Introduction to Preservation

Food preservation is a very popular process used throughout the world and is also one of the oldest technologies discovered by humans (Brain, n.d.). Wikipedia states that preservation of food is a procedure of treating and handling food in a way that conserves its value for longer. Maintaining food (salting, cooling, cooking) is beneficial because it stops or greatly slows down spoilage to prevent food borne illnesses, Wikipedia says. When preserving the values of food, texture and flavor is extremely important (Wikipedia, 2008). Food has not been well preserved if it becomes dry, hard, or if it does not taste good. Another essential element of food preservation is preventing bacteria, fungi and other micro-organisms from growing (Wikipedia, 2008). The food becomes unhealthy when micro-organisms are growing on it. Preservation techniques must also destroy enzymes naturally found in a food that cause it to spoil or discolor quickly, asserts Brain. Enzymes are delicate because they act as a catalyst for a chemical reaction since they are a necessary component of a special protein (Brain, n.d.). Brain also states that when the temperature of food reaches 150 degrees Fahrenheit (66 degrees Celsius), enzymes are destroyed. All food contains bacteria if not sterilized or sealed (Brain, n.d.). Therefore, sterile food contains no bacteria and prevents spoilage. Two or three hours after milk is left on a kitchen counter, the bacteria will already have spoiled the milk, therefore by putting it in the fridge, it will not eliminate the bacteria already there but slow down the creation of bacteria enough for the milk to stay fresh a week or two, states Brain. Behind all forms of food preservation, we have discovered there are two main reasons for the process: to slow down the activity of disease-causing bacteria and to kill the bacteria altogether (Brain, n.d.).

According to Wikipedia, when it comes to food preservation, there are many different processes such as: heating to kill or denature organisms, oxidations, use of sulphur dioxide, toxic inhibition, smoking, use of carbon dioxide, vinegar, alcohol, etc. There are also processes like dehydration ‘drying’, osmotic inhibition (use of syrups), low temperature inactivation, freezing, ultra high water pressure, fresherized, a kind of “cold” pasteurization that prevents food deterioration and unhealthy food caused by naturally occurring pathogens which are killed by the pressure (Wikipedia, 2008). Through these processes, methods used at home are mentioned.

Preservation Methods

Refrigeration

Preservation methods are forms of preservation that can be used by ordinary citizens. Refrigeration is the most popular form of food preservation (Brain, n.d.). The advantages of refrigeration are that it slows microbial reproduction, states McKinnon. McKinnon also states the disadvantages are that as time goes by, food starts to lose its nutrients. It takes longer for food to spoil because refrigeration tends to decrease the speed of bacterial action to a crawl (Brain, n.d.). Even though refrigeration has disadvantages, it still remains extremely popular since it’s easy and effective.
Canning

Another very popular method is canning. Since 1825, canning has been a way to store food for long periods of time (Brain, n.d.). According to Wikipedia, to kill or weaken any remaining bacteria as a form of pasteurization is the purpose of canning. Wikipedia also states it involves cooking fruits or vegetables, sealing them in sterile cans or jars, and boiling the containers. Boiling food in the can kills the bacteria and the can is sealed (either before or while the food is boiling) to prevent any new bacteria from getting infected, says Brain. Once you open the can, bacteria will begin attacking the food (Brain, n.d.). Therefore, the contents will remain sterile until the container is opened, Brain concludes. Various foods, because they have varying degrees of natural protection against spoilage, may require the final step which occurs in a pressure cooker (Wikipedia, 2008). Similarly to refrigeration, canning has advantages and disadvantages. According to Mckinnon, the advantages are that it destroys microorganisms & autolytic enzymes. The disadvantages are that water-soluble nutrients can be lost into liquid in the can (Mckinnon, 2001). Another disadvantage, added by Brain, is that boiling food changes the taste and texture of the food as well as its nutritional content but this does not tend to bother people much. Cans come in all shapes and sizes and include jars (Brain, n.d.). Sealable containers can also serve as cans as well as glass jars, foil and plastic pouches and boxes (Brain, n.d.). Canning is also very easy and since it works well, people use it in their daily lives.

Drying

Drying is one of the oldest methods of food preservation. To delay or prevent bacterial growth, it reduces water activity sufficiently, states Wikipedia. Brain also says that after food is dried, most bacteria die or become completely inactive. The advantages of this method are that it produces a concentrated form of food and retains most nutrients (Mckinnon, 2001). Mckinnon asserts that the disadvantages are that the food can lose some nutrients such as thiamin & vitamin C. So, to retain vitamin C, sulphur dioxide is sometimes added to dried fruits, Mckinnon says. Some people are uncomfortable with this substance so they don’t use it. Instead, they use dehydration to preserve the nutrients (Brain, n.d.). Examples of elements that are easy to dry are soup and milk which can last for years (Brain, n.d.). Normally, drying completely alters the taste and texture of food, says Brain. People would probably prefer if the taste and texture of food was not altered, but they don’t always mind. At a grocery store, according to Brain, you will notice dehydrated products such as : powdered milk, dehydrated potatoes in a box, dried fruits and vegetables, dried meats (like beef jerky), powdered soups and sauces, pasta, and instant rice. Drying is another great example of a food preservation method used throughout the world.

Vacuum Sealing

A less popular method is vacuum sealing. The storage of food in a vacuum environment like an air tight bottle is the purpose of vacuum-packaging, according to Wikipedia. Wikipedia also establishes that when packaging, it is necessary to have a vacuum and oxygen free atmosphere (a modified atmosphere): low
oxygen tension delays growth of facultative anaerobes and inhibits strict aerobes. Vacuum sealing is another effective way to preserve foods.

**Freezing**

Freezing, similar to refrigeration, is a commonly used process (commercially and domestically) for preserving foods such as prepared foods which, if unprepared, would not have required freezing (Wikipedia, 2008). Brain states that freezing is used to stop bacterial action altogether. The advantages of freezing are that it prevents microbial growth with low temperatures and unavailability of water, says Mckinnon, and it causes bacteria to become completely inactive (Brain, n.d.). Another advantage of freezing is that it has no effect on taste or texture of most meals. Even though freezing changes fruits which become mushy, it has minimal effects on vegetables affirms Brain. The disadvantages are that the food loses some B-Group vitamins and vitamin C, when the blanching of vegetables, prior to freezing, occurs (Mckinnon, 2001). Freezing is a form of drying that has less effect on a food’s taste than normal dehydration does and removes all moisture (Brain, n.d.). According to Brain, in freeze-drying, the frozen food is placed in a strong vacuum and the water in the food turns from ice into vapor (sublimates). Brain also says that freeze-drying works extremely well on fruits such as apples but is most commonly used to make coffee immediately. Freezing can be used on almost all foods: meats, fruits, vegetables, beverages, etc (Brain, n.d.). Therefore, freezing is also used regularly.

**Smoking**

Smoking is a method that is quite popular throughout the world. Through the use of smoke, meat, fish and some other foods may be preserved and flavored (Wikipedia, 2008). The advantages of smoking are that from smoke, you can preserve foods by drying and by incorporating substances, affirms Mckinnon, but cancer in regions of the world has been caused by eating a lot of smoked foods. Even though this is a very important disadvantage of smoking, it is still used as a preservation method on a daily basis today.

**Adding salt or sugar**

Adding salt or sugar is another method of food preservation. Salting, especially meat, is an ancient preservation technique (Brain, n.d.). Sugar preservation, on the other hand, includes the creation of too high osmotic pressure for microbes to survive caused by cooking in high sucrose concentration (Wikipedia, 2008). According to Brain and Wikipedia, the salt draws out moisture and creates an environment inhospitable to bacteria, and sugar is used to preserve fruits: apples, pears, peaches, apricots by adding syrup. Preserved materials can also be cooked in sugar to the point of crystallization (Wikipedia, 2008). Then, Wikipedia states that the resultant product is stored dry. The advantages of adding salt or sugar is that it makes water unavailable for microbial growth, Mckinnon says, and the process does not destroy nutrients. The disadvantages are that it increases the content of salt and sugar in food (Mckinnon, 2001). Salted meat can last for years if salted in cold weather (so that the meat does not spoil while the salt has time to take effect), says Brain. The process of salting is briefly described in the following passage from John Steinbeck's "The Grapes of Wrath": “Noah carried the slabs of meat into the kitchen and cut it into small salting blocks, and Ma patted the course salt in, laid it piece by piece in the kegs, careful that no two pieces touched each other. She laid the slabs like bricks,
pounded salt in the spaces” (Brain, n.d.) A keg (wooden barrel) full of salt and meat is the technique expressed in the following passage (Brain, n.d.). Brain also states that today, found widely in the southern part of the United States, salting is used to create salt-cured "country ham", dried beef (which can be bought in jars at most grocery stores), corned beef and pastrami which is made by soaking beef in a 10-percent salt water brine for several weeks. Adding salt or sugar is a very diverse way of preserving food.

**High heat processing**

Pasteurization and appertization are both forms of high heat processing. Their purpose is the delivery of heat sufficient enough to inactivate target micro-organisms to the desired extent, says Wikipedia. The advantages of high heat processing are that it stops autolytic enzymes' activity and destroys microorganisms (Mckinnon, 2001). Mckinnon also wrote the disadvantages of this preservation method are that foods may lose nutrients that are sensitive to heat (Mckinnon, 2001). High heat processing is quite effective and works well on many foods.

**Chemical preservatives**

Chemical preservatives are another way to preserve foods. According to Mckinnon, the advantages of chemical preservatives are that they prevent growth of microbes, and in addition, the food retains all of its nutrients. Mckinnon also shows us that some people are sensitive to some chemical preservatives, as a disadvantage. There are three classes of chemical preservatives that are commonly used in foods: benzoates, sodium benzoate; nitrites, sodium nitrite; and sulphites, sulphur dioxide (Brain, n.d.). Another common preservative is sorbic acid for which you will often see on food labels (Brain, n.d.). All of these chemicals either kill the bacteria or reduce its speed of multiplication, Brain asserts. Brain also says that different types of chemicals are used in ingredients of different foods. Therefore, if left on the kitchen counter, food which includes chemical preservatives will not spoil. Pancake syrup, for example, can sit out because of the ingredients it contains (Brain, n.d.). Using chemical preservatives is a great way of enabling foods to last longer.

**Ionizing radiation**

Ionizing radiation is used to take out the bacteria from foods. According to Wikipedia, when food is entered in contact with ionizing radiation, it becomes irradiated. High-energy electrons, X-rays, and gamma rays cause ionizing radiation to happen (Wikipedia, 2008). Wikipedia also says that food irradiation (radurization, radicidation and radappertization) is the delivery of ionizing radiation. The advantages of ionizing radiation are that it causes foods to sterilize whose flavor would change with heating (spices), and decreases the velocity of sprouting potatoes (Mckinnon, 2001). Another advantage is that the shelf life of strawberries and mushrooms is expanded by ionizing radiation, establishes Mckinnon. The disadvantages are that, since it extends the shelf life of fresh foods, it can lead to greater nutrient losses than if the food was eaten earlier after harvesting (Mckinnon, 2001). Ionizing radiation is an effective method of food preservation.

**Pickling**
According to Wikipedia, pickling is a method of preserving food by placing it or cooking it in a substance that slows down or kills bacteria and other micro-organisms. Wikipedia also states this material must be utilizable to humans. In the past, pickling was widely used to preserve meats, fruits and vegetables (Brain, n.d.). Today, it is only used to produce "pickles" or pickled cucumbers (Brain, n.d.). Brain also asserts the preservative qualities used by pickling are salt combined with acid, such as acetic acid (vinegar). Acid is used because acid environments delay the growth of bacteria in food (Brain, n.d.). According to Brain, to make pickles from cucumbers, the vegetables must be soaked in 10% salt water brine for several days. Then the vegetables are rinsed and stored in vinegar to preserve them for years (Brain, n.d.). Pickling is an excellent method of preservation when preserving pickles or pickled cucumbers, but when it comes to storing other foods, pickling is not useful.

**Pasteurizing**

Pasteurizing is another great way to preserve and clean food. Brain states that pasteurization is a compromise (Brain, n.d.). Brain also says pasteurization (always liquid) is the process of heating food to a high enough temperature to kill certain but not all bacteria and to disable certain enzymes. In return, effects on taste can be minimized to your preferred quantity (Brain, n.d.). Milk, ice cream, fruit juices, beer and non-carbonated beverages are commonly pasteurized foods, states Brain. Milk, for example, can be pasteurized by heating it to 145 degrees Fahrenheit (62.8 degrees C) for half an hour or 163 degrees Fahrenheit (72.8 degrees C) for 15 seconds (Brain, n.d.). The product is completely sterilized when ultra high temperature (UHT) pasteurization is used (Brain, n.d.). According to Brain, the temperature of the milk is raised to about 285 degrees Fahrenheit (141 degrees C) for one or two seconds, sterilizing the milk, in UHT pasteurization. A box of rice milk requires no refrigeration because it has been pasteurized (Brain, n.d.). Pasteurization is used often on foods to eliminate all the bacteria.

**Fermenting**

Fermentation is another effective method of food preservation. Fermentation uses yeast produced alcohol which is a good preservative because it kills bacteria (Brain, n.d.). Fermented grape juice is used to create wine, which can last quite long (decades if necessary) without refrigeration. Brain says that normal grape juice, on the other hands, would mold in days. Fermenting is a great way to allow foods to keep their value for longer periods of time.

**Carbonating**

Carbon dioxide is a form of enriched modified atmosphere in a packaging. When using carbon dioxide as a method of preservation, there is specific inhibition of some micro-organisms (Wikipedia, 2008). Brain (n.d.) says carbonated water is water in which carbon dioxide gas has been dissolved using pressure. According to Brain, Carbonated water slows down bacterial growth by taking away the oxygen. Brain also states that carbonated beverages (soft drinks) contain a preservative naturally.

**Other methods**
Wikipedia (2008) says that lye is a preservation method since it makes food too alkaline for bacteria to grow. Another method shown is jellying. Foods may be preserved by being cooked in a substance that hardens to form a gel (Wikipedia, 2008). According to Wikipedia, such substances include gelatin, agar, maize flour and arrowroot flour. Juggling, modified atmospheres, nitrogen gases, burial in the ground, addition of weak acids, lactic fermentation, ethanol and emulsification are other methods of preservation on Wikipedia.

Irradiation

What is food irradiation?

Nestle (2006) says heat treatments worked but ruined the look of fruits. Treatments used to be done by toxic gases, but now this technique is considered an environmental hazard (Nestle, 2006). The Canadian Food Inspection Agency (n.d.) and Wikipedia (2008) say that they now reveal food to a controlled amount of energy called "ionizing radiation" in the process of food irradiation. The Canadian Food Inspection Agency and Wikipedia also state that X-rays, gamma rays, and electron beam radiation are the three types of radiation allowed in most places. Nuclear radiation, according to Brain (n.d.), kills bacteria without significantly changing the food containing bacteria.

Why is food irradiated?

Brennand (n.d.) states that food is irradiated for the effect of when it is processed by heat, refrigeration, freezing. It is irradiated for the same benefits as treated with chemicals to destroy insects, fungi or bacteria (Brennand, n.d.). What it destroys, according to Brennand causes food to spoil or causes human diseases. Brennand says food is irradiated to make it possible to keep food longer and in better condition in warehouses. Hospitals use irradiation to sterilize food for immune-compromised patients (Brennand, n.d.). Irradiation destroys disease-causing bacteria, according to Brennand. He says it reduces the incidence of food borne illness. Canadian Food Inspection Agency (n.d.) states ionizing radiation penetrates food, killing microorganisms without raising the temperature of the food a lot. One problem is that irradiated food can become contaminated after the treatment (Canadian Food Inspection Agency, n.d.). Consequently, the Canadian Food Inspection Agency states proper storage and handling & cooking are very important. According to Nestle (2006), radiated foods are sometimes infested exotic species of fruit fly. Nestle declares they are under quarantine. They cannot import foods unless the foods are treated first to get rid of flies, eggs, or bacteria (Nestle, 2006). According to Wikipedia (2008) Irradiation is used to kill bacteria, molds and insect pests, reducing the ripening and spoiling of fruits, and at higher doses inducing sterility. Brain (n.d.) says food will be become sterile and can be stored on shelves without refrigeration if the food is sealed in a plastic bag and then is irradiated. Unlike canning, when you irradiate food, you do not change the taste or texture of the food (Brain, n.d.).

Are irradiated foods still nutritious?

Brennand (n.d.) says that irradiated foods are wholesome and nutritious. Methods of food processing and storing at room temperature a few hours lowers content of some nutrients, such as vitamins (Brennand, n.d.). At a low radiation, nutrient losses are not measurable or are not even significant. High
radiations are used, according to Brennand, to extend shelf-life or control harmful bacteria. The nutritional losses are about the same as cooking and freezing (Brennand, n.d.).

**Does irradiation make food radioactive?**

Brennand (n.d.) says it doesn’t. This question comes up often because people have a problem with the words "nuclear radiation" (Brain, n.d.) Brennand states that radioactivity in foods can occur two ways: the contamination of foods with radioactive substances can cause foods to become radioactive, and the penetrating energy in the nuclei of atoms that make the food can make foods radioactive. The irradiation process takes place when the food is passed through an irradiation field (Brennand, n.d.). However, Brennand also states that the food itself never contacts a radioactive substance. The ionizing radiation used by irradiators is too weak to break down the nucleus of only one atom of a molecule that makes up any kind of food, states Brennand. Irradiated foods will never become radioactive in any way. (Wikipedia, 2008)

**Does eating irradiated food present long-term health risks?**

Brennand (n.d.) responds by answering “no”. Federal government and scientists reviewed hundreds of studies on the effects of food irradiation before concluding that it is generally safe (Brennand, n.d.). To make recommendations about poultry irradiation, according to Brennand, U.S. Food and Drug Administration scientists reviewed additional relevant studies. Brennand says independent scientific committees in Denmark, Sweden, United Kingdom and Canada have reaffirmed the safety of food irradiation. The Canadian Food Inspection Agency (n.d.) says food irradiation received international endorsement from the World Health Organizations and the International Atomic Energy Agency. Extensive research and testing showed that irradiated foods are safe. Health Canada reviewed petitions for new applications of irradiation process to ensure safety of foods listed Food and Drug Regulations as allowed to be irradiated and sold in Canada (Canadian Food Inspection Agency, n.d.). The source, the energy level, and total absorbed dose for identified foods are specified by regulations (Canadian Food Inspection Agency, n.d.). National and international expert bodies have declared food irradiation as wholesome (Wikipedia, 2008).

**Does irradiation destroy all bacteria, resulting in a sterile produce?**

At the levels normally used in food processing, according to Brennand (n.d.), irradiation destroys most, but not every microorganism present. Therefore it does not sterilize the food (Brennand, n.d.). Brennand says that consumers should take appropriate precautions, like refrigeration, proper handling and proper cooking, to eliminate all harmful bacteria. Brennand states that after the treatment, disease-causing and food spoiling organisms that have survived start to multiply again if the food is not properly handled. The Canadian Food Inspection Agency (n.d.) also agrees in saying that irradiated food must be handled properly like other foods to prevent re-contamination. The disease-causing organisms in irradiated foods are just as dangerous as in non-irradiated foods (Brennand, n.d.). One concern, according to Brennand, has been that irradiation does not kill the bacteria that cause botulism. Studies have also shown that in irradiated and non-irradiated foods, spoiling organisms will grow and alert consumers that there is spoilage before botulism bacteria produces toxin (Brennand, n.d.). The Canadian
Food Inspection Agency also says that nothing can guarantee food safety. Food irradiation reduces the bacteria and other microorganisms that may be present on food, according to the Canadian Food Inspection Agency.

**Does irradiation cause chemical changes in food, producing substances not known to be present in non-irradiated food?**

Brennand states (n.d.) irradiation produces chemical changes in foods. Substances that appear are called "radio-lytic products", and according to Brennand, they are not mysterious to us. They have been scrutinized by scientists in making safety assessments of irradiated foods (Brennand, n.d.). Brennand states that any treatment causes chemical changes in food. For instance, heat treatments, or cooking, produce chemicals are called "thermolytic products" (Brennand, n.d.). Scientists find the changes in food created by irradiation minor to those created by cooking, says Brennand. Brennand also says the products created by cooking are so significantly changed that consumers can smell and taste them. Only a chemist with extremely sensitive lab equipment may be able to detect radio-lytic products (Brennand, n.d.).

**Will my risks of radiation exposure increase significantly if I live next to an irradiator?**

No, according to Brennand (n.d.), the use and transportation of radioactive materials is monitored by Nuclear Regulatory Commission, states agencies and the Department of Transportation. This includes the facilities in which they are used and the equipment in those facilities (Brennand, n.d.). Brennand says that radioactive material is sealed within two layers of metal that prevent corrosion and oxidation. When shipped, Brennand says it is placed within brick layers of lead that prevent gamma rays from escaping. Facilities must include many safety features to prevent both environmental and worker exposure, states Brennand. For example, when radioactive cobalt is in the storage position in an irradiator, it is under water and otherwise shielded (Brennand, n.d.). According to Brennand, the irradiator is operated by remote controls and many other protections are required to prevent workers from entering irradiation enclosure.

**For what other purposes is irradiation technology now used in the United States?**

In addition to cancer treatments, irradiation is used for many purposes, asserts Brennand. This includes performing security checks on hand luggage at airports, making tires more durable, making manures for gardens sterile, making non-stick cookware coatings, making wool purified, making medical products like surgical gloves sterile, and destroying all bacteria in cosmetics (Brennand, n.d.). According to Wikipedia (2008), international administration on whether foods may be irradiated or not varies worldwide from no regulation to full banning on irradiation. Wikipedia says that it is estimated that about 500,000 tons of food items are irradiated per year world-wide in over 40 countries.

**What foods are currently permitted to be irradiated and sold in Canada?**
According to the Canadian Food Inspection Agency (n.d.), for now, only some foods are approved for irradiation and sale in Canada. Until recently, Brennand states that only irradiated dried spices and enzymes were allowed to be marketed in the United States. Onions, potatoes, wheat, flour, whole wheat flour, whole or ground spices and dehydrated seasonings are now approved to be irradiated (Canadian Food Inspection Agency, n.d.). Brennand says that in January 1992, irradiated strawberries from Florida were sold at the North Miami supermarket. Sales of irradiated products are ongoing in several grocery stores (Brennand, n.d.). Poultry irradiation began commercially in 1993, according to Brennand. Brennand states that irradiation of food has been approved in 37 countries for more than 40 products. According to Brain (n.d.) the irradiation of chicken was approved for some time but it was only recently that the FDA approved irradiation of beef. Irradiation of these meats, as Brain also declared, prevents many forms of food poisoning. Belgium and France are the largest marketers of irradiated food. These countries irradiate 10,000 tons of food per year, and the Netherlands with 20,000 tons of irradiated foods per year (Brennand, n.d.). Therefore, irradiated foods are not very common in most countries.

**How can I tell if food has been irradiated?**

According to Brennand (n.d.), irradiated food cannot be recognized by sight, smell, taste, or feel. Instead these irradiated foods will be labeled with a logo with the words "Treated with Radiation" or "Treated by Irradiation" to prevent you from buying irradiated foods without knowing it (Brennand, n.d.). The Canadian Food Inspection Agency (n.d.) authenticates this statement by saying that pre-packaged foods that have been wholly irradiated display the international radiation symbol and a statement that the product has been irradiated. Food that is not pre-packaged must have a sign with this information displayed beside the food (Canadian Food Inspection Agency, n.d.). Although, when single ingredients are irradiated, it is a whole different story. Only pre-packaged foods that contain an irradiated ingredient that composes more than 10% of the product has to indicate in the ingredients that the product is irradiated, establishes the Canadian Food Inspection Agency. On the other hand, if the irradiated material in the food counts for less than a tenth of the product, it does not need to be labeled (Canadian Food Inspection Agency, n.d.).

**Conclusion to Preservation**

To conclude, food preservation is used to allow us to import larger quantities of food and store them for longer. Two of the most common forms of this, are in almost every single house in North America, Europe and Australia: fridges and freezers. There are also massive quantities of canning in the most developed countries and continents. There are many different types of methods of preservation, from freezing, to carbonating. But, the main effort in doing this has always remained the same. The reason for preserving foods is to prevent the growth of microbial organisms, and ensure the safety and life duration of an item.

This technique was used since ancient times. It has been continuously reoccurring in history and will always happen in the future. Food preservation was discovered by ancient civilizations and is now used all around the world, and will remain one of the longest lasting and most efficient technologies.
developed by human cultures. One of the techniques that will probably be used more and more as technologies grow is the process of ionizing radiation to irradiate foods. Nevertheless, this does cause controversy because of the simple words “nuclear radiation”. To conclude, the preservation of food is a great method to keep food healthy and maintain its most important values for longer amounts of time.
References


