FERMENTATION

Fermentation, a remarkable form of anaerobic respiration, takes center stage primarily in the domains of fungi and bacteria. While ancient civilizations harnessed this process for the production of wines, it wasn't until Gay Lussac's discoveries that the enigmatic nature of alcoholic fermentation began to unfold.

Types of Fermentation

Alcoholic Fermentation: In the realm of fermentation, especially orchestrated by yeast, glucose undergoes incomplete oxidation under anaerobic conditions, leading to the conversion of pyruvic acid into carbon dioxide (CO_2) and ethanol.

- **Pyruvic Acid Decarboxylation:** Pyruvic acid undergoes decarboxylation, facilitated by the enzyme pyruvic acid decarboxylase, yielding acetaldehyde and CO_2.
- **Alcohol Formation:** Subsequently, acetaldehyde transforms into alcohol through reduction by 2NADH + H+, orchestrated by alcohol dehydrogenase.

Example: Commonly observed in yeast and specific bacteria, the ethyl alcohol produced is excreted from microorganisms, with a critical limit to prevent self-poisoning. A concentration of about 13% is the maximum sustainable within microorganisms. Distillation is employed to achieve higher alcohol concentrations in beverages.

Lactic Acid Fermentation:

Here, pyruvic acid from glycolysis undergoes reduction to form lactic acid, a process facilitated by homofermentative lactic acid bacteria, such as Lactobacillus lacti.

During intense physical exertion, when oxygen is insufficient for cellular respiration, pyruvic acid is converted into lactic acid using lactate dehydrogenase.

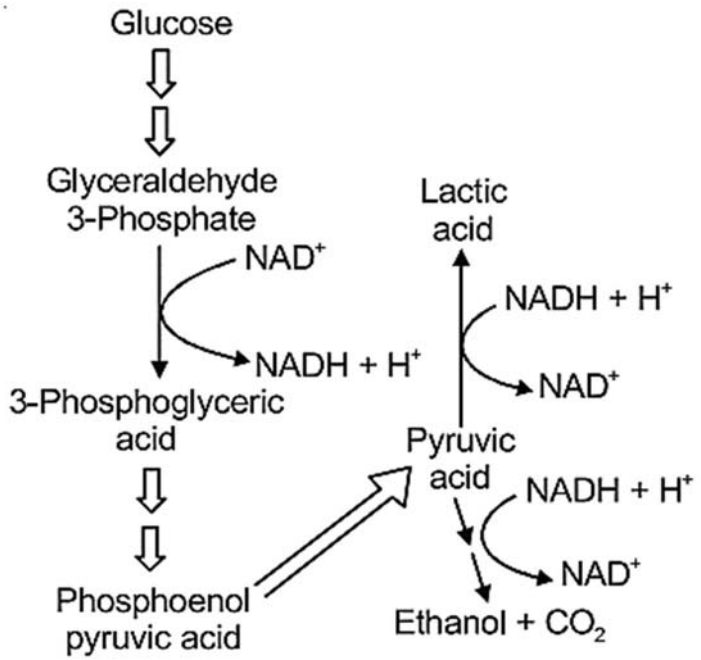

Fig. : Major pathways of anaerobic respiration

Special Features of Alcohol and Lactic Acid Fermentation:

- In both forms of fermentation, the energy released is modest, constituting less than seven percent of the energy within glucose, with not all of it being harnessed in high-energy ATP bonds.
- These processes pose hazards as they result in either acid or alcohol production.
- The net gain in both types of fermentation is 2 ATP.
- Alcohol fermentation liberates CO_2 alongside ethanol, whereas lactic acid fermentation exclusively yields lactic acid.
- NADH + H+ serves as the reducing agent, undergoing reoxidation to NAD+ in both fermentation processes.

Fermentation, a captivating anaerobic symphony, showcases the resourcefulness of microorganisms in adapting to diverse metabolic pathways, offering unique solutions to energy needs in varying environments.