

Microbes In Human Welfare

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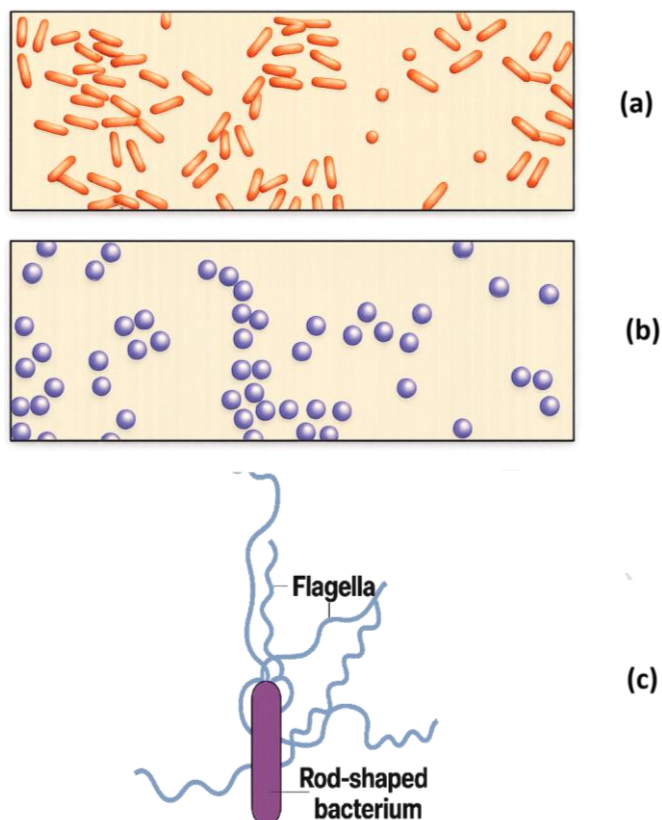
- Besides macroscopic plants and animals, **microbes** form a major component of biological systems on Earth.
- These microscopic organisms are highly diverse and essential for various ecological and industrial functions.

Presence and Diversity of Microbes

Microbes are ubiquitous—they are found:

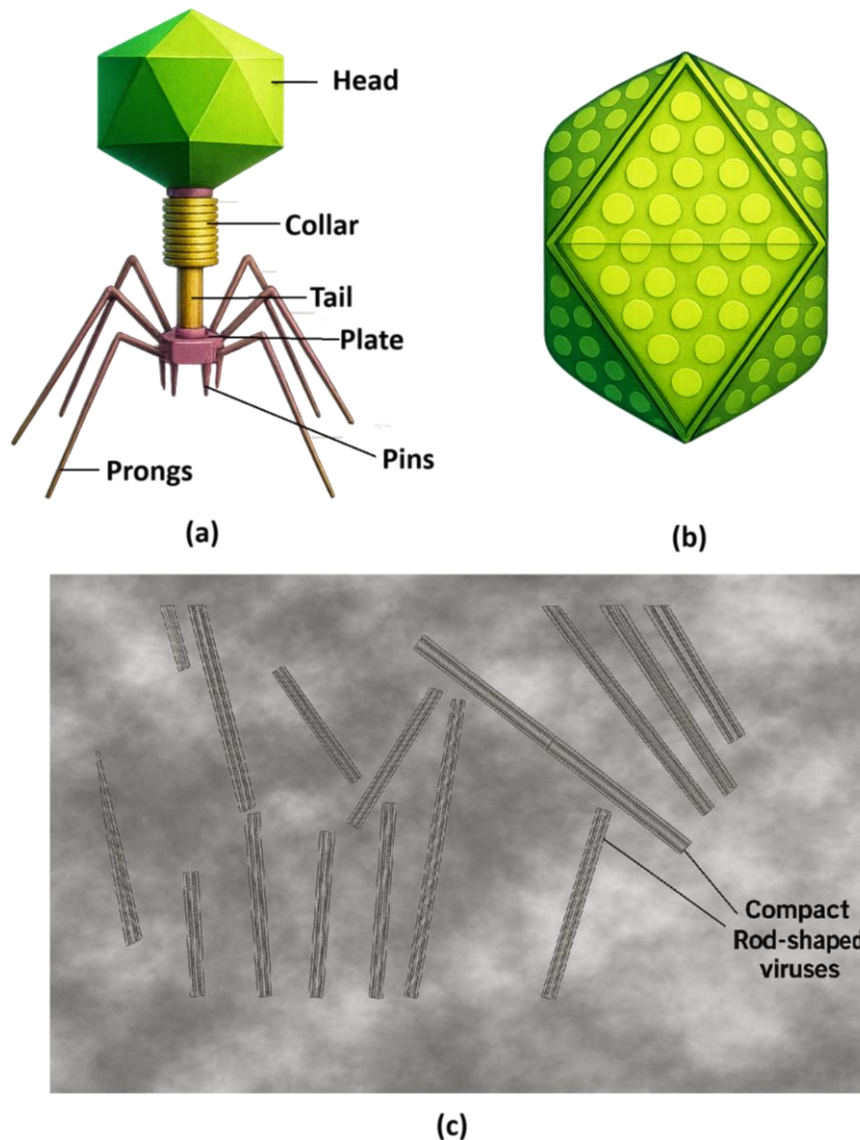
- In **soil, water, and air**
- Inside the human body as well as animals and plants
- Even in extreme environments, such as:
 - Thermal vents/geysers, where temperatures may reach up to **100°C**
 - Deep soil layers
 - Under thick layers of snow
 - Highly acidic or alkaline environments

Types of Microorganisms



Bacteria: (a) Rod-shaped, magnified 1500X; (b) Spherical shaped, magnified 1500X; (c) A rod shaped bacterium showing flagella, magnified 50,000X

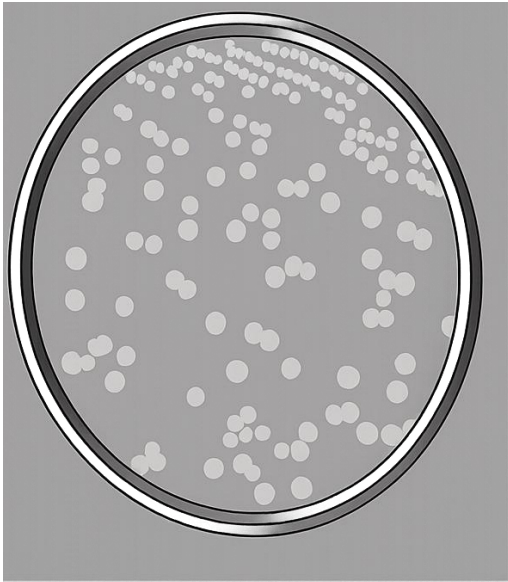
- Microbes include:
 - Bacteria
 - Fungi
 - Protozoa
 - Microscopic algae
 - Viruses, Viroids, and Prions (proteinaceous infectious agents)
- These organisms may belong to different **biological kingdoms** (e.g., Monera, Protista, Fungi), and many of them are only visible under a microscope.



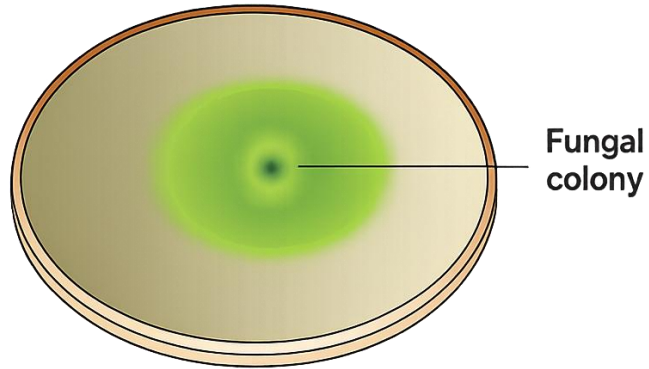
Viruses: (a) A bacteriophage; (b) Adenovirus which causes respiratory infections; (c) Rod-shaped Tobacco Mosaic Virus (TMV). Magnified about 1,00,000–1,50,000X

Microbial Cultures

- Certain microbes such as **bacteria** and **fungi** can be:
 - Grown on nutritive media in laboratory conditions
 - Form visible **colonies** Such microbial cultures are vital for studying the structure, behavior, and utility of microbes.

**(a)**

(a) Colonies of bacteria growing in a petri dish;

**(b)**

(b) Fungal colony growing in a petri dish

Harmful vs. Beneficial Microbes

- While you have learned in Chapter 7 that microbes are responsible for many **diseases** in:
 - Humans
 - Animals
 - Plants
- It is important to understand that **not all microbes are harmful**.

Microbes as Benefactors of Human Welfare

- In fact, microbes play a **crucial role in human welfare**. Some of the most significant beneficial applications of microbes include:
 - Industrial production (e.g., alcohol, antibiotics, organic acids)
 - Medical applications (e.g., vaccines, enzymes)
 - Agricultural enhancement (e.g., biofertilizers, biopesticides)
 - Environmental cleanup (e.g., sewage treatment, bioremediation)

Microbes In Household Products

- Microorganisms play a significant role in our daily lives, often without us even realizing it.
- They are extensively used in the preparation of a variety of household food products through the process of **fermentation**.

1. Curd Formation

- The most common example of microbial use is the conversion of milk into curd.
- This is carried out by **Lactobacillus** and other **lactic acid bacteria (LAB)**.
- These bacteria:
 - **Grow in milk** and produce lactic acid, which coagulates and partially digests milk proteins.
 - A small amount of curd (called **inoculum or starter**) contains millions of LAB.
 - When added to fresh milk under suitable temperature, it promotes multiplication of LAB, resulting in curd formation.
- **Nutritional Benefit:** The curd has enhanced nutritional quality due to increased **vitamin B12** content.
- In the human stomach, LAB also help inhibit the growth of disease-causing microbes.

2. Fermentation of Dough (Idli & Dosa)

- The dough used in preparing **idli** and **dosa** is fermented by naturally occurring bacteria.
- During fermentation, these bacteria produce carbon dioxide (CO₂), which causes the dough to puff up.
- This is a result of anaerobic respiration (fermentation pathway) by microbes.
- The fermenting bacteria typically come from the ingredients or the environment.

3. Bread Making

- Bread dough is fermented using **baker's yeast** (*Saccharomyces cerevisiae*).
- Yeast fermentation leads to the production of **CO₂**, causing the dough to rise and become soft and spongy.

4. Traditional Fermented Foods and Drinks

- In various cultures, microbes are used to **ferment traditional foods and beverages**:
 - **Toddy** – a fermented drink made from the sap of palm trees, common in parts of southern India.
 - Fermentation of fish, soybean, and bamboo shoots to produce traditional fermented dishes in different regions.

5. Cheese Production

- Cheese is one of the oldest fermented food products made using microbes.
- The **flavor, texture, and appearance** of various cheese types are due to specific microbial strains used during fermentation.

Examples:

Swiss Cheese:

- Characterized by large holes.
- Formed due to **CO₂ production** by the bacterium *Propionibacterium sharmanii*.

Roquefort Cheese:

- Ripened using specific fungi.
- The fungal growth gives it its distinct flavor and texture.



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