FOOD IRRADIATION ISSUES, TECHNICAL AND PUBLIC, IN THE UNITED STATES

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In the past few years in the United States there have been a few controversies relative to our food supply. A certain segment of our population has always been concerned about food additives and the use of pesticides, the allegation being that those chemicals are "unnatural" and can lead to deleterious effects among the consuming population. The issue of pesticide use reached a peak several years ago with the news that eythylene dibromide (EDB), commonly used to disinfest grain, could have long-term carcinogenic effects. The food and agricultural industries are searching for safer chemicals or other techniques to ensure a safe and varied food supply. One technique being studied is Food Irradiation.

"Food Irradiation" is defined, for the purposes of this presentation, as the use of ionizing radiation in food processing.

Current proposals and uses for food irradiation limit the sources to certain radioactive isotopes (cobalt-60, cesium-137) which are sufficiently long-lived and emit penetrating radiation for practical use, and to machines (x-ray, electron beam) which can produce sufficient penetrating radiation with rather simple technology. There are advantages and disadvantages of each source. Radioactive isotopes need to be shielded when not in use; machines produce the radiation only upon electrical stimulation but are more complex technically. Isotope sources have limited useful lives because of radioactive decay.

In a typical food irradiation facility, containers of food are transferred automatically into the radiation field produced by the source. The food is irradiated for a particular time dependent upon the strength of the source. The irradiated food is then automatically transferred outside the radiation field for shipment. Shielded walls would be necessary around the radiation area to protect the public and workers. If the source is a radioactive isotope, a shielded safe would be necessary for storage of the source while it was not being used for irradiation.

There are quite a few reasons for which food irradiation would be useful in processing. In order of increasing radiation dose, food irradiation would be useful for:

Inhibition of sprout formation, and thus increase the shelf-life of sprouting vegetables at 50-150 Gy;

Insect disinfestation at 200-800 Gy;

Elimination of spoilage organisms at 1,000 to 3,000 Gy;

Elimination of pathogenic and parasitic organisms for which 3,000 to 8,000 Gy is necessary;

Food sterilization at 25,000 to 50,000 Gy.

A problem can occur in that spoilage organisms are eliminated at levels lower than that necessary to eliminate pathogenic organisms. The natural taste-smell test for suitability for food may thus become unreliable. If the spoilage organisms are eliminated but pathogenic organisms are allowed to proliferate, organoleptic tests for freshness would be invalid.

For increase in shelf-life, irradiation is suitable for some foods but not others. Papayas, mushrooms, onions, and shrimp can have their shelf-lives extended because of the retardation of evident aging processes. The amount of radiation to be used for each food must be determined empirically. Some species of cherries, for example, can be shelf-life extended, whereas others would be degraded by the irradiation. Irradiation conditions must be determined for each specific food item.

Food irradiation, like anything else, is not a panacea. There are problems associated with irradiation in that food quality may be affected at higher doses, the hygienic quality of the food must be controlled prior to irradiation, and reirradiation may lead to organoleptic deterioration of the food product. As with any other type of irradiation, the effects of food irradiation are cumulative with dose; therefore, food would need to be labeled that it had been irradiated so that a future processor does not reirradiate the food causing deterioration.

Historically, the idea of food irradiation arose in the 1940's when the U.S. Army experimented with the irradiation of food for field use. At that time, many of the techniques currently in use had not been developed resulting in the food's having the famous "wet dog" taste. By selective irradiation techniques of particular foods many of those early problems have been eliminated. Current techniques can include cryogenic temperatures during irradiation, for example.

In 1963 the Food and Drug Administration approved the use of food irradiation to control insect infestation in wheat.

In 1964 the Food and Agricultural Organization of the United Nations issued recommendations concerning food irradiation that included the following:

(1) Legislation concerning food irradiation must be promulgated;
(2) The safety of the food irradiation must be cleared;

(3) Specific foods must be cleared individually;
(4) Compliance must be accomplished using chemical testing, licensing, biological testing, labeling, dosimetry, and record keeping.

In 1980 an FDA committee concluded that animal feeding experiments are not necessary for foods at less than 1000 Gy. That conclusion resulted from chemical analyses of foods which had been irradiated compared to those which had not been irradiated and consideration of the levels of radiolytic products produced versus the amounts that would be necessary for practical animal experimentation.

In 1983 the FDA approved the use of irradiation to control microorganisms and insects in spices. The consideration here included the fact that spices not only are susceptible to microorganism and insect infestation, but also are a relatively small portion of the diet.

In 1985 the FDA approved the use of up to 1000 Gy to control trichinosis in pork. I understand that we are perhaps the only developed nation which has a pork trichinosis problem, and, therefore, our pork is not suitable for export to most other countries in the world.

In April, 1986, the FDA permitted further use of irradiation to inhibit the growth and maturation of fresh food and to disinfect foods adulterated with insects. All foods that are irradiated must be labeled to show this fact, both at the wholesale and at the retail levels. Thankfully, a previous recommendation to use the term "picowaved" has fallen by the wayside. Labeling needs to contain a statement concerning the radiation treatment and bear a symbol which, as the public becomes accustomed to it, may be all that would be required for labeling in the future.

There have been quite a few myths concerning the food irradiation process, and we should discuss some of those myths. First of all, of course, the use of the sources proposed will not make the food radioactive.

Since irradiation causes chemical changes in foods, concern has been expressed that there would be deleterious nutritional deficiencies caused in the irradiated items. It is true that irradiation does result in chemical changes in the foods, and some of the vitamins can be affected. However, those nutritional deficiencies are very small compared with nutritional deficiencies induced by other methods of food processing, such as cooking, or even by storage of the food. Some foods which showed a large decrease in certain vitamins are really minor sources of those vitamins in the American diet.

Some critics have emphasized that irradiation can produce new chemicals in foods. There are radiolytic products induced in food by irradiation. The major radiolytic products are already present in part per million quantities in foods with no apparent harmful effects to the consumer. Unique radiolytic products, that is, those produced only by irradiation and not by any other food processing techniques, are chemically similar to substances already found in food and are of such very small quantities (much less than parts per billion) that they cannot be considered deleterious to the consumer.

Another criticism focuses on the possibility that reirradiation of the same food at various stages in processing can increase the concentrations of radiolytic products. It is true that as dose increases the concentration of radiolytic products in the food also increases. However, because irradiation can also degrade the radiolytic products, the concentration of those products reaches a plateau at approximately 10 kGy, after which further irradiation eliminates as many of the radiolytic products previously formed as causes further radiolytic product formation.

Others emphasize the hazards to workers and public with the use of such a dangerous modality as intense sources of ionizing radiation. Of course, standard health physics techniques are necessary for safe operation of the facility.

A last myth, which has recently surfaced, is that food irradiation is being promulgated simply as a way to use the radioactive wastes that have been produced as byproducts of nuclear power and weapons production. In accordance with this myth, we would become so dependent upon the radioactive isotopes for food irradiation that we would continue nuclear power and defense weapons production simply to obtain the isotopes for this modality. In the United States, this myth is given credence by the fact that the Department of Energy is funding much of the food irradiation research; the fact that DOE must do so under Congressional edict is not considered. The argument, of course, does not address accelerator sources which are proposed for future facilities.

In summary, food irradiation cannot be a panacea to solve all food processing problems. It can, however, be used to save a large percentage of the world's food supply which is lost to pest infestation; it can increase the shelf-lives of many foods, thus increasing the variety of foods available to a larger population; it can eliminate much of the use of carcinogenic insecticides in our food supply; it can reduce the salmonella and trichinosis problems in meat items.