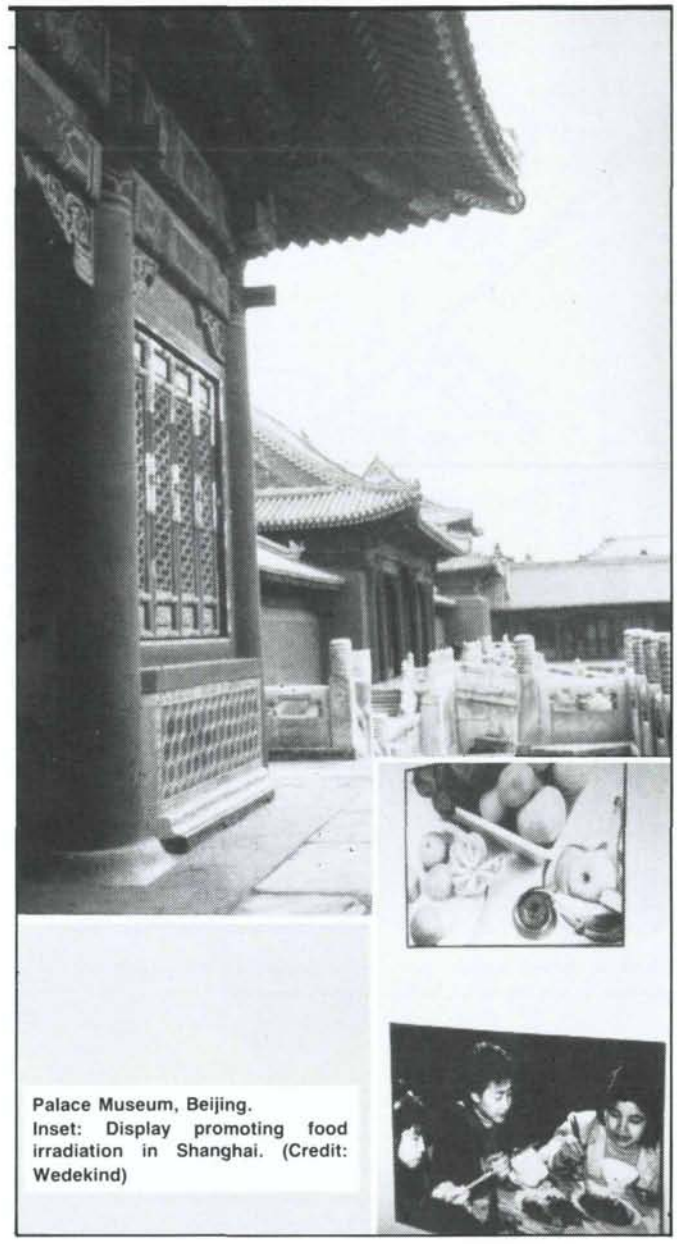
China's move to food irradiation

The table is being set for commercialization

by Lothar H. Wedekind



Palace Museum, Beijing. Inset: Display promoting food irradiation in Shanghai. (Credit: Wedekind)

More than a thousand years ago, during the Tang Dynasty, the beautiful Queen Yang may have set the tone for Chinese determination to overcome problems of food supply. History teaches she ordered teams of riders on horseback to deliver fresh lychee from southern Fujian where the fruit was grown to northern Xian where it was in high demand, a distance of about 2000 kilometres. With a racehorse distribution chain of riders galloping day and night, the goods reportedly were delivered in just about three days.

China has historically fought to balance food supplies and demands, and regional shortages due to natural and other causes remain a serious concern. Though the world's most populous country, China only has about one-fifteenth of the earth's arable land. The nation can ill afford food waste, or to ignore potential weapons against it.

Increasing food production alone may not be the answer for China, or for other developing States. Pressures on food supplies will heighten in developing nations as the overall population is expected to grow by 45% over the next 15 years, notes the Food and Agriculture Organization (FAO), yet already nearly three of every four people in the Third World live in countries short of productive land.

Not surprisingly, given the needs and outlook, many developing countries are taking the lead in moving to promote commercialization of food irradiation. Although the preservation process, like others, is not practical or effective for all foods, irradiation has proved it can safely and effectively help extend supplies by prolonging storage times and reducing losses to spoilage and waste of specific food items.

In the bustling port of Shanghai, home of 12 million people and long the heart of China's industrial and commercial progress, the table is being set.

In January 1986, the first of five regional irradiation facilities planned in the country mainly to process foods officially opened in Shanghai. Irradiated potatoes, mushrooms, rice, onions, garlic, peanuts, pork sausage, and, soon, apples will be introduced in mass marketing trials as part of economic feasibility tests.

One trial run late last year of 25 tons of labelled irradiated apples sold out in under two days, even though they were treated to hold for months in storage, reports Mr Cao Xue Xin, an engineer at Shanghai's Science and Technology Commission involved in the project. Marketing research has become integral to steps being taken in China to help determine commercial viability and consumer acceptance of irradiated foods.

"It is very important to develop food irradiation ... and, in a word, we are actively and carefully heading

Mr Wedekind, editor of the *IAEA Bulletin*, served as press officer at the Shanghai seminar.

Racks of boxed apples move automatically to the irradiation chamber at the Shanghai facility. (Credit: Wedekind)

towards commercialization,'' says Mr Zhou Ping, vice-chairman of the Chinese State Council's Leading Group on Nuclear Power, a body of senior policymakers who set the country's priorities in nuclear and related fields.

While no one is reported to be going hungry in China, food security, seasonal shortages, and the nutritional quality of the Chinese diet are topics drawing acute attention, according to Mr Lu Liangshu, Director of the Chinese Academy of Agricultural Science. Under the country's modernization drive, food irradiation is being promoted as a tool that fits.

Rapid development planned

Mr Zhou and other Chinese officials outlined China's past and future directions at a recent international food irradiation seminar in Shanghai sponsored by the FAO and IAEA. The meeting was attended by about 170 participants from China and 22 other countries, primarily from the Asian and Pacific region where activities are accelerating to promote technology transfer, governmental and consumer acceptance, and regulatory harmony in the field. Three food irradiation plants currently are operating in the region and 14 more are planned over the next 5 years.

If current plans hold in China, the nation will emerge as far more than the regional leader in demonstrating food irradiation's potential.

Besides the Shanghai facility, four other commercial-size demonstration plants are reported being built primarily for food irradiation near provincial capitals: Chengdu in the southwest; Zhengzhou in the north; Nanjing near the eastern coast; and Lanzhou in the Chinese interior. Operations are expected to start at all four within the year.

Additionally, other irradiation facilities — near Beijing, Jinan, Tianjin, and the Shenzhen Economic Zone near Hong Kong — are reported under construction as ''multipurpose'' plants that will mainly sterilize medical supplies but process some foods and other products as well.

Major objectives at facilities over the next four years will be to ''smooth the path'' toward commercial applications of specific foods by testing irradiation's economic competitiveness under local market conditions, Mr Wu Jiaxiang of the State Science and Technology Commission's Department of High Technology reported at the seminar.

How fast food irradiation develops commercially in China, as elsewhere, is largely a question of economics. One analysis done at the University of Beijing found that it is not yet economically competitive nationwide, and that ''considerable'' transportation costs stemming from a lagging distribution system are a major reason why. At the local level, the picture is otherwise: In Shanghai, for instance, the trial marketing run of irradiated apples showed that ''significant economic gains'' can be expected, reported Mr Cao.

To compensate for infrastructural shortcomings, China is following a pragmatic approach to commercialization, with the strategy to design and build irradiation plants flexible enough to adapt to local market conditions and located near good transportation links, based on seminar reports. Most cities planning food irradiation plants are either major transportation centres or situated near important Chinese agricultural areas.

Local realities: Specific needs

At the FAO/IAEA seminar, Mr Zhou of the State Council reported that the country continues to suffer high food losses, up to 30% for some commodities, primarily due to preservation and storage problems.

Other food preservation methods are practiced, but not all are well advanced. Refrigeration clearly remains too expensive for China, as for most developing nations, to institute on a wide scale. Chemical fumigation, which right now is reported as less expensive to use in the country than food irradiation, is applied on rice, grains, and other foods. But there is growing concern over pollution and potential health effects, as well as over barriers that chemically treated products for export increasingly must overcome in international food trade, says Prof. Wu Jilan of the University of Beijing. Foods for export are potential candidates for food irradiation, and research has been done on vegetables, seafood, and spices, such as red peppers popularly used in Szechuan cooking.

At the local and regional level, food supply problems crystallize: Serious regional shortages hurt local economies and keep many fruits and vegetables out of Chinese homes much of the year, restricting consumer diets, seminar participants reported. Mr Cao of the Shanghai Science and Technology Commission offered a proverbial description of his city's vegetable market, both from the standpoint of suppliers and consumers: "Spoil in the harvest seasons, short in the off seasons. Worry when piling up, hasty when running short." A recent market survey found that 10 to 20% of vegetables spoil every year at an estimated cost of "tens of millions of yuan", or upwards of US $3 million. Fruits fare as badly, with those lost in transport and storage annually amounting to more than 28 000 tons valued at 12 million yuan, or roughly US $4 million.

Interest in food irradiation's benefits primarily is tied to such conditions. By using gamma waves to reduce or eliminate pathogens and food-spoiling microorganisms, the country aims to prolong storage times so that localities can better control distribution to help them override seasonal shortages and stabilize food supplies.

High technological investment

The Shanghai irradiation centre, which opened in January 1986 and is run by the Shanghai Nuclear Research Institute, plans to process up to 35 000 tons of vegetables a year, or about 45% of the city's annual supply, as well as some spices, fruits, and non-food products. Working with the Shanghai Vegetable Company, a primary role will be to "stimulate commercialization" in the area, reported Mr Cao of the city's Science and Technology Commission.

Built in 18 months, the facility is a Chinese design stocked with domestically produced cobalt-60 rods; source capacity is 500 000 curies. With the exception of Canadian and Swiss participation in two of the country's facilities, other irradiators also will bear the "Made in China" label in both design and major components. Chief designer is the Institute of Nuclear Engineering in Beijing.

Chinese scientists and engineers have been studying food irradiation at small irradiators built throughout the country since 1958, but it wasn't until the end of the Cultural Revolution in 1976 that activity intensified. Today about 100 small research irradiators are reported to be operating to support research in various fields, and more than US $10 million has been invested in food irradiation's development over the past 10 years, estimates Prof. Wu of the University of Beijing.

Today, no less than six national bodies are directly involved in various facets of food irradiation's development: the State Science and Technology Commission (policy, regulation), the State Economic Commission (marketing, licensing), the Chinese Academy of Sciences (research), the Ministry of Agriculture, Husbandry, and Fishery (research support), the Ministry of Public Health (food safety, clearances), and the Ministry of Nuclear Industry (operations).

Seminar participants toured the Shanghai Irradiation Centre. (Credit: Wedekind)

So far, the Ministry of Public Health has approved seven irradiated foods as safe for human diets: rice, potatoes, onions, garlic, peanuts, mushrooms, and pork sausages; approval No. 8, for apples, is expected shortly. Persuasive in the actions were assurances of safety from international food and health authorities, namely the Codex Alimentarius Commission of the FAO and World Health Organization (WHO), and the country's own nutritional and safety studies. China's studies included eight tests of volunteer medical students and citizens who ate irradiated potatoes, rice, pork sausages, mushrooms, and other vegetables over periods of two to four months. The tests concluded "there were no harmful effects at all after consumption of irradiated foods," Mr Dai Yin of China's Institute of Food Safety, Control, and Inspection reported at the FAO/IAEA seminar.

All told, more than 25 separate foods now are seen as potential candidates for food irradiation processing, including fish, bamboo shoots, cauliflower, carrots, dried dates, strawberries, and oranges.

Growth paths and prospects

Despite their country's own long experience, Chinese officials at the Shanghai meeting stressed their openness to foreign participation and co-operation in food irradia-

International co-operation

China is poised to become a more active participant in international efforts for food irradiation's development. At the Shanghai seminar, Mr Zhou Ping, vice-chairman of the Chinese State Council's Leading Group on Nuclear Power, announced that the country has decided to join the joint FAO/IAEA Asian Regional Co-operative Project on Food Irradiation (RPFI).

Under the project, countries in Asia and the Pacific have banded together to address issues related to marketing and trade of irradiated foods. They have agreed to assist and evaluate shipping trials of irradiated foods and to actively promote adoption of regulations that would provide legislative harmony. RPFI member countries now are Australia, Bangladesh, India, Indonesia, the Republic of Korea, Malaysia, Pakistan, Philippines, Thailand, and Viet Nam, all of which sent experts to the Shanghai seminar. The project's overall objectives emphasize the transfer of technology to local industries and the co-ordination of research and pilot-scale studies on selected products of particular interest to the region.

Based on these developments and others, it is reasonable to expect that more countries in the Asia and Pacific region will be using food irradiation in years ahead to combat high rates of food losses and improve the quality of certain foods. Post-harvest food losses in the region remain high — estimated at 30% for grains, between 20 and 40% for fruits and vegetables, and up to 50% for fish — and there is growing recognition of potential health and economic benefits arising from their reduction.

Most countries in tropical regions are major producers of fruits and vegetables, yet face serious problems of insect infestation. Treatment with ionizing energy is seen as a way of meeting quarantine requirements of international trade so that export markets can be expanded, especially in view of increasing limitations associated with the use of chemical fumigants.

Currently, Japan is the only country in the region with a commercial-scale food irradiator and it has been successfully marketing irradiated potatoes since 1974. In addition to China, other countries moving to construct irradiators in the region are Australia, Bangladesh, the Republic of Korea, Malaysia, Pakistan, Philippines, and Thailand.

FAO/IAEA food irradiation seminar in Shanghai. (Credit: Wedekind)

— Information based in part on "Food Irradiation — an alternative technology", a keynote address by Paisan Loaharanu, Head of the FAO/IAEA Food Preservation Section, at the ASEAN Workshop on Food Irradiation, in Thailand, November 1985.

tion's development. "China has a good will to co-operate with other Third World countries and developed countries in the design and construction of irradiation facilities, communication of science and technology, training, and technical service", Mr Gu Junren of Beijing's Institute of Nuclear Engineering reported at the FAO/IAEA seminar. On hand to hear the message were representatives from American, Canadian, Dutch, French, and West German irradiation firms who are interested in the Chinese market.

Just how far China's plans are carried in years ahead will be important to food irradiation's commercial future. If the fast-growing national economy can sustain the current and projected pace for irradiation's local and regional commercialization, China clearly will be leading the way in using gamma waves to preserve food. In the process, obstacles still hampering the technology's worldwide development may be easier for other countries to overcome.

At the Shanghai seminar, a panel of experts from Australia, New Zealand, Japan, Bangladesh, India, Thailand, and China summarized five major barriers to progress: a lack of commitment and investment from the food industry; absence of approval for the use of ionizing energy as a food process by most governments; uncertainty about consumer reaction; limited information on the economic feasibility of the process on a commercial scale; and insufficient experience on how the process may be controlled and regulated commercially, particularly for purposes of trade.

Countries were urged to take steps to implement legislative recommendations of the Codex Alimentarius Commission as part of actions to harmonize regulations, to conduct market and economic studies to stimulate wider interest in food industries, and to establish and document good manufacturing practices, strict hygienic standards, and satisfactory processing controls. The Codex Commission has established a recommended General Standard for Irradiated Foods and an associated Code of Practice for facility operations.

To address and help solve problems more specifically related to trade, the FAO, WHO, and IAEA have

formed an International Consultative Group on Food Irradiation composed of experts nominated by 23 governments. The group's major work is directed at trade promotion, training, economic feasibility studies, and public and consumer information.

In the future, national and international organizations, food industries, trade associations, and consumer organizations all will have an important role to play in introducing the technology on a commercial scale in many countries. In particular, actions in Canada, France, Italy, Netherlands, the United Kingdom, the United States, and other industrialized countries in which food irradiation is drawing more notice are important to progress, especially concerning legislative acceptance and industrial interest. Recent positive signs for the technology's wider acceptance and commercialization will be instrumental to technology-transfer activities in the developing world directed at alleviating food losses and extending supplies to help combat hunger and stimulate economic development.

Worldwide, as of 1985, there are 24 commercial irradiation facilities in 11 countries that treat food as at least part of their throughput, according to IAEA. By 1990, the number of irradiation facilities for foodstuffs is expected to surpass 50, with operations spread among 17 countries.

Research and demonstration over the past three decades has long established the merits and safety of food irradiation as a technology holding important benefits for food producers and consumers alike. With an increasing number of commercial and demonstration plants becoming available to process a variety of foods, even more evidence is in the making.

United States: New food irradiation rule adopted

A long-awaited rule stipulating requirements for low-dose radiation processing of foods has taken effect in the United States. As published in the US *Federal Register* by the Food and Drug Administration on 18 April 1986, the new rule requires all retail irradiated food products to carry a label clearly stating treatment with radiation and accompanied by the international symbol for the process.

At the wholesale level, irradiated food products also will require labels saying "treated with radiation — do not irradiate again" or similar wording. "The labelling requirement applies only to a food that has been irradiated, not to a food that merely contains an irradiated ingredient but that has not itself been irradiated," the rule says in part.

After two years, or as of 18 April 1988, the rule stipulates that all wording requirements for labelling irradiated food products will be dropped, leaving only the international symbol to inform consumers.

The new FDA rule allows fresh fruits and vegetables to be treated with radiation at up to I kilogray, and herbs and spices at up to 30 kilogray. Under previous rules, the FDA already allows radiation treatment of potatoes, wheat and wheat flour, food grade enzymes, and pork products for trichinae control. Previously, herbs and spices also could be treated with radiation for microbial and insect control at up to 1 kilogray. These levels are far below those that have been recommended as safe for all foods by the Codex Alimentarius Commission of the Food and Agriculture Organization and World Health Organization.

FDA Commissioner Frank E. Young called the new rule "a landmark development that will foster the use of this process, thereby providing better and safer products for the public and also enhancing the market potential for the producers, not only in this country but also for export".

Information drawn from CRA INFO, the newsletter of the US Atomic Industrial Forum's Committee on Radiation Applications.