

Contamination and Spoilage of Food and Dairy Products

**Cereals, Sugar products, Vegetables, Fruits, Meat
and Meat products, Milk and Milk products, Fish &
Sea foods, Poultry and Canned foods**

Food Spoilage

- **Food spoilage is defined as damage or injury to food rendering it unsuitable for human consumption**
- **Food must be considered spoiled if it is contaminated with pathogenic microorganisms or various poisonous agents, such as pesticides, heavy metals etc**
- **In most cases there does not need to be an evident sign of spoilage, the food might look normal and only after eating it or by careful bacteriological and toxicological investigation, one is able to realize the defect**

Storage life of some foods

Food product Storage life (days) at 21°C

Food Products	Time in Days
<ul style="list-style-type: none">•Raw beef and mutton•Raw fish•Raw poultry•Leafy vegetables	1-2
<ul style="list-style-type: none">•Dried salted or smoked meat and fish•Dried fruits and Seeds	360 or more
<ul style="list-style-type: none">•Fresh fruits	1-7
<ul style="list-style-type: none">•Root crops	1-20

Causes of food spoilage

- (a) Growth and activity of microorganisms**
- (b) Enzyme activity of food constituents**
- (c) Chemical reactions between food components**
- (d) Vermin attack**
- (e) Physical changes due to freezing, cooking**

Sources of microorganisms in food

The primary sources of microorganisms in food include:

- 1. Soil and water**
- 2. Plant and plant products**
- 3. Food utensils**
- 4. Intestinal tract of man and animals**
- 5. Food handlers**
- 6. Animal hides and skins**
- 7. Air and dust**

Signs of spoilage of different types of food

- ✓ Changes in color
- ✓ Changes in odor
- ✓ Changes in texture e.g slime formation
- ✓ Accumulation of gas or foam
- ✓ Accumulation of liquid

Spoilage by microbial growth occurs much faster than spoilage by microbial extracellular or intracellular enzymes in the absence of viable microbial cells

Significance of Microorganisms in Food Spoilage

A- Microbial Types

- Raw and most processed foods normally contain many types of molds, yeasts and bacteria capable of multiplying and causing spoilage
- Bacteria and yeasts cause rapid spoilage of foods
- In foods where bacteria or yeasts do not grow favorably and foods are stored for longer period of time such as breads, hard cheeses, fermented dry sausages and acidic fruits and vegetables, spoilage due to mold growth is more prevalent
- Anaerobic packaging of foods have greatly reduced the spoilage of food by molds, but not by anaerobic and facultative anaerobic bacteria

B- Microbial numbers

- **Microorganisms must multiply to certain levels in order to be able to cause food spoilage**
- **This is referred to as spoilage detection level**
- **Bacteria and yeasts need to grow and reach 10^7 cells/g, ml or cm^2**
- **The spoilage detection level can range from 10^6 - 10^8 cells/g, ml, or cm^2**
- **Higher initial loads of spoilage bacteria or yeasts and a storage conditions that favors rapid growth will cause the food to spoil more rapidly**
- **Food with low initial microorganisms load and stored at 4c, the generation time will be longer, spoilage will take more time to occur and food could be stored for long time**

C- Predominant Microorganisms

- Unspoiled, nonsterile food generally contains many types of microorganisms from different genera**
- When the same food is spoiled, it is found to contain predominantly one or two types and they may not even be present initially in the highest numbers in the unspoiled fresh product**

Important Food Spoilage Bacteria

A. Psychrotrophic Bacteria - These bacteria are capable of growing at 5°C and below, but multiply rapidly at 10-25°C

- Many foods are stored on ice and in refrigerator and some are expected to have a long shelf life; 50 days or more
- Between processing and consumption, they can be temperature abused to 10°C and higher

a. Psychotropic aerobic spoilage bacteria

Pseudomonas fluorescens, Pseudomonas fragi, Acinetobacter, Moraxella, Flavobacterium, Some molds and yeasts

b. Psychotropic Facultative Anaerobic Spoilage Bacteria

Lactobacillus viridescens, Lactobacillus sake, Lactobacillus curvatus, Leuconostoc carnosum, Leuconostoc gelidum, some Enterococcus Spp., Alcaligenes Spp., Enterobacter Spp., Some Microaerophilic yeasts

C. Thermotolerant Psychrotrophs

- They include facultative anaerobes such as spores of *Bacillus coagulans*, *Bacillus megaterium*, *Lactobacillus viridescens*

d. Anaerobes

Clostridium laramie, *Clostridium putrefaciens*

- The spores survive low-heat treatment, following germination and outgrowth, the cells grow at low temperature

- When food is temperature abused above 5°C, some true mesophiles can also grow, however at 10-15°C psychrotrophs will grow much faster than these mesophiles

B. Thermophilic Bacteria - This group of bacteria grow between 40-90⁰C with optimum temperature at 55-65⁰C

- Some high heat processed foods are kept warm between 50-60⁰C for a long period of time e.g at restaurants.
- Spores of some thermophilic *Bacillus* and *Clostridium Spp.* Can be present in these heat-treated foods, which at warm temperature germinate and multiply to cause spoilage
- Some thermotolerant vegetative bacteria surviving low heat processing (such as pasteurization), or thermophiles can also multiply in these warm foods especially if the temperature is close to 50⁰C
- These include some lactic acid bacteria such as *Pediococcus Spp.* and *Streptococcus Spp.*, *Bacillus* and *Clostridium Spp.*
- They can also survive and cause spoilage of foods as that are cooked at low heat (60-65⁰C) as for some processed meat or kept warm for long time

C. Aciduric *Bacteria* - These are the bacteria that can grow in food at pH 4.6 or below

- They are associated with spoilage of acidic food products such as fruit juices, pickles, salsa, salad dressing and fermented sausages**
- Heterofermentative and homofermentative lactic acid bacteria have been associated with such spoilage**
- Yeasts and molds are aciduric and are also associated with spoilage of such foods**

Food Types

On the basis of susceptibility of spoilage, foods can be grouped as:

- 1. Perishable - which spoil quickly within few days and must be kept refrigerated or frozen, perishable foods include dairy products, meat, poultry, fish**
- 2. Semiperishable - have relatively long shelf life; few weeks or months. e.g bread, butter, cake , many canned fruits**
- 3. Nonperishable - having very long shelf life for months or years e.g canned fruits and vegetables, dried fruits and vegetables, pea nut butter**