Microbes are moving from houses to factories for their uses

The branch of biology which deals with the study of microorganism are called as “Microbiology”. the biosphere i.e the biotic and abiotic component has a variety of microorganisms that exhibit beneficial activities. They include small algae, fungi, bacteria, protozoans, mycoplasmas and related organisms. A large number of microbes help human civilization through their useful activities. These activities are either of domestic, industrial or commercial importance. It has several applied branches such as medical microbiology, food microbiology, industrial microbiology, etc.

Microorganism were exploited for useful purpose long before 600 BC . Without knowing their existence and characterstics. Baby lonin and Sumerians used to yeast to make alcohol. In Hindu Vedas the bhagwat geeta use of butter is also mentioned

History reveals that many other applications of microbial process that results in the production of desirable food and beverage.

Louis pasture in 19th century cleared the role of microbes in theses process

Microorganism during natural condition produce large amount and variety of chemical substances. These chemicals are important for

1. Treatment of harmful diseases
2. Processing of food
3. Storage of food and thei products

As well as human population is increasing the amount or require of microorganism products is also increasing. So the microbes are moving from houses to factories for their uses. It require three main components for industrial uses.

1. Substrate (Raw material)
2. Microorganism
3. Moderatre environment

Major uses of microbes in the factories

1. Pharmaceutical
2. Commercialy valueabe chemical solvent, enzyme, intermediate compound etc
3. Food supplements
4. Alcohal beverage

5. Biofuel
6. Vaccine

Industrial uses of bacteria

1. Microbes as the source of food:

Some microbes or their fruiting bodies are directly used as a source of food, rich in protein. The term ‘SCP’ or single cell protein denotes dead and dried cells of microbes like bacteria, algae, molds and yeasts. They are obtained by growing microbes of various groups on different substrates. These microbes include bacteria like. Bacillus subtilis, fungi like, species of Candida and Saccharomyces cerevisiae and algae such as species of Chlorella.

Mushrooms and truffles are directly used as food. They belong to basidiomycetes (fungi) and produce large fleshy fruiting bodies which are edible. They are low calorie, sugar-free, fat-free but rich in proteins, vitamins, minerals and amino acids.

Some common examples of edible mushrooms are-

Common name Biological name

A. White button mushroom- Agaricus bisporus
B. Paddy straw mushroom- Volvariella volvacea
C. Oyster mushroom- Pleuratus florida

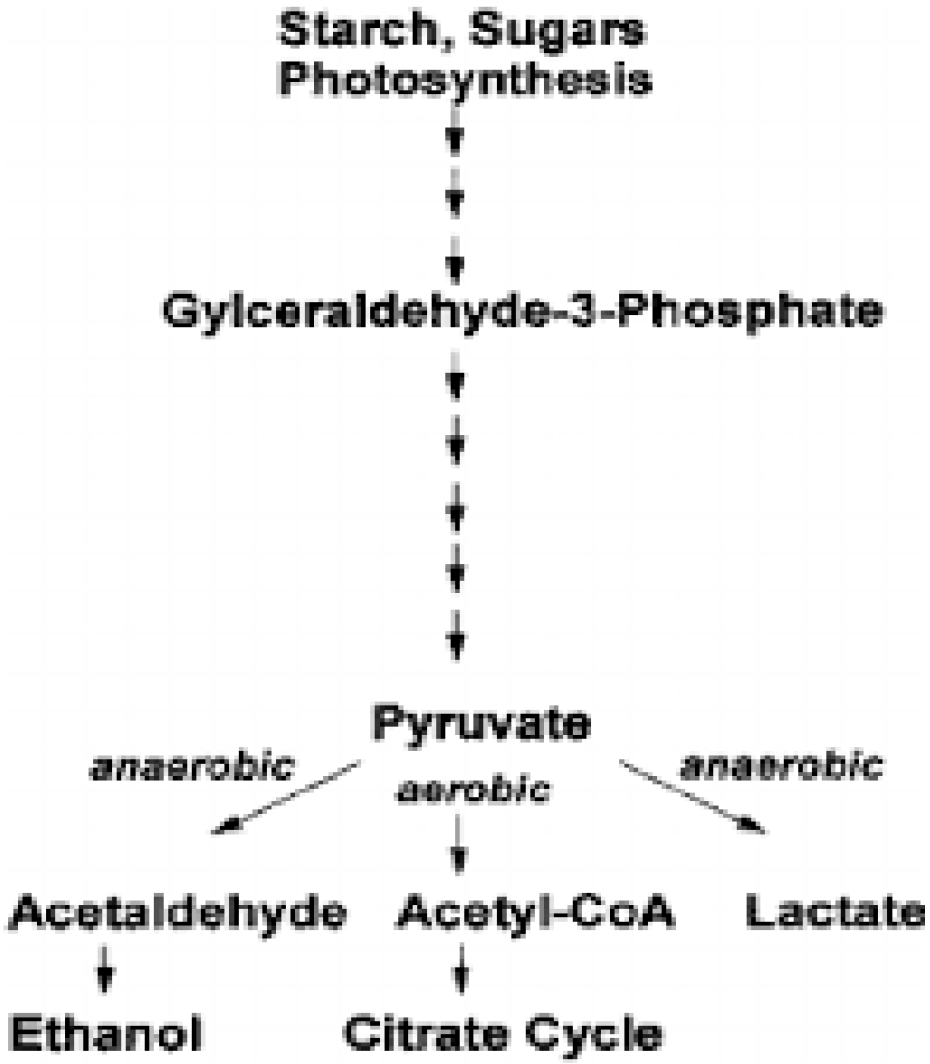
2. Production of Alcoholic Beverages:

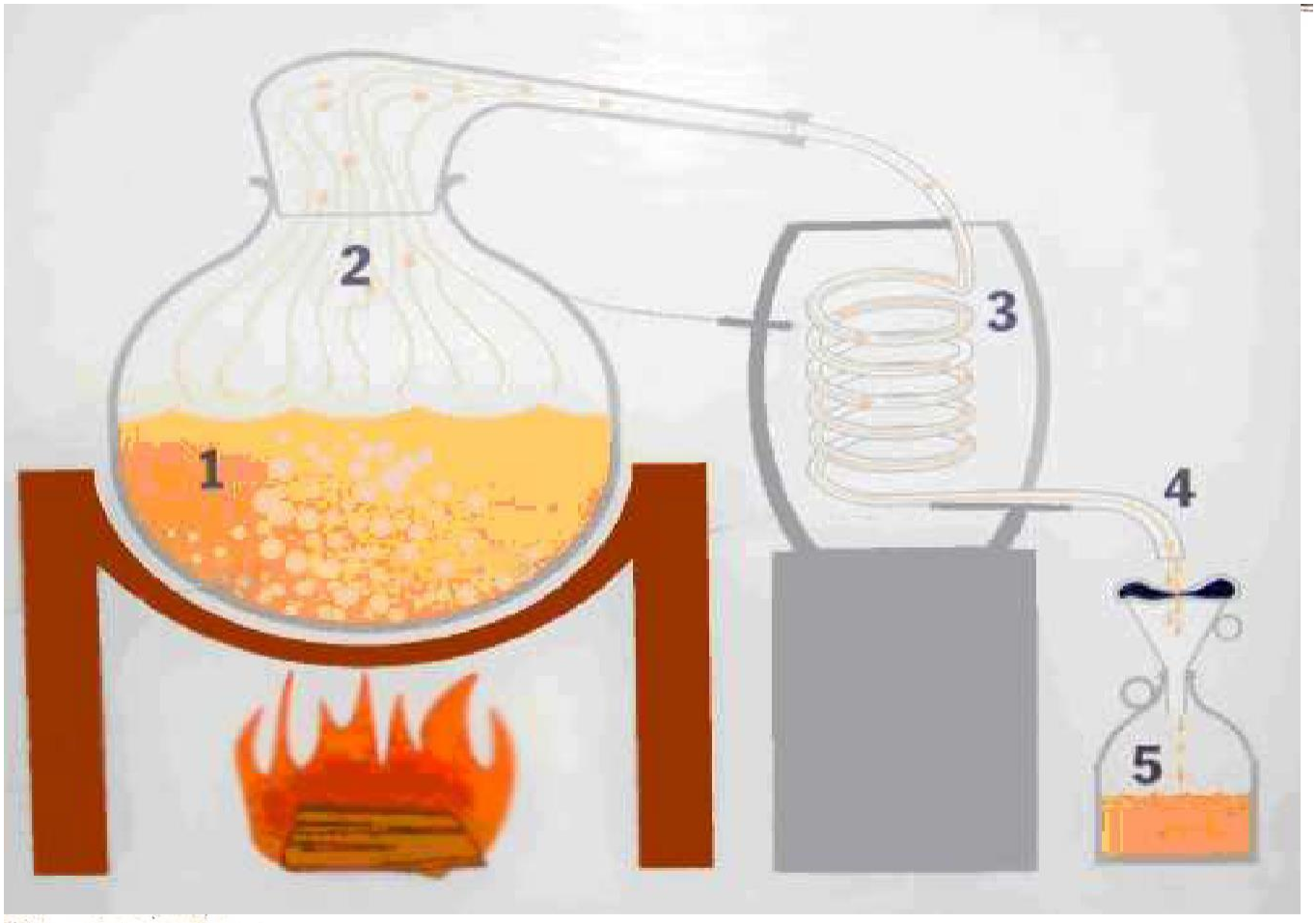
Alcoholic beverages are the products of alcoholic fermentation of specific substrates. They include liquors like wine, beer and whisky. The use of microbes in making fermented beverages is known since about 700 B.C. to Egyptians, Romans and Greeks.

A number of strains of the’ yeast. Saccharomyces cerevisiae var. ellipsoideus are used in industrial production of wine. Different flavours of wine are obtained by using different fruit juices.

Beer is another alcoholic liquor obtained from fermented grains, mostly barley. Suitable strains of S. cerevisiae are used for fermentation. ‘ It is produced through various steps like malting, mashing and fermentation. It is allowed to stand for a few days. Then it is clarified, carboxylated, filled in bottles, packed and marketed. Wine and beer are produced without distillation.

Whisky is obtained by fermenting mixed’ grains of corn, wheat, bailey, etc. The product of fermentation is then distilled.


Starch, Sugars
Photosynthesis
Gylceraldehyde-3-Phosphate
Pyruvate
anaerobic
aerobic
anaerobic
Acetaldehyde
Acetyl-CoA
Lactate
Ethanol
Citrate Cycle



Alcohalic Distillation Process

3. **Organic Acid Fermentation**:

A number of organic acids are obtained by fermentation using various microbes as given below.

Microbes used in Organic acid

A. Citric acid -Aspergillus niger
B. Gluconic acid -Aspergillus niger
C. Fumaric acid -Rhizopus arrhizus
D. Acetic acid -Acetobacter aceti
E. Lactobacillus delbruecjii and L. bulgaris are in lactic acid production. Whey is the waste product of dairy industry. Discarded whey directly release in environment. In open environment it causes pollution in air by foul smell, water pollution and causes diseases. By using lactobacillus bacteria whey cay be converted in to lactic acid

4. **Vitamin Production:**

Vitamins are complex organic compounds required in very small quantities for normal growth and development of the body. They include vitamins A. B, C, D, E and K. They may be water

soluble (vitamins B and C) or fat soluble (vitamins A, D, B and K). All the vitamins are not produced in human body. Therefore, they are to be consumed through food or tablets.

Vitamins are manufactured by fermentation technology using different microbial sources as given below.

Name of the vitamin Microbial source

A. Vitamin B2 - Neurospora gossypii, Eremothecium ashbyi
B. Vitamin B12 - Pseudomonas denificans .
C. Vitamin C Aspergillus niger

5. Antibiotic. Production:

Some secondary metabolites, products of fermentation, have therapeutie importance arid are used in medical treatment. For example, penicillin and a number of other antibiotics are used in control of infectious diseases.'

Antibiotics are the substances produced in small amounts by certain microbes to inhibit die growth of other microbes. They may be anti-fungal (fungistatic or fungicidal) or anti-bacterial (bacteristatic or bactericidal) in nature.

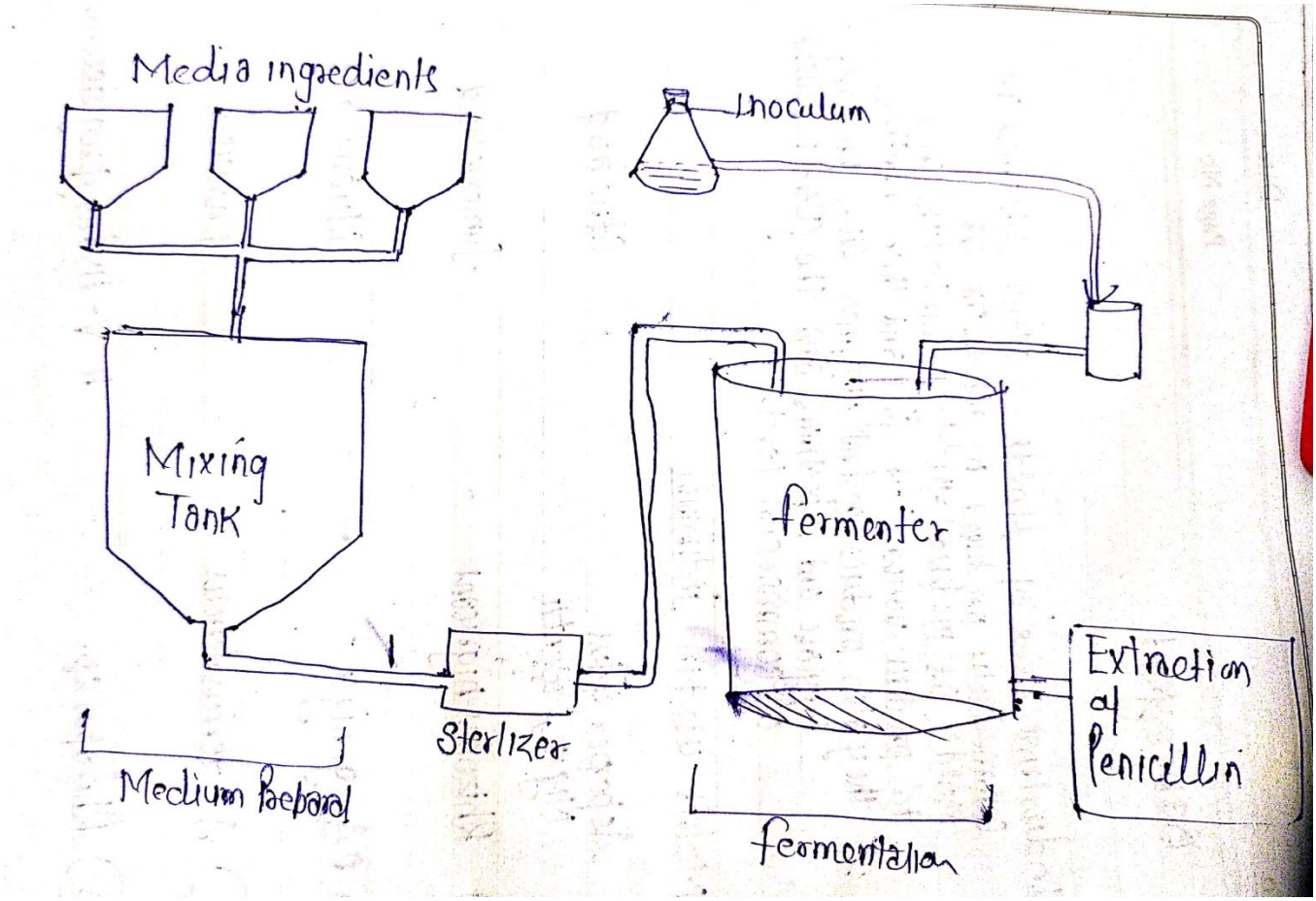
The first antibiotic was discovered accidentally by the British physician Dr. Alexander Fleming in 1929 when he was working with the pathogenic bacterium Staphylococcus aureus. Since then a number of antibiotics have been produced and used therapeutically. Some common antibiotics and their microbial sources are listed below.

Antibiotic produced Microbial source

1) Chloromycetin Streptomyces venezuelae

ii) Erythromycin Streptomyces erythreus

iii) Penicillin -Penicillium chrysogenum



iv) Streptomycin Streptomyces griseus

Many deadly diseases such as plague, whooping cough, diphtheria and leprosy, which Used to kill millions all over the world can be now controlled by antibiotics.

6. **Hormone production**

A. Insulin production

Earliest use of recombinant technology

Modify E.coli cells to produce insulin; performed by Genentech in 1978

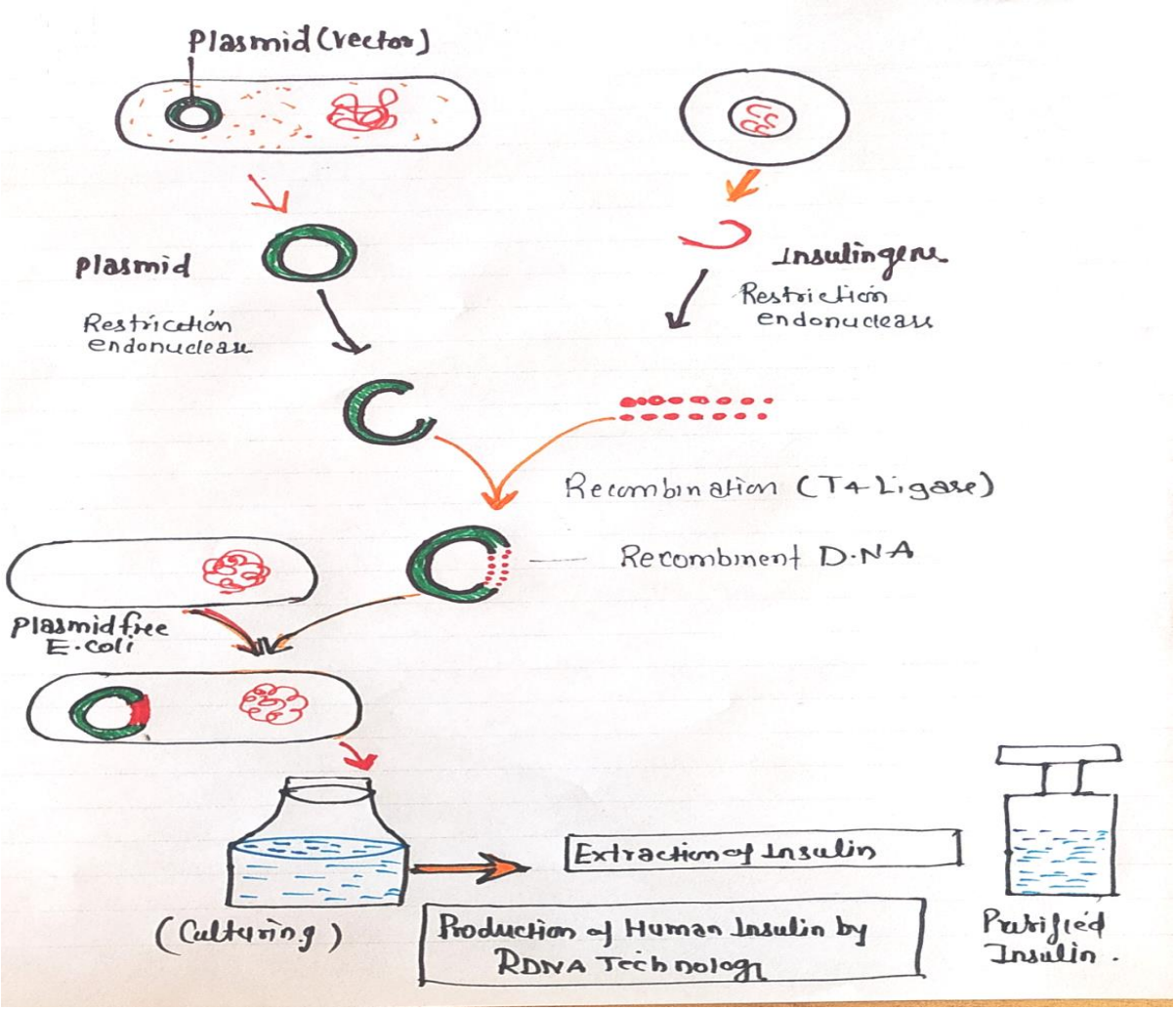
Prior, bovine and porcine insulin used but induced immunogenic reactions

Also, there were many purification and contamination hassles.

To overcome these problems, researchers inserted human insulin genes into a suitable vector (E.coli)

Producing Recombinant Insulin

1. First, scientists synthesized genes for the insulin.
2. They were then inserted into plasmids along with a strong ligase promoter.
3. So recombinant DNA forms
4. The recombinant DNA or plasmid transfer in to plasmid free bacteria or E. coli.
5. Recombinant DNA bacteria culture
6. The insulin extraction from culture medium
7. Now purified insulin under laboratory conditions



B. Gibberellin Production: fungus Gibberella fujikuroi

Gibberellins are a group of growth hormones mainly produced by higher plants and fungi to promote growth by stem elongation. The first lavor llins was isolated by two Japanese scientists Yabuta and Sumiki in 1938 from rice seedlings infected with the fungus Gibberella fujikuroi. About 15 types of gibberellins have been isolated from G. fujikuroi. Gibberellins have many

practical applications. They are used to induce parthenocarpy in apple, pear etc. They are used in breaking dormancy and inducing flowering also.

8. Enzyme Production:

Enzymes are biocatalysts, which either initiate or accelerate all biochemical processes in living organisms. A number of hydrolytic enzymes that degrade starch, proteins, fats and pectin into simple compounds are known. Traditionally, amylase, papain and pectinase were used in food processing. In recent years, many more enzymes are being produced for getting desirable lavor of cheese and butter, sweetness of confectionaries, animal feed, soyabean milk, modification of food gums, etc. Following are a few examples of enzymes used in industrial food processing.

Name of the enzyme Microbial source

i) Invertase -Saccharomyces cerevisiae

ii) Pectinase -Sclerotiana libertine

iii) Lipase -Rhizopus spp

iv) Cellulase -Trichoderma konigi

9. Dairy industry:

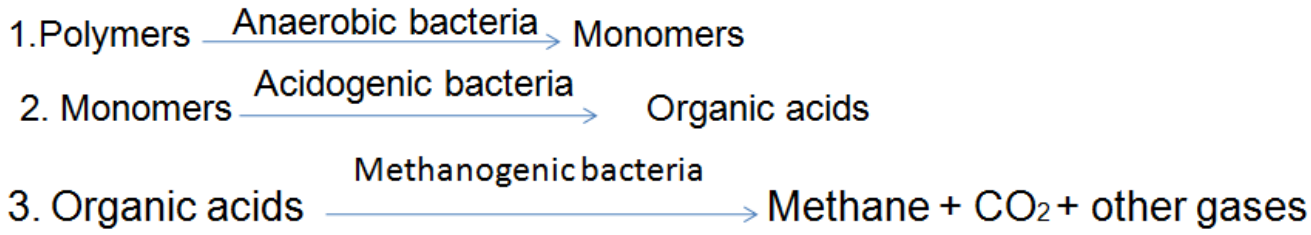
Various products are obtained from milk in dairy industry using microbial species. Some of these products are cheese, yoghurt, buttermilk, paneer etc. Species of Streptomyces, Penicillium and Lactobacillus are commonly employed. At the domestic level, preparation of fermented milk products started in the early period of human civilization. Curd and buttermilk were produced using lactic acid bacteria. Cheese too is a product of fermentation by fungi.

10.(Methanococcus and Methanobacillus.)

The anaerobic digestion occurs by certain anaerobic bacteria like species of Clostridium, Pseudomonas, etc. m this process complex insoluble polymers are converted to simple soluble monomers with the help of bacterial hydrolytic enzymes. These monomers are further converted into organic acids,chiefly acetic acid by enzymes of acidogenic bacteria Finally, acetic acid is transformed to biogas by the enzymes of methanogenic bacteria. These bacteria include species of Methanococcus and Methanobacillus.

Bio gas plant (diagrammatic)

Biogas



11. Paper industry The manufacturing of paper involves two majaor operations

1st physical and chemical treatment of cellulose for the purpose to separating the cellulose fibers to making pulps

2nd Febrication of pulp

The microbe degrade the cellulose and make the pulp of cellulose by which paper sheet forms

12. Microbes in mining- Biomining is the process of using **microorganisms** (**microbes**) to extract metals of economic interest from rock ores or mine waste. ... Valuable metals are commonly bound up in solid minerals. Some **microbes** can oxidize those metals, allowing them to dissolve in water. Bacteria Thiobacillus thioxidans and thiobacillus ferroxidanswhen gorw in cu ores produce acid . After oxidation of the ores precipitate this process is known as leaching.

13. Vaccine- Vaccines can be classified as traditional or recombinant based on their method of production.

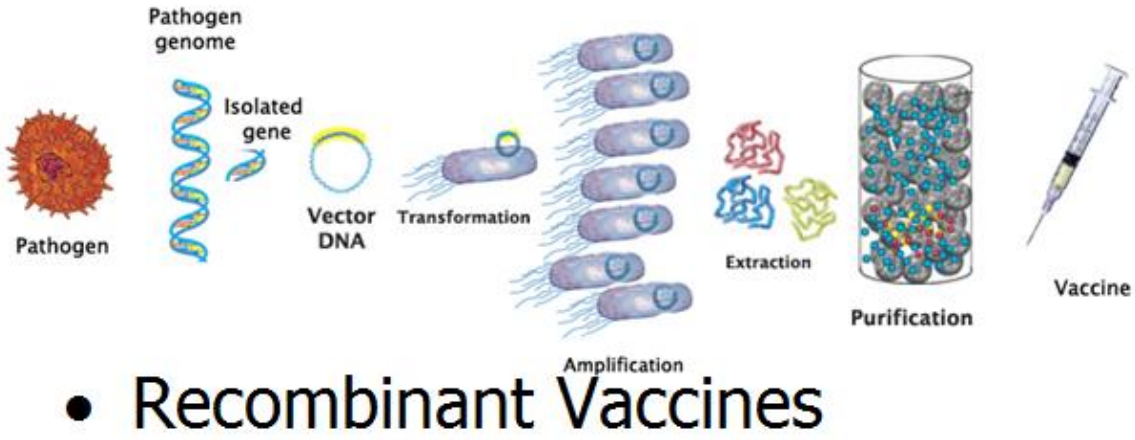
A. Traditional vaccines are made by killing or weakening the pathogen and injecting it into the patient to stimulate the patient's immune system to produce antibodies against the disease. Then, in theory, if the patient came in natural contact with the disease organism, the body's immune system would mount a response and prevent illness in the patient.

B. Live attenuated vaccines contain a version of the living microorganism that has been weakened in the lab so it can no longer cause disease but will illicit a strong immune response. The remote possibility exists that an attenuated microorganism in the vaccine could revert to a virulent form and cause disease, especially in an immuno-compromised host. Examples of live attenuated vaccines in use today include: **measles, mumps, rubella, oral polio vaccine and the chickenpox vaccine.**

Inactivated, or killed, vaccines are safer especially since these microorganisms are not allowed to mutate; however, they do stimulate a weaker immune response and may require multiple doses over time.

C. Subunit vaccines are made by injecting portions of viral or bacterial structures, usually proteins or lipids from the microorganism, to which the immune system responds.

D. **Recombinant vaccines** Recombinant vaccines are created by cloning genes for desired antigens and inserting the cloned antigen into a host cell to produce large quantities of the cloned viral or bacterial antigenic protein. This protein is then purified and injected into the patient, and the patient's immune system makes antibodies to the disease agent's protein, protecting the patient from natural disease.



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