

BACKGROUND: Food Irradiation

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The Food and Drug Administration on Dec. 2 approved irradiation to control microorganisms on fresh and frozen red meats including beef, lamb and pork. This FDA approval--and some previous ones--were based partly on research by chemist Donald W. Thayer of USDA's Agricultural Research Service.

Following is an overview of irradiation and some of Thayer's findings over the years. For example, he was the first to discover that irradiation could control the meat-contaminating pathogen *E. coli* 0157:H7. He has also found that irradiation kills the *Cyclospora* parasite on raspberries and strawberries.

Irradiation: An Overview

Irradiation passes through food in the form of radiant energy, without leaving any residue. Ionizing radiation--that which produces enough energy to kill bacteria and other pathogens in food--involves the use of gamma rays produced by cobalt or cesium, or X-rays or electrons from machine sources. The Food and Drug Administration has declared that low-dose irradiation of food presents no health risk.

In the 1920's, a French scientist discovered that irradiation could preserve food. During World War II, the U.S. Army tested irradiation on fruits, vegetables, dairy products and meat. Irradiated food has been routinely used for years by NASA.

Donald W. Thayer, a research chemist with USDA's Agricultural Research Service, and colleagues at ARS' Food Safety Research Unit of the Eastern Regional Research Center in Wyndmoor, Pennsylvania, have been testing irradiation on food for 16 years.

Not only does irradiation extend the shelf life of fruits and vegetables, but it also kills pests. Thayer likens irradiation to pasteurization. "When used with the proper handling and processing techniques, irradiation greatly reduces the risk that contaminated meat, poultry and other foods will reach consumers."

"Irradiation reduces the chance of foodborne pathogens reaching the consumer," says Thayer. "Scientific studies conducted worldwide over the past 40 years have shown irradiation to be a wholesome process."

According to Thayer, during the irradiation process, food never comes in contact with any radioactive material. The gamma rays, X-rays, or electrons used in the process do not make food radioactive. Irradiation, he says, is similar to exposure to sunlight or being X-rayed for medical reasons. Specific doses of radiation can kill rapidly growing cells, such as those of insects or spoilage and pathogenic bacteria. But the process has little effect on the food itself because there is no cellular activity in the food. The changes that do occur are similar to the effects of canning, cooking or freezing food.

One concern raised with irradiation is that it may affect the nutritional aspect of food. Thayer reports that irradiation can minimally affect some very sensitive vitamins like B1 in pork.

"But it has been estimated that if all the pork in the United States were to be irradiated, Americans

would lose only 3.2 percent of the vitamin B1 in their diets," Thayer says. "Irradiation converts small amounts of vitamin C in fruit to another equally usable form, so nothing is lost. In fact, multigenerational studies of animals fed irradiated foods show that not only is it safe, but the nutritive value remains virtually unchanged."

Herbs, spices and seasonings can introduce bacteria that may cause spoilage or foodborne disease in food that must be stored or transported before reaching consumers. Some commercial food processors treat spices with methyl bromide to kill insects or with ethylene oxide to control bacteria and mold. Both these chemicals are extremely toxic.

But most spices, herbs and dry vegetable seasonings in the United States are treated with ionizing radiation, which was sanctioned for this particular use by FDA in 1986.

In 1963, FDA authorized the first use of irradiation to treat food in the United States. Wheat and wheat flour were irradiated to rid them of insects. An electron beam--a result of collaborative research between ARS and the U.S. Army--is used to kill insects on about 400,000 tons of wheat a year at the port of Odessa, Ukraine. This irradiation treatment is not used in the United States because for the time being we have other fumigants and methods of getting pests out of grain.

It was 23 years later, in 1986, that irradiation was approved to control insects and inhibit growth and ripening in fruits, vegetables, and grain. Irradiation increases the shelf life of very perishable sweet onions to three months and not only extends the shelf life of tomatoes, but also allows them to be picked when fully ripe. Most flavorless tomatoes taste that way because they're picked green to ensure they get to market before they rot. Zapped by irradiation, mushrooms can last for three weeks without browning or cap separation and strawberries can stay in the refrigerator for three weeks without decay or shrinkage.

Even the dreaded *Cyclospora* parasite succumbs to irradiation. Thayer and colleagues have completed four studies of this pest that has recently been found on raspberries and strawberries.

"We used a dose of irradiation that is recommended for fresh fruit on raspberries infected with *Cyclospora*. Not only does irradiation inactivate the parasite, but it also doubles the raspberries' shelf life," Thayer reports. "More research is planned on irradiating *Cyclospora*, but it reacts in much the same way as *Toxoplasma gondii*, a species of organism that continues to sporulate after irradiation but does not multiply in its host."

Most of Thayer's irradiation work has been with meat to rid it of harmful microorganisms that cause foodborne illnesses.

He was the first to discover that *E. coli* 0157:H7 could be controlled by radiation and he and colleagues have successfully used irradiation against other foodborne pathogens including *Bacillus cereus*, *Clostridium botulinum*, *Listeria monocytogenes*, *Salmonella*, *Staphylococcus aureus* and *Toxoplasma gondii* on meat and poultry.

FDA's 1990 approval to use irradiation on poultry to eliminate harmful pathogens was, in part, a result of Thayer's research, as was the Dec. 2, 1997, approval to irradiate red meat.

In addition to USDA scientists and FDA, the list of endorsers of irradiation includes the U.S. Department of Health and Human Services, U.S. Public Health Service, U.S. Army, National Association of State Departments of Agriculture, American Medical Association, American Dietetic

Association, American Meat Institute, Institute of Food Technologists, and National Food Processors Association. The World Health Organization and the Codex Alimentarius Commission sanction the use of irradiation, which is also being used in about 40 countries.

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