INTERVIEW: DR. ARUN SHARMA

Producers and Consumers Benefit From Food Irradiation Technology

Dr. Arun Sharma is the head of the food technology division of the Bhabha Atomic Research Center of India. He has more than 300 publications in national and international journals, and in 2006, he received the Indian Nuclear Society's award for outstanding achievements in the field of radiation and radioisotope applications. This interview with Matthew Ehret-Kump took place at the International Meeting on Radiation Processing in Montreal, June 14.

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21st Century: **Can you describe for our readers what food irradiation is, how it is different from chemical food treatments, and why it is so necessary for nations to attain food security?**

Sharma: Food irradiation is a physical process. The U.S. Food and Drug Administration treats it as an "additive" process, but it is actually a physical process by which the controlled doses of radiation are applied to commodities. Commodities are exposed to controlled doses of radiation to achieve certain objectives, such as food safety, food security, or to overcome quarantine barriers.

Ionizing radiations achieve these objectives by inactivating DNA, the genetic material, of microorganisms or insects that contaminate food, or, at very low doses, by preventing or delaying physiological processes such as sprouting, ripening, and senescence of fresh fruits and vegetables.

Ionizing radiations used for processing food include gamma radiation from radioisotopes such as cobalt-60, or electrons generated through machine sources called electron accelerators, or X-rays. When electrons fall on certain targets such as tantalum or tungsten, they get converted into X-rays. So, one can use gamma rays from radioisotopes, and/or electron beams or X-rays from machine sources.

When you say chemicals these are mainly fumigants. Fumigants like methyl bromide, and ethylene dibromide are used for killing insects in stored grains, cereals, and their products, or in fruits, both fresh and dry. Ethylene oxide (ETO) is used for destroying microorganisms in foodstuffs.

There are problems with chemical methods. The biggest problem is that they are not environmentally friendly. Since they are halogenated (chlorine- and bromine-containing) hydrocarbons, they react with ozone. Also, they leave residues on food materials which could be carcinogenic or harmful to human health. Therefore, governments around the world have plans to phase them out by 2015 under the Montreal Protocol, and irradiation is a good alternative.

Moreover, irradiation is a cold treatment. It is also called cold pasteurization.

21st Century: **What does that mean?**

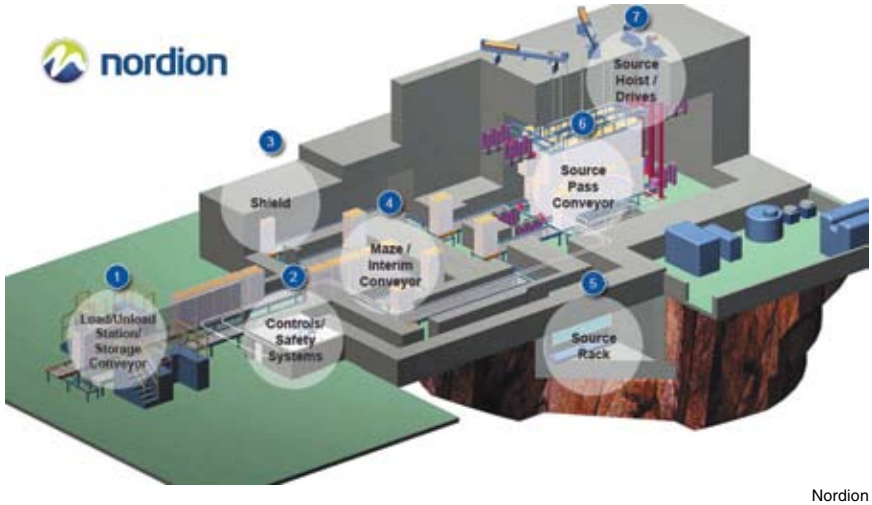
Sharma: That means that it doesn't raise the temperature of the commodity being processed by it. The commodity retains its fresh, or as it is, character. Unlike heating, it doesn't change the texture or flavor of food, whereas, thermal treatments, as you know, change it completely.

Chemical treatments also sometimes change some of the characteristics of food like color, besides being harmful. So, irradiation is a very friendly treatment for agricultural commodities.

21st Century: **Can all food products be irradiated, or only some?**

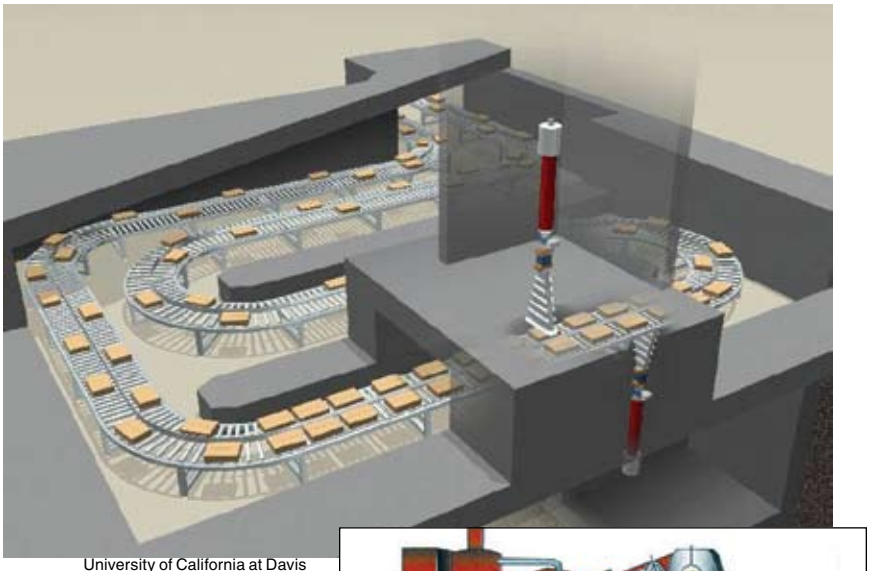
Sharma: In principle, you can process most foods by irradiation, by manipulating the conditions of irradiation. In general, to achieve objectives mentioned above, the food is exposed to doses less than 10 kGy (1 gray is 1 joule of energy absorbed in 1 kilogram of food), that can be applied under ambient conditions.

To sterilize certain categories of food like meat products, and make them am-



Nordion

An interactive illustration of a gamma ray irradiator (using cobalt as a source). The product moves on a conveyor belt past the irradiation source, where it receives a preprogrammed and timed exposure.



University of California at Davis

Illustration of an electron beam irradiator plant. The product moves on a conveyor belt and passes under a machine (inset) that generates and accelerates electrons, bending them to scan the product.

bient stable (for example, astronaut meals), doses of radiation much higher than 10 kGy are used, and the process is carried out at very low temperatures, to eliminate unwanted changes in food flavor while achieving the desired objective of total sterility.

This is one technology that allows you to process most of the food commodities; but certain food commodities are treated in a better way with other processes. One example that can be given is milk and milk products. Irradiation is normally not used here, because we already have thermal technologies working very well for milk and milk products. And also, some of these products may be very sensitive to radiation-induced oxidative changes affecting flavors.

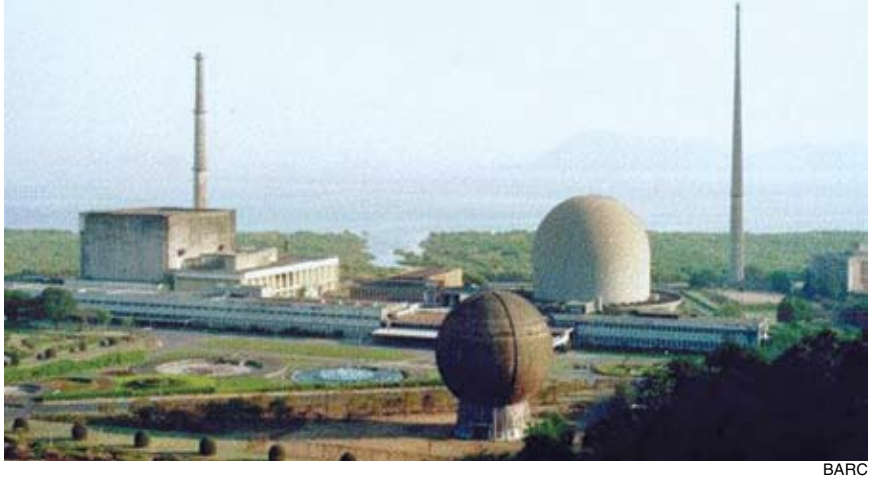
Irradiation can be a very effective way of ensuring food safety and security, in commodities like spices, grains, cereals, dry fruits and vegetables, and fresh produce.

21st Century: **Food spoilage is a great problem in the world right now. We have two physical problems which are compounded. On the one hand, we have been lowering per capita production of agriculture in recent years, but at the same time, much of what we have produced has gone to spoilage. If a large-scale irradiation program were applied more seriously by national governments, how much food could be saved from food spoilage globally, more generally, and India more specifically?**

Sharma: Food spoilage is a major problem in developing countries, mainly because the means to store food in a proper way—like cold storage facilities, silos, appropriate or adequate packaging—are not available. Sometimes, even roofed or indoor storage is not available, and often the grains in jute bags are stacked in open fields with a tarpaulin cover. This results in a lot of spoilage.

It is well documented that spoilage can be as high as 50 percent in some of the fresh produce like fruits and vegetables, and as high as 25-30 percent in cereals and grains. And, looking at the cost of these commodities in today's market, and calculating for the volumes at today's prices, the figures could be mind-boggling—running into billions of dollars in losses.

It is worth preventing the spoilage, and using it to uplift the segment of population for which food is not quite affordable, and those living below the poverty line. So, there is a lot to be gained by the use of appropriate technologies like irradiation to prevent spoilage and making food available to the underprivileged section of our society.



BARC

The Bhabha Atomic Research Center is multidisciplinary and pursues the full range of nuclear science and engineering technologies. BARC was founded by the great Indian scientist Dr. Homi Bhabha in 1944, just after the announcement of the discovery of fission. Four years later, India set up its Atomic Energy Commission. A research reactor began operation in 1956.

IRRI

Food irradiation can make a big difference in developing countries, where proper storage is not available, and food spoilage can be as high as 50 percent. Here, grain stored in the open in jute bags.

Exported spices are irradiated abroad, but India would also benefit from spice irradiation domestically, Sharma says, to prevent loss in storage to insects, fungi, and other contaminants. Here, spices in Mapusa Market, Goa, India.

21st Century: **In your conference presentation you mentioned that even though India was the largest producer of spices in the world, only a mere 2,000 tons were irradiated. Could you say something more about that?**

Sharma: Well, you see this irony in spice irradiation. The fact is that ultimately, irradiation, like any other technology, is need based. In India, as institutional cooking is rather small, and there are only a few large food service companies, most of our spice consumption is at the household level. The traditional cooking methods where spices are used during cooking and tempering take care of most of the resident spice microflora, and no major safety issues are encountered.

But when these spices are to be exported to be used in institutional cooking, or used directly to spice or garnish cooked food, the food safety issues assume importance. Microorganisms and pathogens in spices can live happily or even outgrow in cooked food, posing health risks to consumers. Therefore, there is a need for spices to be free of microbes and to decontaminate them by a cold treatment like irradiation.

In India, irradiation could be used for another purpose, that is for preventing storage losses in spices or retaining their quality. There are spoilage losses in spices too. Many times the spices get infested with insects that bore into them and reduce their quality. Sometimes, during storage, spices also get infected with toxin-producing fungi, and may get contaminated with carcinogenic mycotoxins like aflatoxin, and these spices would not pass the test of quality for human consumption.

Therefore, I think there is a need for applying this technology in India too for improving storage of spices, and not as

Irradiation helps preserve commodities like these in storage, which means more food available for human consumption. At left, nonirradiated compared with irradiated (right).

Government of India

A demonstration irradiation facility for spices, began operation at Vashi, Navi Mumbai, in January 2000.

much as a food safety measure as is done in the rest of the world. Therefore, spices exported from India are mostly irradiated abroad rather than at home. So it is purely driven by the perceived need.

21st Century: **Many people have argued against the idea of having a mass irradiation program because the process has a tendency to raise the price of the food, since it is still at a stage where it is very expensive. What would you say in response to this critique?**

Sharma: See again, the increase in the cost of food by this process is relative, in the sense that if you have large throughputs—that is, if you have economies of scale—then the processing costs are very insignificant. In fact, we have worked out these costs, and most of the time they can be less than 5 percent of the commodity cost. That is insignificant compared to the gains you have with the application of the technology.

Those gains can be in terms of saving the commodity, or in terms of improving the quality of the commodity, or in terms of gaining market access. And, those gains are tremendously large compared to the processing costs that you incur. And, if you use the facility at the designed throughput level, you will always benefit.

21st Century: **And every technology at its earliest stages is always expensive, but as we saw with the expansion of nuclear energy in the 1950s and 1960s, through governments offering national insentives and proper mission orientation, the price would obviously go down.**

Sharma: That's right. As you use the technology more and more, in the example you have cited of nuclear energy, where over the years, the costs and the time of installation of nuclear power plants have drastically come down. As a result, the cost of generating electricity from nuclear plants has also reduced. This ultimately benefits the consumer.

Similarly, here, as for any other technology, when it improves or used on a large scale, the cost definitely comes down and additionally, its employment potential also increases. Those are the benefits of using the technology on a large commercial scale.

21st Century: **For all of this to happen though, at this point, when you look at the speculative monstrosity that the world economy has tended to become over the past decades, it will be very important for nations to clean things up and return back to a sane economic program, where money is a servant of the people and not of speculative finance for middle men who have no interest in the general welfare.**

Sharma: Yes, you are very right. The actual benefits of the technology should go to the primary growers, the primary producers, and the consumers. The middlemen? Of course they are a part of the stakeholder chain, but they should not be the major beneficiaries of this supply chain. That is how everyone can have a win-win situation.

Basically, the primary grower, and the consumer should benefit largely from the technology. Of course, the middlemen and traders have their stakes. We don't deny them their role and due. I think it is good for the countries and the economies if the primary producers and consumers benefit from the technology.

21st Century: **That's a good lesson!**

USDA

A 2007 press conference in Washington, D.C. celebrating the first imports of irradiated Indian mangoes. The United States bans imported tropical fruit that is not disinfested.