Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Food & Environmental Protection Newsletter

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Contents

To Our Readers	1	Feature Articles	7	Technical Cooperation Projects	22
In Memory of Mr. David Byron	3	Forthcoming Events	12	Food and Environmental Protection Laboratory	32
Staff	4	Past Events	13	Recent Publications	39
ReNuAL News Brief	5	Coordinated Research Projects	20		

To Our Readers

Photo: FAO / Katia Iversen

As arrangements were being finalized for the International Symposium on Food Safety and Quality: Applications of Nuclear and Related Techniques, we learned the sad news that our Section Head, Mr. David Byron, had passed away on the evening of the 3 November, in Florida USA after a long illness. David was much loved for his ability to get things done and his great energy and purpose in working with people. We miss him as our section head; he was our inspiration for the Food and Environmental Protection subprogramme for many years. Our condolences and thoughts are with his family and his wife Petra. The symposium itself was a fitting tribute to David and the legacy of work he leaves behind. We have received many messages of sympathy from his former friends and colleagues worldwide – thank you for your kind thoughts.

The International Symposium was held to widely acclaimed success at the IAEA Headquarters in Vienna, Austria from 10 to 13 November 2014. We welcomed more than 300 scientists, laboratory analysts, policymakers, regulators, food producers and others concerned with food safety and quality, and the integrity of the food supply chain. Many touching tributes were given in memory of David Byron, and it was our great honour to dedicate the

event to David, including the David. H. Byron Award for the best poster presentation.

The Food and Environmental Protection Subprogramme is part of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture (the Joint Division) which this year celebrates its half century of exemplary collaboration within the United Nations system. During this time the Joint Division has promoted the mandates of both the International Atomic Energy Agency (IAEA) through peaceful uses of nuclear related technology to promote global health and prosperity and of the Food and Agriculture Organization of the United Nations (FAO) in its efforts to eliminate world hunger and reduce poverty through sustainable agricultural and rural development, improved nutrition and food security.

As you will see from the article inside this edition, the celebration of the 50th anniversary of the Joint Division was held on the 29 September 2014 in conjunction with the "ground-breaking" for the project to modernize the Nuclear Sciences and Applications Laboratories in Seibersdorf. It is fitting that this important landmark year also coincides with the capital investment project to support the renovation and modernization of laboratories including the Food and Environmental Protection Laboratory (FEPL). As you will recall, the Member States of the IAEA have called for this initiative, which is termed the ReNuAL project. This is particularly important for the Joint FAO/IAEA Division with its five laboratories collectively known as the Agriculture and Biotechnology Laboratories at the Seibersdorf complex, including our FEPL.

There are two feature articles in this newsletter. Each provides an overview of the subprogramme achievements, one focusing on our new direction which includes the development and promulgation of methods to analyse food to determine its authenticity in terms of composition and/or geographical origin and the other providing more information on our developing laboratory networks. The International Symposium on Food Safety and Quality and subsequent feedback has confirmed the relevance of the Food and Environmental Protection Subprogramme and of nuclear and related techniques. Our focus will remain on meeting the needs of Member States.

Feedback from the Symposium underlined the importance of our strategy to develop novel, cost effective food authenticity testing techniques, emphasised the continuing need for support and capacity building in regard to the detection and control of agrochemical residues and contaminants in food, agriculture and aquaculture and underlined our recent initiatives and future plans for activities in the area of food irradiation.

Recognition of the importance of the work we do has also allowed access to additional, extrabudgetary funding through the Peaceful Uses Initiative[1]. This funding has enabled us to leverage our expertise and networks to support food and environmental protection. In November we held a major workshop and training events; taking advantage of, and fully capitalizing on, the symposium by hosting these events alongside and immediately after the symposium, maximizing the impact for the participants and making best use of our financial and human resources to involve as many participants from different Member States as possible.

On a more personal note regarding our staff, we say a fond farewell to Mr. Lan Chen who left us at the end of November having completed his work at IAEA Headquarters of providing assistance and support for the implementation of the International Symposium. We wish Chen every success for the future. We also extend a warm welcome to two new members of staff; Mr. Enrique Nacif and Ms. Yasmin Leithner. Enrique joins us as a Team Assistant at IAEA headquarters and Yasmin is an intern assisting the Food and Environmental Protection Laboratories in Seibersdorf.

In closing, best wishes to you our readers and to your families for a happy, healthy and prosperous New Year.

Sincerely,

Carl M. Blackburn
Acting Section Head

[1] http://www.iaea.org/newscenter/focus/peaceful-uses-initiative

In Memory of Mr. David Byron

David Byron. Photo: IAEA

Mr. David Byron devoted his professional life to food standards and the protection of consumers, by working to improve food safety and quality. A "Chicago boy" by birth, his family also had links to food production through relations who farmed and with whom he spent many a happy vacation in his youth. Not only did farming enable David to drive cars, tractors and heavy machinery from a relatively early age, the experience also stimulated his interest in food production and quality, setting the course for his future career. From college he joined the Peace Corps and spent two years in Benin working to support improvements in agricultural production, then back in the USA as a meat inspector with the US Food Safety and Inspection Service. He worked his way through the ranks to the central administration in Washington DC, and for 16 years with the Food and Agricultural Organization (FAO) of the United Nations based in Rome with the Codex Alimentarius Commission. David was a leading figure in the promotion and coordination of food standards. Latterly, from 2003 until his death on 3 November 2014, David was based in Vienna at the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture as the Head of the Food and Environmental Protection Section.

David worked extensively with the Codex Alimentarius Commission, established jointly by FAO and WHO to develop and harmonize international food standards, guidelines and codes of practice to protect the health of the consumers and ensure fair practices in the food trade. When he joined the Joint FAO/IAEA Division his expertize was put to good use in IAEA standards setting committees and in Nuclear Emergency Preparedness and response. He was a strong advocate for food irradiation, and also responsible for nuclear and related techniques for the detection and control of residues and contaminants in food and more latterly for food authenticity. During the Great East Japan Earthquake and tsunami of March 2011 and the Fukushima Daiichi nuclear emergency he was one of the experts who supported the FAO and IAEA by working in coordination with other international organizations, keeping Member States informed of developments and addressing the public about food issues – and had been involved in developing emergency preparedness and responses to radiological emergencies affecting food and agriculture.

His work was characterized by his professionalism, decency, and a tough and uncompromising approach. He was a leader who could be firm but was always fair and treated all with the uppermost politeness and respect. He was particularly admired for his plain spoken, no nonsense frankness, that always cleared away the obfuscation and brought relief and clarity of purpose. Most of all it was his jocularity, appetite and zest for life that his friends will miss, coupled with his kindness and tenderness. He was a unique figure, someone who could never go unnoticed, who it would be impossible to lose in a crowd. He will be sorely missed by his many friends. We extend our condolences to his wife Petra, his daughters Olivia and Vanessa, his mother Alice and his two brothers Jamie and Danny.

Food and Environmental Protection Subprogramme

http://www-naweb.iaea.org/nafa/fep/index.html
http://www-naweb.iaea.org/nafa/fep/fep-laboratory.html
http://www.fao.org/ag/portal/age-index.html

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ReNuAL News Brief: Third Quarter of 2014

Breaking Ground on the Future Nuclear Applications Laboratories

Participants join the DG in the groundbreaking

On 29 September, IAEA Director General Yukiya Amano was joined in Seibersdorf by representatives of Member States and the Food and Agriculture Organization of the United Nations (FAO), as well as IAEA staff members, to break ground on the Renovation of the Nuclear Applications Laboratories (ReNuAL) project, and to celebrate the 50th anniversary of the FAO/IAEA Joint Division of Nuclear Techniques in Food and Agriculture. There were over 200 participants, with 48 Member States represented.

ReNuAL is an initiative to modernize the eight laboratories in Seibersdorf that belong to the IAEA's Department of Nuclear Sciences and Applications. The project calls for the construction of a new Insect Pest Control Laboratory (IPCL) to replace the existing IPCL, and a new Flexible Modular Laboratory (FML) to house three additional laboratories, by the end of 2017.

DG Amano and DDG Semedo cut a 50th anniversary cake

DG Amano was joined for this event by IAEA Board of Governors Chair Ms. Marta Ziakova, and FAO Deputy Director General and Coordinator for Natural Resources Ms. Maria Helen Semedo, who each delivered remarks in support of ReNuAL and the achievements of the Joint Division.

In his remarks, DG Amano said, "Our symbolic groundbreaking today marks the start of the implementation of the ReNuAL project. I am confident that with the active support of Member States, by 2017, we will have a cluster of modern, well-equipped laboratories here in Seibersdorf that we can all be proud of."

Moving from Planning to Construction

In July, an architectural and engineering firm was contracted to develop the conceptual designs for the Insect Pest Control Laboratory and the Flexible Modular Laboratory, and to update the master plan for the Seibersdorf site. This plan will guide the development to be carried out in the frame of ReNuAL and other related initiatives on the site.

Initial rendering of the new Insect Pest Control Laboratory (IPCL)

The conceptual design for the IPCL has been completed, and will be completed for the FML by the end of November. Planning for the latter is more complex as it will house multiple laboratories and is being designed to allow laboratory space to be more easily adapted to different activities and needs, and to be modular to make any future expansion more cost-effective.

IAEA International Atomic Energy Agency

ReNuAL Renovation of the Nuclear Applications Laboratories

The IPCL will house laboratory sub-groups dealing with plant pests, livestock pests, human disease vectors and genetics/microbiology. The FML is designed to house laboratories with similar activities to maximize synergies, for example, through the sharing of equipment and certain types of laboratory space. For this reason, the FML will house the Food and Environmental Protection Laboratory, the Soil, Water Management and Crop Nutrition Laboratory, and the Terrestrial Environment Laboratory.

The purpose of the conceptual designs is to provide the basic layout and structure of the new buildings, and in doing so to provide a greater degree of certainty regarding the costs of construction.

Upon completion of the conceptual designs, the detailed designs will be developed. These will build further on the conceptual designs and add greater detail by making more concrete decisions on smaller elements of the two buildings, such as the number, size and type of windows, and the number and type of light fixtures to be used.

Initial rendering of the new Flexible Modular Laboratory (FML)

With these designs and cost estimates, a tender for construction can then be issued, and it is estimated that construction will begin sometime in mid-2015.

Building Momentum in Resource Mobilization

As was reported to the 59th General Conference in September, ReNuAL has so far raised approximately €860 000 in cash and funding for cost-free experts. These funds and experts have been used to support the initial planning for the project and are now supporting the design work that is being carried out.

Also during the General Conference, China announced the in-kind donation of an irradiator that can potentially serve the needs of several laboratories: the Animal Production and Health Laboratory, the Insect Pest Control Laboratory and the Plant Breeding and Genetics Laboratory.

In the resolution related to ReNuAL that was passed by the General Conference, Member States expressed strong support for the project and requested its further development and implementation. Included in this was a specific request for the Secretariat to prepare thematic packages that would separate the various elements of the project into somewhat smaller components that would enable Member States to support specific programmatic areas according to their own interests and priorities.

The Secretariat will develop these packages once more detailed cost information from the conceptual designs of the Insect Pest Control Laboratory and Flexible Modular Laboratory is fully available.

Seeking Biosafety Level 3 Laboratory Capabilities

A number of Member States have expressed support for the establishment by the Agency of biosafety level 3 capabilities that would enable the Animal Production and Health Laboratory to respond to emerging challenges related to transboundary animal diseases. These capabilities are one of the group of project elements now defined as ReNuAL Plus (ReNuAL+), which was introduced by DG Amano in September to ensure that needs additional to those identified under ReNuAL can be addressed – provided the necessary extrabudgetary resources are available.

The process for licensing and constructing such a facility is complex and can take three to five years. For this reason, the Secretariat has been reviewing various options for obtaining biosafety level 3 capabilities. These include their establishment in Seibersdorf, or possibly at a facility in Mödling belonging to the Austrian Agency for Health and Food Safety (AGES in German). This facility already has biosafety level 3 capabilities and the associated infrastructure that is required, and therefore can potentially support the capabilities sought by the Agency.

AGES facility in Mödling

The IAEA, the Government of Austria and senior AGES staff are in consultations to review the options available for the establishment of these capabilities. These consultations will continue in the coming months. Provided a mutually agreeable solution can be identified, the estimated resource requirements for obtaining the capabilities required by the IAEA will be determined and communicated to Member States.

Feature Articles

Using Nuclear Techniques to Combat Food Fraud

Technical Officers: Russell Frew and Andrew Cannavan

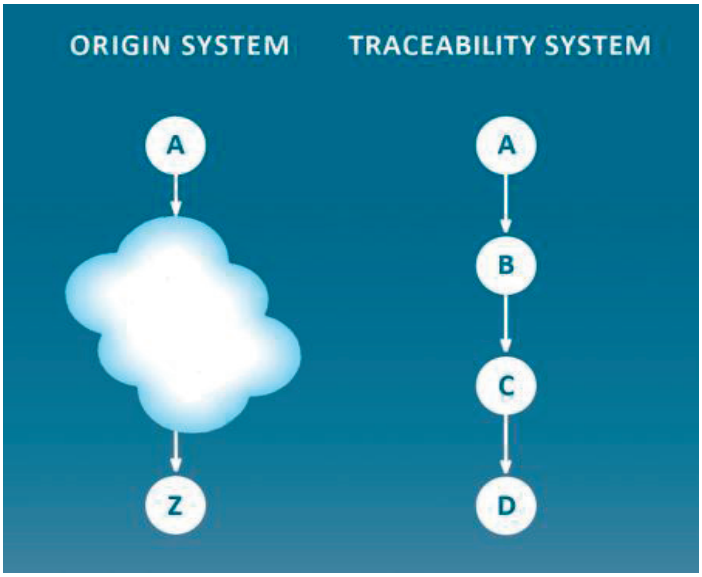
Horse meat in your beef burger. Melamine in milk powder. Dilution of your superior-quality honey, whiskey, fruit juice or rice with inferior substitutes. Reports of food fraud make regular headlines in the media, but how big is the problem? It is very difficult to say because one of the objectives of the deception perpetrated on consumers is to avoid detection, but an estimate by the World Customs Organisation puts the cost of food fraud at US $49 billion annually. There are many different types of food fraud, but two have particular food safety implications; economically motivated adulteration (EMA), and substitution.

A Federal Register Notice[2] of a 2009 FDA Open Meeting defines EMA as *"The fraudulent, intentional substitution or addition of a substance in a product for the purpose of increasing the apparent value of the product or reducing the cost of its production, i.e., for economic gain. EMA includes dilution of products with increased quantities of an already-present substance (e.g., increasing inactive ingredients of a drug with a resulting reduction in strength of the finished product, or watering down of juice) to the extent that such dilution poses a known or possible health risk to consumers, as well as the addition or substitution of substances in order to mask dilution."*

The investment by producers in technology to ensure safety and quality should result in higher prices and greater market access for their produce. The higher prices, however, provide the motivation for fraudsters. When a fraudster puts a genuine producer's label on a cheaper product to pass it off as the higher quality article the result is, at the very least, a loss of sale for the genuine producer. If the consumer has a bad experience with the item, brand damage will result and possibly even liability for recall or response.

The horse meat scandal of 2013 prompted the UK Government to commission Professor Chris Elliott to review the integrity of food supply networks. One of the key conclusions from the Elliott review was the need for enhanced analytical technologies and in particular greater networking of laboratories using these techniques for verifying the authenticity of food. A take-home message from the recent FAO/IAEA International Symposium on Food Safety and Quality: Applications of Nuclear and Related Techniques (Vienna, Austria, 10 to 13 November 2014) was that nuclear and related techniques for traceability and authenticity are key to ensuring the integrity of national and global food control systems. It was agreed that South/south cooperation and support from agencies such as the Joint FAO/IAEA Division are essential for the effective implementation of such systems.

What does this mean for the Member States? The increasing globalisation of the food supply provides greater opportunities for countries that produce high-quality and safe food. However, the monetary motivation and opportunities for fraudsters are also increasing. The high-value markets are requiring increasingly sophisticated traceability systems. There are very good systems available for tracing food through a supply chain, but they all suffer from a significant flaw. Traceability systems are essentially a paper-trail that passes information along the supply chain. The food is identified by a label attached to the package - maybe a bar code or radio frequency tag. Therefore the traceability system is actually tracking the packing but not the contents. All such systems require an independent means of verification. This is where nuclear and isotopic techniques play a significant role because they provide information on the environment where the food was produced and hence furnish a link back to the point of origin of the food.



The difference between an origin and a traceability system: *Origin refers to the starting point...the farm where the produce was harvested.*

[2] FDA. 2009. Economically motivated adulteration; Public meeting; Request for comment, Docket No. FDA-2009-N-0166. *Federal Register* 15497

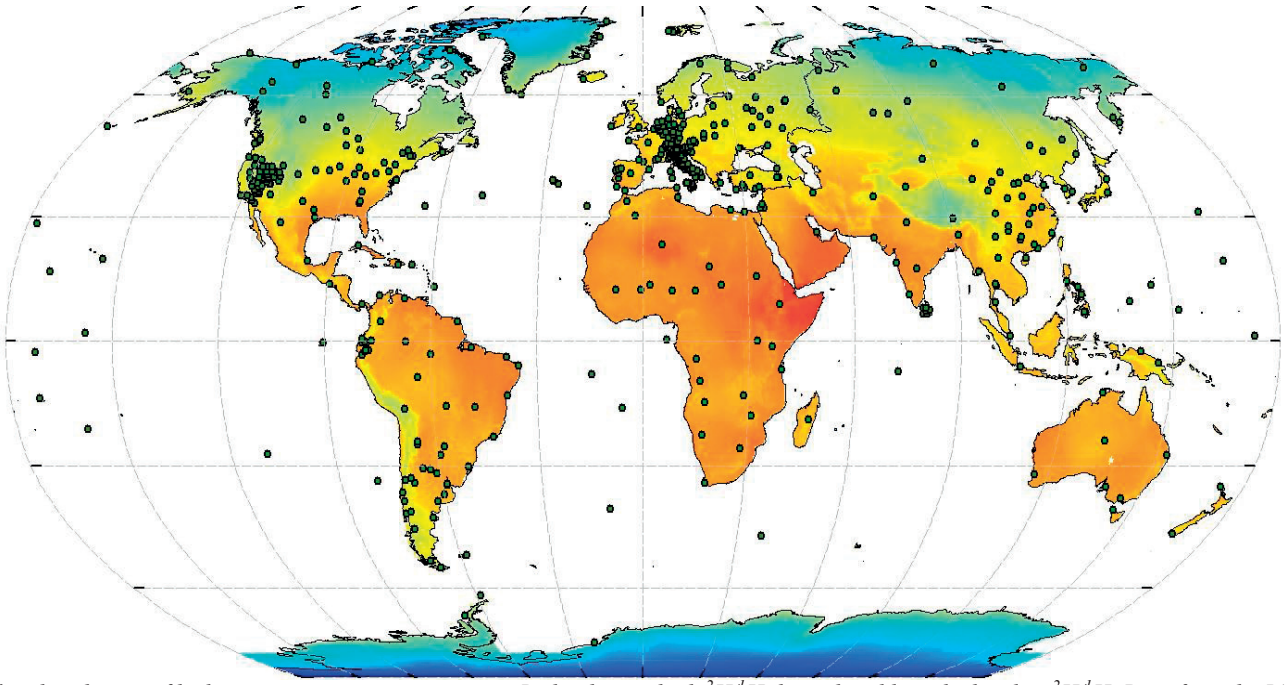
Traceability measures the journey of a product, point-to-point, from its origin to its consumption. Traceability systems cannot reliably answer questions about origin because they depend on the weakest link in a chain of evidence.

The stable isotope technique makes use of measurements of the chemistry of the food itself - inherent properties that cannot be readily counterfeited. Such techniques are complementary to conventional traceability systems; the chemical measurements are not a traceability system *per se* but enable verification of origin. This can provide an important audit capability for conventional traceability and also a means of rapidly determining origin should a food safety incident occur as a result of substitution of product.

What are stable isotopes? The isotopes of an element differ only in the number of neutrons in the nucleus. Thus the stable isotopes are naturally-occurring non-radioactive variants of the same element. The extra mass imparts very subtle differences in how the isotope will behave chemically compared to its lighter isotope. Two general rules apply; heavier isotopes form stronger bonds and so a reaction involving the heavier isotope will generally occur at a slower rate. If equilibrium is established, the heavier isotope will preferentially reside in the more condensed phase.

During food production, the components of the food undergo a complex series of (bio) chemical reactions involving the light elements (H, C, N, O and S). These elements all have at least two stable isotopes. The ratio of these isotopes in the food is dependent on the environmental conditions at the time the food was produced. This isotopic fingerprint of a sample can be read using isotope ratio mass spectrometers. The fingerprint of the sample can be compared with specifications previously established for food from that origin to either verify that it matches, or to indicate that there is likely to be a problem with the declared origin if the isotopic fingerprint in the sample does not match the expected fingerprint in authentic samples from that origin.

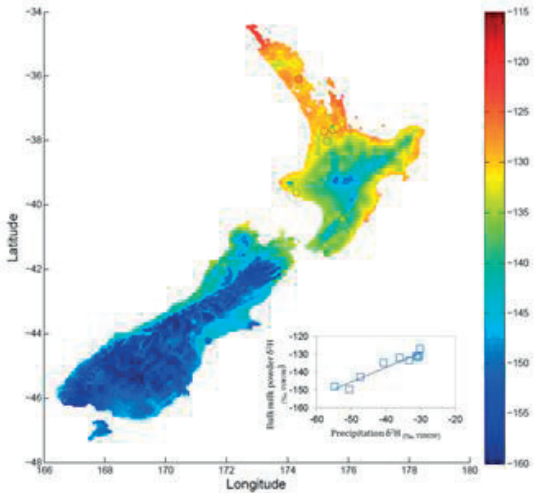
An example of utilising isotopic patterns is the measurement of the H and O isotopes in rainfall. The IAEA has been collecting isotope data from precipitation for many decades and so the pattern of geographical distribution is well known. The same pattern is passed up through the food chain and is expressed in any natural product. The challenge in applying the technology to make use of these patterns is in measuring the very subtle isotopic differences in the food matrix.



Geographic distribution of hydrogen isotopes in precipitation. Red indicates high $^{2}H/^{1}H$ through to blue which is low $^{2}H/^{1}H$. Data from the IAEA GNIP database.

The Food and Environmental Protection Subprogramme has a long track record of building capacity within Member States for food safety including developing and transferring nuclear and related techniques for determining residues and contaminants in food, thereby verifying that the food is fit for consumption. Food authentication and traceability have become increasingly important aspects of food control systems, and the Food and Environmental Protection Laboratory (FEPL) has responded to Member State requests for assistance in this respect by initiating applied

research, method development and capacity building projects. Research in our laboratory has concentrated on two key areas; preparation of quality control materials, and the development of analytical techniques for verifying the authenticity and origin of foods. Although the key nuclear-related technique is the measurement of stable isotopes, the FEPL is also working on complementary techniques such as metabolomics, or chemical fingerprinting and marker identification, for food authenticity, detection of adulteration and verification of origin. In addition to these laboratory activities, the FEPL also coordinates international research projects and gives the technical support and management to capacity building projects in a number of countries.



Food origin map based on hydrogen isotopes. A model that utilises measured relationships among the hydrogen isotopes in rainfall and milk powder can predict the hydrogen isotopic composition of milk produced across New Zealand. The use of such models greatly reduces the cost of developing a database for a traceability system. Ehtesham et al., (2013)

Preparation of quality control materials

The point of origin technique is essentially a mapping exercise. Producers need to measure sufficient numbers of samples to adequately define the specification for their produce. Measurements from a questioned sample can then be compared to the database of authentic samples. Data validity is therefore a key issue, and so quality control is essential. At present there is a lack of suitable stable isotope reference materials that are food based. To help in addressing this issue, FEPL is developing grain and dairy product materials that are being used in collaborating laboratories in our coordinated research and technical cooperation projects initially as quality control materials, and may ultimately be certified as reference materials.

Development of analytical techniques for verifying authenticity and origin

Analytical techniques for measuring stable isotopes are generally well-established. However there are a few very important techniques that need to be developed or adapted to the facilities available to Member States. The accurate measurement of hydrogen isotopes in food is complicated because a significant portion of the hydrogen in natural materials is loosely bound (e.g. carboxylic acids and amine groups). Such hydrogen can exchange with hydrogen from ambient water and so part of the isotope signal measured may arise from the lab environment rather than from the food's origin. FEPL has been adapting a method for measuring only the methoxyl hydrogen in a sample (it is non-exchangeable) so that it can be achieved on a standard elemental analyser with minor modification. Validation of this technique is currently under way, and once validated the technique will be transferred to Member States through training at Seibersdorf and in Member State laboratories. A similar approach is being taken to develop and adapt a method for measuring non-exchangeable hydrogen isotopes in sugar. This is an important tool for verifying that expensive sugar products such as honey, maple syrup, palm sugar etc., have not been diluted with cheap sugar from rice.

Coordinated research and capacity building

The FEPL currently coordinates two international research projects that focus on combatting food fraud and improving traceability, each involving collaborating laboratories in 15 countries. A project on the "Implementation of Nuclear Techniques to Improve Food Traceability" has just undergone its 3-year review and on the basis of the results produced so far, funding has been approved for the final two years. A second research project, "Accessible Technologies for the Verification of Origin of Dairy Products as an Example Control System to Enhance Global Trade and Food Safety" commenced in 2013. To help Member States in building capacity, two training courses on the application of stable isotope and trace element analyses for food traceability have been run under a regional technical cooperation project in Asia and the Pacific on building technological capacity for food traceability and food safety control systems through the use of nuclear analytical techniques. Capacity is also being developed in this field through two national projects (China and Uruguay).

The need for analytical methods to help combat food fraud, to underpin mechanisms for tracing the origin of food

commodities, authenticating food products, detecting adulteration and verifying food traceability has grown rapidly in recent years, and will most probably increase in the future with the continuing growth in the complexity of food supply chains. FEPL will expand its activities in this field of work and provide assistance to Member States as and when the need arises.

Building Food Safety Networks in Africa through our Work on Food and Environmental Protection

Technical Officer: James Sasanya

In the last newsletter, we featured our support for food safety programs in IAEA/FAO Member States focusing on countries in Latin America and the Caribbean as an example. This feature article highlights our efforts to establish laboratory networks in Africa and the activities supported by the Joint FAO/IAEA Division through the technical cooperation program. Under the Africa Regional Cooperative Agreement on Research, Development and Training Related to Nuclear Science and Technology (AFRA), a project on "Establishing a Food Safety Network through the Application of Nuclear and Related Technologies" is being implemented. This involves food and environmental safety related institutions in Algeria, Botswana, Cameroon, Egypt, Ethiopia, Mauritius, Namibia, Nigeria, South Africa, Sudan, Tunisia, Uganda, United Republic of Tanzania and Zimbabwe, working closely to address common needs and challenges.

The project has thus far enhanced the application of nuclear techniques in food safety control programs such as the use of radio receptor assay techniques in these Member States. These rapid laboratory screening tools have been established by sub-regional networking and collaboration, it is paving the way for the establishment of a fully regional network. The project's inaugural meeting and training took place in Tanzania in August 2012, and subsequently four sub-regional workshops have since been held in Tunisia, Mauritius, Cameroon and Ethiopia (training over 60 scientists/lab personnel). This is in addition to group training on ISO standards and analytical methods held at meeting in Nigeria and South Africa respectively. As planned at the inception of RAF5067, participating institutions are working with each other and sharing experiences, knowledge and resources with the support of the FEP Section. Trainees from one event have become resource persons in subsequent initiatives. For instance, at the end of 2013 Tanzania's Food and Drug Authority trained a laboratory technician from Botswana's National Veterinary Laboratory (BNVL) on analytical tools they became familiar with through an earlier RAF5067 event. Subsequently, in early 2014 BNVL consolidated and promulgated the knowledge they had obtained from Tanzania by training two analysts from Uganda.

Having access to a broad range of validated analytical methods to support food and environmental safety laboratory work is one of the biggest challenges faced by Member State institutions. In addition to obtaining analytical methods through the Joint FAO/IAEA's food contaminant residue information system (FCRIS) database, the RAF5067 network has identified ways to share their own laboratory methods. For example, analysts from Egypt, South Africa, Ethiopia, Uganda and Zimbabwe trained together for one month on various analytical techniques at the Onderstepoort Veterinary Institute in South Africa. Through their training and collaboration at that event, they have established an understanding of each other's needs and the benefits of sharing their own methods of analysis.

By growing as a network and working collaboratively, RAF5067 participants have also undertaken proficiency testing using inter-laboratory trials of radio-receptor assay tools obtained as part of the sub-regional workshops. Furthermore, these activities have served as a springboard for establishing an African Food Safety Network, AFoSaN (www.africanfoodsafetynetwork.org). The AFoSaN members are to encourage many other laboratories to join in their activities and collaborate on pertinent food safety issues. One of the major concerns in many IAEA Member States and being addressed in the AFRA RAF5067 project is the issue of aflatoxins (potent carcinogens) in foods. In this regard, the AFoSaN is collaborating in the Partnership for Aflatoxins Control in Africa (PACA) under the African Union Commission (www.aflatoxinpartnership.org/). Thus PACA representatives participated in the RAF5067 sub-regional food safety stakeholder workshop held in Ethiopia from 24 to 28 November 2014, to discuss and find ways of jointly addressing the challenges and opportunities associated with controlling Aflatoxins.

Members of AFoSaN also participated in the International Symposium on Food Safety and Quality organized by the Joint FAO/IAEA Division in Vienna, Austria and participated in discussions on global food safety issues. They also took this opportunity to visit the Austrian Agency for Health and Food Safety to find out more about

their work in Austria and Europe and this has laid the foundation for future collaborations with this EU reference laboratory. Our AFoSaN colleagues also joined with others from Cuba and the Republic of Korea and participated with an additional 60 stakeholders at an event arranged by the Permanent Mission of Japan, planned to coincide with the Joint Division's International Symposium. The event focused on "Building Laboratory Networks" using recent initiatives developed through the Food and Environmental Protection subprogramme including food safety, food quality as well as animal health and disease diagnosis.

The AFoSaN network is planning to grow to include many other institutions from at least 30 African countries in the next 2 years. The AFoSaN members are also exploring possibilities for interregional networks to address food safety issues. The Joint FAO/IAEA Division is continuing to partner with these institutions, using the network as an efficient means of meeting requests from Member States for support in food safety and quality issues where nuclear and related techniques can assist food and environmental protection.

AFoSaN members at the Learning about the Austria Agency for Health and Food Safety in Vienna, Austria, 14 November 2014. Photo courtesy of J.J. Sasanya.

Forthcoming Events

Experts Meeting on Assessment and Prognosis in Response to a Nuclear or Radiological Emergency
IAEA Headquarters, Vienna, Austria 20–24 April 2015

Technical Officer: Carl Blackburn

As the deadline approached for the finalization of this Newsletter the Section became involved with the planning of an International Experts Meeting on Assessment and Prognosis in Response to a Nuclear or Radiological Emergency. This will include sessions devoted to the impact of a nuclear or radiological emergency on food, feed, drinking water and agricultural products as well as on environmental modelling and monitoring. We therefore strongly encourage experts in this area to participate in the meeting which will have been formally announced by the IAEA once this newsletter is published. The overall objective of this meeting is to provide a forum for experts to discuss issues, challenges and solutions related to the assessment and prognosis process in response to a nuclear or radiological emergency. More information will be made available in the IAEA website[3].

"MAN-IMAL Man-Animal Food Health: Transdisciplinary Management of Global Health and Nutritional Safety"

Technical Officer: Andrew Cannavan

Our colleagues at the National College of Veterinary Medicine, Food Science and Engineering (ONIRIS) in Nantes, France are pleased to announce that, following the successful launch of their "One Health" Master's Programme in November 2013, **applications for the 2nd year Master's Degree are now open for the academic year 2014–2015.** More information is available on the website: **http://www.man-imal.fr/en/**

The 2nd year Master's Programme is entitled "MAN-IMAL Man-Animal Food Health: Transdisciplinary Management of Global Health and Nutritional Safety" and is taught entirely in English.

It includes a Biological & Chemical Risks module covering subjects such as: indicators for chemical hazard analysis, methods and tools for hazard analysis, toxicology principles, statistical aspects, metrology, etc.

Classes take place in Nantes (France) from November 2014 to September 2015 and the programme is open to international students in the following fields: medicine, pharmacy, veterinary, agricultural or food-processing engineering.

The application form must be completed online via the MAN-IMAL website: http://www.man-imal.fr/en/ (see ''Apply now'').

[3] http://www-pub.iaea.org/iaeameetings/

Past Events

International Symposium on Food Safety and Quality: Applications of Nuclear and Related Techniques IAEA Headquarters, Vienna, Austria 10–13 November 2014

Technical Officer: Carl Blackburn

The International Symposium was held at the IAEA Headquarters in Vienna, Austria from 10 to 13 November 2014. This article is a brief summary and we plan to provide more details as a Feature Article in the next Newsletter.

The symposium included several sessions covering a wide range of topics involving nuclear techniques in food and agriculture; not only food irradiation but also analytical technologies for food authentication, traceability and contaminant control. Emerging opportunities and threats to the integrity of the food supply and potential control techniques were also covered, and there were interesting discussions on international standards, consumer protection and trade issues.

More than 300 researchers, laboratory analysts, policymakers, regulators, food producers and others were present and participated. Information was presented on contemporary and novel applications involving nuclear and related techniques, and the participants discussed different perspectives and future opportunities. The Symposium not only show-cased the area of work covered by Food and Environmental Subprogramme but it also served to provide a forum for interdisciplinary networking between professionals from different backgrounds, national institutes, academia, industry, and international organizations.

The presentations from the Symposium are now freely available via the internet[4]. As are the presentations provided at the Satellite workshop: "Food Control Systems and the Role of Different Stakeholders in the Food Supply Chain", that was held immediately after the Symposium[5].

The staff of the Food and Environmental Protection Section and Laboratory would like to thank all who participated at the symposium and during the satellite workshops. They proved to be successful and popular events. We are making arrangements for selected contributions to be published in a special edition of a leading scientific journal and hope to bring you more news on this soon.

FAO/IAEA training workshop on "Application of Quality Assurance and Control in Analytical Laboratories to Address Food Safety and Quality" IAEA Laboratories, Seibersdorf, Austria 10–21 November 2014

Technical officer: B. Maestroni and V. Ochoa

Protection of the integrity of the food supply is of utmost importance in terms of food security, food safety and quality, consumer protection and international trade. Techniques to maintain and assure the quality and safety of food are necessary throughout the food production and supply chain. The need for methods to monitor and verify food safety and quality is evidenced by the ever growing list of food product recalls due to contamination. Emerging issues have highlighted the need for continued refinement, development and innovation to improve measures to ensure food safety and quality. All of the above requires intensive practical and theoretical training.

To help meet these requirements, the Joint FAO/IAEA Division held a training workshop on "Application of Quality Assurance and Control in Analytical Laboratories

[4] http://www-pub.iaea.org/iaeameetings/cn222Presentations.aspx
[5] http://www-pub.iaea.org/iaeameetings/cn222Presentations.aspx#SatelliteEvent

to Address Food Safety and Quality" which took place in IAEA Vienna International Centre (10-14 November) and IAEA Laboratories, Seibersdorf, Austria (17-21 November).

The workshop was focused on food safety and quality and included protection of the integrity of the food supply chain as a holistic process, involving multiple stakeholders and requiring the application and integration of different analytical methods and processing technologies. It brought together experts in these fields who presented contemporary applications and discussed future perspectives and opportunities, providing a forum for interdisciplinary networking between all stakeholders in the farm to fork food chain.

The workshop comprised two different activities: the first week involved participation at the "International Symposium on Food Safety and Quality: Applications of Nuclear and Related Techniques" and participation at the satellite event on 14th November 2014 on "Food Control Systems and the Role of the Different Stakeholders in the Food Supply Chain". More than 80 participants took part at the event that covered food control systems, the role of the analytical laboratory and national food safety agencies in the farm to fork chain decision making based on quality input data and risk assessment, risk based management options and communication and panel discussions.

The second week was focused on an intensive analytical training provided at FAO/IAEA Food and Environmental Protection Laboratory premises in Seibersdorf, Austria. 23 participants from 21 countries took part at the training workshop. More detailed information will be made available in the next newsletter in June 2015.

Participants of the Satellite event on "Food Control Systems and the Role of the Different Stakeholders in the Food Supply Chain", Vienna, Austria. Photo courtesy of B. Maestroni.

Participants of the FAO/IAEA training workshop on "Application of Quality Assurance and Control in Analytical Laboratories to Address Food Safety and Quality at Seibersdorf laboratories. Photo courtesy of B. Maestroni.

New IAEA Collaborating Centre

The National Center for Electron Beam Research (NCEBR) at Texas A&M University is now an IAEA Collaborating Centre for Electron Beam Technology for Food, Health and Environmental Applications.

The Centre has an excellent electron beam facility for demonstration and training purposes that benefits from the excellent support and environment of Texas A&M University Agri Life Research which is comprised of more than 1 600 full-time employees (600 with a PhD) and conducts research touching almost every aspect of agriculture and life science. The NECBR is involved in several IAEA Coordinated Research Projects and Technical Cooperation Projects. The centre has hosted many IAEA sponsored fellowships and IAEA sponsored participants from around the world have also attended their annual hands-on workshop on radiation processing, Technical and scientific training in the areas of food irradiation, microbiology and electron beam processing has also been provided for many of our colleagues from around the world. The irradiation facility is also approved by the USDA-APHIS for the phytosanitary irradiation of fresh produce.

IAEA Director General Yukiya Amano presents the IAEA plaque to Suresh Pillai at the official designation ceremony.

The Centre designation was commemorated by a plaque being presented by IAEA Director General Yukiya Amano. The ceremony was held in College Station, Texas on November 2014 in presence of Dr. Mark Hussey -Interim President of Texas A&M University, Chancellor John Sharp, Dr. Craig Nessler, Director of Texas A&M AgriLife Research and Dr. Suresh Pillai, Director of the Center on 7 November 2014.

The Twenty Fourth Meeting of the Inter-Agency Committee on Radiological and Nuclear Emergencies Luxembourg City, Luxembourg 19–24 November 2014

Technical Officer: Carl Blackburn

The Technical Officer represents the FAO at the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE). The IACRNE provides for the formal coordination between the different relevant international intergovernmental participant organizations and ensures consistent arrangements and capabilities for preparedness and response to nuclear and radiological incidents and emergencies are developed and maintained[6]. This is in relation to the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. The two prime legal instruments that establish an international framework to facilitate the exchange of information and the prompt provision of assistance in the specific event of a nuclear or radiological emergency.

This 24th Meeting of IACRNE was hosted by the European Commission at their office in Luxembourg City. The forthcoming activities for the IACRNE were discussed and include: revision of the IAEA Safety Requirements No. GS-R-2, development of IACRNE standard operating procedures, production of a leaflet relating to the Joint Plan of the International Organizations (JPLAN), the planned meeting of Competent Authorities identified under the Early Notification and Assistance Conventions, and various other activities related to IACRNE Working Groups, for example the coordinated international exercises. In addition, the United Nations Environment Programme was welcomed as a new IACREN participating member organization and it was noted that membership now includes eighteen participating entities with an additional seven corresponding members.

Under the arrangements between FAO and IAEA for information exchange and technical support in relation to food and agriculture in the case of a nuclear or radiological emergency, the Joint FAO/IAEA Division is the FAO focal point and also staffs the FAO desk in the IAEA Incident and Emergency Centre (IEC). The Joint FAO/IAEA Division coordinates and ensures the dissemination of information between the IEC and FAO headquarters. In this regard the Technical Officer reported the following matters of interest to the meeting participants;

Emergency Response Guidance Targeting Food and Agriculture

A joint FAO/IAEA initiative to develop a publication "Guidance for Responding to Nuclear and Radiological Emergencies Affecting Food and Agriculture" is on-going. Consultants are currently being recruited to produce an initial draft document which aims to offer guidance to agricultural and food departments. Although general standards and guidelines dealing with emergency preparedness and response are available, few if any are specifically tailored to the agriculture sector, e.g. for organizations responsible for crop and livestock production and agricultural land or irrigation water. Policy makers in the agricultural sector do not readily understand radiological protection principles, nor the associated terminology and technical language. In this regard Member States have indicated their need for easy to understand guidance that focuses specifically on agricultural activities. Guidance will aid competent authorities in Member States and facilitate the development of land, water and crop management strategies to minimize the impact of radionuclides on food and agriculture and support rural communities to regenerate in a sustainable fashion. Authoritative guidance will also support understanding and promote the information flow between different countries

[6] http://www-ns.iaea.org/tech-areas/emergency/inter-agency-matters.asp

as well as between different organizations and government departments.

Codex Alimentarius Standard Guide Line Levels for Radionuclides in Food

The Joint FAO/IAEA Division participated at the Eight Session of the Joint FAO / WHO Codex Committee of Contaminants in Foods (CCCF), held at The Hague, Netherlands, 31 March to 4 April 2014. This included providing a report to up-date the committee on Joint FAO/IAEA activities including those related to radionuclides in food and water, and work on mycotoxins and heavy metal contaminants. Based on the report, the CCCF resolved to re-establish an electronic working group to evaluate the application of Codex guidelines for radionuclides in foods and water, co-chaired by The Netherlands and Japan with the support of the Joint FAO/IAEA Division.

The electronic working group is following up on the conclusions and recommendations of an Inter-Agency Working Group instigated by the IAEA in 2013 to discuss international standards and the conditions under which they are intended to be used, including the guideline levels for radionuclides in the General Standard for Contaminants and Toxins in Food and Feed (CODEX STAN 193-1995). The issues raised in this regard include i) the stage of food production to which the Codex guidelines on radionuclides apply; ii) the period of time these guidelines should apply in food trade following a nuclear and radiological emergency; iii) the identification of internationally validated methods of analysis of radionuclides in food; and iv) the development of sampling plans to enhance the implementation of the Codex guidelines. A paper and questionnaire with was developed and subsequently circulated to participating member states with a deadline of 31 October for response. A report of the findings will be produced for consideration by the CCCF at its next meeting in New Delhi, India from 16 to 20 March 2015.

The Technical Officer also reported on The Joint Divisions participation in a technical meeting and subsequent activities concerning Reference Levels for Radionuclides in Foodstuffs and Drinking Water and this item is reported separately in this newsletter.

Technical Meeting on Reference Levels for Radionuclides in Foodstuffs and Drinking Water Following a Nuclear Accident
IAEA Headquarters, Vienna, Austria
8–12 September 2014

Technical Officer: Carl Blackburn

The Technical Officer represented the FAO at this technical meeting. The purpose of the meeting was for participants to provide input and guidance on the development of a Technical Document (TECDOC). The IAEA was requested to prepare this TECDOC with the input of International Organizations by the Radiation Safety Standards Committee (RASSC) at its 35th meeting in November 2013. The meeting discussed the various international and national standards related to food and drinking water and was very useful in clarifying the correct application of such standards. However, it should be noted that the proposed TECDOC is not intended to address response and controls during an emergency as this is covered by existing emergency preparedness and response standards but the focus of the TECDOC is to serve as a reference document on current standards and to help countries develop appropriate reference levels (activity concentrations) for use in the longer-term should residual (post-accident) radionuclide levels remain elevated but the emergency is ended. A copy of the meeting report is available from the Technical Officer on request. It was noted that the Codex Alimentarius approach[7] to calculating guideline levels for radionuclide concentrations in food destined for international trade would also be helpful for calculating radionuclide reference levels in other scenarios. The TECDOC is being produced and an initial draft version was provided to the thirty-seventh Radiation Safety Standards Committee meeting.

[7] http://www.fao.org/fileadmin/user_upload/agns/pdf/CXS_193e.pdf

Joint FAO/IAEA Division Represents the IAEA at the 37th Session of the Codex Alimentarius Commission Geneva, Switzerland 14–18 July 2014

Technical Officer: James Sasanya

During the session, the officer provided a report on past, current and future activities of the Joint Division relevant to Codex Alimentarius; participated in a side event on Scientific Advice to Codex; interacted with delegations with regards to activities of the IAEA pertinent to respective Member States; and responded to questions/comments in session and during informal interactions.

The IAEA supports Codex Alimentarius Activities; 37th Codex Alimentarius Commission meeting. Photo courtesy of J.J. Sasanya.

Thirty-Seventh Meeting of the IAEA Radiation Safety Standards Committee (RASSC) IAEA headquarters, Vienna, Austria 24–25 November 2014

Technical Officer: Carl Blackburn

The Technical Officer represented the FAO at the meeting. RASSC met in session to consider various radiation standards issues including work related to the development of reference levels for radionuclides in foodstuffs. A report of the Technical Meeting on Reference Levels for Radionuclides in Foodstuffs and Drinking Water Following a Nuclear Accident of 8 to 12 September at the IAEA Headquarters (mentioned separately in this Newsletter) was presented and a preliminary draft TECDOC on developing reference levels for radionuclides in foodstuffs and drinking water was also presented for information. The meeting discussed these developments and in addition to food and water related matters the secretariat raised a recommendation for the development of guidance on the control of contaminated (non-food) commodities for example reference surface contamination levels. The latter point was noted and is to be developed through RASCC working groups.

The RASCC was also up-dated on progress on producing the IAEA report on the Fukushima Daiichi accident. Approximately 180 experts from over 40 countries and various international organizations (including the FAO) were involved in the writing the report and it is now being reviewed and edited. Formal publication of the report is planned for the 59th IAEA General Conference in September 2015.

248th American Chemical Society National Meeting and Exposition San Francisco, USA 10–14 August 2014

Technical Officer: Andrew Cannavan

The American Chemical Society (ACS) is the world's largest scientific society and one of the world's leading sources of authoritative scientific information. The theme of the 248th National Meeting was 'Chemistry and Global Stewardship', focusing on aspects of chemical enterprise related to sustainability of world resources and the responsibilities and opportunities chemists have to serve the broader public. The meeting comprised a large number of individual symposia with different themes. The Food and Environmental Protection Laboratory (FEPL) Head gave an invited oral presentation on the application of stable isotope measurements and metabolomics for traceability and authenticity of milk, fruit juices and honey, in the session 'Authentication and Adulteration of Food', organised by the ACS Division of Agricultural and Food Chemistry (AGFD).

Meetings were convened by the AGFD chair of the 'Authentication and Adulteration of Food' session to discuss with the paper presenters possible methods to further disseminate the information presented in the session. It was decided that an ACS publication comprising an overview and summaries of the presentations is the best option. This concept will be further developed over the next year. The ACS meeting also included the 13th International Union of Pure and Applied Chemists (IUPAC) International Congress of Pesticide Chemistry. The FEPL Head participated in a number of sessions of the

congress. Several posters were presented in these sessions by counterparts in IAEA TCPs and other collaborators, including two posters co-authored by staff from the FEPL at Seibersdorf; 'Comparison of estimated KD and KOC for pesticides using pure active ingredient and formulated product in soils from Latin America and Europe using radiometric techniques' and 'Integrated analytical approaches to assess indicators of the effectiveness of pesticide management practices at a catchment scale'. Both posters focused on technology and methods transferred through training courses run by the FEPL. The methods are being effectively disseminated by the RALACA laboratory network, established under FEPL projects.

The inclusion in the ACS meeting of a symposium on food authentication and adulteration, and the wide scope of the speakers' presentations in the symposium, is a good indication of the growing importance of this topic in food control. Stable isotope analysis is one of the key techniques used, and IAEA is widely accepted as a world leader in the application of this technique to underpin food control systems. There was a lot of interest shown in the presentation of the work done at Seibersdorf in integrating isotopic and complementary techniques to support the concept of a technology package for food authenticity testing. This has already led to an interchange of ideas and concepts for possible collaboration between the Joint FAO/IAEA Division and the US FDA.

In the field of food contaminant control (pesticide residues), the presence at the meeting of many IAEA TC counterparts and FAO/IAEA CRP collaborators, as participants and presenters, was a measure of the continuing high impact of the work of the Joint Division in this field, especially in Latin America. It was clear from the various presentations that there are still many problems in this area for which the Joint Division can supply feasible solutions through the use of nuclear and related techniques.

IAEA Participation in ASEAN – WTO Pesticide Residue Data Generation Training Workshop Bali, Indonesia 24–28 November 2014

Technical Officer: Johannes Corley

The Technical Officer (TO) was invited by ASEAN to present on study conduct including the use of stable isotope internal standards for residue analytical methods, compilation of data and submission of reports to the Joint FAO-WHO Meeting on Pesticide Residues (JMPR) for the establishment of international food safety standards. The meeting was held in Bali, Indonesia and was sponsored by ASEAN, WTO, the USDA and the IR-4 Project and aimed at capacity building within ASEAN countries for generating food safety data.

Several ASEAN countries including Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Singapore, Thailand and Vietnam are participating in a global study on the development of data on the use of safer pesticides in crop production. The magnitude of residue data generated in the project is to be submitted to the JMPR for review and establishment of international food safety standards (Maximum Residue Limits, MRL). The participants represented different aspects of the study including field scientists, laboratory scientists and quality assurance personnel.

Participants of the ASEAN – WTO Pesticide Residue Data Generation Training Workshop. Photo courtesy of J. Corley.

The workshop consisted of training on residue analysis method development (including the use of stable isotope internal standards to improve method performance) and validation, sampling and sample analysis, storage stability evaluation, quality assurance, report generation and submission to JMPR. The trainers were from Michigan State University and Rutgers University in the U.S.A. and the FAO/IAEA Joint Division in the Vienna, Austria.

The Technical Officer discussed the use of stable isotopes as internal standards in improving data quality and speed of analysis as well as reliability and acceptability standards for an analytical method. He also discussed planning the study and matching testing parameters to final GAP directions for agrochemical use, the submission process for JMPR review and Codex MRLs.

The participants in the meeting developed a better understanding of the use of nuclear techniques in residue analytical methods, developing a study suitable for submission to the JMPR, the actual submission process and

the importance of food safety standards in international trade.

Exploring Global Partnerships for Better Control of Veterinary Drug Residues to Better Public Health and Enhance Trade
Paris, France, 4-5 November 2014

Technical Officer: James Sasanya

Following an invitation by the Common Wealth Agricultural Bureau International (CABI), UK and Food Animal Residue Avoidance Databank (FARAD) of the USA, the Technical Officer represented the Joint Division at a two day expert consultative meeting to explore possible development of a Global Database on Veterinary Drug Residues in foods. The meeting was supported by the Standards and Trade Development Facility (STDF) of the World Trade Organization and sister institutions.

The FAO, WHO, OIE, STDF secretariat, FARAD and associated Universities in the USA, CABI and World Veterinary Association attended. Others were the International Meat Secretariat, International Federation for Animal Health (IFAH), Safe Supply of Affordable Food Everywhere (SSAFE) as well as The Health Products Regulatory Authority (HRPS). The African Union's Inter-African Bureau for Animal Resources also sent their contributions.

Once commenced, such work would complement the important work of Codex Alimentarius and Joint FAO/WHO Expert Committee on Food Additives and facilitate trade in safe animal products. The Joint FAO/IAEA Division could support and promote the residue database through Food Contaminant Residue information System, our own database on analytical methods.

Coordinated Research Projects (CRPs) and Research Coordination Meetings (RCMs)

CRP Reference Number	Ongoing CRPs	Scientific Secretary
D52037	Implementation of Nuclear Techniques to Improve Food Traceability	Frew, R. Cannavan, A.
D52038	Accessible Technologies for the Verification of Origin of Dairy Products as an Example Control System to Enhance Global Trade and Food Safety	Frew, R. Cannavan, A.
D62008	Development of Generic Irradiation Doses for Quarantine Treatments	Hénon, Y. Parker, A.G.
D62009	Development of Irradiated Foods for Immuno-compromised Patients and Other Potential Target Groups	Blackburn, C.M. Hénon, Y.
D61024	Development of New Applications of Machine Generated Food Irradiation Technologies	Hénon, Y.
D52039	Development and Strengthening of Radio-Analytical and Complimentary Techniques to Control Residues of Veterinary Drugs and Related Chemicals in Aquaculture Products	Sasanya, J.J.
CRP Reference Number	**Closing CRPs**	**Scientific Secretary**
D52036	Development of Radiometric and Allied Analytical Methods to Strengthen National Residue Control Programmes for Antibiotic and Anthelmintic Veterinary Drug Residues	Sasanya, J.J. Cannavan, A.
D62008	Development of Generic Irradiation Doses for Quarantine Treatments	Hénon, Y. Parker, A.G.

Coordinated Research Project (CRP) Response to Nuclear Emergency affecting Food and Agriculture

Technical Officer: Carl Blackburn

This international research effort aims to develop and assess systems for innovative data collection, management and geo-visualization in terms of "electronic platforms" that can be used in both routine monitoring and also for emergency response to nuclear and radiological incidents that could affect food and agriculture. This project also aims to stimulate the development of electronic methods of maintaining, sharing and visualizing food and agricultural monitoring data. Work so far has had an early success in developing and promulgating an advanced geo-visualization tool. Details of the CRP and its objectives are available online at http://www-naweb.iaea.org/nafa/swmn/crp/swmcn-nuclear-emergency-food.html.

Final Research Coordination Meeting of the Coordinated Research Project on the Development of Generic Irradiation Doses for Quarantine Treatments IAEA Headquarters, Vienna, Austria 2–6 June 2014

Technical Officer: Yves Hénon

The final Research Coordination Meeting (RCM) of the Coordinated Research Project (CRP) on the Development of Generic Irradiation Doses for Quarantine Treatments was held in the headquarters of IAEA in Vienna, Austria from 2 to 6 June 2014.

The overall objective of the CRP was to validate generic treatment doses for groups of arthropod pests of quarantine significance in international trade. Considerable progress has been made since the project commenced in 2009. The CRP enabled participants from 15 different countries to share expertise and create a network of scientists with common interest.

During the course of the project, 38 different pest species were studied of which 13 were fully completed using very large numbers of insects in confirmatory tests, to validate treatment efficacy at levels of phytosanitary security commonly used internationally.

Two treatments, one for the European corn borer (*Ostrinia nubilalis*) and one for three species of mealy bugs (*Pseudococcidae*) are at an advanced stage of the International Plant Protection Convention (IPPC) approval process. Other generic and species specific treatments have been developed as a result of this CRP that will be submitted at the next IPPC call for treatment proposals.

The effects of irradiation on the sensory and nutritional attributes of 24 fresh commodities were studied. At least 16 commodities were not significantly affected by doses that they would receive in a commercial irradiator (≥ 800 Gy).

The results of this research will strengthen existing irradiation standards developed under the International Plant Protection Convention (IPPC), thereby helping to enable international trade for various fruits and vegetables through the use of generic irradiation doses for a wide range of quarantine pests

Participants of the RCM at the Vienna International Centre, Vienna. Photo courtesy of Y. Hénon.

Technical Cooperation Projects

Country/Region	Project No.	Title	Technical Officer
Azerbaijan	AZB5001	Establishing a Spectrometry Laboratory at the State Metrology Service under the State Committee for Standardization, Metrology and Patents	Kis-Benedek, G. (NAEL) Blackburn, C.M.
Benin	BEN5008	Establishing Enhanced Analytical Capability to Comply with International Standards for the Evaluation and Control of Veterinary Drug Residues in Food of Animal Origin	Sasanya, J.J.
Benin	BEN5009	Monitoring Safe Food Supply through Total Diet Studies and the Application of Nuclear and Complementary Analytical Techniques	Hénon, Y. Blackburn, C.M. Sasanya, J.J. Pitois, A.R.R. (NAEL)
Botswana	BOT5010	Enhancing Veterinary Drug Residue Monitoring Capabilities	Cannavan, A. Sasanya, J.J.
Belize	BZE5007	Supporting Sustainable Capacity Building through Distance Learning for Laboratory Personnel of the National Agricultural Health Authority	Corley, J. S. Viljoen, G. J. Maestroni, B.M.
Central African Republic	CAF5007	Enhancing Laboratory Capacity to Control Chemical and Bacteriological Hazards in Foodstuffs of Animal Origin	Sasanya, J.J.
Costa Rica	COS1007	Establishing Gamma Irradiation Capabilities at the Costa Rican Institute of Technology (ITCR) for the Use of Radiation Processing Technology	Hénon, Y. Blackburn, C.M.
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	Sasanya, J.J.
China	CPR5021	Facilitating the Application of Electron Beam for Food Irradiation	Hénon, Y. Byron, D.H. Blackburn, C.M.

Ecuador	ECU5027	Improving Food Security and Environmental Sustainability by Monitoring Wetlands as Indicators of Good Agricultural Practice in Palm Oil Production	Maestroni, B.M. Corley, J. S.
Ecuador	ECU5028	Consolidating Food Security and Environmental Sustainability in Palm Oil Production Using Nuclear Applications	Cannavan, A. Maestroni, B.M. Nguyen, M.L. Heng, L.K.
El Salvador	ELS7006	Building Capacities to Minimize Environmental Contamination and to Protect the Health of the Rural Population by Strengthening Research Capabilities and Laboratory Infrastructure	Maestroni, B.M.
Guatemala	GUA7004	Developing Capabilities to Evaluate the Transfer and Fate of Water Pollutants to Improve the Management of Major Basins and the Safety of Agricultural Products	Maestroni, B.M. Nguyen, M.L.
Malaysia	MAL5029	Applying Mutation Breeding and Optimized Soil, Nutrient and Water Management for Enhanced and Sustainable Rice Production	Nguyen, M.L. Nielen, S. Blackburn, C.M.
Mongolia	MON5019	Assessing and Enabling the Implementation of Food Irradiation Technologies	Sasanya, J.J. Cannavan, A.
Morocco	MOR1008	Developing Application and Implementation of Quality Management Protocols for Multipurpose Gamma Irradiation Facility	Hénon, Y. Sabharwal, S. (NAPC) Blackburn, C.M.
Morocco	MOR5033	Using Nuclear Techniques to Support the National Programme for the Generic Improvement of Annual and Perennial Plants and to Develop Agricultural Production	Hénon, Y. Sabharwal, S. (NAPC) Nguyen, M.L. Blackburn, C.M. Sarsu, F.
Morocco	MOR5034	Improving Veterinary Drug Residue Detection and Animal Disease Diagnosis with Nuclear and Molecular Techniques	Naletoski, I. Sasanya, J.J.
Namibia	NAM5013	Assessing the Spatial Distribution of Lead, Cadmium and Selected Pesticide Residues in Livestock Farming	Corley, J.S. Cannavan, A. Sasanya, J.J.
Niger	NER5017	Improving Onion Quality and Storage Life by means of Gamma Irradiation	Hénon, Y. Blackburn, C.M.

Oman	OMA5003	Strengthening National Capabilities in Food Safety and Food Traceability	Corley, J.S. Maestroni, B.M.
Pakistan	PAK5048	Strengthening Capabilities to Monitor and Control Veterinary Drug Residues in Foodstuffs	Sasanya, J.J
Panama	PAN5022	Determining Pesticides and Inorganic Pollutants in Vegetables and Studying the Adsorption and Migration Through Nuclear Technologies in Zones of High Pollution Incidents to Guarantee Safe Food for Consumers	Maestroni, B.M.
Paraguay	PAR5010	Strengthening the National Network of Laboratories Involved in Chemical Risk Analysis to Ensure Food Safety Through the Use of Nuclear and Complementary Non-Nuclear Techniques	Corley, J.S. Maestroni, B.M. Sasanya, J.J.
Qatar	QAT5004	Upgrading the Central Food Laboratory	Blackburn, C.M. Ceccatelli, A. (NAEL)
Africa	RAF5067	Establishing a Food Safety Network through the Application of Nuclear and Related Technologies	Sasanya, J.J. Cannavan, A.
Asia	RAS5057	Implementing Best Practices of Food Irradiation for Sanitary and Phytosanitary Purposes	Blackburn, C.M. Byron, D.H.
Asia	RAS5061	Supporting Food Irradiation Technology to Ensure the Safety and Quality of Meals for Immunocompromised Patients and Other Target Groups	Blackburn, C.M. Hénon, Y.
Asia	RAS5062	Building Technological Capacity for Food Traceability and Food Safety Control Systems through the Use of Nuclear Analytical Techniques	Frew, R. Cannavan, A. Maestroni, B.M. Jandrić, Z.
Asia	RAS5071	Strengthening Adaptive Climate Change Strategies for Food Security through the Use of Food Irradiation (RCA)	Hénon, Y. Blackburn, C.M.
Asia	RAS7026	Supporting the Use of Receptor Binding Assay (RBA) to Reduce the Adverse Impacts of Harmful Algal Toxins on Seafood Safety	Cannavan, A. Bottein, M.
Latin America	RLA5065	Improving Agricultural Production Systems Through Resource Use Efficiency (ARCAL CXXXVI)	Maestroni, B.M. Nguyen, M.L. Sakadevan, K.

Latin America	RLA5066	Increasing the Commercial Application of Electron Beam and X Ray Irradiation Processing of Food	Hénon, Y. Blackburn, C.M.
Latin America	RLA7019	Developing Indicators to Determine the Effect of Pesticides, Heavy Metals and Emerging Contaminants on Continental Aquatic Ecosystems Important to Agriculture and Agroindustry (ARCAL CXXXIX)	Maestroni, B.M. Vasileva-Veleva, E.T. (NAEL)
Sri Lanka	SRL1008	Providing Technical Support for Smooth, Safe and Sustained Operation of the Multipurpose Gamma Irradiation Facility	Hénon, Y. Sabharwal, S. (NAPC) Blackburn, C.M.
Sri Lanka	SRL5043	Supporting the Operation of a Gamma Irradiation Facility for Preservation of Food, Sterilization of Medical Products and Quarantine of Fruits	Hénon, Y. Blackburn, C.M. Sabharwal, S. (NAPC)
Sudan	SUD5035	Establishing a Laboratory for Monitoring Veterinary Drug Residues and Prohibited Substances in Livestock and Livestock Products through Application of Nuclear and Related Techniques to Protect Public Health	Sasanya, J.J. Cannavan, A.
Uganda	UGA5034	Strengthening National Capacity for Testing and Monitoring of Drug Residues in Animal Feeds and Animal Products	Sasanya, J.J.
Uruguay	URU5029	Implementing a System for Traceability and Authenticity to Ensure Food Safety of Cheeses and Wines	Frew, R.

Enhancing Capabilities to Monitor Environmental and Food Contaminants in Mongolia 6–8 October 2014

Technical Officer: James Sasanya

The Technical Officer undertook a mission under technical cooperation project MON5019 that involves the State Central Veterinary Laboratory (SCVL) of Mongolia.

From the 6 to 8 October 2014 the Technical Officer visited the project counterparts to review performance, provide further technical advice and conduct seminars (Fig 2) in the provision of services in relation to radionuclide and elemental analysis.

The IAEA partners SCVL in Mongolia's development. Photo courtesy of J.J. Sasanya.

Seminar on analytical methods at the State Central Veterinary Laboratory, Mongolia. Photo courtesy of J.J. Sasanya.

Stakeholder Workshop on Food Safety Yaoundé, Cameroon 13–17 October 2014

Technical Officer: James Sasanya

With the Joint FAO/IAEA Division' support, 38 food safety stakeholders from 12 institutions in Cameroon and 8 other African countries as well as an IAEA expert from Germany took part in a one week workshop under an IAEA-AFRA technical cooperation project that is establishing a network of food safety laboratories using nuclear and complementary analytical techniques.

Some of the participants at a Sub-regional Food Safety Stakeholder Workshop in Yaound, organized under IAEA regional project RAF5067. Photo courtesy of G. Medoua.

Among others, the event discussed ways to promote a more 'holistic' understanding of food safety (e.g. appreciating that chemical/natural and microbial hazards may exist in the food) and the complementarity between nuclear/isotopic techniques and non-nuclear but necessary laboratory techniques in national or regional food safety programs. Ways to enhance networking e.g. through the African Food Safety Network (AFoSaN; www.africanfoodsafetynetwork.org) were also discussed.

RAF5067 participants from Botswana and Uganda at poster session of the International Symposium on Food Safety in Vienna. Photo courtesy of J.J. Sasanya.

RAF5067 members at the Learning about the Austria Agency for Health and Food Safety in Vienna, 14 Nov 2014. Photo courtesy of J.J. Sasanya.

The network is hoping to grow to include many other institutions from at least 30 African countries in the next 2 years. They are also exploring possibilities for interregional networks to address global food safety concerns. The Joint FAO/IAEA Division hopes to continue partnering these Member States in such worthwhile endeavours.

RAF5067 members at a meeting organized by the Permanent Mission of Japan to the IAEA to "Building Laboratory Networks in Food Security", 14 Nov 2014. Photo courtesy of J.J. Sasanya.

IAEA assists Paraguay in its pursuit of International Standards in Food Safety and Quality
Paraguay, 26–30 May 2014

Technical Officer: Johannes Corley

Paraguay's objective of strengthening the national network of laboratories involved in chemical risk analysis to ensure food safety through the use of nuclear and complementary non-nuclear techniques is being supported via the TC project PAR5010, with technical support provided by FEP/NAFA/NA. The Technical Officer (TO) visited Paraguay and met with the Project team to evaluate and discuss the best path to ensure the project's success.

The participating institutions in the project are Instituto Nacional de Alimentación y Nutrición (INAN), Instituto Nacional de Alimentación y Nutrición (SENAVE), Servicio Nacional de Calidad y Salud Animal (SENACSA), Centro Multidisciplinario de Investigaciones Tecnológicas (CEMIT) and University of Asunción, Faculty of Chemical Sciences in Paraguay.

INAN is primarily involved in food nutrition, analysis of essential elements in food and analysis of various food products for naturally occurring toxins. INAN is well equipped with several Gas Chromatographs (GC) including, GC-MS (ion trap), GC ECD + FPD as well as flame and graphite furnace Atomic Absorption (AA) instruments. Dr. Laura Mendoza, Director, INAN requested IAEA assistance in getting support from the manufacturer of a new microwave digester that was delivered to INAN but not operational (with no installation or user manuals available). The TO was able to contact the manufacturer and had an installation and user manual sent to INAN. At the TO's request, the manufacturer also offered assistance with set-up and installation. The instrument is now fully functional and in routine use at INAN. There were several ongoing cooperative projects involving shared use of INAN's equipment and expertise from SENAVE and scope for more in conjunction with the PAR5010 project.

SENACSA labs are involved in analysis of environmental contaminants (pesticides, PCB's, etc.), heavy metals and veterinary drug residues in products of animal origin. Their activities receive support from several sources including the Meat Producers Association of Paraguay. SENACSA was in the process of developing methodology for veterinary drugs including antibiotics, anabolic steroids, etc. with the goal of being accredited for several of the methods within approximately 1 year. The laboratory is well equipped with instruments including a LC-MS-MS, HPLC/Fluorescence + DAD, AA (GF + Flame), GC-ECD, FPD, NPD, MSD and ELISA. Some hurdles facing SENACSA included the high cost of accreditation, difficulty in obtaining standards (including stable isotope internal standards) and budgeting.

INAN laboratories. Photo courtesy of J. Corley.

SENAVE works on seed quality control, biological controls, and plant health and chemical residue analysis and the laboratory is currently ISO17025 accredited (2010). SENAVE now has 4 methods certified and have more validated with the aim of pursuing certification. Several of SENAVE's methods are up for re-certification in 2014 and the assistance of the PAR5010 project in procuring standards and reagents was appreciated. Obtaining recertification and getting newly validated methods certified was SENAVE's goal for 2014/2015. SENAVE's experience with ISO17025 and the accreditation and certification processes is valuable to other institutions in Paraguay. SENAVE has a LC-MS-MS system which arrived damaged. However, they are committed to repairing the LC-MS-MS and have it fully operational in the coming months. Bringing the LC-MS-MS on line would be a tremendous boost to SENAVE's capacity for analysing food products of vegetable origin for chemical residues.

CEMIT is an autonomous laboratory within the University of Asuncion, a University Extension program providing service to the public as well as the University. CEMIT is involved in instrumental analysis, physicochemical characterization, microbiological assays, food chemistry and toxicology, cosmetic assays, water quality, hydrobiology and biotechnology. Both CEMIT and the University of Asuncion, Faculty of Chemical Sciences are involved in diverse areas of research including food safety and toxicology. Dr. Francisco Ferreira who is affiliated both with CEMIT and the Faculty of Chemical Sciences

was sent on fellowship training to Mexico on Quality Management Systems (QMS) in food analysis as part of the PAR5010 project. He has and continues to conduct training in Paraguay on QMS in Food Safety, imparting knowledge and experience gained through the IAEA sponsored fellowship (train the trainer) to other institutions in Paraguay.

Joint meeting with participating institutions at the University of Asuncion in San Lorenzo. Photo courtesy of J. Corley.

A joint meeting coordinated by the Technical Officer was held between the participating institutions to discuss the project, its goals and priorities as well as the strengths and weaknesses of the facilities in Paraguay. There were several strengths including the quality of the staff, personnel and management as well as modern analytical instruments at most facilities. However, some of the equipment was aging and needed updating. All participating institutes agreed that there was an urgent need for reference materials and analytical standards, parts and supplies for equipment maintenance, training in analytical method development and validation, training in data handling and developing quality management systems. All expressed a need for a comprehensive quality management system covering all participating institutions in Paraguay. These deficiencies are being remedied by the IAEA through the organization and funding of training hosted by Agrolabs in Mexico and SAG Chile, procurement of needed analytical standards and reference material as well as the procurement of a GC-MS/MS instrument in order to achieve Paraguay's goal of strengthening the national network of laboratories involved in chemical risk analysis to ensure food safety through the use of nuclear and complementary non-nuclear techniques.

Increasing the Commercial Application of Electron Beam and x ray Irradiation of Food in the Latin America and Caribbean region
Mexico City, Mexico
28 July–1 August 2014

Technical Officer: Yves Hénon

The first coordination meeting of this Technical Cooperation project (RLA5066) was held in Mexico City from 28 July to 1 August 2014. It was attended by participants from Argentina, Bolivia, Brazil, Costa Rica, Cuba, Dominican Republic, Ecuador, Peru and Uruguay. Ecuador will also join the project.

All food technologies available to conserve and protect what is produced must be employed in order to meet the challenge of supplying an expanding world population with an adequate, safe and affordable food supply. The use of food irradiation is growing but remains limited. As of today, more than 95% of the 37 500 tons of food irradiated in the Latin America and Caribbean region are treated by gamma radiation from cobalt-60, a technology with an uncertain future. While the perception of a technology involving radioactive materials remains largely negative, there are doubts on the availability and affordability of cobalt-60. It is also increasingly difficult to obtain a license for new gamma facilities and to ship cobalt-60 to users outside the four producing countries. In contrast, electron and X ray technologies rely on electricity to generate the ionizing radiation that has effects similar to gamma radiation on food. One of their major advantages is that they can be switched-on and switched-off.

There are currently 17 electron beam facilities in the region, none of which are capable of producing X ray. Eight of these are in-house facilities used for polymer modification (cables, tires…). Five facilities, of which four are in-house, are used exclusively for medical devices sterilization. Small quantities of food are treated in two facilities (in Brazil and Ecuador) for a total of a few hundred tons, less than 5% of the total food irradiated in the region.

The group was received by the Director General of ININ, Dr. Lydia Paredes, and visited the gamma irradiator (current source activity: 800 kCi) where significant volumes of spices and dehydrated products are irradiated.

The project will include a series of activities that will create the necessary conditions to facilitate the introduction of the food irradiation by EB and X ray including:

- Approximation of food irradiation regulations and licensing requirements for EB and X ray,
- Preparation of training material and capacity building through training in various institutes,
- Organization of a regional meeting with USDA-APHIS,
- Technical and economic feasibility studies.

The relevance of EB and X ray technologies will be assessed before detailed technical solutions are designed and validated. Three particular applications were selected by the participants:

- Phytosanitary treatment of fresh produce (export oriented activity);
- Reduction of the microbiological and parasitic risks in fish and seafood (food safety - intra-regional trade);
- Reduction of post-harvest losses by inhibition of sprouting in potatoes and garlic (food security – domestic market).

Each country will create a national food irradiation steering committee that will include representatives from all stakeholders.

The participants agreed on an approach by which non-technical aspects will be given as much importance as technical aspects. These include the design of communication strategies, market analysis and economic feasibility that will be carried out by unbiased professionals rather than by irradiation specialists.

Meeting at ININ. Dr. Lydia Paredes (Director General), Miguel Alcerreca (Project Leader) and Carmina Jimenez (Program Management Officer, IAEA-TC). Photo courtesy of Y. Hénon.

IAEA Conducts Training in Food Sampling Techniques for Food Safety in Oman 8–12 June 2014

Technical Officer: Johannes Corley

Oman's objective of Strengthening National Capabilities in Food Safety and Food Traceability using nuclear and related-non-nuclear techniques is being supported via the TC project OMA5003 with technical support provided by FEP/NAFA/NA. The Technical Officer (TO) for the project, along with Dr. Jin-Wook Kwon from The Ministry of Food and Drug Safety (MFDS), Republic of Korea, visited Oman to conduct an education and training workshop on sampling techniques for food safety monitoring sponsored by the IAEA. The workshop was attended by scientists representing the Ministry of Regional Municipalities & Water Resources, Ministry of Agriculture & Fisheries (Directorate General of Agriculture and Livestock Research), Ministry of Agriculture & Fisheries (Fisheries Quality Control Center), Ministry of Commerce & Industry, Public Authority for Consumer Protection, and the Royal Court Affairs as well as faculty from Sultan Qaboos University.

The TO introduced the subject of sampling and pesticides/veterinary drugs/contaminants in food and the importance of sampling in obtaining reliable, representative and defendable results in residue testing/monitoring. In addition to the standard theoretical and statistical aspects of sampling, the training involved practical/hands-on sampling exercises and the development of Standard Operating Procedures (SOP) for sampling, sample processing and storage as well as tracking and documentation.

Dr. Jin-Wook Kwon introduced the subject of pesticides and other chemical contaminants found in food, their origins, passage through the environment and humans and final fate and, the TO introduced the concept of sampling and its importance in generating representative results. Discussions were encouraged and exercises were provided to enable the participants to identify the correct techniques and errors/wrong assumptions critical to sampling.

A series of lectures followed about the theory, statistical approaches, and international (including Codex and SANCO) sampling guidelines for various commodities including animal, fish, and fruit/vegetable products of varying sizes. The group was tasked with choosing the

commodities to be sampled based on availability and importance to Oman. For fruit/vegetables, sweet melon (cantaloupe), dates and hot chili peppers were chosen and for animal products, shrimp and fish were to be sampled. The second task assigned to the group was to develop a set of SOPs for sampling each of the commodities based on size of commodity, batch, and uniformity of batch/lot and using the guidelines provided in the morning's lectures/discussions. Clear detailed guidance was to be provided in the SOP for obtaining a random, unbiased and representative sample of adequate size as outlined in the Codex guidelines. The SOP's developed by the group was to be used by the samplers to conduct the exercise. One of the, "guidelines" developed by the group was further written out into a detailed SOP by the TO whereas, the other was not. In the "detailed SOP", the TO also added a few extra details to ensure that the exercise went smoothly while clearly distinguishing these extra details from the points developed by the group.

Participants to lectures on sampling. Photo courtesy of J. Corley.

The actual sampling took place at Oman Central Market. The samplers were provided the SOPs as developed by the group as well as the detailed version drafted by the TO. The samplers quickly learned the importance of detail in an SOP as several questions about the intent/meaning of the SOP arose when detail was not provided. The samplers realized the importance of speed and care during sampling to avoid damage to the shipment (batch), especially for items stored under controlled environments. They also learned the importance of avoiding contamination to the sample and cross-contamination between samples. The samples were transported in coolers to the refrigerators at the laboratory.

Sampling dates at Oman's Central Market, as part of the sampling exercise. Photo courtesy of J. Corley.

The Samplers led the discussions on their sampling experiences. The discussion focused on the need for a detailed, step-by-step SOP to ensure a smooth and easy experience. They also discussed the importance of documentation related to sample identification and sampler notes made during the actual process. The next exercise in developing SOPs for sample handling and processing incorporated the lessons learned from the previous exercises including the importance for detail and documentation. The SOPs written for sample handling and processing were used by the assigned persons to log-in each sample and store in the appropriate location as clearly stated in each SOP. Again, discussions centered on omissions from the SOPs and the importance of each SOP being detailed and covering all aspects of international sampling guidelines. Sample processing took place at the Food and Water Laboratories; Ministry of Regional Municipalities and Water Resources in Muscat.

While in Oman, the TO also met with Mr. Mustafa El Zein El Muzamil FAO representative in Oman and discussed several areas of possible cooperation between the FAO and the IAEA in the area of food safety and international standards.

TO meets FAO representative in Oman. Photo courtesy of J. Corley.

The participants found the workshop and training exercise to be very helpful for building capacity for a strong National Food Safety program in Oman. The participants understood the importance of the sample being representative and unbiased in order for the results to be reliable. They also learned the importance of clear, detailed SOPs incorporating good science and statistical principles for a successful, internationally recognized, food safety program. Several other activities related to the OMA5003 project including procurement of equipment, reagents and consumables as well as planned IAEA sponsored trainings at AGES in Austria are currently on-going.

Strengthening and improving the national capabilities to control levels of radioactivity contamination in agroindustry goods
Guatemala, 4–8 August 2014

Technical officer: Britt Maestroni

The technical cooperation project (TCP) GUA/7/004 is about strengthening and improving the national capabilities to control levels of radioactivity contamination in agroindustry goods. Food and Environmental Protection laboratory (FEPL) staff travelled to Guatemala under (TCP) GUA/7/004 to meet the new counterparts, to revise the logical framework matrix and the work plan, and to visit some of the laboratory facilities in Guatemala.

The focus of the project is on the preparation of a draft national proposal for controlling the levels of radionuclides in cardamom.

The technical officer (TO) revised the logical framework matrix to prepare a realistic work plan for 2014-2016. The TO visited the laboratories of the Faculty of Chemistry and Pharmacy of the University of S. Carlos located in Guatemala City and discussed pending issues with the former project counterpart.

The TO also visited some of the laboratories of the Ministry of Health located in Villa Nueva, like the Food and Water contaminant laboratory. The TO was very impressed by the laboratory environment, the infrastructure and the capacity of the personnel. The FEPL staff was glad to note that the participation of the laboratory head at FAO/IAEA training workshops in 2012 and 2013 had positively contributed to improve the quality of work at the laboratory. It was mentioned that this laboratory is looking into getting accredited in the short term. The TO also visited the Institution called ICTA (Instituto Ciencias Tecnologicas Agricolas) and discussed some of the programmes of the Institute, for example on the cardamom production chain including a revision of the good agricultural practices. As a result of the mission a logical framework matrix and a new work plan have been prepared for project GUA/7/004. The counterparts have now a clear idea of what shall be done under the project, what are the deadlines and what are the expectations by the IAEA. At the de-briefing meeting the project management officer in charge was very happy with the results achieved under this mission.

Counterparts of project GUA/7/004, Ms. Claudia Quintero Jordan and Mr. E. Ariel Gutiérrez, with the TO on the premises of the Ministerio de Energía y Minas (MEM) in Guatemala City (August 2014). Photo: Courtesy of B. Maestroni.

Food and Environmental Protection Laboratory, Seibersdorf

Authentication of Indian citrus fruit/fruit juices by untargeted and targeted metabolomics

Technical Officer: Zora Jandrić

Citrus fruits are one of the most important horticultural crops grown India, mainly in Assam, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Nagaland, Rajasthan, Tamil Nadu and West Bengal states. Citrus fruits/fruit juices are a food commodity that is often targeted for mislabeling. The control of labelling compliance plays a key role in the protection of high quality fruit/fruit juices from fraudulent practices, including substitution with other similar products of significantly lower value. Adulteration of fruit juices (e.g. addition of other low value fruit juices, or other unknown adulterants) is relatively common and is difficult to detect; its full extent is unknown.

The Food and Environmental Protection Laboratory is collaborating with one of the research contract holders, the Indian Agriculture Research Institute, in the CRP "Implementation of Nuclear Techniques to Improve Food Traceability". Authentic citrus fruit samples *(Citrus reticulate blanco, Citrus reticulata, Citrus tangerine, Citrus tangerine, Citrus paradisi, and Citrus maxima)* were obtained from the Indian Agriculture Research Institute and analysed by an untargeted method using ultra performance liquid chromatography-quadrupole-time of flight mass spectrometry to identify characteristic markers that could be used to control citrus fruit authenticity (Fig. 1).

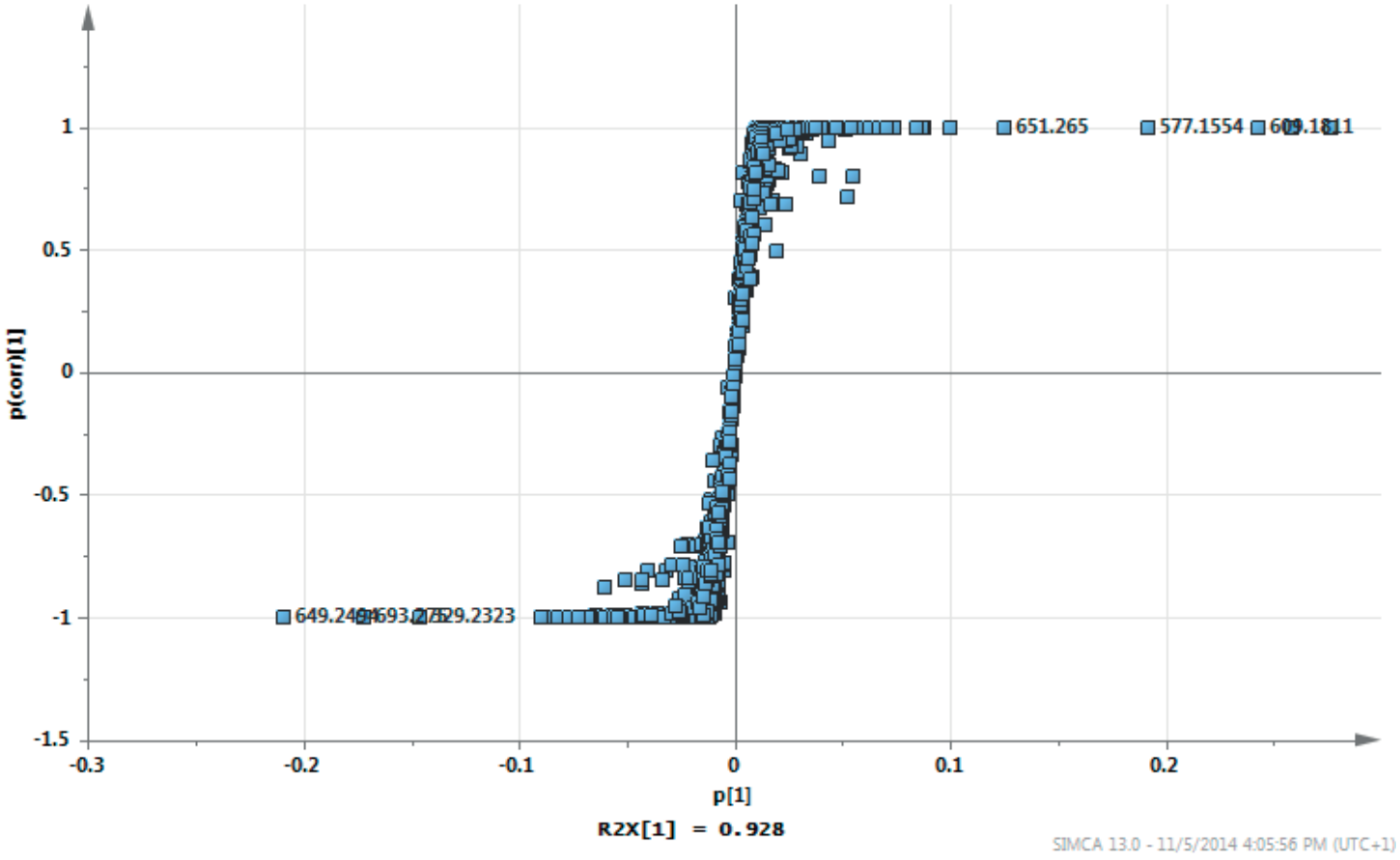


Figure 1. S-plot of pure orange and mandarin juice to identify characteristic markers.

The markers identified were: hesperidin, neohesperidin, narirutin, naringin, and limonin-17-β-D-glucopyranoside. A targeted liquid chromatography-tandem mass spectrometry method was then optimised for the analysis of these markers (hesperidin, neohesperidin, narirutin, naringin, and limonin-17-β-D-glucopyranoside).

Ratios of limonoid to hesperidin and narirutin, narirutin to hesperidin, naringin to limonoid, and nehesperidin to hesperidin have the potential to be used to control citrus fruits/fruit juices authenticity and to detect adulteration down to 2% (Fig. 2).

Having demonstrated the potential of this methodology for the detection and control of fraudulent practices in the fruit juice industry, further samples provided by our partners in India will be tested in the coming months to expand the dataset and investigate the robustness of the method.

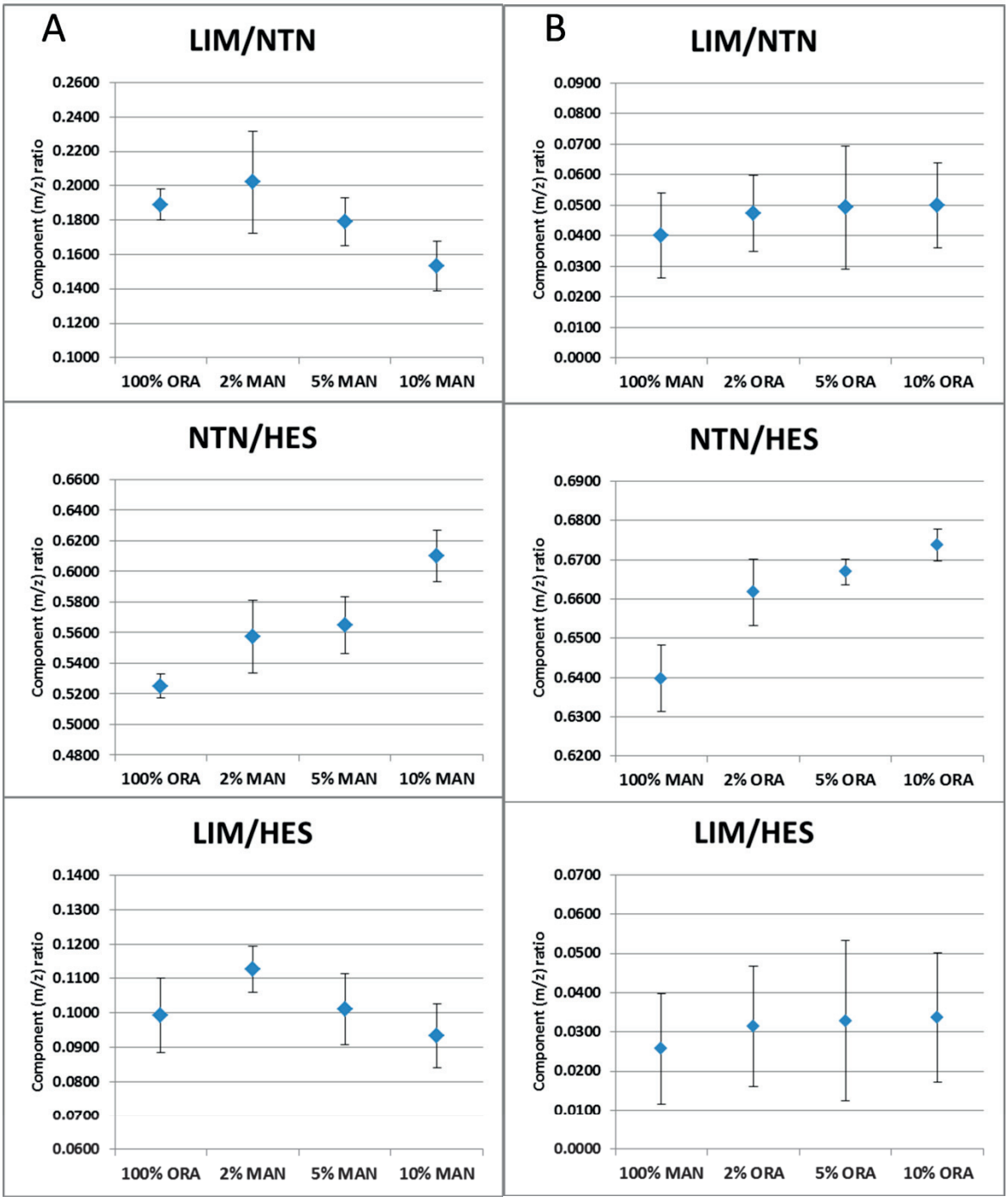


Figure 2. LIM/NTN, NTN/HES, and LIM/HES, ratios in reference and adulterated: orange juice with mandarin (A); mandarin with orange (B) at 2/5/10 % adulteration level (mean ± SD, n=6).

Validation of a gas chromatographic method for several pesticides in potatoes

Technical officers: B. Maestroni and V. Ochoa

Potatoes are an important staple food all over the world. To protect the crop from various diseases farmers apply a range of regulated pesticide formulations which can sometimes leave residues in the crop. To ensure safe food for consumers it is important to apply end control testing to agricultural products. As part of an initiative under the "Red Analitica de Latino America y el Caribe" (RALACA) network the FAO/IAEA Food and Environmental Protection Laboratory contributed to the validation of a multi-residue method for 26 pesticides in potato. The method included the pesticides that are most frequently employed in agricultural production of potatoes. The aim of this study was to validate the method according to the Codex Alimentarius Guidelines on Good Laboratory Practice in Pesticide Residue Analysis (CAC/GL 40-1993). Within laboratory method validation was conducted to provide evidence that the method is fit for the purpose for which it is to be used. The method performance was characterized in terms of its scope, specificity, accuracy, sensitivity, repeatability and within laboratory reproducibility.

A multiresidue method for pesticides in potato using QuEChERS and GC-MSD detection was adapted and validated according to the procedure summarised in Figure 1.

The processed and homogenized sample was extracted with acidified acetonitrile. A mixture of anhydrous magnesium sulphate, sodium chloride and sodium citrate salts was added for pH adjustment and phase separation. After shaking and centrifugation, an aliquot of the organic phase was cleaned up adding PSA and anhydrous magnesium sulphate. The cleaned-up extract was concentrated over nitrogen and redissolved in ethyl acetate. The final extract was filtered and injected for the analysis by GC-MSD.

The experimental design used potato as the matrix for the analysis of 26 pesticides at 3 spiking levels: 10 µg/kg as low spike (based on Codex MRLs), 100 µg/kg as medium spike and 500 µg/kg as high spike. Six replicate samples were spiked at each level and the study was repeated 3 times. Matrix blank and reagent blank were injected in all batches. It was shown that the chromatographic response was exclusively due to the compounds injected in the system. Matrix effects were evaluated in due course of the method adaptation. It was noticed that matrix effects were present for several pesticides. Matrix matched calibration was used to compensate for matrix effects.

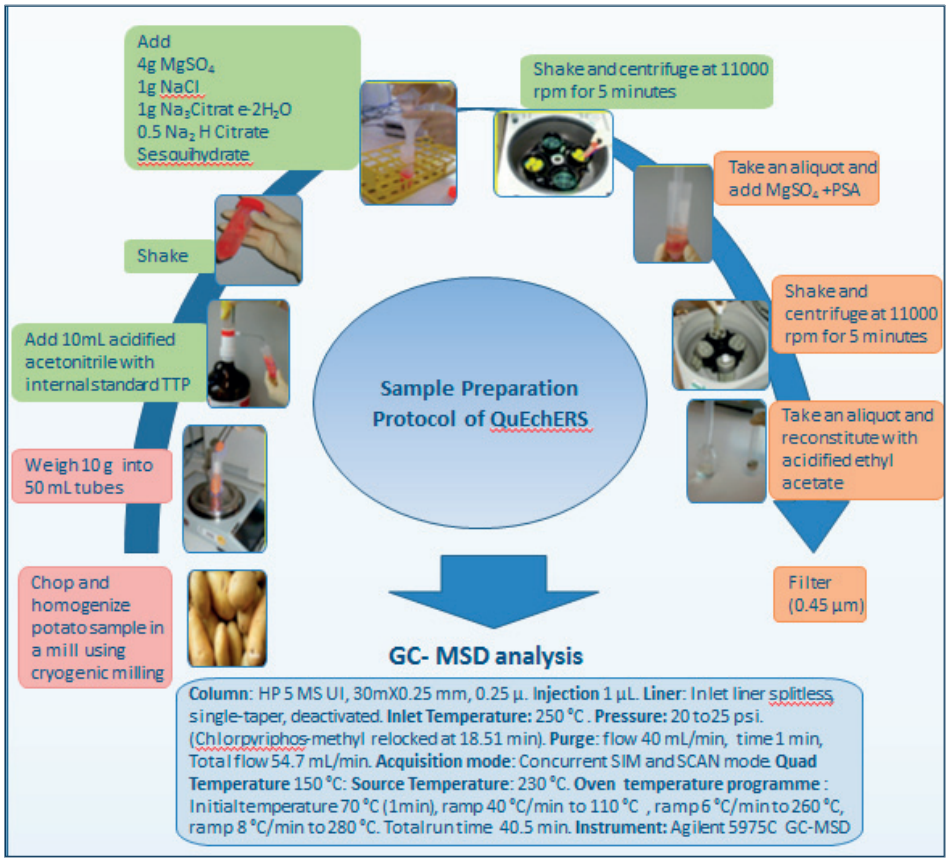


Figure 1: General description of the method.

A minimum of five point calibration injected in duplicate was prepared with matrix matched calibrators and an internal standard was used to correct for possible chromatographic effects. Compound recoveries were estimated by weighted linear regression. Good linearity was achieved for the majority of the pesticides with correlation coefficients of regression (R^2) > 0.99 and standard deviation of relative residuals < 20%.

Homogeneity of variances at the different spiking levels was assessed by one way ANOVA. A typical within laboratory recovery was established for each compound and method validation results are shown in Table 1 where CV_R and CV_r are the within laboratory reproducibility and repeatability standard deviation respectively.

Table 1: Method validation results.

Compound	Recovery (%)	n	Sd	CV_R (%)	CV_r (%)
Azoxystrobyn***	79	34	16	20	9
Benalaxyl	95	51	14	15	10
beta Endosulfan *	89	35	13	15	8
Bromopropylate*	98	35	12	12	9
Chlorothalonil	67	38	14	20	14
Chlorpyrifos methyl	85	53	12	14	7
Chrlorpyrifos*	96	35	12	13	7
Deltamethryn*	76	33	21	27	12
Diazinon*	87	35	15	18	7
Dimethoate*	88	41	10	11	8
Ethoprophos	82	50	13	15	9
Fipronil*	103	32	18	17	10
Fludioxinil***	88	32	20	23	8
Flutolanil	96	53	15	16	10
Kresoxym methyl*	98	35	19	20	11
Metalaxyl	88	53	13	14	9
Methidathion**	94-84 (MS-HS)	35		6-8%	6-8%
Parathion methyl*	80	35	11	14	7
Pirimiphos ethyl	93	53	14	15	9
Pirimiphos methyl	90	53	13	15	8
Propyzamide	88	41	10	11	10
Pyraclostrobyn**	89-74-62 (LS-MS-HS)	51		7-17%	7-16%
Pyrimethanil	93	53	15	16	9
Tebuconazole*	94	35	15	16	8
Tolclofos methyl	88	53	13	14	7
Vinclozolin***	91	35	15	16	8

(*) Pesticides only quantified and validated at medium and high spike levels.
(**) It was not possible to establish a typical recovery value for the three spiking levels considered in the validation plan. There was a significant difference between the variances at all spiking levels.
(***) The recovery was calculated only at medium and high spiking level. The value for the recovery at low level was 103% R with 10%CV for azoxystrobyn (n=18), 109% R with 12%CV for fludioxinil (n=18), 110%R with 7%CV (n=16) for vinclozolin.

Average recovery for spike levels meets the Codex within laboratory Method Validation criteria (60-120%). Repeatability and reproducibility values meet Codex requirements for precision ($\mathbf{CV_r}$ <20%, and $\mathbf{CV_R}$ <20%).

The method validated at the Food and Environmental Protection Laboratory is quick and relatively cheap. The precision of the method is good for all analytes and accurate quantitation was achieved by using matrix matched calibrators. It can be applied to the analysis of potato samples for the determination of several classes of compounds in both developed and developing countries regulatory laboratories that are equipped with GC-MSD. The validation of the method must be supported and extended by method performance verification during routine analysis. Additional data to refine the reproducibility value shall be produced during analytical quality control (AQC). AQC may be also used to extend of scope of the method to new analytes, new matrices and new levels. Future work involves the assessment of the accuracy by analysing certified reference materials, participation in proficiency tests or other inter-laboratory comparisons.

Nuclear Techniques applied to the generation of input data for first tier risk assessment

Technical officers: B.M. Maestroni and V. Ochoa

As part of an initiative under the "Red Analitica de Latino America y el Caribe" (RALACA) network the FAO/IAEA Food and Environmental Protection Laboratory (FEPL) contributed to generating field sorption data to be used as input parameters in first tier risk assessment models. The goal of this study was to use nuclear technology to determine the soil sorption coefficient (*Kd*) and the soil organic carbon sorption coefficient (*Koc*) of chlorpyrifos as it behaves in a formulation as well as a pure active ingredient when applied to soil.

Chlorpyrifos is an organophosphate insecticide, used to control foliage and soil-borne insect pest on a variety of food and feed crop. Approximately 10 million pounds are applied annually in agricultural settings. This pesticide is moderately persistent in soils with a half-life between 60-120 days, but can vary from two weeks to over a year depending on the soil type and climate conditions. The soil sorption coefficient (Koc) ranges from 652 to 30381 l/kg. The concentration and persistence of chlorpyrifos in water will vary depending on the type of formulation. For example, a large increase in chlorpyrifos concentrations occurs when emulsifiable concentrations and wettable powders are released into water. As the pesticide adheres to sediments and suspended organic matter, concentrations rapidly decline. The increase in the concentration of insecticide is not as rapid for granules and controlled release formulations in the water, but the resulting concentration persists longer. The pesticide is very toxic to fresh water fish, aquatic invertebrates and estuarine and marine organisms.

The pesticide soil sorption test was performed with using a batch equilibration method according to OECD (2000) and using 14C-chlorpyrifos as a radiotracer according to the procedure described in figure 1. A liquid scintillation counter was used to determine the activity of the radiotracers extracts.

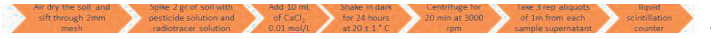


Figure 1: Schematic soil sorption test

The Freundlich adsorption isotherm is an empirical relation between the concentration of a pesticide adsorbed onto the soil (C_s) in relation to the amount of pesticide in equilibrium in the solution (C_e):

$$Log\ C_s = Log\ K_f + \frac{1}{n} * Log\ C_{eq}$$

Figure 2 and 3 show the adsorption Freundlich isotherm for the active ingredient (using a dilute solution of pure chlorpyrifos) and the commercial formulation respectively.

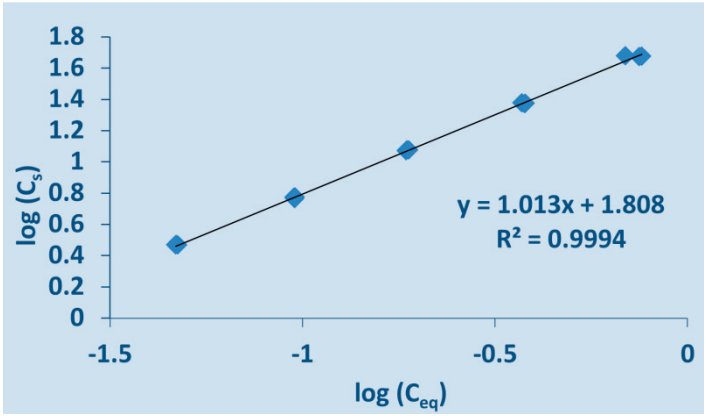


Figure 2: Freundlich Isotherm for chlorpyrifos as active ingredient.

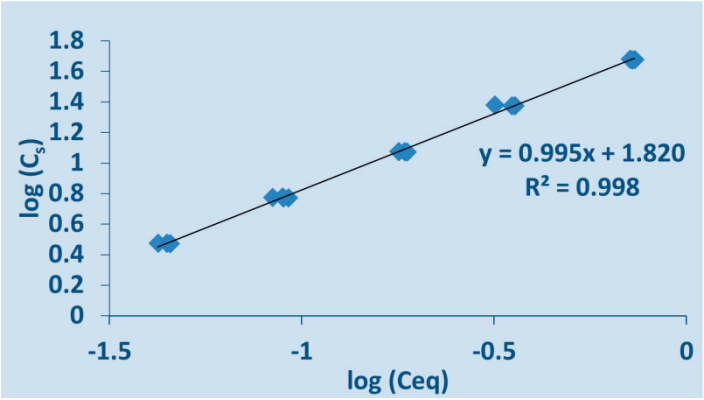


Figure 3: Freundlich isotherm for chlorpyrifos in a commercial formulation.

The regression line equations are directly shown in the figures. Table 1 contains the results for *Kd* and *Koc* as calculated through the Freundlich equation.

Table 1: Chlorpyrifos Kd and Koc data for the active ingredient and the commercial formulation.

Chlorpyrifos data	Slope	Intercept	n	*Kd* (L kg-1)	*Koc* (L kg-1)
Active ingredient	1.013	1.808	0.99	64.34	1641
Formulation	0.995	1.820	1.00	66.08	1686

Koc is regarded as a more universal parameter related to the hydrophobicity of the pesticide molecule, which applies to a given pesticide in all soils.

The values obtained in this study confirm data published in the literature; the soil sorption coefficient (*Koc*) of chlorpyrifos ranges from 652 to 30381 l kg-^{1}.

The difference of *Koc* values between the active ingredient and the formulation of chlorpyrifos is small (2.7%); however, published data in the literature indicates that formulation additives could make the pesticide more available in water for example in case of run off. Hence the importance to determine the *Koc* of the formulation and that of the active ingredient. The determination of sorption of pesticides (Kd and Koc) in local soils is important to calibrate tools such as Pesticide Impact Rating Index (PIRI) and have more reliable results for assessing pesticide management practices and environmental changes (estimate of pesticide leaching and runoff).

The use of the nuclear technique is an efficient and a rapid method for the generation of input data for further environmental modelling.

The use of analyte protectants and matrix matched calibration in gas chromatographic analysis for pesticide residues in potatoes

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While validating a method for the detection of pesticides in potato samples it was observed that matrix effects were present for several pesticides. Since the effective elimination of the sources of the matrix-induced response enhancement is not feasible in practice, a means of compensating for such effects is necessary. Two distinct approaches studied at FEPL included the use of matrix-matched calibration standards and the use of analyte protectants (AP). AP's minimize pesticide interactions with the active sites in the gas chromatographic system and protect them from degradative interactions. The FAO/IAEA Food and Environmental Protection Laboratory (FEPL) carried out a study to evaluate the use of AP and matrix matched calibration in gas chromatographic analysis for pesticide residues in potatoes.

Homogenized samples were spiked with a mixture of pesticides at 0.5 mg/kg and subjected to a multi residue method validated at FEPL for the detection of several pesticides in potatoes samples using gas chromatography coupled to mass spectrometry (GC-MSD). According to this method the processed and homogenized sample was extracted with acidified acetonitrile. A mixture of anhydrous magnesium sulphate, sodium chloride and sodium citrate salts was added for pH adjustment and phase separation. After shaking and centrifugation, an aliquot of the organic phase was cleaned up adding PSA and anhydrous magnesium sulphate. The cleaned-up extract was concentrated over nitrogen and redissolved in ethyl acetate. The final extract was filtered and injected for the analysis by GC-MSD.

Matrix matched calibrators were prepared by spiking dried blank sample extracts with three different pesticide mixture concentrations at 0.1, 0.5 and 1 ng/µL in acidified ethyl acetate. Solvent calibrators were prepared at the same concentrations and injected in duplicate. All calibration curves had R^2 >0.99. The AP used in the study was a combination of ethylglycol, gulonlactone and sorbitol in ethylacetate: DMSO (80:20).

The effect of AP was tested at different concentrations to find an optimal value for compensation of matrix effects, as shown in table 1.

Table 1: AP concentrations added to the solvent calibrators.

	Concentration of gulonlactone and sorbitol (mg/mL)	Concentration of ethylglycol (mg/mL)
AP25	0.30	3.00
AP40*	0.48*	4.80*
AP60	0.72	7.20
AP80	0.96	9.60
AP200	2.40	24.00

To identify the optimal concentration of AP, a statistical optimization was carried out and a simple linear or quadratic regression was fitted to the analyte recovery and four possible cases were considered as shown in table 2.

Table 2: statistical hypothesis for optimization

	Optimization of AP
1	Within the range studied (0-200)
2	At minimum AP concentration
3	At maximum AP concentration
4	No effect of AP concentration

Figure 2 shows the recoveries for certain pesticides when the calibration was prepared in matrix (MM), solvent without AP (SOL), or solvent with increasing amount of AP (SOL+AP25-SOL+AP200). The recovery in solvent at AP levels AP40-AP60 approached the recovery obtained through matrix matching. However increasing the amount of AP decreased the precision for all pesticides studied.

The effect of AP on the recovery values was variable among the pesticides. For most pesticides studied, there was no relationship between the amount of AP and recovery. Azoxystroyn, Etho-prophos and Pyrimethanil showed a simple linear relationship indicating zero as the optimal concentration of AP in solvent.

As a conclusion under our laboratory conditions, the use of AP for solvent calibration did not improve the results. Further studies are needed to understand the reason behind the unsuccessful application in our laboratory. Matrix matched calibration by the preparation of calibration standards in blank extracts, which imparted similar matrix-induced enhancement as in the sample extracts, was acceptable and was therefore used as a quantification approach in the method.

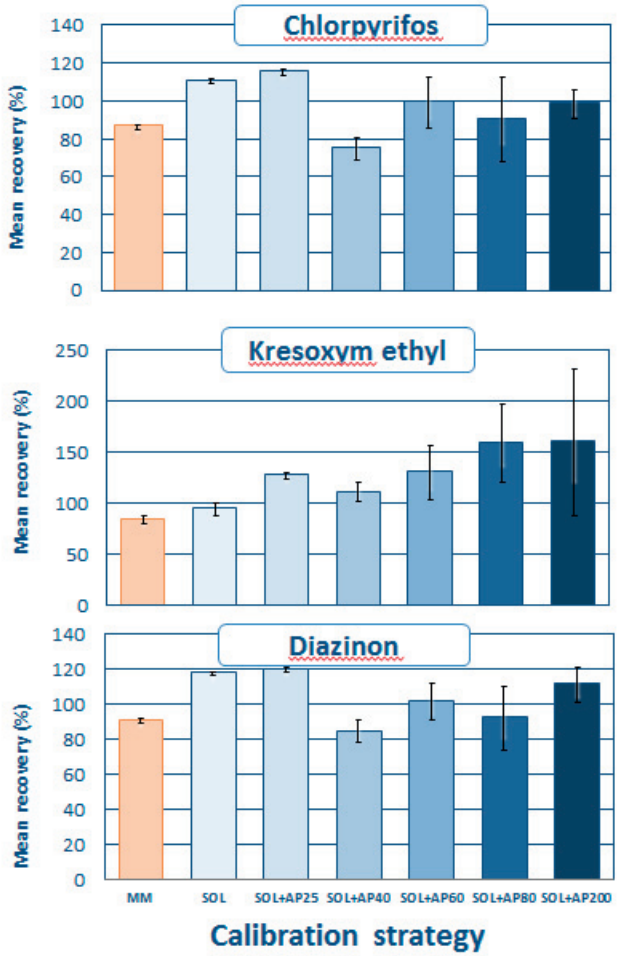

Figure 2. Mean recovery values and standard deviations for the different calibration strategies in three of the pesticides analysed.

Recent Publications

S. Pillai, C. Bogran (Texas A&M University, USA) and C. Blackburn (IAEA, Austria), Ionizing irradiation for phytosanitary applications and fresh produce safety; Pages 221-232 in Global Safety of Fresh Produce. A Handbook of Best Practice, Innovative Commercial Solutions and Case Studies, Jeffrey Hoorfar (Ed) , ISBN: 978-1-78242-018-7, Woodhead Publishing 2014.

Jandrić, Z., Frew, R., McComb, K., Haughey, S, Elliott, C and Cannavan A. (2014). Discrimination of honey of different floral origins by a combination of various chemical parameters. Book of abstracts of the 2nd Food Integrity & Traceability Conference, Belfast, UK, 8−10 April 2014, 57.

J.J. Sasanya; A. Cannavan; C. M. Blackburn (2014). Activities of the Joint FAO/IAEA Division of Nuclear Techniques In Food And Agriculture (CX/CF 14/8/4). Eighth Session of the Codex Committee on Contaminants in Foods, The Hague, Netherlands, 31 March–4 April 2014.

J. Corley; J.J. Sasanya; A. Cannavan (2014). Activities of the Joint FAO/IAEA Division of Nuclear Techniques In Food And Agriculture (CX/PR 14/45/4). Forty Sixth Session of the Codex Committee on Pesticide Residues, Nanjing, China, 5−9 May 2014.

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