Lec.4 ***Food Technology***

***Food Safety and Preservation***

Food safety has become one of the biggest consumer issues of recent years, from the public perception that food additives are harmful, to the high profile scares about *Listeria, Salmonella* and mad cow disease; there has been an increasing public feeling of distrust of the market food industry. Yet despite public concerns about issues such as genetic modified foods, pesticides, fertilizers and animal feeds, one of the biggest threats to food safety. The challenge for the food industry is to use methods of preparation and processing that destroy pathogens and prevent recontamination of food.

There are several bacteria that pose a significant threat to food safety, most can be killed by cooking and re-infection can be avoided by preventing cross contamination and by appropriate cold storage.

 *Bacillus cereus* is found on virtually every agricultural commodity, but generally at levels too low to cause illness. Eating foods on which the organism has grown and formed toxins, will result in food poisoning. Toxins are responsible for illness, causing diarrhea and vomiting, these can be very resistant to heat and extremes in pH.

*Campylobacter* bacteria been recognized as the cause of enteritis, many cases of infection have been associated with un-chlorinated water and unpasteurized milk, but it is also often found raw poultry meat. The bacterium infects the intestinal tract, excreting toxins causing abdominal pain, fever, and diarrhea and vomiting.

The harmful bacterium *Staphylococcus aureus*, is readily destroyed by the normal cooking process, its toxin however, is very resistant to boiling. Botulism is a very serious type of poisoning caused by eating food containing the toxin produced by the bacterium *Clostridium botulinum* for which the spores are very resistant to many cooking processes.

The toxin produced by *Clostridium botulinum* bacterium is among the most toxic of all naturally occurring substances, the lethal dose may be as little as 5mg, fortunately, it is inactivated by heating at 90oC for just a few seconds. Symptoms of infection include weakness and fatigue followed by blurred vision and difficulty in swallowing. Through careful control, incidents of poisoning by *Clostridium botulinum* from commercially processed foods are rare, cooking a food container to temperatures equivalent to 121oC for three minutes is generally sufficient to kill the organism.

The growth and viability of micro-organisms in foods is influenced by:

 1- The availability of water.

2- The presence of high concentrations of osmotically active substances such as salt or sugar also influences growth and viability.

3-The presence of acids, preserved foods vary from neutral pH to acidic, only fungi are likely to grow below pH 3.7.

 Although a mild heat treatment is often desirable for foods in this category to stop fungal spoilage and inactivate enzymes, acidic foods, such as fruit, require pasteurization to destroy vegetative organisms. It is not always necessary for spores to be destroyed in this pH range, as any spores present are unable to germinate below pH 4.5. Low acidic foods such meat, fish and milk require sterilization to ensure that resistant spores are destroyed.

Since heat treatment often affects the quality, appearance, texture and taste of food as well as micro-organism content, the choice of heat treatment conditions is important. Heat is an effective way of eliminating microbial hazards when combined with adequate hygienic practice, such as the hygiene of personnel and sterilization of equipment, this helps to minimize the chance of infection with the human parasites such as tapeworms.

***Food preservation***

Food preservation refers to any of a number of techniques by which food is kept from spoilage and maintains food with desired properties or nature for as long as possible. In general, each step of handling, processing, storage, and distribution affects the characteristics of food, which may be desirable or undesirable.

 **Food preservation techniques:**

**# Pasteurization**

Pasteurization is a process for preservation of liquid food, the process is mainly applied to dairy products, milk is heated at about 72 °C for 15 seconds to kill the pathogenic bacteria present in it and cooling it quickly to 4 °C to prevent the remaining bacteria from growing.

**# Vacuum packing**

Vacuum-packing stores food in a vacuum environment, usually in an air-tight bag, the [vacuum](https://en.wikipedia.org/wiki/Vacuum) environment strips bacteria of oxygen needed for survival.

**# Artificial food additives**

Preservative food additives can be antimicrobial, which inhibit the growth of [bacteria](https://en.wikipedia.org/wiki/Bacterium) or [fungi](https://en.wikipedia.org/wiki/Fungus), including [mold](https://en.wikipedia.org/wiki/Mold). Common antimicrobial preservatives include [calcium propionate](https://en.wikipedia.org/wiki/Calcium_propionate), [sodium nitrate](https://en.wikipedia.org/wiki/Sodium_nitrate), [sodium nitrite](https://en.wikipedia.org/wiki/Sodium_nitrite), [sulfur dioxide](https://en.wikipedia.org/wiki/Sulfur_dioxide), [sodium bisulfite](https://en.wikipedia.org/wiki/Sodium_bisulfite),  etc.

**# Irradiation**

Irradiation of food is the exposure of food to [ionizing radiation](https://en.wikipedia.org/wiki/Ionizing_radiation); the type of ionizing radiation used is [gamma rays](https://en.wikipedia.org/wiki/Gamma_ray) . The technology may be compared to [pasteurization](https://en.wikipedia.org/wiki/Pasteurization); it is sometimes called "cold pasteurization", as the product is not heated.

 Treatment effects include:

1- Killing bacteria, molds, and insect pests.

2- Reducing the ripening and spoiling of fruits.

3- At higher doses inducing sterility.

 **Pulsed electric field #**

Pulsed electric field (PEF) is a method for processing cells by means of brief pulses of a strong electric field. PEF holds potential as a type of low-temperature alternative pasteurization process for sterilizing food products. In PEF processing, a substance is placed between two electrodes, then the pulsed electric field is applied, the electric field enlarges the pores of the cell membranes, which kills the cells and releases their contents.

**Modified atmosphere #**

Modifying atmosphere is a way to preserve food by operating with an atmosphere modified to reduce the oxygen concentration and increase the CO2 concentration.

 **Non-thermal plasma#**

This process subjects the surface of food to a "flame" of ionized gas molecules, such as helium or nitrogen; this causes micro-organisms to die off on the surface.

**High-pressure food preservation #**

High-pressure food preservation refers to the use of a food preservation technique that makes use of [high pressure](https://en.wikipedia.org/wiki/High_pressure), food can be processed, so that it retains its fresh appearance, flavor, texture and nutrients while disabling harmful microorganisms and slowing spoilage.

**# Biopreservation**

Biopreservation is the use of natural or controlled [microbiota](https://en.wikipedia.org/wiki/Microflora%22%20%5Co%20%22Microflora) or [antimicrobials](https://en.wikipedia.org/wiki/Antimicrobial) as a way of preserving food and extending its [shelf life](https://en.wikipedia.org/wiki/Shelf_life).

 Beneficial bacteria or the [fermentation](https://en.wikipedia.org/wiki/Fermentation_%28biochemistry%29) products produced by these bacteria are used in biopreservation to control spoilage and render [pathogens](https://en.wikipedia.org/wiki/Pathogen) inactive in food. [Lactic acid bacteria](https://en.wikipedia.org/wiki/Lactic_acid_bacteria) (LAB) have antagonistic properties that make them particularly useful as biopreservatives. When LABs compete for nutrients, their [metabolites](https://en.wikipedia.org/wiki/Metabolite) often include active antimicrobials such as lactic acid, acetic acid, hydrogen peroxide, and [peptide](https://en.wikipedia.org/wiki/Peptide) [bacteriocins](https://en.wikipedia.org/wiki/Bacteriocin%22%20%5Co%20%22Bacteriocin). Some LABs produce the antimicrobial [nisin](https://en.wikipedia.org/wiki/Nisin%22%20%5Co%20%22Nisin), which is a particularly effective preservative.

 LAB bacteriocins are used as an integral part of [hurdle technology](https://en.wikipedia.org/wiki/Hurdle_technology), using them in combination with other preservative techniques can effectively control spoilage bacteria and other pathogens, and can inhibit the activities of a wide spectrum of organisms, including resistant [Gram-negative bacteria](https://en.wikipedia.org/wiki/Gram-negative_bacteria).

**Hurdle technology #**

[Hurdle technology](https://en.wikipedia.org/wiki/Hurdle_technology) Hurdle technology is a method of ensuring that [pathogens](https://en.wikipedia.org/wiki/Pathogen) in [food products](https://en.wikipedia.org/wiki/Food_product) can be eliminated or controlled by combining more than one approach. These approaches can be thought of as "hurdles" the pathogen has to overcome if it is to remain active in the food. The right combination of hurdles can ensure all pathogens are eliminated or rendered harmless in the final product.

Examples of hurdles in a food system are:

1- High temperature during processing,

2- Low temperature during storage.

 3- Increasing the [acidity](https://en.wikipedia.org/wiki/Acidity).

4- Lowering the [water activity](https://en.wikipedia.org/wiki/Water_activity) .

5- Presence of [preservatives](https://en.wikipedia.org/wiki/Preservative) or [biopreservatives](https://en.wikipedia.org/wiki/Biopreservative%22%20%5Co%20%22Biopreservative).

 According to the type of pathogens and how risky they are, the intensity of the hurdles can be adjusted individually to meet consumer preferences in an economical way, without sacrificing the safety of the product.