

Status of Food Irradiation Around the World November 2006

Food irradiation is the process of exposing food to high levels of ionizing radiation. The practice has been in existence since the 1950s, but has been more widely used in recent years.

Irradiation has three main purposes: to eradicate pests such as fruit flies on harvested crops, extend the shelf life of food, and kill disease-causing microorganisms, such as *E. coli*, *Salmonella* and *Listeria monocytogenes* found in meat, eggs and other foods. In order to eradicate these microorganisms, higher doses of radiation and greater exposure times are needed than for pest control or shelf life extension. The radiation dose limit in the United States is the equivalent of up to 1 billion chest X-rays.

Irradiation facilities use either gamma rays, X-rays or electron beams. Gamma rays are emitted by the radioactive isotope cobalt-60. Electron beams, or e-beams, are produced by linear accelerators with a maximum energy of 10 million electron volts (MeV). X-rays have a maximum of 5 MeV.

Of the three varieties, X-rays are capable of penetrating most deeply into food, but the process is extremely expensive and energy intensive, so large amounts of food

would have to be irradiated to make it affordable. Therefore, cobalt-60 irradiation is most widely used in the food industry. However, the radioactivity of cobalt-60 has been a concern for neighbors living in close proximity to these irradiation facilities.

The increasing construction of irradiation facilities around the world could have a direct effect on international trade. Pests, such as fruit flies, have been a barrier to trade for countries producing tropical fruits and vegetables. Irradiation may provide a means for eradicating pests, making exotic produce eligible for export to the United States. Internationally, the United States is perceived as a market for irradiated food. In 2006, trade agreements on food irradiation were signed between the United States and various countries around the world. This trend is expected to continue.

This report presents the current status of food irradiation around the world. The first section presents updates by country. The second section provides information about the multinational organizations working to promote food irradiation, including governmental, industry and non-governmental organizations.

STATUS REPORTS BY COUNTRY

Asia

CHINA

China is a rapidly growing market for irradiation, as is the Asia Pacific region at large. China is supportive of irradiation and growth has been rapid in recent years.

The first food irradiation facility was built in 1987. China had only seven facilities in 2003, but the country had 78 by March 2006, with 50 of them processing food. Both gamma and e-beam are used.

Most irradiation facilities have been designed and built by Chinese companies. The facilities are in areas where development is booming, with clusters of plants around Shanghai, Beijing and Yangtze.

The Chinese company JPY operates the three largest gamma irradiators in China. Its Shenzhen facility is the largest, built in 1987 with 2.6 million curies of cobalt-60. The second-largest facility was built in Shanghai in 2003 and has 2 million curies. The third facility was built in Tianjin in 2005 with 0.7 million curies.

As the World Trade Organization makes China a part of international markets, multinationals have greater opportunities to enter the irradiation market and increased competition will likely undermine the profitability of Chinese companies. The multinational corporation Sterigenics already has an e-beam facility in Shanghai.¹ Mergers and market restructuring will likely occur in the irradiation industry.²

In 2005, 140,000 tons of food were irradiated. This was a tremendous increase from the 80,000 tons irradiated in 2001. Irradiation is used primarily to keep garlic from sprouting. It is also used to control bacteria in dehydrated

vegetables, spices, grains and medicinal herbs. More use in the future is expected as a treatment for exported food.²

Regulation

Thirty national regulatory standards for irradiation have been established in China since the 1980s. The Ministry of Public Health approved irradiation in 1986, including rules for facility management, personnel, dose, labeling and punishment for violations.

The first three items cleared for irradiation were pollen, hog carcasses, and sweet potatoes. Many food types have since been added, including dried nuts; processed fruit, dried spices, fruit, vegetables, frozen packaged meat (beef, pork, poultry), beans, grains and grain products, and cooked meat (beef, pork, poultry).

The following institutions support irradiation in China:

- China Society of Nuclear Agriculture Sciences: Nuclear applications for agriculture, plant breeding and irradiation.
- Quality Inspection and Test Center of Irradiated Products, Ministry of Agriculture: legal inspection agency for irradiated food.
- China Isotope and Radiation Association: organizes meetings, provides trainings, helps buy cobalt-60.²

THE PHILIPPINES

Since 2002, several media reports have discussed U.S. interest in providing financial assistance for a food irradiation facility in the Philippines. The facility would treat fruits and vegetables for export to the United States. The mango industry is highly productive in the Philippines, and an export market could absorb excess production. However, most produce cannot be exported due to invasive pests, poor fruit quality, short shelf life and high transportation costs.

The Philippine government believes irradiation could be an effective quarantine treatment for disinfesting fruits for export. The government has lobbied the U.S. Department of Agriculture for a \$10 million grant for the facility. In response, the USDA donated 9,300 metric tons of wheat in 2005 that the Philippines could sell to raise money for the facility. At most, however, the Philippines could raise only \$1.5 million by selling the wheat. No other USDA assistance has been reported since 2005.

THAILAND

In February 2006, the USDA's Animal and Plant Health Inspection Service signed an agreement with Thailand allowing the use of irradiation to kill pests on fruits and vegetables exported to the US. Thailand is the first country to reach such an agreement with the United States.

APHIS approved the import of six irradiated fruits from Thailand: mango, mangosteen, pineapple, rambutan, litchi and longan, and in exchange, Thailand will allow the import of irradiated U.S. agriculture commodities, such as citrus.³

INDIA

India uses irradiation on many agricultural commodities and for many years has been an international center for developing the food irradiation industry. Irradiation has been approved for onions, potatoes, shallots, rice, spices, dried seafood, raisins, figs, dates, fresh seafood, frozen seafood, meat products and mangoes.

The Indian government has supported food irradiation, and the Department of Atomic Energy has built two demonstration facilities that use cobalt-60, both near Mumbai. The facility at Vashi, Navi Mumbai is a high-dose facility that processes spices and dry vegetables (30 tons/day). A low-dose facility in Lasalgaon irradiates onions (10 tons/day), cereals and cut flowers.²

Although India is mostly using cobalt-60, e-beam plants are also being planned. The Board of Radiation and Isotope Technology manages an e-beam machine at the Bhabha Atomic Research Centre (BARC) for commercial services. Two more private companies are operating foreign-built e-beam facilities. Two e-beam machines are under construction by BARC.

India has two additional irradiation plants and three more are being planned. Government support is substantial, as the Ministry of Food Processing is paying for 25 percent of projects, and the Ministry of Science and Technology is making low-interest loans for up to 50 percent.²

In March 2006, President Bush went to India and reached an agreement with Prime Minister Manmohan Singh to use irradiation as a postharvest treatment for fruits and vegetables for trade. Bush said, "the United States is looking forward to eating Indian mangoes."

India is the largest producer of mangoes in the world, accounting for half of all production, but it is only the third-largest exporter. Mangoes make up 15 percent of the total fresh fruits exported from the country. Additional agreements must be reached between the United States and India before mangoes can be irradiated for export to the United States.⁴

IRAN

Iran is investigating the use of irradiation to reduce bacterial contamination in shrimp. Researchers at the Atomic Energy Organization of Iran and the Veterinary General Department of Hormozgan Province are investigating the dosage necessary to reduce contamination in shrimp. The researchers hope irradiation can replace existing chemical treatments.⁵ As of 2003, commercial food irradiation facilities were located in Tehran and Yazd.

PAKISTAN

Pakistan plans to construct two food irradiation facilities, in Lahore and Karachi. The plants are being established jointly by the Pakistan Horticulture Development and

Export Board and the Pakistan Atomic Energy Commission. They plan to irradiate a variety of foods, including rice, wheat, cereals, fruits, vegetables and spices with gamma rays.⁶ Construction has begun on the Lahore facility.⁷

South and Central America

MEXICO

The Mexican company Phytosan is planning to build two food irradiation facilities in Mexico. The first plant in Matehuala is expected to open in April or May of 2007. The second would open in Guadalajara in 2008. Both would be located in fruit fly-free regions and would irradiate guava, star fruit, grapefruit, mandarin oranges and mangoes for export to the United States. On April 25, 2006, Mexico and the United States signed an agreement to use irradiation as a postharvest treatment for fruits and vegetables for export.⁸

BRAZIL

In July 2006, the Brazilian Ministry of Agriculture held a meeting to discuss a proposed regulation for using irradiation to eliminate pests on exports. The agency believes the technology could open up new export markets for fresh fruits, particularly mangoes. Brazil exported 115,000 tons of mangoes in 2005, which brought \$76 million into the country.⁹

Irradiation is not new to Brazil. Tech Ion, a partner of U.S. irradiation company SureBeam, announced vague plans to build between 10 and 20 food irradiation facilities in Brazil a few years ago. However, SureBeam's 2004 bankruptcy seems to have curtailed Tech Ion's plans.

Europe

The EU has placed on ban on further irradiation approvals due to scientific research questioning the safety of some chemicals formed when food is exposed to radiation. The "radiolytic products" in question are cyclobutanones which have been linked to genetic damage.

Anti-irradiation organizations have launched a campaign working to maintain the ban on further irradiation approvals in the EU and to challenge existing approvals to reduce the amount of irradiated food in Europe.

FRANCE

France allows the irradiation of frozen herbs, garlic, shallots, casein, egg whites, frozen shrimp, poultry, frozen frog's legs and additional foods.

The French Collective Against Food is a coalition of food, environment, anti-nuclear and other consumer organizations. The French collective is writing a report on the global food irradiation situation and plans to publish the report and disseminate it through member organizations and the

media in 2006. The report will be used to try to reinvigorate the debate on food irradiation in France and Europe.

UK AND IRELAND

Irradiation monitoring is taking place in Europe, and, both the UK and Irish governments reported finding illegally irradiated food products in 2006. The UK reported that half of all food supplements tested were either wholly irradiated or contained an irradiated ingredient. None of the irradiated products were labeled.¹⁰

In February 2006, AEA Technology (AEAT), a company that was formerly part of the UK Atomic Energy Authority, was found guilty of a series of failings that led to a Cobalt-60 transportation incident two years ago. The company was reprimanded and fined for exposing its employees and subcontractors "to potentially very high risks from radiation."¹¹

In Ireland, 14 samples of noodles tested positive for irradiated ingredients. None of them were labeled. All irradiated products were removed from sale.¹²

North America

UNITED STATES

The United States has roughly 50 irradiation facilities, though most are used for medical supplies and other non-food items. Food irradiation is unpopular among consumers in the country, in part because of federal labeling rules. The U.S. government requires all single-ingredient irradiated foods sold in stores to be labeled "Treated with Irradiation" and carry the "radura" symbol. However, irradiated food served in restaurants, hospitals, schools, nursing homes, day-care centers and other institutional settings do not require a label.

Food Irradiators in the United States: Sadex Corporation purchased SureBeam's e-beam irradiator in Sioux City, Iowa; Food Technology Service in Florida irradiates food at its cobalt-60 facility in Mulberry; and former SureBeam partner Hawaii Pride operates an X-ray irradiator for papayas and other tropical fruit in Hilo, HI.

Retailers: Several companies are known to sell irradiated ground beef in the United States: Wegmans supermarkets in several Northeast states, Publix supermarkets in several Southeast states, Omaha Steaks via mail order, and Schwan's via home delivery. Large amounts of irradiated spices are used in prepared foods that are not required to be labeled.

Recent Government Action: In August 2005, the FDA legalized the irradiation of molluscan shellfish, including oysters, clams and mussels. The agency approved this practice despite the detection of health problems in lab animals fed irradiated shellfish, the presence of chemical byproducts in

irradiated shellfish linked to genetic damage in lab animals and human cells, and the presence of an unpleasant yellow liquid in irradiated oysters that resembles saliva. In addition, the FDA failed to follow its own safety guidelines before issuing this approval.

Still pending before the FDA are industry requests to irradiated crustacean shellfish (including shrimp, crabs and lobsters), and ready-to-eat foods (such as deli meats, pre-bagged salads, frozen meals and baby food).

Recent Indicators of Consumer Apathy: A string of failures makes it clear there is little demand for irradiated food in the United States. As a result of low consumer demand, several irradiation companies have struggled. The 2004 bankruptcy of San Diego-based SureBeam was the most notable failure, resulting in the virtual end of irradiated meat sales and the idling of three irradiators, in Sioux City, Iowa, and near Chicago and Los Angeles. Sadex bought SureBeam's Sioux City facility and reportedly has restarted the plant.

Another failure was the closure of a food irradiation facility operated by CFC Logistics in Milford Township, Pennsylvania, near Philadelphia. This cobalt-60 facility shut down after just a year and a half of operation, citing low demand for irradiated food, particularly for the USDA's school lunch program. CFC Logistics, an affiliate of Hatfield Quality Meats, faced significant opposition from local residents concerned about the safety of the facility and about irradiated foods in general.

In the fall of 2006, food irradiation received renewed media attention in the United States following the E. coli outbreak in spinach from California. As a publicity stunt, Sadex CEO David Corbin ate spinach intentionally contaminated with E. coli and then irradiated. Sadex is among several companies that have claimed future outbreaks could be controlled by using irradiation. However, the FDA has only approved irradiation for fruits and vegetables for plant pest concerns, and not for food safety concerns caused by E. coli and other bacteria.

On May 29, 2003, the USDA dropped its ban on irradiated ground beef in federal nutrition programs, such as the National School Lunch Program. In September 2004, irradiated ground beef was made available to schools at a cost of 29-80 cents more per pound than non-irradiated ground beef. The choice to serve irradiated beef was left up to local school officials. Although Nebraska, Texas and Minnesota made requests for irradiated beef the first year, their orders were never filled due to the higher cost.

For the past three school years, no states have ordered irradiated ground beef through the USDA. About a dozen school districts, including Los Angeles; Washington, DC; and Iowa City, Iowa, have banned irradiated food, citing health concerns and parental opposition.

New U.S. Facilities: A Hawaiian company, Pa'ina Hawaii, is attempting to build a food irradiation facility next to Honolulu International Airport on Oahu. This facility would use cobalt-60 to irradiate produce for export. The local organization Concerned Citizens of Honolulu has raised concerns about aviation accidents, terrorist threats and tsunamis. On behalf of the local group, Earthjustice Hawaii successfully petitioned the U.S. Nuclear Regulatory Commission to require an environmental review of this proposal. The assessment is currently being conducted. The plant has already been delayed significantly because of this legal challenge.

The Role of the United States in Irradiation Around the World: The United States has promoted the use of food irradiation around the world. An October 2002 ruling by APHIS allowed fruits and vegetables irradiated for pest control to be imported into the United States. APHIS requires each country to petition individually and detail which types of products would be imported. Countries must demonstrate that irradiation would remove all regulated pests and then sign a formal agreement with the United States. Thus far, Thailand, India and Mexico have signed such agreements.

Oceania

AUSTRALIA AND NEW ZEALAND

These foods are approved for irradiation in Australia and New Zealand: herbs, spices, herbal infusions, and 9 tropical fruits – mangoes, papayas, lychees, rambutans, custard apples, longans, carambolas, mangosteens and breadfruit. Also approved but not classified as “food” items are “therapeutic” herbal teas/infusions, other therapeutic goods, pet food and grain fed to animals.

Despite a very strong push from the government, irradiation remains widely unpopular among consumers in Australia and New Zealand, so no new irradiation applications have been made. Labeling in Australia and New Zealand is still inadequate, as is monitoring by the government. Free trade agreements with the United States and China, and discrepancy in regulatory systems around the world, mean that while more irradiation is expected, monitoring of irradiation will remain difficult.

In April 2006, the consumer advocacy coalition Food Irradiation Watch released an Irradiation-Free Food Guide for consumers in Australia and New Zealand. As of November 2006, Food Irradiation Watch had distributed 18,000 copies through various outlets including health food stores, restaurants and organic delivery services. In response to the guide, three companies, including 2 large corporations, recently adopted irradiation-free policies.

On March 10, 2006, unlabeled irradiated mangoes were discovered on sale at three stores in New Zealand. There

were no signs in the store or labels on the mangoes, which were sold under the Australian Gold brand. Despite letters and phone calls from food safety advocates regarding this breach of regulations, no enforcement was carried out. As mango season starts again, campaigners will keep an eye out for irradiated mangoes on the market.¹³

Community members in Narangba, Queensland, Australia, the site of a Steritech cobalt-60 irradiator, are filing a class-action lawsuit against the State government for placement of hazardous, noxious and offensive industries, including the irradiator, in their neighborhood.^{14,15}

Africa

SOUTH AFRICA

South Africa has the capacity to produce a large amount of fruit for export to the UK, EU and United States. Under new U.S. rules, South Africa can export irradiated lemons to the United States. South African scientists are also experimenting with citrus, apples and pears.

The South African Nuclear Board reports plans to use a Cape Town facility to irradiate fruit for export, but many questions remain. Still unknown is how widely irradiated products will be accepted, and whether distributors will make a commitment to sell them. Shipping trials are planned for 2007, with commercialization possible by 2008.²

Multinational Organizations

FOOD AND AGRICULTURE ORGANIZATION AND INTERNATIONAL ATOMIC ENERGY AGENCY

The Joint Food and Agriculture Organization/International Atomic Energy Agency Division of Nuclear Techniques in Agriculture has long promoted the use of nuclear technologies to reduce food safety hazards. Both the FAO and IAEA are affiliated with the United Nations.

Among its many activities, this agency is working to harmonize irradiation regulations. The ultimate goal is for member nations to comply with new labeling and treatment standards enforceable through the World Trade Organization.

The IAEA supports irradiation technology throughout the world. Developing nations receive 49 percent of the support, least developed countries receive 39 percent, and developed countries receive the rest. China and India are among the largest targets for expansion.

At the 2006 International Meeting of Radiation Processing held in Malaysia, the FAO/IAEA listed the following as “promising places” for irradiation around the world:

- Egypt
- Iran
- Moldova
- Pakistan
- Philippines
- Poland
- Saudi Arabia
- Syria
- Tunisia
- Vietnam²

INTERNATIONAL IRRADIATION ASSOCIATION (IIA)

The new International Irradiation Association (iiA) re-branded itself by adopting a new name and electing a new board in November 2005. Board membership includes major industry players Revis, IBA, MDS Nordion, Steris, Sterigenics, and Johnson & Johnson. The IAEA has transferred its membership to iiA. This industry-funded organization works to harmonize regulations, defend the industry against regulatory costs, and develop new uses for radiation technologies.

The organization was open for membership in January 2005. The membership includes irradiation service providers, suppliers of irradiation facilities and equipment, consultants, suppliers of items such as dosimeters and users of the irradiation services. Companies with an interest in e-beam, gamma and x-ray technologies are represented.¹⁶ As of March 2006, the iiA had 38 companies in 16 countries. The geographic representation of the iiA is:

- 39% Europe
- 29% Asia and Australia
- 32% North America
- 5% Rest of the World²

INTERNATIONAL COUNCIL ON FOOD IRRADIATION (ICFI)

The ICFI is a new international, non-governmental organization that promotes irradiation to government regulators, the food and nuclear industries, and health professionals around the world. It replaced the International Consultative Group on Food Irradiation, which for many years was the leading industry and government organization that advised the World Health Organization, IAEA and FAO on irradiation research, policy and advocacy. It also advised the UN-affiliated Codex Alimentarius Commission, which in 2003 followed the Group’s recommendation to permit any food to be irradiated at any dose, no matter how high.

Endnotes

- ¹ Sterigenics International. <www.sterigenics.com>
- ² International Meeting on Irradiation Processing, Kuala Lumpur, Malaysia, Feb. 26 - March 3, 2006.
- ³ "United States, Thailand sign agreement on irradiation use for fruits and vegetables." *USDA News Release*, Feb. 1, 2006.
- ⁴ "India seeks early breakthrough for mango exports to US, Japan." *Fresh Plaza* (Netherlands), March 19, 2006.
- ⁵ "Iranian researchers irradiate shrimps." *Mehr News Agency* (Tehran), Sept. 23, 2006.
- ⁶ "Post harvest advanced technologies knocking at exporters doors." *Balochistan Times*, July 9, 2006
- ⁷ FPCCI terms trade policy 2006 as export centered." *Pakistan Newswire*, July 19, 2006
- ⁸ Phytosan S.A. <www.phytosan.com>
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- ¹¹ "Transport case prompts HSE reminder on the importance of radiation protection controls." *Health and Safety Executive*. London, Great Britain. Feb. 20, 2006.
- ¹² "Survey of Noodle Products for Evidence of Irradiation 2005." *Food Safety Authority of Ireland*. March 2006.
- ¹³ "Zapped Aussie mangoes cause shock in New Zealand." *Food Irradiation Eye* (Food Irradiation Watch, Brisbane, Australia), August September 2006.
- ¹⁴ *Food Irradiation Watch*. <www.foodirradiationinfo.org>
- ¹⁵ Personal communication with Robin Taubenfeld, *Food Irradiation Watch*, Nov. 2, 2006.
- ¹⁶ International Irradiation Association. <www.doubleia.org>