Radiation Preservation of Fish and By-products

by K. Vas

Fish and fishery products constitute a sizeable portion (10-20%) of the total protein consumption, and a major part (50-70%) of the animal protein consumption of the population in many of the 17 Member States of the Agency in South and South-East Asia and the Far East. Around one-third of the world's population (ca. 1000 million people) live in these 17 countries (Afghanistan, Australia, Bangladesh, Burma, India, Indonesia, Japan, Khmer Rep., Korea Rep., Malaysia, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Viet Nam).

In absolute figures, the per capita daily intake of both total and animal protein are generally low in this area. The serious deficiency in animal protein consumption could, at least partially, be remedied by increasing the aquatic protein supplies by *(a)* increasing the catch and *(b)* by preservation of what has been caught, in order to reduce the tremendous losses presently occurring during handling, transport and storage of this highly perishable commodity.

Although more than one-fourth of the total world catch (ca. 20 million tons) is produced in the area (half of it by Japan), this could and should be increased considerably. In the meantime, preservation of the present catch is of tremendous importance. This is especially true for populations living away from the coast, lakes or streams. It is very difficult, if not impossible, to supply fresh fish and fishery products to these people because a great deal quickly spoils during transport, especially in hot and humid areas.

It is quite clear, therefore, that any measures which could ease the situation should be tried and, if successful, applied as soon as practicable.

The treatment of fish and fishery products by ionizing radiations (e.g. gamma rays from ^{60}Co or ^{137}Cs and X-rays or electrons from machine sources) has a potential to contribute to the preservation of fish. Irradiation has been shown to effectively reduce spoilage caused by micro-organisms and/or insects and to slow down the deterioration process. This is done in a unique way: without denaturing the treated product, and without changing its palatibility, as usually happens with heating (cooking, canning, frying), freezing, drying or smoking, etc.

The safe storage life ("keeping quality") of fish can be considerably prolonged (two to three-fold at the minimum) by rather small doses (e.g. 100 – 200 krad) of ionizing radiation without any detectable change in flavour, odour, texture and appearance, i.e. the sensory quality characteristics of the fresh fish or fishery product. In addition, irradiation has also been advantageously combined with other food processing methods, as e.g. with boiling, drying or salting, where such processed commodities have to be rendered less perishable. A further special feature of fish irradiation is that the fresh or processed product can be irradiated in the final packing because of the easy penetration of gamma rays through packaging materials. In this way, some bacteria of public health significance (pathogenic, food poisoning micro-organisms like *Salmonella, Staphylococcus,* etc.) can be eliminated

without altering the sensory qualities of the product, and under conditions where re-infestation or re-infection are prevented. This constitutes a great advantage from the point of view of food hygiene. Some researchers predict that irradiation may well become as important in improving the hygienic status of lumpy, solid foods like meat or fish, as is heat pasteurization of liquid foods like milk.

The desirability of making the irradiation of fish and fishery products the subject of common experiments in the South and South East Asian and Far East region was based on studies carried out in various laboratories in the region, as well as the findings of a Technical Assistance Mission to the area in 1971/72, and an FAO/IAEA Study Group Meeting on Food Irradiation in Bangkok (1971).

COLLABORATION

As a result, fish preservation by irradiation was among the first topics suggested for collaborative studies under the IAEA-sponsored Regional Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA), which became operational in June 1972.

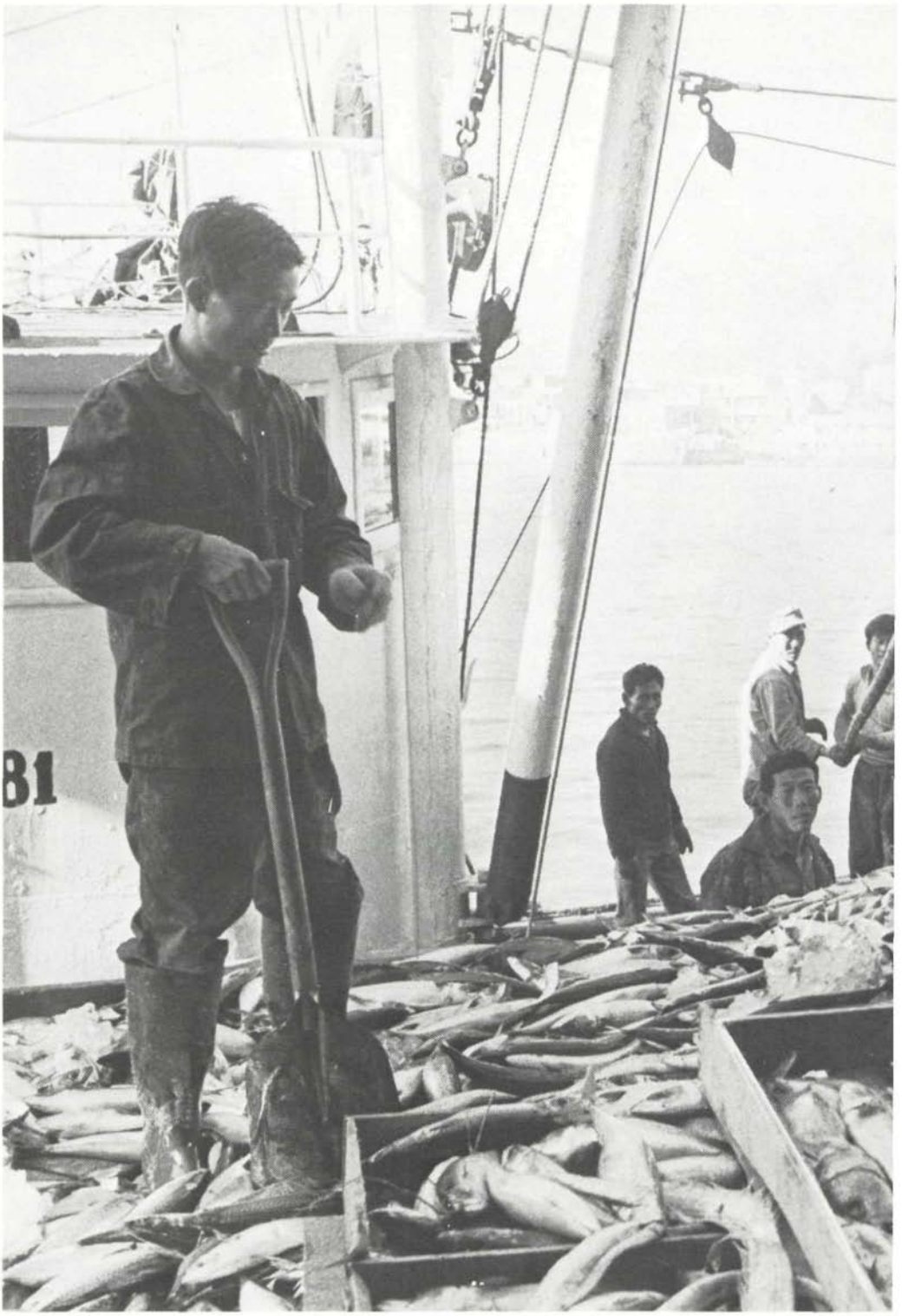
Following an FAO/IAEA Panel meeting on Aspects of the Introduction of Food Irradiation in Developing Countries at Bombay, in November 1972, it was suggested that collaborative fish irradiation studies be initiated as the first regional project under the RCA. A meeting of scientists authorized to represent the Governments willing to participate in the venture, was recommended.

This plan was accepted by an informal meeting of Government Representatives on the future of the RCA held during the 17th Session of the General Conference of the IAEA in Vienna in 1973. The offer of the Philippine Government to host the initiating meeting was accepted, and the Working Group to launch the Asian Regional Project on Radiation Preservation of Fish and Fishery Products (RPF) met in November 1973 in Manila.

This meeting was attended by representatives of **Bangladesh, India, Indonesia, Korea, Pakistan, the Philippines, Singapore** and **Thailand.** The **Federal Republic of Germany** and **Japan** sent observers who also served as consultants and greatly contributed to the scientific deliberations.

The Working Group accepted a Project Agreement draft which foresees regional co-ordination of the scientific programme by common planning, distribution of labour and reporting at annual co-ordination meetings. To achieve these goals, the Governments will make scientific facilities (equipment, materials, etc.) available, for the purpose of common work. Each Government pledges to provide the services of personnel required to operate, maintain and administer its installations and to bear the costs. The Governments make available, at their installations, places for foreign scientists nominated by the Agency or by the other participating Governments, for work in the RPF. Participating Governments will also send scientists to other countries to conduct collaborative research on RPF.

According to the draft agreement, the IAEA will facilitate the exchange of scientific and technical personnel among installations in different participating countries by means of its Fellowship system. It will also assist in the compilation, publication and distribution of the results of the RPF. In addition, the Agency will consider granting research contracts and assist in securing materials, services, equipment and facilities needed for the RPF.



A good catch of mackerel is unloaded at the Pusan fishmarket, Korea, but its poor keeping qualities limit its va

anyone further inland. Photo: United Nations.

This collaborative work will be guided by the Joint Committee of the RPF, composed of one representative of each Government and of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture.

RESEARCH TOPICS

As regards the scientific programme, the Working Group agreed that research topics will be selected primarily from the following areas:

(a) Radiation treatment (radurization and radicidation) of fresh, cooked, semi-dried and dried fish to prevent microbiological spoilage and to improve the hygiene of the commodity.
(b) Disinfestation studies on sun-dried fish and smoked fish to prevent their deterioration due to insect damage.
(c) Botulism studies to prevent the occurence of *Cl. botulinum* toxins in the irradiated product.

After surveying the personnel and equipment available for the RPF in the various laboratories, the Working Group agreed to concentrate work, at the start, on two major research topics:

(i) Shelf-life extension by irradiation of fresh and dried fish.
(ii) Selection of packaging materials suitable for the irradiation of dried fish.

It is expected that the above work will greatly contribute to the solution of the problems of technological and economic feasibility of fish irradiation in the Region and/or in the individual participating countries. It will have to be found out whether, under the conditions of infrastructure, trade practices, etc. likely to prevail in these countries in the not too distant future, irradiation can be introduced as an efficient means of preserving fish and fishery products, should public health approval become available in the meantime. In spite of the importance of obtaining public health clearance for irradiated fish, it was decided to carry out botulism studies in fish at a later date, when more laboratories can deal with these expensive and time-consuming experiments. At present, Thailand and Indonesia are carrying out such work on a national basis.

Under item (i), experiments to study the shelf-life extension of fresh mackerel, as well as the shelf-life extension and sanitation of dried mackerel, are planned.

Under item (ii), suitability of packaging materials already approved abroad for use in food irradiation, and the suitability of some packaging materials of local origin for their usefulness in food irradiation will be studied.

On these items, work can be performed for a possible initial duration of 5 years.

It was decided that no costly wholesomeness evaluation experiments would be carried out under the RPF. The results of extensive tests are already availabe in a number of countries (including some in the region). As the International Project in the Field of Food Irradiation is now working on some further aspects of the evaluation of wholesomeness of irradiated fish, it is expected that the results will become available before the completion of the technological experiments described above.

A survey of personnel available to the RPF in the 8 participating countries showed a minimum of 53 scientists and 35 auxilliary forces, with experience in the fields of biochemistry, food technology, microbiology and entomology.

Although all participants in the Working Group meeting wanted to start the project immediately, formal accession to the RPF will have to occur in stages as follows: –

At first, only signatories to the RCA (i.e. India, Indonesia, the Philippines, Singapore and Thailand) may sign the RPF Project Agreement. After this, the Joint Committee, to be formed of representatives of the above countries, may invite other interested countries which are not yet signatories to the RCA (at present: Bangladesh, Korea, and Pakistan), to participate.

Both the Project Agreement and the detailed scientific programme of the RPF are currently being submitted to the Governments for their final approval.

It is to be hoped that the results of this first collaborative effort under the RCA will help to avert a substantial portion of the present huge losses of this valuable source of animal protein, and to improve the hygienic state of nutrition of the population in the area by this very peaceful use of atomic energy: food irradiation. The work performed under the special regulations of RCA might furthermore foster the independance and autonomy in nuclear science and technology of the developing countries involved.