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## Food Irradiation: *Questions and Answers*

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**Q. *What is food irradiation?***

- A. Irradiation is a process of exposing substances to radiant energy. A more specific and practical description for food irradiation is a process of exposing food to radiant (ionizing) energy for a specified length of time. The amount of exposure is controlled to produce various preservation effects including killing microorganisms that cause spoilage or disease as well as killing insects in foods such as grains or spices.

The radiant energy used in the process is very short light waves with very high energy (gamma rays, X-rays or electron beams). The energy is emitted from machines that produce electron beams or X-rays or from radioactive materials like cobalt-60 or cesium-137 that emit gamma rays. The waves can pass through packaging and some of the energy is absorbed by molecules in the food or living organisms.

**Q. *How does food irradiation work?***

- A. The process of irradiating food is quite simple. Large cases of food or food products can be loaded in pallets onto a conveyor system which will carry them into the irradiation chamber, past the irradiation source, and back out to an unloading station. The speed at which the conveyor moves determines the dose the food product receives and is controlled by computers. The irradiation source (usually cobalt-60) is contained in slender pencil-like stainless steel

casings about 18 inches long by 3/8 inch in diameter. At the heart of the facility, the casings are contained in a lead-lined chamber surrounded by 6½ feet thick concrete walls.

Because waves of irradiation energy are so very short, they penetrate foods or food packaging easily. The energy level is so high, it can even penetrate and break up molecules. Exposure of the food to irradiation energy is controlled so that the dose only causes physical and chemical changes in targeted cellular components, *not* nuclear changes in the atoms that make up food. Living microorganisms may be killed or their genetic material may be damaged to prevent reproduction, but molecules are not changed to the extent that they become radioactive. Gamma irradiation may be compared to turning on a light, illuminating a room, and turning it off again. Gamma rays pass into foods, affect the food or target organism, and leave the food. How the rays affect the food depends on the food, the dose and the organisms in the food.

**Q. *What is a “dose” of irradiation?***

- A. With food irradiation, the “dose” should not be confused with something added to the food. The “dose” for food irradiation is the amount of radiation absorbed by the food and is not the same thing as the level of energy transmitted from the radiation source(s). The dose is controlled by the intensity of radiation and the length of time the food is exposed.

kGy stands for *kilogray*, the unit for measuring the amount of radiation energy absorbed by food when it is exposed to the ionizing radiation. A *gray* (Gy) equals one joule per kilogram; a *kilogray* is 1000 Gy.

**Q. How long has irradiation been used?**

A. Actually, the first patent application for food preservation by irradiation was filed in 1905! But it has really been the last 40 years that irradiation has been in use. Soldiers in the U.S. Army, astronauts in the space program and some hospital patients have been eating food sterilized by irradiation for about that long. Since World War II, extensive research on radiation processing has been sponsored by the U.S. Army and studied by scientists. Although it has been a pioneer in research on food irradiation, the U.S. did not produce irradiated foods commercially until 1992, except for spices. Even a very small percentage of spices irradiated, however. The amount of food irradiated commercially and the number of retail outlets offering irradiated foods have remained small. The concerns about food safety as well as consumer reaction has made the industry wary of applications.

**Q. What kind of foods are irradiated?**

A. Approvals have been granted by FDA and USDA for several uses of food irradiation:

1. Insect control in wheat and wheat flour, 1963.
2. To inhibit sprout development in white potatoes, 1964.
3. To kill insects and control microorganisms in herbs, spices and vegetable seasonings, 1983 and later revisions.
4. To control trichinosis in fresh pork, 1985.
5. To control insects and microorganisms in dry enzyme preparations, 1985.

6. To control insects and ripening in vegetables, fruits and seasonings, 1986.
7. To control microorganisms in fresh or frozen uncooked poultry (including pathogens such as *Salmonella*), 1990 and later revisions.
8. To control microorganisms in fresh chilled or frozen meats, 1997 (FDA) and 1999 (USDA).

These processes still have not been adapted on a large scale by the food industry in the U.S. In fact, until 1992, the only food irradiation was done with a small percentage of spices added to other foods and preparations of the enzyme *rennet* for cheesemaking. Irradiated flour and pork have not been in the grocery stores because manufacturers have not found it commercially practical. The only times that irradiated fruit had been sold in the U.S. was for consumer research studies.

Since 1992, only four retail stores in the U.S. have offered irradiated foods on a continuous basis. These have been primarily produce, although more than a dozen different irradiated foods are being sold. Beginning in 2000, however, distribution of irradiated foods including meats began increasing in the U.S. and more time is needed to tell the true story of consumer acceptance. Food irradiation has been approved by 40 other countries and 27 are considered to have adopted the process successfully.

**Q. If spices are irradiated, why doesn't the label say so?**

A. The spices currently being irradiated are used in prepared foods. The law does not require that irradiated spices sold in the U.S. carry the logo/label if they are in packaged foods where they constitute one small ingredient. Packaged spices on our store shelves are usually treated by chemical fumigation and not by irradiation.

**Q. What are the benefits of food irradiation?**

- A. Food irradiation offers a number of benefits:
1. Food irradiation can extend the shelf life of many fresh foods (keep them fresher longer). This may be done through preventing sprouting, deactivating mold, and killing spoilage bacteria.
  2. Food irradiation can improve world food supplies. There could be less food waste through reduction of postharvest losses. The United Nations estimates that over 25 percent of the world's harvest is lost to spoilage and waste. Irradiation could allow many food items that now spoil quickly to be shipped to other countries, or to be grown, irradiated and stored in other countries.
  3. Food irradiation could replace fumigants and other pesticides, resulting in a reduction of chemical residues in food.
  4. Food irradiation can improve food safety by destroying the microorganisms that cause foodborne illness and parasites that cause diseases. Consumers who have a high risk for foodborne illness, such as the elderly, the very young, and those with compromised immune systems, would especially benefit from irradiated food.
  5. Food irradiation causes little change in the 'fresh' characteristics of foods because the process raises the temperature of foods very little, if at all, at the doses used. In fact, it can extend shelf life of produce and make it possible to keep these foods longer and in better condition.

**Q. Can irradiation be used for foods already containing microbial toxins or viruses?**

- A. No. Just like with canning, freezing or other food processes, only good quality, wholesome food should be irradiated. Processes to destroy bacteria may not destroy pre-formed toxins and viruses. Food processors will not be adopting food irradiation for the purpose of covering up badly contaminated, or unwholesome, food in the food supply.

**Q. What are the problems with irradiation?**

- A. It is difficult to think of any problems with food irradiation technologies, aside from the need for specialized processing facilities. The design and management of facilities has already been well-studied, however.

Concerns have been raised about the nutritional quality of irradiated foods and the creation of harmful new substances in foods. Extensive research has shown that neither concern is well-founded. Most of the chemical compounds found in irradiated foods are identical to those found in baked or broiled food. The nutritional quality of irradiated food is essentially equivalent to that of fresh food products; the range of values is affected more by how we store and take care of the food than it is by the process of irradiation.

**Q. Tell me more about how irradiation affects the nutritional value of food?**

- A. At doses below 1 kGy, irradiation does not affect the nutritional content of foods. Proteins, carbohydrates and fats are not greatly affected by irradiation at doses up to 10 kGy. Losses of these nutrients are still small at very large doses, up to 50 kGy.

No trace minerals are lost at any irradiation dose.

A small percentage of vitamins may be lost when doses of irradiation are above 1 kGy. Still, these losses are about the same as, or even less than, those from other processes like cooking, canning or freezing. Losses can be reduced by irradiating food at low temperatures in the absence of oxygen. Further loss can be minimized by storing foods in sealed packages at low temperatures.

**Q. How will I know if food has been irradiated?**

- A. Throughout the history of food irradiation in this country, labeling has been considered essential to inform consumers. Initial labeling requirements were approved in 1986. Those regulations required that all products be labeled at the packing/wholesale and retail levels. At the retail level, the label was required to contain an international symbol (logo) known as the *radura*, a circle partially broken in the top half with a plant-like petal image in the center. This symbol had to also be accompanied by one of these statements: "treated with radiation" or "treated by irradiation." In 1990, the requirement for a disclosure statement was made permanent. It was determined that the public was not yet familiar enough with the meaning of the *radura* logo for it to be used without a statement.



The manufacturer was also permitted to voluntarily add a phrase to truthfully describe the primary purpose of the treatment and the type of radiation used. Unpackaged (loose) fruits and vegetables could be labeled on each piece, on the shipping container if prominently displayed, or on a sign near the commodities.

Legislation in November 1997 (The FDA Modernization Act of 1997, Public Law 105-115) contained food provisions that directed FDA to review its labeling rule for irradiated foods. The agency was told to revise the labeling rule so that the disclosure statement could not be required to be more prominent than the declaration of ingredients. The ruling did not exclude making a disclosure of irradiation through use of the *radura*.

A notice of proposed new regulations for labeling requirements for irradiated foods was published by the FDA in February 1999. Comments about labeling of irradiated foods were requested, and 15 stated questions were posed for respondents to address. Comments were due in May 1999; no new rules have been published as of this date. FDA has the development of a final rule in their 2001 agenda. The *radura* symbol with an accompanying statement is still required.

FSIS-USDA requires that irradiated meat and poultry be properly labeled. The *radura* logo must be on the label of packages of product where the entire content was irradiated, as well as the phrase "treated by irradiation (or with radiation)." If irradiated meat is used in a meat product such as pork sausage, the ingredient statement must list "irradiated pork" as an ingredient.

If a meat or poultry producer uses the word "irradiated" in the product name, it is not necessary for the producer to place the phrase "treated by irradiation (or with radiation)" on the label. The "*radura*" logo must, however, be on the label.

Also, according to the USDA's Agricultural Marketing Service, foods labeled "organic" may not be irradiated.

**Q. Does any government agency monitor the use of irradiation in foods?**

- A. The Food and Drug Administration (FDA) has authority over food irradiation as a food additive. It is the agency responsible for reviewing petitions for approval and issuing regulations.

Guidelines for use may be issued by other agencies responsible for various commodities, however. For example, subsequent to FDA approvals of irradiation for disinfecting fruits and vegetables, USDA's Animal and Plant Health Inspection Service (APHIS) issued guidelines for irradiation as a quarantine treatment for papayas. After irradiation of fresh pork to control trichina was approved, USDA's Food Safety and Inspection Service issued guidelines for the use of the process. Likewise, because of the jurisdiction of FSIS over meat and poultry products, in 1992 USDA issued rules for irradiation processing of poultry. (It was USDA and Radiation Technology Inc. of New Jersey that petitioned FDA for approval of the radiation-pasteurization of poultry in the 1980s.)

**Q. Will I need to refrigerate irradiated foods?**

- A. At the approved doses, irradiation does not eliminate the need for careful handling, storage and cooking of perishable foods. For example, the levels of irradiation that have been approved for poultry and now meat can reduce numbers of pathogenic and spoilage bacteria, but do not sterilize the products. Thus, poultry and meat products will continue to require proper refrigeration and handling by retailers and consumers to prevent surviving organisms and later contaminants from multiplying.

The low dose of irradiation approved for fresh pork in 1985 affected only the microscopic trichina parasites, sterilizing them so they can't reproduce inside the human body to cause trichinosis. That dose is too low to kill other common bacterial pathogens still on the pork. Higher doses that offer control of most meat pathogens are now approved for pork through the approvals for red meat issued in 1997. However, irradiation is still viewed as a complement to, not a replacement for, proper food handling practices including storage.

The other low-dose irradiation processes approved in this country can extend shelf life, but shelf life is still measured at the same storage temperatures as otherwise recommended.

**Q. Is irradiation technology used for other purposes in the U.S.?**

- A. Irradiation technologies are now being utilized in medicine, making nonstick cookware coating, in manufacture of some plastic food wraps and for making tires more durable! Some of the medical needs for irradiation include sterilizing surgical supplies, medical and dental X-rays for diagnosis of disease, treatment of some diseases, sterilizing pharmaceutical products and producing sterilized food for special hospital diets. X-rays are used to inspect food and luggage at airports. Irradiation is also used to increase brilliance of precious stones such as diamonds, or to change the appearance of other stones such as topaz.

**Q. Will irradiated food cost more?**

- A. Estimates of expected price changes for specific foods are difficult to make, as the volume of food that will be treated and other factors will greatly influence item costs. As interesting background, however, a study of the economics of food irradiation by Rosanna Mentzer

Morrison of the Economic Research Service, USDA, estimated the costs of using an electron accelerator and a cobalt-60 irradiator for irradiating selected foods (fish fillets, papayas, chicken and strawberries) in facilities of various sizes. Assumptions about inputs, operating procedures, utility costs and many other factors had to be made in this analysis.

Average costs per pound for the irradiation process were similar for the two types of irradiators, but initial investment costs varied up to \$1 million between the two types. Irradiation treatment costs ranged from 0.5 to 7 cents per pound\*, with the costs per pound declining as the volume of treated food increased. Hours of annual

operation also will influence irradiation costs. Under-utilization of facilities raises cost per unit and there are high fixed costs to operating an irradiator. Price will also be influenced by transportation costs to get the food to an irradiation facility.

\*Costs varied from 0.5 cent per pound for an electron accelerator irradiator treating 416 million pound of chicken per year to 7 cents per pound for an electron accelerator facility irradiating 6 million pound of fish fillets per year.

(Source cited: Morrison, R. M. An Economic Analysis of Electron Accelerators and Cobalt-60 for Irradiating Food. Technical Bulletin No. 1762. Economic Research Service, U.S. Dept. of Agriculture, Rockville, MD. June 1989).

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