

Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Second Year)

Subject: Botany

Paper Code: BOC 104

Paper Title: Plant Physiology

Unit: 06

Module Name: Anaerobic respiration

Module No: 44

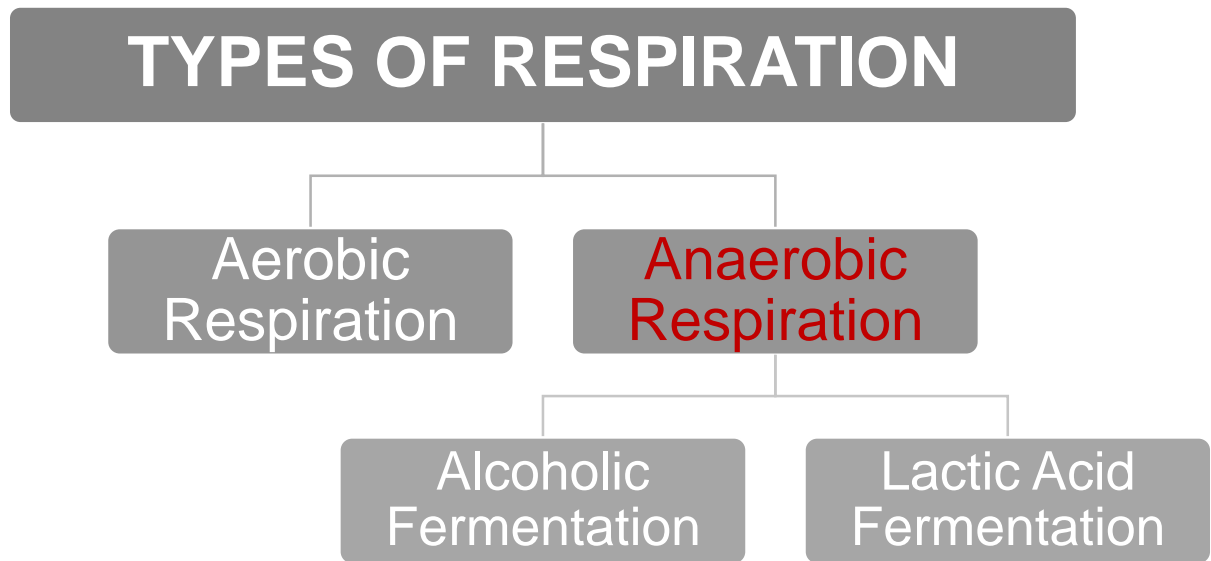
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Notes

Introduction:-

The energy stored in carbohydrates molecules during photosynthesis is released during cellular oxidation of carbohydrates in to carbon dioxide and water is called as **respiration**.

- Types of respiration-

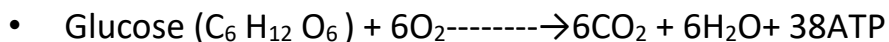


ANAEROBIC RESPIRATION:

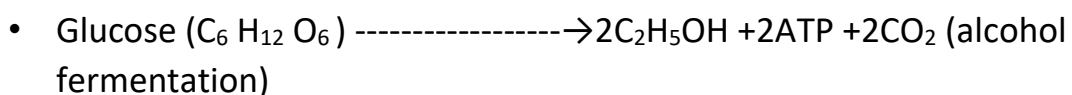
- Takes place in the absence of oxygen.
- It occurs in Cytoplasm or Cytosol.
- Anaerobic respiration is one in which glucose is partially oxidised without using oxygen to yield lactic acid or ethyl alcohol and 2 ATP molecules.

- **Overall reactions-**

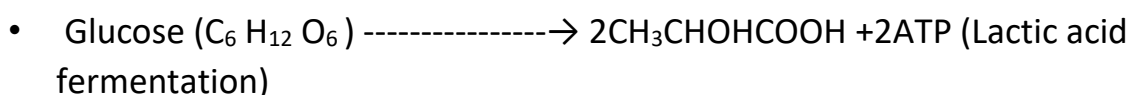
- Aerobic respiration-



- Anaerobic respiration-

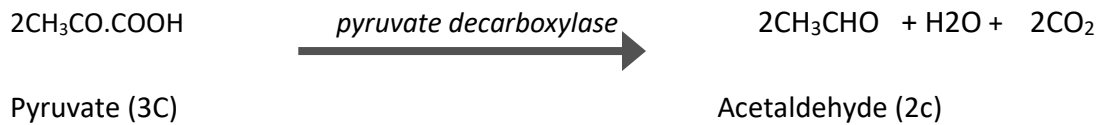


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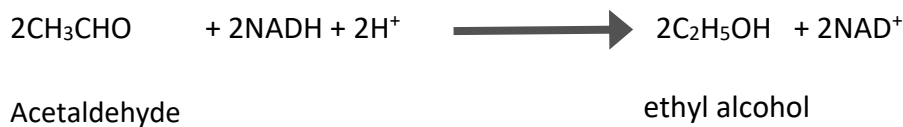


A) Alcoholic fermentation:-

Decarboxylation:- the pyruvate is first decarboxylated to acetaldehyde in the presence of the enzyme *pyruvate decarboxylase*. Thiamine pyrophosphate (TTP) is required as co factors in the reaction. ad Zn²⁺ ion



Reduction:- Acetaldehyde is then reduced to ethyl alcohol by the enzyme *alcohol dehydrogenase* coenzyme NADH (produced in glycolysis) is oxidised



Therefore overall equation for anaerobic respiration involving alcoholic fermentation is as follow

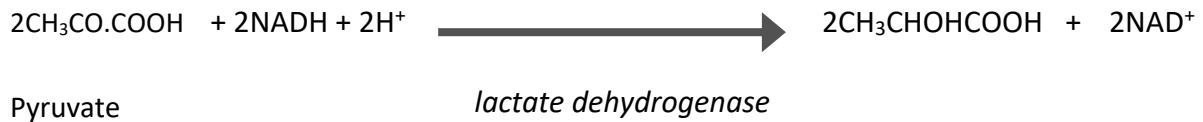
- Glucose (C₆ H₁₂ O₆) ----->2C₂H₅OH +2ATP +2CO₂ (alcohol fermentation)
Alcohol

The first reaction is catalyzed by pyruvate decarboxylase, a cytoplasmic enzyme, with a coenzyme of thiamine pyrophosphate (TPP, derived from vitamin B1 and also called thiamine). A carboxyl group is removed from pyruvic acid, releasing carbon dioxide as a gas. The loss of carbon dioxide reduces the size of the molecule by one carbon, making acetaldehyde.

The second reaction is catalyzed by alcohol dehydrogenase to oxidize NADH to NAD+ and reduce acetaldehyde to ethanol. The fermentation of pyruvic acid by yeast produces the ethanol found in alcoholic beverages.

B) Lactic acid fermentation

The pyruvate is converted into lactate by the enzyme *lactate dehydrogenase*, coenzyme NADH (produced in glycolysis) is oxidised.



Therefore overall equation for anaerobic respiration involving Lactic acid fermentation is as follow



Lactic acid fermentation:-

- Homolactic fermentation:- one molecule of glucose is converted into 2 molecules of lactic acid. Ex:- lactobacillus.
- Heterolactic fermentation:- it yield carbon dioxide and ethanol in addition to lactic acid. Ex:- leuconostoc
- The fermentation method used by animals and certain bacteria, like those in yogurt, is lactic acid fermentation. This type of fermentation is used routinely in mammalian red blood cells and in skeletal muscle that has an insufficient oxygen supply to allow aerobic respiration to continue (that is, in muscles used to the point of fatigue). In muscles, lactic acid accumulation must be removed by the blood circulation and the lactate brought to the liver for further metabolism.
- There is net gain of only 2ATP molecules during glycolysis stage during the anaerobic respiration and most of the energy contained in glucose molecule is wasted as heat.
- In absence of oxygen , the formation of oxidizes 2NAD⁺ during anaerobic respiration (fermentation) ensure continued operation of glycolytic pathway in absence of oxidised NAD⁺ , the reaction is catalysed by glyceraldehyde 3 phosphate dehydrogenase cannot take place.

Significance :-

- Anaerobic respiration is economically important - many of our foods are produced by microorganisms respiring anaerobically.
- Yeast is used to make alcoholic drinks. When yeast cells are reproducing rapidly during beer or wine production, the oxygen is used up. The yeast has to switch to using anaerobic respiration to ensure it can survive. Ethanol and carbon dioxide are produced.
- Ethanol is the alcohol found in In bread-making, bubbles of carbon dioxide gas expand the dough and help the bread rise.

Sr. No.	Alcoholic fermentation	Lactic acid fermentation
1	The Mechanism involves glycolysis, decarboxylation and reduced.	The Mechanism involves hydrolysis, glycolysis and reduced.
2	It occurs in bacteria and some fungi like yeast	It occurs in lactic acid bacteria and muscles cells of higher organism
3	CO ₂ and ethyl alcohol are the end product	Lactic acid is the end product
4	Initial substrate is glucose	Initial substrate is lactose
5	The process is intra-cellular	The process is extra cellular or intra-cellular

