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Nuclear Techniques in Food and Agriculture

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To the Reader

As indicated in the July 2005 issue of our newsletter, future 2006-2007 activities of the Food and Environmental Protection Section of the Joint Programme and the Agrochemicals Unit of the FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf will encompass a coordinated and comprehensive “farm to fork” approach to food production systems, i.e. strengthening compliance with food and environmental safety standards through good agricultural practices. Laboratories and trained staff capable of establishing reliable sampling and analytical regimes for quantifying potential hazards within specific production practices or in individual food products are indispensable for informed decision-making and improved food safety and environmental protection.

In this regard, I am pleased to report that we recently concluded a training workshop on an Introduction to QA/QC Measures in Pesticide Residue Analytical Laboratories at our Joint FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf from 12 September to 7 October 2005. The Workshop was attended by 23 participants from 22 developing countries and to date, both verbal and written feedback indicates that the workshop was very successful. We are planning to hold similar workshops on an annual basis in the future so that we might better respond to our Member State requests for laboratory training that further strengthens our efforts in enhancing good agricultural practices. Further details on the workshop are highlighted in the Feature Article Section of this newsletter.

The Joint Programme also continues to welcome the strengthening of our technical inputs to initiatives being undertaken by Codex, as highlighted in document CAC/28 INF 7, which was presented to the most recent 28th Session of Joint FAO/WHO Codex Alimentarius Commission (FAO Headquarters, Rome, Italy, 4-9 July 2005). The Representative of the IAEA highlighted activities of the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture Relevant to Codex, including emergency preparedness and response to nuclear emergencies affecting agriculture as well as inputs to the continued elaboration of the revised Codex Guideline Levels for Radionuclides. I am also pleased to note that efforts of the staff of the Joint FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf helped to ensure the final adoption of a comprehensive Codex text on Guidelines on the Use of Mass Spectrometry for Identification, Confirmation and Quantitative Determination of Residues. Details of these and our other activities related to Codex are contained in the Past Events and Forthcoming Events Sections of this newsletter.

Continuing Member State requests for assistance in the application of Codex and other related international standards is reflected in part by the fact that the Food and Environmental Protection subprogramme is currently evaluating at least 40 concepts for future IAEA technical cooperation projects for the 2007-2008 biennium. These proposals cover, among other areas, the use of irradiation for sanitary and phytosanitary applications, the evaluation of food contamination arising through water and soil, and the implementation of quality assurance and quality control procedures in both pesticide and veterinary drug residue laboratories. A supplement to this newsletter also highlights revisions to the Food Irradiation Clearances Database, which demonstrates the continued growth of government approvals for foods treated by ionizing radiation.

I also wish to report that a temporary staff member, Ms. Gesa Schad, joined the Agrochemicals Unit on 14 November 2005 for a period of three months to work on method validation for the quality control of trypanocidal drugs. Her work is covered by a project administered by FAO, with funding provided by the International Federation of Animal Health (IFAH). The Agrochemicals Unit is also pleased to welcome the arrival of Bruno Magalhaes Carniero, who is a cost-free expert from Brazil assisting staff in training and method development for veterinary drug residue analysis.

In closing, I wish to convey my best wishes to you and your families for a happy, healthy and prosperous New Year.

Sincerely,

David H. Byron

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Feature Article

Training Course on Introduction to QA/QC Measures in Pesticide Residue Analytical Laboratories, Seibersdorf, Austria, 12 September – 7 October 2005

Techincal Officers: Andrew Cannavan/ Britt Maestroni

Group photo of Training Workshop participants

Backround

One of the major activities of the Food and Environmental Protection Subprogramme is training. The Agrochemicals Unit at Seibersdorf is the central laboratory of the FAO/IAEA Training and Reference Centre for Food and Pesticide Control (TRC). The TRC was established in 1998 and an additional training laboratory facility, funded by FAO and through donations from Austria and Sweden, was opened in 1999.

The TRC was established to strengthen the analytical capabilities of developing country Member States and to assist in the control of food quality and safety, especially with respect to meeting international requirements for safe, quality assured products and in order to participate in international trade. It also helps introduce and implement quality assurance and quality control systems in testing laboratories in Member States.

The Agrochemicals Unit contributes to the activities of the TRC through laboratory-based training in subjects such as laboratory quality assurance and quality control (based on the principles of ISO 17025 and OECD Good Laboratory Practices), pesticide residue analysis, veterinary drug residues analysis and sample preparation. Workshops and training courses are designed for national officials involved in planning, decision making and supervision, as well as analysts working at the bench. Participants in the programme gain experience which they can use to improve conditions in their home countries, and are encouraged to further spread the training by organizing workshops in their own countries. They may also become potential lecturers in regional IAEA training courses or workshops. Since the inception of the TRC, many such courses have been held. The most recent of these was the training workshop *Introduction to Quality Assurance/Quality Control Measures in Pesticide Residue Analytical Laboratories*, which was held from 12th September to 7th October at Seibersdorf.

The workshop was designed to provide a basic understanding of the principles of laboratory quality management systems and the quality control procedures necessary to apply such systems. The workshop was comprised of lectures, discussion and feedback sessions, and practical exercises in the laboratory. Twenty-three participants were selected from well over one hundred applications received, and with the inclusion of three additional scientists who were undergoing fellowship training in the Agrochemicals Unit, there were a total of twenty-six participants from twenty-four developing countries. The participants, although varying to some degree in experience and background, proved to be well informed and enthusiastic. An initiative employed for this workshop was the inclusion during the first few days of some team-building and presentation skills exercises. This approach proved to be very successful and resulted in good interaction and information exchange between the participants from the start of the workshop.

Hands on training

The lectures covered topics such as basic statistics, quality principles and systems, accreditation, documentation of laboratory work, method validation, measurement uncertainty, reporting of results, sample extraction and clean-up, and new developments in pesticide residue analysis. Lectures were presented by staff of the Agrochemicals Unit and the Food and Environmental Protection Section and other IAEA staff, as well as invited lecturers from Uruguay, Brazil, USA, Hungary, OECD and FAO. Participants also gave individual presentations on their laboratories and group presentations on food safety

issues as well as other group exercises undertaken during the workshop. The practical sessions included demonstrations of sample preparation, extraction and clean-up techniques and group sessions on TLC, HPLC, GC and GC-MS methods. The emphasis was on identifying, discussing and demonstrating quality control issues (such as system suitability checks, recovery samples, control charts) during the practical sessions.

The workshop also included presentations on HPLC and GC troubleshooting, provided by Agilent personnel, and a visit to the AGES (Austrian "Agentur fuer Gesundheit und Ernaerung Sicherheit) laboratories in Vienna, where workshop participants viewed the procedures in place for sample reception, processing and analysis in an accredited national laboratory.

The final morning of the workshop was taken up by a presentation and round-table discussion session on the role of the analytical laboratory in the implementation of good agricultural practices and food safety and trade, which included representatives of FAO, USDA, AgroVet and ILAU GmbH.

The presentation of certificates to conclude the workshop took place in a very upbeat and happy atmosphere amidst mutual congratulations, just after the announcement that Mr. ElBaradei and the IAEA had been awarded the Nobel Peace Prize.

Overall, the workshop was considered very successful, due in no small part to the enthusiasm and interaction of the participants. In addition to tackling a heavy workload during the day and "homework" in the evenings, the participants made good use of the opportunity to see some of the local sights and many of them visited Venice, Salzburg and Budapest, ably assisted by the IAEA's Ms. Ruby Cueto, to whom we all owe our gratitude for her organizational capabilities and dedication.

Feedback on the workshop from participants and lecturers alike has been very good and the organising team is using the lessons learned and incorporating good suggestions into the programme for the next workshop, which is scheduled for September 2006.

There was good team spirit between all training workshop participants and staff

Forthcoming Events

International Appraisal on the Application of Relevant International Safety Standards to the Radiation Protection of the Public in the Area of Influence of the Ezeiza Center, Buenos Aires, Argentina, 4-9 December 2005

Technical Officer: David H. Byron

The IAEA Division of Radiation, Transport and Waste Safety, at the request of the Government of Argentina, is coordinating an International Appraisal on the Application of Relevant International Safety Standards to the Radiation Protection of the Public in the Area of Influence of the Ezeiza Atomic Center in Buenos Aires, Argentina from 4-9 December 2005. The appraisal will be conducted by representatives of UNSCEAR, PAHO, WHO, FAO, IRPA, ICRP and IAEA.

The objectives of the peer review are:

- To determine whether there is any environmental contamination from radioactive elements in the districts of Ezeiza, Esteban Echeverría and La Matanza in Buenos Aires, Argentina, in such a way that a health hazard has been generated and, if so, the nature of the hazard;
- To verify whether the water for consumption supplied to the population is contaminated with radioactive elements and thereby rendered harmful to health;
- To determine whether such contamination can be attributed to the activities of the Ezeiza Atomic Centre site or any other possible origin; and
- To evaluate the work done by the Argentine Nuclear Regulatory Authority, in relation to the case in question.

In view of our collaborative efforts with the Joint FAO/WHO Codex Alimentarius Commission in the further elaboration of the guideline levels for radionuclides,

it is anticipated that staff from the Joint FAO/IAEA Programme will represent FAO on this occasion.

Activities of the Joint FAO/IAEA Programme Related to the Codex Committee on Food Additives and Contaminants

Technical Officer: David H. Byron

The Joint Programme, in collaboration with the IAEA Division of Radiation, Transport and Waste Safety, continues to take the lead in the revision and expansion of the Codex Guideline Levels for Radionuclides in Foods Following Accidental Nuclear Contamination for Use in International Trade (CAC/GL 5-1989) to additional radioisotopes and to guideline levels for long-term use.

In this regard, the 37th Session (April 2005) of the Codex Committee on Food Additives and Contaminants (CCFAC) returned the draft Revised Guideline Levels for Radionuclides in Foods for Use in International Trade to Step 2 for revision by a working group led by the European Community and the IAEA for circulation, comments at Step 3 and consideration at its next session. It was further agreed that the working group would consider the current draft text in its entirety, with a particular emphasis on:

- Revisions to the scope of the guidelines to clarify that the guideline levels only apply in situations related to nuclear accidents or radiological events and do not apply to routine monitoring purposes; and
- The separation of guideline levels specific to general and infant food categories.

The *ad hoc* working group on the proposed draft Revised Guideline Levels for Radionuclides in Foods for Use in International Trade was hosted by the IAEA at its Headquarters in Vienna, Austria from 8-9 September 2005. The meeting was attended by representatives from Belgium, Finland, France, Germany, Switzerland, the United Kingdom, the United States of America and the European Commission. Representatives of the FAO/IAEA and the EC served as moderators.

The working group had for its information and consideration a background historical summary of the elaboration of the Codex guideline levels for radionuclides in foods (1989-present); the Opinion of the EC Article 31 Group of Experts on the proposed draft Codex Guideline Levels for Radionuclides in Foods for Use in International Trade; an extract from the report of the 37th session (April 2005) of the CCFAC, and the latest version of the proposed draft Revised Guideline Levels for Radionuclides in Foods for Use in International Trade arising from the 36th Session (March 2004) of the CCFAC.

As requested by the 37th Session of the CCFAC, the working group reviewed and reached consensus on the draft text in its entirety, with particular emphasis on revisions to the scope of the guidelines to clarify that the guideline levels only apply in situations related to nuclear or radiological emergencies and do not apply to routine monitoring purposes, and to the separation of guideline levels specific to general and infant food categories. In reaching this consensus, the working group also made additional consequential amendments to the text.

Governments and international organizations are currently invited by the Codex Secretariat to comment at Step 3, as directed in document CX/FAC 06/38/38, on the proposed draft revised *Guideline Levels for Radionuclides in Foods Contaminated Following a Nuclear or Radiological Emergency for Use in International Trade.*

Final Research Coordination Meeting (RCM) of the Coordinated Research Project Irradiation to Ensure the Safety and Quality of Prepared Meals; D6.20.07; (place and date to be determined)

Technical Officer: Tatiana Rubio-Cabello

All contract and agreement holders have been invited to participate in this meeting. The purpose of the meeting is to evaluate the research work done since the beginning of the Coordinated Research Project (CRP) and especially since the second Research Coordination Meeting held in Pretoria, South Africa in April 2004.

The participants have worked under this CRP on the microbiological, sensorial and nutritional quality of approximately 30 different prepared meals treated with irradiation. Most of them have been ethnic dishes.

It is important to also note that most of the investigators have been working closely with the end users (food companies, catering services) in order to facilitate the transfer of the technology.

The data generated under this CRP will be published as an IAEA-TECDOC in the second semester of 2006.

Past Events

Workshop on Irradiation as a Quarantine Treatment; Ankara, Turkey, 21-25 May 2005

Technical Officer: Tatiana Rubio-Cabello

Under the Technical Cooperation Project "Implementation of food irradiation technology in Turkey" (TUR/5/022) a workshop was organized on irradiation as a quarantine treatment at the Headquarters of the Turkish Atomic Energy Authority in Ankara, from 21-25 May 2005.

The workshop was attended by participants from quarantine directorates of five provinces, the Quarantine Department of General Directorate of Protection and Control Ministry of Agriculture and Rural Affairs (MARA), Cut Flower Exporters Union, Izmir and Antalya Exporter Unions, West Mediterranean Agricultural Research Institute, Gamma-Pak Sterilisation company, Paletsan Wood Packaging and Plastic Production, Consulting & Marketing Company and the Turkish Atomic Energy Authority.

The workshop included discussions on the physical, chemical and biological effects of irradiation on food; national and global development on food irradiation, present and future activities; international standards on food irradiation; the use of irradiation for post-harvest and quarantine commodity control in Turkey; current quarantine applications on agricultural commodities in Turkey; trade of irradiated foods and cost analysis in Turkey; experiences and regulatory aspects on the practical application of irradiation as a phytosanitary treatment in USA; marketing and consumer acceptance; economics and regulatory aspects in Turkey; dosimetry and process control in food irradiation; alternative applications to methyl bromide fumigation for post-harvest, quarantine commodity and protected horticulture in Turkey; regulations related to wood packaging materials in respect to IPPC-ISPM/15 and quarantine problems in the trade of agricultural commodities of Turkey. The programme also included a scientific tour to the Ankara Nuclear Research Center in Agriculture and Animal Sciences at Saray, Ankara, where the participants had the opportunity to visit different laboratories as well as the Co-60 pilot irradiation facility.

On the last day of the workshop, the participants evaluated the usefulness of this activity and discussed the feasibility to implement food irradiation technology as a quarantine treatment in Turkey, taking into account the quarantine problems to be solved in the country, the phasing out of methyl bromide and its increasing cost, market opportunities and the present legislation.

As a result of a round table discussion the participants agreed to the following conclusions and recommendations:

Participants at Workshop in Ankara, Turkey

1) Quarantine officials gained valuable knowledge on food irradiation technology and they recognized the importance of looking for alternatives to the use of methyl bromide due to the phasing out of this fumigant and the increase in price. In Turkey, the cost of the methyl bromide has increased 300% during the last years.

2) The quarantine officials also recognized the importance and effectiveness of irradiation as a wide spectrum quarantine treatment, especially for dried and fresh fruits, nuts, vegetables and cut flowers.

3) More training in this field at the national, regional and international level is required. The participants requested that the IAEA support, both technically and financially, future training activities in the use of irradiation as a quarantine treatment.

In order to start with the implementation of this new quarantine treatment, it was agreed that it is necessary to translate the "Guidelines for the use of Irradiation as Phytosanitary Measures" into Turkish and disseminate this information to the different provinces of the country (ICPM Publication No: 18, April 2003).

Activities of the Joint FAO/IAEA Programme Related to the 28th Session of the Codex Alimentarius Commission; Rome, 4-9 July 2005

Technical Officer: David H. Byron

The IAEA and the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture and the FAO/IAEA Agriculture and Biotechnology Laboratory of

the Agency's Laboratories at Seibersdorf provide direct support to the Codex Alimentarius Commission in its efforts to enhance food quality and safety, the protection of consumers and the promotion of trade in food and agricultural products. This assistance is primarily directed to the Codex Committee on Food Additives and Contaminants, the Codex Committee on Pesticide Residues and the Codex Committee on Methods of Analysis and Sampling.

A report (CAC/28 INF/7) presented by a Representative of the IAEA to the most recent 28th Session of the Joint FAO/IAEA Codex Alimentarius Commission highlighted our activities in the areas of emergency preparedness and response to nuclear emergencies affecting agriculture; the growing use of ionizing radiation to ensure the safety and quality of food, for reducing post-harvest losses and in satisfying plant quarantine regulations; the incorporation of Codex methods of analysis for pesticide residues into our Food Contaminant and Residue Information System (INFOCRIS); new distance learning web-based resources; and recent publications, including a technical document on the Validation of Thin-Layer Chromatographic Methods for Pesticide Residue Analysis IAEA-TECDOC-1462.

Consultants Meeting on the Role of Analytical Laboratories in the Application of Good Agricultural Practice in the Production of Fresh Fruits and Vegetables and Animals and Animal Products, IAEA Vienna, Austria, 14-15 July 2005

Technical Officer: David H. Byron

A consultants meeting on *The Role of Analytical Laboratories in the Application of Good Agricultural Practice (GAP) in the Production of Fresh Fruits and Vegetables and Animals and Animal Products* was held at IAEA Headquarters in Vienna, Austria from 14-15 July 2005. The Meeting was attended by representatives of FAO, IAEA, the International Laboratory Accreditation Cooperation (ILAC) and the Association of Analytical Chemists (AOAC).

The consultants meeting addressed the role of analytical laboratories, including their relationship to the farm community, in the application of GAP in the production of fresh fruits and vegetables and animals and animal products.

The objectives of the meeting were:

- To report on current governmental, intergovernmental and non-governmental international initiatives in the use of analytical laboratories, including inter-laboratory networks, to support the application of GAP in the production of fresh fruits and vegetables and animal and animal products;
- To provide recommendations on activities that should be initiated or better promoted from the analytical laboratory point of view in order to support the application of GAP at the farm level (giving feedback and training, disseminating information on quality concepts);
- To provide recommendations on the need to produce and/or harmonize guidance on the basis of Codex and other intergovernmental standards with special emphasis on the role of analytical laboratories in the production of fresh fruits and vegetables and animals and animal products;
- To study the feasibility of holding a national or regional workshop on the role of analytical laboratories in the application of GAP in the production of fresh fruits and vegetables in early 2006, and on animals and animal products in mid to late 2006, including topics for discussion related to the role of analytical laboratories and their relationship to farmers in the promotion of GAP;
- To recommend a roster of experts in the different GAP areas (geographical and institutional representation) for reference purposes; and
- To recommend capacity building activities (training materials, including key points, training initiatives, workshops, meetings, research project proposals) to be able to directly support farmers in the implementation of GAP.

The meeting discussed the above objectives in detail and arrived at the following conclusions and recommendations:

- Collaborative demand-driven efforts between the IAEA, FAO and other relevant governmental and non-governmental agencies should be strengthened through current and future joint activities, including through technical cooperation and research coordination.
- Strengthen the capabilities of laboratories and laboratory networks at the regional and/or national level to support extension services, farmer cooperatives, farm schools, distance learning and other farm-based programmes, considering the needs of small scale producers, in assessing the implementation of GAP for internal and external markets;
- Laboratories should play an integral role in GAP activities by monitoring and evaluating its application through pilot programmes, field trials, data collection, interpretation and feedback;
- Strengthen laboratory capacity building through assistance programmes to develop infrastructures,

methods and quality systems consistent with the objectives of GAP, including:

- The use of relevant standards, guidelines and codes of practice (governmental and non-governmental) related to the production of fresh fruits and vegetables and animal products (e.g. Codex, IPPC, OIE).
- Provide a source of quality data to parent expert bodies (JECFA, JMPR) to assist in their risk assessment activities
- Enhance communication between laboratories and other relevant parties (e.g. extension services, farm associations, certification bodies) so as to better inform the public.

- Strengthen training programmes and activities to enhance technical expertise and knowledge through workshops, seminars, eLearning and other initiatives related to:
  - Farmer/community awareness of lab activities related to GAP;
  - Sampling requirements and procedures;
  - Harmonization of methods of analysis;
  - Measurement uncertainty and proficiency testing;
  - Quality control, quality assurance and accreditation requirements; and
  - Data interpretation.
- Further develop research projects, including the use of nuclear methods, to evaluate the impact of the application of GAP, including the identification and use of environmental indicators.

The meeting supported the convening of regional workshops on the role of analytical laboratories in the application of GAP in the production of fresh fruits and vegetables, and animals and animal products.

Final Research Coordination Meeting (RCM) of the Coordinated Research Project on Use of Irradiation to Ensure Hygienic Quality of Fresh, Pre-Cut Fruits and Vegetables and other Minimally Processed Food of Plant Origin (D6.10.22); Islamabad, Pakistan; 25-29 July 2005

Technical Officer: Tatiana Rubio Cabello

The overall objective of the Coordinataed Research Project (CRP) was to evaluate the effectiveness of irradiation as a method to ensure microbiological safety of fresh, pre-cut produce and other minimally processed food of plant origin and to appraise the quality of such products subject to radiation doses sufficient to control infectivity of these pathogens. The specific objective of this CRP was to use validated methods for microbiological determination of food and validated procedures for the irradiation of food in controlling various foodborne pathogens in fresh, pre-cut produce and other minimally processed food of plant origin.

This RCM was held in the Marriot Hotel, Islamabad, Pakistan from 25-29 July 2005. All contract and agreement holders were invited to participate in this meeting.

During the meeting the participants informed in detail the results obtained within the last 18 to 24 months and also discussed the results obtained during the last five years of research.

The programme of the meeting also included a seminar on “Awareness on Commercialization of Food Irradiation”. The objective of the seminar was to inform professionals of the public and private sector of the advantages of using food irradiation technology in order to comply with national and international standards of food trade.

A press release about the meeting was published in 13 different newspapers in Islamabad, as well as on TV channels and radio.

The opening of the RCM in Islalmabad, Pakistan

In total, the participants researched more than 30 types of vegetables and sprouts, and eight types of fruits related to 12 pathogenic bacteria.

The general conclusions of this CRP were as follows:

1. Doses up to 2.0 kGy were useful to assure a good microbiological quality of fresh fruits without affecting their sensory attributes and nutritional as well as commercial quality. However, the mixed fruit (pineapple mixed with guava) samples showed changes in sensory attributes when exposed to doses higher than 1.0 kGy. On the other hand, pineapple itself could tolerate doses higher than 2.0 kGy.

2. In general, most of the studied minimally processed vegetables can be irradiated with doses up to 2 kGy. These doses are effective in reducing the initial microflora in 4-5 logs and at the same time extending the shelf-life of the products without an adverse effect on their sensory characteristics.

Participants of the RCM in Islamabad, Pakistan

3. Irradiation of sprouts rather than seeds was recommended as a final treatment, as irradiation of the seeds was not sufficient to guarantee sufficient reduction of pathogens. Based on D10 values observed for the most resistant organism studied (L. monocytogenes), irradiation with 2.5 kGy was recommended to ensure the microbiological safety and inactivate vegetative pathogenic bacteria by 5 log-cycles.

Final Research Coordination Meeting (RCM) of the Coordinated Research Project on Quality Control of Pesticide Products; D5.40.03; Yangon, Myanmar, 28 November – 2 December 2005

Technical Officer: Josef Brodesser

The third and final RCM on the above CRP was held from 28 November to 2 December 2005 with the active contribution of contract holders from China, Greece, Hungary, India, Nigeria, Turkey, Vietnam, and the host country, Myanmar. The results and outcomes of the research activities of the past years were presented and discussed, and a work plan for concluding the last phase was elaborated upon. Computational questions concerning the theoretical statistics background and the evaluation of results were explained and discussed in detail. In light of the subsequent symposium, the RCM participants and invited national experts reported and discussed the impact and implications of the use of pesticides in their respective countries.

During the meeting it was discovered that certain parts and details of the research were still incomplete. It was agreed with the participants that the CRP work has to focus further on details and the subsequent consideration of open questions. Therefore, it was concluded that the current research period would be extended until the second half of 2006 to allow for the completion of outstanding work.

The research results achieved to date show that pesticide formulation analysis, following a multimethod approach instead of the commonly used single compound analysis, allows for results comparable with those obtained by methods collaboratively validated through CIPAC (Collaborative International Pesticides Analytical Council) and AOAC (Association of Analytical Communities) collaborative trials. This CRP approach provides a valuable alternative to the predominant single method procedures, as it allows laboratories to increase their efficiency and sample throughput at the same level of confidence and reliability of results. Costs and time needed to perform the analyses can be reduced considerably at the same time.

The results of this CRP will be summarized in an IAEA-TECDOC to be prepared for publication in the coming year.

Participants of the final RCM in Yangon, Myanmar

Status of Coordinated Research Projects

Validation of Thin-layer Chromatographic Methods for Pesticide Residue Analysis, D5.20.33 and D5.20.34

Technical Officer: Josef Brodesser

As of August 2005, the output of the coordinated research projects D5.20.33 and D5.20.34 is available as a comprehensive IAEA-TECDOC-1462. It is available as a hardcopy upon request, or it can be downloaded from the internet under http://www-pub.iaea.org/MTCD/publications/PDF/te_1462_web.pdf.

Testing the Efficiency and Uncertainty of Sample Processing for Analysis of Food Contaminants, D6.10.23

Technical Officer: Josef Brodesser

The renewed CRP work programme, which was agreed during the 2nd RCM held in Madurai, India, in February 2005, is being worked on by the CRP participants. The current research focuses on expansion towards new food commodities and new pesticide active ingredients. Particular attention is paid to food commodities of large crop size, such as mango, pomelo and jackfruit, where the concentration of pesticide residue can vary considerably on one single fruit, as well as between individual crops. In order to estimate the relevant uncertainties, a systematic investigation is in process to fill existing gaps with regard to Codex MRLs and existing variability factors.

Use of Irradiation to Ensure the Safety and Quality of Prepared Meals; D6.20.07

Technical Officer: Tatiana Rubio Cabello

Please see *Forthcoming Events* of this issue.

Quality Control of Pesticide Products, D5.40.03

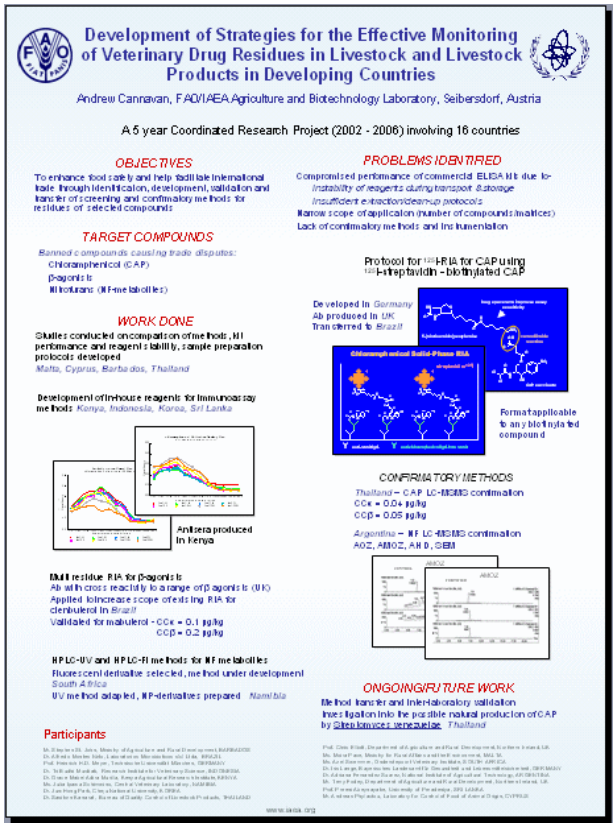
Technical Officer: Josef Brodesser

Please see *Past Events* section of this issue.

Development of Strategies for the effective monitoring of veterinary drug residues in livestock and livestock products in developing countries; D3.20.22

Technical Officer: Andrew Cannavan

Work is ongoing on the final phase of the project. A summary of the results of the CRP to date was presented as a poster (see below or http://www-naweb.iaea.org/nafa/fep/public/PragueAbstract-Poster_CRP.html) at the 2nd International Symposium on Recent Advances in Food Analysis in Prague, 2-4 November 2005 (see *FAO/IAEA Agriculture & Biotechnology Laboratory – Meetings/ Conferences* section of this issue). The final RCM is tentatively planned for November 2006, at a venue yet to be agreed upon.



Results of the CRP presented as a poster at the 2nd International Symposium on Recent Advances in Food Analysis in Prague.

Current Technical Cooperation Projects

Project Number	Title	Technical Officer
ANG5003	Veterinary Drug Residue Monitoring Programme	D. H. Byron
BEN5003	Veterinary Drug Residue Monitoring Programme	D. H. Byron
BGD5024	Phytosanitary Treatment for Insect Pests Infesting Fresh Fruits and Vegetables	T. Rubio-Cabello
BOL5015	Developing Pesticide Residue Monitoring Capabilities in Support of Cash Crops	I.G. Ferris
BKF5005	Regulatory Control and Monitoring of Contaminants and Residues	J. Brodesser
BRA5058	Applying Ionizing Radiation for Food Security and Health Care	T. Rubio-Cabello
CHI5022	Detection of Pesticide Levels in Water and Agricultural Soil Using Nuclear Techniques	I.G. Ferris
CHI5046	Certification of Exported Animal Products Using Nuclear and Other Analytical Techniques	D. H. Byron
COS5026	Management and Appropriate Use of Insecticide-nematicides	I.G. Ferris
CPR5016	Strengthening the Quality Assurance System for Food Irradiation	T. Rubio-Cabello
GUA5015	Establishing a Food Irradiation Plant	T. Rubio-Cabello
HAI5003	Enhancing Crop Productivity through the Applicatoin of Isotope Nuclear Techniques	I.G. Ferris
JAM5009	Developing Soil Fertility Management	I.G. Ferris
MAK5005	Upgrading of Food Safety System	J. Brodesser
MOR5024	Industrial Application of Irradiation	T. Rubio-Cabello
NIC5007	Determining Drug Residues in Bovine Meat Exports	D.H. Byron
NIR5030	Regulatory Control and Monitoring of Contaminants and Residues in Fresh Produce	J. Brodesser
NIR5033	Improvement of Quality Management and Food Safety Monitoring Using Isotope Techniques	J. Brodesser
PAN5015	Quality Assurance in Pesticide Residue Analysis for Agriculture Production	K. Gross
RAS5042	Application of Food Irradiation for Food Security, Safety, and Trade (RCA)	T. Rubio-Cabello
RER9074	Long-term Countermeasure Strategies and Monitoring of Human Exposure in Rural Areas Affected by the Chernobly Accident	I.G. Ferris
ROK5034	Nutrient Efficient Crops and Safe Use of Pesticides in Sustainable Crop Production	I.G. Ferris
SEN5027	Regulatory Control and Monitoring of Contaminants and Residues in Fresh Produce	J. Brodesser
SLO5002	Protecting Groundwater and Soil Against Pollutants Using Nuclear Techniques	I.G. Ferris
SRL5037	Assessing Impact of Pesticides on Water Catchments and Groundwater	J. Brodesser
SYR5018	Pesticide Degradation in Food and Environment	I.G. Ferris
SYR5020	Implementation of Quality Assurance and Quality Control Procedures in Pesticide Residue Analysis Laboratories	J. Brodesser
THA5047	Application of Food Irradiation for Sanitary and Phytosanitary Certification	T. Rubio-Cabello

FAO/IAEA Agriculture & Biotechnology Laboratory, Seibersdorf

A triple-quadrupole liquid chromatograph — tandem mass spectrometer (LC-MSMS) has been installed in the Agrochemicals Unit (ACU). Food control laboratories in many Member States are already equipped with similar instrumentation and the Training and Reference Centre will now be able to offer training in the application of the technique to solve residue analysis problems and to broaden the scope of application of the instruments in those countries. The LC-MSMS will also be used for method development for both screening and confirmatory methods for pesticides and veterinary drug residues and for applied research to support CRPs coordinated by Unit staff and other collaborative projects with national and international organisations.

Staff

A temporary staff member, Ms. Gesa Schad joined ACU on 14th of November for three months to work on validation of methods for the quality control of trypanocidal drugs in collaboration with the Department of Pharmaceutical Sciences, Strathclyde Institute for Biomedical Sciences, UK. This work is part of a project run by FAO with funding from the International Federation for Animal Health (IFAH), which aims to build capacity in Sub-Saharan Africa to control the quality of trypanocidal drugs on the market and combat the usage of counterfeit products of poor quality, which may be ineffective and lead to the development of trypanosomes resistant to the currently available trypanocides.

It has been agreed with a laboratory in Brazil that a cost-free expert in veterinary drug residues analysis will join ACU for a three-month period to assist in staff training and method development. Mr. Bruno Magalhaes Carniero, from Microbioticos Laboratories in Campinas, will join the Unit in December 2005.

Fellowships and training

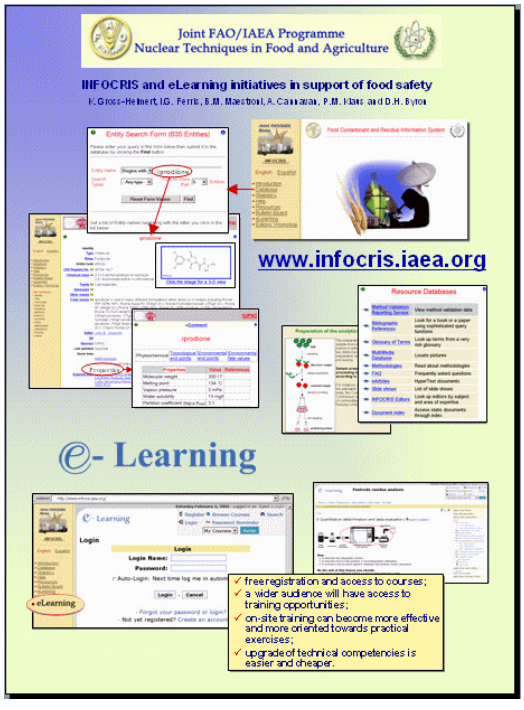
Two fellows completed their studies with the Agrochemicals Unit at the end of October: Lawal Shitta-Bey (Nigeria), who was trained in maintenance and troubleshooting of laboratory instrumentation and Jasna Dokic (Serbia/Montenegro), who trained in HPLC methods for veterinary drug residues. Another fellow, Ms. Ana Topolovic (Serbia/Montenegro) left the unit at the end of November, having trained for three months on the application of HPLC, with veterinary drug and pesticide residue methods as examples. In addition to this, seven of the participants in the training workshop held at Seibersdorf in September/October (see the Feature Article in this issue) were supported through TC fellowships. The Unit also accommodated one scientific visitor, Ms. Siriphan Sukmak (Thailand), 10-14 October. The fellows and the scientific visitor have indicated that their time in the Unit was useful and enjoyable and they were satisfied with the training provided.

Methods

Multiresidue methods have been developed for residues of seven sulphonamide drugs and for five macrocyclic lactone anthelmintics in animal tissues by HPLC. Both methods are currently being validated and will be published in the INFOCRIS database within the next few months.

Meetings/Conferences

The Unit Head presented two posters, "The development of strategies for the effective monitoring of veterinary drug residues in livestock and livestock products in developing countries" (see page 11 of this issue) and "INFOCRIS and eLearning initiatives in support of food safety" (see below or http://www-naweb.iaea.org/nafa/fep/public/PragueAbstract-Poster_INFOCRIS.html), at the 2nd International Symposium on Recent Advances in Food Analysis in Prague, 2-4 November.



Poster on "INFOCRIS and eLearning initiatives in support of food safety", presented at the 2nd International Symposium on Recent Advances in Food Analysis in Prague

The Unit Head participated as a keynote speaker and panelist in Food Safety Summits run by Waters Coorporation in China (17-18 October) and Singapore (for Asia/Pacific) 20-21 October (funded by Waters Coorporation). The material presented was entitled "Veterinary drug residues; implications in Asia". The China Food Safety Summit was attended by 25 representatives of institutes in China, including Government institutes and laboratories, universities and one privately owned laboratory.

The Asia/Pacific Food Safety Summit in Singapore included 37 participants from institutes in Indonesia, Japan, Republic of Korea, Malaysia, Thailand, Taiwan (China) and Singapore.

The Unit Head also participated in the first meeting of the Advisory Board for the EU Framework 6 Integrated Project "*Biocop; New Technologies to Screen Multiple Chemical Contaminants in Foods"* in Prague, 7-8 November.

British Crop Protection Council (BCPC) Annual Conference on Crop Science and Technology 2005; Glasgow, UK, 31 October – 2 November 2005

Technical Officer: Britt Maestroni

The main issues arising from the Conference were:

- UK consumers are pressing retailers to deliver produce totally free of pesticide residues, partly because the concept of maximum residue levels (MRLs) is often misunderstood. MRLs are actually often regarded as safety limits, instead of being considered the maximum levels likely to occur if good agricultural practices (GAPs) are followed.
- Retailers, to avoid undermining consumer trust, are now pursuing a policy of eliminating residues from their produce, thus challenging the UK (and EU) fresh produce industry.
- For producers this means developing production protocols which will greatly reduce, or ideally eliminate, the occurrence of residues above reporting limits.
- The UK apple industry has reacted to this issue, and started successful research in this direction. However the challenge still has not been addressed for other types of produce, where alternatives to pesticides for major pest and disease problems do not exist, and where not using pesticides would result in a major loss in quality.
- Manufacturers of crop protection products are investing money into research of active ingredients that reflects the trend of reduced residues found in food. The research is targeting major crops, leaving out the minor crops because of economical reasons.
- The EU review programme of council directive 91/414/EEC is having an impact on the availability of active substances, both through commercial withdrawals of substances, and more recently through active ingredients failing to meet the demanded standards of environmental, use and consumer safety. In some cases manufacturers have decided that the cost of providing new data for re-registration purposes would not be economically viable.
- In some cases, the loss of certain specific active ingredients has already led to resistance problems as a result of overusing existing allowed pesticides. Insecticide resistance is a long term effect that growers need to cope with.
- Congress lecturers presented evidence that resistance to pesticides, although a tangible and existing issue, is fairly stable over the years and the European regions. The Insecticide Resistance Action Committee (IRAC) is an industry initiative formed 20 years ago, that provides a coordinated industry response to the development of insecticide resistance in insect and mite pests and helps farmers in tackling the issue. The web site contains a lot of information and useful tips on insecticide resistance management. www.irac-online.org.
- The harmonization of European regulations on pesticide residues, together with the growing demands of European retailers in terms of quality and safety, is imposing serious challenges to the developing countries' sector of fresh fruits and vegetables (FFVGs). It is imperative for these countries to bring their products into conformity with the new regulatory and commercial requirements. If they fail to do so, they are in danger of losing their current market shares in the EU with the obvious economical consequences.
- The American IR-4 crop grouping project: the purpose of this project is to classify crops that are botanically or taxonomically related or culturally similar, with the ultimate objective to facilitate international harmonisation of MRLs if adopted by international authorities.
- So far risk assessment has been focused on the direct adverse impact of pesticides on wildlife, and ecotoxicological criteria have been established for the approval of pesticides. However, since the EU came up with regulatory positions on GMO, the issue of evaluating the indirect effects of pesticides on wildlife has emerged. In the UK, the Advisory Committee on Pesticides (ACP) has strongly recommended that the Pesticide Safety Directorate (PSD) target research into this direction.

- Directive 91/414/EEC requires that if a pesticide fails to pass preliminary risk assessment for environmental risk then it may not be authorised for use unless an "appropriate risk assessment" shows that it will cause no unacceptable impact. One option is to use probabilistic risk assessment, which takes into account variability and uncertainty. EUFRAM is an EU-funded concerted action that involves 29 organizations, including regulatory authorities, government research institutes, agro-chemical companies, consultancy companies and universities. EUFRAM aims to assist the implementation of probabilistic methods for assessing the environmental risks of plant protection products in Europe. www.eufram.com.

Distance Learning

Technical Officer: Kerstin Gross

New eLearning courses

Two new eLearning courses have recently been launched under http://elearning.iaea.org/ATutor/

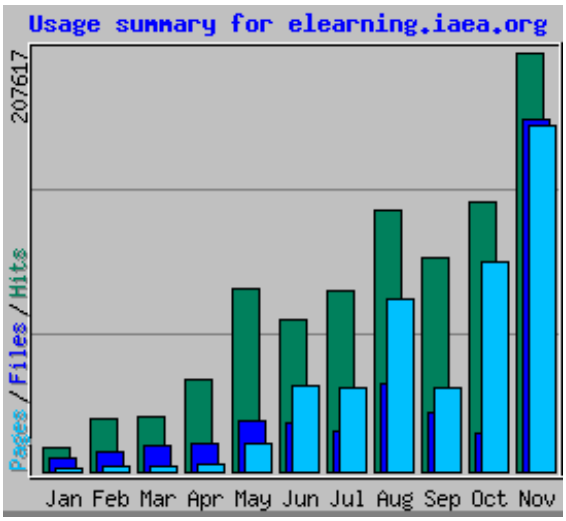
1. The **Laboratory Pre-requisites course** comprises information on:
   - laboratory safety and first aid basics;
   - correct and safe handling of reference materials and radiotracers;
   - preparing chemical solutions and making dilutions;
   - correct and safe handling of basic laboratory equipment;
   - laboratory waste management; and
   - cleaning procedures of labware and equipment.
2. The **Basics of Radiotracer Use course** includes topics on:
   - basic background information on radioactivity and radiation;
   - introduction to radiotracers;
   - working with radiotracers; and
   - using radiotracers in pesticide residue analysis and environmental and metabolic studies.

Other eLearning courses available on the system are: Pesticide Management, Pesticide Residue Analysis, Statistics Manual, Project Management, and Time Management.

The **eLearning courses are free** and anyone can join at any time. The system tracks students' progress thus saving valuable connection time. If you haven't already done so, register now (http://elearning.iaea.org/ATutor/registration.php).

New eLearning appearance and features

The eLearning system has been successfully upgraded in October 2005. New learning management features for administrators, instructors and students are now available, including a backup manager, new tracker and course statistics, improved file manager, glossary search, and system announcements. Further, students and instructors can find each other more easily by using the course's directory to send email messages. Last but not least, the login and course pages have been redesigned to give a clearer arrangement and layout. A full list of the new features is listed under the INFOCRIS Bulletin Board (http://www-infocris.iaea.org/en/W3.exe$BBShow?ID=12). Feedback from students and tutors emphasizes that the changes have made the system "more friendly and flexible."



User statistics of the elearning system

Other Activites on Food Irradiation

Thirty years experience in potato irradiation at Shihiro radiation facility in Japan

Irradiated potatoes in storage at the Shihiro radiatin facility in Hokkaido, Japan

In many countries, commercial food irradiation started in the second half of the 1980s, and the amount of foods treated by ionizing radiation is continually increasing. Prior to this trend, a potato irradiation plant was built at Hokkaido in northern Japan in 1973. This plant is well known as the first successful food irradiation plant for commercialization in the world.

The township of Shihiro is located in the Tokachi field in Hokkaido. This area is blessed with optimum climatic conditions for the cultivation of high quality potatoes and is proud of the largest quantity of potato production in Japan. Every year potatoes are harvested in September, and are shipped over an eight-month period until April of the following year.

In the Shihoro township, five agricultural cooperative societies in four towns of this area have built a common facility equipped with a warehouse of more than 100,000 tonne storage capacity for the collection, storage, and shipment of potatoes. The Shihoro Isotope Irradiation Center was built beside this institution and began operations in 1974. In recent years, the potatoes sold at retail stores amounted to 40,000 tonnes. Among these, about 8000 tonnes of potatoes are annually irradiated and shipped to retailers from the end of March to April. The present activity of the Co-60 source is ca. 150,000 Ci.

Thus, sprout inhibition by gamma-irradiation has been successfully continued and this clean, environmentally friendly process contributes to the year round domestic potato supply and to the agricultural production in this area.

New consignments of irradiated mangoes and papayas

The 2004 modification of the bilateral quarantine agreement year between Australia and New Zealand allows for the use of ionizing radiation as a phytosanitary treatment option for mangoes. In 2004 two consignments of irradiated mangoes were sent from Australia to New Zealand under this agreement. Additional consignments sent in 2005 have been monitored from harvest to retail sale; the fruit arrived in excellent condition and sold very quickly. It is expected that a total of 20 pallets will be sent from Australia to New Zealand during this season.

Malaysia and China also started transport trials (200 boxes of irradiated papayas) through the involvement of the private sector (exporters). The dose required was between 0.2–1 kGy.

Irradiated papayas from Malaysia

Nuclear Preparedness

Emergency Preparedness and response to nuclear emergencies affecting agriculture

States are responsible for countermeasures on their territories. Hence capacity building is essential. To this end, the OECD Nuclear Energy Agency (NEA) has developed the INEX 3 exercise scheme as the latest in its International Nuclear Emergency Exercise (INEX) series. The INEX 3 exercises focus on consequence management following a radiological emergency, including agricultural countermeasures, and emphasizes national decision-making processes after serious radiation contamination has taken place. They are table-top exercises based on a generic "footprint" radiation contamination pattern and exercise timeline. Participating countries can use this scenario to examine how they might implement agricultural countermeasures such as applying food restrictions, adopt other countermeasures such as travel or trade restrictions, and move towards recovery management

Table-top exercises are a very cost effective and efficient way to test national emergency response plans for nuclear emergencies affecting agriculture. They provide participants with an excellent opportunity to interact and understand the roles and responsibilities of the agencies involved in protecting the food chain. Participants will get to know the key procedures/resources as well as the people responding to the emergency. Clearly, those who exercised together and know each other personally will provide a much more coherent response than those who come together for the first time and are confronted with a serious nuclear or radiological emergency.

The first invitation to participate in the INEX 3 exercise was distributed in Dec 2004 to national nuclear emergency management authorities. To date, 20 countries have completed or are intending to conduct an INEX 3 exercise. However, other countries are also invited to participate in the INEX 3 series according to national interest. National participants interested in holding an INEX 3 exercise may wish to contact their national nuclear emergency management authorities, and the OECD NEA (Brian.AHIER@oecd.org) to obtain more information on the exercise, including the INEX 3 technical materials and details about the NEA INEX 3 evaluation workshop planned for May 2006. Additional information on countermeasures can be found in the STRATEGY datasheets (http://www-naweb.iaea.org/nafa/emergency/countermeasures.html).

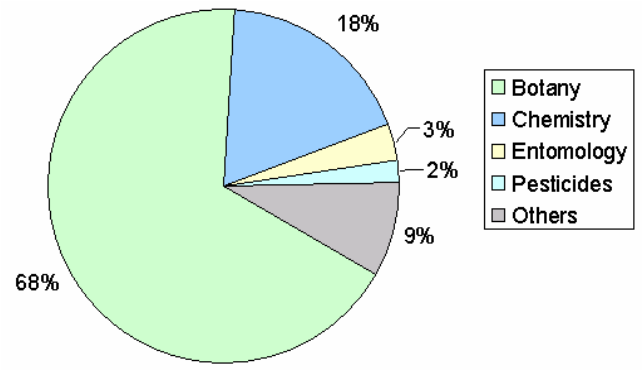
Any feedback on the datasheets is welcome and should be sent to Mr. David Byron (D.H.Byron@iaea.org).

Websites

- Food and Environmental Protection Section http://www.iaea.org/programmes/nafa/d5/index.html
- FAO/IAEA Training and Reference Centre for Food and Pesticide Control: http://www.iaea.org/trc
- eLearning: http://elearning.iaea.org/ATutor/login.php
- International Database on Insect Disinfestation and Sterilization – IDIDAS: http://www-ididas.iaea.org/
- International Food Contaminant and Residue Information System – INFOCRIS: http://www-infocris.iaea.org

FAO/IAEA database of glossary terms (http://www-infocris.iaea.org/en/w3.exe$GloForm)

The Joint FAO/IAEA Programme maintains a set of common resources that may be reassembled into knowledge objects (http://www-infocris.iaea.org/w3.exe$PassCheckStart?ID=S75), such as chemical or microbiological entities, eArticles, slide shows and eLearning courses. The multilingual glossary is a particularly important resource and provides clients with an explanation of common technical terms. The main subject categories are botany, chemistry, entomology, pesticides and nuclear sciences.

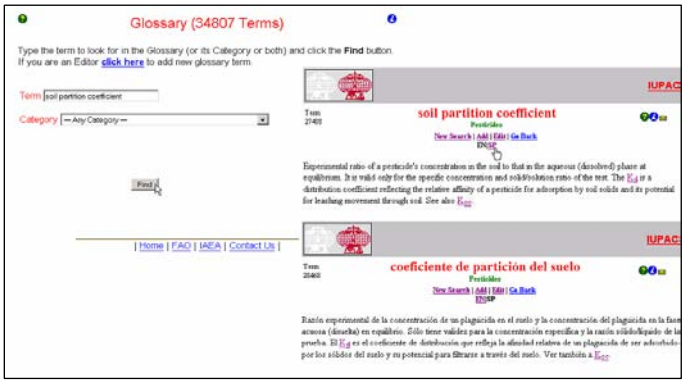


Major glossary categories—total of 34807 terms (25-11-2005)

Clients may quickly retrieve terms via the search form or browse the 28 subject categories.

The terms are displayed under the banner of the contributing sponsor, in this case IUPAC.

The glossary search form is used as a resource on FAO/IAEA web sites. It is linked under the eLearning glossary tab (http://elearning.iaea.org) or tightly integrated as with the FAO/IAEA/IFDC Direct Application of Phosphate Rock decision support system (http://www-iswam.iaea.org/dapr/srv/en/infocrisGlossarySearchForm).



Searching the glossary (left) and displaying the definitions in English (top right) and Spanish (bottom right)

Under the FAO/IAEA/IUPAC project on global availability of information on agrochemicals over 6,000 terms have been added from the so-called Gold Book. Named in recognition of the contribution of the late Victor Gold, this IUPAC glossary provides authoritative definitions spanning all fields in chemistry.

Each term is displayed as a portable document format or Adobe Acrobat file, e.g.:

substitution reaction
A *reaction, elementary* or *stepwise*, in which one atom or group in a *molecular entity* is replaced by another atom or group. For example,

$CH_3Cl + OH^- \rightarrow CH_3OH + Cl^-$

1994, *66*, 1169

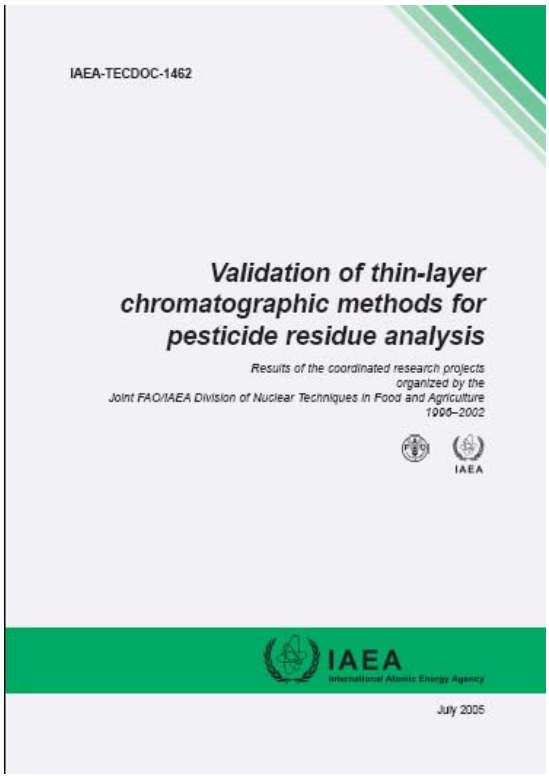
IUPAC Compendium of Chemical Terminology 2nd Edition (1997)

The reference "1994, *66,* 1169" at the end of the substitution reaction term refers to the *Pure Applied Chemistry* citation or other source where the original definition appears. Where additional information is available, highlighted terms within individual terms link to other entries. A cross (+) against an entry implies that use of the term is discouraged. The 2nd edition of the IUPAC Compendium of Chemical Terminology is online (http://www.chemsoc.org/cgi-shell/empower.exe?DB=goldbook). Alan D. McNaught and Andrew Wilkinson (Royal Society of Chemistry, Cambridge, UK) compiled the online version. Alan McNaught is also the gatekeeper of the Joint Programme's chemistry glossary.

The glossary is a continual "work in progress" given that only 2% of the glossary has been translated from the English definitions. Further, the IUPAC Gold Book (http://gold.zvon.org) and pesticide glossary (http://www.iupac.org/projects/2004/2004-002-1-600.html) are both currently under revision. These activities are aimed at improving the scope and assisting international communication among researchers, regulatory authorities, toxicologists, agriculturalists and students.

Bookmark http://www-infocris.iaea.org/en/w3.exe$GloForm or contact the system administrator (INFOCRIS.feedback@iaea.org) if you would like to become a category translator.

Publications



Validation of Thin-Layer Chromatographic Methods for Pesticide Residue Analysis, *IAEA-TECDOC Series No. 1462*

This IAEA-TECDOC gives a comprehensive overview of the practical application of TLC in pesticide residue analysis. It includes the description of various techniques for the development of TLC plates and different modes of detection of the TLC spots. The results of the participants' research work and interlaboratory collaboration are also summarized.

Thin layer chromatography (TLC) was widely used in the 1960s and 1970s for pesticide residue analysis, and to a lesser extent when gas-liquid chromatography (GLC) and high performance liquid chromatography (HPLC) became readily available. In recent years, there have been new developments in the quality of plate coating and in detection techniques, as well as in extraction and clean up that make it possible to apply TLC according to current international quality requirements.

The TLC methods described in this publication are intended for laboratories where irregular power supply, lack of service or limited budgets are hampering the regular use of GLC and HPLC techniques. The TLC analytical techniques allow for screening, semi-quantitative determination and confirmation of pesticide residues and other organic trace contaminants and pose minor requirements on equipment and laboratory infrastructure. Therefore, the main application is to complement other instrumental techniques of pesticide residue analysis.

A Coordinated Research Programme CRP was initiated for investigating the applicability of TLC detection methods to complement the instrumental techniques used in pesticide residue analysis. Two similar projects were started in 1997 and 1998. The titles of the projects were (i) Validation of Thin-layer Chromatographic Screening Methods for Pesticide Residue Analysis and (ii) Alternative Methods to Gas and High Performance Liquid Chromatography for Pesticide Residue Analysis in Grain.

Scientists from eighteen countries participated in the two projects. The major tasks in the program were to adapt the methods, check the repeatability and reproducibility of Rf values and the minimum detectable quantities (MDQ), and to apply the methods for determining various pesticide residues in representative matrices. Furthermore, the methods have been extended and validated for other pesticides and commodities of interest.

The IAEA officers responsible for editing the manuscript were J. Brodesser and D.H. Byron of the Food and Environment Protection Section, Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture. A. Ambrus of the Centre for Plant Health and Soil Conservation in Budapest, Hungary assisted in finalizing the manuscript for publication.

SUPPLEMENT

DATABASE ON APPROVALS FOR IRRADIATED FOODS
(sorted by Country/Class of Food)

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

ALGERIA

Class of food	Product(s)	Objective	Date*	Technological recommended dose* (kGy)
1	Any	Sprout inhibition	11.04.05	
2	Any	Delay ripening/physiological growth	11.04.05	
		Disinfestation		
		Shelf life extension		
		Quarantine control		
3	Any	Disinfestation	11.04.05	
4	Any	Reduction of pathogenic microorganisms	11.04.05	
		Shelf-life extension		
		Control of parasites		
5	Any	Reduction of pathogenic microorganisms	11.04.05	
		Shelf life extension		
		Control of parasites		
6	Any	Reduction of pathogenic microorganisms	11.04.05	
		Disinfestation		
7	Any	Disinfestation	11.04.05	
8		Microobial control	11.04.05	

Note: Medium absorbed dose of 10 kGy

*The list of foods to be irradiated and comercialized as well as the absorbed doses to be applied to each type of food, will be approved by the Ministry of Agriculture in conjuntion with the Ministry of Commerce.

ARGENTINA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Garlic, potato Onion	Sprout inhibition	02.03.89 03.04.89	0.15 (max)
2	Strawberries	Shelf life extension	03.04.89	2.50 (max)
	Asparragus	Delay physiological growth	02.08.94	2.00 (max)
	Mushrooms	Delay physiological growth		3.00 (max)
3	Dried fruits (any), nuts Dried vegetables (any)	Disinfestation	09.12.92	1.00 (max)
4				
5				
6	Spices, condiments	Microbial control	09.12.90	30.00 (max)
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

AUSTRALIA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2	Breadfruit, carambola, custard apple, longan, litchi,mango,mangosten papaya (paw paw), rambu-tan	Quarantine treatment	27.02.03	0.15 (min)–1.00 (max)
3				
4				
5				
6	Spices and herbs	Disinfestation	20.09.01	3.00 (min)–6.00 (max)
		Control sprouting		
		Microbial control		2.00 (min)–30.00 (max)
	Herbal infusions*	Disinfestation		3.00 (min)–6.00 (max)
		Control sprouting		
		Microbial control		2.00 (min)–10.00 (max)
7				
8				

* Fresh, dried or fermented leaves, flowers and other parts of plants used to make beverages, except tea

AUSTRIA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable seasonings (dried)	Microbial load	20.09.00	10.00 (max)
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

BANGLADESH

Class of food	Product(s)	Objective	Date*	Technological recommended dose (kGy)
1	Any	Sprout inhibition	6.05	0.20 (max)
2	Any	Delay ripening/physio logical growth	6.05	1.00 (max)
		Disinfestation		1.00 (max)
		Shelf life extension		2.50 (max)
		Quarantine control		1.00 (max)
3	Any	Disinfestation	6.05	1.00 (max)
4	Any	Reduction of pathogenic microorganisms	6.05	5.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites		2.00 (max)
5	Any	Reduction of pathogenic microorganisms	6.05	7.00 (max)
		Shelf life extension		3.00 (max)
		Control of parasites		3.00 (max)
6	Any	Reduction of pathogenic microorganisms	6.05	10.00 (max)
		Disinfestation		1.00 (max)
7	Any	Disinfestation	6.05	1.00 (max)
8				

* Date of publication of the official gazette

BELGIUM

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Garlics, onions, potatoes, shallots	Sprout inhibition	08.06.04	0.15 (max)
2	Vegetables	Disinfestation Quarantine treatment	08.06.04	1.00 (max)
	Fruits	Shelf-life extention		2.00 (max)
3	Cereals and pulses	Disinfestation Quarantine treatment	08.06.04	1.00 (max)
	Cereals flakes	Microbial control		10.00 (max)
	Rice flour			4.00 (max)
4	Fish and shellfish (crustaceans and mollusks)	Microbial control	08.06.04	3.00 (max)
	Shrimps (frozen)			5.00 (max)
5	Poultry meat (mechanically separated, minced, crushed, broken up)	Microbial control	08.06.04	5.00 (max)
	Poultry (domestic foul, geese, ducks, pigeons, guinea fowl, quails, turkeys)			7.00 (max)
	Offal of poultry			5.00 (max)
	Frog legs (frozen)		08.06.04	5.00 (max)
6	Herbs, spices, and vegetable seasonings (dried)	Microbial control	08.06.04	5.00 (max)
				10.00 (max)
	Deep frozen aromatic herbs			
7	Dehydrated blood, plasma, coagulates	Microbial control	08.06.04	10.00 (max)
8	Casein, caseinates	Microbial control		6.00 (max)
	Arabic gum			3.00 (max)
	Egg white		08.06.04	3.00 (max)

Explanation for classes of foods: 1. Bulbs, roots and tubers; 2. Fresh fruits and vegetables (other than class 1); 3. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; 4. Fish, seafood and their products (fresh or frozen); 5. Raw poultry, meat and their products (fresh and frozen); 6. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; 7. Dried food of animal origin; 8. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

BRAZIL

Class of food	Product(s)	Objective	Date*	Technological recommended dose* (kGy)
1	Any	Sprout inhibition	30.01.01	
2	Any	Delay ripening/physio logical growth	30.01.01	
		Disinfestation		
		Shelf life extension		
		Quarantine control		
3	Any	Disinfestation	30.01.01	
4	Any	Reduction of pathogenic microorganisms	30.01.01	
		Shelf-life extension		
		Control of parasites		
5	Any	Reduction of pathogenic microorganisms	30.01.01	
		Shelf life extension		
		Control of parasites		
6	Any	Reduction of pathogenic microorganisms Disinfestation	30.01.01	
7	Any	Disinfestation	30.01.01	
8		Microbial control	30.01.01	

Note*: The dose is determined by the technological purpose.

BULGARIA

Class of food	Product(s)	Objective	Date	Technological rec-ommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable seasonings (dried)	Microbial load	28.03.02	10.0 (max)
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

CANADA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Onions	Sprout inhibition	25.03.65	0.15 (max)
	Potatoes		09.11.60	
2				
3	Wheat and wheat products	Disinfestation	25.02.69	0.75 (max)
4				
5				
6	Dry vegetables season-ings and spices	Microbial control	03.10.84	10.0 (max)
7				
8				

CHILE

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Onion, potato	Sprout inhibition	29.12.82	0.15 (max)
2	Date	Disinfestation	29.12.82	1.00 (max)
	Papaya	Delay ripen-ing/physiological growth	29.12.82	1.00 (max)
		Disinfestation		
	Mango	Delay ripening/physio-logical growth,	29.12.82	1.00 (max)
		Disinfestation		
		Shelf-life extension		
	Strawberry	Shelf life extension	29.12.82	3.00 (max)
3	Pulses (cocoa beans)	Disinfestation	29.12.82	1.00 (max)
	Cereals : rice, wheat and wheat products	Disinfestation	29.12.82	1.00 (max)
4	Fish (teleosteos) and fish products	Disinfestation	29.12.82	2.20 (max)
		Microbial control		
		Shelf life extension		
5	Chicken	Microbial control	29.12.82	2.20 (max)
		Shelflife extension		
6	Spices and condi-ments	Disinfestation	29.12.82	10.00 (max)
		Microbial load		
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

CHINA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Any (fresh vegeta-bles)	Sprout inhibition	10.06.97	1.50 (max)
2	Any (fresh fruits)	Shelf life extension	10.06.97	1.50 (max)
3	Cereal grains (rice, wheat)	Disinfestation	10.06.97	0.60 (max)
	Beans			0.20 (max)
	Dried nuts and fruits			0.40 (max)
4				1.00 (max)
	Beef and poultry meat (frozen)	Microbial control	10.06.96	2.50 (max)
	Pork	Parasite control	23.02.94	0.65 (max)
6	Spices	Microbial control	10.06.97	10.00 (max)
7				
8	Pollen	Microbial control	23.02.94	10.00 (max)
	Cooked meat food for livestock and poultry		10.06.97	8.00 (max)
	Sweet potato wine		23.02.94	4.00 (max)

COSTA RICA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Onions, potatoes	Sprout inhibition	07.07.94	0.15 (max)
2	Dates	Disinfestation	07.07.94	1.00 (max)
	Papaya	Delay ripening/ physiological growth		1.00 (max)
		Disinfestation		
	Mangoes	Delay ripening/physiolo-gical growth,		1.00(max)
		Disinfestation,		
		Shelf-life extension		
	Strawberries	Shelf life extension		3.00 (max)
3	Pulses (cocoa beans)	Disinfestation	07.07.94	1.00 (max)
	Cereals : rice, wheat and wheat products	Disinfestation		1.00 (max)
4	Fish(teleosteos) and fish products	Disinfestation Microbial control Shelf-life extension	07.07.94	2.20 (max)
5	Chicken	Microbial control	07.07.94	2.20 (max)
		Shelf life extension		
6	Spices and condi-ments	Disinfestation	07.07.94	10.00 (max)
		Microbial load		
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

CROATIA

Class of food	Product(s)	Objective	Date*	Technological recommended dose (kGy)
1	Any	Sprout inhibition	21.06.94	0.50 (max)
2	Any	Delay ripening/physio logical growth	21.06.94	3.00 (max)
		Disinfestation		
		Shelf life extension		
		Quarantine control		
3	Any (cereals. pulses and dried fruits)	Disinfestation	21.06.94	1.00 (max)
	Dried fruits	Microbial load		10.00 (max)
4	Any (fish and sea-food)	Reduction of pathogenic microorganisms	21.06.94	5.00 (max)
		Shelf-life extension		
		Control of parasites		
	Frog legs	idem		8.00 (max)
5	Any	Reduction of pathogenic microorganisms	21.06.94	7.00 (max)
		Shelf life extension		
		Control of parasites		
6	Any	Reduction of pathogenic microorganisms	21.06.94	30.0 (max)
		Disinfestation		
7	Any (milk products, powered eggs)	Disinfestation	21.06.94	3.00 (max)
		Microbial control		
8	Meals for immuno-suppressed pa-tients, arabic gum, enzimes, eggs and egg products	Microbial control	21.06.94	10.00–45.00 (max)

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

CUBA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Garlics	Sprout inhibition	01.04.87	0.08 (max)
	Onions			0.06 (max)
	Potatoes			0.10 (max)
2	Avocados	Delay rip-enig/physiological growth	01.08.92	0.25 (max)
	Mangoes	Delay rip-enig/physiological growth	01.07.92	0.75 (max)
3	Pulses (cocoa beans)	Disinfestation	01.01.88	0.50 (max)
	Oil seed(sesame seeds)		01.10.93	2.00 (max)
	Milled (cocoa dehy-drated)		01.01.89	2.00 (max)
4	Fish (fresh)	Shelflife extension	01.01.91	3.00 (max)
	Fish (dried)	Disinfestation	01.05.93	1.00(max)
	Seafood	Shelf life extension	01.01.91	3.00 (max)
5	Meat	Microbial control	01.08.91	5.00 (max)
	Meat products		01.03.90	4.00 (max)
6	Spices	Disinfestation	01.08.90	5.00 (max)
7	Animal blood (dried)	Disinfestation	01.01.90	2.00 (max)
8	Casings (hog)	Microbial control	01.10.88	7.00 (max)

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

CZECH REPUBLIC

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Any	Sprout inhibition	12.03.04	0.20 (max)
2	Any	Delay ripening/physio logical growth	12.03.04	1.00 (max)
		Disinfestation		
		Quarantine control		
		Shelf life extension		2.00 (max)
3	Cereals and their milled products, pulses, dried fruits	Disinfestation	12.03.04	1.00 (max)
		Microbial control		10.00 (max)
4	Any *	Reduction of pathogenic microorganisms	12.03.04	5.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites		2.00 (max)
	Frozen frog legs	Microbial control		5.00 (max)
5	Poultry meat	Reduction of pathogenic microorganisms	12.03.04	7.00 (max)
		Shelf life extension		
		Control of parasites		3.00 (max)
6	Any	Reduction of pathogenic microorganisms	12.03.04	10.00 (max)
		Disinfestation		1.00 (max)
7	Dehydrated blood, plasma, coagulates	Disinfestation	12.03.04	10.00 (max)
	Casein, caseinates	Microbial control		6.00 (max)
8	Gum arabic	Microbial control	12.03.04	3.00 (max)
	Egg white	Microbial control		3.00 (max)

*Fish and seafood

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

DENMARK

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices,	Microbial control	23.12.85	10.00 (max)
	Vegetable season-ings (dried)	Microbial control	20.09.00	10.00 (max)
7				
8				

EGYPT

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Garlic, onions, pota-toes and yams	Sprout inhibition	09.01.01	0.20 (max)
2				
3				
4				
5				
6	Herbs, spices and dried garlics and onions.	Microbial control	22.10.97	10.00 (max)
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

FINLAND

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried)	Microbial load	20.09.00	10.00 (max)
	Spices		13.11.87	
	Vegetable season-ings (dried)		20.09.00	
7				
8	Sterile meals	Microbial load	13.11.87	10.00 (max)

FRANCE

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Garlic, onion, shallot	Sprout inhibition	12.07.84	0.75 (max)
2				
3	Cereal flakes Cereal germs Rice flour	Microbial control	16.06.85 17.05.85 13.01.88	10.0 (max)
	Dried fruits Pulses	Disinfestation	13.01.88	1.00 (max)
4	Sea food (shrimps)	Microbial control	10.10.90	5.00 (max)
5	Poultry	Microbial control	01.09.90	5.00 (max)
	Meat and their prod-ucts		23.03.85	
6	Herbs (dried)	Microbial control	22.05.90	10.00 (max)
	Spices		10.02.83	
	Vegetable seasoning (dried)		20.09.00	
7	Dry food of animal origin (animal blood dried: Plasma and blood products)	Microbial control	04.12.86	10.00 (max)
	Casein/caseinates		21.07.91	6.00 (max)
8	Arabic gum	Microbial control	16.06.85	3.00 (max)

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

GERMANY

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable season-ings (dried)	Microbial load	20.09.00	10.00 (max)
7				
8				

GHANA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Any	Sprout inhibition	15.01.97	0.20 (max)
2	Any	Delay ripening/physio logical growth	15.01.97	1.00 (max)
		Disinfestation		
		Quarantine control		
		Shelf-life extension		2.50 (max)
3	Any	Disinfestation	15.01.97	1.00 (max)
		Reduction of pathogenic microrganisms		5.00 (max)
4	Any	Reduction of pathogenic microorganisms	15.01.97	5.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites		2.00 (max)
5	Any	Reduction of pathogenic microorganisms	15.01.97	7.00 (max)
		Shelf life extension		3.00 (Max)
		Control of parasites		2.00 (max)
6	Any	Reduction of pathogenic microorganisms	15.01.97	10.00 (max)
		Disinfestation		1.00 (max)
7	Any	Disinfestation	15.01.97	1.00 (max)
		Control moulds		10.0 (max)
8	Any	Reduction of pathogenic microorganisms	25.02.98	> 10.00
		Sterilization		
		Quarantine control		

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

GREECE

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable seasonings (dried)	Microbial load	20.09.00	10.00 (max)
7				
8				

HUNGARY

Class of food	Product (s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried)	Microbial load	20.09.00	10.00 (max)
	Spices	Microbial load		
	Vegetable seasonings (dried)	Microbial load		
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

INDIA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Garlic, ginger	Sprout inhibition	06.04.98	0.15 (max)
	Onion		06.04.98	0.09 (max)
	Potato		09.08.94	0.15 (max)
2	Mango	Delay ripening/ physiological growth.	06.04.98	0.75 (max)
		Disinfestation		
3	Wheat and wheat product Disinfesta-tion	Disinfestation	06.04.98	1.00 (max)
	Rice		0.6.04.98	1.00 (max)
	Pulses		02.05.01	1.00 (max)
	Dried fruits (dates, figs, raisins)		06.04.98	0.75 (max)
4	Any	Disinfestation,	02.05.01	6.00 (max)
		Microbial control		
		Shelf-life extension		
5	Any	Microbial control	06.04.98	4.00 (max)
		Shelf-life extension		
6	Spices	Microbial control	09.08.94	14.00 (max)
7				
8				

INDONESIA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Any	Sprout inhibition	29.12.87	0.15 (max)
2				
3	Cereals	Disinfestation	29.12.87	1.00 (max)
	Pulses	Microbial control	10.02.95	5.00 (max)
	Dried fruits	Disinfestation	29.13.87	1.00 (max)
4	Shellfish (frozen shrimps)	Microbial control	10.02.85	5.00 (max)
	Frog legs (frozen)		10.02.95	7.00 (max)
5				
6	Spices	Microbial control	29.12.87	5.00 (max)
			10.02.95	10.00 (max)
7	Fish (dried)	Disinfestation	10.02.85	5.00 (max)
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

ISLAMIC REPUBLIC OF IRAN

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Spices	Microbial load	09.07.90	10.00 (max)
7				
8				

IRELAND

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable seasonings (dried)	Microbial load	20.09.00	10.00 (max)
7				
8				

ISRAEL				
Class of food	**Product(s)**	**Objective**	**Date**	**Technological recommended dose (kGy)**
1	Potatoes	Sprout inhibition	30.07.67	0.15 (max)
	Onions, garlics, shallots		06.03.85	
2	Any	Delay ripening/ physiological growth. Disinfestation	17.02.87	1.00 (average)
3	Any	Disinfestation	17.02.87	1.00 (average)
4				
5	Raw poultry and poultry sections	Microbial control/shelf-life extension	17.02.87	7.00 (max)
6	Spices, dried vege-tables	Microbial control	17.02.87	10.00 (max)
7	Animal feed	Microbial control	19.07.73	15.00 (average)
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables,spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

ITALY

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Potatoes, onions and garlics	Sprout inhibition	30.08.73	0.15 (max)
2				
3				
4				
5				
6	Herbs (dried), spices,	Microbial load	18.07.96	10.00 (max)
	Vegetable season-ings (dried)	Microbial load	20.09.00	10.00 (max)
7				
8				

JAPAN

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Potatoes	Sprout inhibition	30.08.72	0.15 (max)
2				
3				
4				
5				
6				
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables,spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

KOREA, Rep. of

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Potato	Sprout inhibition	28.09.87	0.15 (max)
	Onion		16.10.87	
	Garlic		14.12.91	
2	Mushrooms	Disinfestation	16.10.87	1.00 (max)
3	Chesnuts	Disinfestation	16.10.87	0.25 (max)
	Cereals or legumes and their powder as ingredients of food products	Disinfestation and microbial control	24.05.04	5.00 (max)
4				
5				
6	Spices (dried)	Microbial control	13.09.88	10.00 (max)
	Vegetable seasonings (dried)		19.05.95	7.00 (max)
	Dried vegetables			7.00 (max)
	Tea (included later)		24.05.04	10.00 (max)
7	Dried food of animal origin (meat, fish, shellfish)	Microbial control	14.12.91	7.00 (max)
	Egg powder		24.05.04	5.00 (max)
8	Sterile meals (for 2nd pasturization)	Microbial control	19.05.95	10.00 (max)
	Sauces		24.05.04	
	Enzime preparations, aloe, ginseng and yeast powder			7.00 (max)
	Soy sauce, soybean and red pepper paste, and, other powdered products (Doenjang, Kochujang, Kanjang)		14.12.91	7.00 (max)
	Starch as ingredient of food products			5.00 (max)
	Algae food		24.05.04	7.00 (max)

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables,spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

LIBYAN ARAB JAMAHIRIYA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Garlic	Sprout inhibition	89	0.04 (max)
	Onion			0.08(max)
	Potato			1.00 (max)
2	Dates	Disinfestation		1.00 (max)
3				
4				
5	Poultry meat	Microbial control		4.00 (max)
		Shelf-life extension		
6	Spices	Microbial load		10.00 (max)
7				
8				

LUXEMBOURG

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable season-ings (dried)	Microbial load	20.09.00	10.00 (max)
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

MEXICO

Class of food	Product(s)	Objective	Date*	Technological recommended dose (kGy)
1	Any	Sprout inhibition	06.09.05	
2	Any	Delay ripening/physiological growth	06.09.05	
		Disinfestation		
		Shelf life extension		
		Quarantine control		
3	Any	Disinfestation	06.09.05	
4	Any	Reduction of pathogenic microorganisms	06.09.05	
		Shelf-life extension		
		Control of parasites		
5	Any	Reduction of pathogenic microorganisms	06.09.05	
		Shelf life extension		
		Control of parasites		
6	Any	Reduction of pathogenic microorganisms	06.09.05	
		Disinfestation		
7	Any	Disinfestation	06.09.05	
8	Any	Microbial control, reduction of pathogenic microorganisms etc	06.09.05	

Note*: The dose is determined by the technological purpose.

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables,spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

NETHERLANDS

Class of food	Product(s)	Objective	Date*	Technological recommended dose (kGy)*
1				
2				
3	Pulses, dried fruits, cereal flakes	Disinfestation	01.08.92	1.00 (average)
4	Prawns/shrimps	Reduction of pathogenic microorganisms	01.08.92	3.00 (average)
	Frog legs			5.00 (average)
5	Poultry meat	Reduction of pathogenic microorganisms	01.08.92	7.00 (average)
		Shelf life extension		
6	Spices, herbs, dried vegetables	Reduction of pathogenic microorganisms. Disinfestation	01.08.92	10.00 (average)
	Vegetable sea-sonings		20.09.00	10.00 (max)
7				
8	Deep frozen meals	Microbial control, reduction of pathogenic microorganisms etc	01.08.92	10.00 (average)
	Arabic gum			75.00 (average)

NEW ZEALAND

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2	Breadfruit, carambola, custard apple, longan, litchi, mango,mangosten papaya (paw paw), rambutan	Quarantine treatment	27.02.03	0.15 (min)–1.00 (max)
3				
4				
5				
6	Spices and herbs	Disinfestation	20.09.01	3.00 (min)–6.00 (max)
		Control sprouting		
		Microbial control		2.00 (min)–30.00 (max)
	Herbal infusions*	Disinfestation		3.00 (min)–6.00 (max)
		Control sprouting		
		Microbial control		2.00 (min)–10.00 (max)
7				
8				

* Fresh, dried or fermented leaves, flowers and other parts of plants used to make beverages, except tea

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

NORWAY

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable seasonings (dried)	Microbial load	20.09.00	10.00 (max)
7				
8				

PARAGUAY				
Class of food	**Product(s)**	**Objective**	**Date***	**Technological recommended dose (kGy)***
1	Any	Sprout inhibition	31.01.00	0.20 (max)
2	Any	Delay ripening/physiological growth	31.01.00	1.00 (max)
		Disinfestation		
		Quarantine control		
		Shelf-life extension		2.00 (max)
3	Any	Disinfestation	31.01.00	1.00 (max)
4	Any	Reduction of pathogenic microorganisms	31.01.00	5.00 (max)
		Shelf-life extension		3.00 (max)
5	Any	Reduction of pathogenic microorganisms	31.01.00	5.00 (max)
		Shelf life extension		
6	Any	Reduction of pathogenic microorganisms	31.01.00	10.00 (max)
		Disinfestation		1.00 (max)
7	Any	Disinfestation	31.01.00	1.00 (max)
8	Any	Microbial control, reduction of pathogenic microorganisms …	31.01.00	>10.0

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

PERU

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)*
1	Any	Sprout inhibition	05.12.01	0.20 (max)
2	Any	Delay ripen-ing/physiological growth	05.12.01	1.00 (max)
		Disinfestation		
		Quarantine control		
		Shelf-life extension		2.50 (max)
3	Any	Disinfestation	05.12.01	1.00 (max)
		Microbial load		5.00 (max)
4	Any	Reduction of pathogenic microorganisms	05.12.01	5.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites		2.00(max)
5	Any	Reduction of pathogenic microorganisms	05.12.01	7.00 (max)
		Shelf life extension		3.00 (max)
		Control of parasites		2.00 (max)
6	Any	Reduction of pathogenic microorganisms	05.12.01	10.0 (max)
		Disinfestation		1.00 (max)
7	Any	Disinfestation	05.12.01	1.00 (max)
		Control moulds		3.00 (max)
8	Any	Microbial control, reduction of pathogenic microorgan-isms etc	05.12.01	>10.0

* It is determined by the technological purposes

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

PHILIPPINES

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)*
1	Any	Sprout inhibition	01.03.04	0.20 (max)
2	Any	Delay ripening/physio logical growth	01.03.04	1.00 (max)
		Quarantine control*		1.00 (max)
		Shelf-life extension		2.50 (max)
3	Any	Disinfestation*	01.03.04	1.00 (max)
		Microbial control reduction of pathogenic microorganisms etc		5.00 (max)
		Inhibit sprouting		0.25 (max)
4	Any (includes frog legs and freshwater and terrestial inverterated)	Reduction of pathogenic microorganisms**	01.03.04	7.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites**		2.00 (max)
5	Any	Reduction of pathogenic microorganisms **	01.03.04	7.00 (max)
		Shelf life extension		3.00 (max)
		Control of parasites **		2.00 (max)
6	Any	Reduction of pathogenic microorganisms	01.03.04	30.00 (max)
		Disinfestation*		1.00 (max)
7	Any	Disinfestation	01.03.04	1.00 (max)
		Control moulds		3.00 (max)
		Reduction of pathogens microrganisms **		7.00 (max)
8	Any	Reduction of microorganisms **	01.03.04	***
		Sterilization		***
		Quarantine control*		***

Note: The dose is determined by the technological purposes

* Minimum dose may be determined for a particular pest

** Minimum dose may be specified keeping in mind the objective of the treatment to ensure hygienic quality of the food

*** Maximum dose to be specified for particular purpose and foodstuff

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

POLAND

Class of food	Product(s)	Objective	Date*	Technological recommended dose (kGy)
1	Onions	Sprout inhibition	04.07.03	Up to 0.06
	Potatoes	Sprout inhibition	04.07.03	0.025 – 0.10
	Garlic	Sprout inhibition	04.07.03	0.03 – 0.25
2	Mushrooms	Shelf-life extention	04.07.03	1,0 – 2,5
3				
4				
5				
6	Spices & Herbs	Microbial load	04.07.03	5.00–10.00
	Dried Vegetable	Microbial load	04.07.03	5.00–10.00
	Dried mushrooms	Microbial load	04.07.03	3.00–10.00
7				
8				

* Decree of the Minister of Health 15.01.2003

PORTUGAL

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable seasonings (dried)	Microbial control	26.12.01*	10.00 (max)
7				
8				

* Date of publication of the Decree No 297 (26/12/01)

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

RUSSIAN FEDERATION

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)*
1	Onion	Sprout inhibition	17.07.64	0.06 (max)
	Potato			0.03 (max)
2	Any	Delay ripening/physiological growth	11.07.64*	
		Disinfestation		
		Shelf life extension		
		Quarantine control		
3	Grains (corn, wheat)	Disinfestation	01.01.59	0.30 (max)
	Rice			0.70 (max)
4				
5	Poultry	Shelf-life extension	04.07.66*	6.00 (max)
	Red meat and red meat products		01.02.67*	8.00 (max)
	Pork meat and pork meat products		11.07.64*	
	Rabbit meat and rabbit meat products			
6	Dried vegetables	Reduction of pathogenic microorganisms	11.07.64	4.00 (max)
		Disinfestation		
7		Disinfestation		
8	Food concentrates (dried)	Disinfestation	06.06.66	0.70 (max)
	Pudding (dried)			

* Conditional approval

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

SAUDI ARABIA

Class of food	Product(s)	Objective	Date*	Technological recommended dose (kGy)*
1	Any	Sprout inhibition	07.01.02	
2	Any	Delay ripening/physiological growth	07.01.02	
		Disinfestation		
		Shelf life extension		
		Quarantine control		
3	Any	Disinfestation	07.01.02	
4	Any	Reduction of pathogenic microorganisms		
		Shelf-life extension		
		Control of parasites		
5	Any	Reduction of pathogenic microorganisms	07.01.02	
		Shelf life extension		
		Control of parasites		
6	Any	Reduction of pathogenic microorganisms	07.01.02	
		Disinfestation		
7	Any	Disinfestation	07.01.02	
8	Any	Microbial control, reduction of pathogenic microorganisms etc	07.01.02	

* The dose is determined by the technological purpose

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

SOUTH AFRICA

Class of food	Product(s)**	Objective	Date	Technological recommended dose** (kGy)
1	Any	Sprout inhibition	29.10.02	
2	Any	Delay ripening/physiological growth	29.10.02	
		Disinfestation		
		Shelf life extension		
		Quarantine control		
3	Any	Disinfestation	29.10.02	
4	Any	Reduction of pathogenic microorganisms	29.10.02	
		Shelf-life extension		
		Control of parasites		
5	Any	Reduction of pathogenic microorganisms	29.10.02	
		Shelf life extension		
		Control of parasites		
6	Any	Reduction of pathogenic microorganisms	29.10.02	
		Disinfestation		
7	Any	Disinfestation	29.10.02	
8	Any	Shelf stable	29.10.02	
9	Honey, garlics	Phytosanitary	29.10.02	
10	Any	Irradiated food plus additional treatment where irradiation does not sterilize completely	29.10.02	
		Special microbiological concerns and where radiation does not sterilize completely		
		Radiated outside South Africa		
11	Any	Radiated outside South Africa	29.10.02	

* The Guidelines for monitoring irradiated foodstuffs in South Africa (October 2002) establishs 11 classes of foods instead of the 8 classes proposed by the ex International Consultative Group in Food Irradiation

* *The approval of foods to be irradiated and comercialized as well as the absorbed doses to be applied to each type of food, is given by the Ministry of Health and/or Ministry of Agriculture to individuals or companies for specific commodities. The approvals are based on the recommendations of the Codex Alimenntarius Commission voulme XV: Codex General Standards for Irradiated Foods and Recommended International Code of Practice for the Oeration of Radiation Facilities used for the Treatment of Food and taking into account that Codex does not impose any restriction in the kinds of food that may be irradiated

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables,spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

SWEDEN

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable seasonings (dried)	Microbial load	20.09.00	10.00 (max)
7				
8				

SPAIN

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1				
2				
3				
4				
5				
6	Herbs (dried), spices, vegetable seasonings (dried)	Microbial control	20.09.00	10.00 (max)
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

SYRIAN ARAB REPUBLIC

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)*
1	Any	Sprout inhibition	02.08.96	0.20 (max)
2	Any	Delay ripening/physiological growth	02.08.96	1.00 (max)
		Disinfestation		
		Quarantine control		
		Shelf-life extension		2.50 (max)
3	Any	Disinfestation	02.08.96	1.00 (max)
		Microbial load		5.00 (max)
		Shelf-life extension		5.00 (max)
4	Any	Reduction of pathogenic microorganisms	02.08.96	5.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites		2.00 (max)
5	Any	Reduction of pathogenic microorganisms	02.08.96	7.00 (max)
		Shelf life extension		3.00 (max)
		Control of parasites		3.00 (max)
6	Any	Reduction of pathogenic microorganisms	02.08.96	10.00 (max)
		Disinfestation		1.00 (max)
7	Any	Disinfestation	02.08.96	1.00 (max)
		Control of moulds		3.00 (max)
8				

TUNISIA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Potatoes, onions, garlics	Sprout inhibition	24.05.02	0.15 (max)
2				
3	Pulses and dried fruits	Disinfestation	24.05.02	1.00 (max)
4				
5				
6	Spices Vegetable seasonings (dried)	Microbial load	24.05.02	10.00 (max)
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

UKRAINE

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)*
1	Onion	Sprout inhibition	17.07.64	0.06 (max)
	Potato			0.03 (max)
2	Any	Delay ripening/physiological growth	11.07.64*	
		Disinfestation		
		Shelf life extension		
		Quarantine control		
3	Grains (corn, wheat)	Disinfestation	01.01.59	0.30 (max)
	Rice			0.70 (max)
4				
5	Poultry	Shelf-life extension	04.07.66*	6.00 (max)
	Red meat and red meat products		01.02.67*	8.00 (max)
	Pork meat and pork meat products		11.07.64*	
	Rabbit meat and rabbit meat products			
6	Dried vegetables	Reduction of pathogenic microorganisms	11.07.64	4.00 (max)
		Disinfestation		
7		Disinfestation		
8	Food concentrates (dried)	Disinfestation	06.06.66	0.70 (max)
	Pudding (dried)			

* Conditional approval

UNITED KINGDOM

Class of food	Product(s) *	Objective	Date	Technological recommended dose (kGy)
1	Any	Sprout inhibition	01.01.91	0.20 (max)
2	Any	Shelf life extension	01.01.91	1.00 (max)
3	Cereal grains	Disinfestation	00.01.91	1.00 (max)
	Pulses			
	Dried fruits			
4	Fish and shellfish	Microbial control	01.01.91	3.00 (max)
		Shelf life extension		
5	Poultry meat	Microbial control	01.01.91	7.00 (max)
6	Spices, condiments	Microbial control	01.01.91	10.00 (max)
7				
8	Steril meals			

* Specific license has to be issued for foods within authoriesd classes of food

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

UNITED STATES OF AMERICA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Potatoes (white)	Sprout inhibition	08.07.64	0.15 (max)
2	Any	Delay ripening/physiological growth	18.04.86	1.00 (max)
		Disinfestation		
		Quarantine control*	23.10.02	1.00 (max)
	Seeds for sprouting	Microbial control (pathogens)	30.10.00	8.00 (max)
3	Wheat and wheat powder	Disinfestation	21.08.63	0.50 (max)
4	Shellfish (fresh or frozen)	Control of pathogenic microorganisms (vibrio and other species)	16.08.05	5.50 (max)
5	Poultry meat and their products	Reduction of pathogenic microorganisms, shelf-life extension	02.05.90	3.00 (max)
	Red meat and meat by products		03.12.97	4.50 (refrigerated)–7.00 (frozen) max
	Pork meat	Control of parasites (Trichinella spiralis)	22.07.85	1.00 (max)
6	Spices, herbs, vegetable seasomimgs	Microbial control	18.04.86	30.00 (max)
7	Animal feed and pet food	Microbial control	28.09.95	25.00 (max)
8	Enzime preparations (dried or dehydrated)	Microbial control	10.06.85	10.00 (max)
	Fresh shell eggs	Control of pathogens (Salmonella spp)	21.07.00	3.00 (max)

Note: Irradiation phytosanitary treatment for imported fruits and vegetables

URUGUAY

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)
1	Potato	Sprout inhibition	23.06.70	0.15 (max)
2				
3				
4				
5				
6				
7				
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

THAILAND

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)*
1	Garlic, potato, onion	Sprout inhibition	04.12.86	0.15(max)
2	Papayas	Delay ripening/physiological growth	04.12.86	1.00 (max)
		Disinfestation		
	Mango	Delay ripening Disinfestation icrobial control		1.00 (max)
	Strawberry	Shelf-life extension Microbial control		3.00 (max)
3	Cereals (wheat and wheat products, rice)	Disinfestation	04.12.86	1.00 (max)
	Fermented cocoa	Microbial control		5.00 (max)
	Dried fruits (jujuba)	Disinfestation		1.00 (max)
4	Fish products	Microbial control	04.12.86	2.20 (max)
		Shelf-life extension		
	Shellfish (shrimps)	Microbial control		5.00 (max)
5	Chicken	Microbial control	04.12.86	7.00 (max)
		Shelf life extension		
	Sausages	Microbial control		5.00 (max)
		Shelf-life extension		
	(specific sausages: nham and moo yor)	Control of parasites		
6	Spices and condiments	Microbial control	04.12.86	10.00 (max)
		Disinfestation		1.00 (max)
7	Fish (dried)	Disinfestation	04.12.86	1.00 (max)
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

TURKEY

Class of food	Product(s)	Objective	Date*	Technological recommended dose (kGy)*
1	Any	Sprout inhibition	06.11.99	0.20 (max)
2	Any	Delay ripening/physiological growth	06.11.99	1.00 (max)
		Disinfestation		
		Quarantine control		
		Shelf-life extension		2.50 (max)
3	Any	Disinfestation	06.11.99	1.00 (max)
		Reduction of Microbial load		5.00 (max)
		Shelf-life extension		5.00 (max)
4	Any	Reduction of pathogenic microorganisms	06.11.99	5.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites		2.00 (max)
5	Any	Reduction of pathogenic microorganisms	06.11.99	7.00 (max)
		Shelf life extension		3.00 (max)
		Control of parasites		3.00 (max)
6	Any	Reduction of pathogenic microorganisms	06.11.99	10.00 (max)
		Disinfestation		1.00 (max)
7	Any	Disinfestation	06.11.99	1.00 (max)
		Control of moulds		3.00 (max)
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

VIETNAM

Class of food	Product(s)	Objective	Date*	Technological recommended dose (kGy)*
1	Any	Sprout inhibition	09.11.04	0.20 (max)
2	Any	Delay ripening/physiological growth	09.11.04	1.00 (max)
		Disinfestation		
		Quarantine control		
		Shelf-life extension		2.50 (max)
3	Any	Disinfestation	09.11.04	1.00 (max)
		Microbial load		5.00 (max)
		Shelf-life extension		5.00 (max)
4	Any	Reduction of pathogenic microorganisms	09.11.04	7.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites		2.00 (max)
5	Any	Reduction of pathogenic microorganisms	09.11.04	7.00 (max)
		Shelf life extension		3.00 (max)
		Control of parasites		2.00 (max)
6	Any	Reduction of pathogenic microorganisms	09.11.04	10.00 (max)
		Disinfestation		1.00 (max)
7	Any	Disinfestation	09.11.04	1.00 (max)
		Control of moulds		3.00 (max)
		Reduction of pathogenic microorganisms		7.00 (max)
8				

Explanation for classes of foods: **1**. Bulbs, roots and tubers; **2**. Fresh fruits and vegetables (other than class 1); **3**. Cereals and their milled products, nuts, oil seeds, pulses,dried fruits; **4**. Fish, seafood and their products (fresh or frozen); **5**. Raw poultry, meat and their products (fresh and frozen); **6**. Dry vegetables, spices, condiments, animal feed, dry herbal and herbal teas; **7**. Dried food of animal origin; **8**. Miscellaneous foods, including but not limited to: honey, space foods, hospital foods, military rations, liquid egg thickeners.

ZAMBIA

Class of food	Product(s)	Objective	Date	Technological recommended dose (kGy)*
1	Any	Sprout inhibition		0.20 (max)
2	Any	Delay ripening/physiological growth		1.00 (max)
		Disinfestation		
		Quarantine control		
		Shelf-life extension		2.50 (max)
3	Any	Disinfestation		1.00 (max)
		Microbial load		5.00 (max)
4	Any	Reduction of pathogenic microorganisms		5.00 (max)
		Shelf-life extension		3.00 (max)
		Control of parasites		2.00 (max)
5	Any	Reduction of pathogenic microorganisms		7.00 (max)
		Shelf life extension		3.00 (max)
		Control of parasites		2.00 (max)
6	Any	Reduction of pathogenic microorganisms		10.00 (max)
		Disinfestation		1.00 (max)
7	Any	Reduction of microorganisms		1.00 (max)
		Control of moulds		3.00 (max)
8		Reduction of microorganisms		> 10.00
		Sterilization		
		Quarantine control		

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