

FOOD SPOILAGE

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Food Spoilage

A number of factors are responsible for spoilage of food. These are:

- ✓ Infection by microorganisms
- ✓ Action of enzymes
- ✓ Damage by insects, parasites and rodents
- ✓ Characteristics and storage conditions of food
- ✓ Mechanical damage

1. Microbial Spoilage: Bacteria, Yeasts and moulds may infect food after harvesting, during its handling, processing and storage. But not all microorganisms cause spoilage, e.g., lactic acid bacteria are used in the making cheese and other fermented dairy products, yeasts for the production of wine and beer and *Acetobacter* bacteria for vinegar production. Spoilage organisms are present everywhere-in soil, air, water and even in the raw and processed food.

(i) Bacteria

These are unicellular microorganisms that are classed as plants though they do not contain chlorophyll. A bacteria cell is about $1\mu\text{m}$ in length and somewhat smaller in diameter. Bacteria are classified according to their shape. Cocci are spherical, bacilli are cylindrical and spirilla and vibrios are spiral. Bacteria spores are more resistant than yeast or mould spores grow in acid media in which yeasts and moulds thrive. They multiply by 'fission' or division of cells.

The important groups of bacteria are:

- a) Bacillus: rod-shaped
- b) Coccus: spherical
- c) Coccobacillus: oval-shaped
- d) Aerobes: require atmospheric oxygen for growth, e.g., *Acetobacter aceti*
- e) Facultative anaerobes: can grow with or without atmospheric oxygen
- f) Mesophiles: require a temperature below 38°C for growth
- g) Obligate thermophiles: grow between 38 and 82°C
- h) Facultative thermophiles: grow over the whole range of temperatures covered by mesophiles and obligate thermophiles and below
- i) Psycrotrophs: grow fairly well at refrigeration temperatures and some can even grow at temperatures below freezing.

Important food spoilage bacteria

Group	Genus
Acetics	Acetobacter and Gluconobacter
Lactics	Lactobacillus, Leuconostoc, Pediococcus, Streptococcus
Butyrics	Clostridium
Propionics	Propionobacterium
Proteol Gytics	Bacillus, Pseudomonas, Clostridium, Proteus, etc

Some useful bacteria

Acetobacter sp.

These bacteria, also known as “vinegar bacteria”, cause significant spoilage in the wine industry but are necessary for vinegar production. The important species are *Acetobacter aceti*, *A. orlensis* and *A. schutzenbachi*. They are very small, usually non-motile and generally do not form spores. These bacteria are aerobes and in the presence of oxygen convert a tough shiny film on the surface of wine and the growth is known as “Vinegar mother”, while the other grows throughout the wine without forming “vinegar mother”. These bacteria can be easily destroyed by heating to 65°C.

Lactobacillus sp.

- ✓ Different organisms of this group, also known as “lactic acid bacteria”, have different properties but all of them produce lactic acid from carbohydrates. Those which are used in distilling and brewing industries are facultative thermophiles which grow abundantly at 50 to 55°C and produce much lactic acid. Mesophiles are used in the preparation of pickles. *Lactobacillus plantarum* is generally found in pickles and olives. The other important species are *Pediococcus cerevisiae*, *Leuconostoc mesenteroides*, *Streptococcus faecalis* and *Lactobacillus brevis*.

(ii) Yeasts

Yeasts are unicellular fungi which are widely distributed in nature. They are somewhat larger than bacteria. The cell length is about $10\mu\text{m}$ and the diameter is about a third of this. Most yeasts are spherical or ellipsoidal. Yeasts that multiply by means of 'budding' are known as 'true yeasts'. Under suitable conditions the sugar is converted into alcohol and carbon dioxide gas is evolved.

Yeasts + Sugar \longrightarrow Alcohol + Carbon dioxide

Pseudo-yeasts

- ✓ These are like true yeasts but do not form spores. All the members of this group are particularly unsuitable for fermentation purposes as they produce off-flavours and cloudiness.

Yeasts causing food spoilage

Yeasts	Product spoiled
<i>Saccharomyces</i>	Low-sugar products
<i>Candida</i>	High-acid foods, salty foods, butter
<i>Brettanomyces</i>	Beers, wines
<i>Zygosaccharomyces</i>	Honey, syrups, molasses, wines, soy sauce
<i>Pichia</i>	Wines
<i>Hansenula</i>	Beers
<i>Debaryomyces</i>	Meat brine, Cheese, sausages etc
<i>Hanseniospora</i>	Fruit juices
<i>Torulopsis</i>	Milk products, fruit juices, acid foods
<i>Rhodotorula</i>	Meat, sauerkraut
<i>Trichosporon</i>	Chilled beer

(iii) Moulds

Moulds are multicellular, filamentous fungi belonging to the division Thallophyta but are devoid of chlorophyll. They are larger than yeasts. They are strict aerobes and require oxygen for growth and multiplication and tend to grow more slowly than bacteria. The most important moulds are:

- a) *Penicillium* sp. (Blue moulds)
- b) *Aspergillus* sp. (Black moulds)
- c) *Mucor* sp. (Gray moulds)
- d) *Byssochlamys fulva*

2. Enzymatic Spoilage:

The changes in foods during storage can be produced both by enzymes present in the food or by enzymes from microorganisms that contaminate the food. A good example of the former is the ripening of banana due to the enzymes present which hasten the ripening process. After some time the fruit become too soft and unfit to eat. If there is a bruised spot on the fruit, yeasts can grow and produce enzymes which spoil the fruit.

Enzymes convert starch into sugars, protein into amino acids, and pectin into pectic acids and thus change the constituents of food.

Some fruits and vegetables turn brown when damaged or when their cut surfaces are exposed to air due to the presence of the enzymes phenolase, peroxidase etc. The actions can be easily controlled by regulating the temp. and excluding moisture and air.

