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REACTIONS

FROM THE AMERICAN NUCLEAR SOCIETY TO TEACHERS INTERESTED IN THE NUCLEAR SCIENCES

Radiation Helps Provide Safe, Plentiful Food

Radiation plays a vital role in relation to our food.

Radiation technology helps produce many disease resistant crops. Irradiation helps control pests in food that has been harvested, extends the shelf-life of some foods by destroying organisms which would cause spoilage, and kills food-borne organisms that can cause life-threatening illnesses.

What is Food Irradiation?

Irradiation is a decades-old process which uses ionizing radiation to kill bacteria, parasites and insects in food. The process exposes food to gamma rays from cobalt-60 or beams of electrons or x-rays. Irradiated food is NOT radioactive.

Does irradiation harm the food?

The irradiation process does not deplete vitamin content or alter molecular structure of food any more than canning or freezing.

What foods are approved for irradiation?

The U.S. Food and Drug Administration (FDA) has approved irradiation of spices, wheat and flour, potatoes, pork, fruits and vegetables, poultry, and red meat.

How can I tell if food has been irradiated?

In the U.S., irradiated food must be identified with the green, flower-like international symbol for irradiation (the radura) and the words "Treated with Radiation" or "Treated by Irradiation."

Can Irradiation be used to make spoiled food good?

No. Neither irradiation nor any other food treatment can reverse the spoilage process. If food already looks, tastes, or smells bad – signs of spoilage – it cannot be "saved" by any treatment.

Does irradiation destroy all bacteria?

No. Irradiation it is equivalent to pasteurization for solid foods, but it is not the same as sterilization.

Irradiation is not a substitute for comprehensive food safety nor a substitute for good food-handling practices in the home.

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New Technology in Centuries-Old Spice Business

It has been estimated that 45% of all spices sold around the world come from India. For centuries one of the major economic influences in India's Kerala State has been the spice trade – particularly trade in black pepper.

Pepper plants do not require intensive care. Planted at the base of shade-giving trees, they demand little attention until after the monsoons when the crop is harvested. This is one reason that pepper becomes a worry-free way for households to supplement their income. Many people grow pepper as a secondary crop.

People in the area have little difficulty selling whatever pepper they can grow to traders in the port city of Cochin. Much of the black pepper exported to Asia, Europe and the United States is grown by small producers in Kerala state.

The growth in demand for agriculture products like pepper has been accompanied by higher standards for food safety. Eliminating micro-organisms from the spice is a critical step for India's pepper export industry.

Steam sterilization and fumigation – the traditional methods for processing – are still used and accepted by importing countries. However, some of the chemicals used in fumigation are considered damaging to human health and the environment. As a result, use of irradiation is becoming increasingly common.

The irradiation process is economical and effective and accepted by international standards. Commercial spice irradiation is practiced in over 20 countries. ■

For more information, see
http://www.fao.org/english/newsroom/news/2003/20224-en.html

Saving Cocoa Trees

Radiation Helps Produce Virus Resistant Cocoa Trees

Chocolate lovers may never think about trees as they enjoy their favorite candy or other chocolate flavored treat. But, it is the cocoa tree which produces the beans that ultimately provide that distinctive and compelling flavor.

According to the IAEA, it is estimated that 14 million people are employed in the cocoa industry worldwide, with about 3.2 million people in Ghana alone. Cocoa bean production is clearly of significant economic importance. Further, it is estimated that nearly 90% of the world's cocoa production is from small holdings of less than 5 hectares. Thus, for many small farmers, their family's livelihood depends upon the survival of their cocoa trees.

Ghana produced about 500 thousand tonnes of cocoa beans in 2003. That is roughly 15% of the world's supply, second only to Cote D'Ivoire which produces about 40% of the world's supply. The importance of cocoa production to Ghana is further explained when you realize that 40% of Ghana's total exports (totaling about US $2 billion annually) are from cocoa.

Cocoa production can be significantly impacted by pests and diseases with an estimate of up to 40% in losses from these causes. Cocoa Swollen Shoot Virus (CSSV), for example, has resulted in the destruction of 200 million cocoa trees in Ghana in the last 50 years.

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Key Words

ionizing radiation - radiation with enough energy to remove an electron from its atom

irradiation - exposure to ionizing radiation (does not make the irradiated material radioactive)

radioactivity - the property of certain atoms to spontaneously emit particles or gamma radiation

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Brief History

Food irradiation is not new. Research began early in the 20th century in the United States. That research accelerated in 1953 as part of the government's "Atoms for Peace" program.

The FDA began approving food irradiation in 1963. At first, approval was to rid wheat and flour of insects and to control sprouting of potatoes. In 1983, irradiation of spices and seasonings was approved. In 1985, the FDA endorsed irradiation of pork to prevent the spread of trichinosis. In 1986, fruits and vegetables were approved for radiation.

Irradiation of poultry was approved in 1990 to kill salmonella and other pathogens. In 1997, irradiation was approved for red meat (to kill *E. coli*). Then, in 2000, the U.S. Department of Agriculture (USDA) allowed irradiation of meat, meat byproducts, and meat products such as ground beef.

Acceptance is Widespread

More than 40 nations have approved the use of food irradiation. These nations include: the United States, China, France, Germany, Israel, Japan, the Netherlands, South Africa, and the United Kingdom.

Many Benefits of Irradiation

The ability of irradiation to retard spoilage and increase the shelf-life of food is particularly beneficial in areas lacking refrigeration. In addition, irradiation kills harmful bacteria that cause food-born diseases, such as salmonella in poultry and some seafood, trichinosis in pork, and cholera in fish.

The World Health Organization (WHO) endorsed food irradiation in 1992 as a food-preservation technology. The head of the organization's food safety unit noted then that irradiation is needed in a world where food-borne illnesses are on the increase and where one-quarter to one-third of the global food supply is lost after harvest.

In 1997, WHO again endorsed the process and was joined by the United Nations Food and Agriculture Organization and the International Atomic Energy Agency.

The ability to rid food of harmful bacteria with irradiation could reduce the number of food-poisoning incidents. In the United States alone, more than 76 million Americans are affected by food-related illnesses each year, and more than 5,000 die, according to the USDA.

A series of incidents involving illnesses and deaths caused by *E. coli*-tainted ground beef led the USDA to advocate research on irradiating ground beef. The need for a Nebraska processing plant to close and destroy 25 million pounds of meat possibly contaminated by *E. coli* heightened interest in irradiating ground beef. In 1997, the FDA approved irradiation of beef, lamb and pork. Shortly after that, the USDA announced it would allow irradiation of red meat. In February 2000, the USDA amended regulations to allow irradiation of refrigerated or frozen uncooked meat, meat byproducts, and other meat products.

The Irradiation Process

The irradiation process simply exposes food to gamma rays (from cobalt-60) or to electron beams and X-rays from accelerator machines.

Prepackaged food is moved by conveyer into a thick-walled room housing the irradiator, which has pencil-like rods of cobalt-60. Exposure time varies from 15 to 45 minutes depending upon the food.

Since the food is prepackaged, bacteria is prevented from contaminating the food after it has been irradiated. When the process is completed, the rods of cobalt-60 are retracted into a pool of water which acts as a radiation barrier, shielding workers in the facility.

The electron-beam process works in a similar manner, but the ionizing radiation comes from an accelerator rather than a radioisotope. Both processes have been certified safe and both are used widely. Neither process leaves any radiation in the treated food.

The same process has been used to sterilize medical devices, bandages, condoms, tampons, contact lens solutions, and food for astronauts.

Health and Safety

Irradiation does not increase human exposure to radiation, because it does not make food radioactive. Many studies have been conducted with no conclusive evidence that eating irradiated food is harmful.

Some vitamins in food may be reduced, in minimal amounts, by irradiation. Vitamins A, C and E and thiamine are particularly affected. However, researchers have found that the reduction is generally less than that which results from cooking, canning or freezing.

Some opponents of irradiation claim that unique radiolytic products are formed in certain foods during exposure to gamma rays. Studies have identified no radiolytic products unique to irradiated foods, and none that suggest harm.

It is worth noting that some foods contain naturally occurring radiolytic products, such as benzene and formaldehyde. Other radiolytic products are produced in certain instances when meats are grilled over a fire.

Irradiated food sold in stores must be identified with the radura and the words "Treated with Radiation" or "Treated by Irradiation." Since the federal government lacks jurisdiction over establishments selling prepared foods, irradiated foods could be served without such labeling. And, irradiated ingredients (such as spices) need not be identified on the labels of prepared and processed foods.

Public Opinion

A study at Purdue University found that people's attitudes about irradiation improved significantly when they learned about the technology. Two groups of adults were shown a seven-minute educational video on food irradiation. They were polled before and after the video. One group's acceptance of food irradiation grew from 54 to 90 percent; the other improved from 69 percent to 99 percent. ■

Sources of Additional Information

http://www.foodsafety.gov/
Gateway to Government Food Safety Information

http://www.foodsafety.gov/~fsg/irradiat.html
Information about Irradiation

http://www.nei.org/index.asp?catnum=3&catid=190
Overview of Food Irradiation (history, the process, benefits, public opinion)

http://fsrio.nal.usda.gov/document_reslist.php?product_id=139
Food Safety Information from USDA

http://www.mda.state.mn.us/dairyfood/irradiation.pdf
Frequently asked questions about Food Irradiation (from Minnesota Dept. Agriculture)

http://www.iaea.org/icgfi/documents/catch-the-wave.htm
Food Irradiation information from International Atomic Energy Agency (IAEA)

members.ift.org/NR/rdonlyres/5BB0A8B0-ADF8-4721-A266-A0AEB84E1A79/0/foodsafety_irradiation.pdf
Article from FOOD Technology, a publication of Institute of FOOD Technologists

http://uw-food-irradiation.engr.wisc.edu
Information from the Food Irradiation Education Group at University of Wisconsin

http://www.epa.gov/radiation/sources/food_irrad.htm
Food irradiation information from EPA

http://fsrio.nal.usda.gov/document_reslist.php?product_id=139
List of factsheets and other information from National Agricultural Library

http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodirradiation.htm
Food Irradiation information from Centers for Disease Control and Prevention

http://www.nclnet.org/food/foodsafety
Information from National Consumers League

Career information

Information about careers in nuclear science and technology can be found at **www.aboutnuclear.org** *and* **http://www.ans.org/pi/edu/students/careers/**

Workshops on Nuclear Science and Technology

*Scheduled as of October 12, 2006**

Baltimore, MD

NSTA Regional Conference, ***Nov. 2-4***
90-minute workshop
Thursday, November 2
2:15pm -3:30 pm
no charge for workshop
Must register for NSTA conference

Wichita Falls, TX

CAST Conference, ***Nov. 9-11***
90-minute workshop
Friday, November 10
8:00 AM
no charge for workshop
Must register for CAST conference

Albuquerque, NM

ANS Teacher workshop
full-day event, 7:45 am- 5:00 pm
Saturday, November 11
$50 registration fee
free Geiger, lunch, materials
Register by Oct. 30 at
http://www.ans.org/pi/edu/teachers/workshops/

Salt Lake City, UT

NSTA Regional Conference, ***Dec. 7-9***
90-minute workshop
Friday, December 8
10:00 a.m. - 11:15 a.m.
no charge for workshop
Must register for NSTA conference

*Workshop list subject to change. New workshops are added regularly. Visit our web site at www.ans.org/pi/edu/teachers to see if something has been added or removed. ■

Radiation Helps Produce Virus Resistant Cocoa Trees

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"CSSV is one of the most important factors limiting the production of cocoa in Ghana," explains Seth Osei Yaw, a senior technical officer from the Cocoa Research Institute of Ghana (CRIG). He notes that attempts to control the disease have consumed manpower and resources that could otherwise have been used to boost productivity elsewhere across the farming sector.

CSSV severely affects the biological functions of the cocoa tree's leaves, stems, and roots. It generally causes seed-bearing pods to be smaller. In some cases, the virus is so virulent that trees are defoliated and die.

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Project #74

Food Preservation and Irradiation

Introduction:

All foods begin to spoil in some way as soon as they are harvested. The presence of pests or organisms (such as mold) which can cause spoilage may accelerate this process. Food irradiation involves killing harmful organisms with gamma rays or electron beams. If you have access to an gamma irradiator, you could easily demonstrate this effect. But, most readers will be without such a resource.

The purpose of this activity is to see if you can show that some other types of radiation have a helpful effect in retarding spoilage. You MAY have access to an ultraviolet "sterilizer" for safety goggles or another UV source. Or, you could test the impact of UV from sunlight on retarding spoilage (although you may introduce other variables such as temperature variations).

Materials:

3 slices of bread
Clear plastic sandwich bags with zip closures on the top
label tape
source for radiation (UV light, sunlight, or gamma irradiator)

Procedure:

Cut the slices of bread into quarters.

Moisten each quarter of slice with water. Gently slide each quarter across the top of your lab table and

Continued next page

Tiny Grids Provide Better Diagnostic Images

Clearer diagnostic images can help save more lives. Tiny grids as small as three millimeters tall have the promise of helping provide clearer x-rays and images from radiotracers. These anti-scatter grids and nuclear collimators, developed by scientists at the U.S. Department of Energy's Argonne National Laboratory, have won an R&D 100 Award from R&D Magazine.

The application of these grids will be particularly helpful in early detection of cancer and other diseases. ■

For the full story and illustrations, visit
http://www.anl.gov/Media_Center/News/2006/CNM061007.html

Access FermiLab Data

Teachers can access data collected by FermiLab research for a variety of projects.

Data for Life Science projects is found at **http://ed.fnal.gov/data/life_science.html**
Data for Earth/Space Science projects is found at **http://ed.fnal.gov/data/space.html**
Data for Physical Science projects is found at **http://ed.fnal.gov/data/physical_sci.html**

Additional materials that may be useful for and by K-12 students are found at
http://ed.fnal.gov/students.html

Element 118 Discovered

A collaboration by Lawrence Livermore National Laboratory in California and the Joint Institute for Nuclear Research in Dubna, Russia, has led to the discovery of a element 118. The discovery, announced October 16, was made when californium was bombarded with calcium ions. Over several months of experimentation, researchers were able to identify three different atoms of 118; each existed for a fraction of a second. Alpha decay of 118 resulted in the production of element 116 and element 114. Element 118 is expected to be a noble gas.

Several years ago another researcher reported discovery of element 118, but the announcement was retracted when no one could reproduce the results and there were allegations of fraud.

The joint effort by American and Russian scientists used a completely different nuclear reaction from the one reported earlier, with different researchers and different laboratories. This was described as an effort to help avoid the possibility of mistaken handling of data or fraud.

The Livermore-Dubna team indicates they are now looking to discover additional superheavy elements, such as element 120. ■

For more information about this discovery, go to:
http://www.llnl.gov/pao/news/news_releases/2006/NR-06-10-03.html

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place it in a separate sealable sandwich bag. Seal each bag.

Put four bags (controls) in a secure place (such as a drawer or closed cabinet) away from light. Label as "control."

Put four bags into your radiation source location for a short period of time (perhaps an hour or perhaps 24 hours, you decide). Label the bags and then move them into a secure place away from light.

Put four bags into your radiation source location for a longer period of time (perhaps several hours or the entire weekend, you decide). Then, move these bags into a secure place away from light.

After 5-7 days, examine and compare the controls with the "irradiated' samples.

Discussion/Exploration:

Are you able to see differences among the various samples?
(Your results will probably vary, depending upon how long you expose the samples to radiation and what type of radiation source you are able to use. Your results are likely to be more dramatic if you have access to a gamma source.)

Examine a table of radiation types and consider the type of radiation you are using. Discuss the relative location of that source on the spectrum in regard to ionizing radiation and where it is located on the spectrum.

Relate any observable results to information you have available about food irradiation. ■

Activity idea adapted from *Introduction to Nucleonics* published by High School District 155, Crystal Lake, Illinois, 1973.

Radiation Helps Produce Virus Resistant Cocoa Trees

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Mutation Breeding Produces Virus Resistant Trees

"Over the past decade, we have employed mutation breeding techniques to identify cocoa strains that have strong resistance to the virus," says Dr. M.R. Appiah, Executive Director of CRIG. "Gamma-radiation induced mutant cocoa varieties are now growing on 25 farms across Ghana with no evidence of a resurgence of the disease."

In this process, under carefully controlled conditions, the buds of cocoa plants are treated with gamma radiation at the laboratories of the Ghana Atomic Energy Commission (GAEC). The radiation causes mutations in the cell DNA and emergence of new plant strains which have disease resistant properties.

By using mutation breeding and getting the new variety planted in test fields, officials have been able to short-cut the conventional plant breeding process by almost ten years. Evidence of success from the field is quite positive.

For farmers using the new strains of cocoa trees, the growing season went well in late 2005. There were healthy harvests and no signs of the "swollen shoot" disease. ■

Want to Avoid Typing URLs?

This issue of ***ReActions* is available online** with all URLs "hot linked" for easy access to resources without typing detailed web addresses. Go to
http://www.ans.org/pi/teachers/reactions
While there, sign up for email notification of future online issues of *ReActions*. ■

For more information
http://www.iaea.org/NewsCenter/Features/2006/Ghana/cocoa.html

Photo Essay
http://www.iaea.org/NewsCenter/Multimedia/PhotoEssays/

Plant Breeding and Genetics info from IAEA
http://www-naweb.iaea.org/nafa/pbg/index.html
http://www.iaea.org/OurWork/ST/NA/NAAL/agri/pbu/agriPBUmain.php

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The Future is in the Atom

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- Upcoming Workshops and more...

Details Inside!

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555 N. Kensington Avenue
La Grange Park, IL 60526-5592

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