Welcome students.

My name is Siddhesh Menon.

In this particular video presentation we will be dealing with one module of microbial Physiology paper, which is the Anaplerotic reactions.

So in this video presentation you will get an understanding of the anaplerotic reactions and the involvement of these reactions in metabolism.

So students get an idea as to what anaplerotic reactions are all about, and they'll be able to cite different examples of these kinds of reactions that exist in nature.

So what are anaplerotic reactions? Before getting an understanding of the concept of anaplerotic reactions, Let us understand the concept of metabolism in a prokaryotic or eukaryotic cell, and especially focusing on the catabolism part.

Now we know that the energy that we need in the system is provided by the energy currency of the cell which is supposed to be ATP. So ATP would be synthesized initially by glycolysis, which is a breakdown of glucose into two molecules of pyruvate, which is under anaerobic condition, which would then be converted into acetyl coa. Acetyl CoA would result in the TCA cycle in combination with the oxaloacetate to form the 6 carbon molecule, called citrate,and then it goes into the TCA cycle in it's different breakdown products. At the same time, which results in the synthesis of ATP molecules and other reducing powers such as NADH, FADH2 and so on,which can go into the electron transport chain resulting in the synthesis of more ATP molecules for this cell.

So we know the amount of ATP that can be generated from one glucose unit through glycolysis and TCA is immense but if you have an understanding of the Amphibolic nature of the TCA cycle, we know that the TCA cycle is involved in both catabolism and anabolism. Which means when the intermediates are being formed in the TCA cycle, they would go through the breakdown products at the same time these intermediate molecules would also serve as biological precursors to be utilized in the synthesis of various other biological molecules.

So we had different examples that we covered up in the Amphibolic pathway module, wherein we know that the intermediates such as Alphaketoglutarate or oxaloacetate would be involved in amino acid synthesis, so they are the precursors for amino acid synthesis, especially glutamate and aspartate. We know Succinyl CoA is involved in providing ring formation of the heme group, which is part of the electron carriers in the electron transport chain.

So since there is an involvement of both catabolism and anabolism of the TCA cycle, there is a high probability that these intermediate compounds would be utilized for these processes and because of

which their concentration in the cell may come down.

So in order to take care of this particular phenomena, we need to fill up these intermediates by providing Intermediates which are falling short through some reactions that are happening outside of the mitochondria.

So anaplerotic reactions are basically the filling up reactions. Since the intermediates are being utilized in the synthesis of biological molecules, an as they are being broken down at the same time, in order to maintain their balance in the cell anaplerotic reactions are being carried out so which are nothing but enzymatic reaction that happens in the cell which contributes to these intermediates of the TCA cycle so that the TCA cycle never falls short of these kind of intermediates.

So basically anaplerotic reactions are the one which replenishes the Krebs cycle intermediates. As these intermediates are being simultaneously utilized for biosynthetic precursors. So there is always a dynamic balance that is being maintained in the concentration of these intermediate's at any given point of time.

Now the most important anaplerotic reaction that is seen right from the prokaryotes such as the bacteria to the most advanced form the eukaryotes,such as in case of humans, is the involvement of the enzyme called pyruvate carboxylase.

Now, this particular enzyme, pyruvate carboxylase is known to act on pyruvate,bringing about a reversible carboxylation of pyruvate to form oxaloacetate. But one thing to note here is this is an energy dependent reaction. So a molecule of ATP would be required for this reaction to happen. Now we know that in glycolysis which begins from glucose and ends up at pyruvate, this particular pyruvate can then serve to be directly converted into oxaloacetate, thus helping to provide the concentration of oxaloacetate for the TCA cycle.

So this is the most important reaction which is being seen ANaplerotic reaction or a filling up reaction of the TCA cycle. Now, the regulation of this, Pyruvate carboxylase enzyme is based on the composition of Acetyl coa as well as oxaloacetate in the cell. Now, what is more important to understand here is the acetyl coa molecule which is produced from pyruvate after the glycolysis gets over, is supposed to be the regulator for the enzyme pyruvate carboxylase.

Now when the concentration of oxaloacetate is less in the cell. Obviously the amount of acetyl coa would increase since the TCA cycle at the start is a combination of Acetyl coa together with oxaloacetate to form citrate. Since the levels of oxaloacetate are low, the concentration of acetyl coa would be high. This high concentration of the acetyl coa acts as a positive regulator of pyruvate carboxylase and stimulates pyruvate carboxylase to produce more of oxaloacetate so that the TCA cycle can run.

So this is one of the most important anaplerotic reaction that is being seen and it is known to produce oxaloacetate, that is, pyruvate carboxylase enzyme via reversible carboxylation reaction.

In addition to this, there are various different anaplerotic reactions that are being seen inthe system, so we'll have a look at some of the examples or some of the reactions that exist throughout in different lifeforms right from the prokaryotic to the eukaryotic forms.

So this is the reaction that I spoke about just now, where in pyruvate in the presence of carbon dioxide or carbonate source together with the energy which is ATP would result in the formation of oxaloacetate and an ATP molecule.

In addition to this there are other reactions, such as the phosphoenol pyruvate, which is the 2nd last product of the glycolysis In the presence of carbondioxide and the enzyme, PP carboxykinase would result again in the synthesis of oxaloacetate. So these reactions are providing more and more oxaloacetate for the TCA cycle to happen simultaneously as the breakdown and the biosynthesis are taking place.

In addition to this, there are other reactions, such as the amino acids. In the Amphibolic nature of the TCA cycle, we have seen that the AlphaKetoglutarate as well as oxaloacetate are involved in the synthesis of amino acids, specifically glutamate as well as aspartate..

So there is a reversible reaction that can happen wherein the glutamate, in the presence of glutamate dehydrogenase enzyme can result in the formation of Alphaketoglutarate and serve the Alphaktoglutarate for the TCA cycle. So we have seen reactions where oxaloacetate is being provided. This is a reaction in which Alpha Ketoglutarate can be provided.

In addition to this, there is an enzyme called the Malic enzyme, which can convert pyruvate into malate. Plus, in addition to this, the fatty acid metabolism pathways that happens in the system can also provide succinyl CoA for the TCA cycle.

Thank you.