TECHNOLOGY

Radiation: Food's New Keeper

By harnessing the nuclear energy from radioactive cobalt and other sources, scientists are now using the atom's power to preserve nature's bounty for man's nourishment.

By BARBARA TUFTY

See Front Cover

➤ NUCLEAR RADIATION is offering an awesome and safe transformation to modern man's living.

Just as the inventions of the tin can over 150 years ago and the frozen food package two decades ago revolutionized the storage and handling of food, now atomic energy may change the looks of the housewife's kitchen and bring new foods to faraway places.

By exposing food to harmless doses of energy rays, scientists find they can destroy the microorganisms that cause spoilage and decay in nature's meats, fruits and other nutrients.

A few doses of energy rays prevent potatoes from sprouting, as shown in the picture on this week's front cover of white potatoes left in the open for six months. The radiated potato is on the left. Source of the radiation is cobalt 60, glowing from the bottom of a pool of water at U.S. Army Laboratories, Natick, Mass.

Benefits of Radiation

The radiated food, wrapped in flexible containers, can be kept indefinitely on shelves at ordinary temperatures, looking as juicy and bright as the day it arrived. Because of lightness in storage weight and no need of refrigeration, such foods could easily travel to newly developing countries where they are urgently needed—and just as easily, exotic tropical fruits could be decontaminated of foreign microbes and be transported to your table.

Food—the chickens, fish, beef, peaches, strawberries, wheat, nuts and more than 5,000 odd varieties of plants and animals that supply man with energy and nutrition—deteriorates naturally soon after it is cut or killed. This spoilage is the result of chemical processes that break down tasty substances into compounds that are unpalatable to human beings and other creatures.

Several agents can bring about this food spoilage, but the major damages are caused by the action of tiny living organisms such as bacteria, molds and yeasts that force their way into cracks, cuts and bruises of food and there continue their life processes. Another important reason food spoils is the action of enzymes, those complex substances that are naturally present in living material and function as catalysts to accelerate certain living processes. Then there are various chemical reactions, such as oxidation, whereby chemicals of the food react with chemicals of the air or environment to form new, unpleasant substances.

This food deterioration can be slowed down or even stopped in several ways, simply by destroying the spoiling agents or by depriving them of things they need, such as water, warmth, air or light.

Throughout the ages, man has managed to slow down the evils of decay by various ingenious methods—drying, salting, pickling, smoking, baking, canning, cooling, freezing, waxing, bottling and packaging. Now he is trying radiation.

Man has come a long way from the days a few hundred thousand years ago when he hovered over his meat drying above red glowing embers to now, when he stands above the 25-foot pool of water watching the eerie blue light around the radioactive cobalt.

Probably the oldest method of preserving food is that of drying. Prehistoric man may have noticed that dried grains, berries and nuts kept for a long time without spoiling, so he started drying meats and fish in the sun and air or smoking them over a fire. In the northern countries, he learned to preserve a piece of meat by packing it deep in a snow bank—a primitive deep freeze.

Salt has been used for ages as a preservative, mainly for meats and fish. By adding water to the salt, or brine, the art of pickling was invented. Later, sugars and spices were added to fruits and vegetables to provide stores of jams, jellies and preserves through the non-growing seasons.

It wasn't until about 1795, however, that man first devised a mechanical process for preserving foods—the hot air dehydration chamber, constructed in France.

First Tin Can

The first tin can—a nickname for the word canister—was created in a simple kitchen by the French confectioner, Nicholas Appert, in response to a reward offered by Napoleon for a method of keeping his military men fed as they moved across Europe or sailed on the seas for long months. Without understanding why, Appert found that food heated in sealed containers did not decay and retained its texture and taste for a long time.

Fifty years later, the French scientist Louis Pasteur looked through his microscope and discovered the existence of tiny living creatures—bacteria. Later he proved that these actually caused food to spoil.

Gradually systems for canning, cooling, freezing and salting foods spread throughout Europe and newly developing America. At the end of the 19th century mechanical refrigerators began to be installed in homes.

Another big revolution in food processing came in the 1920's when Clarence Birdseye overcame tremendous obstacles to develop and sell his quick-frozen products. Only in the late 1940's was this freezing process established as an important competitor to conventional preserving methods. Innovations on this method include dehydration or freeze-drying, whereby water is removed.

Now scientists are trying a brand new process of bombarding the decay-creating organisms with electrons or rays from radioactive sources.

This radiation may be given in small pasteurizing doses which kill some microorganisms but retain the flavor, odor, texture and shape of the original food. Larger doses, ten to a hundred times stronger than the smaller doses, sterilize the food and kill virtually all bacteria.

It is important to remember that this radiation does not leave behind a radioactive residue and is not harmful to anyone who eats these foods. Substances are made dangerously radioactive only when heavy doses of nuclear particles from tremendous energy sources such as the atom bomb or an atomic reactor penetrate and break up the nucleus of the object bombarded. The rays used for preserving foodstuffs are nowhere near so powerful.

U.S. Army Involved

The process of food radiation began after World War II, when isotopes became readily available. As military establishments of every country are always interested in better methods of preserving foods, the U.S. Army has been consistently working on this new research, experimenting in particular with large doses for complete sterilization of foods at their laboratories in Natick, Mass. The Atomic Energy Commission, interested in lighter pasteurization doses, has built a Marine Products Development Irradiator at Gloucester, Mass., to demonstrate the process to the seafood industry.

A typical pasteurization dose contains about 250,000 rads. (A rad is a standard unit of measurement of radiation absorbed by an object.) Scientists figure a few thousand rads inhibit sprouting of potatoes and onions; tens of thousands kill grain insects and meat parasites; a hundred thousand to a million rads kill most microbes in meats, fruits and vegetables; and over a million rads kill all microbes.

For this process essentially two sources of radiation are used. One source is a powerful by-product from AEC nuclear reactors—cobalt 60 or cesium 137. In the AEC irradiator, four activated cobalt slugs are inserted inside a tube of stainless steel which in turn is inserted into an aluminum tube. There are two rows of these tubes, 49 in each row. This collected activated cobalt source constantly sends out gamma rays of approximately 250,000 curies. (A curie is a standard unit of measurement used to describe the intensity of radioactivity in a given amount of radioactive material. One curie equals

the radioactivity associated with one gram of radium.) When not in use, the package of radiating tubes is carefully lowered 25 feet under water which acts as a barrier to the rays. When it is ready to be used, the source is hoisted by remote control into position in a specially protected room, and the food in containers is carried on a mechanical conveyor belt under and over the cobalt.

The other source of radiation used by scientists is a stream of electrons generated by a linear accelerator and aimed directly at the food. This electron stream can be turned on and off, much like a light switch.

Detailed studies are underway to determine the wholesomeness, nutritional value, taste, appearance and safety of these irradiated foods. Such items as bacon, potatoes, and grains for flour have been cleared by the Food and Drug Administration, and petitions for oranges and fish such as haddock, halibut, flounder, sole and cod are being submitted.

Researchers point out that it may yet be several years before these and other irradiated foods are available on the market. Possibly if industry would get started in the process, research would move faster. But the present limitations of high research costs and relative undependability of results with high-quality flavor, color, and texture have kept the business world undecided. The present state of radiation technology is so new, industrialists believe, that the public is not yet ready to accept the product. Researchers point out that it took 15 years before frozen foods became firmly established in the market.

The eventual cost of radiated foods to the shopper will not be significantly higher than that of ordinary food, but the quality will be greatly enhanced.

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CHEMISTRY

Harm in Irradiated Sugar?

➤ WHEN EXPOSED to sufficient radiation, sugar breaks down and can transmit the lethal effects of radiation to living plant cells and possibly other forms of life.

This was found by Cornell University scientists who analyzed irradiated solutions in which plant cells were grown. They found that cane sugar, and not the rest of the solution, was broken down into irradiated chemical substances. Plant cells growing in this material were affected almost as if irradiated directly.

The laboratory for cell physiology, growth and development, headed by Prof. Frederick C. Steward at the N.Y. State College of Agriculture, Cornell University, achieved the scientific find. The researchers, Drs. Richard D. Holsten, Michiyasu Sugii and Prof. Steward reported that although the work primarily involved plants, the evidence has obvious bearing on other living things.

Harmful effects of radiation usually are ascribed to direct radiation in which vital parts of the cells are hit, principally the cell nucleus where hereditary information is carried. But the new work shows that these effects on cells may be produced by stable chemical substances derived from sugar, and they may act long after the direct exposure to radiation has ceased.

Not only do the findings add to an understanding of cell growth and the biological affects of radiation, but they have possible implications for the food industry. If radiation effects can be transmitted by stable chemical products from irradiated sugar, the biological consequences should be known before there is widespread use of radiation sterilized foods, especially those rich in sugar, according to the researchers.

In their experiments, carrot cells were grown in a solution containing coconut milk, a growth stimulant in which Prof. Steward has been able to grow whole carrot plants from free cells. Cell growth was virtually stopped when this solution was sufficiently irradiated. The scientists said, however, that at low dosages of radiation cell growth was stimulated instead of being stopped.

Sugar was found to be the only part of the nutrient solution that could indirectly transmit the radiation effects.

The researchers then irradiated substantial quantities of sugar, and by testing at each step of the way for effects on the growth of carrot tissue and cells, they obtained the harmful product in crude form. While general characteristics of the product have been determined, work is now under way to find its full nature.

To add weight to their findings, the scientists experimented on other plants. They even tried an experiment with fruit flies, and found some ill effects.

Prof. Steward and Dr. Holsten suggested that chromosomal abnormalities found in barley and other plants grown on irradiated media could be attributed to changes in sugar normally present.

The scientists also report that cane sugar is not the only sugar to absorb radiation and transmit its lethal effects, and they indicated it may be general among sugars.

They made it clear that while their work primarily concerned higher plants, there is reason to suspect that similar results might occur in experiments with other living things, including animal and human cells.

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Do You Know?

About 56 registered English language newspapers were published in *India* in 1964.

Scientists working with laboratory mice have found that leukemia viruses may be transmitted from mother to infant through the mother's *milk* and transmission may also be possible through the placenta before birth.

Reduced water *velocities* result in reduced growth of steelhead trout and coho salmon embryos.

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