Lec-9

Anaerobic Respiration

Many bacteria have an electron transport chains that can operate with exogenous electron acceptors other than O_2. The major electron acceptors are nitrate , sulfate and CO_2 but metals and a few organic molecules can also be reduced.

Some bacteria can use nitrate as the electron acceptor at the end of their electron transport chain and still produce ATP, this process is called **dissimilatory nitrate reduction**. Nitrate may be reduced to nitrite by **nitrate reductase :**

$$NO_3 + 2e^- + 2H \rightarrow NO_2 + H_2O$$

However ,this is not effective way of making ATP, because the large amount of nitrate is required for growth a nitrate molecule will accept only two electrons, the nitrite formed is also toxic ,therefore nitrate is further reduced to nitrogen gas this process known as de-nitrification :

$$NO_3 \rightarrow NO_2 \rightarrow NO \rightarrow N_2O \rightarrow N_2$$

Denitrification is carried out by some bacteria like *Paracoccus denitrificans , Pseudomonas* and *Bacillus*

Some bacteria **Methanogenes** use CO_2 or carbonate as a terminal electron acceptor, they reduce CO_2 to methane. Sulfate (SO_4) also can act as the final acceptor in bacteria such as **Desulfovibrio** ,it is reduced to sulfide (S_2 or H_2S) and eight electrons are accepted.

Lipid Catabolism

Microorganisms use lipids as energy sources. Triglycerides or triacylglycerols, esters of glycerol and fatty acids are common energy sources. They can be hydrolyzed to glycerol and fatty acids by microbial lipases ,the glycerol is then phosphorylated ,oxidized to dihydroxyacetone phosphate and catabolized in the glycolytic pathway.

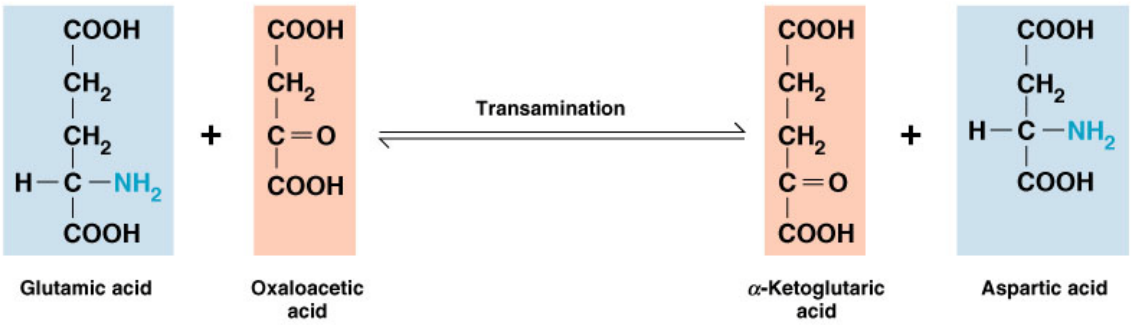
Fatty acids from triacylglycerols and other lipids are oxidized in the **β – oxidation pathway** after conversion to coenzyme A esters, fatty acids are degraded to acetyl-CoA , which can be fed into the TCA cycle or used in biosynthesis ,the cycle also produces acetyl- CoA, NADH and $FADH_2$;NADH

and $FADH_2$ can be oxidized by the electron transport chain to provide more ATP .Lipid fatty acids are a rich source of energy for microbial growth.

Protein and Amino Acid Catabolism

Some pathogenic bacteria, fungi ,food spoilage and soil microorganisms can use proteins as their source of carbon and energy. They secrete **protease** enzymes that hydrolyze proteins and polypeptides to amino acids which are transported into the cell and catabolized.

Deamination: first step in amino acid use it is the removal of the amino group from an amino acid.This is often accomplished by **transamination** the amino group is transferred from an amino acid to an α-keto acid acceptor as in figure below, the organic acid resulting from deamination can be converted to pyruvate ,acetyl –CoA ,or a TCA cycle intermediate and oxidized in the TCA cycle to release energy ,it is also can be used as a source of carbon for the synthesis of cell constituents .Excess nitrogen from de-amination may be excreted as ammonium ion ,thus making the medium alkaline.



(b) Process of transamination