Part II: A Technology Ready for a Production Boom

How the food irradiation breakthrough was achieved

by Marjorie Mazel Hecht

Fish that stays fresh in the refrigerator for two or three weeks, strawberries that don't go bad, potatoes that don't sprout, and flour that doesn't get mealy: This was the promise of food irradiation in the Atoms for Peace days, and 30 years of extensive testing have proved the technology to live up to every bit of the spectacular expectations. Irradiation eliminates insect infestation, retards spoilage, prolongs shelf life, ensures purity, and permits shipping and storage of meats without refrigeration—all at relatively low cost.

Furthermore, food processed with gamma irradiation is perfectly safe, tastes good, and is as wholesome as it is when fresh. For these reasons, irradiated food was selected by NASA as the best way to feed astronauts in flight.

The Natick story

The pioneer agency in food irradiation research is the U.S. Army, which during World War II asked the Massachusetts Institute of Technology (MIT) to investigate whether irradiation could extend the shelf life of foods needed for feeding the troops abroad. Within five years, MIT had demonstrated the efficacy of food irradiation, and in 1953, the Army set up a special laboratory center—the Quartermaster Corps Research and Development Command in Natick, Massachusetts, near Boston—to consolidate the government-sponsored food irrradiation projects.

Food irradiation was forced to remain in a research-only status, however, when in 1958 Congress passed the Delaney Amendment to the Federal Food, Drug, and Cosmetic Act, which classified food irradiation as a "food additive" and specified a very stringent testing and petitioning procedure item by item before the FDA could grant approval for the commercialization of any irradiated food product.

The history of this Natick lab is a success story in the development of an advanced technology. Once scientists knew in general what the technology could do, they set out to perfect it. As described by Dr. Eugen Wierbicki, a research leader in the project and a specialist in meat science, the project was designed to determine which conditions—irradiation level, temperature of processed food, packaging, and so on—would produce the most wholesome and agreeable products as well as to test the effect of feeding irradiated food to generations of animals. Scientists had to be sure, for example, that the irradiation did not cause the formation of any deleterious radiolytic products in the food being processed, and that there were no genetic changes induced from a diet of irradiated food. They also had to solve aesthetic problems, such as the odd smell that the early experiments with high-dose radiation produced in meats.

Just at the point when the Natick laboratory had without question advanced the technology of food irradiation to the commercialization stage—that is, having produced the data that could objectively meet the the stringent specifications of the FDA—the U.S. Army, under the Carter administration, disbanded the program. In October 1980, all 56 scientists at the laboratory were dispersed around the country, the irradiation source (cobalt-60) was given to a state university for research use, and the laboratory was shut down. The ostensible reason given was that the Army should no longer be involved in something that was ready for commercialization. However, this deliberate destruction of a successful U.S. research team on the verge of realizing the fruits of 30 years' labor is a vivid example of how food irradiation in this country has been sabotaged to prevent the technology from implementing its most important promise: The elimination of hunger and starvation in the world simply by preventing food loss to insects and spoilage.

Today only one of the Natick scientists is still working on food irradiation, under the aegis of the U.S. Department of Agriculture, which took administrative control of the Natick project.

Taking the technology off the shelf

The Food and Drug Administration in March 1981 published an advanced notice of its proposed change in regulations for the approval of irradiated foods. Although a very small step—allowing foods processed with up to 100 kilorads to be commercially marketed with no further testing—it was not until Feb. 14, 1984 that the proposal was given a preliminary green light by the secretary of Health and Human Services, Margaret Heckler, whose agency had been reviewing

the proposed change for three years. The public now has a month to comment on the proposed new regulations, after which time the FDA will issue the final version of the new rules, which will then be law.

In announcing the proposed regulations at a Washington meeting of the National Food Processors Association, Mrs. Heckler noted that "30 years of research on the irradiation process have shown that the proposed levels of irradiation are safe and nutritious" and that irradiation would provide an alternative to the use of the pesticide EDB.

Once law, the new regulations will open the door for commercialization of food irradiation in the United States, although Americans will still not enjoy full range of benefits of the technology because the allowable dosage limit is so low. (See below for what 100 kilorads will do.) Also, since profitability depends upon volume with food irradiation facilities, the proposed 100 kilorad limit of the FDA will restrict commercial growth, by restricting the range of products that can be processed.

There is some possibility that the FDA will up its allowable limit to bring it up to the world standard set two years ago. The internationally recommended standard is 1,000 kilorads—10 times higher than that proposed by the FDA, and the World Health Organization and the Food and Agriculture Organization in 1981 stated unequivocally in proposing this standard that "irradiation of any food commodity up to an overall dose of 10 KGy (1 megarad) presents no toxicological hazard." (A rad is a measurement of radiation absorbed; 1 megarad equals 1 million rads, or 1,000 kilorads, or 10 kilograys, a new proposed radiation measurement unit that is not yet universally used.) Furthermore, WHO wrote, "All the toxicological studies carried out on a large number of irradiated foods, from almost every type of food commodity, have produced no evidence of adverse effects as a result of irradiation."

The three-year review of the FDA regulations within the Health and Human Services agency has centered on the question of labeling: Should irradiated foods bear the label "irradiated?" The agency concluded that this was not necessary, except for bulk shipments (those not yet packaged for individual sale) so that the product would not be irradiated again in processing it for sale. Some countries, including the Netherlands and South Africa, have adopted a small symbol to label irradiated products.

Commercialization: How soon?

There is a handful of U.S. private firms ready to go with commercialization of food irradiation, including Radiation Technology, Inc. and Isomedix in New Jersey and International Nutronics in California. Radiation Technology has been an outspoken advocate of commercialization for years, and currently operates plants in the United States to irradiate food for export, including poultry, grapes, strawberries, and fish. International Nutronics just completed a pilot project plant in Irvine, California (see interview).

Once the new FDA regulations finally go through, these companies expect to be on the front line of a long-awaited revolution in food processing. One of the immediate projects will be the use of irradiation on harvested citrus fruits to kill fruit flies and their eggs, now that the pesticide EDB is about to be banned as a fumigant for this purpose. This use of irradiation, in fact, was specifically mentioned by the Environmental Protection Agency as a viable substitute for EDB, although estimates are that it would take at least 18 months to build the on-site plants required in Florida and other citrus-growing areas.

The new regulations should also open up an export boom, for although 28 other countries now permit the marketing of irradiated foods, the U.S. go-slow attitude has been responsible for the sluggish development of food irradiation worldwide. At this point, the total world output of irradiated food is under 2,000 tons per year, a miniscule amount.

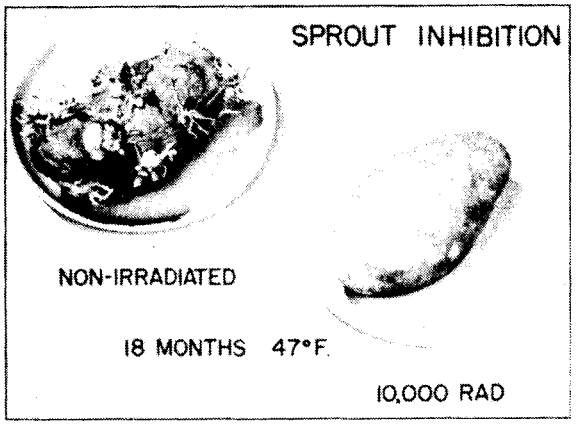
It is in the developing sector, where food spoilage, because of lack of refrigeration and other infrastructure, is a life and death question, that food irradiation could make a critical, short-term difference in providing food to the starving. Even the U.S. Agency for International Development, which is notorious for its funding of population control and low-technology projects only, considers food irradiation an "appropriate technology" for the Third World. In a recent interview, AID official Dr. Robert Morris predicted that within a year the agency would have an active program in this area. At this point, he said, the technology is being reviewed at the top level of the agency in terms of its potential for treating a wide variety of products. It is definitely more appropriate than freezing as a preservation measure and much cheaper than canning; much of the cost of canned foods for a developing sector—50 to 60 percent—is to purchase the containers, Morris said.

The key to how fast this revolution in food production will take hold is consumer acceptance. Here, the fact that the FDA has dragged out its change in regulations over the decade of the 1970s means that the public today is considerably more fearful and less able to apply scientific standards than it was in the Atoms for Peace days or even in the days of NASA's Apollo project. This process of devolution, of course, is deliberately fostered by the environmentalist groups promoting a post-industrial society and the media, and there is every indication that both groups will treat food irradiation as just another assault on their natural environment. The *New York Times*, for example, in its article reporting on the proposed FDA regulations noted that "Some scientists. . .expressed concern about the proposal, saying the long-term safety of food irradiation had not been demonstrated," and then devoted more than one-third of the article to the specific comments of one such scientist, John Gofman. (Gofman's prescriptions for safety testing are such that we probably would not have bathtubs and certainly not automo-

Irradiation: how it works

Food irradiation uses the ionizing radiation (or ionizing energy) from a decaying radioactive isotope such as cobalt-60 or cesium-137 as its radiation source. Ninety percent of the cobalt-60 used in irradiating medical products and food is supplied by Atomic Energy of Canada Limited, a crown corporation, which produces the cobalt-60 as a by-product of its fission reactors. The U.S. Department of Energy is experimenting on a very small scale with cesium-137 as a radiation source, using the waste products from the nuclear defense project. While cobalt-60 has an effective lifetime of 5.5 years before it must be replaced, cesium-137 lasts for 30 years, and its use in food irradiation would literally halve the amount of nuclear waste that the nation has to dispose of.

Irradiation facilities for food or medical supplies are not elaborate. There is the radiation source with its lead shielding, an automatic conveyor system that transports the produce to and from the source, various control systems to manage the processing at the appropriate rate, and storage facilities. The DOE is now building a transportable irradiation unit, the Trans-Portable Cesium-137 Irradiator or TPCI which is expected to test the effectiveness of irradiation in disinfesting crops such as citrus fruits right at the harvest site.



The use of irradiation to inhibit sprouting in white potatoes has already been approved by the FDA. This photograph was provided by Dr. E. Wierbicki, Eastern Regional Research Center, USDA, from research studies.

biles if his judgment prevailed.)

Curiously, a representative for the Isomedix company told this writer that he was not interested in having a pronuclear magazine advocating food irradiation because the company wanted to dissociate itself from the word nuclear to get better consumer acceptance. Specifically, he said he was working with consumer groups associated with Ralph Nader and counting on the cooperation of the Naderites not to attack the irradiation process.

The immediate future

The new FDA regulations would permit 100 kilorads of irradiation to process food. At this low dose level, one of the main applications will be to kill insects. This low-level irradiation is able to easily kill any kind of insect in any physiological stage, compared with other disinfestation measures, which do not always eliminate insect eggs.

With a low dose limit of 100 kilorads:

- potatoes, onions, and garlic can be irradiated to inhibit sprouting (6 to 15 kilorads);
- citrus fruits and tropical fruits can be irradiated to kill all insects and their eggs (20 to 100 kilorads);
- grain in storage can be disinfested (20 to 100 kilorads);
- strawberries and blueberries can be treated to inhibit mold and prolong shelf life for one to two weeks;
- bananas, tomatoes, pears, avocados, mangoes, papayas, and other fruits could have their ripening process delayed (25 to 35 kilorads);
- fresh fish could have its shelf life extended;
- pork could be made free from trichina (the United States now has one of the highest rates of trichinosis among advanced-sector nations and for this reason, a number of European nations embargo U.S. pork products); and
- ground meat could be decontaminated, prolonging its shelf life by lowering its bacteria count (specifically, the pseudonoma bacteria that cause ground meat to putrefy when kept for more than a couple of days, are very sensitive to irradiation).

At the next dose level, 100 to 500 kilorads—above the level that the FDA is scheduled to imminently approve—the irradiation can provide other crucial benefits:

At 100 to 300 kilorads, many pathogens can be eliminated from meats and poultry. For example, salmonella, according to the Interdepartmental Committee on Irradiation Preservation, contaminates as much as half of all chicken and leads to more than a million cases of gastroenteritis per year. Atomic Energy of Canada Limited reports this figure as much higher, 10 to 15 million people in North America yearly, and estimates that 250 irradiation facilities could completely eliminate salmonella in poultry at a cost of 2 cents per pound.

At 200 to 500 kilorads, shelf life of many products can be extended significantly, as can refrigerator storage. Poultry, for example, can stay fresh for up to 25 days. This dose level can also reduce the microbial level of food products

significantly. And at 500 kilorads, frozen shrimp can be guaranteed free from salmonella.

At even higher dose levels, 500 to 1,000 kilorads, spices, condiments, and dehydrated onions can be fumigated efficiently and with no loss of aroma, since irradiation is a dry process. And at 2,000 to 4,000 kilorads, irradiation could serve as a partial replacement for sodium nitrite.

For total sterilization of foods, eliminating all pathogens and viruses, high-dose rates of 1 to 6 megarads are required. With high dose irradiation and secure packaging, food products including meats can stay fresh without refrigeration indefinitely. This is what the astronauts eat in space, and this is the way hospital patients who require germ-free meals can be fed. The Natick laboratory developed a high-dose radiation technique, which first blanches the meat (to prevent enzyme deterioration), vacuum-packs it, and then freezes it and irradiates the packages in the frozen state. Once processed in this way, the meat can be shipped and stored without refrigeration, remaining fresh for years. According to Dr. Wierbicki, these meats were rated tasty in tests by U.S. Army personnel and retained their taste and wholesomeness when tested 10 years later.

The FDA has not yet approved this high dose irradiation for sterilization and long-term storage, but a decision is expected, after the results of a mammoth 8-year study by the U.S. Army and the USDA on irradiation-sterilized chicken are officially reviewed in the near future. To determine wholesomeness, more than 300,000 pounds of sterilized chicken were fed to various animal species for several generations over a period of years.

As reported by Dr. Wierbicki: In all the reports on the study, "...there is not a single indication that the irradiated food performed less efficiently than the nonirradiated control or that it caused any abnormalities in organs, reproduction, and growth (of the animals participating in the study). The only difference between the irradiated food and the canned, thermally processed item, which was the second control, was that the animals usually didn't reproduce and grow as fast as those fed irradiated food. However, this was to be expected, in that thermal canning destroys some amino acids, which is apparent in the protein efficiency ratios of the food."

Many of those who have been working for food irradiation for 30 years, and of course those in the irradiation industry today, have been anticipating the long-awaited commercialization boom since the FDA first announced its intention of changing the regulations on irradiation in March 1981. Their vision is that of the Atoms for Peace years, using the most advanced technology for the benefit of mankind. As the president of Radiation Technology, Inc., Dr. Martin Welt, put it, "The United States can prove to the world that it cares about underdeveloped nations and their peoples by approving radiation preservation of food for American consumers and making use of this same technology for low cost and extended shelf life shipments to the Third World or disaster areas."