Food Irradiation: A Public Health Challenge for the 21st Century

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Although the United States food supply is generally considered one of the safest in the world, foodborne illnesses remain a concern. Each year, millions of Americans become ill and as many as 5000 die from foodborne infections. The United States Department of Agriculture estimates that medical treatment and productivity losses associated with foodborne illnesses cost as much as $37 billion annually. Irradiation, which involves exposing food briefly to radiant energy, can reduce or eliminate microorganisms that contaminate food or cause spoilage. So far, only limited quantities of irradiated foods—spices, herbs, dry vegetable seasonings, and some fresh fruits, vegetables, and poultry—have been available in the United States. Major purchasers are health care and food service establishments. The World Health Organization reviewed 500 studies and concluded that food irradiation poses no toxicological, microbiological, or nutritional problems. In more than 40 years, there have been no accidents in North America involving transport of the types of radioactive isotopes used for irradiation.

Pasteurization or sterilization of food by irradiation is a technology useful for all classes of food, especially meat and poultry. The international unit for the dose of radiation absorbed is the gray (Gy), which is equal to 100 rads or 10,000 ergs per gram. A kilogray is equal to 1000 Gy. In general, doses <10 kGy are pasteurization doses, and doses >10 kGy are sterilization doses. The World Health Organization, the Food and Agricultural Organization, the International Atomic Energy Agency, and many countries worldwide have endorsed food irradiation so that people can have better and safer food. Astronauts have used irradiated sterilized food since the earliest space exploration.

What is food irradiation? Food is subjected to a specific dose of ionizing radiation from a radioactive isotope of cobalt or from devices that produce electrons or x-rays. This process does not make the food radioactive. Irradiation causes a variety of changes in living cells. How can one treatment do so many different things? High doses kill the cells by fragmenting the DNA, thus killing contaminating microorganisms or insects. Lower doses alter biochemical reactions, such as those involved in fruit ripening or spoilage, and interfere with cell division, which is necessary for the reproduction of parasites.

Foodborne illness is one of the largest preventable public health problems in the United States. Studies by the US Centers for Disease Control and Prevention show that foodborne diseases, such as those caused by Listeria, Salmonella, Campylobacter, Vibrios, and Trichinella species, Escherichia coli, and tapeworms and other parasites, claim thousands of lives annually and cause millions of cases of diarrheal disease and complications. Economic losses associated with foodborne diseases are estimated at several billion dollars by the US Department of Agriculture [1]. The enormous tragedy is that many of these deaths, illnesses, and expenses were and are preventable with the application of current knowledge and proven technology—namely, irradiation. However, diseases of human origin can still contaminate food after irradiation or pasteurization, and therefore the hygienic handling of food is important.

At the same time and parallel with research on the irradiation of food came the irradiation of medical supplies, which came into use in the 1960s in the United States. Today, some 80% of all disposable medical items, as well as many other products, are sterilized in this way. In addition, hundreds of household items in daily use are irradiated to ensure sterilization. Further, some products, such as lumber, wooden flooring, and fiberglass wires, are irradiated to extend and increase durability and functionality.
The slow acceptance of irradiation of food, compared with its rapid acceptance and wide use in treating medical products and commercial goods, is a consequence of the revised Food and Drug Act of 1957, in which irradiation was defined as a food additive instead of a process. Accordingly, subsequent US Food and Drug Administration regulations required extensive testing to ensure the safety of food irradiation. Recently, the US General Accounting Office report to the Congress reviewed the process, and its report [1] (which can guide interested readers to the extensive literature—some 6000 articles) supports food irradiation, adding to the endorsements of the world scientific community.

It is unfortunate that so many objections to irradiation have arisen in the past 50 years; they are reminiscent of the innumerable objections that public health authorities have previously faced regarding other services to protect the public, such as chlorination and fluoridation of water, pasteurization, and even vaccination. In contrast to their efforts on behalf of these previous innovations, public health officers did not strongly support food irradiation, even though the American Medical Association, the American Council on Science and Health, the American Veterinary Medical Association, the Council for Agricultural Science, the National Food Processors Association, the American Meat Institute, and universities with food science departments all were early supporters. Fortunately, the leaders of the US Public Health Service supported food irradiation. In 1992, James Mason, MD, then the Assistant Secretary of Health, stated in a Public Health Service Reports editorial conclusion that “The bottom line on food irradiation is that the nation deserves to have—and should claim—the health benefit this technology will surely provide. We don’t know how great that benefit will be—but we do know it will be significant” [2]. Two years later, Philip R. Lee, MD, the Assistant Secretary of Health and Director of the US Public Health Service, stated:

It is the US Public Health Service’s responsibility to use what we know to protect and improve the health of the public. Each modern food-processing advance—pasteurization, canning, freezing—produced criticism. Food irradiation is no different. It is up to leaders in the health professions to dispel the myths.

The technology of food irradiation has languished too long already. Perhaps our nation has become dangerously complacent about the importance of public health measures. The current health care debate offers us both a mandate and an opportunity to increase the understanding in the importance of public health for ensuring personal health. If this message is lost, our efforts to advance and protect the nation’s health will not succeed. [3]

In 1999, Michael Osterholm, of the Minnesota Health Department, organized a symposium to promote food irradiation to public health officials and food industry officers. In 2000, the first irradiated hamburger patties became available in Minnesota and the upper Midwest and were widely accepted and are now available nationwide. In addition, the Florida Health Department has taken a leadership role in promoting the acceptance of irradiated meat, poultry, and other products, such as fruit and vegetables, for the young and old, especially those in nursing homes and hospices.

Milk pasteurization was a new public health practice in 1900, a process important in the control of childhood diseases and in improving nutrition. This technology cannot be applied to many common food sources of infection, including meat, poultry, fish, vegetables, and fruit. The development and application of irradiation in 2000 offers a low-cost solution to an age-old health problem. Indeed, on the basis of scientific evidence, food irradiation is an effective means of controlling foodborne pathogens and enhancing food safety. However, although irradiation is approved for use on most food items, the lag in consumer acceptance has precluded the extension of this technology to a broader spectrum of food items.

Since the advent of antibiotics some 50 years ago, there has been increasing concern regarding their use in food production. Antibiotics are used in the treatment and prevention of animal diseases, and some are used to promote growth. Some of the gram-negative bacteria—Salmonella, Campylobacter, and coliforms—have developed resistance to antibiotics; they are frequently identified as the cause of human diseases that do not respond to antibiotic therapy. However, irradiation of meat and poultry that might be contaminated with bacteria resistant to antibiotics effectively inactivates these pathogens, just as it does other contaminants. In this regard, irradiation is effective in protecting the public health.

As stated previously, the objections to pasteurization, canning and freezing, water chlorination and fluoridation, and vaccination, as well as misinformation and misconceptions regarding the safety of food irradiation, have fueled consumer skepticism. To paraphrase Pogo, “We have met the enemy, and the enemy is us.” There is an urgent need for health practitioners to speak out on the benefits of irradiation to ensure food safety for all of us in the 21st century.

References

A Supplemental Reading List appears in the electronic version of this article, immediately after the references.

