Food irradiation makes progress

by J. van Kooij*

About a quarter of the world's food production is lost after harvesting, even though a number of food preservation methods are readily available. Losses occur especially in the tropical regions where most developing countries are situated: perhaps because the available food preservation technologies do not function efficiently in such environments, or because they do not lend themselves to the habits of food consumption in most developing countries. People in such countries are accustomed to buying fresh food for immediate consumption at home. They would welcome any new technology which would keep food fresh for a longer time.

A new technique, irradiation processing, has several uses, most of which prolong the useful life of foods in the condition in which they have been obtained. Food irradiation processing has been studied by scientists for many years. It induces virtually no temperature rise in the treated products, and is therefore often termed a "cold" process. Fish, fruits, and vegetables remain fresh, and the physical state of frozen or dried commodities is unchanged. The agents causing spoilage (bacteria, insects) are reduced in numbers or eliminated from packaged food, and if the packaging materials are impermeable the food is not recontaminated. Irradiation of packaged food has a particular bearing when hygiene is difficult to maintain, as is often the case, for example, in tropical conditions.

In the past fifteen years, food irradiation processing policies and programmes have been developed both by a number of individual countries, and through projects supported by FAO, IAEA and WHO. These aim at achieving general acceptance and practical implementation of food irradiation through rigorous investigations of its wholesomeness, technological and economic feasibility, and efforts to achieve the unimpeded movement of irradiated foods in international trade. Food irradiation processing has many uses. It may be used, for example, for:

- Inhibition of the sprouting of vegetables (potatoes, onions, garlic, yams)
- Shelf-life extension of fresh produce (such as fruits, fish, meats) by delaying ripening, or reducing the number of micro-organisms that spoil food
- Control of pathogenic organisms and parasites found in food
- Insect disinfestation of food, and
- Microbial disinfection of spices and dry food ingredients.

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Assurance of the safety of irradiated foods

Demonstration of the wholesomeness of irradiated foods has been given high priority, as evidenced by IAEA participation in the International Project on Food Irradiation (IFIP), and by support of a co-ordinated research project on wholesomeness studies. The international project was concluded in 1981, after having achieved its primary objective: the acquisition of data from a large number of toxicological and specific studies of interactions between irradiation and the wholesomeness and chemistry of treated foods and food components. On the basis of these data, a Joint FAO/IAEA/WHO Expert Committee on the Wholesomeness of Irradiated Food (JECFI), convened in November 1980, was able to recommend the acceptability from a toxicological standpoint of any food commodity irradiated up to an overall average dose of 10 kilogray (kGy). It considered that the toxicological testing of foods so treated was no longer required. As regards microbiological and nutritional acceptability of irradiated food, the Committee concluded that the irradiation of food up to 10 kGy introduced no special nutritional or microbiological problems. However, the Committee emphasized that attention should be given to the significance of any changes in each particular irradiated food in relation to its rôle in the diet.

The past three years have been particularly noteworthy for the considerable efforts made to disseminate information in Member States on the wholesomeness of irradiated food. The most important vehicle for information exchange has been the FAO/WHO Codex Alimentarius Commission (CAC). In the framework of the Joint FAO/WHO Food Standards Programme, a revised draft General Standard for Irradiated Foods was developed by an *ad hoc* expert working group convened by FAO, IAEA and WHO in July 1981. The revised draft reflecting the conclusions of the 1980 JECFI meeting, was circulated to the 122 governments which are members of the CAC and to interested organizations for their comments. The revised draft Standard was discussed and amended at two meetings of the Intergovernmental Codex Committee for Food Additives. The elaboration of the Standard was successfully concluded at the meeting of the CAC in July 1983, at which the Commission adopted the Codex General Standard for Irradiated Foods.

The Codex General Standard

The scope of the Standard clearly indicates that its provisions refer only to the processing of food with ionizing radiation. It is also assumed that food processed

by irradiation, like any other food, will be subject to general food regulations relating to quality, hygiene, weights and measures and so on. The Standard is valid for all foods treated up to an overall average dose of 10 kGy, and recognizes that food irradiation has been established as safe for general application up to an absorbed dose of 10 kGy. This is not a level above which irradiated foods become unsafe; rather, it is a level at or below which safety has been established.

The process of food irradiation is to be carried out in facilities licensed, registered, and controlled by the appropriate national authority. The absorbed dose cannot be checked on the product as it moves in trade. Although many investigations of means of detecting physical, chemical and biological changes in foods subjected to irradiation have been carried out, no satisfactory method for identifying foods as irradiated has been developed: although certain effects can be identified, there is not sufficient precision for regulatory purposes. Therefore, control of commercial food irradiation can only be performed in the irradiation plants.

Referring to "Technological Requirements", the Standard stipulates that the irradiation of food is justified only when it fulfils a technological need or where it serves a food hygiene purpose, and that it should not be used as a substitute for good manufacturing practices. The doses of radiation applied shall be commensurate with the technological and public health purposes to be achieved and shall be in accordance with good radiation processing practice. Guidelines for quantitative measurement of dose and process control are provided in the Recommended International Code of Practice for the Operation of Irradiation Facilities used for the Treatment of Foods.

The "Labelling" provisions of the Codex General Standard for Irradiated Foods clearly state that the shipping documents shall provide all necessary information on the basis of which it would always be possible to identify the origin of the irradiated foods. A number of food products will be irradiated after packaging. The Codex General Standard for the Labelling of Prepackaged Foods (a revised version is being prepared) will provide mandatory provisions for the labelling of such foods. Foods irradiated in bulk containers are to be declared as irradiated on the relevant shipping documents.

With respect to labelling, the report of the 1980 JECFI meeting states: "Irradiated foods would be subject to regulations covering foods generally, and to any specific food standards relating to individual foods. It was therefore not thought necessary on scientific grounds to envisage special requirements for the quality, wholesomeness, and labelling of irradiated foods".

Some irradiated foods can later be processed into different products: for example, potatoes may be prepared as flakes or chips; onions converted into dried powder, deboned chicken meat into soups, and so on. For products to be further processed, declaration of this fact on the shipping documents can be very useful to inform the processors of specific qualities imparted to the products by irradiation, such as the absence of Salmonella, avoidance of the risk of sprouting when the onions or potatoes are kept outside, and so on.

Some irradiated foods, such as spices, can later be used as ingredients in manufactured foods. Not all ingredients of a manufactured food need be irradiated, and usually the means of processing is not declared. Is it necessary to indicate on a product label that just one of the ingredients has been irradiated?

Special labelling requirements are often requested by consumers and consumer organizations. However, there is considerable confusion and misinformation about irradiated foods. Any word or statement containing the word "irradiated" or "irradiation" may inspire fear of a non-existent danger: this is more than just misleading, and it may cause the consumer to avoid the product. The Report of an FAO/IAEA Consultants' Meeting on Marketing, Market Testing, and Consumer Acceptance of Irradiated Foods, issued in July 1983, cited the scientific evidence on the safety of irradiated food (JECFI 1980) and recommended that a label carrying a statement of the process not be required. Consumers should be informed and educated by other methods, such as intermediary information and educational channels, the press, consumer organizations, and so on.

National regulatory progress

Several countries have legislation which provides for a general interdiction on irradiated food, with authority to grant exemption for individual foods under specific conditions. On the basis of such national regulatory systems some 80 approvals – "unconditional" and "provisional", covering many different foods – have been issued. In addition, several countries have given restricted clearances for experimental batches and/or for limited market testing.

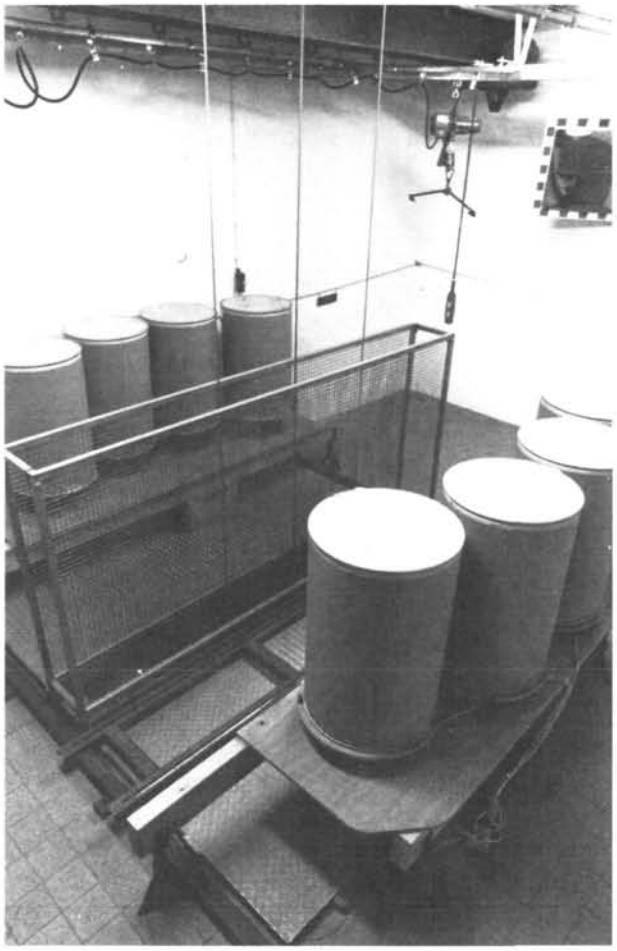
Information on the safety of irradiated food, and on the efficacy of the process, which is now available offers competent national authorities the means to adapt the existing legislation, where necessary, or to develop appropriate legislation in countries without any form of legislation on food irradiation. It may be stressed that the Codex General Standard for Irradiated Foods serves as a model for individual countries. Incorporating its provisions in national legislation would protect consumers and facilitate international trade. Evidence of concrete regulatory progress has occurred during the past few years in a number of countries: Bangladesh, Canada, Chile, Denmark, France, Hungary, The Netherlands, Norway, South Africa, and the United States of America.

The progress which has been achieved reflects either group clearance of individual foods on the basis of JECFI's recommendations and the Codex General

Unconditional and provisional clearances of food products in different countries

Foods	Argentina	Bangladesh	Belgium	Canada	Chile	Denmark	France	Hungary	Israel	Italy	Japan	Netherlands	Norway	Philippines	Poland	South Africa	Spain	Thailand	Uruguay	USA	USSR
Potatoes	x	x	x	x	x	x	x		x	x	x	x		x	x	x	x		x	x	x
Onions		x	x	x	x		x	x	x	x		x			x	x	x	x			x
Garlic			x				x			x						x					
Shallots			x				x														
Wheat, flour, whole wheat flour		x		x	x															x	
Spices		x	x		x		x	x				x	x							x	
Chicken		x			x				x			x				x					
Fish and fishproducts (chilled, frozen)		x			x							x									
Frozen shrimps		x										x									
Froglegs		x										x									
Rice and ground rice products		x			x							x									
Ryebread												x									
Egg powder												x									
Blood proteins												x									
Cocoa beans					x							x									
Dates					x																
Pulses		x			x																
Papaya		x			x											x					
Mango		x			x											x					
Strawberries			x		x							x				x					
Paprika			x																		
Mango achar																x					
Bananas (fresh, dried)																x					
Litchis																x					
Dry food concentrates																					x
Grain																					x
Dried fruits																					x
Mushrooms												x									
Endive												x									
Asparagus												x									
Battermix												x									

Standard for Irradiated Foods, or the development of rules permitting a general use of food irradiation. An example of the latter is the Proposed Rule for Irradiation in the production, processing and handling of food, issued in the United States of America in February 1984. The regulations proposed there would permit food to be irradiated to inhibit the growth and maturation of fresh fruits and fresh vegetables, to disinfest food of insects at doses not to exceed 1 kGy and to disinfect spices of microbes at doses not to exceed 30 kGy. "Now is the time to move forward with this promising technique", said Ms Margaret M. Heckler, Secretary of the US



Inside the Pilot Plant for Food Irradiation used in training and feasibility studies at the International Facility for Food Irradiation Technology (IFFIT) in the Netherlands. Products are placed in drums or boxes on rotating tables, or on conveyor belts, on both sides of the irradiation source. The source is raised from the pool in which it is stored into the wire-net cage shown here between the drums.

Department of Health and Human Services, when introducing the Proposed Rule.

The Health Protection Branch of the Ministry of Health and Welfare of Canada published in July 1983 "Proposed Revised Regulations for the Control of Food Irradiation". These regulations would facilitate submissions respecting new uses of irradiation for the purpose of increasing the quality, safety, and shelf-life of foods. In March 1982, the French Commissariat à l'Energie Atomique published a document entitled "Radiation Preservation of Food: Efficacy and Absence of Risks to Man". Toxicological data are no longer required in France for doses up to 10 kGy when petitioning for clearances. In Bangladesh and Chile, public health authorities in charge of food irradiation permit the use of the technique for a large number of foods, by reference to the Codex Standard adopted by CAC in 1979 and to the recommendations of the 1980 JECFI respectively.

More widespread, purposeful use of food irradiation depends on acceptance of irradiated foods or the process of food irradiation by national public health agencies, the food industry and trade, and by consumers. The FAO/IAEA Consultants' Meeting mentioned earlier assumed that probably no single, unbiased government agency could promote food irradiation, and suggested that a national "steering committee" be established in each country to guide food irradiation applications through existing systems, which vary from country to country and involve complex institutional issues, towards practical use.

Research and training

The Food Preservation Section of the Joint FAO/IAEA Division is responsible for assisting and advising Member States of the IAEA and FAO on the safe and effective use of food irradiation on a practical scale to reduce post-harvest losses and various kinds of spoilage of food supplies and agricultural commodities. The IAEA also collaborates with FAO and WHO in establishing general acceptance of the various food irradiation applications in Member States. The Food Preservation Section supports at present three interregional and one regional (Asian and South Pacific) Co-ordinated Research Programmes to facilitate the practical application of this technology.

Co-ordinated research projects carried out over the past four years have established the technological feasibility of irradiation for sprout inhibition (potatoes, onions, yams, garlic), mould control (mangoes, papayas), insect disinfestation (citrus fruits, mangoes, dried fish, dates, rice, cocoa-beans), microbial disinfection (spices, dry ingredients), control of pathogenic organisms (shrimps, frog legs, poultry), and shelf-life extension (fruits, poultry, meat, fresh fish).

The Asian Regional Co-operative Project on Food Irradiation (RPFI) has co-ordinated research and pilot-scale studies on selected products of particular interest to the region, such as fishery products, tropical fruits, onions and spices. Activities to transfer food irradiation technology to local industries under the RPFI will be initiated soon.

Research on food irradiation has had substantial support since 1979 from the International Facility for Food Irradiation Technology (IFFIT). This training centre, sponsored by the IAEA, FAO and the Ministry of Agriculture and Fisheries of The Netherlands, has organized five general training courses on food irradiation, one of which was regional (Latin America), and one specialized course on public health aspects, supplied training facilities to 20 research Fellows from 16 countries, and was involved in the evaluation of the quality of trial shipments of irradiated mangoes, spices, avocado, shrimp, onions and garlic from developing Member States. A total of 109 scientists from 40 countries have participated in the six IFFIT training courses which have been held during the past five years. Data from technological feasi-

bility studies carried out by research Fellows, and from the trial shipments, are contained in 46 IFFIT Reports produced during the past four years. IFFIT maintains, in co-operation with the Dutch Pilot Plant for Food Irradiation, a computerized data base of abstracts of current food irradiation publications.

International collaboration

After the termination of IFIP at the end of 1981 several Member States maintained an interest in continuing international co-operation to facilitate the practical application of food irradiation processing. By mid 1983, a proposal for establishing an International Consultative Group on Food Irradiation, in the form of a "Declaration", was distributed to the Member States of FAO, IAEA and WHO. The main functions of the Group are:

- to evaluate global developments in the field of food irradiation
- to provide a focal point of advice on the application of food irradiation to Member States and the Organizations
- to furnish information as required, through the Organizations, to the Joint FAO/IAEA/WHO Committee on the Wholesomeness of Irradiated Food, and to the Codex Alimentarius Commission.

Upon receipt of sufficient support from governments the International Consultative Group on Food Irradiation became operational on 9 May 1984. Members of the Group are at present: Argentina, Bangladesh, Canada, Egypt, Federal Republic of Germany, France, Hungary, Iraq, Israel, Mexico, The Netherlands, the Philippines, Syria, Thailand, and Turkey. Interest in participation has also been shown by Costa Rica, Finland, Malawi, and Portugal. Several other Member States are expected to join in the course of this year.

The Group is composed of representatives from the governments which have adopted the terms of the Declaration, and has been established for an initial period of five years.

Prospects for practical application

Food irradiation has become established among other technological methods for preserving food. Its commercial application is likely to be slow in the beginning due to specific barriers such as lack of governmental acceptance, lack of realistic techno-economic feasibility studies particularly in developing countries, the high economic risk involved in the initial investment under the uncertain conditions for implementation in some countries, and consumer acceptance.

Transfer of the food irradiation technology to the food industry and trade has become part of the research and development activities in many countries. Pilot-scale irradiators are available, and market testing is well underway in, for example, Algeria, Australia, Bangladesh, Chile, the German Democratic Republic, Hungary, Indonesia, Mexico, Pakistan, Thailand, and Yugoslavia. Pilot installations are planned or are under construction in Ghana, Nigeria, the Philippines, and Sri Lanka.

Commercial applications have been reported in Japan (potatoes), the USSR (disinfestation of cereals), South Africa (extension of shelf-life of fruits and vegetables), Belgium (spices, dried food ingredients), The Netherlands (frozen fishery products, spices, dried food ingredients), Hungary (onions, paprika), Norway (spices), and the USA (spices). It is estimated that the total production of irradiated foods world-wide amounted to 35 000 tons in 1983.

Multipurpose irradiation plants whose uses will include food irradiation have been installed recently or are being planned in, for example, Bangladesh, Belgium, Brazil, Egypt, Federal Republic of Germany, France, Hungary, Indonesia, Israel, Italy, The Netherlands, the Republic of Korea, South Africa, Taiwan, the USA, and the USSR.

Not all countries which have granted clearances for irradiating food actually use the process in practice. Many of the clearances have been conditional on demonstration of the wholesomeness of such foods. Practical applications depend on efficacy, need, economic feasibility, and market requirements. Many developing countries export fruits, vegetables, cocoa-beans, frozen fishery products, copra, tobacco leaves, and so on. These products may harbour insect pests which are subject to quarantine restrictions, or be contaminated with varying levels of micro-organisms of public health concern. Before they permit importation, several countries demand a treatment such as disinfestation or decontamination. Further expansion of the use of food irradiation in the western world would provide the incentive for its commercialization in the developing countries for cash crops such as frozen fishery products, spices, dried fish, and tropical fruits.