THE ISOTOPE ECONOMY

Producing More and Better Food

Lothar Wedekind/IAEA

Using Nuclear and Stable Isotopes

by Marjorie Mazel Hecht

Isotope technologies to increase food production and preserve crops are ready to be mobilized now to help feed the world!

Above: New varieties of rice and other crops have been developed at the Agricultural Genetics Institute in Hanoi, using radioisotope technologies, in collaboration with the IAEA. Here, a test plot at the Institute in 2004.

In the early days of the U.S. Atoms for Peace program, scientists realized that the nuclear fission process could be used for more than just producing electricity and heat. They planned to harness radiation for all sorts of beneficial applications: desalinating water; sterilizing medical supplies and equipment; cancer diagnosis and treatment; space travel; industrial radiography (as diagnostic tracers or for detecting flaws in welds, for example); breeding stronger, more versatile seeds and plants; monitoring agriculture and livestock; controlling insect pests by sterilizing male insects; and disinfesting food crops and extending their shelf life.

For the Atoms for Peace visionaries, the benefits of radiation had no limits! For this reason, the Malthusian oligarchic forces intervened to squelch this optimism, institutionalize scientific pessimism, and to make radiation into a scary word.[1] What the Malthusians feared was that full use of the benefits of radiation would make it possible for all nations to ensure a decent standard of living for their *growing* populations, and that the citizens of nuclear economies would become smart enough to continue to develop technological innovations to support a growing world.

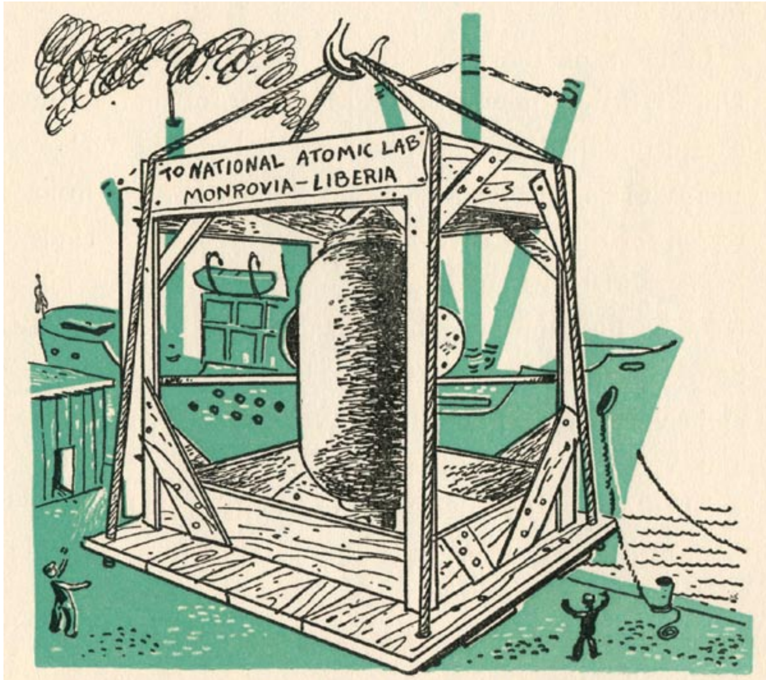
Today, there is no way that our world's 6.7 billion people can survive and thrive, unless we go nuclear, as those pioneers of the 1950s and 1960s intended. This means building 6,000 nuclear plants by the year 2050, simply to keep up with the expected demand for electricity.[2] It means reindustrializing the post-industrial economies by mobilizing around vast infrastructure projects, like the Eurasian Land-Bridge, using the methods that succeeded in the Roosevelt-era Tennessee Valley Authority (TVA). It also means a vast expansion of the known and well-tested nuclear technologies for increasing the food supply—insect control, plant and animal breeding, and food irradiation.

Proliferating Technological Benefits

The main international agency that has sponsored nuclear technologies in the developing sector is the International Atomic Energy Agency (IAEA), which turned 50 in 2007. The IAEA's Technical Cooperation Program, with a budget of $76.8 million, placed about 4,400 trainees in 2006 throughout the world, working in nuclear-related areas. When you consider that we need to double world food production to eliminate hunger, this level of funding and staff is but a drop in the bucket. Imagine what could be done in Africa, for instance, if the projects briefly outlined here were multiplied to exist in every country on the continent.

Plant breeding is one of the IAEA's major Technical Cooperation projects, using controlled mutation induction. This technology, based on the natural mutation of plants, uses radiation techniques to induce genetic changes, from which the favorable characteristics are selected and used to breed new plants. In this way, plants can be made saline resistant, drought resistant, sturdier, or higher yielding.

At a mid-August International Symposium on Induced Mutations in Plants at the IAEA, the head of the agency's Department of Nuclear Sciences and Applications, Werner Burkart, told the 600 plant scientist attendees in his opening address: "Since mutation induction in plants began over 80 years ago, nearly 3,000 varieties from more than 170 different plant species have been introduced, resulting in higher nutritional content, more successful agricultural output, and positive economic impact. Among the many successes of induced mutation is production of wheat in drought-prone parts of Africa, growing of barley in the high Andes mountains of Peru, and boosting of rice production in Vietnam."



Nuclear energy will be brought to less advanced countries.

This illustration by George Wilde from the 1955 children's book, All About the Atom*, by Ira M. Freeman (Random House), captures the Atoms for Peace spirit of that time. As the text states about the less advanced countries: "The main reason for the slow development of many of these lands is the shortage of power." Nuclear energy could make "the neglected parts of the world flourish. In just a few years, they could make more progress than in many centuries before."*

Kenya's research program, in cooperation with the IAEA, is one of the success stories in plant breeding. The Kenya Agricultural Research Institute (KARI) has developed a high-yield, drought-resistant wheat seed, using radiation-breeding techniques. The new wheat seed, Njoro-BW1, was developed over the past decade with mutation plant breeding, under the direction of Prof. Miriam Kinyua, former chief plant breeder and director of KARI. Njoro-BW1 was bred to use limited rainfall efficiently, and it also has only a moderate susceptibility to wheat rust, high yields, and good quality grains for bread baking. With this new seed, farmers have greened the hot and barren dry lands of Kenya, making use of land that was formerly considered unfit for crops.

Wheat is the second most important cereal crop in Kenya, after maize, but the country currently imports two-thirds of its wheat, at skyrocketting prices. Thus the new wheat is vital for

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1. See Marsha Freeman, "Who Killed U.S. Nuclear Power," *21st Century Science & Technology*, Spring 2001 www.21stcenturysciencetech.com/articles/spring01/nuclear_power.html; and Marjorie Mazel Hecht, "The Neo-cons Not Carter Killed Nuclear Energy," *21st Century*, Spring-Summer 2006.

2. James Muckerheide, "How to Build 6,000 Nuclear Plants," *21st Century Science & Technology*, Summer 2005, www.21stcenturysciencetech.com/Articles% 202005/Nuclear2050.pdf

H. Agbogbe/IAEA

Prof. Miriam Kinyua (left), former chief plant breeder and director of KARI, led the drive to produce new varieties of crops in Kenya, including Njoro-BW1 wheat. Here she is walking with farmers and KARI staff in fields seeded with the new drought-resistant wheat.

Kenya's food security. A second wheat variety, DH4, is expected to be released soon. This shares the qualities of Njoro-BW1, and is also hard and red, with high protein and good bread-baking qualities.

In the past five years, in Africa alone, six new varieties of crops using radiation breeding have been released, including sesame in Egypt, cassava in Ghana, wheat in Kenya, banana in Sudan, and finger millet and cotton in Zambia. Such techniques have also been used to develop crops that can tolerate saline soil.

A joint IAEA/UN Food and Agriculture Organization program, which maintains a plant breeding laboratory in Seibersdorf, Austria, has established a network of promising genotypes of selected crops, providing them to farmers. This included in 2006: soybean (in India, Indonesia, and Thailand), peanut (in Bangladesh), mung bean (in China and Pakistan), and sesame (in the Republic of Korea).

Another success story is in Morocco, where saline tolerant plants are beginning to green the otherwise barren saltlands, where the soil has one-third as much salt in it as the ocean. The IAEA estimates that there are more than 80 million hectares of saline soil worldwide that could be greened, in what are called biosaline nurseries. Egypt, Jordan, Syria, Pakistan, Iran, Tunisia, and the United Arab Emirates are now involved in this project.

Stable isotopes are used in the saline project not just for breeding, but also for screening plants to determine their salt tolerance. This involves finding out the relationship between salt tolerance and the ratios of two isotopes of carbon in plants—carbon-12 and carbon-13. Pakistan, which has 6 million hectares of saltlands, is working with Morocco on this project.

Insect sterilization. The Sterile Insect Technique is the only example I know of a good population control program! Male insects are laboratory reared and then sterilized with gamma irradiation. When released into the field, their mating with female insects will produce no offspring. The technique has been used for 50 years as a means of controlling insect populations, usually in conjunction with other methods, such as chemical pesticides. (This is because the insects still bite.)

Insect sterilization has been successfully used on six continents for several different pests: the fruit fly; Mediterranean fruit fly (medfly) in Chile, Mexico, California, and Southwest Asia;

Lothar Wedekind/IAEA

Village leaders and farmers in the village of Thanh Gia in North Vietnam, checking a crop of DT-36 rice in 2004. This hardy variety was developed using radiation technology at the country's Institute of Agricultural Genetics in Hanoi, with IAEA support.

varieties of moth; the melon fly in Japan; and the screwworm in the United States, Central America, and Libya. These pests have caused billions of dollars of damage to food crops and livestock. There are now 10 insectaries—sterile fly breeding factories—the two largest being in Guatemala and Mexico.

The most dramatic success story is the eradication of the tsetse fly from Zanzibar. Tsetse flies attack both humans and livestock, transmitting the sleeping sickness disease (Trypanosomosis), which kills off herds of cattle and debilitates or kills its human victims. In sub-Saharan Africa, there are 22 species of tsetse fly endemic, over 10 million square kilometers (3.86 million square miles). Widespread pesticide-spraying programs in Zanzibar had failed to eradicate the tsetse.

IAEA

Breeding better plants: IAEA researcher Rome Montepeque working with plant mutations in the IAEA's Agricultural Section.

The model program in Zanzibar began in 1994, releasing 72,000 sterile male flies per week by airplane (in biodegradable containers). The flies were mass-bred in insectaries in Tanzania. The sterile flies were marked with a fluorescent dye, so that the ratio of sterile to non-sterile flies could be monitored in traps set across the island to catch the flies.

The last wild fly was captured at the beginning of September 1996. (It was entombed in a Lucite cube and sent to the then head of the IAEA, Hans Blix!)

Another success story is in Southwest Asia, where farmers from Israel, Jordan, and the Palestinian Authority are collaborating to let loose millions of sterile male medflies in the Arava Valley, where this destructive pest turns citrus and other fruit to mush. The flies are released between the Red Sea and the Dead Sea in a two-hour flight.

Livestock breeding. The gains in livestock productivity come from the use of isotopes in monitoring animal nutrition. Radioactive trace elements track digestive processes to help scientists evaluate changes in the animal feed, and design feed that enables the animals to produce better quality milk and meat. The IAEA/FAO program developed an easily digested urea-molasses additive (known as UMB) to animal fodder, for example, that fosters growth, milk production, and reproduction. The UMB is locally produced, and has increased milk production by 10 to 25 percent.

Radioimunoassay techniques, using radioactive iodine to label and track a hormone, have also advanced animal breeding in developing countries, upping milk production and improving reproduction capabilities.

Agricultural efficiency. Both radioactive and stable isotopes are used to track nutrients in soil and provide information for more efficient use of mineral fertilizers. Better soil and crop management as a result of this information has allowed farmers in Africa and Asia to increase yields, under the IAEA/FAO technical cooperation programs.

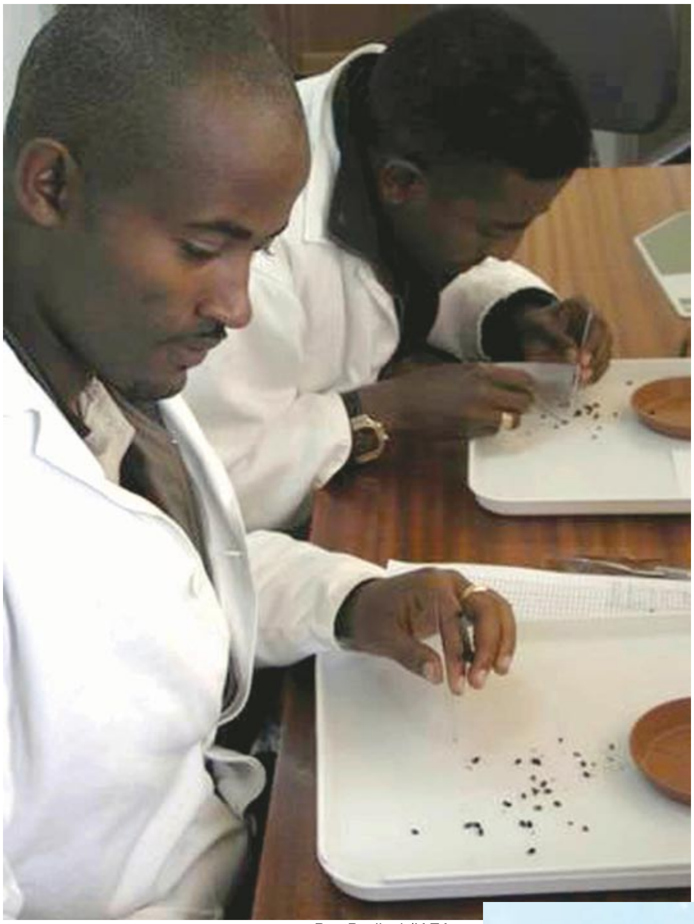
The same is true for the efficiency of water use. Neutron moisture gauges, for example, can accurately measure the moisture in soil. When used with new irrigation methods—mini-sprayers and drippers—the technology has allowed farmers to increase yields with less water, applied in specific stages.

The TVA Method

All of the isotope-based technologies have the potential to increase the quality and quantity of the food supply, as they have already demonstrated for years. But the results are still small-scale compared to the need. The IAEA/FAO program described here was funded at about $76 million a year in 2006. Most of the projects are aimed at improving the lot of the small farmers who make up the majority of the developing sector's agriculture. Imagine the results of gearing up the program in every nation, on the scale of the TVA.[3]

In the 1930s, the Tennessee Valley Authority catapulted a vast area of the U.S. Southeast into the 20th Century, from poverty

3. See the 1945 TVA film, "Valley of the Tennessee," at www.larouchepac.com/news/2008/07/15/ full-versions-documentary-footage-used-film.html



Petr Pavlicek/IAEA

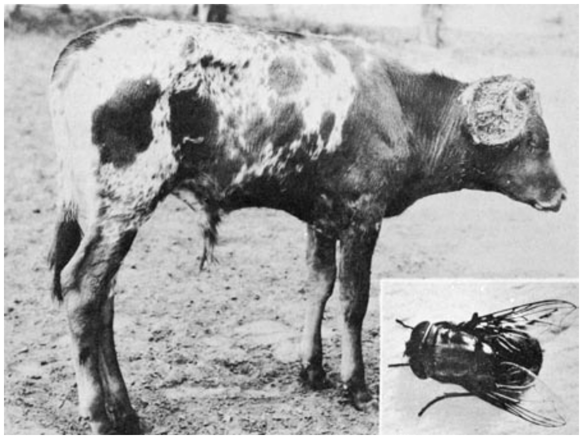
Defeating sleeping sickness: Laboratory technicians in Ethiopia's fly-breeding center separating larvae before they hatch. Inset: Sterile male flies will produce no offspring when they mate.

Harald Baumgartner/IAEA (for flies)

and backwardness. The Federal TVA project, initiated by FDR, planned a large-scale operation to dam the Tennessee River and its tributaries at 49 points, so that rural communities would no longer be at the mercy of nature's whims—floods and droughts.

The building of the dams was essential, but so was the transformation of the people in the area. The TVA recruited farmers into using new methods—contour farming, fertilizers, and new machinery such as tractors. Thirty-thousand farmers were recruited, and their farms served as teaching projects for their neighbors, bringing up the level of farming in the area.

Schools, hospitals, and roads were built. Children could see a future for themselves, a way out of the traditional Appalachian poverty. The TVA brought hope to a forgotten region of the country in a time of Depression. Today we need similar methods to save the lives of millions who are without adequate food to sustain them and to build the infrastructure necessary to eliminate poverty and hunger.



Lloyd E. Brownell, *Radiation Uses in Industry and Science* (Washington, D.C.: U.S. Atomic Energy Commission, 1961), p. 342.

The screwworm is the larva of the fly shown in the inset, which is about three times the size of a common housefly. Screwworms can kill a steer in 10 days if untreated. The female lays eggs—about 200 at a time—in any cut or wound in cattle. The eggs hatch to maggots (screwworms), which then destroy healthy tissue, producing oozing wounds that attract more flies. Irradiating male flies to make them sterile has eradicated screwworms, including in the United States in 1960.

This infrastructure development is crucial in order to make full use of another important tool in increasing the food supply: food irradiation. This technology was envisioned at the dawn of the nuclear age as a lifesaver. Its research was pursued with passion by pioneers, who saw it as a way to provide combat troops with good nutrition, to provide safe food for those who were immune-compromised, and to ensure the safety of the food supply by killing microorganisms. Yet, more than other food-related nuclear technology, its development has been suppressed, or used merely for the specific benefit of the food cartels.

This non-development of food irradiation is a real crime, at a time when 25 to 50 percent (and often more!) of the food produced in the developing sector is lost to rot or insect and rodent contamination.

The Promise of Food Irradiation

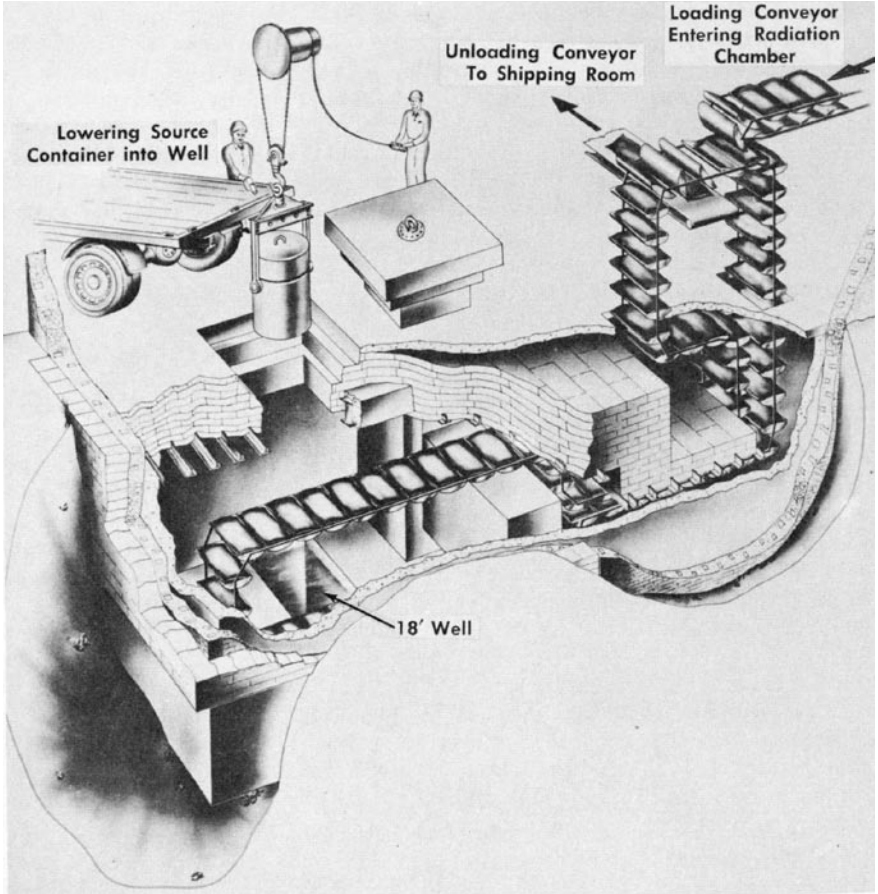
The use of nuclear isotopes from cobalt-60 or cesium, or radiation produced by electron beams, to preserve and disinfest foodstuffs has been researched since World War II. It is safe, relatively cheap, and extremely effective in disinfesting fruits and vegetables; preventing sprouting in onions and potatoes; preserving grains and other stored crops intact for human use, without loss to insects, rodents, and other pests; and eliminating food-borne disease. The taste, texture, and nutrition of the food are preserved.

The radiation process exposes food to low levels of ionizing energy, which can come from three sources: gamma rays (using cobalt-60 or cesium), machine-generated electrons, or X-rays.

The very-short-wavelength radiation penetrates solid particles and kills microorganisms by breaking down the cell walls or destroying metabolic pathways, so that the cell dies. The ionizing energy passes through the food (and its packaging) and kills microbes, bacteria, insects, insect eggs or larvae, parasites, and molds.

Higher-level irradiation can be used to sterilize food, so that no refrigeration is needed. Astronauts, for example, have eaten irradiation-sterilized meals, to prevent foodborne illnesses in space. Cancer patients and others with compromised immune systems also benefit from radiation-sterilized food.

As U.S. public health expert Dr. Michael Osterholm has stressed, there are three pillars of public health that have made the increase of lifespan possible over the last century: pasteurization, immunization, and chlorination. The fourth pillar, he insists, is food irradiation, about which he comments, "I can find very, very few issues in the area of medicine and public health that have unanimous agreement and support of every major public health, medical, and scientific organization in the world."



Lloyd E. Brownell, *Radiation Uses in Industry and Science*, p. 355

Schematic of a flour irradiation facility, designed to treat 100-pound bags of grain, flour, or meal to control insect infestation. At the time, 1960, the estimated cost for a commercial facility like this was $38,320.

Food irradiation has recently been in the news, because on Aug. 22, the U.S. Food and Drug Administration gave the approval for low-level irradiation of iceberg lettuce and spinach to kill the *E. coli* bacteria responsible for widespread illnesses and several deaths. Many products are approved for irradiation in the United States, including spices, grains, fruits and vegetables, poultry, chopped meat, eggs, animal feed and pet treats, and shellfish. Probably most readers have had the benefit of irradiated spices—free from critters and microorganisms—even without knowing it. An estimated 175,000,000 pounds of spices were irradiated in the United States in 2005. In the same year, 18 million pounds of meat and 2 million pounds of fruits and vegetables were irradiated. Other products are available for consumers on a limited basis.

The recent U.S. press coverage has brought out the familiar chorus of fearful naysayers, who have been raising the same, often ignorant or lying objections to irradiation for the last 30 years. From my experience, the purveyors of such irrational or ideological objections have no intention of correcting their misinformation. For more on this topic, readers are referred to other available sources.[4] Instead, the focus here will be on food irradiation in the developing sector.

Food irradiation has been approved in 52 countries for more than 40 products; and there were 150 irradiation facilities in 40 countries, and as of 2005, 20 more irradiators were in construction. From the early days of Atoms for Peace, the IAEA has been concerned with bringing the benefits of irradiation to the places that need it most in the developing sector. The IAEA has researched irradiation technology since the 1950s, testing to find the optimal irradiation conditions for various products. What is the lowest radiation dose, for instance, that will delay sprouting in onions and potatoes, thus making these staples available for consumption for longer periods? All of the IAEA results were made available for use by developing countries,

4. For more information on food irradiation, see www.21stcenturysciencetech.com/steele.html and www.21stcenturysciencetech.com/hecht_irra.html. The Food Irradiation Processing Alliance also has a useful compendium of frequently asked questions on its website, www.FIPA.US, with links to reports on food irradiation by the American Council on Science & Health and the Institute of Food Technologists.

Courtesy of Ron Eustice, Minnesota Beef Council.

One billion pounds of food are now irradiated per year for preservation and disinfestation—a tiny amount compared with the percentage of post-harvest food lost to spoilage in areas where people are going hungry.

through its Food Preservation Section.

The IAEA teamed up with the FAO to offer assistance to governments for specialist training for food irradiation, feasibility studies, and economic development. In the early 1990s, four countries were selected for economic feasibility studies for large-scale commercial irradiators—Chile, China, Mexico, and Morocco.

Some nations began their irradiation program decades ago. Thailand, for example, began irradiated onions (to delay sprouting) in 1971. This was followed by the irradiation of fermented pork sausage, nham, a popular Thai food, which has high consumer ratings. Now, Thailand irradiates many foods, including wheat and wheat products, spices, shrimp, strawberries, and rice. Also in 1971, South Africa began irradiating potatoes, onion, fruits, spices, meat, fish, and chicken. Japan began marketing irradiated potatoes in 1974. Israel approved the irradiation of animal feed in 1973. Russia began irradiation of fruits, vegetables, spices, cereals, meats and poultry starting in 1959; Ukraine began irradiating bulbs, roots, and tubers, as well as poultry and meat in the early 1960s.

China began irradiating spices, vegetable seasonings, sausage, and garlic in Chengdu in 1978. A larger facility in Shanghai began in 1986 to irradiate apples, potatoes, onions, garlic, and dehydrated vegetables. The Shanghai facility aimed at processing about 45 percent of the city's annual supply of vegetables.

Consumer acceptance in China was high: A marketing test in 1985 of 25 tons of apples labeled "irradiated" sold out in less than two days, which surprised the project leadership, because the apples were treated to hold for months in storage. Another survey showed that 10-20 percent of vegetables spoiled every year, at an estimated cost of tens of millions of yuan (minimally $3 million), while fruit loss was estimated at 28,000 tons, valued at 12 million yuan.

Based on the IAEA feasibility study, the Chinese government allocated about $1.1 million to design and construct a commercial irradiator in Beijing to process rice, garlic, and other items for the domestic market. China planned a system of commercial plants, building them near major transportation centers or important agricultural areas.[5]

Commercialization and Globalization

Despite all this activity, commercial food irradiation did not scale up to meet its promise in the 1980s, and certainly not in those countries most in need. The interest was widespread in the developing sector, but development was suppressed largely because of the technology suppression in the United States. Although the U.S. Army and many other laboratories had researched every aspect of irradiation and the specifications for each type of product (and although astronauts were routinely fed irradiated meals to make sure that they did not get food-borne illnesses in space), the commercial powers in the poultry, meat, fish, and produce industries were not interested in the technology. A crushing deterrent was the paradigm-shift to a post-industrial, anti-science culture, with its well-funded Malthusian green groups who opposed any technology that would allow population growth.

This situation changed in the "globalization" and cartelization era of the 1990s, for two reasons.

First, as Europe and the United States outsourced more of their food supplies, imported fruits and vegetables had to be disinfested before importation. Tropical fruits like mangos and papayas, and citrus fruits, for example, could harbor fruit flies that if imported would devastate domestic crops. A frequent disinfestation method (after traditional pesticides were banned) is to pick the fruit green and submerge it in a hot water bath. (This accounts for the tasteless, wooden quality of many long-distance-shipped fruits.) Irradiation provides a solution: Fruit can be picked fully ripe, then irradiated and exported, arriving in a much tastier state at its destination.

When the United States approved irradiation for disinfestation of mangos and papayas, India, which is famous for its mangos, and is the world's largest mango producer, geared up its food irradiation program for the export market. Although India had approved radiation for food preservation in 1955, and

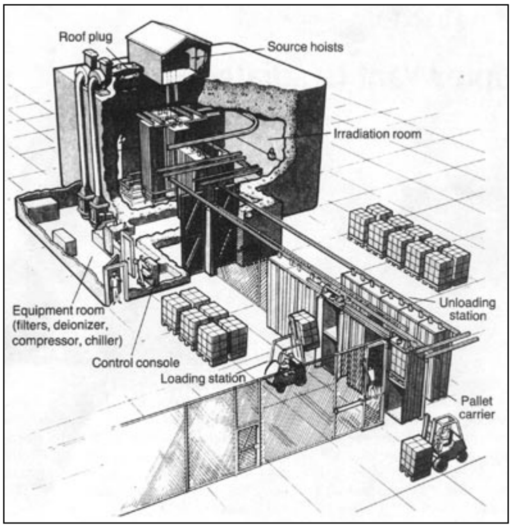
5. Lothar H. Wedekind, "China's Move to Food Irradiation," *Fusion* magazine, November-December 1986.

How Food Irradiation Works

Food irradiation uses the ionizing radiation (or ionizing energy) from a decaying radioactive isotope like cobalt-60 as its radiation source. Electron beams and X-rays can also be used as a source. Gamma rays are able to penetrate more than 24 inches of product, while electron beams can penetrate only about 3.5 inches (in both cases, irradiating both sides of the food product).

The very short wavelength radiation penetrates inside solid particles and kills microorganisms by breaking down their cell walls or destroying the metabolic pathways of the organism so that the cell dies. At higher doses, all microorganisms are killed, sterilizing the processed food.

There is no radioactivity induced in the processed food. The chemical reactions caused by the ionizing radiation do not involve the atomic nuclei of the food, and therefore the atomic structures in the molecules are not changed. Of course, some natural radiation, called background radiation, is present in all foods, but irradiation processing does not add to this.



A Canadian design for a standard pallet irradiator with a cobalt-60 source. The boxed product remains on the same pallet from the completion of packaging, irradiation, and delivery to the customer. For a virtual tour of a similar plant, see www.isomedix.com/JS10000_Tour/Index.html

One of the bugaboos of food irradiation has been the claim that ionizing radiation would change the chemical structure of the food, producing unique radiolytic products (chemicals) that might prove harmful. All the years of testing, however, have determined that of the radiolytic products produced, 90 percent are the same as those in nonirradiated food. The remaining 10 percent are chemically similar to natural food components and constitute only 3 parts per million of the processed food.

The Food and Drug Administration which is responsible for assessing the safety of food irradiation, concluded that the difference between irradiated and nonirradiated foods is so small as to make the foods indistinguishable in respect to safety.

Food irradiation is a "cold" process; that is, it produces no significant temperature increase in the food. This makes it particularly useful for fumigating spices because it does not drive off the volatile substances that give spices their characteristic flavor and aroma. Irradiation also does not damage the nutritional quality of the food.

Decades of research have determined the optimal conditions, packaging, and dose levels for irradiating different types of food products—from grains and vegetables, to shellfish, to cuts of meat and chopped meat. Very low levels of irradiation are required for sprout inhibition (.05 kilogray), slightly more for disinfestation (0.15 kilogray), and greater levels for sterilization (44 kilogray.

Gray*Star, Inc.

*This cobalt-60 irradiator, Gray*Star's Genesis, for food processing, is below ground in a shielded pool. The product is lowered in water-tight containers, called bells, to move past the radiation source in the pool, which is contained in a dry plenum filled with inert helium. This innovative design is less expensive than other irradiators and takes up less space, allowing it to be installed in existing food processing plants.*

The photo at right, taken through 14 feet of water, shows one of the two product bells next to the source plenum.

IAEA

Mangos treated with irradiation can be picked ripe and keep their wholesomeness and flavor longer. High-value mango export has spurred irradiation in India and other countries, but crops for domestic consumption could have a greater impact on the food supply.

moved ahead with products for domestic use, the mango export market spurred major development in pursuit of this high-cash market. An agreement was signed with the U.S. Department of Agriculture in 2006 for India to export irradiated mangos on a commercial scale, under U.S. supervision. As of June 2007, according to Ron Eustice, executive director of the Minnesota Beef Council, and an expert on food irradiation, 75,000 boxes of mangos had arrived in the United States—about 225-250 tons.

Thailand is also approved for the export of mangos and other tropical fruit to the United States. Peru is considering irradiation for asparagus, of which it is the world's largest producer and exporter. The traditional pesticide for asparagus disinfestions, methyl bromide, is being phased out because of the ozone hoax and its Montreal Protocol.

And so, as hundreds of thousands of people face hunger and starvation, one of the tools for producing and preserving more food in the developing sector has been diverted into globalization's high-cash crops. When I asked one food irradiation expert about this, he commented that it was true, but that the revenue generated in those exporting countries would help their domestic situations. This is the typical "free-trade" argument that the Anglo-Dutch empire has been pushing for centuries—as the poor in their former colonies continue to get poorer.

The second reason for the food irradiation gear-up has to do with the highly publicized U.S. outbreaks of food-borne illness—*E. coli* in chopped meat, spinach, and other vegetables—leading to severe illnesses and several deaths. For many large food producers and cartels, now food irradiation is seen as a profitable and necessary business measure.

The Isotope Economy

How do we get from the present situation—the food crisis, the vast underdevelopment of our world, and the imminent global financial collapse that threatens to obliterate civilization as we know it—to the isotope economy, where we will make full use of the known beneficial technologies of the nuclear isotopes and research those not yet known? To do this, we need to revive the spirit of Atoms for Peace today, and institute a crash program to build food irradiation plants and the infrastructure necessary—for harvesting, transportation, and packaging—to the countries that need it most. There are companies that can build a facility to irradiate 50 million pounds of food per year, for $1.6 million, delivered in six months, according to one U.S. expert. With mass production of facilities, the cost and delivery time could be accelerated.

In the Atoms for Peace days in the 1950s and 1960s, food irradiation was seen as so promising that the U.S. Atomic Energy Commission shipped irradiation units to Ghana and Nigeria, for example, for research in this then-nascent technology. There were even plans for small mobile irradiators that could be trucked or taken by rail to harvest sites. What's required now is the political will.

Food irradiation and the other nuclear technologies briefly described here (as well as non-nuclear biotechnologies) are not a "magic bullet" to solve the ongoing food crisis. But they are essential "weapons" in the battle against hunger and disease that are now vastly underused. Any serious campaign to feed the world must expand these technologies—and fully fund the scientific research to discover new beneficial uses of nuclear isotopes. It's time to bring the 21st Century world into "the isotope economy"!

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