FOOD PRESERVATION BY IRRADIATION

In 1809 Nicolas Appert, a French confectioner, accepted 12000 francs offered by Napoleon for revealing his method of preserving foodstuff. His invention of heating and sealing, which we call bottling and canning today, was to be the last important step in food preservation for nearly 150 years. Now irradiation, a by-product of nuclear research, has provided an important new technique to add to the classical and centuries-old processing methods.

The fact that ionizing radiation - X-rays in the particular case - could destroy bacteria was recognized by W.K. Röntgen in 1895, and the first scientific paper known to have been published on the subject, by F. Minck, appeared in a Munich medical journal as early as 1896. Although a patent for the preservation of food by irradiation was first obtained in 1930, serious research did not begin before the early 1940's, and large-scale research has only been going on for about a decade and a half.

To review the present situation and to assess the potentialities, 200 experts from 28 countries and four international organisations met at Karlsruhe, Germany (Fed. Rep.) from 6 to 10 June 1966, at a symposium jointly convened by the Food and Agriculture Organisation (FAO) and the International Atomic Energy Agency (IAEA).

Dr. Walther Schnurr, Director of the Karlsruhe Atomic Energy Research Establishment, helps himself to bacon, kept at room temperature for 21 months after irradiation. (Photo: Kernforschungszentrum)

The question uppermost in the minds of the public at large, of whether irradiation was likely to induce dangerous radioactivity in food, was dismissed as constituting no problem. As, for instance, S. Jefferson (UK) explained, it could be shown that the amounts of radioactivity which could possible be induced in articles sterilized by radioactive cobalt (^{60}Co) or electrons or X-rays up to 5 MeV* are negligible. Most of the activated elements produced were very short-lived and comparatively rare. Even if any of the materials became significantly radioactive, the activity would disappear within a period of between one hour and a day, depending on the possible concentration of certain elements.

Aspects of wholesomeness and possible side effects have been resolved in the minds of many scientists, and of some - as yet only a few - health authorities for a certain number of commodities. Many other foodstuffs are under intensive investigation in research institutes throughout the world.

INCREASING STORAGE LIFE

There is no doubt that the keeping capacity under refrigeration of a wide variety of products can be increased by irradiation. For chicken, for for example, it can be at least trebled; fresh fish, it was stated, would keep over a week longer than untreated; the shelf life of apricots, according to French research workers, had been doubled and even trebled and that of strawberries doubled. Some American scientists said that strawberries constituted the most promising fruit for irradiation treatment but that otherwise few fruits or vegetables had shown encouraging results so far. On the other hand, a Soviet participant reported that in his country several kinds of fruit had been successfully irradiated. The acceptability of meat preserved by irradiation, Charles Merritt Jr. (USA) stated, was hampered by the formation of an irradiation flavour and odour, believed to be due to volatile chemical compounds produced by radiation impact. They were a characteristic for raw meat and the same for beef, pork, lamb and others, varying only in intensity. They also depend on the radiation doses, but not on the type of radiation. Generally speaking, such changes, while making some of the food unattractive, had not rendered them unwholesome. This was proved by a number of experiments reported, which had been going on for years with thousands of animals. Several participants pointed out that more careful investigations had been made into possible hazards from irradiation than had ever gone into negative effects known or suspected to result from traditional cooking or preserving methods.

On the other hand, irradiated bacon has been approved for human consumption by the health authorities and is being processed commercially in the United States. In fact, participants at Karlsruhe were served such bacon which had been kept for 21 months at room temperature (20°C to 38°C) - and showed no sign of deterioration. In the Soviet Union, A.V. Kardashev reported, stable fish preserves had been obtained by gamma irradiation and he hoped to be able to offer radiation-treated caviar for sampling at a future symposium.

* *1 MeV = the energy acquired by an electron under the influence of an electric field of 1 million volts.*

Professor V.I. Rogachev (USSR) reported that various kinds of fresh fruit and vegetables, meat, various meat products, had also been approved for human consumption in his country and released in batches to the public. Semi-processed meat had been found to be particularly useful in railway dining cars and had met with the consumer's approval. In 1966, large commercial batches of irradiated meat were going to be issued to restaurants and shops.

Although it had not been possible to introduce irradiation of raw fish on a commercial scale, this was regarded as one of the most attractive applications. Irradiation at sea would offer particular advantages where fishing grounds were rather distant from ports, as for some fish in the United Kingdom, or in ports where fishing grounds were near but land transport routes extended, as in USA. Applications for clearance by the public health authorities, have been submitted for a number of species, such as flounders, sole, cod and clams. Irradiation of potatoes and onions to prevent sprouting has been successful in a number of countries, particularly in Canada, USSR and USA. Canada, whose efforts began in 1956, was one of the first countries to obtain official approval for irradiated potatoes and also the first to set up a commercial food irradiation plant.

ELIMINATION OF HEALTH HAZARDS

The elimination of micro-organisms which can cause serious diseases and even death, such as salmonella, and viruses like foot and mouth disease, were discussed at great length. They have increased in recent years and can be spread through poultry, eggs and egg products, meat and animal feeding stuff.

Progress has been limited and many questions, particularly whether radiation could produce new resistant mutants of bacteria are still to be resolved. Success would help to eliminate specific hazards and would also increase export possibilities for a number of developing countries.

Since the extent of changes in colour, taste, odour and texture - the latter is of particular importance with fruit because it may reduce its transportability - depend largely on the radiation doses employed, attempts are being made to keep them as low as possible. This can be done either by decreasing the resistance of microorganisms to radiation with the help of heat or chemicals or conversely by lowering resistance to chemicals or heat by first administering low radiation doses. While the ideal would be to render all foodstuff durable at ambient temperatures, some papers described procedures where cooling during or after irradiation seemed indicated.

DISINFESTATION

The fact that up to 60% of harvested grain is being lost annually in certain developing countries in the tropical or sub-tropical regions gives special significance to the disinfestation of grain by irradiation. For wheat approval of the process has been given by the US public health authorities, and in the Soviet Union a pilot disinfestation plant is under construction for the purpose of studying the economics. The changes introduced are

considered to constitute no health problem and a Belgian report indicated that better bread could be baked under certain conditions.

Unfortunately the economics, as with all kinds of foodstuffs, are against irradiation methods in those parts of the world where they are most desperately needed. Grain irradiation plants are large, expensive installations and can only be operated economically if backed by a well-developed transport system, allowing a throughput of large quantities. In addition, a truly economical use of such plant could probably only be achieved if more than one commodity were involved, assuming a continuous utilization over most of the year.

IRRADIATION AS A QUARANTINE MEASURE

Disinfestation of passengers' luggage and of fruit, vegetable and timber consignments at sea ports and air terminals could become routine quarantine measures to prevent the entry of insect pests and destructive organisms into a country. According to P.B. Cornwell (UK), a pilot plant for this purpose should start operating at Honolulu Airport in 1967. To illustrate the importance of the problem, he mentioned that 186 million people, unwitting potential carriers of harmful insects, had crossed the USA borders in 1965 and that of 446 000 consignments, 32 000, or 7%, had been found to be infested. He considered that under certain conditions, irradiation could be more effective than present-day methods and more economical.

There are of course still technical problems, while psychological resistance and legal considerations have to be borne in mind. To overcome this, Israel, according to R.S. Khan, was making important public personalities the first target for information and would also launch a publicity campaign for general enlightment. But Israel was not considering irradiation of citrus fruit until legislation in importing countries was changed.

TAKING THE PLUNGE

D. De Zeeuw (Netherlands) asked why a process which could obviously lead to savings and expansion of markets had not been applied more widely. It was an over-simplification, in his view, to ascribe this solely to the general concern of public health authorities. It was rather the potential impact of the new process, not merely on agriculture and fisheries but on many auxiliary or subsidiary industries as well, which was alarming to many people, especially when they realized that this implied large capital investments. Pressure from the public was also missing since, unfortunately, people generally tended to accept what was being offered and rarely asked for better quality and safer food. Other points raised were that not only should the health authorities take a more advanced view in authorizing the production and sale of irradiated foodstuffs, but that the fact that a commodity had been irradiated should be indicated on the packaging so that the public should have the maximum protection and freedom of choice. After a few countries had taken the plunge, said one speaker, others would quickly follow suit.

It appeared that the general feeling of the experts was that although food irradiation was not a panacea, it was certainly a useful tool for the food technologist which could play an important part in combating hunger, and raising the general standard of living. It would take its place beside, and in many instances in conjunction with, conventional techniques such as heat, refrigeration and chemicals.

SCIENCE CAMP FOR GIFTED PUPILS

One of the nuclear reactor centres now under the Agency's safeguards system to ensure that its material cannot be diverted to military uses is annually the scene of an interesting educational venture, in which IAEA fellows have been able to give assistance.

Pupils of outstanding ability in the sciences at Israeli high schools are given an opportunity to attend an annual Science Camp arranged by the country's Atomic Energy Commission. About thirty of them are chosen on recommendations from principals by a selection committee drawn from the AEC and the Society for the Advancement of Science, which also contributes