

FOOD IRRADIATION IS IT THE GLOBAL FOOD PRESERVATION METHOD FOR FUTURE?

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Although the food supply in the United States has achieved a high level of safety, in recent years there has been an increase of illness and deaths related to unsafe food. With scientists in government, professional organizations, and industry all pointing to food borne illness as their largest food safety concern, consumers are becoming aware of the microbiological hazards that may be associated with their food. One solution to the problem of unsafe food is food irradiation. Food irradiation may solve the problem of harmful bacteria that causes food-poisoning and also preserve food to prolong shelf life and retard spoilage. The method has been researched and approved by the U.S. Food and Drug Administration (FDA), but are consumers ready for food irradiation? Is the process safe? What are the risks involved in this process to both the food we eat and to the environment?

KEYWORDS: *Irradiation, Food Preservation, harmful bacteria.*

INTRODUCTION

Food irradiation, the use of ionizing energy to kill bacteria, parasites and insects in food and to retard spoilage, is not new. The process has had the longest history, more than 40 years, of scientific research and testing of any food process before approval [1]. Research began early in the 20th century in the United States and accelerated in 1953 as part of the government's "Atoms for Peace" effort [1]. In 1963, the U.S. Food and Drug Administration (FDA) began approving food irradiation, first to rid wheat and flour of insects and to control sprouting of potatoes. In the early 1970's the process was adopted to sterilize meats for the astronauts to consume in space, and the practice continues to be used to this day [2]. In 1983, the FDA approved irradiation of spices and seasonings, and in 1985 it approved irradiation to prevent trichinosis in pork. The following year, approval was extended to fruits and vegetables. And in 1990, the FDA approved irradiation of poultry to prevent salmonella and other food-borne bacterial pathogens. Currently, petitions for seafood, ground beef, and eggs are pending approval. Thirty-eight countries permit irradiation of food. Europe alone treats more than 28 billion pounds of food annually with this process [3]. The United States has 40 licensed irradiation facilities; most are used to sterilize medical supplies, but 16 are used to irradiate spices for wholesale use, and several others irradiate food.

Food irradiation has an impressive list of national and international organizations which have endorsed the process, including: The American Dietetic Association,

American Council on Science and Health, American Medical Association, Council for Agriculture Science and Technologist, Scientific Committee of the European Union, United Nations Food Technologists, and the World Health Organization [4]. Experts say that "irradiation can destroy the bacteria, fungi, parasites, and insects that infest food products" [4]. There is a difference between radiation and irradiation. The idea of irradiation, the use of ionizing energy on foods [5], has become very important to us, because it can help eliminate certain types of bacteria that can do harm to a person's health if consumed [4]. "It is a proved safe and effective means of breaking the cycle of food-borne disease" [5]. It controls the organisms and microorganisms that can cause spoilage and disease, as well as decay, in food [5]. According to the article *The Food Zappers* [4], the procedure is simple: "Expose food products to gamma rays from radioactive cobalt, to x-rays, or to a beam of high-energy electrons" [4]. A small dose of radiation can extend the shelf life of produce by a couple of weeks, a slightly larger dose eliminates most disease-causing microorganism, mainly in poultry and beef, and larger doses could most likely sterilize foods, giving them a shelf life of even years [4], and all doses depends on food that exposed to radiation.

The amount of sterilization is dependant on the amount of time that the food was exposed to the radiation and its dosage [1]. During the process, prepackaged food is moved by conveyor into a thick-walled room housing the irradiator. Stainless-steel pencil-like rods of cobalt-60 placed in racks are the most common used energy source [6]. However, gamma rays emitted are very short wavelengths, similar to ultraviolet light [7]. The gamma energy penetrates the food and passes through the food, much in the same way microwaves pass through food, leaving no residue. The food is exposed to the radioactive material for approximately 15 to 45 minutes. Duration of exposure to gamma energy depends on the density of the food, the amount of energy emitted by the irradiator, and the purpose of the process [8]. Regulated doses are set at the minimum levels to achieve the specified purpose or benefits. The levels allowed by the FDA are more restrictive than those used by other countries [7]. Low doses (up to 1 KiloGray) control the trichina parasite in fresh pork; inhibit spoilage in fruits and vegetables; and control insects, mites, and other pest in food. Medium doses (1.0-10 Kilo gray) control bacteria in poultry, and high doses (above 10 Kilo gray) control microorganism in herbs, spices, teas, and other dried vegetables. The same process has been used to sterilize medical devices, bandages, condoms, tampons, contact lens solution and food for astronauts.

When the process is completed, the rods of cobalt-60 are retracted into a pool of water, which acts as a radiation barrier.

Many scientific groups believe food irradiation will benefit consumers' retailers, and food manufactures. Irradiation is used in many nations to retard spoilage and increase the shelf life of food. This is particularly beneficial in areas lacking refrigeration.

The World Health Organization endorsed food irradiation in 1992, calling it a "perfectly sound food-preservation technology." The head of the group's food safety unit said irradiation is "badly needed in a world where food-borne diseases are on the increase and where between one-quarter and one-third of the global food supply is lost post-harvest"[9].

The ability of irradiation to rid food of harmful bacteria could reduce food-poisoning incidents. In the United States alone, according to the national Centers for

Disease Control and Prevention, more than 6.5 million serious cases of food-related illness occur each year, causing more than 10,000 deaths per year. One concern that the Department of Health is looking into is food poisoning caused by toxin-producing bacteria. One of these includes *Escherichia coli* [4]. *Escherichia coli* as it is commonly called, come from the intestinal tracts of all mammals that contaminate raw meat and carcasses while they are being processed [5, 10]; others often spread in the beef while the slaughtering is going on, usually when one intestine is broken. This causes a possible contamination with beef to be used as hamburger meat, if the feces from the intestine come in contact with the beef. According to one article [11]; bacteria existence in unsterilized meat is common and unavoidable. However, one way known to prevent the spread of the bacteria is by cooking the meat thoroughly [10]. *E. coli* 0157:H7, which is one of hundreds of strains of *E. coli* that commonly exist in the large intestines of all mammals [11], is a very serious bacteria to be aware of. Since the outbreaks are so rare, the Centers for Disease Control and Prevention and county health officials don't bother to save the statistics on the illness acquired by the bacteria [10]. Probably the most famous outbreak of *E. coli* 0157:H7 [12] began in contaminated hamburger patties sold by the fast food restaurant chain known as the Jack in the Box. In 3 days, January 11 to January 13, 1993, a dozen patients were admitted to Seattle's Children's Hospital Medical Center with serious and life-threatening symptoms caused by the *E. coli* 0157:H7 bacterium [4, 10, and 12]. The real trouble started a week later when more than 100 cases of *E. coli* food poisoning were reported, including 2 deaths, one in Washington State, and the other in Boise, Idaho; USA. The numbers continued to rise dramatically into early February of 1993 [4]. The outbreak of *E. coli* ended around the end of February, but among the casualties were "600 possible cases, 477 confirmed cases, 144 hospitalizations, and 3 deaths" [4, 12].

However, the largest outbreak of *E. coli* 0157:H7 occurred in Cabool, Missouri (USA) from mid-December 1989 to mid-January 1990, when the public drinking water became contaminated after 2 water mains burst. Among the casualties, 243 people were reported sick and 4 people were pronounced dead [11]. Outbreaks like these have increased the concern over the spreading of *E. coli* 0157:H7 bacteria [12]. However, there may be possible risks involved in irradiating food. While we irradiate food, we are exposing them to high doses and levels of radioactive material or electron beams. Some experts say [1], that important nutrients in the food are destroyed along with the harmful bacteria, especially vitamin C [6, 13]. Researchers have found, however, that the depletion generally is less than that caused by cooking, canning or freezing.

The process will not cause the food to become radioactive, it will however, because chemical changes in the food. The process could cause the formation of new compounds that are referred to as "unique radiolytic products". One of the most frequently raised issues involving irradiation is whether the process forms toxic compounds by rearranging the molecular makeup of certain foods. Some foods contain naturally occurring radiolytic products, benzene and formaldehyde, for example. Others are produced, for instance, when meats are grilled over a fire. Opponents of irradiation claim that unique radiolytic products (URPs) are formed during exposure to the gamma rays.

They argue that URPs, whose health effects are unknown, could be harmful. Extensive studies, however, have identified no radiolytic products unique to irradiated foods, and none that suggest harm. The FDA allows food from potatoes to apples to be

used in the irradiation process [11]. Irradiation does not change the taste or quality of the food; instead, irradiation just destroys the bacteria on and in the food that cause various diseases [5]. It is said that irradiation would eliminate the risks of salmonellas and *Campylobacteriosis*. Irradiation would also end the need to apply various pesticides to the food to eliminate insects that infest the food. Irradiation by itself could do the job in a safer way than the use of sprays [13]. One other concern deals with if the process changes the state of the other substances found on the food [1]. "What happens to the herbicides, insecticides, pesticides, and fungicides used by farmers as well as the additives used by food processors" [1]. In the United States, the Food and Drug Administration (FDA) has examined the irradiation of foods containing pesticide residue. It specifically calculated the amount of radiolytic products that would be expected to be formed if foods containing pesticide residues were irradiated at a dose of 1 kilo gray. This dose is in the upper range of that expected to be used in fruits, vegetables, and grains for dis-infestation purposes.

If the pesticide residue level in the food is about 1 part per million (an average level) then the calculated total yield of all radiolytic products from the pesticide residue would be about 0.000033 milligrams per kilogram of food, or 1 gram in 3000 tons of food. The FDA regards this amount as "virtually nil". It concludes that "the potential toxicity of each radiolytic product from a pesticide chemical residue in foods that are irradiated would be negligible" and that "such pesticide residues do not pose a hazard to health" [1].

Studies have been done on food additives that assume the use of higher doses of radiation. A food additive is defined by the Codex Alimentarius Commission of the Food and Agriculture Organization and World Health Organization as a substance not normally used as a food ingredient but which is deliberately added to the food to produce a technological result. Colorants, man-made antioxidants, preservatives such as potassium sorbate, and polyphosphates are examples of food additives, forming 0.01 to 0.1% of the total food weight. These studies indicate that at a radiation dose of 10 kilogray, which is the maximum dose allowed for food irradiation, yields of all radiolytic products from 3 to 30 parts per billion. For a person with a total annual diet of 500 kilograms of food, these figures correspond to a negligible annual individual intake of radiolytic products between 0.1 and 1 milligram from an additive in a processed irradiated food that accounts for 5% of the total diet. The probability of harm occurring from radiolytic product formation from food additives is therefore considered to be extremely low indeed [1]. Congress defined the sources of ionizing energy as food additives and included them in the Food Additives Amendment to the Federal Food, and Drug, and Cosmetic Act [6], this delegated the regulatory responsibility to the FDA. Additionally, two agencies within the US Department of Agriculture are involved in the process.

CONCLUSIONS

Besides setting maximum radiation levels, the regulation also spelled out labeling requirements for irradiated food. Labels of packaged foods sold at the retail level have to clearly state that the products have been treated with radiation. They also must have a logo, or symbol, to inform shoppers that the products have been irradiated. Further, supermarkets and grocery stores have to identify fresh fruits and vegetables that have

been treated with radiation. FDA said this can be done in various ways, such as counter signs, cards and other displays near the produce bins. Irradiated foods sold at the wholesale level that might be reprocessed must have labeling that advises not to irradiate the product again. FDA's regulation made it clear that it expects the food industry to use only as much radiation as is needed to accomplish the "intended technical effect" on a particular food product. A manufacturer is expected to use a dosage lower than the allowable maximum if that is all that is needed to kill insects or microbial contaminants, or retard the ripening of fruit. In addition to food safety, consumers are frequently concerned about possible environmental effects of food irradiation. But unlike nuclear power plants and weapons manufacturing, there is no uranium or other fissionable material present, and no source of neutrons to produce fission. The amount of energy used in food irradiation is relatively low and produces little heat. There are no hot fluids or gases that could generate an explosion; no radioactive gases, liquids or solids that could be released accidentally in the environment; and no known ways that the materials could be used to produce nuclear weapons. There are still many mixed emotions about this step in preserving food. One problem is that food cannot be tested to see how much radiation it was treated with, making it nearly impossible to detect whether or not the radiation levels were beyond those approved by the Food and Drug Administration [13]. Even though numerous reports on many different tests showed no problems, there were some that brought back abnormal results. Most of these reports, both reporting with and without problems, dealt with animals and humans. Some of these reports found abnormalities in the chromosome number in monkeys and malnourished children that ate irradiated food. One other significant study dealt with 5 malnourished Indian boys. Each of them had chromosomal abnormalities, after they ate freshly irradiated wheat. Although the study was small, it ended up to where no one has tested humans with freshly irradiated food since.

Much of the research has been funded by various food and health organizations, like the United Nations Food and Agriculture Organization, the World Health Organization, and the International Atomic Energy Agency [6]. But, because of the possible risks involved with this process, it is suggested that it should only be used if it is the best way to solve a significant health problem. Yet, most who support the process of irradiation believe that by irradiating food, much food-poisoning illness will be prevented from ever happening. In addition, millions of dollars will be saved. The future of irradiating food, as with all other newly developed scientific processes, is uncertain, but judging by its results, its future is promising. Even though negative results have come out of different tests, the concept of irradiation as a whole is expected to aid people much more than harm them. It could be that once food irradiation becomes a major part of our lives, just about everyone would not have to worry about the idea of having food-poisoning ever again.

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تعريض الأغذية للإشعاع (تشعيع الاغذية) كطريقه بديله لحفظ الاغذيه في المستقبل

تستعرض هذه الدراسة إمكانية استخدام الأشعة كوسيلة لحفظ الاغذيه فيما يسمى حفظ الاغذيه بالإشعاع (تشعيع الاغذيه) وذلك للتخلص من الكائنات الحية الدقيقة (فطريات و بكتيريا) وأيضاً الحشرات والتي تسبب فساد الاغذيه وأيضاً يسبب البعض منها التسمم الغذائي والذي يسبب أضرار صحية ومخاطر على الحياة كما يستعرض البحث مميزات حفظ الاغذيه بالإشعاع في تأمين غذاء أفضل وبيئة أكثر أماناً وخاليه من الكائنات الحية الدقيقة المسببة لفساد الاغذيه والتسمم الغذائي.