Food Irradiation: What Is It?

Radiation is broadly defined as energy moving through space in invisible waves. Radiant energy has differing wavelengths and degrees of power. Light, infrared heat, and microwaves are forms of radiant energy. So are the waves that bring radio and television broadcasts into our homes. Broiling and toasting use low-level radiant energy to cook food.

The radiation of interest in food preservation is ionizing radiation, also known as irradiation. These shorter wavelengths are capable of damaging microorganisms such as those that contaminate food or cause food spoilage and deterioration.

That capability—plus the fact that much of our food supply is lost due to spoilage and insects each year—is why scientists have been experimenting with irradiation as a method of food preservation since 1950. They have found irradiation to be a controlled and very predictable process.

Irradiation can be compared to pasteurization. As in the heat pasteurization of milk, the irradiation process greatly reduces but does not eliminate all bacteria. Irradiated poultry, for example, still requires refrigeration, but would be safe longer than untreated poultry. Strawberries that have been irradiated will last two to three weeks in the refrigerator compared to only a few days for untreated berries. Irradiation complements, but does not replace, the need for proper food handling practices by producers, processors, and consumers.

Two things are needed for the irradiation process.
1) A source of radiant energy, and
2) a way to confine that energy.

For food irradiation, the sources are radioisotopes (radioactive materials) and machines that produce high-energy beams. Specially constructed containers or compartments are used to confine the beams so personnel won't be exposed.

Radioisotopes are used in medical research and therapy in many hospitals and universities. They require careful handling, tracking, and disposal.

Machines that produce high-energy beams offer greater flexibility. For example, they can be turned on and off unlike the constant emission of gamma rays from radioisotopes.

What happens when food is irradiated?

Irradiation is known as a cold process. It does not significantly increase the temperature or change the physical or sensory characteristics of most foods. An irradiated apple, for example, will still be crisp and juicy. Fresh or frozen meat can be irradiated without cooking it.

During irradiation, the energy waves affect unwanted organisms but are not retained in the food. Similarly, food cooked in a microwave oven, or teeth and bones that have been X-rayed do not retain those energy waves.

What foods are irradiated?

Irradiation has been approved for many uses in about 36 countries, but only a few applications are presently used because of consumer concern and because the facilities are expensive to build.

In the United States, the Food and Drug Administration (FDA) has approved irradiation for eliminating insects from wheat, potatoes, flour, spices, tea, fruits, and vegetables. Irradiation also can be used to control sprouting and ripening. Approval was given

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in 1985 to use irradiation on pork to control trichinosis. Using irradiation to control *Salmonella* and other harmful bacteria in chicken, turkey, and other fresh and frozen uncooked poultry was approved in May 1990. In December l997, FDA approved the use of irradiation to control pathogens (disease causing micro-organisms such as *E. coli* and *Salmonella* species) in fresh and frozen red meats such as beef, lamb, and pork.

What are some potential applications for food irradiation?

Because the irradiation process works with both large and small quantities, it has a wide range of potential uses. For example, a single serving of poultry can be irradiated for use on a space flight. Or, a large quantity of potatoes can be treated to reduce sprouting during warehouse storage.

However, irradiation cannot be used with all foods. It causes undesirable flavor changes in dairy products, for example, and it causes tissue softening in some fruits, such as peaches and nectarines.

Irradiation is most useful in four areas.

Preservation

Irradiation can be used to destroy or inactivate organisms that cause spoilage and decomposition, thereby extending the shelf life of foods. It is an energy-efficient food preservation method that has several advantages over traditional canning. The resulting products are closer to the fresh state in texture, flavor, and color. Using irradiation to preserve foods requires no additional liquid, nor does it cause the loss of natural juices. Both large and small containers can be used and food can be irradiated after being packaged or frozen.

Sterilization

Foods that are sterilized by irradiation can be stored for years without refrigeration—just like canned (heat sterilized) foods. With irradiation it will be possible to develop new shelf-stable products. Sterilized food is useful in hospitals for patients with severely impaired immune systems, such as some patients with cancer or AIDS. These foods can be used by the military and for space flights.

Control sprouting, ripening, and insect damage

In this role, irradiation offers an alternative to chemicals for use with potatoes, tropical and citrus fruits, grains, spices, and seasonings. However, since no residue is left in the food, irradiation does not protect against reinfestation like insect sprays and fumigants do.

Control foodborne illness

Irradiation can be used to effectively eliminate those pathogens that cause foodborne illness, such as *Salmonella*.

All methods used to process and preserve foods have benefits and limitations. Some possible applications for irradiation with certain foods are shown in Table 1.

Table 1. Potential food irradiation uses

Type of food	Effect of irradiation
Meat, poultry, fish	Destroys pathogenic organisms, such as *Salmonella, Clostridium botulinum*, and Trichinae
Perishable foods	Delays spoilage; retards mold growth; reduces number of microorganisms
Grain, fruit, vegetables, dehydrated fruit, spices and seasonings	Controls insect infestation
Onions, carrots, potatoes, garlic, ginger	Inhibits sprouting
Bananas, mangos, avocados, papayas, guavas, other non-citrus fruits	Delays ripening
Grain, dehydrated vegetables	Reduces rehydration time

What concerns are raised by opponents of food irradiation?

The term irradiation often evokes fears of nuclear radioactivity and cancer among consumers. The process seems frightening because it is powerful and invisible. Consequently, questions and concerns exist—particularly about the safety or wholesomeness of irradiated food. Here are some commonly asked questions.

Are irradiated foods radioactive?
No, but the similarity between the two words is confusing. It is physically impossible for irradiated food to be radioactive just as your teeth are not radioactive after you've had a dental X-ray. Irradiation is radiant energy. It disappears when the energy source is removed.

Are toxic radiation products produced?
Over the past 30 years, researchers in several countries have evaluated irradiated foods for chemical products (radiolytic products) which may have formed. The toxicity of those products has been studied also. Opponents of irradiation worry that these radiolytic products are hazardous. Biochemical and biomedical tests have not been able to identify any health problems or ill effects associated with tested radiolytic compounds.

How is food irradiation regulated?
The Food and Drug Administration (FDA) regulates all aspects of irradiation: what products it can be used on, what dose can be used, and how those products are labeled. The U.S. Department of Agriculture (USDA) is responsible for the inspection and monitoring of irradiated meat and poultry products and for the enforcement of FDA regulations concerning those products.

Since 1986, all irradiated products must carry the international symbol called a radura, which resembles a stylized flower.


or


Treated with irradiation **Treated by irradiation**

FDA requires that both the logo and statement appear on packaged foods, bulk containers of unpackaged foods, on placards at the point of purchase (for fresh produce), and on invoices for irradiated ingredients and products sold to food processors.

Processors may add information explaining why irradiation is used; for example, "treated with irradiation to inhibit spoilage" or "treated with irradiation instead of chemicals to control insect infestation."

Accurate plant records are essential to regulation because there is no way to verify or detect if a product has been irradiated, or how much radiation it has received.

Is nutritional quality reduced?

Scientists believe that irradiation produces no greater nutrient loss than what occurs in other processing methods, such as canning. For specific comparisons, see Tables 2 and 3 (on next page).

Table 2. Thiamin retention comparison

Meat	Percent in canned sample	Percent in irradiated sample
Beef	21	44
Chicken	22	66
Pork	12	57

Reference: *Journal of Food Science* 46:8, 1981.

Where can I get more information?

For answers to questions about food irradiation or other food safety concerns, contact your local county extension office.

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Table 3. Vitamin content comparison of cooked chicken
Amounts are for 2.2 pounds (1 kilogram) cooked chicken.

Vitamin	Non-irradiated sample	Irradiated sample
Vitamin A, international units	2200	2450
Vitamin E, milligrams	3.3	2.15
Thiamin, milligrams	0.58	0.42
Riboflavin, milligrams	2.10	2.25
Niacin, milligrams	58.0	55.5
Vitamin B_6, milligrams	1.22	1.35
Vitamin B_{12}, milligrams	21	28
Pantothenic acid, milligrams	13	17
Folacin, milligrams	0.23	0.18

Reference: *Journal of Food Processing and Preservation* 2:229, 1978

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