INIS-mf--12859

Food Irradiation Newsletter

JOINT FAO/IAEA DIVISION OF ISOTOPE AND RADIATION APPLICATIONS
OF ATOMIC ENERGY FOR FOOD AND AGRICULTURAL DEVELOPMENT
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA

Vol. 12, No. 2 July 1988

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TO THE READER

The International Consultative Group on Food Irradiation(ICGFI) continues to make progress on a number of areas. This issue reports activities of two training workshops convened in Santiago, Chile and Rehovot, Israel in the past six months.

Special attention of the reader is drawn to the International Conference on the Acceptance, Control of and Trade in Irradiated Foods, jointly sponsored by FAO, IAEA, WHO and International Trade Center (ITC), UNCTAD/GATT, Geneva, Switzerland, 12-16 December 1988. This is the first international conference which will address major policy issues related to acceptance, control of and trade in irradiated foods. It will aim at establishing an internationally agreed document on the topic of the conference among Member States of the sponsoring Organizations. The background and objective, as well as the Participation form and Draft Provisional Agenda of the Conference are included in this issue. Please note that the filled-in Participation form must be submitted to the Joint FAO/IAEA Division through governmental channels.

The summary report of the FAO/IAEA Seminar on Food Irradiation for Developing Countries in Africa is published in this issue. A follow-up to this Seminar is the "Co-ordinated Research Programme on Food Irradiation for African Countries" which will be implemented as soon as funds become available. Institutions in Africa which are interested in collaborating with us under the scope of this CRP are cordially invited to submit research proposals or contact the Food Preservation Section urgently.

A video programme (22 minutes long) has been produced by the ICGFI at the end of last year. National Contact points in ICGFI member countries were provided with master copies for broadcasting on local television stations and disseminate copies to interested parties. The list of such contact points is included in this issue.

Other items of interest in this issue include report of the Working Group on Food Irradiation of the European Society for Nuclear Agriculture convened in Stara Zagora, Bulgaria in 1987; status of practical application of food irradiation in different countries; next IFFIT training course; new regulation on food irradiation in Canada; national seminar on food irradiation in People's Republic of China; and recent publications.

The readers are requested to inform us of highlights on food irradiation developments in their countries for publication under "communication received" of the Newsletter. May we request you to send us this information for inclusion in the next issue before the end of October 1988, please.

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INTERNATIONAL CONSULTATIVE GROUP ON FOOD IRRADIATION (ICGFI)

A. Progress Report (December 1987 - May 1988)

The Fourth Meeting of the International Consultative Group on Food Irradiation (ICGFI) was held at the IAEA Headquarters in Vienna, 3-5 November 1987. A workplan for 1988 and 1989 was approved in the Meeting. In addition to the continuation of activities programmed for 1987, some progress has already been made on activities specified in the approved 1988 workplan. The activities for the period December 1987 to May 1988 are outlined below:

1. ICGFI Reports and Documents

1.1 Model Regulation for Licensing Food Irradiation Facilities. A document proposing a model regulation for use by national authorities involved in the licensing of food irradiation facilities has been prepared and is being finalized for publication.

1.2 Technological Guidelines for Food Irradiation Application. ICGFI has prepared eight guidelines on specific applications of food irradiation based on provisions of the Codex General Standard for Irradiated Foods and its associated Code of Practice. These guidelines were reviewed by experts, edited and printed as ICGFI Provisional Guidelines on Food Irradiation Application. The Codex Secretariat was contacted to consider elaborating these guidelines under Codex procedures to ensure international recognition.

1.3 Food Irradiation Process Control School (FIPCOS).

The curriculum for training operators/supervisors of irradiation facilities was prepared by Prof. B.S. Schweigert and Prof. W.M. Urbain under contract with ICGFI in 1987. It was first circulated to experts for comments. Governments and in particular, national food control authorities, were requested to comment on this curriculum before end of May 1988.

A draft training manual for FIPCOS was also prepared by Prof. W.M. Urbain. Subject to the agreement of the Canadian authorities, the first FIPCOS for training operators/supervisors of irradiation facilities is planned to be held at the Canadian Irradiation Centre, Laval, Canada in October 1988.

In addition, the first draft of a training manual for food control officials has been prepared by another Consultant (Dr. G. Kapsiotis). It is being circulated among national authorities responsible for food inspection for review.

1.4 Information Brochures on Food Irradiation. Four brochures on different aspects of food irradiation, i.e. Food-borne Disease, Safety and Nutrition, Food Loss, and Food Trade plus a brochure on food irradiation for the food industry have been prepared. Comments from FAO and WHO on the brochures were solicited and the possibility of printing the brochures in the USA at no cost to ICGFI is being explored.

2. Workshops/Meetings

2.1 Workshop on the Assessment of the Economic Feasibility of Food Irradiation. ICGFI organized this workshop in Rehovot, Israel, 25 January - 5 February 1988. Eleven participants from developing countries in Europe and Latin America participated in the workshop.

2.2 Workshop on the Use of Irradiation as a Quarantine Treatment for Latin American Countries. This workshop was held in Santiago, Chile from 30 November to 4 December 1987, in co-operation with the Inter-American Institute for Cooperation on Agriculture (IICA) and the Comision Chilena de Energia Nuclear (CCHEN). Eleven participants from eight countries in the region attended the workshop.

2.3 Workshop on the Use of Irradiation to Ensure Hygienic Quality of Food. This workshop was held at the International Facility for Food Irradiation Technology, Wageningen, The Netherlands from 14 to 25 March 1988. Nineteen participants from 19 countries attended the workshop.

2.4 Workshop on Food Irradiation. ICGFI conducted a one day workshop on 30 January 1988 during the Sixth Session of the Codex Co-ordinating Committee for Asia (26 January - 1 February 1988) in Denpasar, Indonesia. Thirty participants, mostly food control officials, from Asian countries attended the workshop

2.6 Task Force Meeting on Public Information of Food Irradiation. This was co-sponsored by the French Commissariat à l'énergie atomique (CEA) and held in Cadarache, France from 18-21 April 1988. Eight world-renowned experts on various disciplines of food irradiation were invited to present reviews on various issues of interest to the public. The report is being prepared for publication.

3. Inventories

3.1 Compilation of Data on Recent Position of Test Marketing and Commercialization of Irradiated Foods. Institutions/organizations dealing with food irradiation were requested to furnish the Secretariat with an update of the status on test marketing and commercialization of irradiated foods, starting from 1980. The deadline for the submission of data was 1 June 1988.

3.2 Update on List of Clearances. The updated list of clearances (as of 22 March 1988) was published as a supplement to the Food Irradiation Newsletter, Vol. 12, No. 1 (April 1988).

3.3 An up-to-date inventory of national regulations on food irradiation is being maintained by the Secretariat.

3.4 An inventory/registry of licensed food irradiation facilities is being maintained.

4. Public Information

The video film on food irradiation has been distributed to all experts of the 26 member countries of ICGFI. In addition, a number of institutions were provided with copies of the video. It has been dubbed into French and Spanish.

Communicado Associates Inc., a public relations company in Canada, was contracted to prepare slides on food irradiation for presentation at the Geneva Conference.

5. Other Non-ICGFI Activities

5.1 FAO/IAEA Seminar for the Developing Countries in Africa on Food Irradiation. This seminar was held in Dakar, Senegal on 15-19 February 1988. It was attended by 40 participants from 19

countries, including 15 African countries. ICGFI activities were discussed in the seminar, and ICGFI publications and film were shown to the participants.

5.2 APRIA International Symposium. L' association pour la promotion industrie agriculture (APRIA) held its international symposium entitled "International Status of Food Irradiation" in Aix-en-Provence, France on 22 April 1988. It was held in conjunction with the ICGFI Task Force Meeting on Public Information of Food Irradiation. Approximately 100 representatives from food companies in France attended the symposium. Participants of the Task Force Meeting attended the symposium.

5.3 Food Irradiation Newsletter. The Vol. 12, No. 1 issue of the Newsletter was published in April 1988. The articles included the ICGFI Annual Report (November 1986 - October 1987) and its 1988-89 programme of work.

5.4 FAO/IAEA Research Co-ordination Meeting on the Use of Irradiation as a Quarantine Treatment of Food and Agricultural Commodities. This meeting will be held in Orlando, U.S.A., 23-27 May 1988.

5.5 Regional Training Course for Latin American Countries. This training course will be held in Santiago, Chile from 20 June to 15 July 1988.

5.6 FAO/IAEA Advisory Group Meeting on Commercial Use of Food Irradiation. This meeting will be held in Vienna, 27 June - 1 July 1988.

8. ICGFI/IICA/CCHEN Workshop on the Use of Irradiation as a Plant Quarantine Treatment Method for Latin America and the Caribbean, Santiago, Chile, November 30 to December 4, 1987.

As part of its 1987 programme of activities the ICGFI co-sponsored a Training Workshop on The Use of Irradiation as a Plant Quarantine Treatment Method for Latin America and the Caribbean. This workshop was co-sponsored by the Inter-American Institute for Co-Operation on Agriculture (IICA), and by the Chilean Nuclear Energy Commission as a contribution to ICGFI.

The workshop was officially opened by Col. Victor Aguilera, Executive Director of the Comisión Chilena de Energia Nuclear, who stressed the importance of this workshop in relation to overcoming plant quarantine barriers to trade, and consequently to economic development of the region. The regional significance of this topic was evident in the large number of people present at the opening ceremony, representing a number of governments from the region.

Eleven participants from eight countries in the region attended this intensive one-week workshop, which covered an introduction to plant quarantine problems, food irradiation development and safety, radiation entomology and the efficacy of irradiation as a quarantine treatment, irradiator design and operation, dosimetry, product quality, and quarantine assurance. Participants were given the opportunity to better understand these concepts through practical sessions on radiation entomology, dosimetry and quality assessment of irradiated fresh produce.

At the completion of the workshop the participants completed a quiz, the answers to which indicated that the workshop was successful in providing an introduction to the use of this technology for quarantine purposes. However, before irradiation is introduced on a commercial-scale for this purpose it

will be necessary to provide more in-depth training to plant quarantine officers.

The participants made the following conclusions and recommendations at the final workshop session:

1. Irradiation is a valid plant quarantine treatment method, since it arrests the development of insect pests in such a way that they cease to pose a quarantine risk.

2. It is recommended that quarantine authorities in the region jointly adopt as the criterion for efficacy of irradiation as a quarantine treatment "the inability to perpetuate the insect species at a new location". Using this criterion quarantine security is established by irradiation at the dose which prevents the presence of normal adult insects capable of flight and reproduction.

3. Governments in the region should initiate discussions with plant quarantine authorities in developed countries, with the aim of preparing protocols for the use of irradiation as a plant quarantine treatment method. These protocols should reflect the above criterion for efficacy.

4. The Joint FAO/IAEA Division, in association with the Plant Production and Protection Division of FAO, should encourage all Member States to adopt the above criterion for efficacy of irradiation as a plant quarantine treatment method.

5. Research should be promoted in each country of the region to establish irradiation quarantine treatments appropriate for the specific produce and plant quarantine problems of that country. This research should be co-ordinated by the FAO/IAEA, to avoid duplication of effort and to ensure rapid adoption of the process.

6. In all countries in the region the Atomic Energy Authorities, Ministries of Agriculture and Ministries of Health should work together to promote the use of this technology as a useful plant quarantine treatment which is safe for consumers and generally not detrimental to product quality.

7. The international agencies (FAO, IAEA, IICA, OIRSA, Acta de Cartagena and Cosane) should promote an extended meeting of Directors of Plant Protection from the region with the aims of promoting research and practical utilization of this plant quarantine treatment method. Resources should be directed to establishing pilot- or commercial-scale facilities in each country.

8. In each country in the region the Atomic Energy Authority and the Ministries of Agriculture, Health and Trade should fully participate together in the International Conference on the Acceptance, Control of and Trade in Irradiated Food, to be held in Geneva in December 1988.

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C. Workshop on the Assessment of Economic Feasibility of Food Irradiation Application Rehovot, Israel (24 January - 4 February 1988)

REPORT

FOREWARD

The International Consultative Group on Food Irradiation (ICGFI) has recommended the training of scientists from developing countries in the methods of conducting feasibility studies on the application of food irradiation technology. The major objective of such studies is to facilitate investment by the food industry and business interests in the

commercialization of the food irradiation process. The first Workshop in this field was organized by the International Facility for Food Irradiation Technology (IFFIT), at Wageningen, The Netherlands, from 25 August to 5 September 1986. The Proceedings of this Workshop have been published as "Handbook for Conducting Feasibility Studies" by CH2M HILL for the Albuquerque Operations Office of the U.S. Department of Energy.

Copies of this Handbook were made available to the participants of the Training Workshop on the Assessment of the Economic Feasibility of Food Irradiation Applications. This present Workshop was sponsored by the ICGFI, the Government of Israel through the Ministry for Foreign Affairs' Division for International Co-operation. The Soreq Nuclear Research Center of the Israel Atomic Energy Commission acted as the local organizer, and IFFIT took part in the co-ordination and administrative arrangements of the programme of this Workshop.

INTRODUCTION and SCOPE of the WORKSHOP

The use of irradiation has proved to be technologically feasible for a large number of food products. A food irradiation project is technically feasible if it is able to achieve the desired technological effects. A study of the technical feasibility involves issues such as:

- Main technological useful effects of food irradiation;
- Good irradiation practices with special emphasis on the tolerance dose (maximum dose) and the minimum dose to achieve the useful technological effect;
- Characteristics of the food irradiation treatment;
- Radiation source utilization (efficacy).

Further development of food irradiation depends on the demonstration of the potential economic advantages and benefits accruing from its application. One major barrier to the implementation of food irradiation in developing countries is the lack of valid economic feasibility studies. Feasibility studies are a tool for developing the information necessary to make decisions at management level on whether irradiation is an appropriate technology to solve particular problems in the fields of food preservation, reduction of losses and the assurance of the hygienic quality of food. An assessment of the economic viability of commercial applications of food irradiation must be based on a laborious study of an Investment Plan for a rather well defined production-capacity of a facility at a selected location, which identifies the investment and operation/maintenance costs of such facility yielding the desired production-capacity, and also defines return on investment. A commercial project is thus economically feasible if the benefits resulting from it exceed the costs and there are no cheaper methods available or acceptable for accomplishing similar technological results.

Besides the aforementioned issues of technical and economic feasibilities, any food irradiation project must also pass the test of financial feasibility, which concerns the commitments of funds sufficient to pay for the project construction and operating costs, and the assurance of an adequate rate of return on investment. Finally, a project is Institutionally, Politically and Socially feasible if the required approvals can be secured, such as licensing permits to install the irradiation facility, clearances to irradiate and to market/trade irradiated products, consumers must respond favourable to irradiated foods, and people to staff the irradiation facility can be recruited.

The objective of the Workshop was to train the participants in the art of conducting studies on the economic feasibility of food irradiation applications. The Workshop's programme consisted of lectures covering food technological, technical, economic, financial, and institutional aspects of

feasibility studies. Emphasis was placed on understanding of the principles of the various tests, which need to be evaluated in order to recommend the adoption of the food irradiation technology. The practical part of the Workshop was devoted to the presentation and discussion of Case Studies by some participants.

The List of Participants is attached to this report, Annex 1.

SUMMARY OF THE DISCUSSIONS

Participants and lecturers present at the General Discussion reinstated the remarks and conclusions embodied in the "Handbook for Conducting Feasibility Studies"* with minor amendments. It was felt that the range of capital investment costs should be widened from 1.5 to 4 million US Dollars instead of 2 to 4 as mentioned in the Handbook. Manually operated facilities should be avoided if the handling might damage the commodity. As regards annual throughput the Workshop was of the opinion that quantities smaller than 20,000 tonnes might be feasible for spices or cork-stoppers. It is advisable to consider smaller scale facilities as entry to market. Comparing "in-house" and "centralized service plant" one should take into account the economic trade-off between large central plant and transportation costs savings of decentralized facilities

Besides the benefits and costs of an irradiation project from a private firm's perspective, it is also essential to look at a project from a public viewpoint; the benefits are widespread to consumers, farmers, and others not directly participating in the project. These indirect benefits are often sufficient to warrant assistance in the development of food irradiation technology by local, national, and international public agencies and organizations. The Workshop wishes to emphasize that the amount of money required to conduct a proper feasibility study is relatively low, i.e. 1% of the capital investment, but nevertheless significant, and it might therefore be difficult to raise the money needed for such study in developing countries. So far the Workshop's comments on the "Summary of the Discussions and Conclusions" mentioned in the Handbook.

The CASE STUDIES identified several irradiation projects with good prospects of being feasible. This illustrates the strong potential for world-wide application of the irradiation technology.

The following deficiencies were noted in the presentation of the Case Studies.

In some Case Studies there was not an adequate statement of the purpose of irradiation and the benefits that could be expected from it, nor contained the Case Studies adequate consideration of alternative methods of accomplishing the purpose. Feasibility studies tend to narrow down to an estimation of the throughput, the selection of the type of source that can handle this throughput, and an estimation of the costs of irradiation. A "feasibility study" is basically an optimization process through which the assumptions made and solutions selected are justified. Consequently, alternative technologies must be addressed in order to demonstrate the credibility of the study. Commercial food irradiation projects usually extend beyond the boundaries of the irradiation plant. Therefore, the project should embrace all activities scheduled to take place at the irradiation treatment, conditions of storage, transport, marketing, educational and training needs of operators, management and control aspects of the irradiation treatment. The

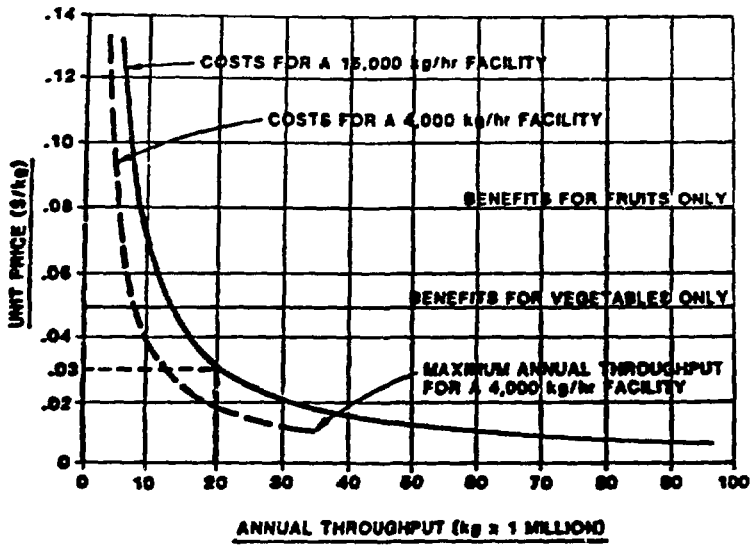
* Proceedings of the Workshop on Economic Feasibility of Food Irradiation Applications, organized by the International Facility for Food Irradiation Technology, Wageningen, The Netherlands; 25 August - 5 September 1986.

main reason for this approach is to force the team, conducting the study, to look at the food and product flow not only during the irradiation process but also during the preceding and succeeding stages of the whole "production-harvest-processing-marketing chain".

Some of the Case Studies did not clearly distinguish between the economic and financial analysis. Economic analysis is conducted to determine the optimal form, size, and throughput of a project. The economic optimum is determined in plan formulation studies on the basis of the principles of marginal analysis. An incremental analysis is conducted with respect to the form, size, and throughput of the project to determine the point where marginal benefits are equal to marginal costs, which is the point where the difference between benefits and costs is maximized. It is not proper to formulate a project on the basis of yearly costs flows. This mixes financial concepts with the economic analysis. The financial analysis is conducted after the optimal project plan has been performed in the economic analysis. One of the objectives of the financial analysis is to arrange a financing program. So the project has suitably timed cash flows. A project nearly always begins with a negative cash flow, because it must be constructed (a cash outflow) before it becomes operational and generates revenues (a cash inflow). This problem can be remedied in preparing the financial plan if the economic analysis demonstrates an adequate internal rate of return (IRR) over the useful life of the facility, in view of the associated risks.

A related concern is whether adequate attention is being given to the "economies of scale" in the Case Study. Engineering cost estimates should be developed for facilities of various design capacity and levels of throughput so the shapes of the cost curves can be analyzed and related to potential throughput and benefits, as demonstrated in the graph below:

FARM BENEFITS & COSTS OF
IRRADIATING FRUITS & VEGETABLES
AT VARIOUS LEVELS OF THROUGHPUT



Presented Case Studies did not always include a Contingency Allowance of at least 15%. This is necessary to provide for unanticipated cost increases and any miscellaneous items not specifically itemized in the cost estimates.

From the discussions held after the various lectures, the presentations of the Case Studies, Status Reports as well as remarks made during the general discussion, the following comments are reported.

The Workshop gave ample attention to the possibility of exporting irradiated products, such as fruits irradiated for quarantine purposes, onions, spices, etc. The possibility of extending the market to other countries should be explored for many food irradiation projects as export sales have to be taken into account in determining plant capacity. For products that have been or are currently being exported the starting point is the collection and evaluation of data related to the quantities exported, unit price, countries to which exports took place, and acceptance of the irradiated products. International trade in irradiated foods hardly exists, mainly because of lack of harmonized regulation between countries. Lack of protocols clearly describing requirements for import as for instance for fruits irradiated for quarantine purpose. A word of caution is necessary as far as exports are concerned. It is more prudent to underestimate rather than overestimate the capacity of the food irradiation plant with respect to the export on foreign markets. The degree of sensitivity to be applied to export market surveys should be greater than in the case of national markets.

A feasibility study has to define the location and site suitable for an industrial irradiation plant. The determination of the location should take into consideration public policies, such as financial incentives offered by local or national investors or by city councils or governmental agencies (financial feasibility), licensing requirements for irradiation sources, basic infrastructure facilities such as transport, availability of electricity, water and communications. The costs for implementing an irradiation facility can considerably increase if construction costs for infrastructure-facilities have to be considered. It is advantageous to locate irradiation facilities near the principal consumption centres if perishable food products or agro-processing is involved. Projects based largely on imported foods need to be located at ports or near terminals.

Irradiation costs tend to increase with smaller maximum/minimum dose ratio requirements. Although food irradiation is a self-regulating process, acceptable limits for the minimum and maximum absorbed doses should be considered from the point of view of efficacy of the source. It is advisable to calculate the Kilo Watt output of the source for the effective minimum dose requirement.

For projects in countries with a high inflation rate, the useful lifetime of the project should be limited to a few years. The main reasons for this approach are that the inflation factor is difficult to predict and to incorporate in the economic analysis of the calculation of the "present worth factor" (Ref. Table 5, page 103 in "Handbook for Conducting Feasibility Studies"), as well as in the "operation/maintenance" costs. Latter costs are, however, very small as compared to the "benefitstream" of the project.

The Workshop was offered Computer models for the economic and financial analysis of an irradiation project. Models were designed to calculate costs, benefits, benefit-cost ratios, net present value, internal rate of return (IRR), and to perform costs flow analysis. The use of these relatively simple computer models permit sensitivity analysis to assess risk by determining how changes in key variables such as throughput and prices would affect the feasibility study conclusions.

Depending on the perspectives, viewed by initiators of food irradiation projects, it can be advantageous to include indirect benefits and indirect

costs in a feasibility study, especially when such projects support infrastructure developments in countries or issues of health improvement of certain groups of the population are involved. In this respect it should be mentioned that the scope of the feasibility study must be defined and clearly understood in order not to omit any essential part and to arrive at an accurate forecast of investment, production costs and cost/benefit stream. The team leader of the feasibility study group should divide the entire study into functional, easily overseeable components as provided in the "Guideline for Implementing a Project in Food Irradiation (Annex 2).

A clear understanding of the problem to which the feasibility study should provide an answer is essential. In setting-up and the conduct of a feasibility study one should consider the kind of information that is required by the initiators, because their perspectives may be different and vary with their responsibilities and involvement. Identification and evaluation of the benefits and of the beneficiaries depend on the view of the various project promoters. Availability of funds (financial feasibility) from investors very much depend on the credibility of the feasibility study. Funds are usually readily available, but there is a large competition between the numerous projects investors can choose.

Implementation of food irradiation applications in developing countries may often require the involvement of governmental agencies. Due to fixed periods of Government administration in some countries the various activities necessary for the implementation of a commercial food irradiation project should start during the first or second year of the new administration.

Irradiation has proved to be technologically feasible for a variety of foods and crops. Several crops are so-called seasonally produced. The availability of products throughout the year is an important prerequisite for an economically viable operation of an irradiation facility. The establishment of small facilities for the irradiation of seasonal products is not efficient from the source-utilization viewpoint. For such facilities one should consider the rent of Co^{60} from a central store as an alternative.

A long period for development of sufficient throughput after construction of the facility has been completed, cannot be tolerated if the project is to be economically feasible. Contracts to assure the necessary throughput should be negotiated before the construction of the facility begins. If such assurances cannot be obtained, it may be advisable to reduce the design capacity of the facility to whatever level is consistent with the anticipated throughputs in the early years of the useful life. A smaller facility with a potential for growth of the throughput may be preferable to a large initial facility with a long period of partially used capacity.

The final step in conducting a feasibility study is to prepare an implementation plan, assuming a techno-economic feasible solution has been determined. A realistic schedule should be drawn up for the various stages of the project implementation, such as negotiations and contracting, project formulation, actual construction and running-in, in terms of time required for each stage as well as the financial consequences.

CONCLUSIONS

Feasibility studies provide a systematic method of determining whether irradiation technology is a suitable treatment for food in a specific application, e.g. commodity, location.

For an irradiation project to be feasible, it must pass five tests: technical, economic, financial, social and political feasibilities.

Feasibility studies of food irradiation application require participation of different qualified professionals, e.g. technologists, economists,

engineers, social scientists and policymakers, in order to adjust the different variables involved in such studies.

Throughput is one of the most important variables to consider in formulating and evaluating an irradiation project. Careful attention must be given to developing a reliable projection of throughput.

The benefits and costs of an irradiation project from a private firm's perspective include the direct revenues and costs anticipated over the useful life of the facilities. From a public viewpoint, the benefits are widespred to consumers, farmers, and others not directly participating in the project. These indirect benefits are often sufficient to warrant assistance in the development of irradiation technology by local, national, and international public agencies and organizations.

A sensitivity analysis should be conducted as part of a feasibility study to assess risk by determining how changes in key variables, such as throughput and prices, would affect the study conclusions.

Although irradiation treatment appears to be economically feasible as a disinfestation method to meet quarantine measures, for the time being its implementation in Latin American countries, which are exporting several commodities to the U.S.A does not seem feasible because of the extensive requirements of the U.S. Department of Agriculture regarding demonstration of the disinfestation of all possible fruit flies.

Economic feasibility of food irradiation facilities require the solicitation of a combination of products to guarantee their optimal utilization.

Proper implementation of an economically viable food irradiation project requires the existance of an adequate infrastructure and competent personnel to operate the facility.

The amount of money required to conduct a proper feasibility study is relatively low in comparison to the advantages it can provide e.g. savings in design and construction costs.

Irradiation appears to have a wide range of practical applications. However, it is not a panacea and alternatives must be thoroughly investigated to make sure the best solution is selected to solve certain preservation problems in food.

RECOMMENDATIONS

Consumer acceptance is an important consideration in determining the level of throughput and the feasibility of an irradiation project. Therefore, it is recommended to carry out more reliable research on consumer acceptance of irradiated foods, and to strengthen this type of research, particularly, in large market areas such as the United States of America, the European Common Market and Japan.

Institutional iasues, such as government ragulations, are presently another serious constraint on the adoption of food irradiation technology. Much more attention should be given to demonstrate the technical effects of irradiation and the potential benefits to society to claar these constraints. A lack of effort in making available to the public scholarly credible information on the benefits of irradiating food probably accounts in large part for the limited support provided by the governments of most countries, in terms of either financing food irradiation projects or streamlining the government approval process.

Adequate attention should be given to "economies of scale" in Case Studies on food irradiation feasibility. If the most optimal throughput cannot be assured, the design capacity must be reduced to the level consistent with anticipated throughputs, i.e. a staged construction is therefore recommended with possible expansion later as markets develop.

Because of the complexity of food irradiation projects co-operation of public and private institutions and organizations is needed to achieve positive results in the shortest time possible.

Economic feasibility studies of food irradiation applications should include the option of electron-accelerators, because of certain technical and psychological advantages. Workshops on the evaluation of their proper use and economics should be organized.

To enhance the economic feasibility of food irradiation facilities Workshops should be organized on applications oriented at the reduction of post-harvest losses in food, which may result in larger quantities of products to be irradiated, and consequently improve the economics of planned facilities by increasing the potential throughputs. Because of the high initial investment, one should not rely solely on national investors but solicits assistance from international organizations.

Implementation of commercial applications largely depend on the acceptance of irradiated foods in international trade. Developed countries are encouraged to accept and to define clear conditions for import of irradiated foods, in particular, radiation disinfested commodities (fruits and spices) and seafoods irradiated to ensure their hygienic quality.

The following scheme for the development of food irradiation is recommended:

- demonstration of the technical feasibility (pilot-scale studies);
- realization of internal consumer acceptance and market testing;
- formation of a multi-disciplinary group responsible for the determination of the necessary parameters involved in an assessment of the feasibility of food irradiation applications;
- definition of internal and external markets for irradiated commodities and their qualification;
- conduct of the economic feasibility study.

ANNEX 1

Participants

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ANNEX 2

Guideline for Implementing a Project on Food Irradiation
(Technological and Economic Consideration)

Feasibility studies are a tool for developing the information necessary to make management decisions on whether irradiation is the appropriate technology to solve particular problems in the field of food preservation. A clear understanding of the study objectives is essential. There are many questions to be answered in determining the feasibility of a specific irradiation project. This Guideline provides a basis for making a sound implementation plan for a Food Irradiation Project.

1. Commodity related information

Name of food product (for agricultural crops also variety, species).

Total production of crop/food (Annual data for at least 5 years).

Production of crop/food (Geographical/regional distribution).

Production of crop on small or large farms (Yiele per acre/ha).

Climate at time of harvest (Temperature range, humidity, rainfall).

Storage of crop at farm and/or local or central storage and packing facilities.

Availability of the food product/crop (seasonal or year round).

Production/hr, or day of processed product (catch of fishery products, poultry processing plant, etc.)

2. Storage and distribution related information

Storage of crop at farm (Estimated losses by months).

Storage of crop at local or central facilities (Estimated losses).

Problems with storage (Pre-processing and post-processing)

Availability of central packing facilities (Capacity).

Involvement of intermediary traders.

Destination of the food product/crop (Auction, wholesale/retail markets).

Distance, time and mode of transportation.

Is transportation readily available (Problems).

Transportation costs (Approximate costs/ton/km).

Are organized wholesale markets available (Where in the region).

3. Food Technology and Radiation Processing related information

Type of spoilage to be controlled or eliminated (Sprouting, decay by micro-organisms, product quality deterioration by parasites, insects, senescence, ripening).

Handling method for product (Pre-and post treatments).

How long can the product be held at ambient temperature/humidity (degrees and relative humidity) without damage or significant reduction of self-life.

What is the water-activity of the product (a_w).

Temperature requirements during storage, before and after irradiation.

Purpose of irradiation treatment.

Minimum dose estimated to achieve the objective of the irradiation treatment.

Maximum dose, the product is estimated to tolerate without adverse effects.

Required dose uniformity within the package.

Packaging requirements (Availability of packaging materials).

Treatment unit (Package, pallet, stored in bins for bulk products).

Physical characteristics of packages (Sizes, weight).

Irradiation conditions (Temperature of product, atmosphere).

How can the product be delivered to the irradiation facility (mode of transportation, palletized or not, and in what time frame).

Seasonality and frequency of deliveries.

Supply to irradiation facility (tons/hr, day).

Upon arrival at the irradiation facility, can the product be stored/held before irradiation or must it be irradiated immediately. (Conditions, if storage is possible).

After irradiation, the product can be stored/held on the irradiator's site, if so, what conditions for storage, and how long.

Are the packaging materials suitable for irradiation treatment at doses required.

Can the packaging material prevent re-contamination (by micro-organisms, insects) of the irradiated product.

4. Marketing and economy of irradiator-operation related information

Price data (Farm price, price of food product after processing seasonal price changes, wholesale and retail prices).

Value of losses of crop/food product (per season, annually or in the market/distribution chain).

Market volume potential for the irradiated product (Domestic export).

Estimated time to develop market for irradiated product.

Are there any other products produced in the same geographic area, eligible for irradiation treatment (Quantity, dose required, type of package involved).

Estimate of product quantities likely to be irradiated in the 1st, 2nd, 3rd, 4th and 5th year of the operation of the irradiation facility.

How much of additional product cost/kg are local producers (or customers) willing to bear for the irradiation treatment versus benefits offered through irradiation.

5. Data on site selection and type of Irradiator

Are there suggested locations for an irradiation facility.

For a potential site, are electricity and fresh water available and can they be reliably supplied. What are the costs of electricity and water.

Soil and water table conditions should be investigated in relation to the construction of shielding of the irradiator.

Costs of the land for a selected site.

Type of irradiation facility to be considered (Radionuclide source or accelerator).

Purpose of the irradiation facility (Pilot-plant, Demonstration-plant, Batch, manually operated plant, Automatic plant, Commodity-based irradiator, Multi-purpose irradiator, Irradiator can also be an additional link in the stream of products through the processing line.

Contract irradiator or "in house" facility of a food processing plant or distribution/marketing centre.

6. Cost Factors of an Irradiation Facility

Capital Costs

Calculation of the costs of Investment in the Source, the Buildings, and the Equipment that are needed to operate the facility.

Annual Operating Costs

Calculation of Operational costs, which include:

Manpower required to operate the irradiation source and to perform the control of the irradiation process (inclusive dosimetry).

Costs of repair, maintenance, spare parts replacement.

Costs of source replenishment (in case of radionuclide facility).

Material handling costs.

Interests on investment capital.

Depreciation costs for the source, building and equipment.

Costs of taxes and insurances.

Unit Processing Cost

The Unit Processing cost is arrived at by dividing the Annual Operating Cost by Annual Throughput.

7. Data of Institutional Issues

Is there a regulation on food irradiation ?. (present or expected status).

Is there a regulation for licensing food irradiation facilities ?.

Which industry and government organizations are currently or intend to be involved with food irradiation ?. What support can they provide ?.

What is the attitude of responsible authorities with regard to legislation in food irradiation, and consumer opinion on irradiated food.

Would there be any difficulty in getting people to staff an irradiation facility for 24 hours per day, and 7 days per week operation ?.

Does appropriate infrastructure exist to implement a food irradiation facility, and what kind of technical assistance is required.

Would the country allow import of irradiated foods.

FAO/IAEA/WHO/ITC-UNCTAD/GATT
International Conference on the Acceptance, Control of, and Trade in Irradiated Food

12 - 16 December 1988

Geneva, Switzerland

INFORMATION SHEET

1. Introduction

The recent increasing interest in the practical application of food irradiation shown by national authorities and food industries has resulted in wider acceptance of this technology and the promulgation of appropriate regulations by many national public health authorities. With the consequent increase in commercial activity, international trade in many irradiated food items can also be expected to increase. This has prompted the Food and Agriculture Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA), the World Health Organization (WHO), and the International Trade Centre UNCTAD/GATT to jointly convene an International Conference on the "Acceptance, Control of, and Trade in Irradiated Food" in December 1988.

The Conference will aim at establishing an internationally agreed document, for the acceptance and control of international trade in irradiated food among the Member States of these sponsoring organizations. It will therefore assess the impact of irradiation technology on international trade in food, and on reducing the incidence of food-borne diseases and widespread post-harvest losses in food and agricultural products.

2. Current and Projected Activity in Food Irradiation

2.1 Wholesomeness of and Legislation on Irradiated Food

A Joint FAO/IAEA/WHO Expert Committee on the Wholesomeness of Irradiated Food (JECFI) concluded in 1980 that any food commodity treated up to an overall average dose of 10kGy (kiloGray) causes no toxicological hazard and hence, toxicological testing of food so treated is no longer required. JECFI also considered that the irradiation of food up to an overall average dose of 10kGy introduced no special nutritional or microbiological problems, but emphasized that attention should be given to the significance of any changes in relation to each particular irradiated food and to its role in the diet. With the conclusions of JECFI, the wholesomeness of irradiated food up to this maximum absorbed dose of 10kGy had been clearly established.

The Joint FAO/WHO Codex Alimentarius Commission, in 1983, was presented with these conclusions of JECFI and declared itself

satisfied with regard to the safety of food irradiation up to an overall average dose of 10 kGy, and adopted the Codex General Standard for Irradiated Food and the Recommended International Code of Practice for the Operation of Radiation Facilities for the Treatment of Food.

So far, 32 countries have approved over 40 irradiated food items for consumption, either on an unconditional or a restricted basis. A number of countries including Bangladesh, Israel, Thailand, United States of America and Yugoslavia have approved the use of irradiation of several major food items treated up to certain doses. It is expected that a number of other countries will follow this process, in line with the Codex recommendation; this is already being considered in Australia, Canada, Chile, Denmark, U.K. and Venezuela.

In addition, a number of governments, including those of Denmark, France and the U.K., have published reports of their own findings on the wholesomeness of irradiated food; these are in general agreement with the conclusions of the JECFI.

2.2 Concerns with Certain Chemicals in Food

Increasing concern with the safety of certain chemical agents, used for decontamination and disinfestation of food, has motivated a number of countries to either restrict or even ban their use. Several Western countries have restricted or prohibited the use of ethylene oxide (ETO), for decontamination of spices and other dry (or dried) food ingredients. In addition, the U.S. Environmental Protection Agency (EPA) has recently banned the use of an effective fumigant, ethylene dibromide (EDB), for insect disinfestation of fruits and vegetables, cereals, pulses and nuts, owing to its suspected carcinogenicity. Similar chemical fumigants, such as methyl bromide, are also suspect and are currently being closely studied.

Thus, there is an urgent need to introduce an alternative treatment to maintain international trade in various food commodities. Such an alternative should not only be effective, but also be residue-free and widely applicable to most commodities. Among the available alternatives, irradiation appears the most viable, since it can satisfy most of the demands for all these fumigants.

2.3 Current Industrial and Commercial Activity

At present, 18 countries have reported commercial activities in food irradiation. In addition, approximately 30 industrial (single or multi-purpose, i.e. food and medical products) irradiators are under construction, or are in an advanced stage of planning, in 17 countries. Thus it is expected, that at least 25 countries will be processing food by irradiation on an industrial/commercial scale by 1990.

The quantity of food currently treated varies from country to country according to market demand and technological or economic

incentives. Spices, vegetable seasonings, and aromatic herbs are most commonly irradiated, to preserve hygienic quality, in the following 14 countries:

Belgium, Brazil, Chile, Denmark, Finland, France, Hungary, Israel, Republic of Korea, the Netherlands, Norway, South Africa, U.S.A. and Yugoslavia.

These foods are usually treated in multi-purpose industrial facilities constructed initially for radiation sterilization of medical, pharmaceutical and biological products, which has preceded commercial food irradiation by 20-25 years. A total of 140 facilities throughout the world are devoted, at least in part, to these industrial applications.

2.4 Expected Future Commercial Developments of Food Irradiation

In order to assist Member States in the proper evaluation and application of food irradiation technologies, an "International Consultative Group on Food Irradiation" (ICGFI) was established under the aegis of FAO, IAEA and WHO in May 1984. The major objectives of the ICGFI are to evaluate global developments in the field of food irradiation, and to provide a focal point of advice on the application of food irradiation to Member States and Organizations. At present, 26 Governments are members of the ICGFI and are contributing either in cash or in kind towards its activities. ICGFI has assigned the highest priority in its programme of work to the promotion of international trade in irradiated foods and on public information on food irradiation.

A Task Force Meeting on the Use of Irradiation to Ensure Hygienic Quality of Food, convened by ICGFI in Vienna in July 1986, concluded that at present, and in the foreseeable future, no technology is available to produce raw food of animal origin, particularly poultry and pork, in which the absence of certain pathogenic micro-organisms and parasites such as Salmonella, Campylobacter, Toxoplasma, and Trichinella can be guaranteed. These foods pose a significant threat to public health. Where such foods are important in the epidemiology of food-borne diseases, irradiation decontamination/disinfection must be seriously considered. This could motivate a number of national authorities to seriously consider the use of irradiation as a terminal treatment of certain foods of animal origin to significantly reduce food-borne diseases.

On a national level, organizations have been formed in some countries to assist the food industry. In France, a club of supporters of food irradiation has been formed by industrial, commercial and public organizations aimed at accelerating the adoption of this technology on an industrial scale. In the USA, the "Coalition for Food Irradiation" was established by trade associations and food companies, to educate the general public on the safety and wholesomeness of irradiated food. Professional societies including the American Medical Association, the Institute of Food Technologists, the American Council of Science and Health, and the Council of Agricultural Sciences and Technology have endorsed the safety and wholesomeness of irradiated food.

A number of developing countries, notably in Latin America and Southeast Asia, which are exporting or could export large quantities of fresh fruits and vegetables are considering the introduction of irradiation technology, for disinfestation of these foods for quarantine purposes and for decontaminating/disinfesting a number of products such as spices and frozen seafood.

3. Purpose of the International Conference

The introduction into world trade of irradiated food has been difficult because unlike other physical processes such as freezing, pasteurization, canning, drying, etc., irradiation does not leave a trace of its effects in observable physical characteristics of the product. Nor does it, like chemical processes, leave perceptible residues in the food. This introduces a need for new concepts for use in controlling products shipped from one country to another.

The association of the process, in the minds of an uninformed public, with the ill effects of direct exposure of human beings to the same physical energy or electron fields, or to contamination of food with radioisotopes from radioactive fallout, tends to create a consumer acceptance problem, particularly where foods are marketed outside the country of origin.

There is therefore a need to develop and formulate an internationally integrated approach towards the application, regulation, control and acceptance of food irradiation by respective national authorities, industries and the food trade. The time to develop such an approach is during the early stages of commercial application of this technology.

4. Participation

Member States should designate experts in various disciplines involving legislation, health, food production and control, trade, public acceptance aspects of food irradiation, and representatives of food trade associations, including experts at the senior policy making level who have authority to speak on behalf of their governments, to attend the Conference. This will ensure proper representation of the differing, though complementary interests of exporting and importing countries, and may lead to the adoption of an internationally agreed document for the acceptance and control of trade in irradiated food.

All persons wishing to participate in the meeting are requested to complete a Participation Form (Annex A) and send it as soon as possible through official channels to the Joint Secretariat. A participant will be accepted only if the Participation Form is transmitted through the government of a Member State of the sponsoring organizations or by an organization invited to participate.

Participants whose designations have been received by the Joint Secretariat will be notified directly two to three months before the meeting.

5. Visas

Designated participants who require a visa to enter Switzerland should submit the necessary application to the nearest diplomatic or consular representative of Switzerland as soon as possible, and in no case later than 2 November 1988.

The costs for the organization of the meeting are borne by the Joint Secretariat. No registration fee is charged to participants.

6. Working languages

Working languages of the meeting will be English, French, Russian and Spanish.

Simultaneous interpretation may be provided between all the working languages if six weeks before the meeting it is seen from the Participation Forms received that these are required.

7. Accommodation

Detailed information on accommodation and other items will be sent direct to all designated participants well in advance of the meeting.

8. Secretariat

The address of the Joint Secretariat is:

Joint FAO/IAEA Division
IAEA-CN-52
Vienna International Centre
P.O. Box 100
A-1400 Vienna
Austria

Telephone No.:	Austria - 222 - 2360(0)
Telex No.:	1-12645
Telefax No.:	43 222 230184
Cable address:	INATOM VIENNA

The Scientific Secretariat of the Conference is composed of:

Mr. P. Loaharanu, IAEA, Vienna (Tel. 2360/ex.1637);
Mr. M. Satin, FAO, Rome (Tel. 57951);
Dr. F. Käferstein, WHO, Geneva (Tel. 913535);
Mr. B. Olsen, ITC-UNCTAD/GATT, Geneva (Tel. 346061).

Conference Organization is provided by Ms. Adriana Sokol, Conference Service Section, IAEA, Division of External Relations (Vienna 222/2360/1317).

ANNEX A

IAEA-CN-52

FAO/IAEA/WHO/ITC-UNCTAD/GATT
International Conference on the Acceptance, Control of, and Trade in Irradiated Food

International Conference Centre, Geneva, Switzerland, 12-16 December 1988

To be sent through official channels to the Joint Secretariat of the Conference:

Joint FAO/IAEA Division
IAEA-CN-52
Vienna International Centre
P.O. Box 100
A-1400 Vienna
Austria

PARTICIPATION FORM

Family name	All initials of given names	Title:	Mr Ms
Institution	Full address		
Present position:	For urgent communications please indicate Telefax No Cable address Telex No		
Nationality	Designating government or organization		
Mailing address (if different from address of institution)			
Date of departure from mailing address			

Indicate below in which of the meeting languages you are able to follow the proceedings of the meeting and in which language(s) you can express yourself:

Language	English	French	Russian	Spanish
Speaking				
Understanding				

Authorized to speak on behalf of his/her government: YES ☐ NO ☐

ANNEX B

1988-03-29

FAO/IAEA/WHO/ITC-UNCTAD/GATT
INTERNATIONAL CONFERENCE ON THE ACCEPTANCE, CONTROL OF AND TRADE IN IRRADIATED FOOD

12-16 December 1988
Geneva, Switzerland

DRAFT PROVISIONAL AGENDA

Monday, 12 December 1988

Opening (Statements by Directors-General/Executive Director of the Sponsoring Organizations)

Election of Chairman and Vice-Chairmen
Appointment of Working Groups' Members

Video/slide presentation

Keynote Paper: Safety and Wholesomeness of Irradiated Foods

Keynote Paper: Food Irradiation - A Contribution to Public Health

Keynote Paper: Food Irradiation - A Contribution to Food Security

Keynote Paper: Food Irradiation - A Contribution to International Food Trade

Tuesday, 13 December

Keynote Paper: Regulations and Controls of Food Irradiation Process

Keynote Paper: Food Industry's Views on Acceptance of Irradiated Foods

Keynote Paper: Consumer Views on Acceptance of Irradiated Foods

Concurrent Sessions of Working Groups

I. Acceptance by consumers, government and industry
II. Regulatory control of the food irradiation process
III. Control of international trade in irradiated food
IV. Role of irradiation in ensuring food safety and security

Government's designated experts are expected to play active roles in the deliberation of these working groups to ensure that the objectives of the Conference are met.

Wednesday, 14 December

Concurrent sessions of Working Groups (continue)

Thursday, 15 December

Plenary: Reports of Working Groups and Preparation of Draft Internationally Agreed Document

Plenary: Consideration of Draft Internationally Agreed Document by the Bureau (Chairmen + Rapporteurs of Working Groups)

Friday, 16 December

Plenary: Discussion of Working Groups reports and Adoption of Internationally Agreed Document

Closing

FAO/IAEA Seminar for Developing Countries of Africa
on Food Irradiation

Dakar, Senegal
15 - 19 February, 1988

Introduction

The amount of post-harvest losses of food is considered to be highest on the African continent. As a result, increasing numbers of countries in Africa are suffering from problems of hunger and malnutrition, which range from chronic to acute. Food irradiation could play an important role in reducing the high rate of food losses especially in the case of food grain, root crops and dried food in this continent provided that proper infrastructure to employ this technique could be identified. Irradiation could contribute positively to the safety of food from microbiological and parasitic infection.

Food irradiation is a physical process which has been found most appropriate in preserving many food items. Since the Codex Alimentarius Commission in 1983 adopted the recommendations of the Joint FAO/IAEA/WHO Expert Committee which in 1980 stated that irradiation of any food commodity up to an overall dose of 10 kGy causes no toxicological hazards, into its Recommended General Standard for Irradiated Foods together with the Recommended Code of Practice for the Operation of Radiation Facilities used for the treatment of foods, research and development activities in food irradiation has been strengthened. As a result 35 countries have given clearance of over 40 different food items. Twenty countries are commercially treating foods by 31 irradiators. It is expected that by 1990 a minimum of 25 countries will be using 55 commercial demonstration irradiators for treating foods on practical scale. This processing technology has generated great interest among the developing countries of Asia, Latin America and also Europe and the Middle East.

The interest in applying food irradiation as a method to reduce food losses is being seriously considered by several African countries. At the request of a number of Governments in Africa, two experts missions were sent in March-April, 1986 to evaluate the need, infrastructure and priority areas of research and development on food irradiation in eight countries in the region. The mission recommended that a regional co-ordinated programme on food irradiation be established with special emphasis on training, research, technology transfer, legislation, expert services and equipment to serve the needs of countries in the region in their consideration of these recommendations on the proposed regional co-operative project with a view to keeping to reduce food losses and increasing food availability to the population in the region, it was considered timely to convene a regional seminar in this field to inform leading scientists, government officials and industry representative in Africa on the safety, applications and benefits of food irradiation. Participants were selected from among senior scientists working in food preservation, senior government officials working in ministries concerned with food, agriculture, public health, industry and commerce as well as those representing enterprises interested utilizing this process.

The Seminar took place at the Salle de Conférence of the Ministry of Foreign Affairs, Dakar, in co-operation with the African Regional Centre of Technology, Dakar, Senegal. There were 40 participants from 14 African countries including invited speakers and observers from Canada, Egypt, France, Israel, Nigeria and USA, and also of the representatives from FAO/IAEA and the African Regional Centre of Technology.

A large number of papers (42) were presented at the Seminar by African participants as well as invited speakers. Eight technical sessions covering different practical aspects of food irradiation were convened as follows:

Session I Radiation Disinfestation of Food and Agricultural Products.
Chairman: J. Laizier

Session II Irradiation as a Method of Reducing Food Losses.
Chairperson: T. Roberts

Session III Food Irradiators and Irradiation Technology for Processing of Foods.
Chairman: H.M. Roushdy

Session IV Economic Feasibility of Food Irradiation.
Chairman: M. Sahasrabudhe

Session V Regulatory and Public Health Aspects of Food Irradiation.
Chairmen: J. Laizier, M. Shahasrabudhe

Session VI Commercialization and Technology Transfer of Food Irradiation.
Chairman: A.O. Olorunda

Session VII Consumer Acceptance and Public Information Aspects on Food Irradiation.
Chairman: D.B. Thomas

Session VIII Panel Discussions, and Seminar Conclusions and Recommendations.
Chairman: H.M. Roushdy

Rapporteurs of scientific sessions: V. Appiah; O. Kane; B.E. Chishya

The summary of the presentation of the papers is given as under:

(a) Basic aspects on radiobiology was introduced to the participants. Characteristics of photons, electrons, accelerated electrons and gamma-rays in relation to their penetrability to biological materials were explained. Radiation effects on biological systems were explained with particular reference to food irradiation. It was mentioned that irradiation is a physical process which disinfests fresh fruits and vegetables and dried products like grains, nuts and dried fish, retards physiological processes like sprouting in roots, tubers and bulbs and decontaminate meat, fish and spices from spoilage and pathogenic microorganisms. Due to these effects, irradiation could be used in checking post-harvest loss and ensuring adequate and safe supply of foods to consumers.

(b) It was reported that production loss of grains in tropical countries is in the order of 40% due to infestation of rodents, insects and microorganisms. Insects are mainly responsible for the loss of dried foods in storage. Pesticides which are traditionally being used to combat insects are getting ineffective due to development of resistance in certain groups of stored product insects. Besides these chemicals are not totally effective due to poor penetrability; they leave toxic residues to food products and the application of the process is time consuming. Irradiation was advocated as an alternative process to pesticide application. A number of papers reported on the problems of infestation by insects in storage and prospects and achievements in a number of products in African countries with special reference to cereals, pulses and cocoa beans. Quality evaluation of disinfested and disinfected products from insects and moulds respectively showed that irradiated products were wholesome. Post harvest loss of grains due to

insects varies between 10 to 100%; a significant quality of which could be checked by irradiation. Irradiation has also been shown to be advantageous over the treatment of grains with chemicals.

(c) The African participants mentioned post-harvest losses of foods in their countries and the possible beneficial effects of irradiation in reducing these losses. Several important products were mentioned such as yams, potatoes and onions. These products face high post-harvest losses. Yams faces a storage loss of over 50% in six months. This could be averted with a low dose of radiation which could inhibit sprouting and retain organoleptic qualities. Similar results were obtained with potatoes and onions. Research and developmental activities in the regional laboratories have already shown that irradiation has potential to check sprouting of these products and reduce subsequent losses in storage.

(d) Some papers were presented on economic feasibility of food irradiation in Africa. It was reported that several post harvest techniques in checking post harvest food loss in Africa are being tried to solve the overall food supply situation. Irradiation is one of the methods which is showing some potential; and in some countries in Africa it has been demonstrated in small scale studies a promising method for preservation of yams, onions and potatoes by inhibition of sprouting, and grains and fishery products by disinfesting and decontaminating from insects and microorganisms respectively. Establishment of irradiation facility is capital intensive. Therefore, careful studies are needed to assess the cost benefit of irradiation processing of foods. The available infra structure such as manpower, supplies and utilities also needs careful consideration. Careful specific economic feasibility studies would indicate whether irradiation or some alternate method would be appropriate to introduce commercially in reducing post harvest loss of foods.

(e) The public health aspects of food irradiation were reviewed by a number of participants. It was pointed out that food-borne diseases are a plague both in developed and particularly in developing countries, where climatic conditions as well as the lack of adequate reliable refrigeration facilities considerably aggravate this public health hazard originating from contaminated foods of animal origin as well as of contaminated water. Irradiation could also be used for decontaminating meat and fish from pathogenic microorganisms and parasites.

(f) Food regulations in different countries were reviewed with special reference to the actions and results of the Joint FAO/IAEA/WHO Expert Committee on Food Irradiation that accelerated the process of clearances in many countries and also were the basis of the formulation and adoption by the Codex Alimentarius Commission of the Codex General Standard for Irradiated Food and the Recommended International Code of Practice for the Operation of Irradiation Facilities. It was reported that there was practically little legislation on food irradiation in African countries. As there is a need for this technology to reduce considerable post harvest losses and certain food borne pathogenic diseases and to assume a significant step towards attainment of self-sufficiency and security in food supply, this technology desarves special attention.

(g) Action to be taken on consumer acceptance and public information was dealt with in detail. The propar way to conduct market testing and consumers acceptance studies was demonstration by a number of participants who converged into certain effective procedures which gave more than satisfactory results. These were centered on effacting the consumers acceptance poll in actual market tests with irradiated products, adjacent to the non irradiated products and on the use of effective attractive pictorial and colour schemes. The more effective

public information media in the region seemed to be television in the urban areas, radio in rural areas and press in some areas. Finally the commercialization and technology transfer aspects of food irradiation were reviewed both from global and local (Canada, Algeria, Cote d'Ivoire, Japan, U.S.A.) aspects followed by discussions on strategies in Europe, North America and the rest of the World.

A panel of experts participated at the round table discussion to assess the potential application of the technology in Africa. It was recognized that post-harvest losses of foods due to various causes is very high in African continent. To attain self-sufficiency in foods, a suitable method is needed to reduce post harvest losses. The presentation in the Seminar on different aspects of food irradiation processing was considered and the following conclusions and recommendations were made:

CONCLUSIONS

1. It was agreed that post-harvest loss of foods in Africa is a serious problem. Irradiation can reduce some of these post-harvest losses. Some of the items for which technical feasibility has been established for food irradiation preservation include yams, onions, potatoes, maize, millet, sorghum, cowpeas and other pulses, cocoa beans, spices (pepper) and condiments, meat and poultry, fish and fishery products, animal feed, etc.

2. In order to assess the nature and magnitude of losses, the present post-harvest handling of food items must be taken into consideratioin and analyzed. Thereafter conventional proper handling techniques to reduce food losses should be considered prior to or in parallel with the consideration of food irradiation processing in each country.

3. Specific needs of each country/region should be looked into in order to determine priority areas and the possibility of inter-regional/international co-operation for R&D in the application of food irradiation technology. Research results already achieved by other countries, but particularly those in the region, may be applied to make best use of collective experience. Such action has been successful in Asian countries for the past thirteen years. Additional research specific to some local products may need to be performed to supplement existing data. This research may be performed locally or in regional "Centres of Excellence".

4. A project should be undertaken only if irradiation provides a better technical and economic solution to a need than other technologies and is supported by public health approval so that the application of the technology has the possibility of success.

5. In considering the local demand, a suitable choice of the type and size of the facility should be made. The design should allow up-grading in both size and automated operation to meet future expansion of the existing facility, but small commercial scale facilities, of low cost, should be considered to start with.

6. Whatever type of equipment chosen, (whether Gamma or Electron Beam) safety, reliability, maintainability, and simplicity of operation should be of major consideration.

7. It is recognized that for a project to be concluded on a reasonable schedule, technology transfer and training should be incorporated into the complete package. In addition back-up technical infrastructure in the country should be strengthened.

8. Food borne disease is a significant problem in many African countries. Some causes are contaminated food of animal origin as well as contaminated water. The problem is aggravated by the lack of adequate and reliable refrigeration and by hot and humid climate. Radiation decontamination could be usefully applied to reduce the problem caused by contaminated meat and fish products coupled with protective packaging.

9. There are practically very few countries in Africa which have cleared irradiated food. African countries might consider adoption of the Codex General Standard for Irradiated Foods and Recommended International Code of Practice for the Operation of Irradiation Facilities used for the Treatment of Foods, which supply a proper, internationally recognized base line.

10. Consumer acceptance studies performed with irradiated products appear to be the most appropriate way to poll consumer attitudes. Slight modifications, taking into account the local target population and its socio-economic condition could be applied.

11. Familiarization of Senior Government Officials to the benefits of Food Irradiation, as regards attainment of self-sufficiency of safe and secure Food supplies in Africa, appears to be the most urgent measure to be adopted in order to promote interest in and acceptance of this technology.

12. National Governments should initiate policies that will lead to improvements in the post-harvest marketing systems of the major staple foods. Such policies among others should include: 1) price efficiency inducing to consumer direction by improving market information and establishing consumer grades and standards, 2) structural policies designed to modify the behavior of the middle man to improve market performance through establishment of co-operatives, 3) system analysis and specification of marketing procedure to determine costs, returns, and economy of scale, and 4) clear policies to strengthen existing infrastructure, e.g. roads, storage facilities, etc. These measures are necessary to improve the efficiency of post-harvest systems.

Coordinated Research Programme on Food Irradiation for African Countries

1. Title

Co-ordinated Research Programme on the Application of Irradiation Technique for Food Processing in Africa.

2. Scientific Background

Agriculture dominates the economy of African countries as 80% of the people are directly dependent on it. In spite of efforts made by many national and international organizations, the shortage in food supply ranges from chronic to acute. Post-harvest losses are one of the fundamental causes of the shortage of food supply. This directly affects the nutritional status of the growing population of the continent. Cereals, legumes, roots and tubers and fishery and fishery products constitute the dietary requirements of the people. Due to lack of proper post harvest handling, food faces considerable losses in storage, transportation and marketing. The climatic nature of the continent allows rapid growth of fungi, bacteria, insects and other spoiling agents. As a result huge quantities are lost due to these causes. Table I shows the estimated food losses in Africa.

Research and development work leading to the application of suitable method/methods is/are considered essential to control pest-menace in checking the loss of foods. In recent years irradiation processing of foods has shown

Table I. Reported Losses in Staple Foods

Stable foods	Range of losses %
Roots and Tubers	
Cassava	20-60
Yams	15-60
Potatoes	8-95
Cereals	
Maize	10-30
Sorghum	5-40
Millet	10-50
Rice	6-24
Plantains and Bananas	35-100
Fish	
Fresh	20-50
Dried	20-35
Fruits	
Citrus	20-95
Pineapple	20-70
Mango	20-50
Papaya	40-100
Avocados	43
Vegetables	
Tomatoes	20-50
Onions	16
Pepper	15
Lettuce	62
Cauliflower	49
Cabbage	37
Carrots	44

B. Chinsman, Food Irradiation Development in Africa, in Food Irradiation Processing, Proceedings of a Symposium, Washington, D.C., 4-8 March 1985. STI/PUB/695, IAEA, Vienna, Austria.

bright prospects in alleviating post harvest losses in many foods. Low doses of radiation retard the physiological processes such as sprouting in tubers and bulbs and ripening in fruits and vegetables, decontaminate or lower the growth of microorganisms in meat, fish and spices, dry foods and fruits and disinfest dry foods and fruits from the damages of insect pest, thereby reducing post-harvest losses. Therefore, irradiation can play an important role in reducing high rate of food losses in African countries especially ir the cases of food grains, root crops, dried foods and some vegetables and fruits. Irradiation will also contribute positively to the safety of the available food from microbiological and parasitic infections. A need therefore remains to look into the proper perspective such as to conduct necessary research and development works and to identify proper infrastructure prior to application of this new technology. Since many African countries have shown keen interest in embarking on food irradiation, the present CRP has been proposed, the implementation of which will improve the food supply in African countries by checking post harvest loss and will earn economic benefits to the participating nations.

3. Scientific Scope and Proposed Programme Goals

The main objective of this programme is to investigate and assess the role of irradiation as a method of reducing post-harvest food losses of some crops e.g. bulbs and tubers, food grains and dried foods of the region. To attain this objective, the following research areas have been identified:

(i) to evaluate and strengthen research activities where food irradiation can play an important role;
(ii) to assist in conducting techno-economic feasibility studies in selecting countries which have potentials for practical application of food irradiation processing, and
(iii) to provide data on radiation preservation of selected foods to local industries.

4. Anticipated Collaborating Institutes

Institutions in the following countries have expressed interest to collaborate: Algeria, Cameroon, Côte d'Ivoire, Egypt, Ghana, Kenya, Libya, Morocco, Niger, Nigeria, Senegal, Sudan, Zaire and Zambia Institutions in these countries have been invited to submit research contract proposals under the scope of this CRP.

5. Implications for the Future

- Estimated duration of the programme: 5 years
- Coordinated meetings: 1.1/2 years.

6. Estimated Programme Cost

- Co-ordinated meetings
  (Total of four meetings planned) US$ 160,000

- Fourteen Research Contracts
  (5000 each for five years) US$ 350,000

Report of ESNA Working Group on Food Irradiation
Stara Zagora, Bulgaria
31 August - 4 September 1987

by

J. Farkas

It is a pleasure to report that the Working Group on Food Irradiation had one of its most successful meetings in Stara Zagora both as the number of participants and the number and scope of presentations concerned. Altogether about forty participants from 12 countries and the Joint FAO/IAEA Division attended our eight sessions. Each session provided many useful practical and scientific informations and opportunities for lively discussions. We noted with pleasure that a number of scientists from the host country have not only attended the meeting but our Bulgarian colleagues have contributed significantly to the scientific programme of our sessions.

Following our tradition, the programme has been started with status reports on food irradiation of the participants' countries, namely from Bulgaria, Egypt, Federal Republic of Germany, France, the German Democratic Republic, Hungary, Israel, the Netherlands, Poland, Syria, United Kingdom and

the USA. The chairman of the Working Group reviewed recent international developments in implementation of the food irradiation process, and the representative of the Joint FAO/IAEA Division provided information on the forthcoming International Conference on the Acceptance, Control of and Trade in Irradiated Food to be held in Geneva, December 1988 under the auspices of relevant specialized agencies of the United Nations.

Twenty five research reports and technical papers formed the core of the more formal sessions covering a wide field of expertise from dosimetry and technical innovations in commercial radiation facilities to fundamental aspects of radiation microbiology of food. Presentation of several video films have also enriched our sessions. This multi-disciplinary character of our working group makes our program interesting for both specialists and generalists.

Concerning various applications of food irradiation, both the scientific interest and the techno-economic development have pointed mainly towards sprout inhibition of bulbs and tubers, as well as to the radiation decontamination of meat, poultry and dry ingredients. noticeable progress have been reported also in the field of identification of irradiated dry ingredients. The Working Group noted with satisfaction that in spite of emotional controversies stirred by various anti-groups, and lack of harmony in legislations of various countries, more and more commercial applications, marketing trials, demonstration plants and co operative projects are emerging, frequently with active participation of members of our Working Group, particularly in the G.D.R, the Netherlands, France, Poland and Hungary. We believe that this rewarding progress in the application of those technologies which have been developed often with active participation of our fellow members is also a cohesive force for our Working Group, making it as one of the strongest unit of our beloved ESNA family. We thank to our hosts that they provided us with an excellent meeting forum and a pleasant atmosphere both technically and socially.

Programme of the Working Group Sessions:

Session 1, Monday, August 31/Chairman: J. Farkas

Status reports on food/feed irradiation in the participants' countries:

Bulgaria/Grozdanov
Egypt/Farag
F.R G./Heide
France/Vidal
G.D.R./Jantz
Hungary/Kiss
Netherlands/Langerak
Poland/Fizer/Tysek
Syria/Sharabi
United Kingdom/Maitland-Kraft
U.S.A./Sivinski

Session 2, Monday, August 31/Chairperson: N. Dimitrova

Recent international developments in the implementation of the food irradiation process/J. Farkas, Hungary.

FAO, IAEA, WHO, ITC-UNCTAD/GATT International Conference on the Acceptance, Control of and Trade in Irradiated Foods/M. Lapidot, IAEA.

Contributed research papers:

Experience in dosimetry for an industrial irradiation facility/Chr. Grahn, G.D.R.

Technical innovation at *Gammaster*.

Video-film presentation/Ms. J. van Herk, Netherlands.

Session 3, Monday, August 31/Chairman: Wl. Fiszer.

Control of sprouting and rot in potatoes and onions by low-dose and combined treatment/D.Is. Langerak, Netherlands.

Onion irradiation - a case study/G. Hübner, G.D.R.

A trade deal with irradiated onions between G.D.R. and Hungary/Gy. Zachariev, I. Kiss, J. Farkas, Hungary, and G. Hübner, R. Döllstädt, G.D.R.

Video-film presentation/M. Lapidot, IAEA.

Session 4, Tuesday, September 1/Chairman: G. Hübner.

Contributed research papers:

The effect of high energy electrons on the preservation of mushrooms/Agaricus bisporus/K. Smierzchalska, D. Swiniarski, Poland.

Biochemical changes in stored pears after irradiation, $CaCl_2$ and kinetic treatments. I. Lipoxygenase activity in relation to the breakdown disorders/S. Farag, H. Daood, E. Kovacs, Egypt/Hungary.

Effect of 60 Co gamma radiation on the content of patulin and the chemical composition of apple juices/S. Bachman, H. Zegota, M. Pietka, Poland.

Effect of gamma rays irradiation of grape on the content and quality of wine/D. Hadjiiski, D. Nachkow, Bulgaria.

Effects of Irradiation on mechanically deboned meat/J. Gracz, T. Radomyski, K. Trojanowska, Poland.

Session 5, Tuesday, Sept.1/Chairman: D. Is. Langerak.

Use of gamma irradiation in the control of Salmonella in poultry/A. Grozdanov, I. Kaloyanov, G. Monov, N. Dimitrova, Zl. Trendafilova, M. Dilova, R. Petkov, Bulgaria.

Poultry meat irradiation - Effect of temperature on chemical changes and microorganisms inactivation/T. Hanis, F. Jelen, P. Klir, J. Hnukova, B. Perez, M. Pesek, Czechoslovakia/Cuba - presented by J. Farkas.

Slide presentation/J.S. Sivinski, U.S.A.

Irradiation of egg products/I. Kiss, A. Halmágyi, A.P. Király, Hungary.

Session 6, Tuesday, Sept. 1/Chairman: M. Lapidot, IAEA

Identification of irradiated spices by means of chemiluminescence, thermoluminescence and viscosity measurements/L. Heide, W. Bögl, F.R.G.

Effect of ionizing radiation on some properties of paprika powder/J. Kispéter, J. Beczner, I. Borbély-Kiss, M. Halász-Fekete, L. Sirokmán, L. Varga, Hungary.

Preliminary studies on the feasibility of an identification of some irradiated dry ingredients/J. Farkas, A. Koncz, M. Kristianova, E. Sipóz, Hungary.

Combined action of irradiation and nitrite on inactivation of Streptococcus faecalis in model systems/T. Atanassova-Assenova, Bulgaria.

Resistance/in vitro/of Yorsinia enterocolitica at gamma-rays treatment/Z. Kounev, T. Spasov, Bulgaria.

Effect of gamma radiation and ultrasonication on heat resistance of aerobic bacterial spores/J. Farkas, E. Andrássy, K. Kiss, Hungary.

Session 7, Thursday, Sept. 3/Chairman: J.S. Sivinski.

Determination of mould infection of irradiated food by chemical and immunological methods/J. Beczner, I. Kiss, P. Biacs, F. hajdu, Hungary.

Effect of gamma irradiation on survival of natural microflora and some nutrients in cereal meals for human consumption/T. Hanis, J. Hnukova, P. Jelen, P. Klir, B. Perez, M. Pejek, Czechoslovakia/Cuba - presented by I. Kiss.

Application of gamma-rays for sterilization of forages contaminated with Salmonellae/M. Steffanova, I. Jankoff, V. Steffanov, I. Balimezoff, Bulgaria.

Radiation sterilization of biopreparations/R. Grigorova, Bulgaria.

Session 8, Thursday, Sept. 3/Chairman: I. Kiss.

General Discussion.

INTERNATIONAL FACILITY FOR FOOD IRRADIATION TECHNOLOGY
(I F F I T)

PROSPECTUS

Title: IFFIT TRAINING COURSE ON RESEARCH METHODOLOGY AND TECHNICAL FEASIBILITY OF FOOD IRRADIATION

Place: International Facility for Food Irradiation Technology (IFFIT) within the State Institute for Quality Control of Agricultural Products (RIKILT), Bornsesteeg 45, 6708 PD Wageningen, The Netherlands.

Date: 17 - 28 October 1988

Organizers: IFFIT in cooperation with RIKILT, and the International Agricultural Centre (IAC), Wageningen, The Netherlands.

Purpose: The objective of the course is to provide training, both theoretical and practical, in research approaches and methodologies in studies on the technical and economic feasibility of food irradiation.

Participants' qualifications: Applicants must have academic training and experience in food sciences including food technology. Applicants have to be actively engaged in research work of immediate

practical interest in the fields of technology, biology, physiology, and chemistry of food irradiation. As the course will be conducted in English, participants must give evidence of a good working knowledge of the language. Medical certificate of fitness to travel and work and of good health must be provided.

Other Requirements: For reasons of IFFIT's project administration, applicants are requested to present a description of their present work, together with the completed application form. Applicants selected for participation will be required to prepare and bring along to the training course a report on the present status of food irradiation in his/her country, including government policy and programmes, activities completed, ongoing and planned, and specific problems as well as needs in application and applied research.

The nominating institution will be required to indicate the intended use to be made of the trainee and his/her training upon return from the course and its willingness subsequently to supply information on such use for purposes of evaluation of the effectiveness of IFFIT in meeting indicated needs.

Nature of Course: This course is specifically intended for food scientists involved, or becoming involved, in the various aspects of food irradiation research to train them in the proper conduct of studies with irradiated and non-irradiated, but otherwise treated, products. The course will also provide information on the technical feasibility of food irradiation applications for products of public health and/or economic importance. Emphasis in the course will be placed on experimental design, statistical analysis of data and the preparation of reports for publication.

Participation: The course is open to scientists from developing countries. The number of participants is limited to a maximum of 15. The selection of participants will be made from among the nominations mainly on the basis of criteria such as qualifications of the applicants and the prospects for use of the training. Applications should be submitted on the attached Application Form for Training Course. Completed forms should be returned and received by the IFFIT Project Director, c/o RIKILT, P.O. Box 230, 6700 AE Wageningen, The Netherlands, not later than 29 July 1988.

Administrative and Financial Arrangements: The applicants and the nominating Institutions will be informed by the Project Director in August 1988 on the selection of the candidates for this training course.

Participants should be provided, by their Institutes or other sources, with an air-ticket, one way, from their hometown to Amsterdam (The Netherlands). The air-ticket (economy class rate) for return from Amsterdam to the hometown of the participant will be provided by IFFIT upon arrival at the course.

Alternately, participants may be provided, by their Institutes or other sources, with a return air-ticket from

their hometown to Amsterdam and be reimbursed, upon arrival at the course, for this air-fare up to the cost of a one-way economy class air-ticket by the most direct route to Amsterdam.

Participants will be accommodated with full board at the expenses of IFFIT in the Hostel of the International Agricultural Centre (lunches at RIKILT on course days). In addition, participants will receive spending money of Dutch Guilders 126.00 per week. Any alternate arrangements will be at the expense of the participant.

The organizers of the course do not accept liability for the payment of any costs or compensation arising from damage to or loss of personal property, or from illness, injury, disability or death of a participant while he or she is travelling to and from or attending the course, and it is clearly understood that each Institution, in nominating participants, undertakes responsibility for such coverage. Institutions would be well advised to take out insurance against these risks for the participants nominated by them. Participants should make their own arrangements for passports, visa and vaccinations.

Arrival at the Course:

Participants should arrive in Wageningen not later than Sunday, 16 October 1988, in order to ensure their presence at the opening of the course on Monday, 17 October 1988. Selected candidates will obtain detailed instructions on the arrangements for travel to Wageningen and where to report on arrival, in due time.

National Seminar on Food Irradiation Development in China

People's Republic of China, Beijing
11 - 15 January 1988

Since the early 1960s, China began its studies of food irradiation for potential commercial application of this technology. In the past ten years, the Chinese have placed considerable emphasis on the development of this food preservation technology nationwide to: (1) minimize food losses due to spoilage by insect pests and microorganisms; (2) extend the shelf life of fresh agricultural commodities such as fruits and vegetables; and (3) raise the public health standards by decontaminating foods that might contain pathogenic bacteria such as *Salmonella* spp.

An Asia-Pacific Regional Seminar on the Practical Application of Food Irradiation, jointly sponsored by FAO/IAEA and hosted by the Chinese government was successfully held in Shanghai in April 1986. In late 1986, IAEA Project CPR/5/002 Food Irradiation (in China) was approved and was implemented at the Shanghai Irradiation Centre (SIC) in 1987 for a period of three years. The project consists of three parts: expert services, equipment, and fellowship.

The national seminar in Beijing is an outgrowth of the Shanghai Regional Seminar (April 1986). The national authorities felt that it was time to review what progress had been made since, and to determine how and when a

national food irradiation co-ordination committee could be formed to guide and assist in an orderly, co-ordinated development of food irradiation among 200 laboratories in various cities in 23 provinces in China (There are 28 provinces in China).

The seminar opened on Monday, 11 January 1988 at the auditorium of the Youth Development Centre in Beijing. There were 161 registered delegates representing research laboratories across China, government agencies connected with food resources and food preservation, scientific and professional societies including the Consumer Union. Dr. Christopher Rigney of the Food Preservation Section, Joint FAO/IAEA Division, and Dr. James H. Moy of the University of Hawaii were representing the FAO/IAEA at the seminar. There were also 15 reporters representing a dozen dailies in China.

The importance of the seminar could be viewed from the fact that it was held in the capitol city, and that both the Vice Minister, Mr. Qitao Huang of the Ministry of Nuclear Industry and Mr. Jun-Ru Ma, Deputy Director of the Department of High Technology of the State Science and Technology Commission gave opening addresses completely and enthusiastically endorsing the development of food irradiation in China, and strongly committing all the national units to work together towards a common goal.

More than 80 technical papers were presented in the first three and a half days of the seminar, and ample time was allocated for delegates to participate in three concurrent sessions to discuss a number of major problem areas that needed close attention:

- The relationship between legislating and promoting the commercialization of irradiated foods;
- The obstacles to early commercial processing and marketing of irradiated foods in China;
- Major problems in research and development of food irradiation technology;
- How to improve the administration, operations, utilization, and economics of irradiators already built;
- How to utilize dosimetry to control product quality and operational safety;
- How to have better horizontal cooperation and coordination in food irradiation research and development;
- How to strengthen international cooperation and exchange in food irradiation technology;

Dr. James Moy presented three lectures in the seminars:

- Commercial food irradiation developments in the U.S.A. and Canada;
- Test marketing of irradiated Hawaiian Papayas in California;
- Efficacy of irradiation as a quarantine treatment for agricultural commodities.

In addition to this opening remarks, Dr. Rigney presented two lectures on:

- Worldwide status of food irradiation developments;
- The role of international agencies in the development of food irradiation.

The Beijing Seminar was a success in the opinion of the two IAEA/FAO representatives and all those who participated. This was the third seminar on food irradiation held in China, the previous two being in Chengdu in 1977 and Shanghai in 1986. There was a great deal of practical interchange on the current status of food irradiation activities in China, and a better understanding of some of the problems that still need solutions.

Interest in and enthusiasm about food irradiation remain very high in China. Feeding studies of a variety of irradiated foods with 382 Chinese volunteers for one to two months continuously three years ago were unprecedented and lent much credence to proving the safety of irradiated foods.

The future of food irradiation in China will depend on several factors: (1) the coordinated efforts for a national development programme; (2) the continued support for research and development by national and international agencies; (3) proper training of irradiation facility operators; (4) successful marketing of selected irradiated foods across the country, and (5) proven economic feasibility of irradiating these selected products.

Status of Practical Application of Food Irradiation
(as of June 1988)

Country	Company(City)	Estimated Food Item	Total Quantity (Tonne/Annum)
Argentina	National Atomic Energy Commission Buenos Aires	spices, cocoa powder, spinach	~50
Belgium	IRE (Fleurus) dehydrated vegetables, frozen food	Spices,	8-10,000
Brazil	EMBRARAD (Sao Paulo)	spices	~ 200
Chile	CCHEN (Santiago) potatoes, dehydrated vegetables, chicken	onions,	~ 500
China	Shanghai Irradiation Center	potatoes, apples	~500
Cuba	Institute of Food Industrial Research (Havana)	potatoes onions	~ 500
Finland	KOLMI-SET Oy (Ilomantsi)	spices	not reported
France	Conservatome (Lyon)	spices	~2,500
	Caric (Paris)	spices, poultry	~ 500
	S.P.I. (Vannes) (frozen deboned chicken)	poultry,	~ 2,000

Country	Company(City)	Estimated Food Item (Tonne/Annum)	Total Quantity
France	Oris (Nice) vegetable seasonings	spices,	~200
German, Dem. Rep.	Central Inst. Isotop. Radiat. Res. (Weideroda)	onions	~600
	Queis Agric. Coop. (Spickendorf)	onions	~5,000
	VEB Prowiko (Shoenebeck)	enzyme solution	~300
Hungary	AGROSTER (Budapest)	spices	~400
Israel	Sorvan (Yavne)	spices	~120
Japan	Shihoro Agricultural Coop. (Hokkaido)	potatoes	~15-20,000
Korea, Rep. of	KAERI (Seoul)	garlic powder	not reported
Netherlands	GAMMASTER (Ede)	spices, frozen food, poultry, dehydrated vegetables, egg powder	~18,000
Norway	Inst. for Energy Technol. (Kjeller)	spices	not reported
South Africa	Nuclear Devel. Corp.	fruits, potatoes, onions	not reported
	ISO-STER (Johannesberg)	spices, dehydrated vegetables	~1,000
	High Energy Processing (Pelindaba)	fruits, spices potatoes, onions	~20,000
Thailand	OAEP (Bangkok)	onions, fermented sausages	~600
U.S.A.	ISOMEDIX, inc. (N.Y.)	spices	~1,000
	Radiation Technol. (N.J.)	spices	~500
	Radiation Sterilizer (Cal.)	spices	~1,800
USSR	Odessa Port Elevator (Odessa)	grain	~400,000
Yugoslavia	Ruder Boskovic Inst (Zagreb)	spices	not reported
	Boris Kidic Inst. (Belgrade)	spices	~100

NEW REGULATION ON FOOD IRRADIATION IN CANADA.

Information Letter No. 746 (4 June 1988)
Head Protection Branch
Health and Welfare Canada

SUMMARY

On July 28, 1983, Information Letter (I.L.) No. 651 was issued outlining proposed regulations dealing with food irradiation. The Branch was of the opinion that, with renewed interest in this process, it is essential to have meaningful and strengthened regulations in place at an early date to facilitate the handling of submissions for new applications of this technology. It was considered that this strengthening of the regulations could be best accomplished by establishment of a new Division of 27 of the Food and Drug Regulations to deal exclusively with ionizing radiation, and transfer to this new Division the existing irradiation regulatory provisions from Division 16 which deals with food additives. The result would be strong, relevant and clean-cut regulations pertaining to ionizing radiation which would (1) define and impose constraints upon sources used in the process, (2) delineate detailed pre-clearance requirements specifically applicable to the irradiation of food, and (3) enhance the Branch's ability to undertake an inspection and compliance program by setting out requirements for record-keeping.

I.L. No. 651 also specifically addressed the international position elucidated in the 1981 report of the Joint Food and Agriculture Organization/International Atomic Energy Agency/World Health Organization Expert Committee on the Wholesomeness of Irradiated foods. In this report, entitled Wholesomeness of Irradiated Foods, it was concluded that:

> "...irradiation of any food commodity up to an overall average dose of 10 kGy presents no toxicological hazard; hence toxicological testing of foods so treated is no longer required".
>
> and
>
> "The Committee, having reviewed new evidence, was able to formulate a recommendation on the acceptability of food irradiated up to an overall average dose of 10 kGy".

The 1983 Health Protection Branch Information Letter (No. 651) in commenting on this position indicated that the absence of evidence of adverse effects as a result of irradiation below this dosage level formed the basis for the proposal of requiring safety tests only when foods were irradiated above 10 kGy. Although there have been no new data to alter this stated position, it was subsequently recognized that a regulatory exclusion for toxicity testing of foods irradiated below 10 kGy does not reflect possible future developments in safety testing/assessment. Thus, while the Health Protection Branch does not intend to alter the position that food irradiation is a process and should be considered as such, and accepts in principle the lack of toxicological hazards for foods irradiated below 10 kGy, the Health Protection Branch will examine each submission on a case-by-case basis to determine if additional or new toxicity testing is required. This will be of particular significance in those instances where a food commodity which is not a member of a class of foodstuffs already subjected to extensive toxicity testing is proposed to be irradiated. Therefore, the pre-clearance requirements delineated in the proposed Division 27 have been revised as follows. Section B.27.005(f) (Annex II) will read:

"(f) where the Director so requests, data establishing that the proposed irradiation is safe under the conditions proposed for the irradiation;"

The Health Protection Branch received 17 formal detailed replies to I.L. No. 651, having mailed approximately 7000 copies to regular recipients on the Branch mailing list. The breakdown of replies was as follows: private companies, 7; trade associations, 2; provincial governments, 2; nuclear industry, 2; scientific professional associations, 1; foreign governments, 1; consumer advocacy groups, 1; and individual consumers, 1. The Branch has also received a considerable number of informal replies and letters dealing with scientific, philosophical, and social issues concerning food irradiation.

Replies to the draft proposals contained in I.L. No. 651 along with Branch responses, are presented in Annex I (not included in this Food Irradiation Newsletter, please refer to original I.L. No. 746) under subject headings corresponding to the order of the draft regulations as originally presented. To assist the reader, a short statement of purpose of each proposed regulation is offered under each heading.

Following detailed comments on each of the draft regulations is a section dealing with miscellaneous comments and issues that have been raised by individual consumers and consumer groups as well as in the media. While these comments and issues were not specifically related to I.L. No. 651, they nonetheless are related either directly or indirectly to food irradiation.

The Branch is aware of and did take into account the views of an appreciable number of people who are opposed to food irradiation in the first instance for a variety of reasons including safety concerns. Safety-related concerns are addressed in Annex I to this Information Letter. The Branch considers that appropriate labelling requirements should enable individuals opposed to this treatment to avoid irradiated foods. However, the Branch also took cognizance of the fact that the irradiation process constitutes an international activity which, even if not undertaken in Canada, could be applied to foods imported into this country. For this reason, together with increased interest in applying the process to domestically produced foods, for example, to reduce microbiological hazards, the Branch considers that strengthened pre-clearance and compliance regulations are required. The best way to achieve these ends is to recognize food irradiation as a process in its own right and control its application to foods under regulations other than food additive regulations.

With regard to labelling, the Health Protection Branch supports the need to label all irradiated foods and has recommended this course of action to the Department of Consumer and Corporate Affairs (CCA). Insofar as the matter of labelling falls under that Department's jurisdiction, CCA is presently developing appropriate labelling regulations.

Thus, after having considered all of the comments received to I.L. No. 651, the Branch is proceeding to implement the new regulatory proposals incorporating the changes mentioned above. These revised proposals may be found in Annex II to this I.L. The changes from the proposals outlined in I.L. No. 651 are as follows;

(1) to require the generation of toxicological data under conditions of any proposed dose, where such data are not presently available;

(2) to recognize the use of X-ray machines and electron-generating machines as sources of radiation, as well as radioisotopes;

(3) to indicate that efficacy data includes data on minimum as well as maximum doses;

(4) to require details of other treatments, including those expected to be performed by subsequent food handlers up to the consumer level, to be submitted as part of any submission involving a new application of food irradiation and inclusion of a requirement to obtain information on effects of the combination processes on nutritional quality of the treated food as consumed;

(5) to require data on alteration of microbiological populations, as well as chemical and physical alteration; and

(6) inclusion in the Table to Division 27 of "whole or ground spices and dehydrated seasoning preparations", such provision having been promulgated under the Food Additive Tables and published in the Canada Gazette Part II, Vol. 118, No. 20 of October 3, 1984.

It should be noted that other minor amendments to the Food and Drug Regulations will be necessary as a result of adopting the principles implicit in the food irradiation proposal. These amendments relate to modification of the definition of a "food additive" and removal of existing food irradiation provisions from the Food Additives Tables of Division 16.

In addition to this Information Letter, these proposals will also be prepublished in Part I of the Canada Gazette in accordance with current regulatory procedures.

To conclude, the Branch is appreciative of the time and effort taken by all respondents in replying to I.L. 651, Proposed Revised Regulations for the Control of Food Irradiation.

ANNEX II

DIVISION 27

Food Irradiation

Definition

B..27.001. In this Division,

"ionizing radiation" means

(a) gamma-radiation from a Cobalt-60 or Cesium-137 source,

(b) X-rays generated from a machine source operated at or below an energy level of 5 MeV, and

(c) electrons generated from a machine source operated at or below an energy level of 10 MeV.

"irradiation" means treatment with ionizing radiation.

Application

B.27.002. This Division does not apply to foods exposed to ionizing radiation from a measuring instrument used to determine weight, estimate bulk solids, measure the total solids in liquids or perform other inspection procedures.

General

B.27.003. (1) Subject to subsection (2), no person shall sell a food that has been irradiated.

(2) A food set out in column I of an item of the table to this Division that has been irradiated may be sold if:

(a) the food was irradiated from a source set out in column II of that item for the purpose set out in column III of that item; and

(b) the dose of ionizing radiation absorbed by the food is within the permitted absorbed dose set out in column IV of that item.

Records

B.27.004. (1) A manufacturer who sells a food that has been irradiated shall keep on this premises, for at least two years after the date of the irradiation, a record containing the following information:

(a) the food irradiated and the quantity and lot numbers of the food;

(b) the purpose of irradiation;

(c) the date of the irradiation;

(d) the dose of ionizing radiation absorbed by the food;

(e) the source of the ionizing radiation; and

(f) a statement indicating whether the food was irradiated prior to the irradiation by the manufacturer and, if so, the information referred to in paragraphs (a) to (e) in respect of that prior irradiation.

(2) Every person who imports a food that is intended for sale in Canada that has been irradiated shall keep on his premises a record of the information referred to in subsection (1) for at least two years after the date of importation.

Change to the Table

B.27.005. A request that a food be added or a change made to the table to this Division shall be accompanied by a submission to the Director containing the following information:

(a) the purpose and details of the proposed irradiation, including the source of ionizing radiation and the proposed frequency of and minimum and maximum dose of ionizing radiation.

(b) data indicating that the minimum dose of ionizing radiation proposed to be used accomplishes the intended purpose of the irradiation and the maximum dose of ionizing radiation proposed does not exceed the amount required to accomplish the purpose of the irradiation;

(c) information on the nature of the dosimeter used, the frequency of the dosimetry on the food and data pertaining to the dosimetry and phantoms used to assure that the dosimetry readings reflect the dose absorbed by the food during irradiation;

TABLE

	Column I	Column II	Column III	Column IV
	Food	Permitted Sources of Ionizing Radiation/Sources	Purpose of Treatment	Permitted Absorbed Dose
1.	Potatoes	Cobalt-60	To inhibit sprouting during storage	0.15 kGy max.
2.	Onions	Cobalt-60	To inhibit sprouting during storage	0.15 kGy max.
3.	Wheat, Flour, Whole Wheat Flour	Cobalt-60	To control insect infestation in stored food	0.75 kGy max.
4.	Whole or ground spices and dehydrated seasoning preparations	Cobalt-60 Cesium-137 or electrons from machine sources(3 MeV max.)	To reduce microbial load	10.00 kGy max. total overall average dose.

(d) data indicating the effects, if any, on the nutritional quality of the food, raw and ready-to-serve, under the proposed conditions of irradiation and any other processes that are combined with the irradiation;

(e) data establishing that the irradiated food has not been significantly altered in chemical, physical or microbiological characteristics to render the food unfit for human consumption;

(f) where the Director so requests, data establishing that the proposed irradiation is safe under the conditions proposed for the irradiation;

(g) the recommended conditions of storage and shipment of the irradiated food including the time, temperature and packaging and a comparison of the recommended conditions for the same food that has not been irradiated;

(h) details of any other processes to be applied to the food prior to or after the proposed irradiation; and

(i) such other data as the Director may require to establish that consumers and purchasers of the irradiated food will not be deceived or misled as to the character, value, composition, merit or safety of the irradiated food.

VIDEO PROGRAMME ON FOOD IRRADIATION

As stated in the Progress Report of the International Consultative Group on Food Irradiation(ICGFI), a video programme entitled "Food Irradiation - A New Way to Process Food" was produced by ICGFI in late 1987. A master copy of the video (U-MATIC) was sent to the government designated expert of 26 member countries of ICGFI. The readers who are interested in obtaining a copy may contact the respective expert in their country:

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Those who are from non-ICGFI countries may request for a copy of the video from Food Preservation Section, IAEA. In such a case, a blank video cassette should be provided together with information on television system in their countries.

PUBLICATIONS

1. Practical Application of Food Irradiation in Asia and the Pacific.

Proceedings of a Regional Seminar, Shanghai, People's Republic of China, 4-8 April 1986. IAEA-TECDOC-452.

2. Another Publication of Food Irradiation is planned by Pergamon Press.

A special issue of 'Radiation Physics & Chemistry' dealing with the increasingly important topic of food irradiation is planned. It is expected that the issue will contain papers, reviews and communications along the following lines.

1. Scientific papers dealing with the interaction of ionising radiation with food or its constituents.

2. Papers of a more technological nature concerned with present and potential applications of radiation in food treatment.

3. The provision of information on techniques and facilities such as radiation sources, dosimetry and safety measures and on the economics of radiation processing of food.

4. Expert reviews on specialist aspects of the irradiation of food. These should provide authoritative summaries of the present situation in the chosen topic.

5. Notes and short communications including preliminary research results concerned with any aspect of food irradiation for which publication in this issue is especially desirable.

6. Letters to the Editor concerning the irradiation of food.

7. Other [illegible]se unpublished summaries of conference proceedings concerned with ir[illegible]diation of food.

I have great pleasure in inviting you to submit a paper for this issue. All papers will be referred in the usual way. The deadline for receipt of manuscripts will be 31st March 1989. Strict adherence to the deadline should enable the accepted papers to be sent, fully referred and edited, to Pergamon Press by the end of June. I have been informed by Pergamon Press that if this is done publication by the end of 1989 is guaranteed.

Papers should be submitted to me at this address. Format should be in accordance with the Notes and Instructions printed at the back of each issue of the journal.

This letter is also being sent to those on the enclosed list. I would be grateful if you could draw this publication to the attention of any others you may know of who might like to submit a paper.

It would be appreciated if you could let me know within a week or so if you are hoping to submit a paper.

Looking forward to your reply.

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COMING EVENTS

1. 19th Annual Meeting of European Society for Nuclear Agriculture (ESNA): Working Group on Food Irradiation, Vienna, Austria; 29 August - 2 September 1988.

2. 5th Annual Meeting of International Consultative Group on Food Irradiation (ICGFI), Vienna, Austria; 6 - 8 September 1988.

3. Pre-investment Mission on Food Irradiation to Cote d'Ivoire, Ghana and Nigeria; 12 September - 7 October 1988.

4. Second FAO/IAEA Research Co-ordination Meeting on Food Irradiation Programme for Latin America, San Jose, Costa Rica: 10-14 October 1988.

5. First "Food Irradiation Process Control School (FIPCOS)" Canadian Irradiation Center, Laval, Canada; 3-14 October 1988.

6. IFFIT Training Course on Research Methodology and Technical Feasibility of Food Irradiation, Wageningen, The Netherlands; 17-28 October 1988.

7. Final FAO/IAEA Research Co-ordination Meeting on Second Phase of Asian Regional Co-operative Project on Food Irradiation, Bangkok, Thailand; 24-28 October 1988.

8. FAO, IAEA, WHO, ITC-UNCTAD/GATT International Conference on the Acceptance, Control of and Trade in Irradiated Food, Geneva, Switzerland; 12-16 December 1988.

Food Irradiation Newsletter
Joint FAO/IAEA Division of Isotope and Radiation Applications
of Atomic Energy for Food and Agricultural Development
International Atomic Energy Agency
P.O. Box 100, A-1400 Vienna, Austria

Printed by the IAEA in Austria
July 1988

88-02899