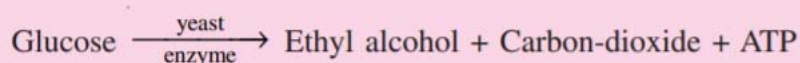


Modern techniques in biotechnology are programming microorganisms for various tasks. In this lesson, you will learn about use of microorganisms in industries.

- Biotechnology is defined as the industrial application of living organisms and their biological processes such as biochemistry, microbiology, and genetic engineering, in order to make best use of the microorganisms for the benefit of mankind
- Biotechnology is applied in many areas to produce foods and medicines, in the development of new diagnostic tools, gene therapy, and DNA finger-printing for forensic purposes.
- Yeasts (Fungi), moulds (Fungi) and bacteria are important microorganisms used in industries.
- Yoghurt, alcoholic beverages, antibiotics, vaccines and biogas can be obtained on a commercial scale by the use of microorganisms
- Fermentation is a process by which sugar is converted into alcohol and CO₂ by yeast.

Fermentation

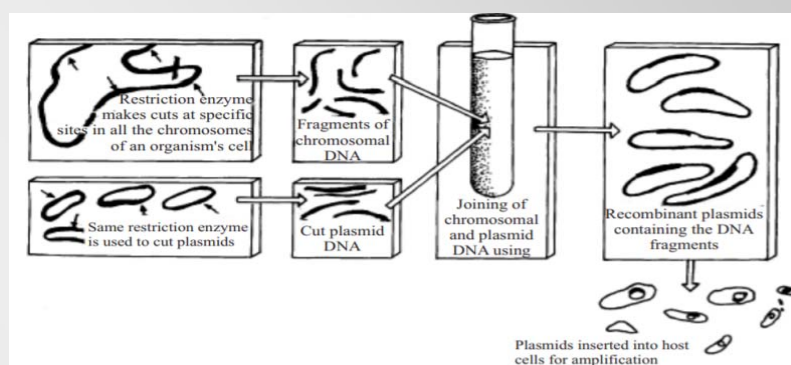
Fermentation is a process by which carbohydrates such as sugar are converted into alcohol.



Yeast is capable of fermenting sugar to alcohol. Fermentation is an energy yielding process.

- Fermentation by the yeast *Saccharomyces* yields beer and that by *Lactobacillus*, yields butter milk.
- In fermentation on large scale, bioreactor and nutrient medium are sterilised by autoclaving. Yeast is inoculated into the medium by support growth system or suspended growth system.
- Yoghurt is made from milk set by a bacterium *Lactobacillus*. Rennet tablets made from calf stomach or ficin from sap of fig trees are used for setting milk into curd.
- Bacteria also yield antibiotics as was discovered by Alexander Fleming. Waksman gave the term antibiotic.
- Antibiotic is a substance produced by a microorganism such as bacteria or fungi which inhibits the growth of another microorganism. Antibiotics are generally small molecules with a molecular weight less than 2000 Da. They are not enzymes.
- The antibiotic interferes with the vital metabolic processes of the pathogenic bacterium and prevents its growth and reproduction.
- Vaccines are prepared (a) from weakened or attenuated germs (first generation vaccines), (b) by recombinant DNA technology (second generation vaccines), or (c) synthetically (third generation vaccines).
- Vitamins may also be generated through fermentation.
- Biogas is made by the action of methanogenic bacteria on waste matter such as the faeces of humans or of cattle.
- Genetic engineering is defined as construction and use of DNA molecules engineered by recombinant DNA technology.
- Recombinant DNA (r-DNA) technology resulted from the discovery of (i) plasmids, and (ii) restriction enzymes.

Sequences of steps in recombinant DNA technology



- Tools of r-DNA technology are cell culture, restriction enzymes, plasmids, ligase and host bacteria.
- Recombinant DNA technology may be used to obtain proteins commercially such as insulin, clotting factors, monoclonal antibodies, enzymes, antibodies and vaccines.
- Genetically engineered organisms carrying foreign genes are called transgenics.
- Transgenic plants may be obtained by using the T1 plasmid of the bacterium *Agrobacterium tumefaciens*.
- Transgenic animals are produced by microinjection of foreign DNA into fertilised eggs or by using retrovirus for introducing foreign DNA into early embryonic stages.
- Genetically engineered bacteria can clean up pollutants from environment. This is called **bioremediation**.
- A mutated gene in a cell may result in some form of genetic disorder/disease. Sickle cell anaemia, Haemophilia, SCID are some single gene human disorders.
- Addition of a normal functioning gene to the defective cells to correct the genetic disease is called **gene therapy**.
- Treatment which is applied to body cells excluding germ line cells is called somatic gene therapy
- **There are three main therapeutic approaches to gene therapy:** (a) ex-vivo gene in Biology therapy, (b) in-vivo gene therapy, and (c) antisense gene therapy.
- Ex-vivo gene therapy includes addition of corrected genes through retroviral cloning vectors.
- In-vivo gene therapy includes direct delivery of corrected genes into the tissues by use of adenovirus.
- Antisense therapy is designed to prevent or lower the expression of gene in order to have less accumulation of a gene product.
- Gene therapy has certain limitations such as (i) somatic cell gene therapy cannot rectify the defect in subsequent generation, (ii) random integration of DNA from outside may interfere with normal gene, (iii) strict safety standards are to be maintained, (iv) proper clones of requisite genes have to be available

Test Yourself

1. Mention the step involved in the process of production of alcoholic beverages by fermentation?
2. Enumerate in a sequence the steps in recombinant DNA technology.
3. Define the term gene therapy. Under what condition does it become necessary to opt for such a therapy?