Food Irradiation

Bisc. 419 Presentation

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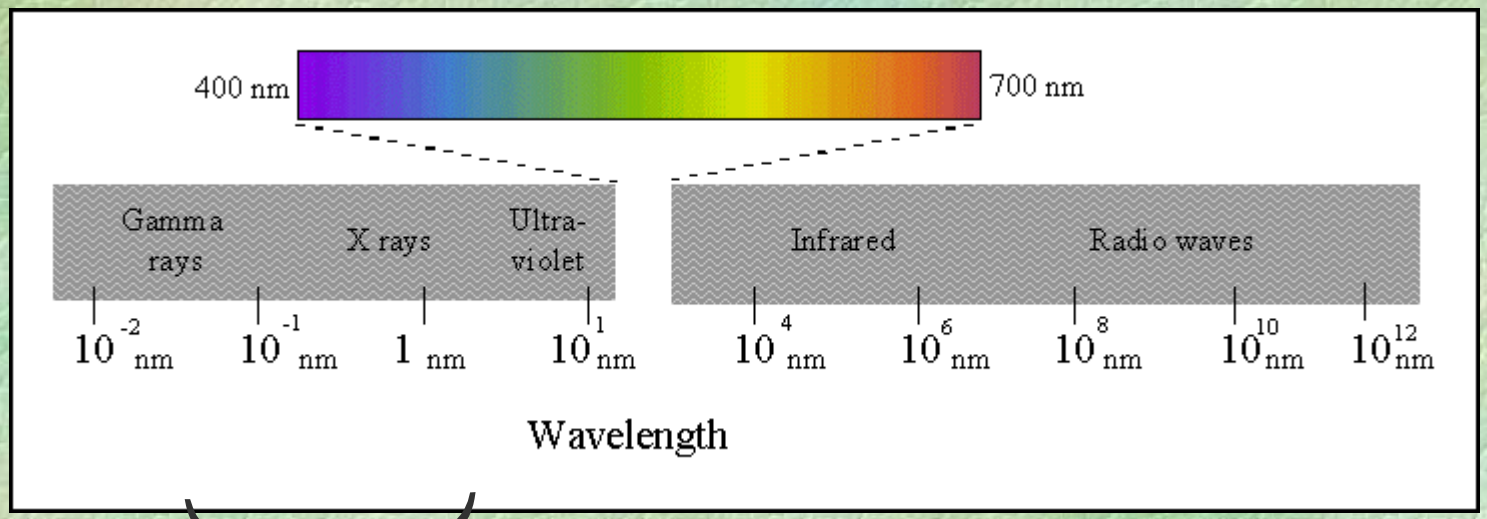
What is Food Irradiation?

•Food Irradiation is a process whereby food is exposed to a carefully measured amount of intense radiant energy, called ionizing radiation.



Food Irradiation

History of food irradiation

•Food irradiation has a 50-year history of scientific research and testing.

•In 1955, the U.S. Army medical department started to assess the safety of irradiated foods.

•FDA soon approved irradiation for wheat and wheat powder in 1963

•. In the 1960s FDA approved it for wheat and white potatoes.

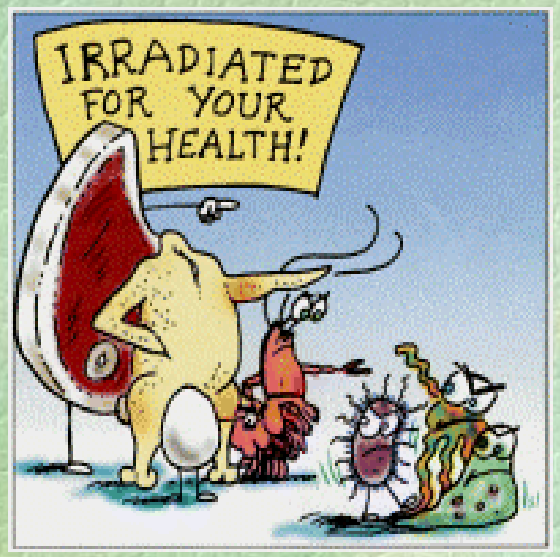
•In early 1970s NASA adopted the procedure to sterilize meats foods for astronauts to consume while in space.

•In 1980s, spices, seasonings, pork, and fresh fruits gained approval.

•Poultry was approved in 1990 and red meats in 1997.

What does food irradiation accomplish?

- Improves **microbiological** safety by :
  - Reducing infestation of grain, dried spices and dried or fresh fruits and vegetables.
  - Inactivating parasites in meats and fish.
  - Eliminating spoilage microbes.
- Extends shelf life of foods.
- Sterilizes foods.
- Reduces the use of chemical fumigants and additives.



How does food irradiation work?

•Ionizing radiation has energy capable of producing ions and other transient reactive molecular species when collision occurs.

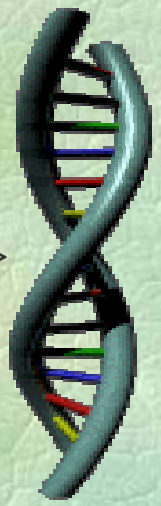
e^- $OH\bullet$ $H\bullet$

These reactive species are capable of degrading and altering biopolymers such as DNA and protein.

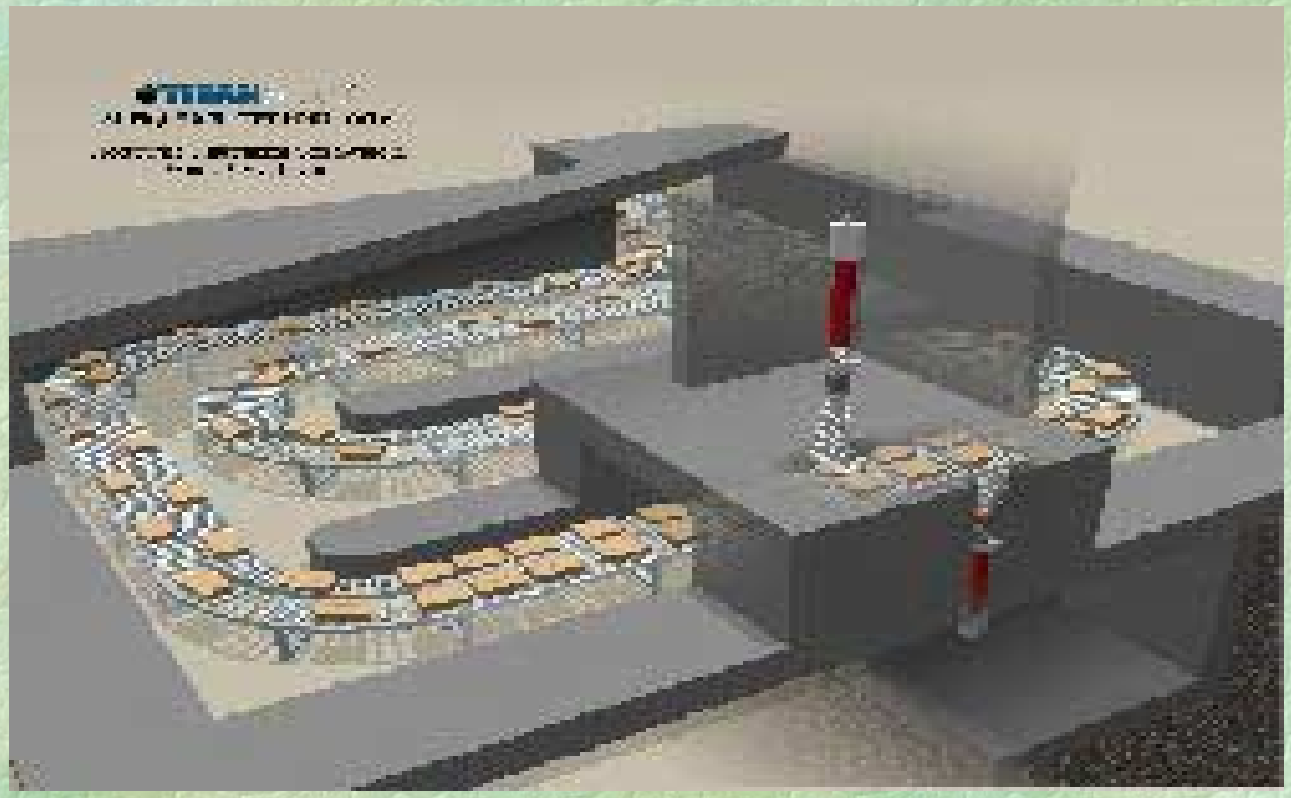
•Ionizing radiation causes DNA damage directly...

- •High energy radiation causes fragmentation of DNA --> inhibiting bacterial growth.

•Enzyme + DNA destruction ---> Microbial death



Process of food Irradiation



•Packaged food is passed under the source of irradiation at a certain speed to receive the desired amount of dose.

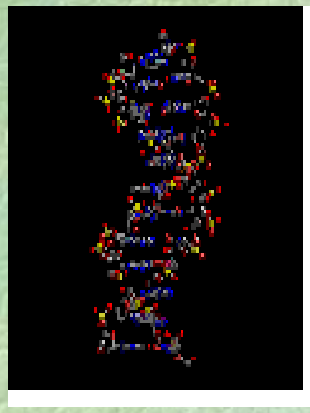
•Sources of Ionizing energy can be gamma rays from Co, Cs.

•In the United States, Co is most commonly used.

•Gamma radiation does not elicit neutrons, particles conferring radioactivity, and thus foods and packages are not made radioactive.

Dose and Effect

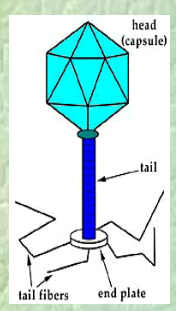
•Irradiation dose is measured in Gray(Gy), where 1 Gy = 100 rad.



•Parasites and Insect pests - Large amounts of DNA Rapidly killed with Dosage value of 0.1 kiloGray.

•Bacteria - Have smaller DNA - D-values 0.3 to 0.7 kiloGray.

•Bacterial spore - due to inertness - 2.8 kiloGray.



•Viruses-Small DNA - Resistant to approved dosages for food.

•Prions, which cause mad cow disease, lack nucleic acids and thus are also not damaged by irradiation.

Commonly Irradiated Products, Dose and Purpose

http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodirradiation.htm

Approval Year	Food	Dose	Purpose
1963	Wheat flour	0.2-0.5 kGy	Control of mold
1964	White potatoes	0.05-0.15 kGy	Inhibit sprouting
1986	Pork	0.3-1.0 kGy	Kill Trichina parasites
1986	Fruit and vegetables	1.0 kGy	Insect control, increase shelf life
1986	Herbs and spices	30 kGy	Sterilization
1990 - FDA	Poultry	3 kGy	Bacterial pathogen reduction
1992 - USDA	Poultry	1.5-3.0 kGy	Bacterial pathogen reduction
1997 - FDA	Meat	4.5 kGy	Bacterial pathogen reduction
1999 - USDA	Meat	4.5 kGy	Bacterial pathogen reduction

Importance of Food Irradiation to Society

- Microorganisms destroy huge amounts of food causing economic problems.
- Additionally, consumption of microbially contaminated food causes serious infections and poisoning.
  - CDC estimates that food-borne bacteria caused 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the U.S. in 1998.
  - Outbreaks of E-coli 0157:H7, alone, are estimated to cause 62,458 illnesses, 1,843 hospitalizations and 52 deaths each year.

The Bad Guys and Bad Stuff

•Salmonella - virtually all species are pathogenic for humans.

Causes: headache, chills, vomiting, diarrhea followed by fever (Salmonellosis or food poisoning).

Food Products: Eggs, milk, meats, canned food (during food handling process).

•E-coli - several strains are implicated as pathogens (enterotoxic), particularly, the O157:H7 strain

Causes: bloody diarrhea, kidney failure in children.

Food Products: Contaminated uncooked or under cooked ground meats.

* Irradiation is considered the only effective means to ensure decontamination from this strain of E-coli.

Bad Guys and Bad Stuff continued...

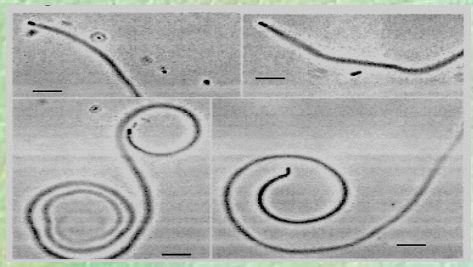
•Campylobacter - C. jejuni, and C. fetus account for majority of diarrhea in children.

Causes - high fever, nausea, cramps, watery and bloody stool.

Food Products - Poultry, pork, raw clams, shellfish.

•Listeria monocutogenes - acid, cold and salt tolerant pathogen is widespread in soil and water.

Causes - Listeriosis (mortality rate of 20-30%) characterized by meningitis and bacteremia.



Food Products - Produce, dairy products, meats.

•H. Pylori -

Causes - ulcers.

Food Products - Specific foods are not known.

Bad Guys and Bad Stuff continued…

•Seeing the extent of burden posed by pathogens in food, it is important to have measures which inhibit their growth and keep food from becoming contaminated (I.e., preventive measures).

•Irradiation as an effective means of controlling microbes and thus preventing illnesses they cause.

Safety, Nutrient Loss, and Radiation Resistance

•During the process, unique radiolytic products are released. But FDA review has concluded that there is no cause for concern that these products are toxic.

•Irradiation does lead to loss of vitamins in foods, but the amount is comparable to losses which occur during cooking.

•Food and package materials are not made radioactive during the process of food irradiation.

•Creation of novel pathogens resistant to radiation is a theoretical threat…but so far no novel pathogens have been found.

Conclusion

•Food irradiation is an effective means of reducing microbes in food, which in turn can reduce food - borne illnesses an reduce economic costs.

•Food irradiation is regulated by such agencies as the FDA, and USDA. It is endorsed by WHO and CDC among other health agencies - It is safe.

•Concerns will always remain, but by following best management practices we can reap the benefits of the technology with minimal consequences.