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Paper Session I-D - Irradiation: The Effects on Our Food

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IRRADIATION: THE EFFECTS ON OUR FOOD

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It is believed that the irradiation process will significantly increase the shelf life of certain foods, (ie: mushrooms, onions, apples, and potatoes). For the following reason this should hold true: The irradiation process kills any bacteria present in the food. Although food contamination can occur at any time, logically, the irradiation process will make the growth of bacteria start over, and therefore delay the decaying of the food.

To determine how much the shelf life of these foods will be improved, samples were observed over a period of six weeks. One set of these foods was a control group. The other set was the experimental group. There were two experimental groups. Both experimental groups were irradiated at an irradiation facility in Mulberry, Fl. (Food Technology Service, Inc.), one of these was kept at the constant temperature of 1 degree Celsius. The other was kept at 28 degrees Celsius. All groups were monitored for decay, pictures were taken, and records were kept concerning the various observations.

The hypothesis was correct. After completing the observation period the following conclusions were formulated. Irradiation of food is useful in the elimination of bacteria. The process extends shelf life of foods significantly when accompanied by refrigeration.

Barth, Margaret M. "Irradiated Foods: Are They Safe to Eat?" Food Safety Fact Sheet May 1992

Hazinga, Cynthia V. "Irradiated Foods: Are They Safe?" Better Homes and Gardens Oct. 1993 : 58+

Lecos, Chris W. "The Growing Use of Irradiation to Preserve Food" Department of Health and Human Services. 5pgs. Online. Available O$d12101721 at psupena.psu.edu

Purpose

A reason for this project is to determine if the irradiation process is an effective means of food preservation.

Problem

How is the shelf life of certain foods, (ie: apples mushrooms, onions, and potatoes) affected by irradiation?

Hypothesis

It is believed that the irradiation process will significantly increase the shelf life of certain foods, (ie: mushrooms, onions, apples, and potatoes). For the following reason this should hold true: The irradiation process kills any bacteria present in the food. Although food contamination can occur at any time, logically, the irradiation process will slow the growth of bacteria, and therefore delay the decaying of the food.

Background

Food irradiation, to those that do not understand what the term actually means, is a helpful procedure, designed to eliminate disease causing bacteria and to extend the shelf life of foods. The process now costs very little (only 1-3¢ per lb. for fresh fruits and vegetables). The key to this wonderful procedure is, of course, the radioactive substance Cobalt 60. This material starts out as Cobalt 59. Co-59 is the only naturally-occurring cobalt isotope. Other isotopes, all of them radioactive, have been artificially produced. Among these, Co-60, which is normally produced by irradiating Co-59 with neutrons in an atomic reactor, is especially important. Natural cobalt is often added to Hydrogen bombs; upon explosion, many neutrons are liberated, which convert the cobalt to Co-60, causing a considerable increase in the total amount of radioactive fallout. This substance has a half-life of about 5 yrs. Co-60 is also used in cancer research and as a source of X rays for radiation therapy. (Grolier CD-ROM 1993).

Radiation

Radiation may be defined as the emission and propagation of energy through space or through a material medium. The type of radiation of primary interest is electromagnetic. The rays most commonly used for food preservation are Gamma Rays. These are electromagnetic radiations emitted from the excited nucleus of elements such as 60Co and 137Cs, which are of importance in food preservation. This is the cheapest form of radiation for food preservation. Other forms of radiation such as Ultraviolet light, Beta Rays, or Microwaves are not as effective do to the fact that they do not penetrate as deep as Gamma Rays, or they cause a heat buildup in foods.

The process

First the food is packaged in boxes, then a special procedure called dose mapping is performed. Dose mapping requires several pieces of a special type of plastic to be placed around the boxes of food (this procedure must be done for different types of packaging and foods to monitor how much irradiation the food is being exposed to). After the plastic has been placed, the container is then “mapped” to ensure that the product is exposed to even levels of irradiation (finds minimum and maximum points of exposure). Dose mapping is only done for new amounts of food in new packages. After dose mapping, that same amount of the same type of food in the same type of packaging is allowed to proceed. The food, after being dropped off at the facility, at the beginning of the procedure, is loaded into giant shelves, via forklift. These shelves run along a track that is suspended from the ceiling of the facility. The shelves proceed along the track into a maze of ninety degree turns. These turns are set at ninety degrees to prevent gamma rays from escaping (gamma rays travel only in straight lines). After proceeding through the maze of six to eight feet thick walls, the shelves are then exposed to the radioactive Cobalt 60. They are exposed in eight positions to ensure uniform dose. The food then exits through the maze, and is removed from the shelves, also by forklift. From there it is loaded onto trucks which then deliver the food to the facilities’ customers.

Safety

The facilities are heavily monitored by the state to confirm that the facilities conform to federal and state regulations. The highest, and the lowest dose of irradiation is recorded, as is the date that it was exposed. The whole process is monitored by computers. If any kind of problem occurs, the Cobalt is immediately dropped into a 9.14 meter(30ft) deep pool of water. The water then acts as a shield to prevent accidental exposure.

Food poisoning / contamination

The purpose, as stated above, is to eliminate bacteria, and to extend the shelf life. This brings about different questions such as: "Doesn't irradiation decrease vitamin content in the food?", and "Is it worth the cost?", or "Is it safe?" These questions are simply answered. "Irradiation does not reduce the nutrient value of food any more than other food preservation processes currently used." (Prevention Jan. 1992). As for the cost of food irradiation, it is worth any cost imaginable to improve the health of the population of the world. Money would be saved in the long run. Already, "The cost of medical treatment and productivity lost due to food-borne illness in the U.S. total more than $1 billion each year." (Barth, 1992). Food irradiation has been researched for well over fifty years. So far it has been reported as being safe. Proving its safety has been the object of great study, especially since NASA uses it to feed their astronauts. Food irradiation is also used in the soviet space program by the cosmonauts.

If irradiation were a more widely accepted way of cleansing and preserving food, there would be less illnesses due to food-borne bacteria, less money spent on replacing spoiled foods, and on recovery from illnesses. "Presently, the Food and Drug Administration (FDA) reports that up to 60% of the poultry sold in the U.S. is contaminated with Salmonella." (Barth 1992). This percentage could be drastically reduced if the food irradiation process were more widely accepted by consumers.

Consumer acceptance / Controversy

Even after the above is taken into consideration, there is still controversy. In fact, many people believe that irradiating food is unhealthy. They are afraid that the food is somehow radioactive. This is no more true than saying that food gives off microwaves after it has been microwaved, or that luggage becomes radioactive after it has been x-rayed at an airport. It is believed that people don't quite understand the concept of food irradiation when such comments are made. People fear radiation, with a good cause, yet should have no fear of the many commercial uses it has. These uses, such as food irradiation,will immensely benefit our society in the long run, if they are allowed to.

Methods

To determine how much the shelf life of these foods will be improved, samples will be observed over a period of six weeks. One set of these foods will be a control group. The other set will be the experimental group. There will be two experimental groups. Both experimental groups will be irradiated at an irradiation facility in Mulberry, Fl. (Food Technology Service, Inc.), one of these will be kept at the constant temperature of 1 degree Celsius. All groups will be monitored for decay, pictures will be taken, and records will be kept on observations.

Results

Over the period of time that the various foods has been observed, a definite pattern has been found. The samples of food that were irradiated and stored at the temperature of 1 degree Celsius showed a definite increase in their shelf life in comparison with their control counterparts at this temperature.

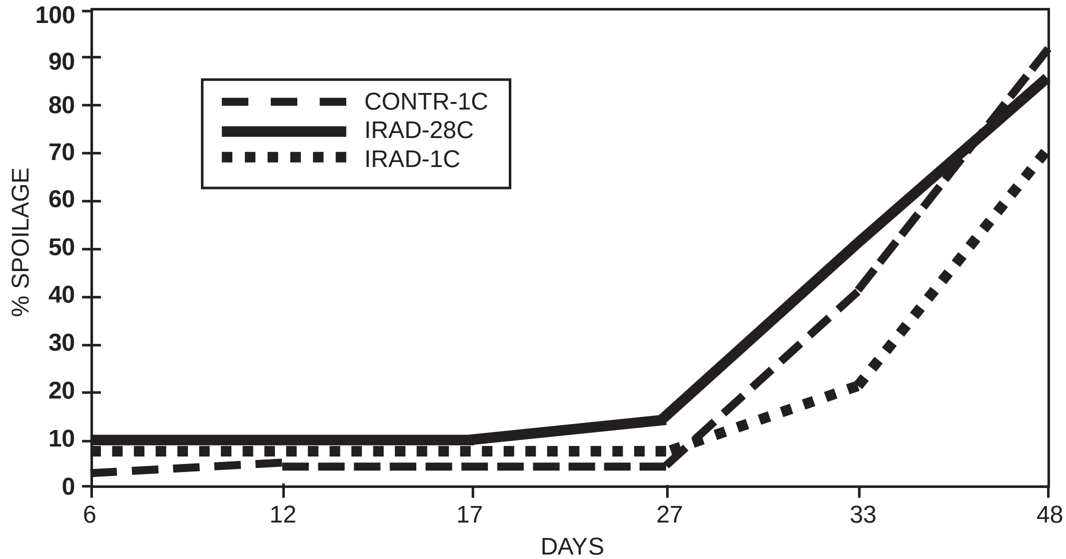
The mushrooms show the most evidence to support this conclusion. By looking at the graph entitled MUSHROOM % SPOILAGE 10/29/96- 12/3/96 we can clearly see that although the irradiated sample that was stored at 28˚C spoiled first, the irradiated sample that was stored at 1˚C outlasted the control group, which was also stored at the same temperature of 1˚C.

Through unfortunate circumstances the apples that were studied had suffered shipping damages (gashes, bruises, etc...), and any data gained from the observation of these samples is questionable. This can be seen by looking at the graph entitled APPLES % SPOILAGE and noticing that all samples start out with significant amounts of damage. The data gathered does show that the irradiated refrigerated group slightly outlasts the other groups. It is believed that similar results would have been observed had such extensive damages to the samples not occurred.

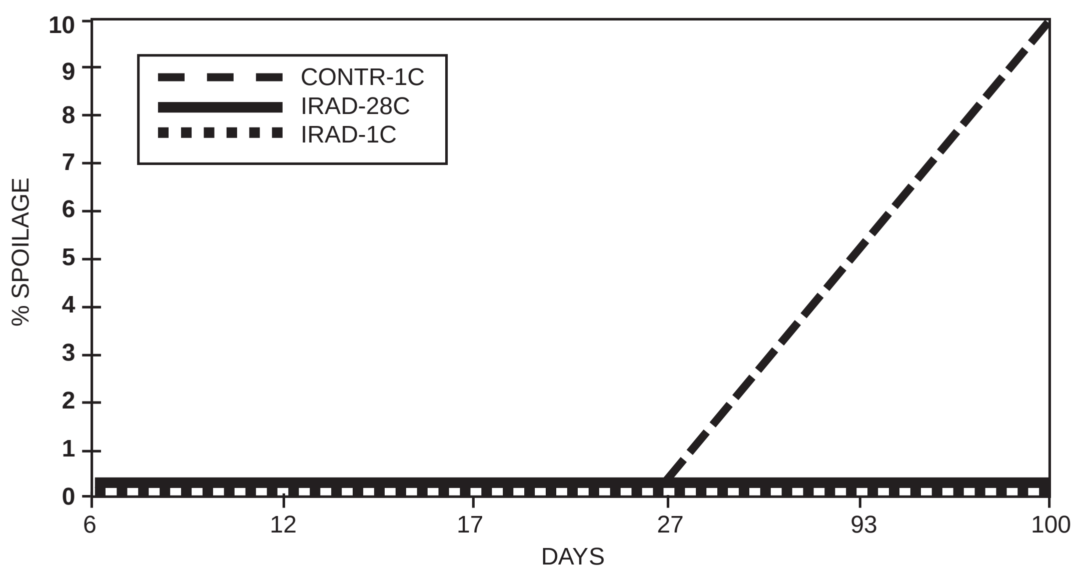
The results from the potatoes also support my conclusion that irradiation and refrigeration go hand in hand in the preservation of our foods. The data in the graph entitled POTATOES % SPOILAGE shows that while the control group at 28˚C started to spoil first, the irradiated group at the same temperature later caught up in decay and surpassed the control group in the rate of spoilage. The reasons for this are as of yet unknown, and only through future study and a continued experiment may the results be found. The control group decayed normally (there was a regular growth of eyes). The irradiated group (28˚C), however, did not produce a single eye. Instead the potatoes rapidly softened, turned to a slimy substance on the inside, and grew mold. The irradiated group at 1˚C is still faring well. As of February 20, 1997 (T116), only one dime-sized patch of mold has been seen, this is believed to have been caused by the moisture in the refrigeration unit.

Results obtained from the observation of the onions has supported the hypothesis. Only minimal data, as seen in the graph ONIONS % SPOILAGE, from this sample is available due to the fact that the rate of decay in onions is far slower than anticipated. The first signs of decay were seen on the control group at 28˚C at T93 (Jan 26, 1997). A sprout was observed. Both irradiated samples still appear to be brand new.

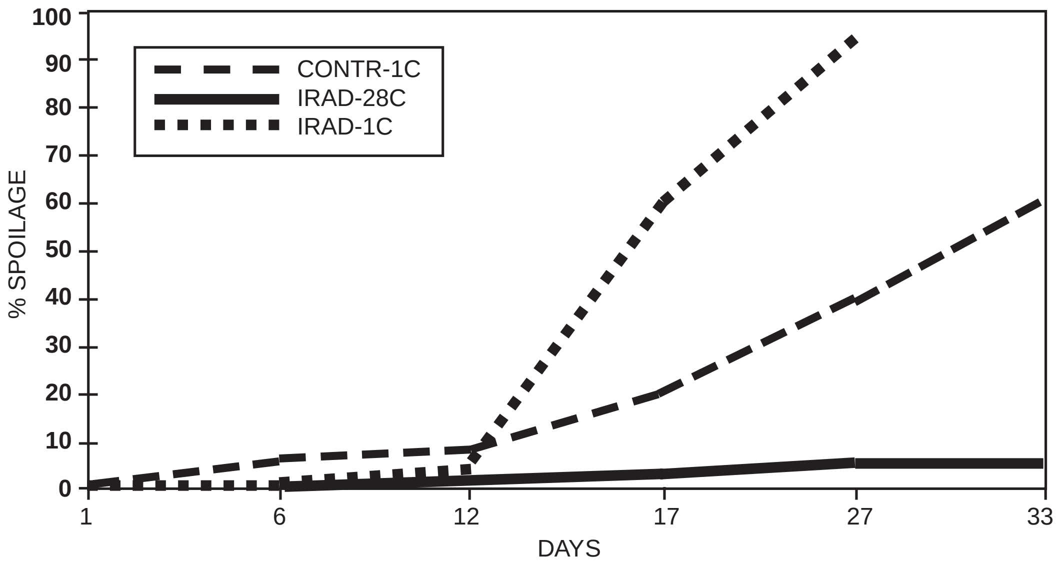
APPLES % SPOILAGE 10/29/96 - 12/12/96



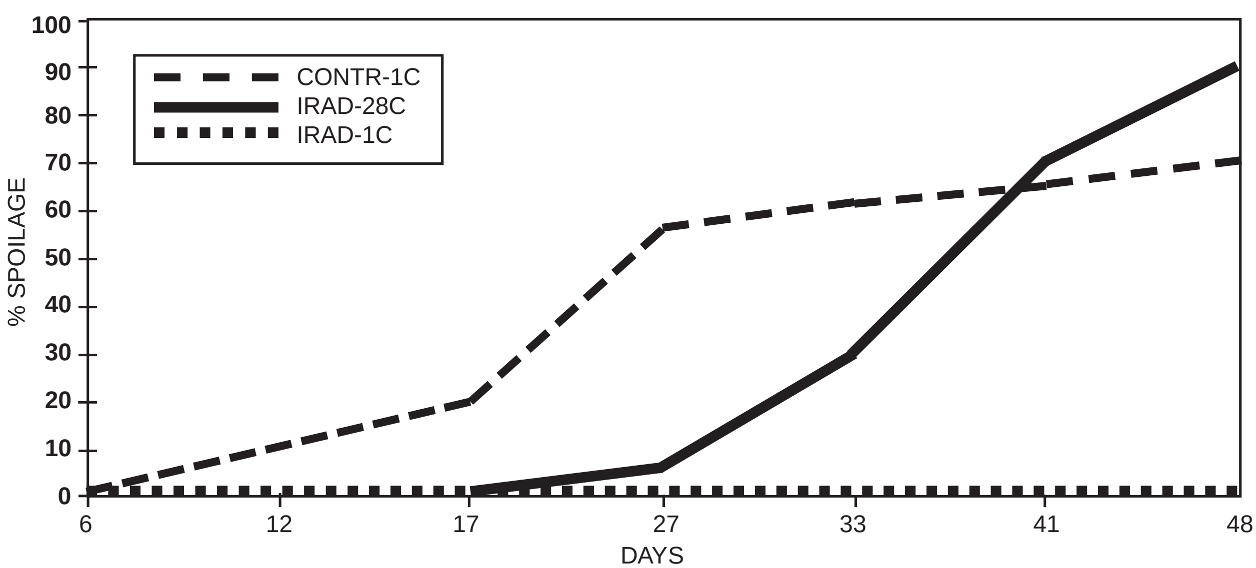
ONION % SPOILAGE 10/29/96 - 2/4/97



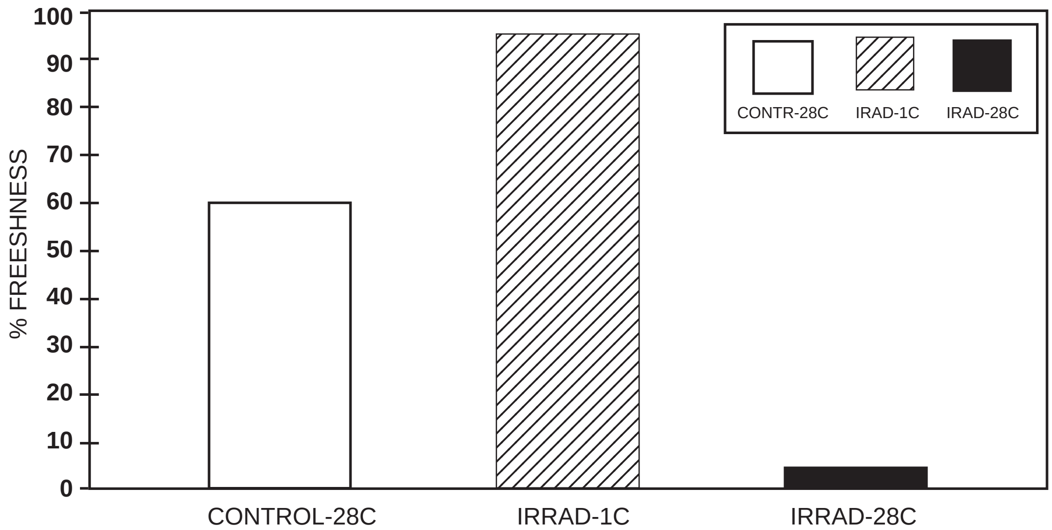
MUSHROOM % SPOILAGE 10/29/96 - 12/3/96



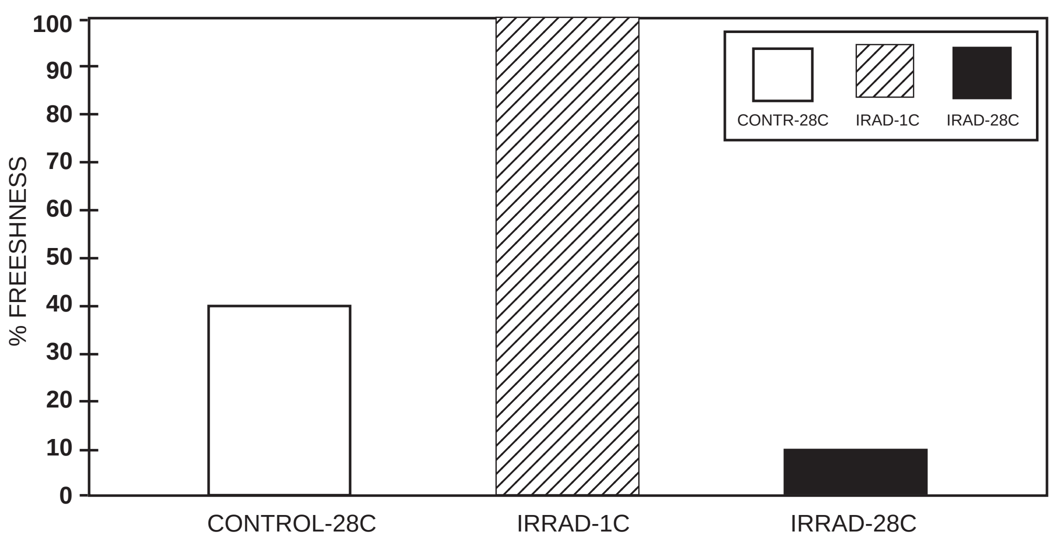
POTATOES % SPOILAGE 10/29/96 - 12/3/96



% FRESHNESS MUSHROOMS AT 27 DAYS



% FRESHNESS POTATOES AT 48 DAYS



Conclusion

In conclusion, the hypothesis was proven correct. Irradiation has a significant impact on the shelf life of certain foods. It has been proven through extensive observation that the irradiation of foods when coupled with refrigeration shows an increase in the shelf life of the foods studied, these foods being apples, mushrooms, onions and potatoes.

It is believed that the data obtained from the study of the apples has been influenced by damages to the apples that occurred during shipping from the irradiation facility (Food Technology Service, Inc.).

Future study

As it has been concluded that irradiation has a significant impact on the shelf life of foods, it has come under question as to whether or not the irradiation process will have an impact on the vitamin content of certain foods. Due to the lack of knowledge in this area, so stated in an article titled "Irradiated Foods: Are They Safe to Eat?" (Barth, 1992), the foods will be analyzed for vitamin C retention. This will give us a better understanding of the effects of irradiation on our food.

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