Ensuring Food Safety in a Changing Climate

Insect pests destroy crops and may act as vectors for diseases. According to the International Plant Protection Convention, pests were responsible for US $220 billion in losses in 2021 due to their destruction of more than 40 per cent of crops. As people and food products move around the world, organisms that present risks to plants and animals can travel with them. Pest introductions and outbreaks cost governments, farmers and consumers billions every year.

Increased global temperatures due to climate change have enabled insect pests to thrive in new geographic areas, threatening crops and livestock and potentially carrying infectious diseases with them.

Increased temperatures, precipitation and humidity caused by climate change also make foodborne infections and toxins more common. Climate change has also supported the spread of fungal growth from tropical zones into temperate regions. Fungi can produce poisonous toxins, known as mycotoxins, that are harmful if consumed by humans.

Preventing foodborne illnesses and the spread of insect pests is key to food safety.

Ionizing radiation at low levels, delivered at just the right dosage through gamma, electron beam or X-ray irradiators, can kill bacteria and fungi, prevent post-harvest spoilage, and stop insects from reproducing. Irradiation does not affect the quality of food, and products do not become radioactive. Unlike pesticides, irradiation does not leave chemical residues that can pose a risk to consumers.

By irradiating food, countries can ensure food safety – hindering the spread of pathogens and pests, preventing foodborne illnesses and extending the shelf life of food products that would have otherwise spoiled due to the growth of bacteria and fungi.

Viet Nam now irradiates more than 14 000 tonnes of food each year. Irradiation can be used on pre-packaged foods, as it does not increase the temperature. It can be applied to food in cold storage or frozen products, such as fruits or seafood, respectively.

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The IAEA and FAO, through the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, have supported Viet Nam in the area of food irradiation since 1999 with the provision of a gamma irradiator to the Hanoi Irradiation Center. Approximately 1 tonne of fruit can be irradiated in an hour using gamma irradiation. In 2013, an electron accelerator was delivered, and today gamma, electron beam and X-ray irradiation are used in the country's 11 food irradiation facilities.

The IAEA's technical cooperation programme, with the Joint FAO/IAEA Centre, supported the training of staff at the Viet Nam Atomic Energy Institute's Research and Development Center for Radiation Technology (VINAGAMMA), which is responsible for carrying out irradiation in the country.

Irradiation ensures that food shipments meet international safety regulations, which are in place to ensure that the transport of agricultural products does not contribute to the spread of pests and diseases. The detection of certain insect pests can be grounds for import bans, which can have serious financial ramifications for the exporting country.

Mangoes and other tropical fruits from Viet Nam are particularly popular exports. The sale of fruit from Viet Nam to the United States of America totals more than US $20 million a year. Food products have been irradiated in Viet Nam for more than 50 years. Originally only expensive products like spices were irradiated, but now the market for irradiated food products is flourishing.

The Science

Irradiation is the exposure of a substance to beams of electromagnetic radiation. Food irradiation uses higher frequency beams capable of breaking chemical bonds and forming positive and negative ions. Energy is transferred into the food products, and the short-lived ions break down large biomolecules, killing organisms that cause spoilage, destroying microbes responsible for food poisoning and slowing down maturation and ripening.

Gamma irradiators use a radionuclide – often cobalt-60 – as their source. Gamma rays can penetrate through dense materials, which gives gamma irradiators the advantage of being able to treat large volumes of food at once while it is still in shipping boxes, pallets or bags. However, the food products need to be exposed to the radiation source for a relatively longer period, depending on the dosage required.

Electron beam irradiators stream electrons through a machine powered by electricity. Electrons are accelerated to nearly the speed of light and having a small but finite mass, they interact with food atoms relatively quickly. Electrons lose their energy over a small distance and deliver energy in less than a second. However, although the time span is shorter, electron beam irradiators limited ability to penetrate food means that only packets or small boxes of food can be irradiated at once rather than whole pallets.

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