

4. MICROBES IN HUMAN WELFARE

Single Page Simple Synopsis

Microbes (bacteria, fungi, viruses, and protozoa) are foundational to human welfare. They are essential for producing household foods, life-saving medicines, and sustainable energy. Furthermore, they play vital roles in wastewater treatment, agricultural soil enhancement, and natural pest control.

FOUR CORE CONCEPTS:

1. Household Products:

- **Dairy:** *Lactobacillus* and Lactic Acid Bacteria (LAB) ferment lactose in milk to create curd, increasing its Vitamin B₁₂ content. Other microbes ferment curds to make cheeses like Roquefort and Swiss cheese.
- **Baking & Brewing:** Baker's yeast (*Saccharomyces cerevisiae*) ferments sugars in dough to produce carbon dioxide CO₂, making bread and idlis light and fluffy. It is also utilized to brew beers and wines through alcoholic fermentation.

2. Industrial Production

- **Antibiotics:** Microorganisms produce potent chemicals that restrict the growth of disease-causing pathogens. For instance, Alexander Fleming discovered the first antibiotic, penicillin, from the fungus *Penicillium notatum*.
- **Enzymes & Bioactive Molecules:** Fungi like *Trichoderma polysporum* produce Cyclosporin A, a vital immunosuppressant used in organ transplant patients. Microbes like *Monascus purpureus* synthesize statins, which act as natural blood-cholesterol-lowering agents.

3. Sewage & Wastewater Treatment:

- **Municipal wastewater** is treated in Sewage Treatment Plants (STPs) to reduce the Biological Oxygen Demand (BOD).
- **Aerobic microbes** consume organic waste, and anaerobic bacteria (methanogens) safely digest the remaining sludge, simultaneously producing biogas (a combustible mix of methane and CO₂).

4. Agriculture & Biofertilizers

- **Biological Control:** Microorganisms act as natural eco-friendly pest controllers, replacing toxic chemical pesticides. For example, the bacterium *Bacillus thuringiensis* (Bt) produces a protein that is toxic to specific insect larvae.
- **Nitrogen Fixation:** Microbes like *Rhizobium* (symbiotic in legume roots), *Azotobacter*, and cyanobacteria (*Anabaena*, *Nostoc*) convert atmospheric nitrogen into usable nitrates to naturally enrich soil fertility.

ROOT POINTS

1. **Microbes** are major components of biological systems on Earth, alongside plants and animals.
2. They are present everywhere: in **soil, water, air, and inside the bodies of plants and animals**.
3. **Lactobacillus** and other lactic acid bacteria (LAB) convert milk into curd.
4. Curd formation improves nutritional quality by increasing **Vitamin B₁₂**.
5. **Baker's yeast** (*Saccharomyces cerevisiae*) is specifically used to ferment bread dough.
6. Large holes in Swiss cheese are produced by CO₂ from the bacterium **Propionibacterium sharmanii**.
7. **Roquefort cheese** is ripened by specific fungi to give it a particular flavor.
8. Whisky, brandy, and rum are produced by the **distillation** of fermented broth.
9. **Antibiotics** are chemical substances produced by microbes that kill or retard other pathogens.
10. **Penicillin** was the first antibiotic discovered, found by chance by **Alexander Fleming**.
11. **Ernest Chain and Howard Florey** established the full medical potential of Penicillin.
12. **Aspergillus niger** (a fungus) is used for the industrial production of citric acid.
13. **Acetobacter aceti** and **Clostridium butylicum** produce acetic acid and butyric acid, respectively.
14. **Statins**, produced by the yeast *Monascus purpureus*, are used as blood-cholesterol lowering agents.
15. **Primary treatment** involves the physical removal of large and small particles via filtration and sedimentation.
16. **Secondary treatment** (biological treatment) involves passing effluent into aeration tanks to grow aerobic microbes.
17. Flocs consume organic matter in effluent, significantly reducing the **Biochemical Oxygen Demand (BOD)**.
18. Once BOD is reduced, bacterial flocs are allowed to sediment, forming **activated sludge**.
19. Biogas is a mixture of gases, predominantly **methane**, produced by microbial activity and used as fuel.
20. Methanogens like **Methanobacterium** are found in both sewage sludge and the rumen of cattle.
21. **Bacillus thuringiensis** (Bt) is a microbial agent used to control butterfly caterpillars.
22. **Baculoviruses** are used for species-specific, narrow-spectrum insecticidal applications in sensitive areas.

23. **Biofertilisers**, including bacteria (Rhizobium), fungi (Mycorrhiza), and cyanobacteria, enrich soil nutrient quality.
24. The domestic sewage in large cities is **processed by aerobic and then anaerobic bacteria in the secondary treatment in Sewage Treatment Plants (STPs)**. [2012 PMT]
25. *Monascus purpureus* is a yeast used commercially in the production of **blood cholesterol lowering statins**. [2012 PMT]
26. An organism used as a biofertiliser for raising soyabean crop is **Rhizobium**. [2011 PMT]
27. During sewage treatment, biogas is produced which includes **methane, hydrogen sulphide, carbon dioxide**. [NEET-2013]
28. A good producer of citric acid is **Aspergillus**. [NEET-2013]
29. Large holes in swiss cheese are formed due to production of large amount of CO_2 by **Propionicbacterium**. [NEET-2016]
30. The fungus used for commercial production of citric acid is **Aspergillus**. [NEET-2016]
31. Cyclosporin A used as immuno suppressive agent in organ transplants, is produced by **Trichoderma**. [NEET-2016]
32. Conversion of milk to curd improves its nutritional value by increasing the amount of **Vitamin B₁₂**. [NEET-2018]
33. **Statin** is a commercial blood cholesterol lowering agent. [NEET-2019]
34. A commercial blood cholesterol lowering agent is **statin**. [NEET-2019]
35. A '**biocontrol agent**' used in the **treatment of plant disease** is **Trichoderma**. [NEET-2019]
36. **Activated sludge** is put into anaerobic sludge digester for further sewage treatment. [NEET-2020]
37. **Activated Sludge** is put into anaerobic sludge digester for further sewage treatment. [NEET-2020]
38. **Trichoderma Polysporum** is the micro organism responsible for the production of an immunosuppressive molecule cyclosporin A. [NEET-2022]
39. Streptokinase produced by bacterium streptococcus is used for **removing clots from blood vessels**. [NEET-2025]
40. **Beer** is an example of non-distilled alcoholic beverage produced by yeast. [NEET-2025]