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THE ETHICS OF FOOD IRRADIATION

by Jennifer Hogan

Introduction

The use of ionizing radiation to sterilize, disinfect, and preserve food is becoming more widespread as technology enables safer irradiation practices; however, public sentiment, wary of the use of radiation, is resisting its implementation. Anti-food irradiation groups believe that there has not been enough study surrounding irradiated food for it to be ethically distributed for consumption. In contrast, pro-food irradiation groups feel that it would be unethical not to irradiate food as the radiation process makes the food safer to eat.

In order to avoid the public’s fear of the term ‘radiation’, food irradiation is often called cold pasteurization or electronic pasteurization. These terms attempt to emphasize the safety of treated food by drawing a parallel to traditional heat pasteurization. By law in the United States, food treated with ionizing radiation is labelled with the Radura symbol together with the word ‘irradiated’ or ‘treated with radiation’. However, labelling has been inconsistent as there are no standards regarding the acceptable levels of radiation or pathogen reduction. There is no other method of distinguishing between unlabelled irradiated food and unirradiated food for a consumer. Additionally, food that has been processed or used in a restaurant is exempt from the labelling requirements.[1]

As of 2003, more than fifty countries around the world have approved the food irradiation process . Facilities in these countries are regulated jointly by the International Atomic Energy Agency (IAEA), the Food and Agriculture Organization (FAO), and the World Health organization (WHO) . Each country maintains its own laws regarding which irradiated foods may be sold within its borders. Within the United States and worldwide a variety of foods are commonly irradiated, including spices, beef, fresh fruit, frog legs, onion, garlic, chicken, pork, fish, rice, potatoes, eggs, seeds, cereals, and ready-to-eat meals . No regulatory agency has reversed its decision to allow the sale of a type of irradiated goods.[2]

Benefits

The benefits of irradiating food are clear and known. The irradiation process can have different beneficial effects depending on the dose of radiation. Radiation dose is measured in gray (Gy); one Gy is equal to the energy of one joule absorbed by one kilogram of matter. However, this is not a good indicator of biological effects as different kinds of radiation react differently with matter. Very low doses, which lie between a range of 0.05 – 0.15 Gy, can be used to inhibit sprouting in potatoes, onions, ginger, and other roots. Fairly low doses of 0.15 – 0.5 Gy kill any insects and parasites present; this is the dose used on cereals, fruits, and dried meats. A low dose of 0.25 – 1.0 Gy will delay ripening in fruits and vegetables. A medium dose of 1.0 – 3.0 Gy will extend the shelf life of highly perishable foods, such as fish and strawberries. A medium dose of 1.0 – 7.0 Gy will eliminate spoilage and pathogenic micro-organisms; this dose is often used on seafood, frozen poultry, and frozen meats. Increasing the dose to 2.0 – 7.0 Gy has an effect on the properties of the food; treated grapes are juicier, and treated dehydrated vegetables have a shorter cooking time. A high dose of 10 – 50 Gy serves to decontaminate the food; this dose level is often used on spices. Very high doses of 30 – 50 Gy, when combined with mild heat, sterilize foods; this is a common treatment for prepared foods and hospital diets.[3] Because of these preservative effects, irradiated foods do not require as much pesticide and fumigant as their non-irradiated equivalents.

As irradiated foods do not harbour disease, unless they are irradiated, some foods, such as fruits and vegetables, are restricted from sale on the international marke. Because irradiating the food makes it safer for consumption as well as easier to transport and store, pro-food irradiation groups believe that it is in the best interest of both the public and the food industry to irradiate food. Just as heat pasteurization of dairy products such as milk and cheese has saved lives, food irradiation can promote positive benefits as well by eliminating botulism, salmonella, and even prions known to cause Creutzfeldt-Jakob disease.[2] It is clear that if food can be made safer, there is an ethical responsibility to continue with the advantageous process.

Methods

There are three different technologies used to irradiate food: electron beam irradiation, gamma radiation, and X-ray irradiation. Each varies in exposure time needed to treat the food, penetrative ability of the radiation, and safety to workers. Electron beam irradiation uses an electron gun to bombard the food with high energy electrons. The treatment time is very short, but electrons do not penetrate deeply into the food, so electron beam irradiation is not a suitable method for all foods.[3] Because there is no radiation source, the machinery can be turned off when not in use; when on, a concrete barrier is all that is needed to protect workers. Gamma radiation techniques usually employ either a cobalt-60 or cesium-137 radioactive source. Although treatment time is merely a few minutes, penetration is excellent.[3] When not in use, the radioactive source is kept under water for safety. While in use, the workers need to remain behind thick concrete barriers.[6] In X-ray irradiation, an electron gun produces an electron beam which strikes a metal target, producing the X-rays. Although the treatment time is longer than that of the gamma radiation technique, the penetration is just as deep.[3] The spread of the beam is controllable, increasing the safety of the workers, and without the use of a radiation source, the machinery can be turned off unless in operation. Workers need only use heavy concrete shielding to protect themselves when the machine is in use. As X-ray irradiation uses an electron gun just like electron beam irradiation, the two techniques can be used in the same facility.[6]

Concerns

Unlike electron beam irradiation and X-ray irradiation, gamma radiation uses a radioactive source. Over time, this source will become depleted in its ability to perform the food irradiation procedure. At that point, the source needs to be discarded and a new one procured. A worry of many environmentalists is that food irradiation through gamma radiation, the most cost effective technology, will produce harmful radioactive waste.[6] Pro-food irradiation groups claim that there is little or no waste as spent cobalt-60 can be ‘recharged’ and that the entire volumes of cobalt-60 and cesium-137 are very small.[7] However, anti-food irradiation groups claim that not all the cobalt-60 will be recharged, producing waste which needs to be stored similarly to the cesium-137. There is concern over the transportation and storage of radioactive waste. They also cite accidents in Georgia in 1988, Hawai’i in 1967, and New Jersey in 1982 where the radioactive water used to store the cobalt-60 or cesium-137 leaked into the groundwater of nearby towns.[8]

Radiation tends to be a sensitive public relations issue largely due to the public’s ignorance of its properties. When irradiated foods first came onto the market, many people thought that the food itself was radioactive; however, the treatment does not leave the food itself radioactive.[9] The statement that treated foods are not radioactive has been widely touted by pro-irradiated food groups. Anti-food irradiation groups, such as the Organic Consumers Association (OCA) and Public Citizen, believe that X-ray and electron beam irradiation methods leave small but significant levels of radiation in the food; these groups quote government and scientific studies to back up their findings.[10, 11, 12, 13] Radiation can damage living cells and their DNA, and groups like the OCA worry that eating irradiated food will increase the risk of cancer in an individual. There have been no long-term studies done on the effects of ingesting irradiated food.[14] Pro-irradiation groups and governments claim that they are not needed as there is no lingering radiation in the food; that is, the food is not radioactive and completely safe so it does not need to be studied.[1]

Although no one disputes the fact that irradiated food has a longer shelf life, many wonder how the irradiation process has changed the food. While a highly subjective matter, changes in the taste and odor of irradiated foods have been recorded. Meats seem most vulnerable to these changes; post-irradiation, meats have been described as smelling and tasting burnt, of sulphur, of blood, of metal, and of acetic acid.[15, 16] Changes in the color of the meat were also recorded. Ground beef is said to take on green, yellow, and brown hues while pork and turkey are recorded as becoming red.[17, 18] With such changes, it is no wonder that the public distrusts irradiated foods. Pro-irradiation groups recognize this problem and are working to develop methods of irradiation that do not damage the sensory qualities of the food, such as irradiating at low temperatures.[3] Nevertheless, it is clear that consumers will not buy ‘off’ tasting food even if it is safe.[2]

Perhaps what worries people more than the cosmetic changes are the nutritional changes that can occur in some irradiated foods. Vitamins and nutrients can be damaged by the ionizing radiation. Vitamins A, C, E, K, and several B complex vitamins are especially vulnerable to degradation due to the radiation. Depending on the food itself and dose of radiation, there can be a 5% to 80% loss of vitamin concentration.[19] Pro-food irradiation groups note that irradiation damages the nutritional value of foods no more than traditional cooking.[1] Anti-food irradiation groups counter that irradiated ‘fresh’ foods contain similar nutritive value as their cooked counterparts and are misleading.[8] The FAO, IAEA, and WHO, in a meeting held in Geneva, Switzerland in 1997, however, concluded that these nutrient losses will not have an adverse effect on individuals because these vitamins are found in abundance in a healthy diet.[20] Anti-food irradiation groups are quick to point out that not everyone being fed irradiated food is eating a healthy diet as irradiated foods are often used in food aid operations.[14]

In addition to vitamin loss, irradiated foods see an increase in other chemicals. The ionizing radiation results in an increase in free radicals in the food. Free radicals are atoms with at least one unpaired electron in the outermost shell. These atoms are highly reactive and can disrupt normal cells, causing damage and DNA mutation.[21] Anti-food irradiation groups worry about the long-term affects of ingesting an increased concentration of free radicals in combination with the decreased consumption of the vitamins E and C which help the human body safely get rid of radicals.[19] As the impact of free radicals in the body is an ongoing research topic, the risk, if there is one, is unknown. Pro-food irradiation groups draw attention to the fact that free radicals are created through many traditional food treatments and that free radicals have no proven toxicological affect on the body.[3]

The creation of exotic chemicals as radiolytic products is a great source of conflict between anti-food irradiation and pro-food irradiation groups. In fact, their very existence is a point of contention. The IAEA claims that the only radiolytic products are common chemicals, such as glucose and carbon dioxide, and that these products are similar to the ones created by cooking.[22] An United States Food and Drug Administration (FDA) study estimates that for food irradiated at 1 kGy, radiolytic products would be less than three parts per million.[23] On the other hand, anti-food irradiation groups say that irradiation produces potentially toxic or carcinogenic chemicals, such as 2-dodecylcyclobutanone and polychlorinated biphenyl.[24, 25] The IAEA claims that they were unable to detect these chemicals in their own tests.[3] Although anti-food irradiation organizations say the IAEA is being irresponsible by allowing the distribution of irradiated food without resolving the issue of radiolytic products, the IAEA stands by its results.[3, 24]

One widely held misconception is that irradiating food will reverse its spoilage; it cannot. Irradiated food must be handled and packaged carefully to avoid contamination with non-irradiated food as well as inorganic contaminates.[3] Many anti-food irradiation organizations wonder if the standards of safe handling will go down if food irradiation becomes widespread.[19] Although anti-food irradiation organizations are skeptical, pro-food irradiation groups insist that the practices of safe handling will not be loosened and that food irradiation will not be used as a cheap alternative to real sanitation issues.[2]

Conclusion

Although the debate around food irradiation is not a moral one, it is an ethical one. It is an issue which polarizes people. Pro-food irradiation organizations, such as IAEA and the FDA, believe that they know enough about the process of irradiation and the ways in which the ionizing radiation interacts with the food to recommend irradiated food for general consumption. These organizations believe that the benefits of safer, irradiated food outweigh any detriments. Irradiating food is good for the environment as less pesticide needs to be used. Most people consuming irradiated either do not know the food is irradiated or do not have a choice. Pro-food irradiation organizations have made an ethical choice to try to improve the health quality of food for people around the world. On the other hand, anti-food irradiation organizations claim that pro-food irradiation groups are favoring the food industry, as food irradiation leads to longer shelf lives, over the good of the consumer. Groups like Public Citizen and OCA, anti-food irradiation organizations, believe that it is unethical to distribute irradiated food for general consumption because of lingering radioactivity, radiolytic products, and decreased nutritional value. These organizations hold that there is not yet enough known about the affects of food irradiation. Additionally, they are concerned over the possible environmental impact of wide-spread radiation use. Instead, anti-food irradiation groups urge companies to use traditional methods of food preservation, such as vacuum packing and flash freezing.

Each type of organization believes that it is looking out for the good of the public and each organization is a proponent of what it believes is correct. If there are side effects to eating irradiated food, it may not be known for years to come. If food is not irradiated now, the world market may suffer due to the spread of diseases. The choice is not clear and may never be. Part of the complexity comes from the fact that if irradiated foods are distributed, they will be eaten by many people, not just the policy-makers. Ethical questions are, by their nature, personal ones. For an informed American consumer, there is a choice due to the FDA's labelling requirements and that choice is simple: if one does not wish to eat irradiated foods, one should not buy them; if one wishes to eat irradiated foods, they are available.

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