended by 79 participants from 18 countries.

The RALACA booth at the 7th Latin American Pesticide Residue Workshops, 5–9 May 2019.

Prof Miriam Loewy, on behalf of the RALACA Board, gave introductory remarks and summarised RALACA and its progress to date, describing the network's structure and its mandate. A number of committees are the heart of the network, addressing different aspects in relation to food safety and environmental sustainability such as proficiency testing, research and academia, emerging contaminants, risk assessment and modelling. Several positive impacts have been observed over the years, such as an increase in the number of accredited laboratories, improvement of analytical capacities in the region in terms of analytical instruments and human resources, the use of integrated monitoring procedures, a new proactive role established for laboratories and the elaboration of risk assessment maps. The network also takes advantage of a new set of analytical standard materials for persistent organic pollutants (POPS) that were distributed among the participants of the IAEA technical cooperation project RLA5069. These analytical standards were added to the existing standard banks in Uruguay and Costa Rica. Associated RALACA laboratories also participated in a proficiency test on emerging contaminants, for which training sessions and webinars were provided through the network. A new committee was also created on risk assessment. Finally the Board announced that the network is seeking legal status in Panama. RALACA is grateful for the voluntary contributions that were raised at the meeting to start the legal process of recognition of RALACA. RALACA recently published the second volume of its newsletter[3], which can be accessed online.

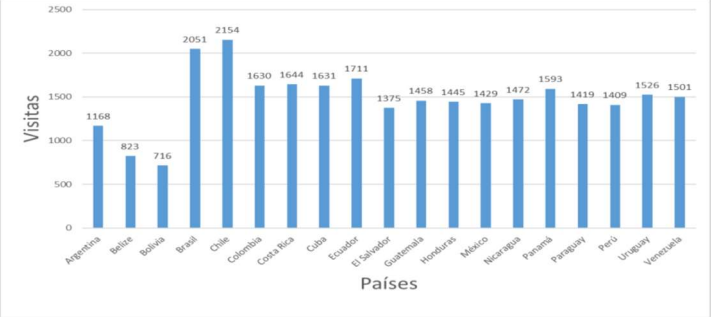
The next speaker, Dr Edoardo Aylwin, gave a presentation on behalf of Dr Nuri Gras, Head of Achipia, who had been invited to the meeting. Dr Gras had prepared a presentation to share some thoughts about ACHIPIA and its tools to support the risk management. The focus was on the network of scientists and laboratories associated with Achipia and the sharing of its tools with the latin America - Cribbean region. Prof Agustin Costa Garcia, from University of Oviedo, Spain, offered full collaboration to RALACA on the development and implementation of quick and cheap sensor technology for monitoring. Ms Brenda Checa, from MIDA, Panama (a member of the RALACA Board), followed up with a monitoring example in Panama, particularly using rapid testing. Dr Pablo Macchi targeted the biomonitoring activities of the corresponding RALACA committee and the major achievements to date, including an invitation to the 5th Latin American Congress of macroinvertebrates and aquatic systems in Panama in May 2020, which is entirely organized by the RALACA Biomonitoring Committee. Dr Dario Maggioni from Universidad del Litoral, Argentina, introduced the recently establish Committee on risk assessment, that will be helping the region on use of monitoring results for risk assessments. Prof Veronica Cesio, from Udelar, Uruguay, targeted another aspect of the RALACA activities, remediation and bio-remediation strategies for the region. MSc. Patricio Henriquez, from CChen, Chile, (a member of the RALACA Board), navigated the RALACA web page to show where to find information about the activities of the committees, the scientific and academic news, the training opportunities, the webinars, and the proficiency testing schemes provided by RALACA and its associated Institutions. The statistics of the web page are very pleasing, (see figure). Finally, after a short presentation by Dr Damila Morais, from Shimadzu, on food safety challenges in Brazil, the meeting opened up for

[1] https://iupac.org/

[2] www.red-ralaca.net

[3] http://red-ralaca.net/images/pdfs/Newsletter_Ralaca_2.pdf

questions from the audience. It became evident that members are unsure how to best contribute to the committees. The Board in its next meeting will prepare working guidelines for its members to clarify the workflows and operations within RALACA. Essentially, scientific developments are shared through joint work presented at different workshops and congresses, face-to-face meetings, periodic webinars and RALACA newsletters, all of which present opportunities to disseminate the activities of the network and the laboratories that comprise it. A cocktail, kindly donated by Shimadzu, concluded the meeting.



Number of visits to the web page of RALACA during 2017–2019 by the different countries in LAC.

The RALACA third general meeting was an important milestone in the process of gaining international recognition. Several new applications to join RALACA have been received from institutes in Latin America, indicating that the network is dynamic and continuously expanding.

The 7th Latin American Pesticide Residue Workshop, Foz do Iguazu, Brazil, 5–8 May 2019

Britt Maestroni

The 7th Latin American Pesticide Residue Workshop (LAPRW 2019) was held from 5 to 8 May 2019 in Foz do Iguazu, Brazil. The meeting was attended by 310 delegates from 30 countries worldwide.

The main topics discussed at the workshop were:

1. Pesticide residues in bees and bee products.

The issue of pressures on pollinators was discussed at length. It was shown that beehives carry information on contamination levels of bees and the environments where they live. Actions to halt the decline of bee populations in Europe were presented, including the continuation of monitoring programmes to improve knowledge of the status, causes and consequences of pollinator decline; identification of management approaches for habitat conservation and to reverse the decline across agricultural, research, and environmental policies; new regulations on plant protection products (Regulations 783/2018; 784/2018 and 785/2018) to completely ban outdoor uses of imidacloprid, clothianidin and thiamethoxam and guidance on the risk assessment of plant protection products on bees. The goal is to raise awareness of the society and some sectors, to contribute to the protection of bees and promote collaboration.

2. Pesticide residues in organic food and the environment.

A presentation by the Kantonales Laboratory in Zurich highlighted the Swiss pre-requisites for organic food, which include no prohibited practices, full traceability and compliance with the maximum residue limit (MRL) at 0.01 mg/kg. An incidence of the detection of bromide residues in Brazil nuts from Bolivia was presented, where methyl bromide had not been applied. This highlighted as situation in which the actual MRL for bromide does not consider the natural background of bromide accumulators. In addition, sources of contamination may occur if a change in technology occurs, for example the occurrence of chlorate residues in cocoa powder due to the new alkalinisation process using membrane technology to develop the flavour and colour. In this case a higher temporary intervention level must be set for chlorate. The conclusion is that implementing controls for organic production is rather complicated as the quality of documentation is insufficient and elucidation of the relevant residue concentrations can be difficult. In Latin America there is also a need for further efforts to understand and to reduce possible exposure risks for ecosystems and human health; the vulnerability of tropical ecosystems is not well studied. It was stated that it is important to maintain biodiversity despite efforts to increase yields of agricultural production.

3. Quality assurance/ quality control/ accreditation challenges.

Issues around measurement uncertainty (MU) for multi-residue analysis of pesticides were presented. It was emphasized that the goal is not to obtain very accurate MU estimates for one specific pesticide in a particular matrix. Instead, it is more important to obtain an overall and realistic estimate for a wide variety of materials and analyte levels covered by the validated scope of a method. It was shown that the most valuable and realistic estimate of MU may be obtained from the reproducibility between laboratories in proficiency tests, provided that the laboratories have performed satisfactorily. The need for certified reference materials (CRM) was also discussed. The number of certified pesticides is limited when compared to multi-analyte methods. In the EU, reference material producers are making an effort to support the pesticides community for relevant policy implementation. The USA National Institute of Standards and Technology (NIST) discussed new models for the development of CRMs. This includes working with stakeholders to determine priorities, desired matrices and levels and use of interlaboratory data to promote faster release of CRMs. Covering all pesticide-matrix combinations is not feasible within the current CRM production system. An open question was left: could new concepts be explored?

4. Monitoring studies and risk assessment.

The issue of whether or not pesticide residue levels are safe for infants and young children was discussed. Food safety for European infants and young children is ensured by legislation on pesticide MRLs for raw food and processed baby food, improvements in the sensitivity of analytical methods in monitoring laboratories for very toxic substances, extensive monitoring programs including sampling of food for infants and young children, funded research in toxicology and dietary exposure, dietary risk assessments using specific consumption data for bottle-fed infants and for infants and children of different age classes from four months onwards with EU regional and seasonal spread of consumption, monitoring and, if required, regulatory actions. The EU-coordinated programme is a harmonised programme that allows comparison among samples of the same food item as well as pesticide results among EU Member States. Data from monitoring provides valuable information that helps in deriving conclusions and setting recommendations to different stakeholders, but the quality of the data is crucial. The European Food Safety Authority (EFSA) works on building well-structured databases, which is essential.

5. Advances in sample preparation and analytical procedures.

The analysis of highly polar pesticides was discussed. The development and validation of a robust, selective multi-residue method for glyphosate and 13 other polar pesticides and metabolites was presented. Pesticide residue analysis in fat tissues was also presented.

6. State of the art and low- and high-resolution mass spectrometry methods.

Advantages and disadvantages of unit-mass and high resolution mass spectrometry platforms for pesticide residue analysis were presented.

The technical officer presented a poster on preliminary studies on the use of GC-IMS profiles to optimise sample preparation for pesticide residue analysis and screen for adulteration of turmeric authored by B. Maestroni, N. Besil, M. Islam, A. Mihailova, A. Abrahim, S. Kelly, A. Cannavan, H. Heinzen and M.V. Cesio. The poster was well received.

In conclusion, the LAPRW represented an excellent opportunity to learn about current pesticide technology, monitoring programs, and current challenges in the Latin American and Caribbean region. There was considerable interest in the work of the Agency in capacity building, including opportunities for potential collaboration with several partners. Participation in the LAPRW was of direct benefit to the work of FEPL and, ultimately, to the Member States.

Joint FAO/IAEA/RALACA Workshop on Quality Control Measures in Food Testing Laboratories, Foz do Iguazu, Brazil, 5 May 2019

Britt Maestroni

The Joint FAO/IAEA/RALACA Workshop on Quality Control Measures in Food Testing Laboratories was held on 5 May in Foz do Iguazu, Brazil. The workshop was attended by 45 participants from 16 countries worldwide. The objective of the workshop was to focus on analytical methods and technologies to ensure food safety. Experts in the meeting helped raise awareness of key quality concepts for the analytical testing of contaminants in food and helped strengthen the analytical capabilities of Member States in the Latin American and Caribbean region. The workshop program included lectures on food contaminant analysis and sample preparation alternatives, quality assurance/quality control measures for the development of analytical methods, instrumental techniques including gas chromatography–tandem mass spectrometry, liquid chromatography–tandem mass spectrometry (LC-MS/MS) and high resolution and accurate mass instrumentation (HRMS), and an insight into current international guidelines/regulations for consumer protection and international trade.

Training workshop participants and lecturers.

After introductory remarks and participants' presentations, Prof Ionara Pizzutti, from CEPARC, Brazil, discussed current challenges for food safety, quality and security in the Latin American region, giving examples on pollination issues and bee mortality. In her concluding remarks she emphasized the need for better communication about food safety among all stakeholders in the farm to food chain. Prof Horacio Heinzen, from UDELAR, Uruguay, addressed the current regulations for food safety and trade. He pointed out that in Latin America it is mainly export commodities that are subject to stringent analytical control, and improvements are necessary for monitoring of the national markets. Dr Susanne Ekroth, from the National Food Agency, Sweden, provided two lectures on the Swedish ethyl acetate (SweEt) multiresidue method as an alternative to the QuEChERS (quick, easy, cheap, effective, rugged and safe) method and the impacts of different parameters on LC-MS/MS and HRMS determination for toxins and pesticides. She discussed the SweEt multiresidue method, the workflows for targeted and non-targeted analyses,

common solvent effects on LC-MS/MS and the need for improved gradients, and the optimization of important parameters for both LC or GC-MS/MS and LC-HRMS. Prof Agustin Costa Garcia, from Univ. of Oviedo, Spain, discussed monitoring and verification of food quality and safety using screening technology for fruits and vegetables. In particular, he addressed analytical methods based on rapid testing, direct measurements using nanotechnology, enzymatic sensors, magnetic particles and provided an example of a monitoring program in Panama for imidacloprid based on immunosensors. Prof Maria Rosa Repetti, from Univ. del Litoral, Argentina, presented on food contaminants analysis in cereals and the problem of mycotoxins that are very stable during food processing. She highlighted that in Argentina there is scarce information about pesticide and mycotoxin contamination in cereal and cereal-based foods. She showed, with the studies she presented, that pesticide residues and mycotoxins were found in 100% of the commercial samples analyzed, with multiple toxins in 95% of samples, hence the need for multi-component and wide scope analytical techniques to assess the quality of cereal-based food. Prof Lucia Pareja, from GACT, Uruguay, presented the development and validation of a multiclass method for the determination of aflatoxin M1, pesticides and veterinary drugs in milk. She discussed the analytical challenge of sample preparation for different classes of compounds, and a final method validated according to DG-SANTE Guidelines Document No. SANTE/11813/2017. Dr Carmen Ferrer, from the European Reference Laboratory for fruits and vegetables in Almeria, Spain, discussed the QA/QC measures for the implementation of residue testing using LC-MS/MS and GC-MS/MS, including the details of the analytical method validation and the performance criteria. Prof Miriam Loewy, from Neuquen, Argentina, discussed all other aspects presented in the DG-SANTE Guidelines Document No. SANTE/11813/2017. Dr Eduardo Aylwin, from Achipia, Chile, described the information network and rapid alert system of Chile, including details of notifications and the management and risk assessment tools for managing risks. Ing Patricio Henriquez participated in individual consultation sessions and provided a presentation of the RALACA framework and tools for communication. Dr Anisleydi Rivero, from UDELAR, Uruguay, provided an insight into analytical control as a tool for the study of biobed performance and clarified QA/QC aspects. Finally, Dr Damila de Morais, from Shimdazu, Brazil, provided a lecture on fully automated derivatization and quantitation of glyphosate and AMPA in beer using a standard UHPLC-MS/MS system. Ms Maestroni ensured the smooth implementation of the workshop and participated in individual consultation sessions on the RALACA network of analytical laboratories to address food safety and environmental protection in the Latin America and the Caribbean. The participants were very satisfied with the training.

The FAO/IAEA/RALACA workshop created an excellent opportunity to interchange experiences, methodologies and practical applications with respect to method validation, quality control, generation of accurate and reliable data for contaminants and analytical testing. The group discussions helped to identify current issues and challenges to improving the technical competence of analytical laboratories.

The 13th Codex Committee on Contaminants in Foods (CCCF), Yogyakarta, Indonesia, 27 April–4 May 2019

Carl Blackburn

The technical officer participated at the 13th session of the CCCF, one of the major food safety and quality standard setting committees of the Codex Alimentarius Commission. The aim was to report on our programmatic work because it is of interest to food control authorities and standard setting bodies. A proposal for the formation of a CCCF electronic working group (EWG) on radioactivity in food in non-emergency situations was also put to the meeting. Time was also invested in the margins of the meeting by engaging in discussions and gaining feedback on our activities and workplans focusing on nuclear science in the area of food safety and control.

The Chair and Secretariat in session at the 13th Codex Committee on Contaminants in Foods.

Formal remarks were given on Joint FAO/IAEA programmatic activities of interest to the CCCF with reference to an information paper[4] Two presentations were given in session; the first by the technical officer to provide a general background on radioactivity in food and the second by Mr Tony Colgan, Technical Secretary, IAEA Radiation Safety Standards Committee. This second presentation focused on IAEA activities in cooperation with FAO and

[4] www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FMeetings%252FCX-735-13%252FWDs%252Fcf13_04e.pdf

WHO plus experts from IAEA Member States relating to the development of guidance material to help national competent authorities establish activity concentration levels for radioactivity in food in non-emergency situations (Requirement 51 of GSR part 3) and to address IAEA General Conference resolution GC(62)/RES/6 – 2018. This resolution requests better harmonization for international guidance material for establishing national reference levels for radionuclides in food and drinking water in existing exposure situations.

The CCCF agreed that it should consider establishing an EWG with European Union (EU) as chair and Japan as co-chair, the Agency volunteered to provide technical input and support for the production of the discussion document. The EU put forward terms of reference and this work item was agreed by Codex participants with slight amendments from the Republic of Korea. There was a good deal of general interest in the subject of radionuclides in food and although the CCCF has a very full work-programme it was agreed that the EWG information paper should be considered at the next meeting of the CCCF in 2020. Feedback on joint FAO/IAEA activities was very favourable, a number of countries from Latin America and Africa expressed their thanks for IAEA support in the area of food safety and control.

Joint Division Supports the 51st Session of the Codex Committee on Pesticide Residues, Macao, SAR, China, 8–13 April 2019

James Sasanya

The officer represented the Joint FAO/IAEA Division at the meeting, one of the several committee meetings of the Joint FAO/WHO Food Standards Programme tasked with: setting and implementing standards and guidelines for control of pesticide residues of public health and trade concern; and facilitating Member Countries especially the developing ones, to better contribute to the process and implement the standards/guidelines. The committee is composed of several IAEA Member States and is a good avenue for sharing work of the Joint Division and interacting, noting priority areas in case a demand arises, or to inform future research and capacity building opportunities.

CCPR51 in session.

The officer took part in a side event on "The Participation of the Joint FAO/WHO Meeting on Pesticide Residues in an International Joint Review of a New Compound".

During the plenary, the officer informed the committee about Agency support to Member States, on building and strengthening laboratory analytical capacity for pesticide residue analysis, monitoring and control, as well as relevant research activities.

Several delegates thanked the IAEA for this support including establishment of food safety networking.

The officer interacted with individual or group delegates to discuss the Agency support and food safety work in general. Some such as Argentina, Chile, Costa Rica, Indonesia, India, Kenya and Uganda among others, explored possibilities for further cooperation.

The IAEA representative and observers at CCPR 51.

The officer was invited to and attended meetings organized by groups of the delegates such as the Codex Committees for Latin America and the Caribbean and Africa to listen to areas of interest arising from or due for discussion in plenary. Such areas included among others: residues limits (or their amendment) impacting trade or public health; and compounds of relevance to developing countries but lack industry/sponsorship support for generation of data needed to establish standards. Examples included pesticide limits for minor crops such as Okra.

The officer guided delegates from Cameroon, Ghana, Kenya, Sudan and Uganda among others, on requests for support to enable them generate residues data and conduct supervised field trials. Relevant national authorities and IAEA TC contacts have since been notified.

Delegates from India and Argentina introduced the need to establish guidelines on use of not-so-new certified reference material (CRM) but still stable enough to support analysis of pesticides and use in supervised field trials. These delegates argued that discarding such material early is costly to developing countries and Codex guidance is required. The committee tasked Argentina and India to prepare a discussion paper for consideration at CCPR52. Delegates from the two countries inquired if IAEA could participate in the preparation of the paper.

The officer discussed with the USDA, possibilities to collaborate and support capacity building requests from various delegates. The officer noted discussions on dual use substances (pesticides and veterinary drugs).

In conclusions: The presence, intervention and work of the Joint Division was appreciated by the committee and continued cooperation is requested.

Participation of the officer helped some countries address certain food safety capacity building challenges. For instance, a delegate from Cameroon's National Laboratory for Analysis of Agricultural Products and Inputs, Department of Regulation and Quality Control of Agricultural Inputs and Products, Ministry of Agriculture and Rural Development is now a co-counterpart of an IAEA TCP "Improving laboratory testing capabilities to enhance the safety and competitiveness of Agricultural products in Cameroon - Phase 1" for the 2020–2021 cycle after interaction with the officer.

Four institutions in Ghana: Environmental Protection Agency; Ghana Standards Authority; Food and Drugs Authority; Plant Protection and Regulatory Services Directorate of Ministry of Food and Agriculture (MoFA/PPRSD) and CropLife, Ghana have also sought support to monitor pesticide and related residues in foodstuff in the country. These have been guided to the right authorities and support is under consideration.

Agency technical contribution has been requested to support Argentina and India prepare a CCPR discussion for possible development of guidelines on use of CRMs under special conditions (expired on paper but still reliable). This matter arises as a recommendation from an interregional training course on establishment of maximum residue limits and risk assessment organized in Argentina by the IAEA, shortly before CCPR51.

Discussions were held with the USDA (and could be pursued further) to jointly support some of the Member States' capacity-development requests to enable them generate pesticide residue data and supervised field trails for minor use/species as in the case of pesticides in Okra. This is particularly interesting to many African countries.

There is increasing interest in addressing standards and guideline for dual-use substances i.e. those used as pesticides in crop production and as veterinary drugs in animal production.

European Geochemical Union General Assembly 2019, Austria International Centre, Vienna, Austria, 7–12 April 2019

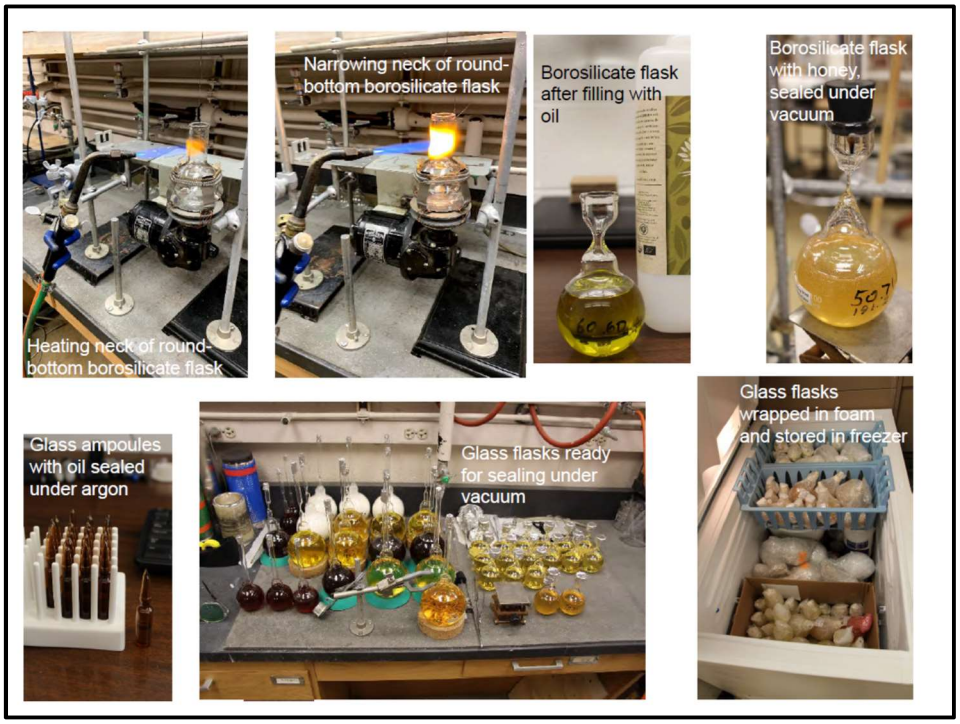
Simon Kelly

The European Geochemical Union General Assembly is one of the world's most well-attended and prestigious events for the geo-sciences and takes place annually at the Austria Centre Vienna. The General Assembly meeting covers a wide range of disciplines including climate science, the Earth's internal structure, volcanology, planetary exploration, and energy and resources. Nuclear techniques, especially stable isotope research, feature in many sessions where it is used to understand the earth's processes and biogeochemistry. Each annual meeting usually has around 15,000 participants from over 100 countries and features around 4500 oral presentations, over 10,000 posters, and approximately 1000 short PICO (Presenting Interactive Content®) presentations. In addition, there are many short courses, education and outreach events.

This year's meeting included a session on 9 April, organised by Mr Sergey Assonov (reference materials specialist in the NAEL - Terrestrial Environment Laboratory), on "Quality control tools in stable isotope measurements: Making your data reliable" (BG1.5/AS5.27). During this session Mr Simon Kelly gave a lecture on food-matrix stable isotope reference materials explaining how stable isotope analysis has been used to detect economically motivated adulteration and substitution of food products since the early 1970s. However, no chemically complex agricultural plant or animal-derived food materials have been offered as isotopic reference standards by organisations such as the International Atomic Energy Agency (IAEA) or the United States Geological Survey (USGS) specifically to underpin detection of food fraud. Accurate stable isotopic characterisation of organic samples relies heavily on the availability and proper use of reference materials (RMs). Ideally a RM should be chemically as similar as possible to the unknown food samples to avoid 'comparisons between apples and oranges'. The fundamental analytical principle of identical treatment of sample and standard advocates chemical similarity of sample and standard, and thus calls for the development of food matrix isotopic reference materials. For example, a dispute about the geographic origin of olive oil should be addressed by isotopic characterization of the olive oils in question relative to well-characterized isotopic olive oil RMs. Unfortunately, there are no such RMs available. Numerous laboratories have prepared their own food-derived 'in-house-standards', but these proprietary RMs are typically stored in air and light where slow oxidation is gradually changing the chemical and isotopic characteristics. Mr Kelly went on to present work that is underway to develop an initial set of calibrated and correctly stored food matrix stable isotope reference

materials including vegetable oils, honeys, cereal flours and animal and fish derived proteins that will be made available to the growing community of scientists involved in the application of stable isotope analysis to confirm food authenticity and provenance. The production of the food matrix RMs was funded through a United States Fulbright Fellowship for Dr Arndt Schimmelmann (Indiana University, Department of Earth and Atmospheric Sciences) hosted by Professor Nives Ogrinc (Jožef Stefan Institute, Department of Environmental Sciences, Ljubljana, Slovenia).

The inter-laboratory ring-test to calibrate the reference materials includes the Joint FAO/IAEA Division's Food and Environmental Protection Laboratory, the Francisco Josephinum Institute of Education and Research (Austria), the Fondazione Edmund Mach (Italy), the Jožef Stefan Institute (Slovenia), the Laboratory of the Government Chemist (UK) and the United States Geological Survey (USA).



Preparation of Food-Matrix Reference Material "mother-stocks" and sub-units by Dr Arndt Schimmelmann.

1st ISO-FOOD International Symposium on Isotopic and Other Techniques in Food Safety and Quality, Portorož, Slovenia, 1–3 April 2019

Simon Kelly

The first ISO-FOOD International Symposium on the use of Isotopes and Other Techniques in Food Safety and Quality took place in Portorož, Slovenia from 01 to 03 April 2019. The event was organised by Professors Nives Ogrinc and Milena Horvat, and Dr David Heath, the European Research Area (ERA) Chair (ISO-FOOD) for isotope techniques in food quality, safety and traceability, in affiliation with the Jožef Stefan Institute in Ljubljana, Slovenia. The symposium was designed to address the requirement for the development of new methods and techniques to verify the quality, authenticity, and safety of food. Much of this requirement is driven by the frequency of major food scandals, globalisation of food sales and the increasing length and complexity of international supply chains. It also reflects changing consumer preferences and the growing number of added-value claims that are attached to food production such as the demand for organic, locally produced, natural, authentic, foods and the adoption of new technologies such as nanotechnology, which offer fascinating possibilities for enhancing food production, but also new analytical challenges and new risk factors. Fortunately, this has coincided with significant advances in instrumentation, where nuclear and complementary techniques play a key role. A need also exists to address the issue of collating, managing, and exploiting the large amounts of isotopic, elemental, metabolomic, proteomic and genetic data that is produced by the latest analytical equipment. Although this data is digitized, its rate of production and complexity often exceeds the limitations of traditional data management tools. To address these different topics the symposium programme was divided into the six sessions: food authenticity and traceability, food safety and quality, foodomics, nanomaterials and nanotechnology, metrology in food, and food databases and semantics.

Mr Simon Kelly was invited to give the first scientific lecture at the symposium in the food authenticity and traceability session on a new rapid method using hydrogen

stable isotope analysis to detect undeclared addition of sugar and sugar syrups to food. The improved procedure for the isotope analysis was developed in the FAO/IAEA Food and Environmental Protection Laboratory and utilizes a simple one-step chemical reaction that makes sugars sufficiently volatile to be separated and measured by gas chromatography coupled to isotope ratio mass spectrometer. The conversion of the derivatised sugars into the measuring gas is achieved using a high temperature chromium-silver reactor that retains carbon, oxygen and fluorine whilst releasing hydrogen gas for stable isotope measurement. 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 fruit juices and honey and those of beet and cane sugars/syrups, which permits the presence of these potential adulterants to be rapidly detected. Mr Kelly also moderated the second food authenticity and traceability oral presentation session and co-judged and awarded the prizes for the poster presentations. The symposium delivered a broad and interesting programme with 15 invited speakers and 31 oral and 59 poster presentations and was well attended by 126 participants from 16 countries.

Mr Kelly giving an invited lecture at the 1st ISO-FOOD International Symposium on Isotopic and Other Techniques in Food Safety and Quality.

The 19th International Meeting on Radiation Processing (IMRP) Strasbourg, France, 31 March–5 April 2019

Carl Blackburn

The IMRP is the premier meeting of researchers and industry involved with radiation processing and it is held every three or four years, the venue has rotated between the Americas, Asia and Europe. This 19th meeting was attended by over 500 participants at a dedicated conference facility: the Palais de la Musique et des Congrès, in Strasbourg.

One of the regional sponsors of the meeting was the IAEA Collaborating Centre Aérial-CRT. The Aérial research facility is in a science park on the outskirts of Strasbourg and therefore the technical officer and many participants from the conference took up the kind invitation to visit the Collaborating Centre. I was very happy to see that the FEERIX project to install a state-of-the-art rhodotron (electron beam and X ray beam generator) is very well advanced. The new facility is housed in a purpose built building and ready to commence its pre-operational tests to qualify the facility and characterize the three different beam lines. The Rhodotron is supplied by IBA Industrial, and this company was the second regional sponsor of the IMRP meeting.

IMRP continues to be an excellent conference where industry and science meet and where particpants can gain a quick and in depth understanding of a wide range of commercial and research applications associated with radiation processing. My interest was of course focused on food irradiation, but it was interesting to learn of developments in other areas and to discuss the implications for food applications.

Multi-purpose, large scale facilities that utilize gamma rays from the radionuclide cobalt-60 (^{60}Co) is still the main technology used by service providers for commercial radiation processing applications. However, there is an increased interest in electron beam facilities, and in the longer-term X ray machines may also become more prevalent, because both are electrically powered and offer an alternative to ^{60}Co. The price and availability of ^{60}Co was also a topic of debate in the margins of the meeting. Nordion, a Sotera Health company highlighted its plans to meet the growing demand for this critical isotope, for example it has pursued a new technology for expanded supply by acquiring intellectual property that enables the radionuclide to be made in Pressurized Water Reactors and Boiling Water Reactors, which represent most of the nuclear power reactors in operation today.

The IMRP conference also provides a fabulous opportunity to network and as I did so I found that there is very strong support for future research and commercial applications using low energy electron beams and low energy X rays that can be fitted in food factories or on packing lines (taking the irradiator to the food as opposed to the current situation where food is taken to the irradiator). The logistics in getting food to irradiators is one of the main barriers to the commercial adoption of the process and all researchers and many from the food industry said that they would welcome research into food irradiation using low energy beams as part of a future IAEA Coordinated Research Project.

It was my pleasure to chair the food irradiation session where four speakers gave presentations from different areas of food irradiation:

- Mr Noriaki Kataoka presented the results of a series of experiments in Japan designed to develop a dry

treatment to ensure that the external surface of shell eggs are free from salmonella entritidis.

- Mr Peter Follett provided a presentation on phytosanitary irradiation (PI), currently the most rapidly increasing food irradiation application in terms of volumes of irradiated food traded internationally. The focus of this presentation was on the efficacy of phytosanitary irradiation applied to fresh produce in modified atmosphere packaging (MAP).
- Ms Monique Lacroix presented the results of her research into a combination treatment where irradiation plus essential oil (EO) extracts are used as anti-fungal and insecticidal treatment for packaged foods. The concept is that biofilms that release EOs can be incorporated into food packaging and in combination with low dose irradiation used to prevent food losses by infestation with moulds and pests.
- Mr Steffen Foss Hansen gave a presentation on food irradiation in terms of the precautionary principle (PP). The PP is used in a variety of forms by policy makers where an activity raises questions about risks or safety and precautionary measures are deemed necessary even though no scientific cause and effect relationship has been proven. His presentation focused on how food irradiation is one of four examples where the application of the PP, has in hindsight, proved to be unnecessary and has led to over regulation. Safety evaluations over some 30 years have indicated that the process is safe when applied correctly.

The meeting closed with the award ceremony of two IMRP Laureates, recognizing significant contributions to the field. I was very happy to see that both were awarded to friends who are former employees of the IAEA: Ms Maria Helena Sampra and Mr Yves Henon. I hope you can join with me in wishing both very heart-felt congratulations on such a prestigious recognition of their individual achievements.

Interregional Training Course on Establishment of Maximum Residue Limits (Pesticide and Veterinary Drugs) and Risk Assessment, Buenos Aires, Argentina, 25 March–5 April 2019

James Sasanya

This interregional training course was attended by 56 participants from: Angola, Argentina, Benin, the Plurinational State of Bolivia, Botswana, Brazil, Cameroon, Chile, Colombia, Costa Rica, Ecuador, Egypt, Honduras, India, Indonesia, Kenya, Lebanon, Mongolia, Morocco, Mozambique and Nigeria. Others included Panama, Pakistan, Paraguay, Peru, Seychelles, South Africa, Sri Lanka, Tunisia, Turkey, Uganda, the United Republic of Tanzania, the United States of America and Uruguay. The event involved collaboration with the IR-4 Project of the United States Department of Agriculture and Rutgers University, and the National Food Safety and Quality Service of Argentina.

Training session on pesticide MRLs at SENASA, Argentina.

The first week included work on: requirements and the process of establishing Maximum Recommended Residue Limits (MRLs) of pesticide and veterinary drug residues in foods; Supervised pesticide field trials for the generation of pesticide residue data; associated good agricultural practices; trial data analysis, interpretation and reporting; calculation of MRLs for pesticide and veterinary drug residues; adoption of pesticide MRLs in the absence of CODEX pesticide MRLs. Additional areas of study included: minor crop pesticide MRL issues; introduction to radiolabelled and related non-radiolabelled studies required in setting MRLs for veterinary drug residues; good laboratory practices to support MRL setting; overview of analytical methods for the determination of residues of veterinary drugs and pesticides in food. Participants also learnt about data requirements by regulatory authorities for veterinary drug MRLs; regulations and international harmonization, for pharmacologically active veterinary substances and; risk assessment principles, toxicological data requirements for veterinary drug residues.

Experiences (including case studies, field trails, national monitoring, good laboratory practices etc) from developed and developing countries such as Canada, Brazil, the United States of America and Kenya were shared, and the mode of delivery was largely interactive in nature.

Interregional project participants on MRL and risk assessment (veterinary drug and pesticide residues) at SENASA, Argentina.

Participants suggested further work and interest in Certified Reference Materials (including stability) and proficiency testing 9PT) requirements; environmental risk assessment; stability test for drugs; and animal trials among others. They also concluded and recommended that such interregional trainings on MRL Establishment of veterinary drugs and pesticides as well as risk assessment be conducted regularly (e.g. every two years).

Interregional Training Course on Antimicrobial Resistance (AMR) Associated with Food Safety, Rabbat and Casablanca, Morocco, 25-29 March 2019

James Sasanya

An interregional training course on AMR was held at the Office National de Sécurité Sanitaire des Produits Alimentaires in Morocco, from 25 to 29 March 2019 and attended by twenty-one participants from Angola, Plurinational State of Bolivia, Chile, Indonesia, Morocco, South Africa, Sri Lanka, Uganda and Uruguay. The training focused on screening for resistance of selected microbes (in food) to certain antimicrobials; AMR monitoring and surveillance; and Good production practices.

Participants of an interregional training on AMR testing and surveillance in Morocco.

The participants benefited from technical content including: AMR in Salmonella (and related pathogens); overview of alternative methods for the detection of AMR and the characterization of Salmonella isolates from food producing animals and food of animal origin and these include mass spectrometry-based methods (MALD-TOF MS); PCR/ESI MS.

Other areas the training covered were: monitoring and surveillance; good production practices and reducing AMR; Antibiotic Sensitivity Testing using E. coli and Salmonella strains isolated and harvested at the ONSSA Laboratory in Rabat; Minimal Inhibitory Concentration including: results and interpretation, risk assessment of AMR as well as development of Novel Antimicrobials in Food and Food Processing. Practical work included presentation of the AMR situation in different countries.

6th Global Feed & Food Congress - The Future of Feed & Food – Are we ready?, Bangkok, Thailand, 11–13 March 2019

Daniela Battaglia

Over 300 delegates have gathered in Bangkok, Thailand, for the 6th Global Feed & Food Congress, organised by the International Feed Industry Federation (IFIF) with the technical support of the Food and Agriculture Organization of the United Nations (FAO) and in collaboration with VIV worldwide.

Under the theme 'The future of Feed & Food – are we ready?' representatives from intergovernmental organizations, private sector associations, CEOs from leading feed and food companies, national authorities and academia discussed innovative solutions to the global challenge to provide safe, nutritious and sustainable animal protein to feed nine billion people by 2050s. Participants addressed several key issues: how policies and investments could help farmers to make better use of technological innovations to secure environmental, social and economic sustainability; how the sector could apply digital revolution to respond to the growing demand for safe food and feed; how animal nutrition innovations could improve animal health and welfare and contribute to contain antimicrobial resistance.

In conclusion, the Congress called for enhanced collaboration among intergovernmental organisations, national authorities, feed and food industry, and academia to address the global challenge to feed the world growing population in a sustainable manner. Precision livestock farming, blockchain technology, big data, internet of things, new feed sources such as insects could all contribute to respond better to the challenge. Economy of scale can enable access of small and medium scale producers to these innovative technologies.

First FAO/WHO/AU International Conference on Food Safety held in Addis Ababa, Ethiopia, 12–13 February 2019

Zhihua Ye

The reporting officer participated in the First FAO/WHO/AU International Conference on Food Safety at the African Union Conference Center in Addis Ababa, Ethiopia, from 12 to 13 February 2019.

The conference was organized by the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), the World Trade Organization (WTO) and the African Union (AU). Around 600 participants from 131 countries have attended in the two-day conference, including ministers of agriculture, health, and

trade. Leading scientific experts, partner agencies and representatives of consumers, food producers, civil society organizations and the private sector have also taken part. The conference aims on transforming food safety knowledge into action for people, economies and the environments with key objectives on identifying strategies/actions to address current and future challenges to global food safety and strengthening commitment at the highest political level to scale up food safety in the 2030 Agenda for Sustainable Development.

First FAO/WHO/AU International Conference on Food Safety.

As a Member of FAO Taskforce for the conference and focal point of AGE to the conference Secretariat, the reporting officer has involved in preparatory activities of the conference since May 2018 and contributed to the selection of topics and speakers for the thematic session on science and innovation for food safety. During two days of the conference, the reporting officer participated all plenary sessions and panel discussions, including:

- Opening session: Director-Generals (DGs) of the three UN organizations and the Chairperson of the AU Commission presented and made opening remarks, respectively.
- Four thematic sessions: (1) Investing in Food Safety, (2) Food Systems in an Era of Climate Change, (3) Science and Innovation at the Service of Food safety; and (4) Empowering Consumers to Make Healthy Food Choices and Support Sustainable Food Systems.
- Four panels: (1) Overcoming food safety challenges by Ministers from 8 countries; (2) Civil society and private sector; (3) Policy makers and heads of national agencies; and (4) Partner organizations
- One side event: African Union special event on trade of safe food in free trade areas;
- Closing session: Chairman's summary was passed and followed by closing remarks from DDGs of FAO and WHO.

Development and application of nuclear analytical techniques were discussed at the Session on Science and Innovation, and at the panel discussion of Civil and Private Sector.

In addition, the reporting officer shared the link of livestream from the conference to all colleagues at the Food and Environment Protection Section and the associated laboratory, which was highly appreciated.

A follow-up event, the International Forum on Food Safety and Trade, which will focus on interlinkages between food safety and trade, is scheduled to be held in Geneva from 23 to 24 April 2019. This Forum will also be co-organized by the three UN organizations (FAO, WHO and WTO) and hosted by WTO. The Forum in Geneva paralleling with the conference in Addis Ababa are expected to stimulate support and lead to actions in the key areas that are strategic for the future of food safety.

It is suggested that representative of the Joint FAO/IEAEA Division be present at the International Forum on Food Safety and Trade to be held in Geneva from 23 to 24 April 2019.

Participation in the International Forum on Food Safety and Trade, Geneva, Switzerland, 23–24 April 2019

James Sasanya

The officer attended the FAO/WHO/WTO-organized event on behalf of the Joint FAO/IAEA Division to contribute to and/or follow deliberations on: the use of new technologies in the realm of food safety and trade; how trade in safe food can be facilitated at the borders; multi-stakeholder coordination and the role of partnerships; and harmonizing food safety regulation in a period of change and innovation.

The International Food Forum in session.

This was a follow-up of a related conference "FAO/WHO/AU International Food Safety Conference" held from 12 to 13 February 2019 in Addis Ababa, Ethiopia. Reports indicate that there are 600 million cases of foodborne illnesses annually, making unsafe food a major threat to human health and economies worldwide. The cost of such diseases in low- and middle-income countries is estimated at US$100 billion or more a year.

Member States acknowledge that food safety plays a key role in achieving a number of Sustainable Development

Goals (SDGs). However, more work is needed to strengthen food safety systems that are also fragmented.

At least 1000 participants from various sectors associated with food safety, registered for the event.

The officer attended and contributed to session-discussions under the following themes: Estimation of National Burden of Foodborne Diseases – An Investment for Better Food Safety Systems; Food Safety, Healthy Diets and Trade; Food Safety and Trade; Digitalization and its Impact on Food Safety and Trade; Ensuring Synergies between Food Safety and Trade Facilitation; Promoting Harmonized Food Safety Regulation in a Period of Change and Innovation. The officer interacted with several delegates on food safety programmes and capabilities in their countries, including gaps to fill.

Some of those met included the Minister of Trade and Industry, Sierra Leone and the Executive Director, Sierra Leone Standards Bureau. Capacity building needs and opportunities (including recent IAEA TC support) were discussed.

The officer also met Uganda's Agriculture attache/alternate permanent representative to FAO, IFAD and WFP who along with the Ag. Director General Health Services discussed projects that can spur development in Uganda especially in agriculture, trade and public health. A recent national food safety-related outbreak and Agency support were discussed. Others met to discuss food safety matters included delegations from Bangladesh, Cameroon, Georgia, Lesotho, Mozambique, Nigeria and Solomon Islands; African Union's Director Rural Economy and Agriculture; UNIDO's Director, Department of Agri-Business Development; Deputy Ambassador for Sierra Leone; Second Counsellor, Permanent Mission of Cameron, among others.

Overall participants raised several needs they consider critical such as laboratory capacity and readiness to meet international-market requirements as well as laboratory accreditation. Lack of meaningful and sustainable investment in food safety control systems was also discussed. In this regard, countries were advised to proactively obtain figures on burden of food-borne disease to make a strong case for investment support.

Equally required are viable indicators to measure progress made. However, it was also noted that countries should invest in routine surveillance to establish realistic estimates of disease burdens. Other areas discussed included: Government data-sharing models; inclusion of nonfood matrices (e.g. water) in national surveillance; culture and food safety interface; incentives for the private sector to be more active in food safety; informal food sector; food safety in emergency or conflict situations and focusing more on public health than trade.

In conclusion, participation in this forum provided the Joint FAO/IAEA Division an opportunity to interact with a range of stakeholders including Member States and sister international organizations that are keen on strengthening food safety control. The event also helped food safety staff at the Joint Division understand better or reconfirm some of the common challenges Member States encounter in strengthening food safety control. The meeting noted how it is important to put greater emphasis on consumer protection and local public health initiatives rather than largely focusing on trade/economic interests.

The demand for strengthening capabilities to test and monitor food hazards and generation of required data to establish an accurate burden of disease, and better management of risks was emphasized at the meeting. While data could be borrowed from a variety of sources elsewhere (e.g. developed countries) for Member States to accurately establish the extent of disease burdens, the solution is for individual countries to invest in national surveillance programmes.

FAO/WHO Stakeholder Consultation and Expert Meeting on Carry Over of Residues of Veterinary Drugs in Feed, FAO Headquarters, Rome, Italy, 7–10 January 2019

Daniela Battaglia

Recognizing the importance of animal feed safety for the production of safe food, the Codex Committee on Residue of Veterinary Drugs in Foods (CCRVDF) requested FAO and WHO to provide scientific advice and risk management options (such as the establishment of maximum limits) to mitigate the unintended and unavoidable presence of residues of veterinary drugs in food of animal origin resulting from carry-over of veterinary drugs in feed. Such residues when present in feed could be transferred to food of animal origin and might pose risk to public health and lead to possible trade disruption. In response to this request, FAO and WHO held a joint Stakeholder Consultation and a joint Expert Meeting respectively on 7 January 2019 and from 8 to 10 January 2019 at FAO Headquarters in Rome, Italy.

Animal feed plays a leading role in the global food production and it is the largest and most important component to ensure the sustainable production of safe and affordable animal proteins. Rapidly growing populations, along with increased urbanization and income, is expected to raise the consumption of animal products by 70% in 2050. The increase in animal production will require an additional amount of feed to be produced. The challenge is not only to meet the growing demand for feed, but to ensure its safety.

Veterinary drugs play a critical role to protect both animal and human health (in case of zoonoses), to ensure animal welfare and the economic sustainability of the livestock sector. Veterinary drugs can be administered to animals through many different pathways, with their incorporation

into feed being one of the routinely chosen options. The use of veterinary drugs requires oversight, control to guarantee its prudent use and to avoid that residues contaminate the food we eat and the environment we live in. To guarantee that the food we eat is safe and does not contain excessive levels of veterinary drug residues, good production and manufacturing practices need to be applied. However, even when all relevant good practices had been fully implemented in feed manufacturing facilities, an unintended and unavoidable presence of low levels of certain veterinary drugs in feed can be observed.

Contamination of feed with veterinary drug residues can occur during feed production, processing, handling or on-farm use and may result in transfer of these residues from feed to food. Where unintended and unavoidable carry-over of a veterinary drug in feed occurs, animal species fed with such feed may be harmed if they are sensitive to those veterinary drugs, and where such animals are used for food, human health may be at risk. Furthermore, such carry-over may lead to detectable residues of a drug in animal tissues for which no regulatory provisions exists in this animal tissue, which often leads to recalls and trade rejections.

To evaluate any potential consequences for food safety from such feed, FAO and WHO has tasked the experts at this meeting to determine whether such low-level presence of residues in food associated with unavoidable and unintended carry-over in feed: (i) would constitute a threat to human health; and (ii) would impact negatively on trade. In addition, potential risk management measures should be developed to mitigate any risk as necessary.

The information gathered during the expert meeting will be used also to evaluate the need for any new work or revision of Codex Code of Practice on Good Animal Feeding or on the development of specific guidance or capacity development assistance to countries for implementing the Code. A report detailing the outcome of the meeting is expected to be published jointly by FAO and WHO later this year.

Coordinated Research Projects

CRP Reference Number	Ongoing CRPs	Project Officer
D52039	Development and Strengthening of Radio-Analytical and Complimentary Techniques to Control Residues of Veterinary Drugs and Related Chemicals in Aquaculture Products	J.J. Sasanya
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 Z. Ye
D52042	Implementation of Nuclear Techniques for Authentication of Foods with High-Value Labelling Claims (INTACT Food)	S. Kelly
D61024	Development of Electron Beam and X-ray Applications for Food Irradiation (DEXAFI)	C.M. Blackburn

1st RCM of CRP D52042 on "Implementation of Nuclear Techniques for Authentication of Foods with High-Value Labelling Claims" IAEA Vienna, Austria, 13 – 17 May 2019

Simon Kelly and Andrew Cannavan

The Joint FAO/IAEA Division held the inaugural meeting for a five-year international project to carry out applied and adaptive research with nuclear and complementary methods to verify the authenticity and origin of foods with high-value labelling claims, e.g. Geographical Indications, organic food and natural rather than synthetic food components. The first Research Coordination Meeting (RCM) took place at the IAEA Headquarters in Vienna from 13 to 17 May 2019. The participants comprised 12 contract holders (from China, Costa Rica, India, Indonesia, Jamaica, Malaysia, Morocco,

Myanmar, Slovenia, Thailand and Uruguay), six agreement holders (from Denmark, Germany, Italy, Japan, New Zealand and Spain) and five observers representing Imprint Analytics (Austria), the Oil Crops Research Institute (China), the Tentamus Global Center for Food Fraud (Germany) and Organic Services (Germany).

Meeting participants in the Vienna International Centre.

Numerous foods are sold at premium prices because of high-value labelling claims related to specific production methods, unique characteristics and origins. Origin-linked products can be part of a virtuous circle of sustainable quality based on the preservation of local resources and other factors described in the FAO-SINERGI guide "Linking people, places and products". Furthermore, these claims include agricultural, geographic, ethical and nutraceutical labelling specifications that add value to the products. In order to protect consumers from fraud and potential unintended food safety issues, standardised or harmonised analytical methods are required to confirm such claims.

Overview of the high-value food products being studied in the new CRP D52042.

Several nuclear, isotopic and related techniques have proven suitable for confirming a wide range of high-value labelling claims such as Geographical Indication (GI), free-range, organic, Halal, natural versus synthetic, etc. The overall objective of this CRP is to enable developing countries to protect and promote food products with high-value labelling claims, that are often targets for economically motivated adulteration, by the development and application of nuclear and related techniques. The project thereby aims to safeguard consumers and reputable producers; ensure regulatory and ethical compliance; stimulate domestic markets and reduce barriers to international trade. The methods and instrumentation that will be used in the project cover a wide range of destructive and non-destructive nuclear and related techniques with a proven record for the determination of food adulteration and origin. Specifically, these cover stable isotope ratio analysis of light mass elements in bulk tissue or specific compounds (IRMS); thermal ionization mass spectrometry (TIMS) and multi-collector-ICP-MS for the measurement of heavy element isotope ratios; liquid scintillation counting to differentiate modern versus old carbon in food components; multi-element analysis by inductively coupled plasma mass spectrometry (ICP-MS), ICP-optical emission spectroscopy (OES), X ray fluorescence (XRF), laser induced breakdown spectroscopy (LIBS) and neutron activation analysis (NAA). In addition, complementary techniques may be used such as nuclear magnetic resonance (NMR) spectroscopy and mass spectrometry for metabolomics and proteomics. Rapid screening methods may also be utilized, for example ion-mobility spectrometry (IMS), near infrared spectroscopy (NIR), hyper spectral imaging and Raman spectroscopy. The breadth and complementary nature of the techniques being used in the project by research contract holders and supported by research agreement holders and the IAEA provide a robust foundation for the determination of food origin and authenticity related labelling claims. Additionally, the track record of each technology in successfully contributing to food adulteration and origin detection is critical with respect to knowledge transfer and rapid implementation and training in countries and regions currently lacking an analytical solution.

The first RCM was formally opened by Mr Zhihua Ye, Head of the Food and Environmental Protection (FEP) Section in the FAO/IAEA's Joint Division of Nuclear Techniques in Food and Agriculture. Mr Ye explained the relevance of the project in relation to the work of the subprogramme on "Improvement of Food Safety and Food Control Systems". He went on to describe the priorities and activities of the FEP Section - food traceability; food authenticity; residues and contaminants analysis; food irradiation and preparedness and response to nuclear emergencies. Mr Ye briefly explained the purpose of the meeting and wished the participants fruitful discussions and a successful kick-off to the CRP. Mr Andrew Cannavan, Head of the FEP Laboratory, thanked Mr Ye for explaining the context of the project and wished the participants a productive and successful meeting and an enjoyable stay in Vienna. The meeting was chaired by Mr Russell Frew, University of Otago, with Mr Kristian Holst Laursen, University of Copenhagen, as the rapporteur and Mr Simon Kelly as scientific secretary.

The Meeting commenced with a presentation from the scientific secretary giving a brief overview of the purpose of

IAEA coordinated research activities and the background and structure of the CRP. This included the duration of the project, the participating countries, the food commodities being studied, the issues around labelling claims and the nuclear and complementary techniques that can be used to verify those claims. The presentation also summarised the expected outcomes of the project and the main aims of the first RCM. The meeting included previous relevant research and the proposed workplan presentations from each of the contract holders and technical presentations from each of the agreement holders. The agreement holders' and observers' technical presentations were on a range of topics of relevance to the contract holders. These presentations reinforced understanding of the principles of food authentication using stable isotope and trace element (SITE) fingerprinting, screening techniques such as near infrared spectroscopy, as well as providing case studies of how the data generated can be applied in actual food authentication situations. The insights provided by the agreement holders helped the contract holders re-formulate the their own worklans for the first phase of their respective projects.

Group sessions in the "World Café" format were then held to evaluate and refine the contract holders proposed workplans and to identify gaps and solutions in sampling, analysis and data interpretation. Each research contract holder's phase 1 workplan was reviewed by the consortium using the World Café session to ensure that high scientific standards and the objectives of the CRP were maintained. The subsequent feedback and discussions led to the identification of common problems and barriers to progression for the entire group. On the basis of these extensive discussions, the contract holders workplans for the next phase of the project were reformulated to strengthen the development of sampling plans, analytical techniques, improvement of datasets/database and networks, and outlining SOPs for optimizing authentic sample collection, analytical protocols and statistical analysis to fulfil the objectives of the CRP. The list of common barriers identified in the Word Café exercise were then reviewed in an open group session to identify solutions that were formatted into an 'action table' assigning tasks and deadlines to all project members. Additional brain-storming sessions were held on information and meta-data required for sampling and database construction.

The focus of the first phase of the project is 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. It was recommended by the meeting that the IAEA should consider the possibility of hosting and maintaining the database from this CRP to ensure its sustainability and legacy in a similar way to the "Water Isotope System for data analysis, visualization and Electronic Retrieval (WISER)" maintained by the Water Resources Programme. All participants emphasized the need 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 to protect and promote added-value food products from the Member States.

Development of a New Food Irradiation Coordinated Research Project (CRP)

Carl Blackburn

The Joint FAO/IAEA Division is convening a meeting of expert consultants in October to receive their advice and guidance in formulating a proposal for a new research project. The proposal concerns the use of low energy beams and related nuclear applications for food safety and quality to enhance food security and help address strategic development goal 2 (SDG2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture). Subject to its approval by the IAEA Committee for Coordinated Research, the proposal will form the basis of a new IAEA CRP planned to start in 2020.

Achieving food security requires an integrated approach that includes making food systems more resilient. Therefore, part of the solution is to make sure that we can do better with the food that we already produce and sustain its quality, ensure its safety whilst minimizing losses and wastage. There is more than enough food produced today to feed everyone, yet about 821 million people are chronically undernourished, and malnutrition affects around one in three people on the planet. Among the great challenges the world faces is how to ensure that a growing global population - projected to rise to around 10 billion by 2050 – has enough quality food to meet their nutritional needs for a healthy life[5].

Food irradiation alone is not a panacea, but it could be part of the solution, especially if there are environmentally friendly and sustainable methods for processing food that can be integrated as part of the usual food supply chain. In many instances' microorganisms reside on or near the surface of food, the irradiation of the external layer may be enough to eliminate spoilage microbes and many pathogenic food-borne organisms. For example, foodstuffs such as fruits, vegetables, fish, poultry and meat may become contaminated with various organisms during their production. In addition, dried products such as herbs, spices and mixes used as ingredients may harbour microorganisms. Washing with water or chemical disinfectants (chlorine dioxide, trisodium phosphate, organic acids) or using steam can reduce levels of spoilage and pathogenic microorganisms, but ionizing radiation is a dry and chemical-free process that can penetrate beyond the outside surface and is recognized as a sustainable and viable approach. However, "conventional irradiation" uses high

[5] http://www.fao.org/sustainable-development-goals/goals/goal-2/en/

energy electron beams, gamma rays or X rays that need the food to be transported to a specialized irradiation treatment centre. The development of new low energy electron beam devices will make it possible to treat food surfaces on a normal food production or packing line, integrated within the normal food operations of a food business.

The proposed aim of the new CRP is to research and develop technologies using low energy beams (below 300 keV) to treat food and agricultural products. The advantage of this new technology is that such machines do not require heavy shielding and can be fitted in-line on conventional food production or packing lines. However, their efficiency at destroying micro-organisms requires that a uniform and consistent dose of ionizing radiation is delivered to the surface layers of food. For this reason, research is necessary to develop methods and devices. Determining and optimizing the relative effectiveness of the techniques and the development of dosimetry systems for rapid, accurate and precise measurements of surface dose may also be a feature of this CRP to support a new area for the use of of food irradiation technology.

Technical Cooperation Projects

Country/Region	Project No.	Title	Technical Officer
Algeria	ALG5030	Contributing to the Implementation of the National Agricultural Development Programme Through Strengthening Soil, Water and Nutrient Management Practices Including Food Safety Using Nuclear and Related Techniques	J.J. Sasanya
Angola	ANG5014	Upgrading Laboratory Services for Control of Food Quality for Human and Animal Consumption	J.J. Sasanya Z. Ye
Bahrain	BAH5001	Determining Pesticide and Mycotoxin Residues in Water and Food	J.J. Sasanya Z. Ye
Bahrain	BAH5002	Establishing a National Quality Control Standard for Foodstuffs and Fishery Products	J.J. Sasanya Z. Ye
Bangladesh	BGD5031	Strengthening Capacities to Monitor and Control Veterinary Drug Residues in Foods of Animal Origin	J.J. Sasanya
Bangladesh	BGD5032	Building Capacity in Improving Food Safety Using Nuclear and Other Complementary Analytical Techniques	S. Kelly Z. Ye

Country/Region	Project No.	Title	Technical Officer
Benin	BEN5011	Strengthening National Capabilities to Improve the Safety and Competitiveness of Exportable Food Products	J.J. Sasanya
Botswana	BOT5017	Enhancing Capabilities for Inter-institutional Monitoring of Chemical Food Contaminants Using Nuclear/Isotopic and Complementary Analytical Techniques	J.J. Sasanya A. Cannavan
Cameroon	CMR5023	Strengthening Laboratory Capabilities to Monitor Contaminants in Fisheries Products	J.J. Sasanya
Colombia	COL5025	Improving Capacity to Diagnose Residual Pesticides and other Contaminants in Exotic Tropical Fruits to Make Food Exports More Acceptable on the International Market	J.J. Sasanya
Costa Rica	COS5032	Enhancing the Capacity to Control Contaminants and Residues of Veterinary Medicines and Pesticides in Foodstuffs of Animal Origin Using Nuclear and Conventional Analytical Techniques	J.J. Sasanya
Costa Rica	COS5033	Assessing and Implementing Biochar Use in Climate Smart and Environmentally Friendly Pineapple Production Using Isotopic Techniques	C.M. Blackburn A. Cannavan M. Zaman
Costa Rica	COS5036	Improving Analytical Capacity to Monitor Food Contaminants and Veterinary Drug Residues Using Nuclear/Isotopic and Complementary Techniques	J.J. Sasanya
Cuba	CUB5019	Strengthening National Capacity for Monitoring Heavy Metals to Improve Soil and Food Quality Using Nuclear and Related Techniques	C.M. Blackburn J.J. Sasanya S. Kelly
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
Ecuador	ECU5028	Consolidating Food Security and Environmental Sustainability in Palm Oil Production Using Nuclear Applications	B.M. Maestroni A. Cannavan J.J. Adu-Gyamfi
Ecuador	ECU5030	Reducing Post-Harvest Losses of Native Potatoes and other Fresh Foods by Irradiation	C.M. Blackburn
Egypt	EGY5026	Establishing a National Reference Laboratory Applying Nuclear/Isotopic and Related Techniques in the Analysis of Food Contaminants	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 Z. Ye
Guatemala	GUA0010	Building Capacity and Enhancing Nuclear Technology	B.M. Maestroni
Haiti	HAI5006	Increasing Productivity and Exportability in the Agricultural Sector through Soil and Water Management and Food Safety Monitoring	C.M. Blackburn J.J. Adu-Gyamfi J.J. Sasanya
Iraq	IRQ5021	Developing Food Safety and Assurance System Using Nuclear and Other Related Technologies	J.J. Sasanya A. Cannavan S. Kelly
Cambodia	KAM5004	Strengthening National Capability for Food and Feed Safety	D. Battaglia J.J. Sasanya
Lebanon	LEB1010	Establishing an Isotopic Ratio Mass Spectrometry Laboratory Dedicated to Authentication and Provenance for Supporting the National Fraud Repression Scheme	M. Groening Z. Ye S. Kelly
Malaysia	MAL5030	Strengthening National Technical Capability in Food Traceability of Edible Birds Nest through the Application of Nuclear and Related Technologies	A. Cannavan S. Kelly

Country/Region	Project No.	Title	Technical Officer
Mauritius	MAR5024	Building Capacity to Analyse Veterinary Drug Residues and Related Chemical Contaminants in Animal Products	J.J. Sasanya
Mauritania	MAU5005	Strengthening of Laboratory Capacity to Monitor Natural, Chemical and Microbial Food Contaminants	J.J. Sasanya
Mongolia	MON5024	Enhancing Food Safety Analytical Capabilities for Veterinary Drug Residues and Related Contaminants Using Isotopic Techniques	J.J. Sasanya D. Battaglia Z. Ye
Montenegro	MNE5004	Strengthening Technical and Institutional Capacities of the National Reference Laboratory for Food and Feed Control	Z. Ye A. Cannavan
Morocco	MOR5037	Enhancing Control of Chemical Food and Feed Contaminants, Animal Disease Diagnosis and Trade in Fresh Fruits	D. Battaglia J.J. Sasanya C.M. Blackburn
Namibia	NAM5015	Developing Capacity of the National Standard Institution and Agro-Marketing and Trade Agency in the Areas of Food Safety	B. Maestroni A. Cannavan
Niger	NER5020	Building Capacity at the Central Laboratory (LABOCEL), Niamey, for Control of Food Products of Animal Origin	J.J. Sasanya
Niger	NER5022	Strengthening Nuclear / Isotopic and Complementary Laboratory Capabilities for Monitoring Contaminants in Food, Feed and Water	D. Battaglia J.J. Sasanya
Nigeria	NIR5039	Enhancing Dietary Exposure Assessment of Chemicals in Food	J.J. Sasanya
T.T.U.T.J of T. Palestinian A.	PAL5010	Strengthening Capability to Monitor Contaminants in Food and Related Matrices through Nuclear and Complementary Analytical Techniques	J.J. Sasanya
Oman	OMA5003	Strengthening National Capabilities in Food Safety and Food Traceability	B.M. Maestroni J.J. Sasanya Z. Ye

Country/Region	Project No.	Title	Technical Officer
Panama	PAN5024	Developing Analytical Capabilities for the Detection of Chemical Contaminants in Food and the Quality of Agrochemicals	B.M. Maestroni
Senegal	SEN5038	Strengthening Laboratory Capabilities for Analysing Veterinary Drug Residues and Contaminants in Food	J.J. Sasanya A. Cannavan
Seychelles	SEY5010	Strengthening Laboratory Capabilities to Enhance Food Safety Using Nuclear and Complimentary Analytical Techniques	J.J. Sasanya
Sierra Leone	SIL5016	Strengthening Laboratory Capabilities to Evaluate and Monitor Levels of Mycotoxins, Toxic Metals and Related Contaminants in Foods	J.J. Sasanya
Sri Lanka	SRL5048	Strengthening National Capability for Food and Feed Safety	A. Cannavan A. Mihailova
Sudan	SUD5039	Enhancing the Capacity to Monitor Pesticide and Veterinary Residues in Food Using Nuclear and Complementary Techniques	J.J. Sasanya
Syria	SYR5024	Enhancing Capabilities to Monitor Naturally-Occurring and Synthetic Anabolic Hormones and other Veterinary Drug Residues in Foods	J.J. Sasanya
Thailand	THA5056	Strengthening Food Safety Laboratory Capacities	J.J. Sasanya D. Battaglia
Uganda	UGA5040	Strengthening Multi-Sectoral Food Contaminant Monitoring Programmes Through the Effective Use of Nuclear, Isotopic and Complementary Techniques	D. Battaglia J.J. Sasanya
Tanzania	URT5033	Establishing the Feasibility of an Irradiator Facility	C.M. Blackburn
Viet Nam	VIE5022	Promoting Interlaboratory Comparison and Accreditation in Testing Chemical Contamination for Food Safety	B.M. Maestroni Z. Ye

Country/Region	Project No.	Title	Technical Officer
Zambia	ZAM5032	Strengthening and Expanding Analytical Capacity to Monitor Food Contaminants using Nuclear/Isotopic and Complementary Tools	J.J. Sasanya
Africa	RAF1006	Facilitating the Commercial Application of Irradiation Technologies	S. Sabharwal (NAPC) C.M. Blackburn
Africa	RAF5067	Establishing a Food Safety Network through the Application of Nuclear and Related Technologies	J.J. Sasanya A. Cannavan
Africa	RAF5078	Establishing a Food Safety Network through the Application of Nuclear and Related Technologies, Phase II	J.J. Sasanya D. Battaglia
Asia	RAS5071	Strengthening Adaptive Climate Change Strategies for Food Security through the Use of Food Irradiation (RCA)	C.M. Blackburn
Asia	RAS5078	Enhancing Food Safety Laboratory Capabilities and Establishing a Network in Asia to Control Veterinary Drug Residues and Related Chemical Contaminants	J.J. Sasanya D. Battaglia G. J. Viljoen
Asia	RAS7026	Supporting the Use of Receptor Binding Assay (RBA) to Reduce the Adverse Impacts of Harmful Algal Toxins on Seafood Safety	M.Y. Dechraoui Bottein (NAEL) A. Cannavan
Asia	RAS5081	Enhancing Food Safety and Supporting Regional Authentication of Foodstuffs through Implementation of Nuclear Techniques (RCA)	S. Kelly Z. Ye
Latin America	RLA5066	Increasing the Commercial Application of Electron Beam and X-ray Irradiation Processing of Food	C.M. Blackburn
Latin America	RLA5069	Improving Pollution Management of Persistent Organic Pollutants to Reduce the Impact on People and the Environment (ARCAL CXLII)	B.M. Maestroni J.J. Sasanya

Country/Region	Project No.	Title	Technical Officer
Inter-Regional	INT5154	Improving Food Safety through the Creation of an Interregional Network that Produces Reliable Scientific Data Using Nuclear and Isotopic Techniques	J.J. Sasanya D. Battaglia

Interregional Training Course on Application of Statistical Principles to Food Safety Laboratories and National Monitoring Plans / Programmes Including Sampling, Amman, Jordan, 16–20 June 2019

James Sasanya

The training course was organized under the framework of an interregional project INT5154, and Asia Pacific Project RAS5078 and attracted ~ 65 participants from the following countries: Angola, Argentina, Benin, Botswana, Cameroon, Chile, Costa Rica, Ecuador, Guatemala, Honduras, Kyrgyzstan, Paraguay, Seychelles, South Africa, Tajikistan, Tunisia, Turkey, Turkmenistan, Uganda, and Uruguay. Others were, Bangladesh, China, Indonesia, Jordan, Lao PDR, Malaysia, Mongolia, Myanmar, Oman, Pakistan, Papua New Guinea, Philippines, Singapore, Sri Lanka, Syrian Arab republic, Thailand, Viet Nam.

The Jordanian Food and Drug Administration in collaboration with the Hotel Geneva, Amman hosted the training that covered a range of topics including (but not limited to): sampling for analysis of pesticide residues; sampling procedures for pesticide residue monitoring for food safety, for field and market samples; sampling of foods for analysis of veterinary drug residues in line with relevant guidelines and regulations; sampling protocols (including representative sampling) for mycotoxins; sub-sampling to produce test samples as well as relevant examples.

Other areas of work included: guidelines and regulations for pesticide residue monitoring and control; practical statistics for analysts in veterinary drug residue and including data interpretation; basic and advanced statistics and statistical tools for method development and validation; quality control; field sampling; method development and validation as we all as implications of sampling and monitoring on public health and international trade.

Knowledge acquired will enhance capabilities of Member States to better implement national programmes for testing residues and contaminants applying acceptable principles of sampling and statistics, both in the field and laboratory. The event provided an opportunity to strengthen regional and interregional networking.

Interregional Training on Certified Reference and Proficiency Testing Material for Food Safety Control Laboratories, Buenos Aires, Argentina, 6–17 May 2019

James Sasanya

The training course was organized in collaboration with National Food Safety and Quality Service of Argentina (SENASA) and the Instituto Nacional de Tecnología Industrial (INTI) and attended by 48 participants from Argentina, Benin, Botswana, Chile, Costa Rica, Indonesia, Indonesia, Morocco, Turkey, Uganda and Uruguay.

Interregional project participants at a training on certified reference material (CRM) and proficiency testing (PT) in Argentina.

The training covered standards, guides and documents associated with ISO 17034 (requirements for competence of reference material producers) with specific content including reference Materials and Certified Reference Materials; requirements for resources, personnel; subcontracting; the provision of equipment, services and supplies. Relevant facilities and environmental conditions were covered.

Further work was done on technical and production requirements: production planning and control; material handling; storage and processing. Measurement procedures, relevant equipment as well as data integrity and evaluation were addressed.

The participants also looked at assessment of homogeneity a general challenge though more pressing when dealing with mycotoxins; monitoring of stability; critical points in the production and characterization of the CRMs.

The training later covered planning of PTs: design; logistics; responsibilities; subcontracting; production and preparation; handling; and statistical criteria among others.

The participants were finally taken through and enhanced their understanding of: receiving and analyzing PT results; test management and associated QMS requirements. A number of cases studies and examples of PTs in food analysis, including experiences across continents, were shared. The participants further discussed the evaluation of PT suppliers.

Workshop on Mitigation and/or Remediation Strategies for Persistent Organic Pollutants (POPs), Foz Do Iguazu, Brazil, 2–5 May 2019

Britt Maestroni

A workshop to review preliminary project results for technical cooperation project (TCP) RLA5069 and to identify possible mitigation and/or remediation strategies for persistent organic pollutants (POPs) took place from 2 to 5 May 2019 in Foz Do Iguazu, Brazil. The workshop was attended by nine participants from Argentina, Chile, Colombia, Dominican Republic, Ecuador, Guatemala, Mexico, Paraguay and Uruguay.

Participants and observers of the workshop on mitigation and/or remediation strategies for persistent organic pollutants, 2-5 May 2019, Foz do Iguazu, Brazil.

The objective of the workshop was to provide capacity building and provide practical advice on strategies for the implementation of the project with the objective of improving the management of persistent organic pollutants. Experts invited to the workshop were Dr Maria Dolores Hernando-Guil from the National Institute for Agricultural and Food Research and Technology, Spain, Dr Sebastian Elgueta from the Agricultural Research Institute (INIA), Chile and Dr Carmen Ferrer, from University of Almeria, Spain.

The workshop included presentations by the participants on the development and validation of analytical procedures for effective extraction and determination of POPs in abiotic and biotic samples. The results of the monitoring programs carried out in target areas initially identified as presenting a high potential risk of exposure to POPs in each country were also discussed. It was recognized that POPs are a problem of global scope and there is a need for coordinated actions to address these chemicals of high concern. Requirements in terms of sampling strategy, types of samples, sampling frequency and sampling locations, were presented. The importance of the sensitivity and accuracy of e analytical methods for quantification of POPs was noted as well as the need for the generation of high-quality data on the presence of POPs in the Latin American region. The invited experts generated an online questionnaire to correlate POPs baseline data with the target areas of study and therefore set up management options for POPs. The potential correlation between POPs measured in core matrices in the region and the different environments (social, industrial, residential areas) will be evaluated in due course of the RLA5069 project.

The meeting participants networking.

The objective of this workshop was to contribute to a better understanding of the actions and measures needed to identify mitigation and remediation strategies for POP's and the importance of technical expertise in POPs analysis. A key aim was to harmonize work in the region on monitoring levels of POPs in order to give decision makers options for targeted and effective mitigation and remediation strategies for the region. Actions undertaken under the Stockholm Convention were presented as an example, to facilitate better understanding and selection of mitigation and remediation strategies targeted to the individual capabilities of each country. The use of biobeds was presented by Dr Anisleidy Rivero, Trace Pollutants Analysis Group (GACT), Uruguay, as a possible solution at field scale; research and development is currently dedicated to fine tune the technology to implement bioremediation. The last day of the workshop was dedicated to analytical issues. Participants had an opportunity to interact with the lecturers and facilitators of the analytical session.

Regional (Africa) Training on Analysis of Toxic Metals in Food and Related Matrices, Cotonou, Benin, 22–26 April 2019

James Sasanya

The training was attended by 26 participants from Benin, Botswana, Burkina Faso, Burundi, Chad, Egypt, Kenya, Madagascar, Malawi, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Uganda and Zimbabwe. Resource persons from Botswana, Nigeria and industry (Perkin Elmer) contributed to the event. Local participants included: Laboratoire de Surveillance Environmentale de la Direction Generale du Ministere du Cadre de Vie et du Developpement; Société Béninoise de Brasseries; Ministére de I'Environnement, de l'habitat et de l'urbanisme; IRGIB Africa University; National Institute of Agricultural Research; Labaratoire Contrôle Qualité des Eaux et des Aliments, Ministère de la Santé.

Participants were welcomed by the Minister of Agriculture of Benin, Hon G. C. Dossouhoui, who in his address highlighted the dangers of toxic metals in food and challenged participants to assure supply of safe food in their respective countries and ensure institutional commitment. The Hon Minister's presence demonstrated Benin's commitment to food safety and its impact on health and the economy.

Participants and Hon Minister of Agriculture Benin at LCSSA.

The training included: targeted analytical methods for metals and matrices; instrument setup and optimization; analysis of toxic metals in foods (plant products) using AAS; sample preparation; introduction to Inductively Coupled Plasma (ICP-Mass Spectrometry). Others included: demonstrations on ICP-MS software use; ICP-MS and AAS troubleshooting and basic maintenance; Total Elemental Analysis: Comparison of Elemental (Atomic/Mass) Spectroscopic Techniques; ICP Applications to Foods and Agricultural Materials; Systematic errors in trace element analyses and elemental speciation, among others.

Participants were also exposed to reliable methods for data analysis; the use of analytical figures of merit to validate results, as well as a demonstration and application of statistical values. The event also provided an opportunity to strengthen networking among the participants.

Practical sessions during a training in Benin on toxic metals.

Asia-Pacific Regional Training Course in Multivariate Data Analysis Using the Chemometrics Add-in for Microsoft Excel, Hangzhou, China, 15–19 April 2019

Simon Kelly

Mr Simon Kelly collaborated with the Vice-President of the Zhejiang Academy of Agricultural Sciences, Professor Yuan Yuwei, to organise a Regional Training Course (RTC) in multivariate data analysis (MDA) using the chemometrics add-in for Microsoft Excel in Hangzhou, China from 15 to 19 April 2019.

The aim of the course was to provide the participants with a powerful, easily accessible and low-cost tool for basic multivariate data analysis. MDA is an essential part of complex analytical experiments and chemometrics is intensively used for processing of various nuclear data e.g. stable isotope and trace element (SITE) data for food authentication and to verify the geographical origin of food to support traceability systems. Professors Oxana Rodioniva and Alexey Pomeranstev, from the N.N. Semenov Federal Research Centre for Chemical Physics, delivered the chemometrics in Excel training to 22 participants from Bangladesh, China, Fiji, India, Indonesia, Japan, Lao P.D.R., Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, R.O. Korea and Singapore, with the assistance of Dr Karyne Rogers (GNS, New Zealand).

The RTC was the 3rd in a series from the Regional Cooperation Activity for Asia-Pacific "Enhancing Food Safety and Supporting Regional Authentication of Foodstuffs through Implementation of Nuclear Techniques" (RAS5081). The participants were supplied with a copy of the book accompanying the course and a free installation of the software that functions as an add-in to Microsoft Excel. Participants undertook computer exercises using Excel matrix calculations, regressions, and determining basic

statistical functions before moving on to more complex classification problems, typically found in food authentication and provenance studies, involving data evaluation with principal component analysis, soft independent modelling by class analogy and partial least squares discriminant analysis. The participants were given plenty of opportunities to ask questions about all aspects of the course and undertake hands-on exercises with their own data. Throughout the course, the students were invited each day to take control of the training computer and to complete their exercises in front of the class. Care was taken to ensure that participants understood the required pre-processing of data and when to remove outliers or other non-essential data. The course finished with a graduation ceremony to present the IAEA RAS5081 course certificates to all participants.

Participants of the RAS5081 Regional Training Course in multivariate data analysis using the chemometrics add-in for Microsoft Excel.

At the end of the course, a technical tour was held to the local speciality Longjing (Green) tea gardens in Westlake and the participants were shown where the tea is grown and then undertook a tea-tasting exercise to try different Hangzhou tea varieties. The overall feedback on the training course by the participants was excellent and the participants were highly motivated to learn and interact with each other to develop new collaborations. All participants were well prepared for the course and coped well with the Excel style format of the software enabling them to have effective and efficient training in a familiar 'software environment'. The course laid the foundation for an essential part of SITE data elaboration, stressing the importance of building reliable and robust MDA models before moving to the testing phase for food authentication methods.

Supporting Food Safety in Rwanda and Africa, Kigali, Rwanda, 18–22 February 2019

James Sasanya

The officer joined a number of IAEA staff to (a) primarily participate in a Task Force workshop on African Union (AU)/IAEA Practical Arrangements; and (b) support food safety activities in Rwanda.

The main purpose was to attend the workshop and share food safety work that the Agency conducts and interact with AU counterparts including understanding their needs in line with the AU/IAEA Practical Arrangements. The mission was also used by the officer to support food safety activities in the country led by the Rwanda Standards Board (RSB) and provide guidance and review with counterparts, a new project design for the 2020–2021 TC Cycle. The workshop was hosted by the African Institute for Mathematical Sciences (AIMS) while interactions with RSB were on-site.

The officer's role was to among others, present work that the Food and Environmental Protection (FEP) conducts on food safety and how that benefits AU Member States. The officer shared highlights of FEP activities including food irradiation, quality, emergency preparedness and food safety. Support to the region under the TC Programme and coordinated research activities was also presented.

The AU delegation presented their work and plans, emphasizing the importance of food contaminants/residues to the region and identified common areas for potential collaboration. The areas mentioned include: capacity building (both human resource and instrumentation) covering a range of hazards such as veterinary drug and pesticide residues; toxic metals; mycotoxins; radionuclides; and microbial hazards etc. Others were: establishing or enhancing laboratory quality management systems and competencies; contaminant and residue prevalence/occurrence data generation using nuclear/isotopic and related techniques to support setting of regulatory limits; establishing or strengthening residues/contaminant monitoring systems; and facilitating some participation in risk management etc.

The officer also participated in various group discussions. AIMS staff expressed interest in research collaborative activities with the Agency such as plant mutation breeding or biotechnology.

The officer visited RSB, to discuss a food safety project designed for the 2020–2021 TC cycle, and to provide technical support to analytical work on food contaminants and residues. The various sections of the laboratory covering mycotoxin, pesticide residues and toxic metals, as well as a section on pharmaceuticals were visited and advised.

Food hazards testing laboratory at the RSB the officer visited.

Discussions were held on analytical instrumentation, staff challenges and plans. The officer identified two

non-operational instruments that require immediate attention and has since followed up with the instrument suppliers in South Africa. A solution has been found to fix the problems.

The officer, Director of the Chemistry unit and the Director General (DG) RSB reviewed the food safety project for the 2020–2021 cycle and made necessary modifications.

In conclusion, the officer's participation at the AU/IAEA Joint task Force meeting facilitated conversations on common areas in food safety control. It also facilitated gap-analysis and an understanding of potential and priority areas to follow-up on.

The mission also enabled the officer to better understand ongoing and future food safety work in Rwanda, especially at the RSB. The officer's presence resulted in diagnosis of some lingering analytical instrument and method logical challenges, and proposed solutions. For instance, the officer has since contacted the instrument suppliers and shared with the country's PMO for possible support. Efforts are ongoing to assist the Member State. The visit also turned out to be a pre-project inception mission.

Supporting Food Safety Testing and Service Delivery in Benin, 11–15 February 2019

James Sasanya

The officer undertook a mission to Cotonou, Benin, to provide technical support to the country's food safety programme where the Central Laboratory for Food Safety Control (LCSSA), Ministry of Agriculture Livestock and Fisheries is a leader. This included assessing progress made under a national food safety project (BEN5011), and discussing prospects including refinement of a new project for the 2020–2021 TC cycle.

The officer reviewed project activities including use of various analytical tools such as radio receptor assay; isotope-based chromatographic/spectrometric techniques and the testing as well as monitoring of a range of contaminants/residues in foods for local consumption and export. These include cashew nuts, pineapples, honey, fruits and vegetables, cereals, oils and fish among others. Extensive review of work done specific laboratory sections including the chemistry, microbiology, quality management and IT was done. Capabilities were critically assessed, and needs identified.

The officer observed that a number of techniques have been accredited with additional ones in the pipeline. The need to upgrade the laboratory quality management system to the new version of ISO (2017) was addressed. The officer visited a number of partners and end-users of the services provided by the counterpart (LCSSA). These included field visits to: Partners for Development, an American Non-Governmental Organisation supporting food security and value-addition; pineapple farmers in Allada; and a major cashew nut factory, among others.

The officer and the countrer part (CP) also met the National AFRA Coordinator and the FAO staff in charge of programming. The officer met the Hon Minister of Agriculture, Livestock and Fisheries who thanked the Agency for support thus far and requested for further cooperation. As advised by the Hon Minister, the officer travelled to Bohicon to asses needs of a testing/diagnostic laboratory.

The IAEA officer and the Hon Minister of Agriculture (2nd left) and his staff at the project counterpart meeting.

The officer worked with LCSSA laboratory staff on improving and expanding analytical-method scope, instrument and method troubleshooting, as well as finetuning a new project designed or the 2020–2021 cycle. Laboratory networking; the new/planned change in the structure of the LCSSA that will take effect soon when LCSSA becomes a Directorate; training of scientists in Africa, were also addressed with the officer providing technical guidance.

In conclusion, the mission was undertaken as planned and benefited the counterpart/country and project support team at the Secretariat. The officer helped LCSSA in the improvement of analytical methods (s) and their effective application to national testing/monitoring activities.

The officer observed that the capacity built thus far at LCSSA has made significant difference in the country. For instance, LCSSA contributes to national needs such as the conducting of Total Diet Studies (testing table ready foods for a wide range of contaminants and residues); testing and removal of obsolete pesticides in conjunction with Ministry of Agriculture and Fisheries and FAO; testing of cashew nuts for local consumption and exports; testing of cotton seed cake for exports and use in local animal feed production. This service to society is in addition to the testing programme on the safety of pineapples and honey (for export) that LCSSA conducts.

Benin produces large volumes of cotton and the seed cake is a major by-product for use in other industries such as the animal/poultry industry. National and international safety

standards for such products must be met to maintain export markets such as the EU's.

The capability to conduct risk assessment based on total diet studies (analysing contaminants in table-ready food commonly consumed in the country) is a major public health requirement and LCSSA is making important contributions as the only laboratory in the country capable of conducting such tests. This has been possible due to the IAEA TC support. The country can collect, prepare and analyse such food samples in the country although external validation may be used to supplement.

Supporting ADB-IAEA Partnership for Strengthening International Food Safety Standards in Agriculture Value Chain in the Central Asia Countries, Astana, Kazakhstan, 4–6 December 2018

Zhihua Ye

The reporting officer participated in the regional workshop on a prospective Asian Development Bank (ADB) - IAEA Partnership for Strengthening International Standards in Agricultural Value Chains in the Central Asia Regional Economic Cooperation (CAREC) Member Countries, from 4 to 6 December 2018 in Astana, Kazakhstan under the framework of a regional technical cooperation project (TCP) RAS5078.

The workshop was organized by the British Standard Institute (BSI) as the coordinator of the ADB funded technical assistance (TA) project entitled "*Strengthening International Food Safety Standards in Agriculture Value Chain in the Central Asia Regional Economic Cooperation Member States*" and attended by 65 participates from 11 CAREC countries, including five ADB international consultants, 10 national specialists recruited from the CAREC Member States and two consultants for another ADB funded TA project on Modernizing Sanitary and Phytosanitary Measures to Facilitate Trade. Others in attendance were one representative of WTO standards and trade Development Facility (STDF), two staff of the United States Agency for International Development (USAID) programme on competitiveness, trade and jobs in Central Asia; five ADB employees and four local support staff.

The workshop was opened by the ADB Country Director of Resident Mission in Kazakhstan. The Vice Minister of Ministry of Agriculture (Ms Gulmira Issayeva) and Vice Minister of Ministry of Health (Mr Alexey Tsoi) of the host country made opening remarks addressing the importance of food safety to the health of consumers, the development of industries and promotion of regional/international trade.

The ADB project officer Ms Samjhana Shrestha reported the implementation of the TA projects in 2018 and the international consultants provided overviews on the key outputs/results obtained during the first year of the project on food safety regulations, laboratory development, capacity building and food safety standards.

On behalf of the Agency, the reporting office gave a presentation on "Nuclear Techniques Contributing to Food Safety and Quality in Member States" with an over review of the role of the Joint FAO/IAEA Division in national food control system; a glance of the FEP in the Joint FAO/IAEA programme; the FEP's objective, mandate and R&D activities on nuclear/isotopic techniques; technology transfer through technical cooperation; and the status and activities of the IAEA-ADB collaboration.

Mr Zhihua Ye presenting the work of IAEA on "Nuclear Techniques Contributing to Food Safety and Quality in Member States" at the workshop.

The support of the IAEA through TCP RAS5078 to the ADB TA project, especially the offer of the training on "Competence of Food Safety Testing Laboratories in Asia-Pacific and Strengthening Food Safety Asia Networking" in Indonesia in 2018 was highly appreciated by the CAREC countries such as Kyrgyzstan, Georgia, Kazakhstan and others at the workshop.

Meanwhile, the reporting officer served as a moderator at the session of the workshop on Laboratory Development in the request of the organizer.

In the request of the ADB project officer Ms Samjhana Shrestha, the reporting officer had specific discussions during the workshop with the project consultants team on how the Agency will provide further support to the ADB TA project in 2019.

The main concern of the team is about one more training course on food safety analysis to be provided by the Agency for regulatory laboratories in the CAREC countries. When training plan of TCP RAS5078 in 2019 was introduced, the ADB representative and the consultant team have decided to request the IAEA to offer the training in Jordan on "Sampling and Application of Statistics in Food Safety Laboratories" for the 11 CAREC countries. They would like to nominate two candidates from each of the 11 countries and wish the Agency would inform ADB in the earliest possible the deadline for the submission of nominees and to whom these nominees could be submitted.

Developments at the Food and Environmental Protection Laboratory

Method Optimization for Pesticide Residue Analysis in Turmeric

Britt Maestroni, Veronica Cesio and Marivil Islam

Herbs and spices (H&S) have been used worldwide throughout human history as ingredients in food, teas and medicines due to their flavours and pharmacological, biological and antimicrobial properties. The largest spice importing trading block is the European Union, and the USA and Japan are the two largest single country importers.

Turmeric (Curcuma longa L.) is an economically important food and medicinal spice plant that grows primarily in tropical and sub-tropical regions including India, China, Taiwan, Sri Lanka, Peru, Australia and Thailand. Due to the growing demand for H&S, agricultural cultivation has become increasingly intensive. The crops, before or after harvest, can potentially be fumigated or treated to prevent pests and fungal infestation. The chemicals used may not always be authorized for use on the crops or, although allowed, may be found at higher levels than the permissible maximum residue limits. In addition, it has been widely demonstrated that H&S are subject to economically motivated adulteration, where dishonest producers or traders extend the product with lower value commodities. Recently, problems of adulteration of turmeric powder with other turmeric species have been detected. The adulterants used may also contain residues of pesticides not authorized for use in H&S. The determination of trace amounts of pesticides and contaminants in H&S is a challenging task due to the presence of natural metabolites that are of similar physicochemical properties to those of the pesticides and at concentration levels that may be an order of magnitude, or more, higher than the target analytes.

The FEPL initiated a study on the optimization and subsequent validation of a multi residue method for pesticides and contaminants in turmeric. The process started with the identification of a suitable blank matrix to characterize the authenticity and the representativeness of turmeric matrices for method validation and for matrix matching during analytical calibration.

The selection of an appropriate blank matrix for analytical determinations in H&S can be troublesome due to the difficulty in selecting a sample that is really representative. Different agricultural areas, different varieties and other factors can contribute to changes in the secondary metabolism of H&S and therefore in their natural profiles. Undetected adulteration may also be a cause of non-natural variation in the matrix profile. Method performance can vary even within the same type of herb or spice, making the definition of representative matrices difficult.

Six commercial samples of turmeric, a composite sample and one turmeric rhizome, processed and oven/freeze dried in the laboratory, were studied for their representativeness as blank matrices for pesticide residue analysis method development. To this end, and in the process of identifying a suitable sample preparation method, the samples were extracted using the commonly recognized standard CEN 15662, SweEt and Dutch MiniLuke sample preparation procedures.

Profiling studies were carried out using headspace gas chromatography coupled to ion mobility spectrometry (GC-IMS) and full scan gas chromatography - tandem mass spectrometry (GC-MS/MS). The GC-IMS provided the advantages of the selectivity offered by gas chromatography and the sensitivity offered by ion mobility spectrometry. The GC-IMS profiles obtained for the three initial sample preparation methods are shown in figure 1.

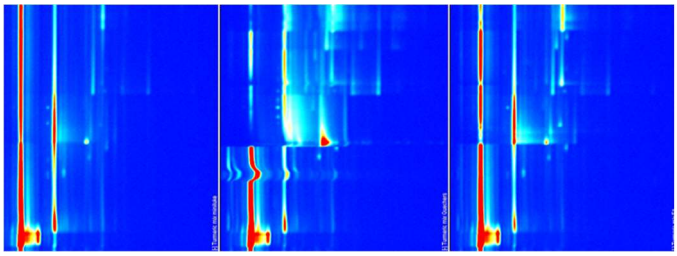


FIG. 1. From left to right the GC-IMS profile of the blank raw extractsobtained by Dutch MiniLuke, CEN 15662, and SweEt procedures.

The evaluated extraction approaches lead to different fingerprints and co-extractive amounts. The zones of the topographic plot containing greater information (coloured spots) were selected to provide input data for principal component analysis (PCA), see figure 2, which was used to study the similarity of the blank matrices.

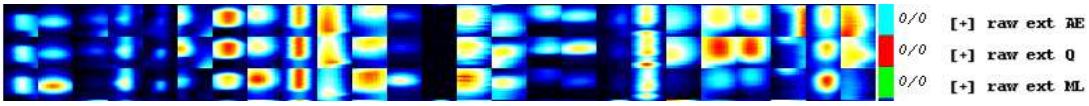


FIG. 2. Visualization of the quantified areas from the topographic plot of the blank raw extracts obtained by Dutch MiniLuke, CEN 15662, and SweEt procedures.

GC-MS/MS, operated in scan mode, provided information on the co-extractive profiles of the blank matrices in addition to the retention times of the analytes of interest. For example, figure 3 shows that, in the case of the SweEt sample preparation procedure, the blank matrix co-extractives mostly eluted at retention times separate from those of the analytes of interest. This is important for the suitability of the turmeric material as a blank matrix for the study.

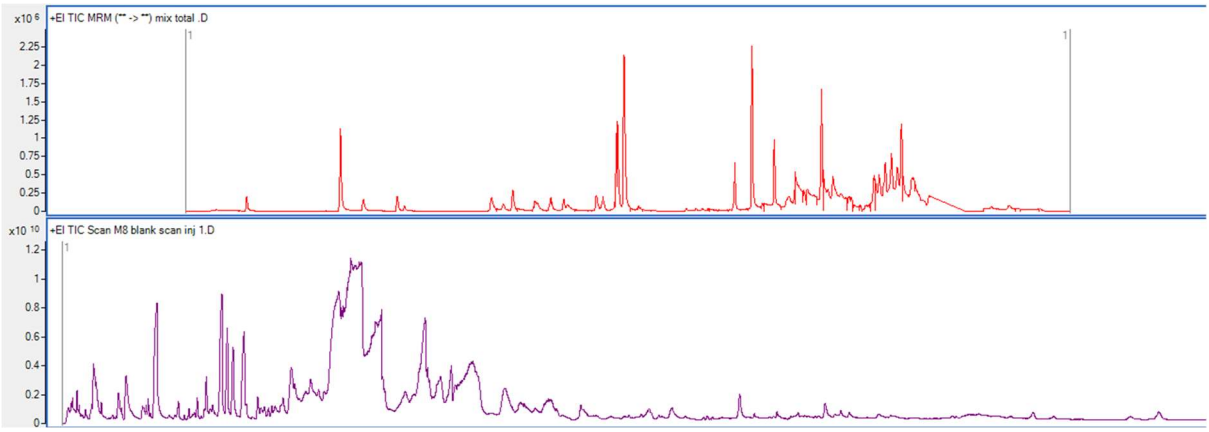


FIG. 3. Total ion chromatograms of the MRMs for the pesticide mixture at 0.05 mg/L (top) and a blank matrix obtained by the SweEt sample preparation procedure (bottom).

The GC-IMS profiles and PCA analysis also provided important information on the homogeneity of mixing the turmeric powders. A composite sample of different turmeric commercial powders, prepared by geometric dilution, was initially found not to be sufficiently representative. After careful homogenization, using a Retsch ball-mill and mortar mixing for 15 mins, the composite sample was shown to be homogeneous and representative of the mixture.

In this study GC-IMS was very useful as a rapid screening tool for turmeric and helped in the selection of the most appropriate matrix for analytical method development.

The second phase of the study was the optimization of a sample preparation procedure for turmeric. The work was very challenging as the presence of high concentrations of numerous natural molecules hindered extraction and analysis, with the consequences of low pesticide recoveries and chromatographic interferences, which affected precision, accuracy and reproducibility as well as system maintenance. Careful optimization of the sample preparation procedure was, therefore, required. Data analysis is ongoing and results will be published soon.

Creating Headspace–Gas Chromatography/Ion Mobility Spectrometry (GC/IMS): A New Nuclear Technique for Food Authentication in FEPL

Marivil Islam, Shunru Jin, Alina Mihailova, Britt Maestroni and Simon Kelly

A new *G.A.S. Flavourspec* gas chromatography/ion mobility spectrometer, equipped with a headspace autosampler, was commissioned in the Food and Environmental Protection Laboratory (FEPL) in March 2019. Ion mobility spectrometry is an analytical technology designed to separately detect compounds of interest in a mixture of gaseous analytes, such as the volatile compounds associated with the flavour and aroma of foods. The separation is based on the specific 'drift times' that ionized compounds need to pass a fixed distance in a defined electric field, the so called 'drift tube'. However, unlike other techniques such as time-of-flight/mass spectrometry, which operate under vacuum, the ions in the IMS drift tube travel at atmospheric pressure versus a flow of inert nitrogen gas or in some cases air. The drift time of each substance is determined by its ion's mass and geometric structure, as retarding collisions with the drift gas molecules are more frequent for sterically hindered compounds. Consequently, IMS can even separate different molecules with the same mass/charge ratio (isobaric molecules). Detection of the ion current is achieved using an electrometer as a function of time. This technology is also widely used by Customs and enforcement authorities for the rapid detection of residues of explosives and drugs of abuse.

Soft chemical ionisation of the volatile molecules is achieved at atmospheric pressure using a β-radiator tritium (^3H) source. This generates reactant ions from residual water in the nitrogen drift gas, which can be described as hydrated protons, $H^+(H_2O)_n$. Chemical ionization of analytes by proton transfer then occurs when their affinity for the reactant ion is higher than their affinity for water. This is typically the case for most organic molecules that contain a hetero-atom such as oxygen, nitrogen or sulphur. Furthermore, the ionisation takes place at place at ambient pressure without the losses associated with systems under vacuum and so IMS is relatively sensitive compared to other techniques with detection limits typically in the low ppb-range for volatile organic compounds (VOCs). A typical IMS spectrum in the absence of anlayte is shown by the blue line in Figure 1. The reactant ion peak (RIP) is clearly seen and this is characteristic of the system that can

be used as an internal standard marker. The spectrum containing analytes is shown by the orange line, with a decreased RIP peak, while the new analyte peaks are correspondingly formed. The drift time is specific for an ion, and the peak height is correlated to concentration, and therefore analyte identification and quantification is possible, respectively. The gas chromatographic separation of the analytes in the *Flavourspec* system, prior to IMS separation and detection, provides a further dimension of separating complex aroma profiles often encountered in foods and beverages. This means that chromatographically separated compounds do not compete for reactant ions when they reach the IMS source (Figure 2) and this yields better sensitivity for the time resolved components of complex mixtures of VOCs. The GC/IMS system therefore achieves a two-dimensional separation of the volatile compounds from the headspace autosampler and detection by the IMS electrometer (Figure 3). Since the IMS measurments are extremely fast (~20 mS/spectrum) a continuous and high-resolution recording of analyte signals are achieved. Figure 4 is an example of the *Flavourspec's* 3D dataset and the corresponding 'heat map' visualisation for green tea.

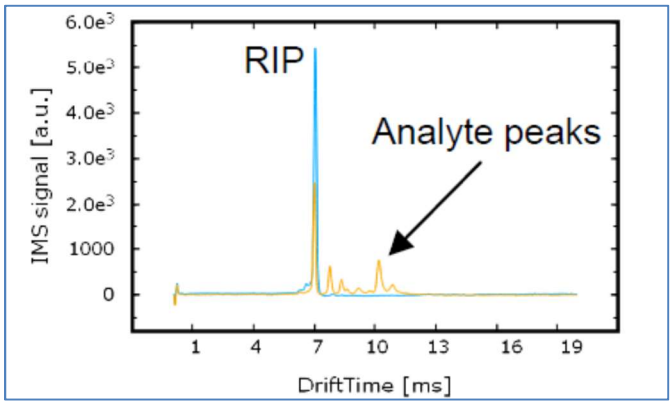


FIG. 1. IMS spectra with and without analyte.

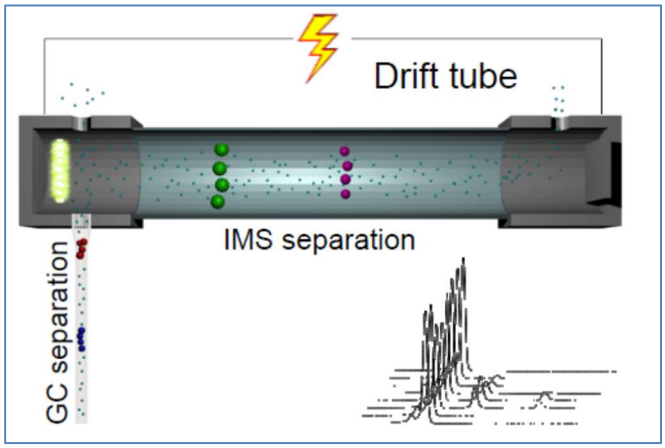


FIG. 2. Schematic of the analyte flow in a GC-IMS system.

FIG. 1 & 2 reproduced and adapted with permission from G.A.S. Technical Note 'Working principle of the GC-IMS technology'.

The flavourspec has been successfully used for many food authenticity and quality applications including the correct allocation of olive oils into their grades; classification of aromatic rice such as Thai Jasmine and Basmati; storage age and quality of green tea, hard cheeses and wine; and detection of rancidity and spoilage in dairy products, fish and fried foods. FEPL is currently in the process of using the flavourspec to develop methods to detect adulteration of Moroccan argan oil and olive oils with cheaper oils such as sunflower and soya oil and to characterise important spices such as turmeric (see in this issue "Method optimization for pesticide residue analysis in turmeric"). It will also be used in food safety applications e.g. detection of low-levels of the preservative formaldehyde in milk and the formation of mould in stored cereals. Some of this research work will be the presented in future editions of the FEP newsletter. Visiting fellows, scientists and interns will have an opportunity to learn operational and analytical methods on the *Flavourspec* instrument, thereby supporting Member State training efforts and raising awareness of this rapid screening nuclear technology. The new *Flavourspec* system also opens the opportunity for collaboration with the other institutes, such as Queen's University Belfast, working on food authentication projects such as ground oregano herb where aroma profiles can be used to detect the presence of adulterants such olive and myrtle leaves.

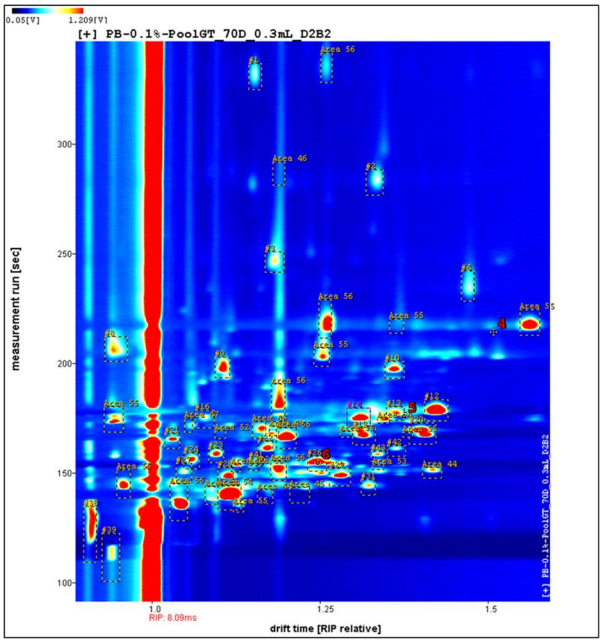


FIG. 3. 2D Spectrum of headspace analysis by GC-IMS of a pooled green tea sample adulterated with 0.1% Prussian blue.

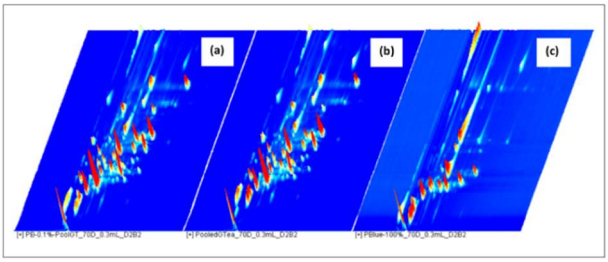


FIG. 4. A 3-D 'heat-map' images without the RIP of a) adulterated green tea, b) pure green tea and c) adulterant.

The new GAS Flavourspec gas chromatography/ion mobility spectrometry system (1) with headspace autosampler (2) and heated incubation oven to generate increased VOCs (3).

FEPL Staff

The FEPL is pleased to welcome our new team assistant, Ms Caroline Wafula, who joined the laboratory staff in February 2019. Since taking up her post, Caroline has undertaken intensive training in the necessary IT systems and has quickly settled into her role, providing effective administrative support for FEPL staff and also assisting with administrative issues in the training programme of the FAO/IAEA Agriculture and Biotechnology Laboratories.

Mr Serik Permatov took up the position of Laboratory Attendant in FEPL at the start of April 2019. Serik is providing much needed support to the scientific staff of the laboratory, enabling work to proceed in an organised, efficient and effective manner. We welcome Serik to the team.

Consultants and Interns

Ms Xiao Xu completed a three month internship in FEPL in January 2019. Xiao gained valuable experience and contributed to experimental work on the application of benchtop and portable screening techniques for food authenticity, focusing on Fourier transform infrared and very-near infrared spectroscopy for the analysis of commodities such as extra-virgin olive oil.

Ms Veronica Cesio Cesconi worked in FEPL on a two-month consultancy focusing on the control of pesticides residues and other chemical contaminants in herbs and spices, with turmeric as the test commodity. Herbs and spices are widely traded, and also known to be prone to contamination and adulteration, thus posing both health risks and potential economic losses to producers. This type of commodity presents many problems for analysis due to the co-extractives, metabolites etc. present in the matrix. Dra. Cesio is Associate Professor of Pharmacognosy & Natural Products in Faculty of Chemistry of the University of the Republic (UdelaR), Montevideo, Uruguay. She has collaborated extensively with FEPL in the past on the development and transfer of food-safety analytical methods for pesticides/chemical residues in food, including a two-week period as a cost-free visiting scientist in November 2017 to work on joint studies on analyte protectant methodology for the analysis of contaminants in herbs. Veronica's considerable expertise and skills in this field, as well as drive and commitment, enabled a lot of progress to be made during her two-month consultancy and this work will be continued both in FEPL and in her laboratory in Uruguay. Our thanks go to Veronica for this continued and fruitful collaboration.

Ms Ying Liang joined the FEPL team as a cost-free expert at the start of June 2019. Ms. Liang has a doctorate degree in Food Science and Technology from the College of Food Science and engineering, Northwest A&F University, Xi'an, China and brings expertise in pesticide residues analysis from her research in the Institute of Food Safety and Nutrition, Jiangsu Academy of Agricultural Science, Nanjing, China. Ms. Liang will contribute to FEPL's work on the development of methods for pesticide residues and other chemical contaminants in food, for food safety and authenticity.

Announcement

Change to Mode of Distribution of Newsletter

Dear Readers,

Please note that paper copies of this newsletter will no longer be circulated by mail. With effect from the next edition, Vol. 23 of January 2020, our newsletter will be available electronically and subscribers will be informed by Email of the link to the latest edition of the newsletter when it is posted on our website This is part of our initiative to be more environmentally friendly by reducing paper use and promoting more sustainable publication methods such as online publications. Thank you for your understanding.
http://www-naweb.iaea.org/nafa/fep/public/newsletters-fep.html
https://www.iaea.org/publications/search/type/food-and-environmental-protection-newsletter

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