A Country with Hungry Mouths To Feed Needs Food Irradiation!

Arun Sharma is the head of the Food Technology Division at Bhabha Atomic Research Centre and Professor at the Homi Bhabha National Institute. He received the Indian Nuclear Society's 2006 award for outstanding achievements in the field of radiation and radioisotope applications, and has more than 300 publications in national and international journals, including chapters in books and encyclopedias, articles for international and national conferences, and invited talks.

Dr. Sharma was interviewed via e-mail by EIR's Ramtanu Maitra.

EIR: What is the scope of the Indian food irradiation program? What products do you irradiate?

Sharma: The Indian food irradiation program has its roots in the research and development effort that started more than five decades ago, alongside its nuclear program as envisioned by Dr. Homi Bhabha, the founder of India's nuclear program. Most of the earlier research work from this center is documented in the best scientific journals of the time. And, the tradition continues even today. In 1987, the government of India set up a National Monitoring Agency to oversee commercial applications of food irradiation. Thereafter, the Atomic Energy Act was amended in 1991 to frame the Atomic Energy (Control of Irradiation of Food) rules (further amended in 1996), to allow commercial applications of the technology.

Also, related legislation for food in India, Prevention of Food Adulteration Act rules (1954), were amended to allow, for the first time, irradiation of onions, potatos, and spices. These rules were further amended in 1998 and 2001 to allow additional food items (**Table 1**).

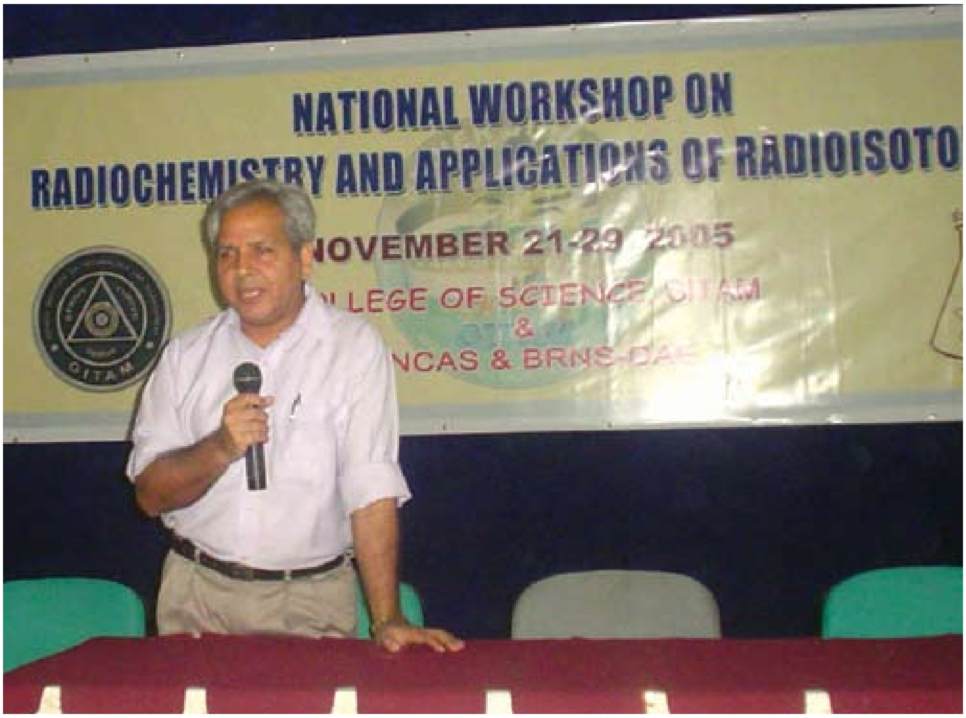
The department has now approached the regulators to allow radiation processing of food on a generic food-class basis. In 2004, the government also amended plant protection and quarantine regulations to include irradiation as a quarantine measure.

The Department of Atomic Energy has set up two technology demonstration units for radiation processing of food and allied products. A Radiation Processing Plant at Vashi, Navi Mumbai, has been operating since January 2000. It is a 30-ton-per-day capacity unit capable of hygienizing spices and other dry ingredients, and is being operated by the Board of Radiation & Isotope Technology (BRIT).

KRUSHAK (Krushi Utpadan Sanrakshan Kendra) at Lasalgaon, near Nashik, is another technology demonstration unit being operated by the Food Technology

TABLE 1
Items of Food Permitted for Irradiation Under 'Indian Prevention of Food Adulteration Act'

Name of food	Dose of irradiation (kGy) Min	Dose of irradiation (kGy) Max	Purpose
Onion	0.03	0.09	Sprout inhibition
Potato	0.06	0.15	Sprout inhibition
ginger	0.03	0.15	Sprout inhibition
Shallots, garlic, rice	0.25	1.0	Insect disinfestation
Semolina (Sooji or Rawa), Wheat atta and Maida	0.25	1.0	Insect disinfestation
Pulses	0.25	1.0	Insect disinfestation
Dried sea-food	0.25	1.0	Insect disinfestation
Raisins, figs, and dried dates	0.25	0.75	Insect disinfestation
Mango	0.25	0.75	Shelf-life extension and quarantine treatment
Meat and meat products, including chicken	2.5	4.0	Shelf-life extension and pathogen control
Fresh sea-food	1.0	3.0	Shelf-life extension
Frozen sea-food	4.0	6.0	Microbial pathogen control
Spices	6.0	14.0	Microbial decontamination



Indian Association of Nuclear Chemists and Associated Scientists

Dr. Arun Sharma speaking on food irradiation at the Gandhi Institute of Technology and Management in 2005.

Division of the Bhabha Atomic Research Centre (BARC), for sprout control in potato and onion, and preservation of agricultural commodities. The unit has been operational since July 2003, and can process about 5 tons of onion per hour.

The department is encouraging entrepreneurs in private and cooperative sectors to set up radiation processing facilities. BARC/BRIT has signed more than 20 memoranda of understanding (MoUs) with entrepreneurs and cooperatives for setting up radiation processing units. Some of these plants are already in the advanced stage of construction or commissioning.

Commercially, we are irradiating spices and dry ingredients like onion powder, and among fruits, mango for export.

EIR: What kind of irradiators do you use, and how many do you have?

Sharma: We are using cobalt-60 based panoramic wet storage irradiators. Currently, 3 irradiators are owned by the Department of Atomic Energy and 12 by private operators. All are multi-product irradiators. They also carry out radiation processing of non-food items like pet food and health-care products.

About 12 irradiators to be built under the MoUs are in the various stages of commissioning, and would come up in the next two to five years.

Mangos for Export

EIR: How is the mango irradiation program going? Are there actually U.S. inspectors at the irradiation facilities and the shipping points? (I read that there were, under the special agreement with the United States.) Do the small farmers benefit from this?

Sharma: As you know, India is the world's largest producer of mangos, totaling about 12 million metric tons, but accounting for less than 1% of the global mango trade. Maharashtra is a leading state that showcases its most sought-after variety, the Alphonso. Another top variety of the region is Kesar. One can tell the difference between the Indian mango and those from the rest of the world only after tasting them!

America's taste for mangos is growing, with 99% of the demand of nearly 250,000 metric tons, valued at around $156 million. It is met mostly by imports from Mexico and South America. In contrast, India exports only around 58,000 metric tons. Of which, this year India exported a meager 275 tons to the U.S.A., which is nearly double the quantity exported last year.

It is the radiation technology and the R&D efforts in BARC of the past several years that made it possible to overcome the quarantine barrier imposed by the U. S.A., which denied market access to the Indian mango for the past 18 years. Thus, there is a huge untapped potential.

There is only one irradiator that is currently geared to carry out radiation processing of mango, that is KRUSHAK. Last year, 157 tons of mango were irradiated. This year, the quantity has almost doubled to 275 tons. Under the pre-clearance program, USDA/APHIS [U.S. Department of Agriculutre/Anmimal and Plant Inspection Serice] posts one inspector at the facility during the irradiation campaign.

Eventually small farmers would benefit, as the demand for good quality mango for export goes up.

IAEA

Mangos treated with irradiation can be picked ripe, and keep their wholesomeness and flavor longer. India is the world's largest producer of mangos.

Origins and Future Prospects

EIR: When did India's program begin? What kinds of research was done at BARC?

Sharma: Mathur, Lewis, Dharkar, and Sreenivasan at BARC were the pioneers of the studies on evaluation of effects of gamma radiation on tropical fruits, including mango, in the early '60s. The delay in ripening of about a week, observed in mango exposed to a low-dose of 250 gray (Gy) and stored at an ambient temperature of 25-30°C, was quite remarkable, and had potential commercial application in India.

These studies were published in well-known scientific journals. A few years later, the efficacy of irradiation for disinfestation of fruits, killing of fruit flies and stone weevils, for overcoming quarantine barriers with similar doses was also demonstrated. It was also found that the best results were obtained if mangos were irradiated at a hard mature stage (80% maturity), during the pre-climacteric phase. There were several studies reported from BARC on the flavor and aroma components of mango, both raw and ripened.

EIR: What are the plans for future development?

Sharma: There is a lot of scope for use of the technology in preservation of grains, bulbs, tubers, fruits,

On the Need for Food Irradiation

These quotes are from two of Dr. Sharma's recent articles.

Food security of a nation, to a large extent, determines its economic stability and self-reliance. With the fast-growing population, shrinking arable land, and increasing costs of agricultural inputs, we should not only aim to increase our agricultural productivity but also effectively preserve and conserve what is produced. . . .

The seasonal nature of production, long distances between production and consumption centers, and the rising gap between demand and supply are some of the factors that have made this need even more relevant today. The hot and humid climate of the country is quite favorable for the growth of numerous insects and microorganisms that destroy stored crops, cause food-borne illnesses, and spoil food products every year resulting in huge economic losses that often remain hidden. . . . In comparison with heat or chemical treatment, irradiation is more effective and appropriate technology to destroy food borne pathogens.

and vegetables; microbial decontamination or hygienization of spices, meat, and fish, and even fresh fruits and vegetables. There is increased interest of private entrepreneurs to sign MoUs with our commercial unit, the Board of Radiation & Isotope Technology. The Ministry of Food Processing Industry, Government of India, is encouraging the adaptation of the technology, providing a 50% subsidy for plant and equipment, and technical civil work costs.

As we move from the technology demonstration phase to more serious deployment, there is a need to liberalize policy and make the technology economically more attractive to entrepreneurs. Government agencies like the Food Corporation of India (FCI) could consider using it in its own warehouses, to save the buffer stocks from destruction by insect pests. This would necessitate the introduction of electron beam machines that would provide high throughputs required for such a purpose. Also, a switchover from jute bags to poly-lined hermetically sealed bags or insect-proof silos, would be required along with the radiation technology.

Further, a generic food class-wise approval for the use of the technology would be required to make the irradiators economically viable by bringing more foods in the ambit of the technology.

EIR: We've noted the trend in the developing sector to go with the irradiation of high-value cash crops for export, instead of preservation of foodstuffs for domestic use. What do you think about that?

Sharma: I think radiation processing is as much use to high-value foods for exports as to the relatively low-value foods for domestic consumption. The technology is essentially need based. Basically, high-value foods need to cover food safety risk; however, low-value food items like grains need to be covered for food losses or food security. In India, for domestic purposes, it is the latter which is important. For a developed country like the U.S.A., it is the former.

EIR: How much of your post-harvest food grain crops is lost to spoilage etc., and how do you think food irradiation will help? What particular crops could be targetted?

Sharma: A recent *Times of India* report says we lose around 100,000 tons of grains every year in our FCI warehouses. The fumigation that is done repeatedly is not effective, and is harmful to both human health and the environment. The damaged grains are probably destroyed or find their way to the market through unscrupulous practices.

Another report in the *Hindu,* put losses in fruits and vegetables worth around Rs. 23,000 crores [$4.8 million]. Can a country like India with so many hungry mouths afford these losses?

EIR: Are you working with other countries on a regional basis to promote food irradiation?

Sharma: Yes, we have regional programs under the IAEA/RCA (Regional Co-operative Agreements), where we work together on commonly identified problems, using solutions based on radiation technology.

EIR: What is your personal background, and how did you get involved in food irradiation?

Sharma: I joined the Training School of Bhabha Atomic Research Centre, Mumbai, in 1975, after finishing a masters degree in microbiology from the National Dairy Research Institute, Karnal. My early work was related to aflatoxin biosynthesis and control in food commodities, for which I was awarded a Ph.D. from the University of Bombay in 1984. I was a DBT Post-Doctoral Associate at the Department of Plant Pathology, University of California, Riverside, during 1990-91, where I worked on the molecular mechanism of host-pathogen interactions. I also studied food irradiation in 1989 at the Royal Institute of Quality Control of Agricultural Products (RIKILT), Wageningen, The Netherlands.

I made substantial contributions to the field of food irradiation technology, with special reference to microbiological safety of foods, and radiation processing of food commodities, including spices and mangos. I was the project manager of KRUSHAK irradiator project at Lasalgaon, near Nashik, for demonstrating the low-dose applications of radiation in preservation of food and agro commodities. As a result of these efforts, Indian mangos could be exported to the U.S.A. after a gap of 18 years.

I've been the chief coordinator for three projects in the field of applications of radiation technology for food preservation and hygienization, and I represented India in the coordinated research programs, and as an expert of the International Atomic Energy Agency. I've been the secretary of the Environmental Mutagen Society of India, and vice president of the Indian Society for Environmental Science & Technology.