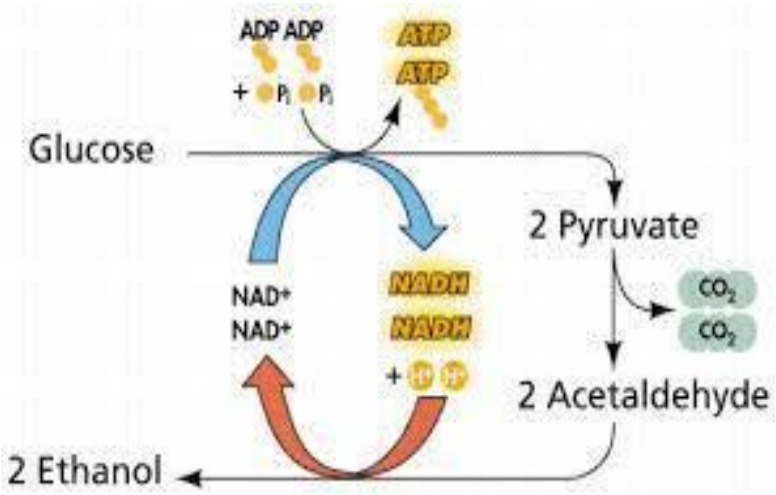
Fermentation

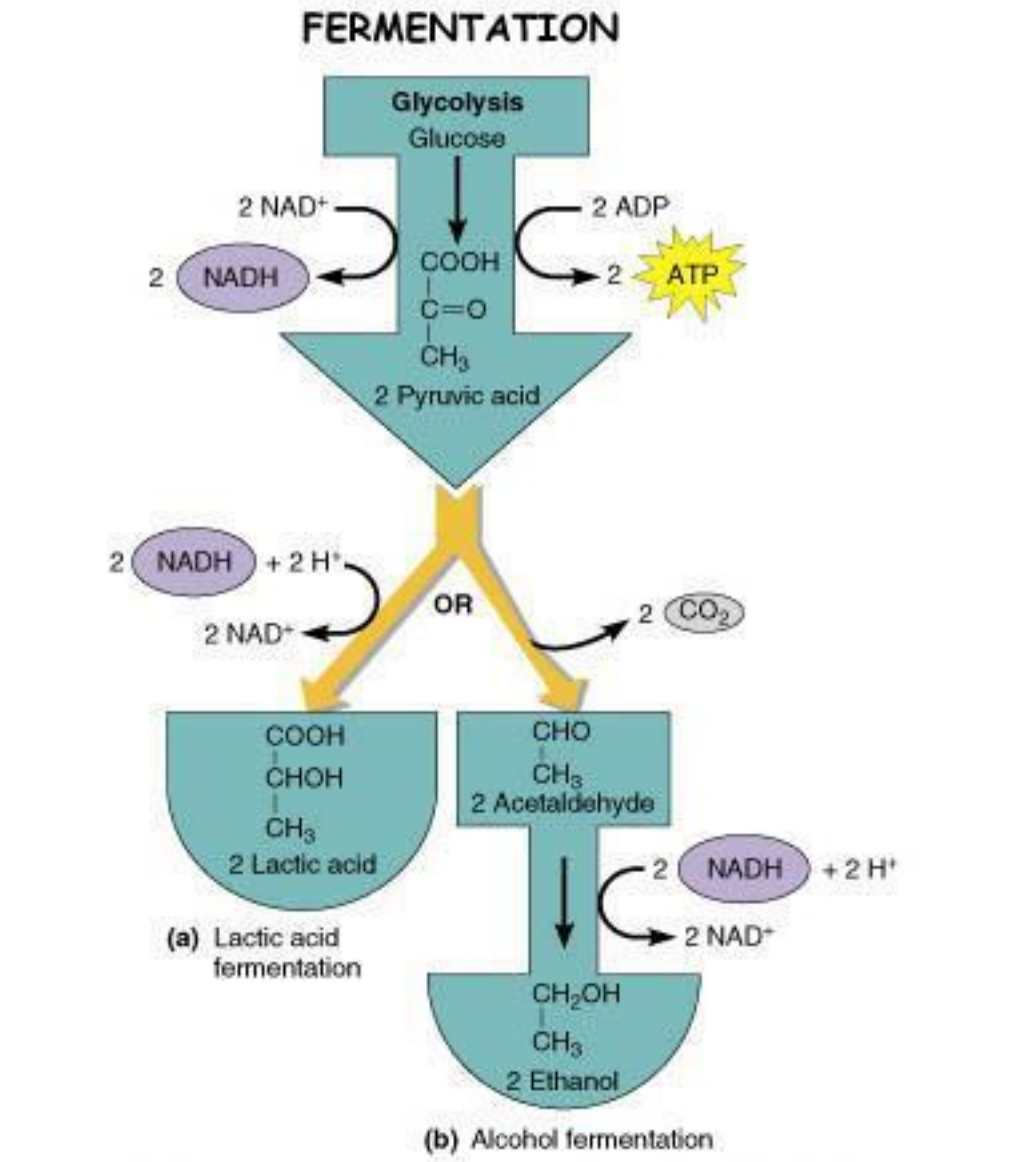
Definition

The chemical process of fermentation is a type of anaerobic respiration because it does not use oxygen as final electron acceptor. Fermentation is a unique process because an organic molecule, usually an intermediary of the chemistry, accepts the electrons.



Process

For example, in the fermentation of glucose by certain bacteria and viruses an intermediately accepts the electrons and proton from NADH formed in reaction of glycolysis. This regenerates the molecules for reuse as electron acceptors. NAD exists in limited supply in the cytoplasm and must be continually regenerated so the glycolysis may proceed. (When oxidative phospborylation is taking place, the NAD is regenerated by giving up its electrons and proton to FAD.)



The bacterium Streptococcus lactis practices fermentation by using pyruvic acid to accept the electrons and proton from NADH. An enzyme reaction converts the pyruvic acid to lactic acid in the process. In a dairy plant, the metabolism is carefully controlled to make buttermilk from fresh milk

. **The fermentation chemistry in yeasts** such as Saccharomyces is somewhat different because yeasts contain a different enzyme. In these cells the pyruvic acid is first converted to acetaldehyde, a process in which carbon dioxide evolves. Acetaldehyde then serves as an acceptor for the electrons and prolong of NADH, and it changes to ethyl alcohol. The liquor industry uses the ethyl

alcohol produced in fermentation to make alcoholic beverages such as beer and wine.

Uses

- The food industry, fermentation results in a broad variety of useful product.
- Vinegar, for instance, is a fermentation product of Acetobator species.
- Swiss cheese develops its flavor partly from the propionic acid of fermentation its holes from fermentation gases.
- Pickles and sauerkraut arc- sour because bacteria ferment the carbohydrates in cucumbers and cabbage, respectively.
- Sausage tastes like sausage because bacteria ferment the meat proteins.

- Thus fermentation is useful not only to the microorganisms but also to consumers enjoy the products of fermentation.

Pharmaceuticals and the biotechnology industry

There are 5 major groups of commercially important fermentation:

1. Microbial cells or biomass as the product, e.g. single cell protein, bakers yeast, lactobacillus, E. coli, etc.
2. Microbial enzymes: catalase, amylase, protease, pectinase, glucose isomerase, cellulase, hemicellulase, lipase, lactase, streptokinase, etc.
3. Microbial metabolites :
    1. Primary metabolites – ethanol, citric acid, glutamic acid, lysine, vitamins, polysaccharides etc.
    2. Secondary metabolites: all antibiotic fermentation
4. Recombinant products: insulin, HBV, interferon, GCSF, streptokinase
5. Biotransformations: phenyl acetyl carbinol, steroid biotransformation, etc.