The Wholesomeness of Irradiated Food

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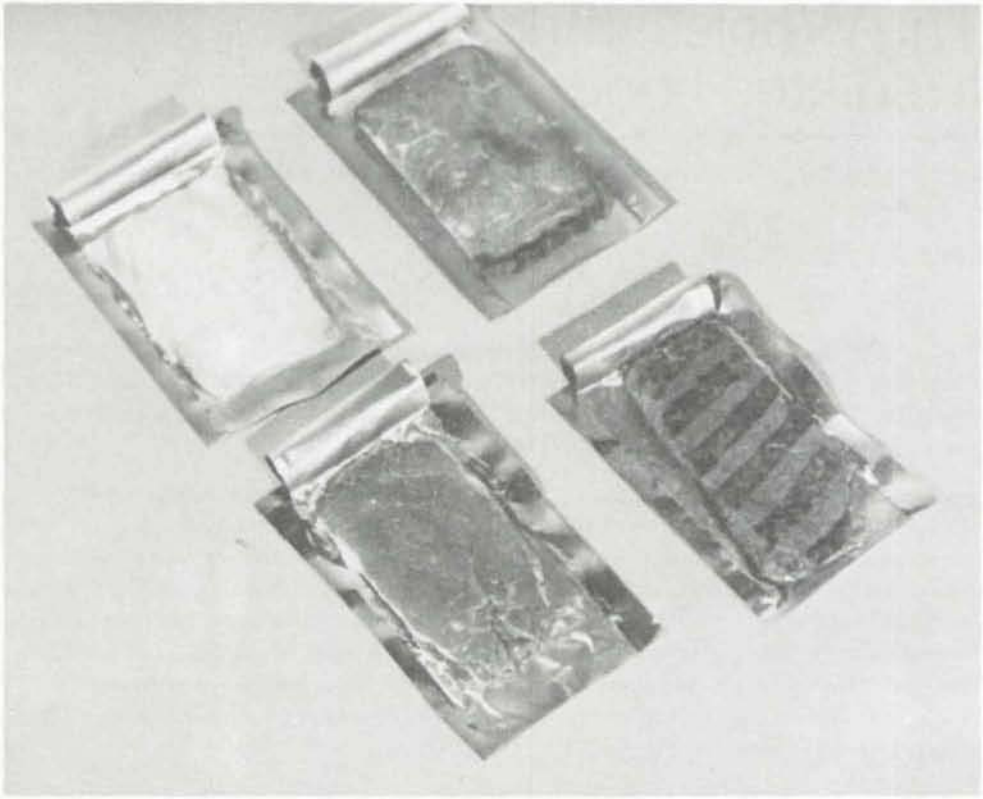
The acceptance of food irradiation as a safe process of preservation by national authorities concerned with the safety of foodstuffs has hitherto made slow progress. The technology has existed for some 25 years but the general attitude towards official acceptance of the process has been marred by irrational and unscientific fears.

As may have been mentioned by previous speakers, the basic process of food irradiation does not differ in the physical sense from any other food processing techniques which involve the application of radiation energy to food. Thus ordinary or microwave cooking uses longer wavelength radiation while food irradiation employs the shorter wavelength of gamma irradiation produced by Co^{60} or Cs^{137} or by electron beams. The energy level used in food irradiation is too low ever to lead to any production of radioactivity in the irradiated food, hence wholesomeness considerations can totally exclude this aspect. The uniqueness of food irradiation rests inherently on the particular type of energy employed and has aroused special attention because of this fact.

The wholesomeness of food treated by heat or microwaves has not been questioned to the same extent, yet the very same question has been raised in relation to treatment by gamma rays and electron beams. Being a new process it requires not only a toxicological but also a microbiological as well as nutritional approach to the assessment of the wholesomeness of irradiated food.

Studies on the radiation chemistry of proteins, lipids and carbohydrates, the main constituents of foods, when irradiated in the Mrad range, have yielded information which shows that these substances react in a reasonably uniform manner to irradiation. Many of the irradiation-induced compounds identified in irradiated foods can also be found in various non-irradiated foods. For those products that have been identified, the quantities found are in the parts per million range or less. Available data on the structures of radiation chemical products in food and the very low concentrations at which they occur, suggest the general conclusion that the health hazard they might represent is negligible.

Radiation chemical data, along with evidence from animal feeding studies, are the basis for assessing the wholesomeness of irradiated food. Compared with chemical studies, animal experimentation is very costly both in terms of time and money. As an example, a long-term study in rats extending over 2 1/2 years using groups of 50 animals of each sex for controls and test groups, together with all ancillary investigations such as haematology, urinalysis, organ function tests, clinical chemistry and histopathology, would cost at today's prices about $100 000. In the past the requirements for various animal tests on irradiated foods had involved expenditures of between $300 000 and $500 000 per food item investigated and an ability to have access to facilities for carrying out these tests. Clearly



Radiation-sterilized meats for the Apollo-Soyuz space project. Shown are ham (top right), beef steak (bottom right), corned beef (bottom left) and smoked turkey slices. Photo: U.S. Army Natick Research and Development Center.

only very few developed countries could undertake and finance such programmes and for these countries irradiation of food was an uneconomic and non-essential alternative to food preservation by refrigeration or chemical treatment.

There are however many areas of the world where such facilities for food storage and preservation do not exist to the same extent or cannot be provided easily for various reasons. In these circumstances, and for many commodities, irradiation of food can contribute greatly to reduction in losses of valuable food from infestation, spoilage or untimely germination. However irradiation had to be proved to be an acceptable means of processing food that did not impair its wholesomeness. It was also recognized that the public and national governments had some concern about the hazards of radiation generally which reflected in a distrust of irradiated foods. Therefore reassurance of the public as to the safety of irradiation as a food process was essential. To this end the three international agencies: FAO, IAEA and WHO jointly developed a machinery for advising interested countries on all aspects, including the wholesomeness, of irradiated foods based on the opinions provided by meetings of internationally recognized experts. To arrive at valid assessments of the safety of irradiated foods these meetings of experts needed scientific data derived initially from extensive animal studies.

Onions treated by irradiation to reduce sprouting have been test marketed in Hungary. Photo: Central Food Research Institute, Budapest.

The International Food Irradiation Project (IFIP) was conceived and set up in 1971 to help in acquisition of wholesomeness information in the most economic and efficient manner and to avoid duplication of expenditure and scientific effort. It was, and is still, guided by the Joint Expert Committee of the three international organizations with respect to the scientific data which need to be gathered. The scientific results as well as the advice of the Joint Expert Committee are made available to each member of IFIP and the costs of investigations are defrayed by the contributions of the whole membership. In addition, the International Project carries out in-house research into the development of appropriate methodology for testing the safety of irradiated food and provides an extensive information service on all aspects of food irradiation. The Project is located in the Institute for Radiation Technology of the Federal Research Institute for Food and Nutrition at the Karlsruhe Nuclear Research Centre.

The studies contracted by the International Project on behalf of the membership included certain mutagenicity studies in rats fed irradiated wheat, multi-generation reproduction studies in mice fed irradiated flour, reproduction and mutagenicity studies in mice and rats and a lifespan feeding study in mice fed irradiated potatoes. Extensive animal studies on mixed fatty and non-fatty fish e.g. lifespan, multi-generation reproduction, teratology and

mutagenicity tests have been commissioned together with short-term rat studies on a variety of representative fish species. Another contract covered multi-generation reproduction, teratology and mutagenicity studies in mice fed irradiated rice. Recently a contract was placed for the investigation of irradiated mangoes in rats by lifespan, reproduction, teratology and mutagenicity studies.

The third Joint FAO/IAEA/WHO Expert Committee on the Wholesomeness of Irradiated Food held in August/ September 1976 in Geneva was able to recommend, on the basis of all available data including those provided by IFIP, the unconditional acceptance as wholesome of irradiated potatoes, wheat, chicken, papaya and strawberries. It gave provisional approval for irradiated rice, fish and onions, thereby implying that sufficient data exist to indicate no hazards to health would arise from consumption of the irradiated product in the diet over the next 4—5 years while additional testing was carried out to establish safety for lifetime use and the findings were evaluated.

The International Project had envisaged for some time that radiation chemical data, along with the negative toxicological, nutritional and microbiological evidence obtained from animal feeding studies during the last 20 years on a large variety of irradiated food commodities, would greatly facilitate the safety evaluation of irradiated foods. It therefore commissioned extensive reviews of the results of radiochemical investigations into basic food components published in the scientific literature.

These reviews indicated that the radiolytic products detected in the wide range of foods and model systems that have been studied do not pose any actual toxicological hazards in the concentrations in which they have been detected. Studies with animals will continue to be important because one cannot assume that chemical analyses have identified all radiolytic products having possible toxicological potential.

However, the general principles of radiation chemical reactions which have now been revealed will permit a reduction in the extent to which biological testing is needed and the application of evidence of safety of one form of irradiated food to other varieties of the same food. This point of view has now been endorsed by the International Joint Expert Committee. This will ease considerably the burden of testing required for acceptance by national authorities of the safety of irradiated foods, whether processed within its own national boundaries or imported as an article of international trade. More indirectly, this supports the future work planned by the International Project to investigate the application of short-term screening tests to irradiated foods to identify those where irradiation forms biologically active compounds in significant quantities.