Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Food & Environmental Protection Newsletter

Vol. 14, No. 2 July 2011

http:/www-naweb.iaea.org/nafa/index.html
http:/www.fao.org

ISSN 1020-6671

Contents

To the Reader

The magnitude 9.0 earthquake and subsequent tsunami that struck off the east coast of Honshu, Japan on 11 March 2011 resulted in significant damage to the nuclear power plant (NPP) at Fukushima Daiichi, with the consequent release of radioactive material into the environment. Air, soil, water and agricultural produce around the damaged NPP were contaminated with radionuclides, chiefly iodine-131, caesium-134 and caesium-137.

Several activities were initiated by the Joint FAO/IAEA Division in relation to the emergency, including recent and ongoing efforts to help ensure the dissemination of information on food monitoring and food restrictions, the consideration of agricultural countermeasures and remediation strategies to mitigate immediate and longer term effects arising from radionuclide contamination, and the interpretation of standards related to radiological protection of the public, to FAO, IAEA and other international organization Member States.

These activities are carried out within the context of FAO obligations as a full party to the IAEA Early Notification and Assistance conventions, and under the FAO co-sponsored Joint Radiation Emergency Management Plan of the International Organizations (EPR JPLAN 2010), which provides the management tools for coordinating international organization arrangements in preparing for, and responding to, nuclear or radiological emergencies. Additional details are provided in the Feature Article section of this Newsletter.

IAEA International Atomic Energy Agency

The Joint Division also continues to strengthen other joint efforts with FAO sister divisions and the IAEA to ensure food safety and facilitate international agricultural trade through activities related to the use of ionizing radiation and the implementation of traceability systems and analytical techniques to control food contaminants and improve food safety.

Specifically, in the area of food irradiation, subprogramme research activities have led to the adoption of three additional phytosanitary irradiation treatments at the most recent Sixth Meeting of the Commission on Phytosanitary Measures (CPM) of the International Plant Protection Convention (IPPC) in March 2011. These treatments are in addition to the three irradiation treatments adopted by the IPPC in 2010, making a total of fourteen internationally accepted post-harvest phytosanitary irradiation treatments for inclusion in the IPPC Standard on Phytosanitary Treatments for Regulated Pests. It is anticipated that research results arising from our Coordinated Research Project (CRP) on the Development of Generic Irradiation Doses for Quarantine Treatments will eventually be submitted to the IPPC for the potential adoption of additional irradiation treatments for generic and specific pests and pest groups of quarantine importance.

In the area of traceability and food contamination control, the Subprogramme has successfully convened the first Research Coordination Meeting (RCM) under our new CRP on the Implementation of Nuclear Techniques to Improve Food Traceability in Vienna, Austria, 16–20 May 2011. The meeting was attended by Research Contract and Agreement Holders from Austria, Botswana, Chile, China, India, Lebanon, Portugal, Singapore, Thailand, Uganda, UK, USA as well as observers from France, Sweden, USA, the IAEA, FAO and UNIDO. The main purpose of the CRP is to provide access to skills and know-how and to establish a harmonized system for the verification of claims related to food origin, production, and authenticity, using nuclear techniques involving mainly isotope ratio analysis and multi-element analysis, as well as complementary methods.

Other activities related to food contamination include the successful holding of the second RCM under the CRP on the Development of Radiometric and Allied Analytical Methods to Strengthen National Residue Control Programs for Antibiotic and Anthelmintic Veterinary Drug Residues at the University of Peradeniya, Sri Lanka, 14–18 March 2011. The meeting confirmed that the main objective of the CRP was to provide National Reference Laboratories of FAO and IAEA Member States with effective and appropriate monitoring methods for residues of selected antibiotic and anthelmintic veterinary medicines through the development and application of analytical methods utilizing radiotracer detection methods in conjunction with confirmatory techniques using stable-isotope labelled analogues.

The third RCM of the CRP on Integrated Analytical Approaches to Assess Indicators of the Effectiveness of Pesticide Management Practices at the Catchment Scale was also successfully held in Vienna, Austria, 6–10 December 2010. The meeting was attended by Research Contract and Agreement Holders from Argentina, Australia, Brazil, Bulgaria, Chile, China, Costa Rica, Ecuador, Hungary, Kenya, India, the Philippines and Sweden, as well as observers from Brazil, Bolivia, Colombia and the IAEA. The meeting discussed progress reports and presentations, including a summary of the 'black-box' monitoring approach; a review of current regional initiatives in the context of integrated analytical approaches to assess the implementation of good agricultural practices, and insights into minimizing agriculture non-point source contamination through the rapid assessment of locally-relevant data.

In closing, we convey our heartfelt thanks and best of luck to Mr. Josef Brodesser, who for the past seven years has successfully contributed to the work of the Subprogramme as a food safety specialist with responsibilities for coordinated research and technical cooperation projects related to traceability as well as the control of pesticide residues and aflatoxins. Our best wishes for a happy and healthy retirement are also extended to Mr. Ian Ferris, who most recently served as a Technical Officer with responsibilities for coordinated research and technical cooperation projects related to pesticide residues and the control of contaminants at a catchment scale. It is hoped that both Josef and Ian will maintain close contact with the Subprogramme.

Best wishes to you and your families for a safe, healthy and happy holiday this summer season.

Sincerely,

David H. Byron

STAFF

Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture, Vienna International Centre, Wagramer Strasse 5, P.O. Box 100, A–1400 Vienna, Austria Phone: +43 1 2600 + extension

Name	Title	E-mail	Extension
Qu Liang	Director	Q.Liang@iaea.org	21610

Food and Environmental Protection Section

Name	Title	E-mail	Extension
David H. Byron	Section Head	D.H.Byron@iaea.org	21638
Carl M. Blackburn	Food Irradiation Specialist	C.Blackburn@iaea.org	21639
Rajendra K. Patel	Consultant	R.Patel@iaea.org	21672
Stella A. Attakpah	Secretary	S.Attakpah@iaea.org	21641
Nima Mashayekhi-Tabrizi	Clerk	N.Mashayekhi-Tabrizi@iaea.org	26061

Food and Environmental Protection Laboratory Seibersdorf

Andrew Cannavan	Unit Head	A.Cannavan@iaea.org	28395
Britt M. Maestroni	Food Scientist	B.M.Maestroni@iaea.org	28398
Mohammad N. Rathor	Laboratory Technician	N.Rathor@iaea.org	28397
Alla Kist	Laboratory Technician	Al.Kist@iaea.org	28393
James J. Sasanya	Consultant	J.Sasanya@iaea.org	28327
Zora Jandric	Consultant	Z.Jandric@iaea.org	28373
Tamara Wimberger	Team Assistant	T.Wimberger@iaea.org	28267

Feature Article

Activities of the Joint FAO/IAEA Division on Nuclear Techniques in Food and Agriculture in Relation to the Japanese Nuclear Emergency

The magnitude 9.0 earthquake and subsequent tsunami that struck off the east coast of Honshu, Japan on 11 March 2011 resulted in significant damage to the nuclear power plant (NPP) at Fukushima Daiichi, with the consequent release of radioactive material into the environment. Air, soil, water and agricultural produce around the damaged NPP were contaminated with radionuclides, chiefly iodine-131, caesium-134 and caesium-137. Several activities were initiated by the IAEA and FAO in relation to this emergency.

Background

FAO Headquarters (Rome) works in partnership with the IAEA through the Joint FAO/IAEA Division on Nuclear Techniques in Food and Agriculture (Vienna) in preparing for and responding to nuclear or radiological emergencies affecting food and agriculture, including the application of FAO capabilities as a critical counterpart in defining and implementing agricultural countermeasures and remediation strategies in response to such events.[1]

These FAO responsibilities are mandated through two international conventions, namely, the *Convention on Early Notification of a Nuclear Accident* (Early Notification Convention), whereby the FAO is responsible to "…. advise governments on acceptable levels of radionuclides appearing in agricultural, fisheries and forestry products entering national and international trade", and through the *Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency* (Assistance Convention), whereby the FAO is responsible to "…. advise governments on measures to be taken in terms of the agricultural, fisheries and forestry practices to minimize the impact of radionuclides and to develop emergency procedures for alternative agricultural practices and for decontamination of agricultural, fisheries and forestry products, soil and water".

With this in mind, the IAEA, international organizations that are party to the Early Notification and Assistance Conventions, and other relevant international organizations that participate in the activities of the Interagency Committee on Radiological and Nuclear Emergencies (IACRNE)[2], have developed the Joint Radiation Emergency Management Plan of the International Organizations(Joint Plan). The Joint Plan describes the objectives of response; the organizations involved in response, their roles and responsibilities, and the interfaces among them and between them and Member States; operational concepts; and, preparedness arrangements. These practical arrangements are reflected in the various organizations own emergency plans, such as the *Cooperative Arrangements between FAO and IAEA in Response to Nuclear or Radiological Emergencies*.

Recent and ongoing activities related to the Japanese nuclear emergency conducted under these conventions and agreements helped to ensure the dissemination of information on food monitoring and food restrictions, the consideration of agricultural countermeasures and remediation strategies to mitigate immediate and longer term effects arising from radionuclide contamination, and the interpretation of standards related to radiological protection of the public, to both FAO and IAEA and other international organization Member States.

Activities of the Joint FAO/IAEA Division Related to the Japanese Nuclear Emergency

Recent and ongoing activities of the Joint FAO/IAEA Division include the following:

- As the focal point between FAO Headquarters and the IAEA Incident and Emergency Centre (IEC) in Vienna, the Joint FAO/IAEA Division has continually manned the FAO Desk in the IAEA/IEC, which includes the preparation and presentation of briefing texts and slides on food contamination and monitoring data and restrictions on food distribution and/or consumption to Member State Board meetings, press conferences and postings on the IAEA website.
- Represented FAO and IAEA in video/teleconferences through the IACRNE to ensure a unified approach in addressing issues related to food and agriculture.
- Actively participated in teleconferences that took place with other colleagues in both FAO and WHO in order to prepare and disseminate "questions and answers" related to food safety and the application of international standards, including the Joint FAO/WHO Codex Alimentarius Guideline Levels for Radionuclides in Foods.
- Participation in, and follow-up to the Joint FAO/IAEA Food Safety Assessment Mission to Japan (see below).
- Promoted knowledge and information sharing on radioactive contamination affecting food and agriculture, including the mechanisms and persistence of such contamination, radionuclide transfer rates and international standards.

1 For additional details, please see the Feature Article in the July 2010 edition of the Food and Environmental Protection Newsletter (Volume 13, Number 2).

2 The IACRNE is an inter-agency body that is responsible for coordinating the arrangements of relevant international inter-governmental organizations in preparing for and responding to nuclear and radiological emergencies.

Activities of the Joint FAO/IAEA Food Safety Assessment Team (26–31 March 2011)

On 26 March, a Joint IAEA/FAO Food Safety Assessment Team (FSAT) was fielded to Japan. The team was comprised of Andrew Cannavan (team leader), Head of the Joint FAO/IAEA Division Food and Environmental Protection Laboratory, Lionel Mabit, a soil scientist from the Joint FAO/IAEA Division Soil and Water Management and Crop Nutrition Laboratory and Jean-Michel Poirson, Senior Officer of EMPRES Food Safety, Nutrition and Consumer Protection Division, FAO (Rome).

The objective of the mission was to provide advice and assistance to the Japanese authorities on technical issues related to food safety and agricultural countermeasures, including sampling and analytical strategies and interpretation of monitoring data to ensure that reliable, continuous updates could be provided on the extent of food contamination in affected areas, with the understanding that the data would form a basis for the development of mitigation and remediation strategies.

The FSAT arrived in Tokyo on Saturday 26 March and were briefed at the Regional IAEA Office by Nobuhiro Muroya, the FACT Coordinator and Yoshizane Ishii (Ministry of Foreign Affairs), who acted as translator for the mission.

From 27–30 March 2011, the FSAT met with local government officials and stakeholders in the agriculture sector in the four prefectures most affected by the nuclear emergency; i.e. Fukushima, Ibaraki, Tochigi and Gunma. At each meeting the team were appraised on the local situation, the prevailing land use and agricultural products produced, monitoring data and any restrictions on food distribution and/or food consumption in place, and the main concerns of local farmers. The FSAT provided relevant technical information and advice in question and answer and discussion sessions, including information on possible mitigation and remediation techniques and strategies that could be employed on a case by case basis depending on the level of contamination, soil type, land use and other relevant factors. The team also observed agricultural production practices and land in the vicinity of the four prefectural capitals and visited a typical farm producing spinach and rice in Tochigi Prefecture.

The FSAT liaised informally with other IAEA Monitoring Teams at various times during the mission to obtain updated information on the radioactivity levels measured. Frequent contact was also maintained with the Joint FAO/IAEA Division and the IAEA/IEC in Vienna and updated technical information was supplied to the team on an on-going basis to assist in the field activities.

The general focus of the discussions in the four prefectures was mainly on remediation strategies and the re-establishment of agricultural practices. Concerns of local government and agricultural sector stakeholders included:

- Mechanisms and persistence of contamination of food and agricultural land.
- Contamination and sampling of groundwater and surface water/rivers.
- Implications of the possible long term release of radioisotopes.
- Effect of climatic conditions on contamination profiles.
- Other radionuclides that should be screened for/monitored.
- Design of sampling plans for monitoring food, soil and other environmental samples.
- Contaminant transfer (soil-plant).
- Disposal of contaminated plants, animal products, soil and packaging.
- International standards for radioisotope levels in food and environment.
- Remediation strategies and methodology—comparisons with Chernobyl.
- Feeding strategy for animals in affected areas.
- Urgent concern over strategies for the next cropping season (especially rice).

A wrap-up meeting with the central government was held in Tokyo on 30 March. The Ministry of Health, Labour and Welfare, Ministry of Agriculture, Forestry and Fisheries, Ministry of Foreign Affairs and the Cabinet Office were represented. The FSAT provided a summary of the objectives of the mission and the activities completed and the issues raised in the four meetings held at prefectural levels were also discussed.

Final meetings were held with Yougo Matsuda, FAO Liaison Officer, and representatives of the Fisheries Agency and the Forestry Agency of the Department of Agriculture, Forestry and Fisheries. A number of issues were discussed and advice was provided by the FSAT on topics such as sampling and monitoring shellfish and the need to monitor radioisotope levels in mushrooms.

The interactions with the FSAT were welcomed by both local and central governmental authorities. The information provided by the team was taken under consideration, and immediate action was taken on some recommendations, such as increased focus on soil sampling and additional monitoring of mushrooms and shellfish, as reflected in the daily data reported through the IEC.

Based on comprehensive discussion, a number of challenges were identified. The main conclusions of the team were:

- As an immediate response, structured contamination monitoring programmes should be established for air, agricultural production, water and soil. This would provide robust and reliable data to facilitate accurate mapping of the contamination and for rapid risk as-

sessment to support emergency management decisions.

- Immediate risk communication channels should be established for farmers to provide clear guidance on immediate (and medium/long term) actions.
- A dynamic remediation strategy should be developed. Criteria and tools must be established to assist the selection of the most appropriate remediation approaches at each stage; initially to minimize contamination of the food supply chain during the persistent release phase and thereafter to assist in the re-establishment of agricultural production.
- The Japanese authorities may wish to consider consolidating emergency intervention levels and provisional guidance levels of contamination.

The IAEA and FAO can continue to offer assistance and support, as well as independent, scientific advice, if requested. The Joint FAO/IAEA Division has the multidisciplinary expertise to assist Japan, and to build capacity in other Member States to respond effectively to similar incidents, through both normative activities (information dissemination, preparation of manuals on sampling and analysis of soil and agricultural produce, information on phyto-extraction of radioisotopes) and operational activities (research projects, building capacity to perform sampling and analysis, etc.). These activities could include an opportunity for research programmes to be instigated to collect information on contamination in the immediate and longer terms to characterize agricultural contamination and to improve the effectiveness of agricultural countermeasures and remediation strategies.

Food Monitoring and Food Restrictions

Food Monitoring Information—30 June 2011 (samples collected from 15 March–30 June 2011)

The Ministry of Health, Labour and Welfare reported food monitoring data for a total of 6379 samples collected from 15 March–30 June in 23 different prefectures for various vegetables, fruit (e.g. cherry, Japanese apricot and strawberry), mushrooms, meat (e.g. beef, pork and chicken), eggs, tea, unprocessed raw and refined tea leaves, dairy products (e.g. unprocessed raw and fresh milk, yoghurt and lactic drinks), fish and seafood. Most of the monitoring continues to be concentrated in Fukushima (2725 samples, approximately 43%) and Ibaraki (876 samples, approximately 14%) prefectures.

Analytical results for 5975 samples (approximately 94%) of the 6379 samples indicated that Cs-134 and Cs-137 or I-131 were either not detected or were below the regulation values set by the Japanese authorities. However, 404 samples were above the regulation values for radioactive caesium and/or iodine (271 samples for radioactive caesium, 60 samples for radioactive iodine and 73 samples for both radioactive caesium and iodine). Out of the 404 samples exceeding the regulation values, 349 samples (approximately 86.4%) were collected in Fukushima and Ibaraki prefectures.

Food Restrictions (As of 30 June 2011)

Updated information on food restrictions was reported on 30 June by the Ministry of Health, Labour and Welfare indicating that restrictions on the distribution of tea leaves were enacted in certain areas of Gunma prefecture.

In Fukushima prefecture (specific areas), restrictions remain in effect on the distribution of raw unprocessed milk, turnips, bamboo shoots, ostrich fern, ume (Japanese apricot), cherry salmon (excluding farmed fish), Japanese dace and ayu/sweetfish (excluding farmed fish). Restrictions on the distribution and consumption of sand lance fish (the whole prefecture), specific non-head type (e.g. spinach) and head-type (e.g. cabbage) leafy vegetables, flower head brassicas (e.g. broccoli, cauliflower) and shiitake mushrooms (specific areas of the prefecture) also remain in effect.

In Ibaraki prefecture as well as in specific areas of Chiba, Gunma, Kanagawa and Tochigi prefectures, there is a continuing restriction on the distribution of unprocessed raw tea leaves.

Potential Future Activities of the Joint FAO/IAEA Division Related to Preparedness and Response to Nuclear or Radiological Emergencies Affecting Food and Agriculture

Potential short term actions

- *Providing advice and technical assistance on immediate action plan in affected areas:*

- Minimizing radioactive contamination of agricultural commodities (crops and animal products).
- Protecting commodities from radioactive contamination in potential contamination areas.
- Safeguarding agricultural production in greenhouses in affected areas.
- Decontaminating techniques for agricultural products.
- Disposal techniques for contaminated agricultural products.

- *Development and application of detecting and monitoring systems of radioactive contamination in food and agriculture:*

- Sampling procedures for agricultural products, farm soils and irrigation water.
- Establishment of a contamination monitoring information system, including simple-to-use global positioning systems (GPS) for the identification of sampling point locations and an inexpensive geographic information system (GIS such as Google Earth Pro) for mapping and monitoring changes in radioactive contamination in time and space (data processing).

- Development of appropriate sample preparation procedures and analytical techniques for assessing radioactive contamination in agricultural products, farm soils and irrigation water.
- Implementation of a contamination monitoring system for food and agricultural products to generate rapid risk assessments in support of emergency management decisions.
- Application of the Joint FAO/WHO Codex Alimentarius Commission Guideline Levels for Radionuclides in Foods to ensure the safety of foodstuffs intended for international trade and local consumption.

Potential medium to long term actions

- *Establishment of agricultural remediation strategies and implementation protocols under different contamination scenarios:*
- Development and application of phyto-extraction measures and provision of assistance in the selection and distribution of locally adapted plant species/varieties for radionuclide accumulation.
- Development and application of physical and chemical techniques to minimize the impact of radioactive contamination in the soils and on-farm water conservation areas.
- Development of protective measures on the contaminated land which is unsuitable for crop production in the medium term.
- Study on transfer factors of radionuclides from soils to agricultural crops under different soil characteristics.
- Implementation of good agricultural practices to minimize the impact of radioactive contamination on crop and livestock production.
- Development of stable- and radio-isotope traceability measurements to help ensure food safety, food authenticity and to support trade in foodstuffs after a nuclear emergency.
- Distance learning and web based modules to train and inform affected communities on agricultural countermeasures against radioactive contamination in the event of nuclear exposure. The documents/photos/videos/guidelines and recommendations will be available in both hard (paper copy) and soft (web) formats. The aim is to develop visual and user-friendly documentation with a step-wise approach for each recommended action plan or activity.

Past Events

International Symposium on Food Irradiation – Role of Irradiation in Food Safety and Security; Seoul, Republic of Korea; 16–19 May 2011

Technical Officer: David H. Byron

The International Symposium on Food Irradiation – Role of Irradiation in Food Safety and Security, was held in Seoul, Republic of Korea, 16–19 May 2011. The symposium was organized by the Korea Atomic Energy Research Institute (KAERI) and the Korea Food Security Research Foundation (KFSRF) and hosted by the Korea Food and Drug Administration (KFDA). The Head of the FEP Section participated in the symposium and presented a congratulatory address, chaired a plenary session on Food Security and Irradiation and Emerging Issues and Solutions to Food Safety, and presented remarks on the "Overview of Global Status and Aspects of Food Irradiation – Activities of the Food and Environmental Protection Subprogramme".

The symposium was opened by Y.J. Kim, Vice-President of KAERI and C.H. Lee, Chairman of KFSRF. Congratulatory addresses were presented by K.H. Lee of the KFDA and the reporting officer. The reporting officer opened his congratulatory address by noting that according to the FAO report on Global Food Losses and Food Waste, approximately one third, or 1.3 billion tonnes, of the total food produced for human consumption every year is lost or wasted. Food losses, which occur at the production, harvest, post-harvest and processing phases, are most prevalent in developing countries, mainly due to factors such as poor infrastructures, low levels of technology and low investment in food production systems. Food waste, on the other hand, is more of a problem in industrialized countries, most often caused by retailers and consumers, where perfectly edible foodstuffs are routinely discarded. It was therefore noted that reducing food losses and waste through the use of food irradiation could have an immediate and significant impact on global food security.

The symposium was further informed that for close to half a century, FAO and IAEA have had a successful partnership through their Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, which includes the Food and Environmental Protection subprogramme. The food irradiation technologies that have been and continue to be developed, validated and transferred through this partnership can play an important role in ensuring safe, wholesome and high quality foods while at the same time facilitating international trade.

The FEP Head stressed that food irradiation is one of the few technologies which address both food quality and safety by virtue of its ability to control spoilage and food borne pathogenic microorganisms without significantly affecting sensory or other organoleptic attributes of foods. Foods are irradiated to provide the same benefits

as processing by heat, refrigeration, freezing or chemical treatments without significantly raising food temperatures or leaving potentially harmful residues. Irradiation can also be used to protect both packaged and unpackaged products from microbiological hazards.

The FEP Head concluded his congratulatory address by thanking the Korean government for hosting an Asian regional Executive Management Meeting to Review and Adopt Guidelines for the Audit and Accreditation of Food Irradiation Facilities in Daejeon in July 2010. It was noted that this was the first international meeting held at the newly built Advanced Radiation Technology Institute (ARTI) of the Korea Atomic Energy Research Institute (KAERI) international conference and training venue, and it was hoped that KAERI/ARTI would continue to collaborate with the IAEA in the further consideration of irradiation technologies.

The FEP Head introduced his presentation (Technical Session I) on an Overview of Global Status and Aspects of Food Irradiation – Activities of the Food and Environmental Protection Subprogramme with background remarks on the IAEA role, objectives and outcomes related to post-harvest applications of food irradiation to ensure food safety, enhance consumer protection and facilitate international trade. Global statistics on the prevalence of food-borne diseases as a problem that could be solved through the application of food irradiation were highlighted, as were the benefits attained through the use of the technology to ensure safe and wholesome food supplies. Statistics on country approvals and irradiation facilities (NUCLEUS databases) and on quantities (by weight and food type) traded were presented, as well as successful inter-agency initiatives towards the elaboration of international standards for food irradiation. Final remarks were presented on specific CRP and TCP activities related to food irradiation in both sanitary (human health) and phytosanitary (plant health) applications, including future challenges related to the adaptation of the technology.

In addition to the Inaugural Session and Technical Sessions I and II held on 16 March, Technical Workshops I and II were held on 17 May and at the final Technical Workshop III, forum discussions and a concluding session were held on 18 May. Forum discussions centred on the lack of acceptance of irradiation technologies by consumers, primarily due to safety concerns; consumer confusion between food irradiation and radionuclide contamination (i.e. radioactive food); the importance of government, consumer and industry education and communication to promote an informed interest in food irradiation, including food security benefits of the technology; the lack of available irradiated foods due to government and industry reluctance to regulate or market irradiated foods; environmental benefits (e.g. decreased use of pesticides and fumigants, decreased food losses) of the technology, and; the promotion of new applications of the technology (electron beam, X ray).

The final day (May 19) was held at the facilities of the Advanced Radiation Technology Institute of the Korea Atomic Energy Research Institute outside the city of Jeongeup, which is located approximately three hours south of Seoul. An introduction as well as a tour of the Institute was conducted during the full day meeting. ARTI undertakes activities related to industrial applications of radiation technologies in the area of food science, biotechnology and agriculture.

In view of the completion of state of the art training facilities in July 2010, and in consideration that food irradiation is a distinct project within the FEP subprogramme, it has also been proposed that the excellent ARTI/KAERI facilities in Jeongeup be newly designated as a Collaborating Centre for Advanced Radiation Technology from the 2012-2013 biennium.

16th Meeting of the Interagency Committee on Radiation Safety (IACRS); ILO Headquarters; Geneva, Switzerland; 12–13 May 2011

Technical Officer: David H. Byron

The 16th Meeting of the Interagency Committee for Radiation Safety (IACRS) was held at the Headquarters of the International Labor Organization in Geneva, Switzerland from 12–13 May 2011. The meeting was attended by IACRS Member organizations from the EC, FAO, IAEA, ILO, OECD/NEA, PAHO, UNSCEAR and WHO and IACRS Observer organizations from the ICRP (by videophone), ICRU, IEC, IRPA and ISO.

The 16th Meeting of the IACRS discussed international organization activities related to the Japanese nuclear accident, including possible follow-up actions; recent developments concerning the revised International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS), including harmonization with the ICRP Statement on Tissue Reactions related to the lens of the eye; radon exposure; radiation risks; occupational exposure, and; the possible elaboration of an IACRS statement on the 25th anniversary of Chernobyl.

As the FAO representative, the FEP Head presented a statement on FAO matters of interest to the 16th IACRS related to the Japanese nuclear emergency (also see Feature Article in this Newsletter), including:

- Activities of the Joint FAO/IAEA Division Related to the Japanese Nuclear Emergency.
- Activities of the Joint FAO/IAEA Food Safety Assessment Team Mission (26–31 March 2011).
- Potential Future Activities of the Joint FAO/IAEA Division Related to Preparedness and Response to Nuclear or Radiological Emergencies Affecting Food and Agriculture.
- IAEA Ministerial Conference on Nuclear Safety.

- Comprehensive update on food monitoring and food restriction information compiled to date.

The FEP Head noted that these activities were undertaken in the context of Project (2.1.3.3) on Preparedness and Response to Nuclear Emergencies and Radiological Events Affecting Food and Agriculture within the IAEA Subprogramme on Improving Food Safety and Consumer Protection (2.1.3).

In response to a statement emphasizing the need to sample foods to enable the application of food restrictions (distribution and consumption) immediately after an accident, the FEP Head noted that the Japanese had already started their sampling programme on 15 March 2011. Other discussions focussed on the publication of a jointly produced (FAO/WHO) International Food Safety Authorities Network (INFOSAN) statement on the Impact on Seafood Safety of the Nuclear Accident in Japan, as well as the consideration of the WHO Guidelines on Drinking Water Quality in establishing consumption restrictions on tap water.

In view of ongoing collaborative work between the FAO, the Interagency Committee on Radiation Safety and the BSS Secretariat in the finalization and adoption of the Basic Safety Standards, as well as follow-up activities related to the Japanese nuclear emergency, it is anticipated that a subprogramme representative will attend the next 17th meeting of the IACRS that will be held at OECD/NEA Headquarters in Paris, France in December 2011.

International Conference on Food Integrity and Traceability; Queen's University Belfast, UK; 21-24 March 2011

Technical Officer: Andrew Cannavan

The international conference on Food Integrity and Traceability was held at Queen's University Belfast, UK, 21–24 March 2011. The event brought together more than 240 scientists, policymakers and industry representatives from 25 countries, representing all five continents, to share research, knowledge and expertise and discuss the key topics relating to the challenges and progress in maintaining and improving the safety and integrity of the food supply. The conference was organised around three themes; reviewing recent progress in delivering safe, authentic and traceable food to the consumer, identifying the greatest current and emerging threats to the integrity of the agri-food supply, and delivering new analytical means of verifying the integrity of the agri-food supply chain.

The FEPL Head assisted in the organization of the conference as a member of the Scientific Committee, presented a keynote lecture entitled Food Integrity and Traceability – The Developing Country Perspective, which outlined the Joint FAO/IAEA Division's successes and ongoing work in this field, and co-chaired a plenary session on identifying and dealing with food safety risks. Two posters were also presented. One of these was on the development in FEPL of a method for the simultaneous determination of tropane alkaloids and glycoalkaloids in seeds and grains by liquid chromatography – tandem mass spectrometry, the first method published allowing screening for both of these important groups of food toxins in a single analysis. The method is rapid, reliable, sensitive and specific and the simple extraction and cleanup procedure and short run time make it suitable for risk assessment and food safety control in both developing and developed country member states.

The second poster presented a cost effective scheme for developing countries to improve food safety using environmental indicators of good agricultural practices at a catchment scale. This was based on a five year coordinated research project (CRP) initiated in 2006 to enhance Member State capacities and methodologies to improve food quality and safety through the use of validated methods and procedures for the detection and monitoring of residues and contaminants in the environment and correlation of the data with food production systems. The CRP integrated risk assessment tools and targeted chemical and biological analytical monitoring as a cost-effective option for developing countries to identify specific water pollutants arising from food production, their sources and occurrences. The monitoring data were critically evaluated and, where necessary, used to improve agricultural production practices. Nuclear and related techniques assisted in generating outputs such as harmonized protocols for sampling and analysis of surface water. Geo-referenced data, guidelines, and access to eLearning courses helped to accelerate capacity building and led to three major outcomes: (1) cost effective, sustainable and catchment-targeted monitoring schemes for surface water; (2) mechanisms to 'feed back' the results of laboratory analysis to the primary producers and extension services; and (3) information exchange on harmonized analytical methods and water monitoring schemes to improve pesticide management practices and the production of safe food.

The contribution of research carried out at FEPL as a partner in the EU 6th Framework Project 'ProSafeBeef' was also acknowledged in a poster presented by Dr. K. Cooper of Queen's University Belfast, UK.

The Food Integrity and Traceability conference was extremely successful and had many more participants than initially envisaged in the planning phase, highlighting the global interest in assurance of the integrity of the food supply chain through traceability and contamination detection and control mechanisms. A second conference on the same theme has been tentatively planned for the future.

29th Meeting of the Radiation Safety Standards Committee (RASSC); IAEA Headquarters; Vienna, Austria; 7–10 December 2010

Technical Officer: David H. Byron

The Radiation Safety Standards Committee (RASSC) is a standing body of senior experts in radiation safety, established by the IAEA Deputy Director General of the Department of Nuclear Safety and Security. RASSC advises the Deputy Director General on the overall programme for the development, review and revision of standards relating to radiation safety. Its objective is to achieve consensus, quality, coherence and consistency in the development of international standards for radiation safety.

The functions of RASSC are:

- To advise on the approach to the development of the radiation safety standards issued in the IAEA Safety Standards Series, covering Safety Fundamentals, Safety Requirements and Safety Guides, both thematic and practice specific, and to advise on priorities.
- To review proposals for the development of new standards relating to radiation safety and to approve the relevant document preparation profiles (DPPs) prior to their submission to the Commission on IAEA Safety Standards.
- To review draft radiation safety standards, considering, throughout the preparation and review process, the value of each draft standard and the needs of users of the standards.
- To approve the text of draft radiation safety standards prior to their submission to Member States for comment and again prior to their submission to the Commission, in accordance with the established procedure.
- To ensure a broad international input in the preparation and review of radiation safety standards.
- To advise on radiation safety standards, relevant regulatory issues and activities for supporting the use and application of IAEA Safety Standards.

The FEP Head mainly participated in RASSC discussions concerning the revision, finalization and adoption of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS) as the FAO cosponsoring organization representative, particularly in regard to the development of emergency preparedness and response procedures for nuclear and radiological emergencies affecting food and agriculture. The FAO has been intimately involved since 2006 with the Inter-Agency Secretariat to Coordinate the Revision of the Basic Safety Standards (BSS Secretariat), which is the body responsible for coordinating the revision of the Basic Safety Standards.

The subprogramme looks forward to its continued collaboration with the RASSC and the BSS Secretariat in the ongoing revision of the International Basic Safety Standards and in assisting governments to effectively respond to nuclear and radiological emergencies through the provision of training and support and the development, coordination and implementation of standards, management procedures and emergency preparedness and response mechanisms related to food and agriculture.

Abu Dhabi Food Control Authority (ADFCA) Radiation Day Workshop and Forum; Abu Dhabi, United Arab Emirates; 23–26 November 2010

Technical Officer: David H. Byron

The FEP Head introduced his presentation on Nuclear Applications for Food Security - The Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture with background remarks noting that after increasing from 2006 to 2009 due to high food prices and the global economic crisis, FAO has estimated that both the number and proportion of hungry people have declined in 2010 as the global economy recovers and food prices remain below their peak levels. Although the number of undernourished is expected to drop from more than one billion in 2009 to 925 million in 2010, it still remains higher than before the crisis, making it difficult to achieve the hunger-reduction targets of the World Food Summit and the Millennium Development Goals. It was further noted that the food import forecast was 1.026 trillion USD in 2010, which was a 15% increase on 2010, despite a 2% decrease in world cereal production during the same period.

It was emphasized that the fall in agricultural production (2.9% to 1.6% from 1960 to 1990, respectively) was far too low to meet the continuing population growth and rise in consumer demand, and that drastic steps were needed to counter the declining productivity of existing cropland and the expected decreases in yields due to climate change, including the spread of invasive pests and diseases and the end of inexpensive fossil fuel supplies. This included the need for a radical reversal of the decline in agricultural research and development investments, together with sweeping changes in the way the world grows its food, so as to achieve the sustainable intensification of agricultural production that is required on existing arable land.

The FEP Head proceeded to highlight the successful FAO and IAEA partnership through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, which includes the Agriculture and Biotechnology Laboratory, the important role of technologies and biotechnologies that are being developed, validated and transferred, especially when integrated with more conventional methods, leading towards a more ecologically friendly second green revolution.

The successful integration of nuclear technologies in the following areas were reviewed and presented, including examples of real outcomes and direct benefits to farmers, communities and the environment in many Member States:

- The optimization of nutrient uptake by plants by producing higher-yielding and better adapted varieties in depleted soils and harsh climates.
- Achieving better soil management to improve soil fertility, sequester carbon, incorporate organic matter, and minimize land degradation and erosion.
- Increasing water and fertilizer use efficiency and reduce water and environmental pollution.
- Assisting in increasing livestock productivity and in the diagnosis and control of trans-boundary animal diseases and pests.
- Contributing to reducing insecticide use and agricultural losses, and the facilitation of agricultural trade, through the suppression and eradication of major insect pests of crops and animals through the integrated application of the sterile insect technique and other environmentally-friendly biological controls.
- Applying optimal radiation doses to destroy bacteria, insects and other organisms that cause spoilage of food and human disease, and to overcome phytosanitary barriers to agricultural trade.
- Helping to optimize production practices and environmental sustainability, reduce food losses, and enhance food distribution through international trade by promoting the efficient use of pesticides and veterinary drugs under good agricultural practices and controlling agrochemical residues, mycotoxins and radionuclide contamination in foods and livestock feed.

Audience comments primarily focussed on the post-harvest eradication of insect pests in dates through the use of irradiation, including the need to harmonize regulations for the use of irradiation in the UAE and through the Cooperation Council for the Arab States of the Gulf (GCC). The participants especially felt that regulations should be harmonized and based on the experience and application of food irradiation in Saudi Arabia.

It was further noted that the ADFCA had not authorized the use of food irradiation to date and although the national proficiency laboratory was able to detect irradiated foods, the import of such foods was not allowed, primarily due to unrelated consumer concerns regarding genetically modified organisms and animal cloning which unfortunately, also led to consumer suspicions and the suspension of the elaboration of regulations for the use of irradiation.

In response to the above remarks, the FEP Head emphasized ongoing work and activities of the Joint FAO/IAEA Division and the Food and Environmental Protection subprogramme, particularly as related to technical cooperation projects for the development of regulations and support for the application of irradiation as well as the establishment of research networks under coordinated research projects related to phytosanitary applications of irradiation, including regulatory and consumer education related to the safety of irradiation. The participants stressed, however, that the problem was not directly related to research on the application of irradiation for the treatment of dates but more related to the promulgation of regulations in the UAE for the use of irradiation in general, including for the irradiation of dates and other foodstuffs.

The participants of the ADFCA Radiation Day Workshop and Forum strongly supported the convening of additional workshops on food irradiation within the UAE and the wider context of the GCC, especially as related to the education of government regulators with a view towards the promulgation of regulations for the application of irradiation for dates and other foodstuffs and for the education of consumers as to the safety of the technology.

The above would entail additional work with the ADFCA and the GCC towards the planning and implementation of workshops and seminars covering the application of irradiation, the promulgation of standards and regulations for the use of irradiation, and the detection and testing of irradiated foods.

Coordinated Research Projects

First Research Coordination Meeting of the Coordinated Research Project on the Implementation of Nuclear Techniques to Improve Food Traceability (D5.20.37); Vienna, Austria; 16–20 May 2011

Scientific Secretary: Josef Brodesser

Technical Officers: Britt Maestroni, Andrew Cannavan

Awareness of food safety has been rising and many importing countries have implemented food control regulations to guarantee the quality and safety of imported foods for their consumers. Authenticity and provenance have evolved to be a major concern in this context and the IAEA has responded with the launch of a new Coordinated Research Project (CRP) on the Implementation of Nuclear Techniques to Improve Food Traceability.

The 1st Research Coordination Meeting (RCM) under the CRP was held at IAEA Headquarters in Vienna, Austria, 16–20 May 2011.

The meeting was attended by Research Contract and Agreement Holders from Austria, Botswana, Chile, China, India, Lebanon, Portugal, Singapore, Thailand, Ugan-

da, UK, USA as well as observers from France, Sweden, USA, the IAEA, FAO and UNIDO.

The meeting recalled that the main purpose of the CRP is to provide access to skills and know-how and to establish a harmonized system for verification of claims related to food origin, production, and authenticity, using nuclear techniques involving mainly isotope ratio analysis and multielement analysis, as well as complementary methods.

The programme of the meeting included presentations, discussions and drafting sessions. The objectives were to:

- Review all research proposals in the context of the CRP objectives.
- Identify strengths, opportunities, limitations and challenges of the individual projects submitted by contract holders.
- Discuss and agree on a common approach and strategy to target the CRP objectives, and prepare a work plan for the following 18 months.
- Identify synergistic opportunities for cooperation among contract holders.
- Establish a partner system[3] between contract and agreement holders.
- Implement a quality control framework for the CRP.
- Prepare recommendations for CRP participants.

Each contract holder presented her/his recent accomplishments and proposed work plan in the project, with an emphasis on how their research will contribute to achieving the CRP objectives. Detailed discussion of the individual research projects took place to identify strengths, opportunities, limitations and challenges of all projects. A discussion session was held using a 'world café' approach to make use of the cumulative intelligence and experience of the group. Within this session, each research proposal was discussed in three rounds where the final round resulted in specific recommendations for the individual research project. Discussion and drafting sessions resulted in the development of a generic work plan for the CRP and specific recommendations for each individual research project for the first 18 months of the CRP. Presentations by agreement holders/observers addressed specific tasks (including quality control, statistics and instrumental aspects) as well as possible challenges within the planned research activities.

The partner system was established within the CRP to enhance contact and interaction between/among contract holders and agreement holders. The partner system consists of at least two contract holders and one agreement holder per group. Other contract holders/agreement holders can participate in these groups according to specific interests. Partnerships were identified and the agreements formalized during the first RCM.

General recommendations were given to all contract holders to try to ensure that they produce data of acceptable quality; these included the implementation of rigorous quality assurance /control measures, such as the regular use of certified reference materials, method validation, and participation in proficiency testing. Reporting was also considered to be important to encourage interaction within the established 'partner system' and to keep the project on track. Besides the more comprehensive annual report, all meeting participants agreed to implement a status update every three months for evaluation by their partners, who will then provide feedback to the respective contract holder.

Meeting Participants of the 1st RCM at the Vienna International Centre

Quality control was identified as one of the major issues in the CRP, in that it is of crucial importance to establish validated methods and to provide evidence of the precision and accuracy of measurements and the data produced, including total combined uncertainties, before inclusion of the data in a database. This is a prerequisite for comprehensive measurements of samples and for providing reliable data. Reference materials must be used where available in order to verify the accuracy of the results. Proficiency tests are one of the most important tools in order to prove 'fitness for purpose' of the applied method. Each laboratory is requested to either participate in existing PT schemes, distribute in-house reference materials to establish between laboratory comparability of results, or participate in a PT scheme which is organized for the specific need of a group of contract holders. Laboratories are requested to report on the successful participation in PT schemes or on the completion of inter-laboratory comparisons. Method validation and satisfactory participation in a PT scheme are prerequisites for the inclusion of data in the project database.

Another important aspect is the identification and application of appropriate statistical methodologies to interpret the collected data. It was recognized that a lack of expertise in certain fields requires training for the participating laboratories in order to ensure data quality. This is especially needed for aspects of metrology and sampling. Statistical data treatment was identified as one of the core issues for the successful interpretation of the final data.

3 A partner system is defined as a collaboration agreement between parties; in this example one or two contract holders are directly linked to one agreement holder for the whole duration of the CRP.

Therefore, the participants suggested that a technical contract be issued under the CRP to provide information, support and training on chemometric data treatment and metrological issues.

It was agreed that the virtual learning internet platform of the FAO/IAEA should be used as an interface for training and as an exchange forum. A specific outcome of the CRP is a database for housing all relevant data for the interpretation of provenance or authenticity of food products. It was agreed that the database should be hosted by an impartial institution (IAEA) and possibly be interlinked with other already existing databases. Further discussion amongst the participants is needed to elaborate the structure of the database and the strategy for data upload. It is the intention to make the project database freely available at the end of the CRP.

The participants finally issued the following recommendations:[4]

- The regular evaluation of research progress and the renewed outline of future scientific work are of utmost importance. Four RCMs for this CRP should be organized.
- If possible, RCMs should be organized to coincide with other scientific congresses on food authenticity and traceability. Furthermore, a one-day seminar could be included in the RCM to engage with stakeholders and government officials in the host country to raise the profile of the CRP.
- The IAEA should provide the necessary resources for additional agreement holders and technical cooperation (e.g. providing access to reference materials or supporting PT schemes).
- The IAEA should host the database generated as one of the outputs of the CRP in order to ensure open access and longevity; this falls within the IAEA's mandate to promote the peaceful use of nuclear-related techniques.
- Horizontal transfer of knowledge among the participants is a key element of the CRP. The IAEA, in collaboration with FAO, should provide additional support for on-site training and training fellowships related to this CRP.

The second Research Coordination Meeting is tentatively planned to be held in Uganda in November 2012.

4 The views and recommendations expressed here are those of the CRP participants, and do not necessarily represent those of FAO or the IAEA.

Second Research Coordination Meeting of the Coordinated Research Project to Develop Generic Irradiation Doses for Quarantine Treatments (D6.20.08); Texas A&M University, College Station, Texas, USA; 11–15 April 2011

Technical Officer: Carl Blackburn, Andrew Parker

Research under this Coordinated Research Project (CRP) on the Development of Generic Irradiation Doses for Quarantine Treatments seeks to establish validated irradiation doses for the treatment of non-fruit fly insect species of quarantine significance. Project results will strengthen existing phytosanitary irradiation standards developed under the International Plant Protection Convention, thereby allowing international trade for various fruits and vegetables through the use of generic irradiation doses for a wide range of quarantine pests.

The 2nd Research Coordination Meeting (RCM) reviewed progress towards the research objective of establishing generic doses for several groups of insect pests of regulatory importance and the allied objectives of researching the effects of low oxygen commodity storage and dose rate on efficacy and commodity tolerances. Good progress has been made overall and it is expected that results of confirmatory tests for mealybugs, Liriomyza leaf miners and some Lepidoptera will be available by the 3rd RCM tentatively scheduled to be held in October 2012.

Research results so far indicate that a generic dose treatment significantly below the currently proposed generic dose of 400 Gy would be suitable for all insects except pupae and adults of Lepidoptera. However, a generic dose for insect mites is still not clear as there seems to be considerable variation between species. It is also likely that tests to validate irradiation dose treatments for two species of mites may also be completed in time for the next RCM.

Second Research Coordination Meeting of the Coordinated Research Project on the Development of Radiometric and Allied Analytical Methods to Strengthen National Residue Control Programmes for Antibiotic and Anthelmintic Veterinary Drug Residues (D5.20.36); Kandy, Sri Lanka; 14–18 March 2011

Technical Officer: Rajendra Patel

The 2nd Research Coordination Meeting (RCM) for the Coordinated Research Project (CRP) on the Development of Radiometric and Allied Analytical Methods to Strengthen National Residue Control Programmes for Antibiotic and Anthelmintic Veterinary Drug Residues

was held at the Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Sri Lanka, 14–18 March 2011. The event was very well organised and the great efforts of the local counterpart, Prof. Preeni Abayanayke and her team, were acknowledged and appreciated by all the participants.

Participants

Rodrigo Granja (Brazil) chaired the meeting with Grace Murrila (Kenya) as the Rapporteur and Rajendra Patel (IAEA) as Scientific Secretary. Other participants were Research Contract Holders Mr. Guilherme de Paula Nogueira (Brazil), Ms. Liu (Linda) Guihua (China), Mr. Shuming Yang (China), Mr. Orlando Lucas (Peru), Mr. Jin Wook-Kwon (Republic of Korea), Ms. Sasitorn Kanarat (Thailand), Ms. Aida Ben Mansour (Tunisia), Ms. Preeni Abeynayake (Sri Lanka) and Research Agreement /Technical Contract Holders Mr. Thomas Kuhn (Austria), Mr. Hubert De Brabander (Belgium), Ms. Alida (Linda) Stolker (Netherlands) and Mr. Terry Fodey (UK). Mr. Philip Kijak and Mr. Chris Elliott were unable to attend but have continued to actively support the project. Ms. Tserendorj Enkhtuya (Mongolia) was also unable to attend. Mr. Leen Van Ginkel (Director, EU Community Reference Laboratory, RIKILT, the Netherlands) was coincidentally in Kandy on a private visit and the meeting appreciated his participation for one day to share his invaluable expertise in residues analysis.

The RCM was formally opened by the Vice Chancellor of the University of Peradeniya, Prof. S.B.S. Abayakoon, who, in his opening speech, highlighted the long standing association with the Joint Division in the field of animal health and food safety and the success of this collaboration resulting in the setting up of a food contaminants laboratory in the Department of Veterinary Public Health and its ISO17025 accreditation by the Sri Lanka Accreditation Board (SLAB). A representative of SLAB presented the Accreditation Certificate to Prof. Preeni Abayanayke.

Participants of the 2nd RCM at the University of Paradeniya in Kandy, Sri Lanka

The main aim of this 2nd RCM was to:

- Evaluate and discuss the progress made by each contract holder in relation to the work plans agreed at the 1st RCM (19–23 October 2009, Vienna).
- Prepare work plans for the next phase of the project. The meeting recognized that the activities and CRP framework may be refined if necessary in order to better meet the objectives of the CRP.
- Facilitate a broader understanding of the relationship each participant has to the overall objectives of the CRP and to promote interaction between the participants.
- Prepare recommendations and guidelines to facilitate project tasks and for the participants to agree a common approach and way forward.

The meeting also recognized that the main objective of the CRP was to provide National Reference Laboratories of FAO and IAEA Member States with effective and appropriate monitoring methods for residues of selected antibiotic and anthelmintic veterinary medicines through development and application of analytical methods utilizing radiotracer detection methods in conjunction with confirmatory techniques using stable-isotope labelled analogues. In this regard, the importance of preparing and disseminating Standard Operating Procedures with appropriate validation data was stressed.

The Research Contract Holders presented their work focusing on results and constraints. Working with the Agreement holders and the Technical Contract holders in small groups, each Research Contract holder revised and finalised their individual work plans and formulated their planned activities and milestones for the next phase of the project.

All the Agreement holders presented their current work on veterinary drug residues at a meeting organised by the Faculty of Veterinary Medicine and Animal Science as part of the events to commemorate World Veterinary Day 2011 (http://www.vet2011.org/). In addition to the RCM participants staff and students of the University of Peradeniya and Representatives attended the meeting from industry. A presentation on analytical approaches to address food authenticity and traceability problems was made by the Scientific Secretary.

Conclusions

- The meeting recognized that the CRP had initiated collaboration between laboratories (network of laboratories) of different member states and that it provides information that can have a regulatory impact, e.g. natural occurrence of substances like chloramphenicol and contamination of the environment by residues of pharmaceuticals will initiate additional risk assessment and evaluations.
- Each Research Contract Holder's work was reviewed to ensure that high scientific standards and the objec-

tives of the CRP were met and their work plans, activities and deliverables for the next phase of the project were finalized.

- To ensure that the primary objective of the CRP to provide National Reference Laboratories of FAO and IAEA Member States with monitoring methods for residues of selected antibiotic and anthelmintic veterinary medicines is met, it was agreed that all methods developed and used by the contract holders will be presented as Standard Operating Procedures with appropriate validation data, using either Codex or EU guidelines. Agreement Holders will provide assistance where needed.
- The first phase of the project focussed on the development of multi-residue methods that are fit for purpose (easy to use and cost effective). However, the results clearly show this is not always possible and the meeting recognised that it may be more cost effective to have two separate methods, e.g. for benzimidazoles and ivermectins.
- It was also agreed that rather than continuing with further method development work, Contract Holders working on benzimidazoles would work towards setting up a 'harmonized' method for benzimidazoles in specific matrices (muscle, liver and milk), based on acetonitrile extraction, solid phase cleanup and LC-UV/MS detection. The method would be collaboratively tested by exchanging samples.
- The work on the preparation of reagents (antibodies and enzyme-conjugates) for the development of immunoassays using radiolabelled substances has encountered some difficulties. It was agreed that the Technical Contract holder will provide participants with appropriate protocols and reagents.
- It was recognized that the time required in obtaining appropriate import licences for reagents and biological samples should not be underestimated. Failure to comply with import regulations could mean the refusal of a carrier to transport the material or cause delays in customs clearance. It was agreed that Contract Holders will examine their national regulations concerning export/import of biological and chemical materials and standards and put in place all the necessary clearances before shipment.

Recommendations

- In line with the work plans agreed at the second RCM, specific reagents (e.g. antibodies and radiolabelled materials) should be transferred to relevant members.
- Methods used and developed by the participants should be validated according to one specific fit for purpose validation procedure (CODEX/EU) and should be described in a standard operating procedure and distributed between all CRP contract and agreement holders.
- Collaborative studies for methods developed in the CRP should be organised by relevant members:
  - Benzimidazoles in meat (China)
  - Aminoglycosides in meat (China)
  - Florfenicol in fish (tilapia and catfish (Brazil))
- To facilitate appropriate risk assessments and development of regulatory policy, the data regarding the contamination of the environment with residues of pharmaceuticals, including veterinary medicines and the naturally occurring pharmacologically active substances (e.g. chloramphenicol), should be collated and disseminated to a wider group of interested stakeholders.
- Finally, the meeting recommended that additional IAEA support should be sought to address emerging issues on food and environmental contamination by veterinary drug residues, e.g. generation of pharmacokinetic data in fish species where this is not available, and environmental impact of increasing aquaculture.

Third Research Coordination Meeting of the Coordinated Research Project on Integrated Analytical Approaches to Assess Indicators of the Effectiveness of Pesticide Management Practices at the Catchment Scale (D5.20.35); Vienna, Austria; 6–10 December 2010

Technical Officer: Britt Maestroni

The 3rd Research Coordination Meeting (RCM) of the Coordinated Research Project (CRP) on Integrated Analytical Approaches to Assess Indicators of the Effectiveness of Pesticide Management Practices at the Catchment Scale was held at the IAEA Headquarters in Vienna, Austria, 6–10 December 2010.

The meeting was attended by Research Contract and Agreement holders from Argentina, Australia, Brazil, Bulgaria, Chile, China, Costa Rica, Ecuador, Hungary, Kenya, India, the Philippines and Sweden, as well as observers from Brazil, Bolivia, Colombia and the IAEA.

The programme of the meeting included progress reports and presentations including a summary of the 'black-box' monitoring approach; a review of the current regional initiatives in the context of integrated analytical approaches to assess the implementation of GAP; and insights into minimizing agriculture non-point source contamination via rapid assessment of locally-relevant data.

Participants of the 3rd RCM at the Vienna International Centre

Trainees from a preceding ARCAL RLA/5/053 three-week training course summarized modules on linking soil and pesticide behaviour at a landscape scale and measurement of sorption coefficient (Kd) and soil organic partition coefficient (Koc) of pesticides using 14C-pesticides. Other presentations were given on bioassays, an introduction to the application of radioisotopic techniques to estimate soil erosion at the watershed scale, modelling transport processes affecting pesticide movement across the landscape including spray drift, and the application of Fourier transform infrared spectroscopy.

Training was provided on the use of GPS and application of geographical information systems as well as new space time modelling tools. Demonstrations were also given on FAO/IAEA web resources, including the new eLearning courses on bioindicators and iPads in the laboratory.

All Research Contract holders presented their progress reports. During the RCM the participants agreed on the key issues for inclusion in a draft generic guideline on "integrated analytical approaches to assess indicators of pesticide management practices at a catchment scale". The following conclusions and recommendations, including the implementation of the overall CRP work plan for 2011, were agreed.

The meeting, while:

- Observing successful and unsuccessful strategies to monitor, evaluate and, where necessary, improve agricultural production practices by feeding back data to stakeholders.
- Noting that there are many possibilities to improve the black-box strategy, and that targeting the easier, quicker and most cost effective options should be the priority.
- Noting benefits from the prevention of non-point pollution at source and the success of integrated analytical approaches to evaluate the effectiveness of pesticide management practices at a catchment scale.
- Noting the importance of evaluating the transport of pesticides across the landscape in the case of low MRLs and/or sensitive local species.
- Utilizing all appropriate communication channels to improve outreach and outcomes from catchment monitoring approaches.

agreed to the following recommendations:[5]

- The Joint Division should draft a generic guideline based on the 3rd RCM discussion on integrated indicators for the assessment of the effectiveness of pesticide management practices, distribute it to participating organizations for further elaboration, and eventually translate it into French and Spanish.
- The Joint Division should disseminate training materials on spatial variability and examples of their application at the catchment scale.
- The CRP should investigate the use of nuclear techniques to scale up and trace the origin of contaminants and utilize them as markers, especially for source identification and apportioning. The IAEA should further encourage the development of training materials on the application of stable isotope technique as well as radiotracers to assess indicators of pesticide management practices at a catchment scale.
- The Joint Division should facilitate the harmonization of analytical procedures and cost effective monitoring strategies, including bioanalytical approaches (bioassay and bioindicators) to complement chemical analyses.
- The CRP contract holders should include the evaluation of the contribution of spray drift to off-site pesticide transport and collect critical spatial data through expert judgement and modelling to assess scenarios about the fate of agrochemicals and to highlight key messages for local stakeholders.

5 The views and recommendations expressed here are those of the CRP participants, and do not necessarily represent those of FAO or the IAEA

Technical Cooperation Projects

Project Number	Title and Project Objectives	Technical Officer
ARG5011	**The Use of Ionizing Radiation for the Phytosanitary Treatment of Fresh Fruit** To strengthen the national technological capacity for the establishment of irradiation services for phytosanitary treatment.	**Blackburn, Carl Michael (NAFA)** **Byron, David Henry (NAFA)**
BEN5004	**Regulatory Control and Monitoring of Mycotoxins to Facilitate Trade** To establish laboratory capacities and analytical procedures for mycotoxin control.	**Maestroni, Britt Marianna (NAFA)** **Byron, David Henry (NAFA)**
BGD5027	**Establishing a Veterinary Drug Residue Laboratory** To establish a laboratory complying with international standards for surveillance of veterinary drug residues and prohibited substances in food of animal origin.	**Cannavan, Andrew (NAFA)** **Patel, Rajendra Kumar P. (NAFA)**
BZE5003	**Providing Technical Assistance and Training for the Control of Chemical Residues in Food.** To help ensure that the food placed on the market for consumers from national or imported sources is free from harmful chemical contaminants by supporting and strengthening the development of a national chemical contaminant residue monitoring programme, and to further increase the technical capacity (in the area of residue testing) of the competent authority in Belize responsible for agricultural health and food safety.	**Maestroni, Britt Marianna (NAFA)**
COL5021	**Cost Benefit Assessment for the Modernization of an Irradiator in Colombia** To develop a proposal for the sustainable operation of a pilot irradiator (100 000 Ci, cobalt-60), through the realization of a cost benefit analysis with account taken of the situation in Colombia.	**Blackburn, Carl Michael (NAFA)** **Sampa, Maria Helena de O. (NAPC)** **Pacheco Jimenez, Ronald Enrique (NSRW)**

Project Number	Title and Project Objectives	Technical Officer
COL5022	**Assessment of the Impact of Pesticide Use in Lake Tota, Boyacá,Colombia** To identify sources of agrochemical pollution; to determine the pesticide transport mechanism, the risk of pollution from agrochemicals applied to the area of the project and the environmental impact and risk to human health; to upgrade the pesticide residue analysis laboratory for monitoring and analysis of pollution in water resources.	**Maestroni, Britt Marianna (NAFA)**
CPR5018	**Building Technological Capacity for Food Traceability and Testing of Pesticide Residues in Food** To provide the technical and regulatory basis for food origin traceability and for monitoring residues of pesticides, in order to ensure food safety and consumer confidence.	**Cannavan, Andrew (NAFA)**
ISR5016	**Supporting a Feasibility Study for Using Irradiation as a Quarantine Treatment** To investigate the technical feasibility of using irradiation as a quarantine treatment on key export commodities.	**Byron, David Henry (NAFA)** **Blackburn, Carl Michael (NAFA)**
IVC5027	**Monitoring of Pesticide Residues in Food Products** To establish a sustainable capacity for control and monitoring of pesticide residues in food products.	**Maestroni, Britt Marianna (NAFA)**
LEB5014	**Upgrading the Environmental and Food Analysis Laboratory at the National Council for Scientific Research** To upgrade the laboratory of environment and food analysis in order to extend analytical capabilities for the analysis of thermo fragile organic compounds.	**Maestroni, Britt Marianna (NAFA)**
MNE5002	**Upgrading Capabilities to Establish Effective Monitoring Systems for Residues in Food and Air Quality** To establish an effective monitoring system for residues in food and air quality in Montenegro by enhancing analytical capabilities and establishing a network of air quality monitoring stations.	**Patel, Rajendra Kumar P. (NAFA)**

Project Number	Title and Project Objectives	Technical Officer
MOR5029	**Conserving and Improving the Quality of Aromatic and Medicinal Plants through Irradiation, and Transfer of this Procedure on an Industrial Scale** To help promote aromatic and medicinal plants in Morocco and to improve the income of those who grow, produce and sell them by valorizing them.	**Blackburn, Carl Michael (NAFA)** **Sampa, Maria Helena de O. (NAPC)**
NIC5007	**Determining Drug Residues in Bovine Meat Exports** To determine veterinary medicine residues and growth promoters through nuclear and complementary techniques to improve production, product quality and diagnostic techniques.	**Cannavan, Andrew (NAFA)** **Patel, Rajendra Kumar P. (NAFA)**
NIR5034	**Feasibility Study on the Optimal Use of an Industrial Gamma Irradiation Facility** To conduct a feasibility study on the optimal use of the new Gamma Irradiation Facility for industrial application in Nigeria.	**Blackburn, Carl Michael (NAFA)** **Sampa, Maria Helena de O. (NAPC)**
PAN5019	**Supporting the Accreditation of a Pesticides Residue Laboratory** To establish an accredited laboratory according to ISO 17025.	**Maestroni, Britt Marianna (NAFA)**
PHI5030	**Upgrading the Gamma Irradiation Facility** To upgrade and increase the throughput of the pilot-scale gamma irradiation facility at the Philippine Nuclear Research Institute (PNRI) to a semi-commercial one.	**Sampa, Maria Helena de O. (NAPC)** **Haji-Saeid, Seyed Mohammad (NAPC)** **Blackburn, Carl Michael (NAFA)**
RAS5046	**Novel Applications of Food Irradiation Technology for Improving Socioeconomic Development (RCA)** To focus on the application of technologies related to new uses of irradiation for sanitary and phytosanitary purposes, including technology transfer to participating RCA Member States.	**Blackburn, Carl Michael (NAFA)** **Byron, David Henry (NAFA)**
RAS5050	**Enhancing Sanitary and Phytosanitary Treatment of Regional Products for Export by Irradiation (RCA)** To enhance treatment of and trade in irradiated products of economic importance in the Asia Pacific region.	**Blackburn, Carl Michael (NAFA)** **Byron, David Henry (NAFA)**

Project Number	Title and Project Objectives	Technical Officer
RLA5050	**Strengthening Laboratory Capacity to Assess the Implementation of Good Agricultural Practices in the Production of Fruit and Vegetables in Latin America** To improve the assessment of good agricultural practices, with the support of analytical laboratories.	**Dercon, Gerd (NAFA)** **Maestroni, Britt Marianna (NAFA)**
RLA5053	**Implementing a Diagnosis System to Assess the Impact of Pesticide Contamination in Food and Environmental Compartments at a Catchment Scale in the Latin American and Caribbean (LAC) Region (ARCAL CII)** To apply a diagnosis and assesment system for evaluating the impact of pesticide contamination in food and environmental compartments.	**Dercon, Gerd (NAFA)** **Maestroni, Britt Marianna (NAFA)**
RLA5055	**Establishing a South American Regional Network of National and Reference Laboratories for Pharmacologically Active Substances and Contaminants in Food of Animal Origin Through Implementation of Approved Nuclear & Conventional Analytical Techniques (ARCAL CIV)** To establish a network of Latin American National Laboratories and Centres of Excellence by introducing harmonized procedures for the analysis of pharmacologically active substances and contaminants in food of animal origin.	**Patel, Rajendra Kumar P. (NAFA)** **Cannavan, Andrew (NAFA)**
SRL8019	**Technical Support for the Establishment and Operation of a Multi-Purpose Gamma Irradiation Facility** To provide technical assistance for the establishment of a multi-purpose gamma irradiation facility (MGIF) in Sri Lanka to sterilize medical products, to develop health care products, and to improve the quality and safety of food and other agricultural products.	**Sampa, Maria Helena de O. (NAPC)** **Blackburn, Carl Michael (NAFA)**
TAD5004	**Improving Laboratory Capacity for Food Safety** To provide assistance in the establishment of a central laboratory for the analysis of contaminants and residues in food and agricultural products and satellite laboratories at the border with neighbouring countries.	**Fesenko, Sergey (NAFA)** **Maestroni, Britt Marianna (NAFA)**

Project Number	Title and Project Objectives	Technical Officer
URU5025	**Determining Pesticide and Antibiotic Residues in Food for Local and Export Consumption** To improve the capability to determine pesticide residues in fresh fruit and vegetables, to introduce the Quecher procedure to analyse pesticide residues and to introduce the use of 14C-labelled pesticides.	**Maestroni, Britt Marianna (NAFA)**
URU5027	**Preparing for the Introduction of Irradiation Techniques** To introduce irradiation technology in Uruguay as a health and plant protection measure that will contribute to stimulating production and improving its quality for both local and external markets.	**Blackburn, Carl Michael (NAFA)**

Food and Environmental Protection Laboratory, Seibersdorf

Training Course on Linking Soil and Pesticide Behaviour at a Landscape Scale; Vienna, Austria; 15 November–3 December 2010

Technical Officer: Britt Maestroni

A training course on Linking Soil and Pesticide Behaviour at a Landscape Scale was organized at the IAEA in Vienna, Austria, 15 November–3 December 2010. The training course was planned as one of the 2010 activities of the IAEA technical cooperation project RLA/5/053 on Implementing a Diagnosis System to Assess the Impact of Pesticide Contamination in Food and Environmental Compartments at a Catchment Scale in the Latin American and Caribbean (LAC) Region.

The training course was attended by 10 participants from Argentina, Bolivia, Brazile, Chile, Colombia, Costa Rica, Cuba, Ecuador and Uruguay.

The purpose of the training was to provide participants with an understanding of the link between soil components and pesticide behaviour.

The training was organized in three modules: (1) measurement of the soil sorption and QuEChERS methodology (2) Definition of local Pesticide Impact Rating Index (PIRI) parameters related to the soil compartment and (3) Assessment of spatial variability and pesticide transport processes. The Food and Environmental Protection Laboratory (FEPL) provided direct technical support and guidance in module (1), hosting and working with the participants at the laboratory in Seibersdorf. The programme for module (1) encompassed the delivery of theoretical and practical sessions including pesticide behaviour, sorption of pesticides to soil and degradation of pesticides in soil. Demonstrations and practicals included measurement of the sorption of pesticides to two different soils using 14C labelled carbofuran, and modified QuEChERS methodology for the measurement of pesticides in soil by gas chromatography with mass spectrometric detection (GC-MSD) and liquid chromatography – tandem mass spectrometry (LC-MS/MS). The sorption technique will help generate local data on Kd/Koc allowing calibration of the PIRI and Pesticide Root Zone Model (PRZM) tools and utilization of their ability to assess 'what if'scenarios.

Module (2), led by Prof. Annemike Farenhorst, Canada, included lectures and training on the role of soil properties, i.e. clay content, mineralogical composition, soil organic matter content and aggregate stability and site conditions, i.e. slope gradient, soil erosion, and soil hydromorphology on the fate of pesticides in the soil and across the landscape; the sensitivity of PIRI and PRZM programs to changes in sorption and degradation parameters; information on how land management practices (e.g. conservation agriculture) influence this fate, and how these practices can help to reduce the impact of the use of pesticides on the environment.

Module (3), led by Dr. Juan Guillermo Cobo, Colombia, included lectures and training on principles of spatial variability in soil properties, and how this variability can be monitored and analyzed; demonstration and use of the software SURFER for visualizing and interpreting spatial soil variation; discussion of the principles and applica-

tions of Near and Mid-Infrared Spectroscopy, in particular Diffuse-Reflectance Infrared Fourier-Transformed (DRIFT) Spectroscopy, including applications for the spatial analysis of soil properties. Overall, the training course was very successful, as evidenced by the fact that all the technical presentations and practical sessions received very positive evaluations from the participants' feedback questionnaire. Equally important, all participants are now capable of training their colleagues and have access to all training materials from the RLA 5/053 website.

Workshop on Bioassays and Bioindicators; São Paulo, Brazil; 22–26 November 2010

Technical Officer: Britt Maestroni

A workshop on Bioassays and bioindicators was organised in São Paulo, Brazil, 22 –26 November 2010, at the Instituto Biologico de São Paulo. The workshop was planned as one of the 2010 activities of the technical cooperation project RLA/5/053 Implementing a Diagnosis System to Assess the Impact of Pesticide Contamination in Food and Environmental Compartments at a Catchment Scale in the Latin American and Caribbean (LAC) Region.

Prof. B. Kohlmann demonstrating sampling of macroinvertebrates

The objective of the workshop was to share experiences about biomonitoring and discuss methodologies to carry out first-tier risk assessments using biological systems. Specifically, the workshop discussed the use of bioassays for ecotoxicological testing, and biomonitoring of aquatic macroinvertebrates as a complementary technique to chemical analysis and isotopic techniques to detect toxicants in water and soil compartments. Integrated monitoring emphasizes the complementarities achieved by coordinated monitoring activities comprising chemical and biological measurements in a variety of environmental media or compartments. While chemical measurements are easily understood, biological monitoring or biomonitoring is the planned and systematic use of living organisms and the study of their responses to determine the quality of their aquatic environment. As such it is a part of a broader concept, called ecological monitoring, based on the use of biological indicators that may be single organisms, species, populations, or biological communities. Biomonitoring has the great advantage of being a temporal process, in other words it is analogous to a movie, whereas physical and chemical analyses are instantaneous processes, more akin to a snapshot in time.

Demonstration of toxicity testing using Daphnia M.

The workshop was attended by 17 participants from 14 different institutions in the Latin America and Caribbean region. The programme of the workshop included lectures by Prof. Bert Kohlann, EARTH University, and Dr. Pedro Enriquez, SAG, Chile; and presentations by other participants, including Dr. Mara M. de Andrea, Instituto Biologico, Brazil and Prof. Edison Barbieri, Instituto de Pesca, Brazil. The programme also included practical training on the collection of macroinvertrebrates in the field, and toxicity testing in the laboratory using *Daphnia M*. All participants were enthusiastic and participated very actively in the activities.

The São Paulo workshop provided a first step by empowering integrated and multidisciplinary teams with the tools to feed back relevant data to both regulators and producers that will catalyze national and regional development. A second workshop on Advanced Workshop on Methodology using Bioassays and Bioindicators is planned for November 2011, in Valdivia, Chile.

Publications

Byron, D.H., and Cannavan, A. (2011), Matters of Interest arising from other International Organisations (CX/CF 11/5/3-Add.1). Fifth Session of the Codex Committee on Contaminanats in Foods, The Hague, The Netherlands, 21-25 March 2011.

Jandric, Z., Rathor, M.N., Švarc-Gajić, J., Maestroni, B.M., Sasanya, J.J., Djurica, R. and Cannavan, A. (2011). Development of a liquid chromatography – tandem mass spectrometric method for simultaneous determination of tropane alkaloids and glycoalkaloids in crops. Food Additives and Contaminants, Part A, 1, doi: 10.1080/19440049.2011.584908, First posted on: 12 May 2011 (iFirst).

Maestroni, B.M. and Cannavan, A. (2011). Sampling strategies to control mycotoxins. In: Determining Mycotoxins and Mycotoxigenic Fungi in Food and Feed, S. De Saeger (Ed). Woodhead Publishing Limited, Cambridge, UK, pp. 3-36.

Cannavan, A. (2011). FAO/IAEA initiatives for food contaminant control in developing countries. Book of abstracts of the Saskatoon International Workshop on Validation and Regulatory Analysis, Saskatoon, Saskatchewan, Canada, 19-22 June 2011, *in press*.

Jandric, Z., Rathor, M.N., Adu-Gyamfi, J., Švarc-Gajić, J., Mayr, L., Resch, C. and Cannavan, A. (2011). Translocation of atropine ^{14}C in soil and its uptake by wheat. Book of abstracts of the Saskatoon International Workshop on Validation and Regulatory Analysis, Saskatoon, Saskatchewan, Canada, 19-22 June 2011, *in press*.

Cannavan, A., Kay, J and Le Bizec, B. (2011). Quality assurance and quality control. In: Chemical Analysis of Antibiotic Residues in Food, Eds. MacNeil, J.D., Wang, J and Kay, J. (Eds). Wiley, NJ, USA, *in press.*

Wang, J., Cannavan, A., Dickson, L. and Fedeniuk, R. (2011) Measurement uncertainty. In: Chemical Analysis of Antibiotic Residues in Food, MacNeil, J.D., Wang, J and Kay, J. (Eds). Wiley, NJ, USA, *in press.*

New eLearning Modules in Nutrition

The IAEA assists Member States in their efforts to develop effective, evidence-based interventions to combat malnutrition in all its forms by nuclear techniques, in particular stable isotope techniques. The unique characteristics of stable isotope techniques make these methods highly suitable for development and evaluation of interventions to address the urgent need to improve nutrition throughout the life cycle.

We are pleased to launch a series of eLearning modules on stable isotope techniques in nutrition to provide practical 'hands-on' guidance in the use of stable isotope techniques to assess human milk intake by breastfed babies, body composition, total energy expenditure and vitamin A body pools. In addition, one module is focusing on the analysis of deuterium by Fourier transform infrared spectrometry (FTIR). All modules have been developed in close collaboration with international experts who have generously shared their expertise and experience. E-learning modules represent an important part of the IAEA's efforts to transfer technology and knowledge in this field and complement a series of documents published by the IAEA recently (please see below).

Please visit the following sites to learn about stable isotope techniques in nutrition:

FAO+IAEA eLearning modules

- Assessing Intake of Human Milk in Breastfed Infants

  http://elearning.iaea.org/ATutor/go.php/92/index.php
- Assessing Body Composition by Deuterium Dilution Technique

  http://elearning.iaea.org/ATutor/go.php/97/index.php
- Doubly labelled Water Technique to Assess Total Energy Expenditure

  http://elearning.iaea.org/ATutor/go.php/91/index.php
- Stable Isotope Methodology to Assess Vitamin A Body Pools

  http://elearning.iaea.org/ATutor/go.php/95/index.php
- Deuterium Analysis by FTIR

  http://elearning.iaea.org/ATutor/go.php/94/index.php

Recently published documents

- IAEA Human Health Series No. 3. (2009) Assessment of Body Composition and Total Energy Expenditure in Humans Using Stable Isotope Techniques http://www-pub.iaea.org/MTCD/publications/PubDetails.asp?pubId=7982
- IAEA Human Health Series No. 7. (2010) Stable Isotope Technique to Assess the Intake of Human Milk in Breastfed Infants http://www-pub.iaea.org/MTCD/publications/PDF/Pub1429_web.pdf

- IAEA Human Health Series No. 12. (2011) Introduction to Body Composition Assessment Using the Deuterium Dilution Technique with Analysis of Saliva Samples by Fourier Transform Infrared Spectrometry (FTIR) http://www-pub.iaea.org/MTCD/publications/PubDetails.asp?pubId=8369

- IAEA Human Health Series No. 13. (2011) Introduction to Body Composition Assessment Using the Deuterium Dilution Technique with Analysis of Urine Samples by Isotope Ratio Mass Spectrometry. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1451_web.pdf

Impressum

Food and Environmental Protection Newsletter Vol. 14, No. 2

The FEP Newsletter is prepared twice per year by the Food and Environmental Protection Section, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and FAO/IAEA Agriculture and Biotechnology Laboratory, Seibersdorf.

International Atomic Energy Agency
Vienna International Centre, PO Box 100, 1400 Vienna, Austria
Printed by the IAEA in Austria, July 2011.

11-26021