

The industrial (economic) importance of bacteria

The economic importance of bacteria derives from the fact that bacteria are exploited by humans in a number of beneficial ways. Despite the fact that some bacteria play harmful roles, such as causing disease and spoiling food, many bacteria serve important roles in both agriculture and industry.

Useful bacteria

Biotechnology and bacteria

Biotechnology: is defined as the use of microorganisms such as bacteria, fungi and algae for the manufacturing and services industries. These include:

-Fermentation processes: such as brewing, baking, cheese and butter manufacturing, Bacteria, often "*Lactobacillus bulgaricus*" in combination with yeasts and fungi, have been used for thousands of years in the preparation of fermented foods such as cheese, pickles, vinegar, wine, and yogurt.

-Chemical manufacturing: such as ethanol, acetone, organic acid, enzymes, perfumes etc. In the chemical industry, bacteria are most important in the production pharmaceuticals.

Genetic Engineering

Genetic engineering: is the manipulation of genes. It is also called recombinant DNA technology. In genetic engineering, pieces of DNA (genes) are introduced into a host by means of a carrier (vector) system. The foreign DNA becomes a permanent feature of the host, being replicated and passed on to daughter cells along with the rest of its DNA.

Bacterial cells are transformed and used in production of commercially important products. The examples are production of human insulin (used against diabetes), human growth hormone ([somatotrophin](#) or [somatotropin](#) used to treat pituitary dwarfism), and infections which can be used to help fight viral diseases.

Using biotechnology techniques or bio medical technology bacteria can also be bioengineered for the production of therapeutic proteins.

Agriculture and bacteria

Agriculture bacteria decompose dead plant and dead bodies in the soil. After decomposition may be just plant regenerate from soil . Agriculture bacteria are useful for our society because they help in production of food. Bacteria play many useful roles in agriculture from biodegradation to food production. Bacteria are often employed in the dairy industry for ripening cheese and giving certain dairy products a specific aroma. Additionally, bacteria such as *Lactobacilli* are known for playing important roles in the process of making butter and ripening milk. Other bacteria including *Bacillus aceti* are responsible for the conversion of a sugar solution into vinegar.

Fiber retting

Bacteria are used to separate fibers of jute, hemp, and flax in the process of retting. The plants are immersed in water and when they swell, inoculated with bacteria which hydrolyze pectic substances of the cell walls and separate the fibers. These separated fibers are used to make ropes and sacks etc.

Digestion

Some bacteria living in the gut of cattle, horses and other herbivores secrete cellulase, an enzyme that helps in the digestion of the cellulose of plant cell walls. Cellulose is the major source of energy for these animals. The bacteria present in the stomach of cattle will help in the digestion of cellulose.

Vitamin synthesis

The *Escherichia coli* that live in the human large intestine synthesize vitamin B and release it for human use. Similarly, *Clostridium butylicum* is used for commercial preparation of riboflavin, and vitamin B & vitamin k.

Pest control

Bacteria can also be used in the place of pesticides in biological pest control. This commonly uses *Bacillus thuringiensis* (also called BT), a Gram-positive, soil-dwelling bacterium. This bacterium is used as a Lepidopteran-specific insecticide under trade names such as **Dipel** and **Thuricide**. Because of their specificity, these pesticides are regarded as environmentally friendly, with little effect on humans, wildlife, pollinators, or other beneficial insects.

Harmful bacteria

Some bacteria are harmful and act either as disease-causing agents (pathogens) both in plants and animals, or may play a role in food spoilage.

Plant pathogenic bacteria

Plant diseases caused by bacteria are commercially important worldwide for agriculture. Besides bacterial pathogens that are already established in many areas, there are many instances of pathogens moving to new geographic areas or even the emergence of new pathogen variants. In addition, bacterial plant pathogens are difficult to control because of the shortage of chemical control agents for bacteria.

Agents of disease

Some bacteria are pathogenic and cause diseases both in animals and plants. However, pathogenic bacteria more commonly affect animals than plants. Certain bacteria that exist in the normal flora on skin and in the mouth and human intestine are also known to cause disease when imbalances have weakened the immune system.

Food spoilage

Bacteria, in relation to food, can have one of these 3 roles:

1-Pathogenic bacteria can cause food –borne disease.

* There are two primary types of food –borne disease:

-**Foodborne infection**: caused by pathogenic bacteria (such as *Salmonella* bacteria. multiplying in a human tract causing: diarrhea, vomiting, fever).

- **Foodborne intoxication** :(food poisoning resulting from a toxin produced by pathogenic bacteria in the food itself, for example *Clostridium botulinum* and *Staphylococcus aureus*).

2-Saprophytic bacteria play a role in biodegradation and cause food spoilage.

3-Cultured bacteria like probiotic bacteria are used in food processing.

Food spoilage: is the process leading to a product becoming undesirable for human consumption (with associated changes involving alterations in taste, odor, color, appearance or texture).



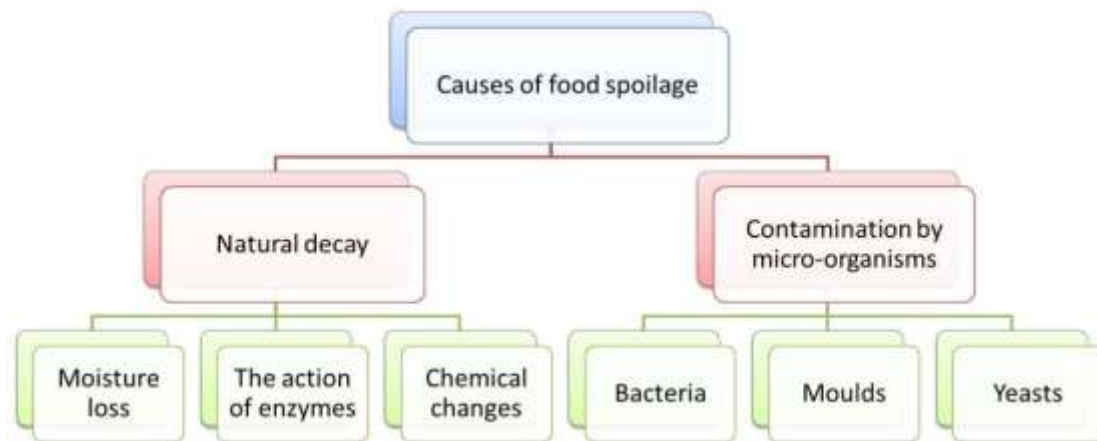
Causes of food spoilage:

Food spoilage is caused by two main factors:

1-natural decay in food: natural process that leads to spoilage of food as a result of:

- Moisture loss.
- The action of enzymes present naturally in the food.
- Chemical changes.

2-Contamination by microorganisms (bacteria, molds (moulds) and yeasts).



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 human and animals
5. Food handlers
6. Animal hides and skins
7. Air and dust

* Examples of action of bacteria involved in food spoilage:

1-Lactic acid formation: Lactobacillus, Leuconostoc

2-Lipolysis: Pseudomonas, Alcaligenes, Serratia, Micrococcus

3-Pigment formation: Flavobacterium, Serratia, Micrococcus

4-Gas formation: Leuconostoc, Lactobacillus, Proteus

5-Slime or rope formation: Enterobacter, Streptococcus

What are the seven basic methods of food preservation?

1. Removal of microorganisms: (Filtration: Used for water, beer, wine, juices, soft drinks, etc.).

2. Low temperature: (Refrigerating & freezing: Retards growth but doesn't stop microbial growth).

3. High temperature:

- Pasteurization: kills pathogens and substantially reduces number of spoiling organisms, different pasteurization processes heat for various amounts of time.

- Canning: Food heated in special containers at high temp for 25-100 min., kills spoiling microbes but not all microbes.

4. Reduced water availability: (drying, freeze drying & add high concentrations of solutes like salt or sugar).

5. Chemical based preservation:

- GRAS-chemical agents "generally recognized as safe"

- pH of food impacts effectiveness of chemical preservation.

6. Radiation:

Ultraviolet (UV) radiation: used for equipment, does not penetrate food.

Radappertization (Gamma radiation): kills microbes in moist foods by producing peroxides from water

7. Microbial product-based inhibition:

- Bacteriocins: bactericidal proteins active against related species.

- Some dissipate proton motive force of susceptible bacteria.

-Some form pores in plasma membranes.

-Some inhibit protein or RNA synthesis.

e.g., **Nisin**: used in low-acid foods to inactivate *Clostridium botulinum* during canning process.