

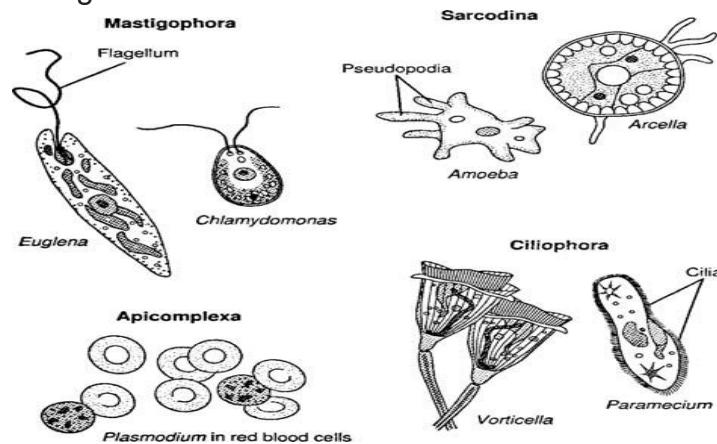
Microorganism

What is microorganism

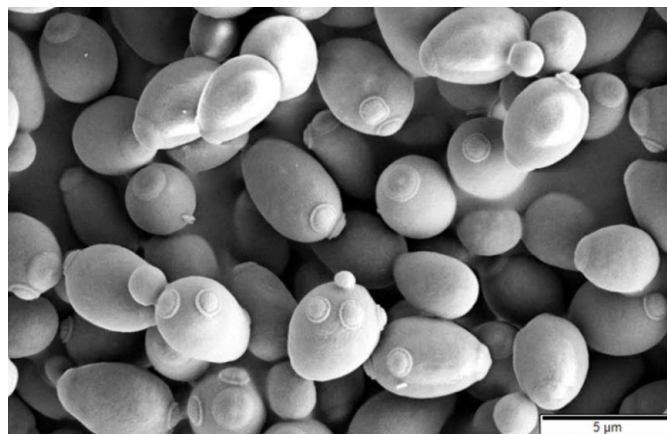
1. Minute living thing, it cannot be seen with naked eyes
2. Diverse and unique life form
3. Ubiquitous in nature
4. They also produce things that of value to us
5. They are used to produce several food, medicines and beverages
6. They also spread diseases

Microorganism

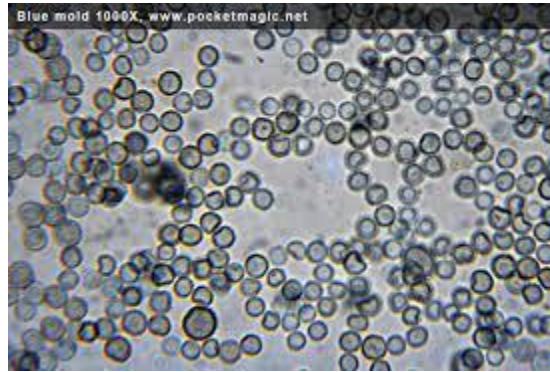
A. Protozoa- **Protozoa** (also **protozoan**, plural protozoans) is an informal term for a group of single-celled eukaryotes, either free-living or parasitic, which feed on organic matter such as other microorganisms or organic tissues and debris.



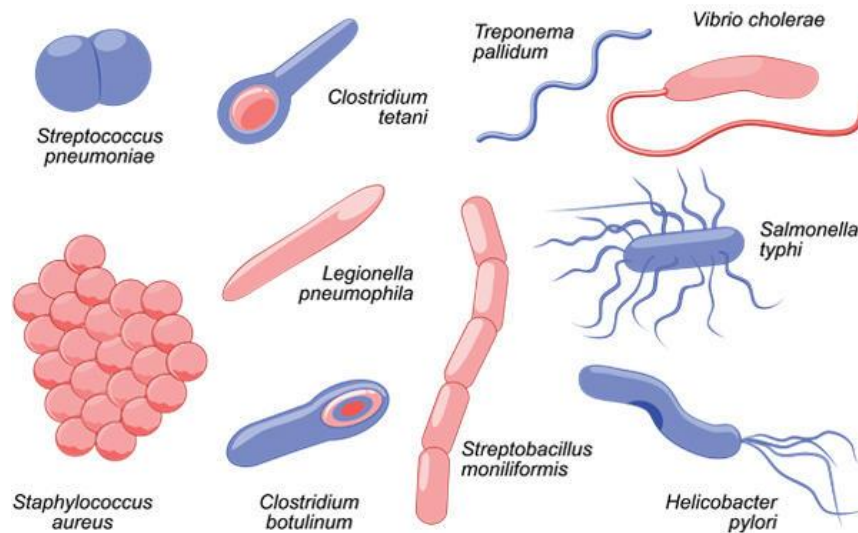
B. Yeast- **Yeast** is a single-cell organism, called *Saccharomyces cerevisiae*, which needs food, warmth, and moisture to thrive. It converts its food—sugar and starch—through fermentation, into carbon dioxide and alcohol. It's the carbon dioxide that makes baked goods rise



C. Molds A **mold** is a fungus that grows in the form of multicellular filaments called hyphae. In contrast, fungi that can adopt a single-celled growth habit are called yeasts.



D. Bacterium- prokaryotes, Unicellular, grow in laboratory, they are harmful as well as beneficial



E. Algae are a diverse group of aquatic organisms that have the ability to conduct photosynthesis. Certain **algae** are familiar to most people; for instance, seaweeds (such as kelp or phytoplankton), pond scum or the **algal** blooms in lakes

Biotechnology-

1. It is applicable of living organism and their products in domestic and industrial process in large scale.
2. While microbiotechnology is the aspect of biotechnology which involves the uses of microorganism and their products.
3. In other words it is the application of scientific and engineering principles to the processing of materials by microorganism to create useful products.
4. Production of antibiotic, organic acid and enzymes by fermentation of natural microbes and genetically engineered using recombinant DNA method.

Scope of microbial biotechnology

Industrial Uses

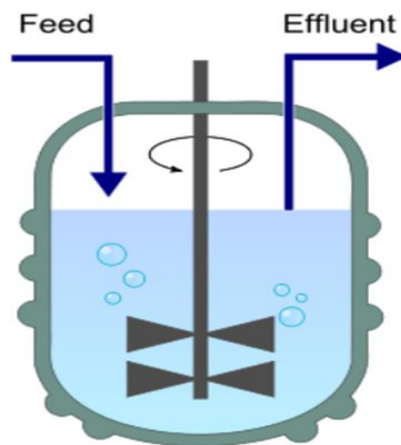
A microorganism converts the useless or cheap raw material in to useful product on large scale in industry by some biochemical process. These biochemical processes require the following

1. An organism-
2. Medium- Substrate or medium or nutrients for organism

3. pH-
4. Temperature
5. Hygiene
6. Filtration and purification
7. By microbial enzymes large molecules are synthesis
 - a. Primary metabolic products which are produce during growth phase of organis eg. Ethanol, Citric acid, amino acids, enzymes, vitamime, etc
 - b. Secondary metalbolic products during atstionary phase eg. Penicillin, cyclosporine and gibberline etc

A. Biotranformation- Biotransformation is the process by which a substance changes from one chemical to another (transformed) by a chemical reaction within the body. It require following condition

1. Sterilization of ferment vessels and their equipments
2. Preparation of pure culture medium
3. Preparation of pure culture for inoculation.
4. Cell growth and synthesis of desired product
5. Extraction and purification of end products
6. Reuse of waste products or disposal of waste product
7. Cleaning of bioreactor

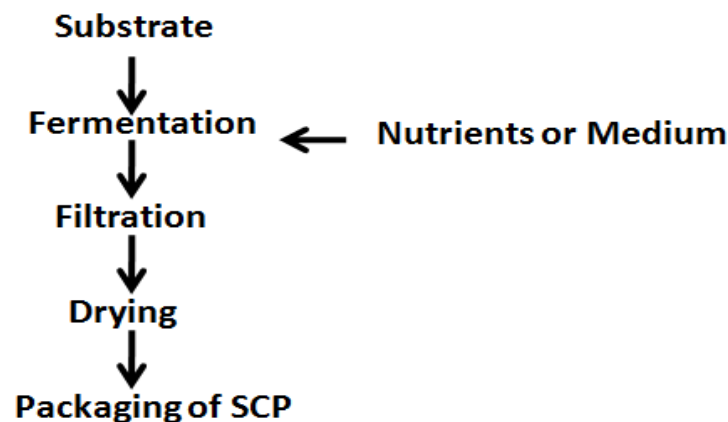


Products of microbe

1. **Alcoholic beverages**-Alcoholic beverages comprise a large group of beverages that contain varying amounts of alcohol (ethanol). Alcoholic beverages produced on an industrial scale include **beer**, **wine**, and China rice **wine**, and distilled spirits such as brandy, whisky, rum, gin, cognac, vodka, tequila, pisco, and China distilled spirit.
2. **Organic acids**- Generally, organic acids are produced commercially either by chemical synthesis or fermentation. However, fermentation processes are the most commonly used method. All organic acids of tricarboxylic acid cycle can be produced in high yields in microbiological processes eg. citric acid and vinegar, succinic acid, fumeric acid and lactic acid
3. **Polyols**- Polyols such as mannitol, erythritol, sorbitol, and xylitol are naturally found in fruits and vegetables and are produced by certain bacteria, fungi, yeasts, and algae.
4. **Polysaccharides**- Microbial polysaccharides are **water soluble biopolymers produced by many bacteria**. Because of their rheological characteristics, microbial polysaccharides are used as binders, coagulants, emulsifiers, film formers, gelling agents, lubricants, stabilizers, and thickening and suspension agents

5. **Sugar-** Glucose, fructose, ribose and sucrose
6. **Vitamines-** B₂ and B₁₂ animal can synthesis theses vitamine but some bacteria *Bacillus subtilis* are able to produce vit B₂ while *E. Remothecium* and *Ashbya* are capable to produce vitamine B₁₂.
7. **Dairy products-** Milk, butter, cheese, yogurt, cream (heavy cream, sour cream, ice cream, whey, casein. LAB's commonly found in dairy products include strains of Streptococcus, Lactococcus, Lactobacilli, Bifidobacteria, Enterococcus, and Pediococci. Within these species there are numerous strain types which can be used in fermentation processes to give specific acidification and flavor profiles to the final product.
8. **Emzymes-** The production of enzymes by fermentation was established business before modern microbial technology. Recombnant DNA technology method was so perfacly suited to the improvement of enzyme production. Several enzymes are produced by microorganism are amylase, protease, pectinase, lipase and chymosin etc
 - a. Amylase used for breakdown of starch and carbohydrates in industries in glucose and other products.
 - b. Chymosin used for cheese production
 - c. Lipase of detergents
 - d. For making multi enzymes
9. **SCP (Singlr cell protein)** It refer the edible unicellular microorganism. When monoculture of bacteria, fungi, and algae has high nutritional value due to 70%-80% of protein, carbohydrate, lipid, minerals, vitamins and essential enzymes. These microorganism are grown in large scale for anthropogenic uses. **SCP** are bacteria (*Cellulomonas*, *Alcaligenes*, etc.), algae (*Spirulina*, *Chlorella*, etc.), molds (*Trichoderma*, *Fusarium*, *Rhizopus*, etc.) and yeast (*Candida*, *Saccharomyces*, etc).

Process of SCP



10. Pharmecetical uses of microbes

- a. **Antibiotics-**Antibiotics are made by microbial fermentation, it acts to kill bacteria in following
 1. Damaging plasma membrane of microbes
 2. Inhibit the synthesis of protein, amino acid and nucleic acid
 3. To induced immunity
 4. Because of increasing the resistance of microbes new antibiotic are developingby using rDNA technology in microbes eg. Amoxicillin, doxycyline, cephalixin, ciprofloxin and azithromycin etc.

- b. **Antiviral**-It suppress the ability of replication of virus eg. Amantadine it is for influenza virus and many other anti viral medicine which are made by microbe
- c. **Insuline**- form by E. coli bacteria recombinant technology. The human insulin gene is transferred in bacterial DNA and after culture it is isolated from culture. Due to the human gene it is good for use in diabetes.
- d. **Vaccine**- Antigen isolate from infected virus and it eliminates the disease-causing activity of virus by making antibody by the injection of antigen. New research has discovered that yeast can produce the antigen against Hepatitis B virus
- e. **Interferon**- These are signaling proteins or in typical words it is a viral-infected cell which gives signal to nearby non-infected cells.

11. Non antibiotic products-Some secondary metabolic products are used

- a. Sex hormone
- b. Lonophores
- c. Weapons against the other bacteria and fungi

12. Microbes in agriculture

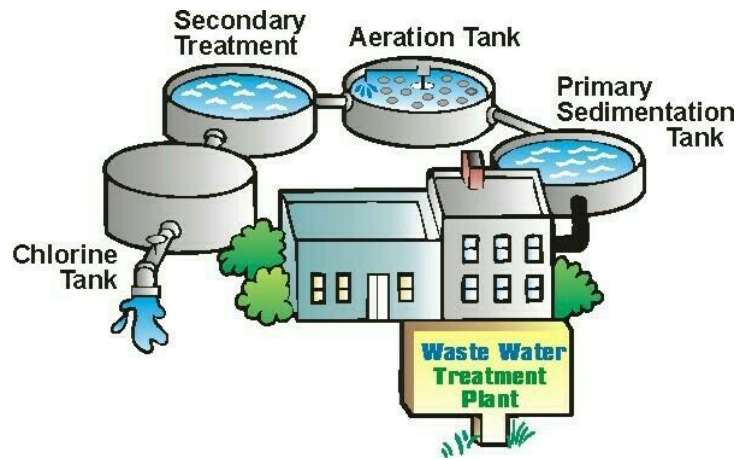
- a. **Biofertilizer** Some microbes through which dependency of N and S fertilizers decreases bacteria give N and S components through biogeochemical cycle. rDNA bacteria induce the decomposition of organic waste and increase the growth of plant
- b. **Bioinsecticides and pesticides**- Synthetic fertilizer causes bioaccumulation and biomagnifications.
 1. **Bacillus Thuringiensis** is toxic for some insect which are harmful for plants. It is not harmful for other animals.
 2. **Buhalo virus**- infects the larva of insect and pest. It is specific for some insect not for all arthropods.
 3. **Brome mosaic virus**- it has recently been researched that this virus infects the rice plant to inhibit the water retaining capacity of plant but it is surprising that the infected plant shows more tolerance for drought.

13. **Biopolymers**- this is the alternate of plastic. Some microbes of PHA family produce biopolymers and can be used as bioplastic and these are biodegradable. rDNA technology is being used to develop such bacteria that can produce huge amounts of bioplastic.

14. Bio fuel

- a. **Biogas**-Biogas plants (Nitrobacter)
- b. **Biohydrogen** Bacteria *Clostridium* and algae *Chlorella* are capable to produce huge amounts of H₂ gas which can be used as a source of energy.

15. **Bioremediation**- It is the process by which hydrocarbon can be broken down into CO₂ and H₂O to clean the environment by removing pollutants from water, soil and air. Some bacteria, cyanobacteria, fungi and algae can break down hydrocarbons more rapidly. Through rDNA technology these microbes and their potentiality to break down hydrocarbons can be induced. **Oil spill** is the big problem of sea pollution, some microbes produce hydrocarbon oxidizing enzymes more rapidly. Essentially, a sewage treatment plant operates by **circulating air to encourage the growth of bacteria to break down sewage**. The goal is to deliver much cleaner, more environmentally friendly effluent. It involves a similar process to a typical septic tank but has some key differences.



16. Heavy Metals extraction - Microorganisms are used in large-scale heap or tank aeration processes for the commercial extraction of a variety of metals from their ores or concentrates. These include **copper, cobalt, gold and, in the past, uranium.**