


Food Irradiation¹

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Food irradiation is one means of food preservation that may not be familiar to many, but it has been in development since the early decades of the twentieth century. If properly applied, irradiation can be an effective way to treat a variety of problems in our food supply, such as insect infestation of grains, sprouting of potatoes, rapid ripening of fruits and bacterial growth. However, it has not yet obtained a significant place in the U.S. food industry. This apparent hesitancy is caused in part by very vocal and active opponents who provide inaccurate information to instill fear about food safety into the public's minds. Many factors of economic feasibility seem to hinge on food industry as well as consumer acceptance, and in turn, have hindered the potential for widespread commercial success of food irradiation.

Radiation is not a modern, man-made creation. We get natural radiation from the sun and other natural components of our environment such as gases and deposits of uranium ore in rock structures. In the 1890s, radioactive substances and X-rays were discovered. Intense research about the biological effects of these radiations began immediately and beneficial uses of these substances were soon found. The biggest contribution of man's use of radiation has been in the medical field -- medical and dental X-rays, detection and treatment of

diseases, sterilization of medical equipment, medical devices, pharmaceutical products, and home products, and production of sterilized food for special hospital diets. It is also interesting to note that for many years precious stones have been irradiated to increase their brilliance, as with diamonds, or to change their appearance, as with topaz, in which irradiation produces a smoky-like appearance in the crystal.

Despite these known benefits of irradiation and the technologies to control its use, consumer acceptance and concern for nuclear issues have hindered the potential for widespread commercial success in this country. However, more than 30 countries have approved and are using food irradiation technologies to ensure food safety. Countries utilizing food irradiation for various purposes include Japan, China, the Soviet Union, the Netherlands and France. In the U.S., irradiated foods have been used by astronauts, the military and hospital patients, but the adoption of the technology for other purposes has been slow despite approvals from the Food and Drug Administration (FDA). For example, the process to control trichinosis in pork, approved in 1985, is still not used. With the recent approval of irradiation for controlling bacteria on raw poultry, attention was again focused on food irradiation.

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History of the Irradiation Preservation of Food

Early in the 1920s, a French scientist discovered that irradiation could be used to preserve food. This technology was not adopted in the U.S. until World War II. At this time there was a need to feed millions of men and women in uniform. The U.S. Army sponsored a series of experiments with fruits, vegetables, dairy products, fish and meats. In 1963, the U.S. saw its first approval of food irradiation when FDA approved its use to control insects in wheat and wheat flour. In 1964, additional approval was given to inhibit the development of sprouts in white potatoes.

In 1983, approval was granted to kill insects and control microorganisms in a specific list of herbs, spices and vegetable seasonings. (The approved list of food products has been increased with later changes.) Then, in 1985, treatment of pork to control trichinosis was added to the list of approvals. In the same year, approval was granted to control insects and microorganisms in dry enzyme preparations used in fermentation-type processes. In 1986, approval was granted to control insects and inhibit growth and ripening in such foods as fruits, vegetables and grains.

Approval was granted in May, 1990, for irradiation of packaged fresh or frozen uncooked poultry. FDA supports it as an effective control of microorganisms responsible for a major portion of foodborne illness, including *Salmonella*, *Yersinia*, and *Campylobacter*. This latest approval is the first approved process to "pasteurize" solid foods, such as poultry. The process reduces but does not eliminate all bacteria. Therefore, processed poultry are safe longer than unprocessed poultry, but still require refrigeration.

What Is "Irradiation?"

Just a mention of the word irradiation usually sparks strong objections, usually based on misunderstanding of the process involved and its effects on foods. Very simply, food irradiation is a process of exposing foods, either prepackaged or in bulk, to very high-energy, invisible lightwaves (radiation). The process controls the amount of radiation the food absorbs.

Food irradiation is a means of preservation; it is used to extend product shelf life. The radiation energy used is able to cause changes in molecules, such as breaking chemical bonds. At small irradiation doses, properties of

the food, such as sprouting and ripening can be modified (usually inhibited). Higher doses can alter molecules in microorganisms so they can no longer cause spoilage or human illness. The microorganisms may be killed or genetically altered so they can't reproduce. It takes lower doses to damage microorganisms and insects than to alter enough molecules in the food to damage it.

For those who want to know more about the radiation that is used and its relationship to other types of energy, it is necessary to look at the electromagnetic spectrum. Food irradiation uses gamma rays, X-rays or electron beams that are part of the invisible lightwaves range of the electromagnetic spectrum. Ultraviolet light (radiation) is also in the invisible range of the spectrum, although the waves of ultraviolet light are not as short as those of X-rays and gamma rays. The shorter the wavelength, the greater the amount of energy per unit.

High energy radiation can break molecules into smaller fragments that may be either electrically charged (ions) or neutral. The electrically charged ions are radioactive. Ultraviolet, X-ray and gamma radiation can break stronger bonds than visible light and even expel electrons from atoms. This is why they may also be called ionizing radiation or ionizing energy.

Other types of radiant energy with longer wavelengths and less energy per unit are infrared and microwave radiation. Thus, conventional cooking methods such as broiling and baking also use radiant energy, but in the infrared range. Cooking with microwaves is accomplished by microwave radiation, energy of yet another wavelength. Microwave radiation is also used to detect speeding cars, to send television and telephone communications, to treat muscle soreness, to dry and cure plywood and to raise bread and doughnuts.

Sources of Radiation (Ionizing Energy)

There are three types of energy that can be used for irradiation of food: X-rays, electron beams and gamma rays. Machines called "electron accelerators" are used to produce beams of electrons to which food can be exposed. If the electrons from the accelerator are stopped by a metal target (such as tungsten foil) first, X-rays are produced and the food is exposed to X-rays. The amount of energy produced by electron beams can be adjusted.

Gamma rays are produced by radioactive substances (called radioisotopes) that continuously emit the high

energy gamma rays. The approved sources of gamma rays for food irradiation are cobalt-60 (the most common) and cesium-137.

Doses and Effects of Radiation

In food irradiation, the radiation "dose" that a food receives 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 it is not the same as the level of energy transmitted from the radiation sources. The dose is controlled by the intensity of radiation and the length of time the food is exposed.

Terms used to describe this "dose" or amount of absorbed radiation, are unfamiliar and confusing to most people. In the past, the term used was **rad**, short for "radiation absorbed dose," which is 100 ergs absorbed by 1 gram of matter. The rad has been replaced by the **gray** (Gy). One gray is equal to 100 rads or 0.00024 Calorie (i.e., diet calorie) per kilogram of food. (0.00024 Calorie per kilogram equals 0.0001 Calorie per pound.) The FDA's regulations describe radiation levels in terms of the **kilogray** (kGy), equal to 1000 Gy.

The dose (number of kGy) permitted varies according to the type of food and the desired action. Treatment levels have been approved by FDA as follows:

- 1) "Low" doses - (up to 1 kGy) designed to
 - a) control insects in grains
 - b) inhibit sprouting in white potatoes
 - c) control trichinae in pork
 - d) inhibit decay and control insects in fruits and vegetables
- 2) "Medium" doses - (1-10 kGy) designed to
 - a) control *Salmonella*, *Shigella*, *Campylobacter* and *Yersinia* in meat, poultry and fish
 - b) delay mold growth on strawberries and other fruits
- 3) "High" doses - (greater than 10 kGy) designed to
 - a) kill microorganisms and insects in spices
 - b) commercially sterilize foods, destroying all microorganisms of public health concern (e.g., to sterilize food to the same degree as if they were thermally sterilized (canned); however, no commercial applications of this dosage have been approved by FDA for use in the U.S. with the

exception of some special hospital diets for immune-deficient patients.)

When radiation energy is absorbed by food, it causes a variety of chemical and physical reactions. The amount of energy the food absorbs is controlled so the changes produced have desirable food preservation effects while maintaining the safety, quality, and wholesomeness of the food. The food itself does not become radioactive.

Perishable foods treated with all but high doses, however, must still be refrigerated. Refrigerated storage life is extended, but the need for cold storage is not replaced by irradiation. Microorganisms are destroyed by radiation more easily than enzymes which lead to food deterioration (color, flavor and texture changes, for example). Many enzymes survive the current levels of radiation processing, although refrigeration can slow down many enzymatic changes. In addition, not all microorganisms are destroyed. The process does not protect the food against reinfestation or contamination. Therefore, irradiated perishable foods are still considered perishable.

Facilities

Facilities for irradiating food are similar to those in operation for sterilizing medical equipment and do not resemble nuclear reactors in any way. There are no explosives or materials that could cause widespread dissemination of radioactive material. Facilities using cobalt do not use materials from nuclear defense industries. Facilities used, however, must comply with plant and worker safety requirements of the Nuclear Regulatory Commission and the Occupational Safety and Health Administration.

At an irradiation facility, the radiation source (usually the cobalt-60) is contained in slender pencil-like stainless steel casing about 18 inches long by 3/8 inch diameter. The casings, in turn, are contained in a lead-lined chamber. Packaged food travels in pallets on a conveyor between 6-1/2 foot thick concrete walls into and through a chamber where it is exposed to the radiation source (gamma rays if cobalt-60 is used). Pallets may be turned to allow uniform exposure over the route. Radiation dosage is controlled by a computerized rate of passage (conveyor speed) through the chamber.

As of June 1989, there were three facilities in the U.S. which irradiated food on a commercial scale. Those in operation have been facilities for sterilizing medical and

other supplies, and who sometimes divert to irradiate bulk loads of spices. One hospital in Seattle is approved for irradiating special diets for immune-deficient patients mentioned previously.

Adoption of the Technology

Although some food radiation treatments have been approved in the U.S. since 1963, only irradiated spices are found on the market today. The food industry is slow to invest in this technology because of uncertainty over the public acceptance of food. The only two times that irradiated food other than spices has been *sold* in the U.S. (as of June 1989) were research test markets. In 1986, 2 metric tons of mangoes irradiated in Puerto Rico were test marketed in Miami, FL. In 1987, irradiated Hawaiian papaya were tested in Anaheim and Irvine, CA. These test market studies as well as others in France, Argentina and South Africa indicated good consumer acceptance and willingness to buy.

Worldwide, over 30 countries approve some form of irradiation and many groups of consumers readily accept these products. As of 1986, Japan irradiated over 10,000 pounds of potatoes annually. The Netherlands irradiated 2 tons of food daily, and Belgium irradiated 1 ton daily. South Africa routinely irradiates mangoes, papaya, and other vegetables. Canada has a facility dedicated to irradiating potatoes.

Labeling of Irradiated Foods

Because the beneficial effects of irradiating foods are not discernable to consumers, labeling has been considered essential if consumers are to be adequately informed. After much debate, the FDA approved initial labeling requirements in April, 1986. The regulations required that all produce be labeled at the packing/wholesale and retail levels. Suggested wording and an international symbol (logo) were provided.

At the retail level, the label must bear the symbol plus one of these statements: "treated with radiation" or "treated by irradiation." In addition, the manufacturer may add a phrase which truthfully describes the primary purpose of the treatment, such as "treated with radiation to control spoilage." For unpackaged fruits and vegetables, labels may be on each piece, on the shipping container placed in prominent consumer view, or on a sign near the commodities identifying the use of the treatment.

For irradiated foods sold at the wholesale level, the logo and the wording are still required. In addition, however, they must be accompanied by the caution "do not irradiate again." Irradiated spices sold in the U.S. do not need to carry the logo if they are in packaged foods where they constitute one small ingredient. Most packaged spices in stores are usually treated by chemical fumigation, not by irradiation.

Safety of Irradiated Foods

Irradiated food does **not** become radioactive. At the radiation energy levels used in food processing, only **chemical** changes are possible, not **nuclear** changes that would make the food itself radioactive. Over 35 years of research suggest that the chemical by-products of radiation ("radiolytic products") are mostly the same as by-products of conventional cooking or other preservation methods. Animal feeding studies show no toxic, teratogenic or mutagenic effects from irradiated foods. In addition, irradiation leaves no chemical residues in food.

In 1981, the Food and Agricultural Organization (FAO) of the United Nations, the International Atomic Energy Agency (IAEA), and the World Health Organization concluded that "any food irradiated up to an average dose of 1 Mrad or less is wholesome for humans and therefore should be approved without further testing" (WHO, 1981 in IFT, 1987). (A Mrad equals 10 kGy.) Also in 1981, the U.S. FDA concluded that food irradiated with up to 1 kGy is "wholesome and safe for human consumption, even where the food that is irradiated may constitute a substantial portion of the diet," and that food "compromising no more than 0.01% of the daily diet [ex., spices] and irradiated at 50 kGy or less also can be considered safe for human consumption" (FDA, 1981).

Before approving low dose irradiation of foods, the FDA reviewed over 400 toxicity studies, which included animal feeding studies. The U.S. Army Medical Department fed irradiated foods to 41 human volunteers in 15-day tests in 1955-58 and showed no unfavorable effects. More recently, in 1986, the People's Republic of China reported on eight experiments with 439 human volunteers. Their diets included 60% of ingredients irradiated at levels from 0.1-8 kGy. During and after these trials, there were no significant differences in the clinical, physiological and biochemical evaluations between the subjects receiving the irradiated foods and those receiving comparable food without such processing.

Changes in Irradiated Food

Food irradiation is sometimes called a "cold" process; it achieves its effect with little rise in the temperature of the food. There is little if any change in the physical appearance of irradiated foods as they do not undergo the changes in texture and/or color as foods preserved by heat pasteurization, canning or freezing. Food remains close to its original state. Problems that have occurred are some off-flavors in meat and excess tissue softening that has been documented in fresh peaches and nectarines.

As with all preservation or cooking methods, some chemical changes occur in irradiated food. When high energy particles strike matter, electrons are lost from atoms and ions are formed. Newly formed radiolytic products may then interact to create new compounds in the food that were not present before treatment, a few of which could produce off-flavors. (In meat, this can be partly controlled by maintaining low product temperatures during the irradiation process.) The most common chemical reaction during food irradiation is the conversion of water to hydrogen peroxide. Reactions like these occur in all types of food preservation, and those few reactions unique to irradiation are not harmful.

The FDA concluded that "very few of these radiolytic products are unique to irradiated foods; approximately 90% of the radiolytic products...are known to be natural components of food" (FDA, 1986). Some of these are fatty acids just like those that result from the breakdown of triglycerides, amino acids that make up proteins, and compounds (hydrocarbons) commonly found in the waxy coverings of fruits like apples, pears and berries. Others are fatty compounds just like those found from cooking meat by common methods such as grilling. The other 10% of radiolytic compounds are chemically very similar to natural components in food. The chemistry of irradiation is very predictable and the products of an individual component such as proteins are not affected by the type of food or other food components present. Radiolytic products have been critically tested for toxicity and no evidence of hazard has been found.

Radiation does not impair activity of certain nutrients, but overall nutrient retention in irradiated foods is similar to retention with other preservation methods. Vitamin C (ascorbic acid) reduction has been reported, but it is attributed to a shift from ascorbic acid to dehydroascorbic acid, a change that is mostly insignificant from a nutritional standpoint. Tocopherol, which have Vitamin E activity, appear to be very sensitive to irradiation in the presence of oxygen. Vitamin K seems relatively stable.

These adverse effects of irradiation on vitamins can be reduced by excluding oxygen and light, keeping the food at a low temperature, and using the lowest dose need for treating (processing) food.

Consumer Acceptance

Studies on consumer acceptance have been done with few irradiated products. Bruhn, Schutz and Sommer (1986) examined change in consumer attitudes toward food irradiation as the result of opportunities to read about and discuss the technology. They found that consumers in general showed a higher level of concern for preservatives and sprays than for food irradiation. "Alternative" consumers who were a vocal segment of ecologically sensitive consumers, were more skeptical about the safety and advantages of the process. They also were initially more aware of food irradiation and their concern increased after educational efforts. After educational efforts, conventional consumers adopted a minor concerned attitude toward irradiation, but a discussion leader knowledgeable in food irradiation reduced concerns of conventional consumers compared with the impact of a non-expert leader. These researchers concluded that the attitudes of conventional consumers can be positively influenced by an educational effort and the influence is most effective when the consumer can interact with someone knowledgeable about irradiation.

Wiese Research Associates (1984) found that less than 25% of a national telephone sample were aware of food irradiation technologies. Among those aware, 75% were concerned, but in general, consumers were more concerned about chemical sprays and preservatives than irradiation. Those with fewer concerns had more formal education and higher levels of awareness.

A market survey of the effects of irradiation on demand for papaya in California in the 1960s suggested that demand would be reduced by 23% if the fruit were treated with irradiation (Huang, et.al., 1987). Acceptance of irradiated produce is quite high in South Africa. Reportedly, 90% of consumers reacted positively to its introduction in the late 1970s. However, the test marketing was accompanied by an extensive educational campaign that involved mass media and supportive consumer organizations (Bruhn, et.al., 1986).

Even though some test marketing has shown some hope for consumer acceptance, irradiated foods have caused picketing and violent protests at other areas. Consumer studies seem to suggest that people are more

interested in the safety and wholesomeness of the foods rather than benefits of the process for any specific foods. These and other findings also seem to indicate that as knowledge and awareness of the technologies increase, so might its acceptance. History indicates that consumer acceptance will continue to influence the extent to which irradiation gets adopted as an alternative food processing technology.

Summary

There is no doubt that food irradiation involves many complex issues. If properly applied, irradiation can be an effective method of reducing organisms which cause food spoilage and human illness. Some benefits of food irradiation include:

- a) Reduction of postharvest losses (less food waste);
- b) Reduction of chemical residues in foods (could replace fumigants and other pesticides)
- c) Reduction of risks of foodborne illness from bacteria (*Salmonella*, *Campylobacter* and *Shigella*)
- d) Reduction of the risk of trichinosis from pork;
- e) More appealing "fresh" characteristics for foods because it is a relatively "cold" process and foods closely resemble those in their fresh state.

The potential benefits of food irradiation may come closer to realization now that regulatory barriers are beginning to be removed, interest in alternatives to pesticides is high and some studies are demonstrating consumer acceptance of products. See Table 1 for Clearances as of March 22, 1988, for use of ionizing energy on foods in the United States.



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Additional Related Resources

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Table 1. Clearances as of March 22, 1988, for use of ionizing energy on foods in the United States (IAEA, 11988a)

Product	Purpose of treatment	Sort of clearance	Dose permitted, kilograys	Date of approval
Wheat and wheat flour	Insect disinfection	Unconditional	0.2 - 0.5	21 August 1963
White potatoes	Shelf-life extension	Unconditional	0.05 - 0.1	30 June 1964
White potatoes	Shelf-life extension	Unconditional	0.05 - 0.15	1 November 1965
Spices and dry vegetables seasonings (38 commodities)	Decontamination/ insect disinfestation	Unconditional	30 maximum	5 July 1983
Dry or dehydrated enzyme preparations (including immobilized enzyme preparations)	Control of insects and/or microorganisms	Unconditional	10 maximum	10 June 1985
Pork carcasses or fresh, non-heat processed cuts of pork carcasses	Control of <i>Trichinella spiralis</i>	Unconditional	0.3 maximum 1.0 maximum	22 July 1985
Fresh foods	Delay of maturation	Unconditional	1	18 April 1986
Food	Disinfestation	Unconditional	1	18 April 1986
Dry or dehydrated enzyme preparations	Decontamination	Unconditional	10	18 April 1986
Dry or dehydrated aromatic vegetable substances	Decontamination	Unconditional	30	18 April 1986

Potential Questions and Answers

Q. What is 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 a 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 6-1/2 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. How long has irradiation been used?

A. Actually, the first patent application for food preservation by irradiation was filed in 1905! But it has only been during the last 40 years that irradiation has been in use. Soldiers in the U.S. Army, astronauts in the space program and some few 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. has not been involved in food irradiation on a commercial scale except in the case of spices. Only a very small percentage of spices are irradiated, however. 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 for several uses of food irradiation:

- a) To control insects in wheat and wheat flour, 1963
- b) To inhibit sprout development in white potatoes, 1964
- c) To kill insects and control microorganisms in herbs, spices and vegetable seasonings, 1983 and later revisions.
- d) To control trichinosis in fresh pork, 1985.
- e) To control insects and microorganisms in dry enzyme preparations for fermentation-type food processes, 1985.
- f) To control insects and control growth and ripening in fruits, vegetables and grains, 1986.
- g) To control microorganisms, including pathogens such as *Salmonella*, in fresh or frozen uncooked poultry, 1990.

These processes still have not been adapted by the food industry in the U.S., with the exception of a small percentage of spices added to other foods and preparations of the enzyme rennet for cheesemaking. Irradiated flour and pork are not in the grocery stores because manufacturers have not found it commercially practical. The only times irradiated fruit has been sold in the U.S. have been for consumer research studies, and the fruit carried the appropriate labeling. More than 30 other countries are using food irradiation technologies to ensure food safety, however. Appendix B of this section lists foods being irradiated on a practical basis as of 1988.

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:

- a) 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.
- b) 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.
- c) Food irradiation could replace fumigants and other pesticides, resulting in a reduction of chemical residues in food.
- d) Food irradiation can improve food safety by destroying the microorganisms that cause foodborne illness and parasites that cause diseases.
- e) 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.

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 storage and handling, for example.

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

- A.** Labeling has been considered essential to inform consumers. Initial labeling requirements were approved in 1986. The regulations require that all produce be labeled at the packing/wholesale and

retail levels. At the retail level, the label must bear an international symbol (logo) plus one of these statements: "treated with radiation" or "treated by irradiation." The manufacturer *may* add a phrase which truthfully describes the primary purpose of the treatment. Unpackaged fruits and vegetables may be labeled on each piece, on the shipping container if prominently displayed, or on a sign near the commodities.

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 regulations for the use of this processing. Likewise, because of the jurisdiction of FSIS over meat and poultry products, USDA will develop rules or regulations 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.

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. The levels of irradiation that have been recently approved for poultry can reduce numbers of pathogenic and spoilage bacteria, but do not sterilize the product. Thus, poultry products will continue to require proper refrigeration and handling by retailers and consumers to prevent surviving organisms from multiplying.

The low dose of irradiation approved for fresh pork in 1985 affects only the microscopic trichina parasites, sterilizing them so they can't reproduce inside the human body to cause trichinosis. The dose is too low to kill other common bacterial pathogens still on the pork. Irradiated fresh pork

under these guidelines would still have to be refrigerated and thoroughly cooked before use. Refrigerated shelf life, 1-2 days in the home refrigerator, would not be extended by the irradiation.

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.** No estimates of expected price changes for specific foods were located. 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).

Media

Suggested Consumer Column/Newsletter Item for Agents

The Controversy: Food Irradiation

"Send x-rays through my food? Wait a Minute!"

If that's your reaction to recent discussions about food irradiation, you may be anxious to hear the facts about this not-so-new method of food preservation.

Irradiation can be an effective way to treat many problems in our food supply, such as insects in grain, sprouting of potatoes, rapid ripening of fruits and bacterial growth.

But you are probably more familiar with a different form of radiation in the medical field. Radioactive substances and x-rays have been used for more than 100 years for medical and dental x-rays, detection and treatment of diseases, sterilization of medical equipment and devices and pharmaceutical products, and production of sterilized food for special hospital diets. It's also been used to increase the brilliance of precious stones.

But irradiating foods? Actually, more than 30 countries have approved food irradiation technologies to ensure food quality and safety. In this country, although the process has been approved by the Food and Drug Administration, the public has been slow to accept the use of this technology.

Food irradiation is, most simply, a means of food preservation to extend the shelf life. It is a process of exposing food, either prepackaged or in bulk, to very high energy, invisible lightwaves (radiation).

The radiant energy is absorbed by food and causes a variety of chemical and physical reactions, such as stopping sprouting or killing insects. The amount of

energy the food absorbs is controlled so the changes have desirable food preservation effects while maintaining the safety and wholesomeness of the food. The food itself does *not* become radioactive.

Even though food has been irradiated to extend its shelf life, you still must refrigerate perishable foods.

Facilities used to irradiate foods must comply with the plant and worker safety requirements of the Nuclear Regulatory Commission and the Occupational Safety and Health Administration. There are no explosives or materials that could cause widespread dissemination of radioactive materials at these plants.

Although some radiation treatments of food have been approved in the U.S. since 1963, only irradiated spices have been on the market. The food industry has been slow to invest in this technology because it is uncertain how the public will accept irradiated foods.

In preparation for use of the technology, the FDA has approved label requirements to let the public know when a food has undergone irradiation. The international symbol features a stylized plant inside a broken circle. The symbol is to be accompanied by the statement "treated with radiation" or "treated by irradiation."

The potential benefits of food irradiation are impressive. It could: reduce postharvest losses which means less food waste; reduce chemical residues in foods by replacing fumigants and other pesticides; reduce the risks of foodborne illness from bacteria; and reduce the risk of trichinosis in pork.

Studies seem to indicate that as knowledge and awareness of the technologies increase, so might its acceptance among consumers. The food industry will continue to respond to the wishes of the public, but also wants the public to know the benefits of this technology.