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ISSN: 2167-7662
Bioenergetics: Open Access

Commentary

Significance of Tricarboxylic Acid Pathway in Glucose Metabolism

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DESCRIPTION

Tricarboxylic Acid Cycle (TCA cycle), also known as the Krebs cycle and citric acid cycle, is the second stage of cellular respiration, a three-step process that allows living cells to break down organic fuel molecules in the presence of oxygen to obtain the energy they require to grow and divide. The majority of plants, mammals, fungi, and many bacteria engage in this metabolic process. The TCA cycle is carried out in the matrix of intracellular structures known as mitochondria in all organisms with the exception of bacteria.

The catabolism, or breakdown, of organic fuel molecules such as glucose and some other sugars, fatty acids, and some amino acids is largely regulated by the TCA cycle. These very massive molecules must first undergo degradation into acetyl coenzyme A, a two-carbon chemical, in order to join the TCA cycle (acetyl CoA). Acetyl CoA is transformed into carbon dioxide and energy once it has been introduced into the TCA cycle. The hydrogen atoms (or electrons derived from them) do not directly react with oxygen in the oxidation reactions of the Krebs cycle, but rather transit through a succession of hydrogen or electron carriers, known as the respiratory chain.

The citric acid cycle happens in the mitochondrion matrix of eukaryotic cells. In prokaryotic organisms, such as bacteria, without mitochondria, the citric acid cycle reaction sequence is carried out in the cytosol, and the plasma membrane, rather than the inner membrane of the mitochondrion, is the site of the proton gradient for ATP synthesis. Three NADH, one FADH2, and one GTP make up the total yield of energy-containing molecules from the citric acid cycle.

A vital metabolic process that links the metabolism of proteins, fats, and carbohydrates is the citric acid cycle. Eight enzymes carry out the cycle's operations, totally oxidizing the two-carbon acetate molecule present in the form of acetyl-CoA to produce two molecules each of carbon dioxide and water. The two-carbon organic product acetyl-CoA, which enters the citric acid cycle, is created by the catabolism of carbohydrates, lipids, and proteins. The cycle also changes one equivalent of Flavin Adenine Dinucleotide (FAD) into one equivalent of FADH2, three equivalents of Nicotinamide Adenine Dinucleotide (NAD+) into three equivalents of reduced NAD+ (NADH), and one equivalent of each of Guanosine Phosphate (GDP) and Inorganic Phosphate (Pi) into one equivalent of Guanosine Triphosphate (GTP). The oxidative phosphorylation pathway uses the NADH and FADH2 produced by the citric acid cycle to produce ATP, which is a powerful source of energy. One of the main sources of acetyl-CoA is the glycolysis of carbohydrates, which produces pyruvate, which the pyruvate dehydrogenase complex then decarboxylates to produce acetyl-CoA.

Significance of Krebs cycle

- Amino acids, a metabolic by-product of proteins, are deaminated and transformed to pyruvate and other intermediates of the Krebs cycle.
- The Krebs cycle, also known as the citric acid cycle, is the last process of oxidation of glucose, lipids, and amino acids. They enter the cycle and are metabolized, for example, aspartate is deaminated to produce pyruvate, glutamate to -ketoglutarate, and alanine to oxaloacetate.
- Acetyl CoA, created by the -oxidation of fatty acids, enters the Krebs cycle and is the main way that cells make ATP.
- Complete oxidation of nutrients results in the production of a significant amount of energy. It is crucial for gluconeogenesis, lipogenesis, and the inter conversion of amino acids.
- The production of amino acids, nucleotides, cytochromes, chlorophylls, and other chemicals involves the employment of a variety of intermediary molecules. As cofactors (FAD, NAD, and coenzyme A) for numerous enzymes, riboflavin, niacin, thiamin, and pantothenic acid
- The Krebs cycle is regulated by the availability of NAD+ and the use of ATP in physical and chemical activities. The genetic defects of the Krebs cycle enzymes are associated with neural damage
- Since the liver plays a crucial role in the majority of biological processes, injury to liver cells has far-reaching effects. Hyperammonemia, which results in convulsions and coma in liver disorders, occurs. Because of the removal of -ketoglutarate

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Received: 02-Jan-2023, Manuscript No. BEG-23-19671; **Editor assigned**: 04-Jan-2023, PreQC No. BEG-23-19671 (PQ); **Reviewed:** 18-Jan-2023, QC No. BEG-23-19671; **Revised:** 25-Jan-2023, Manuscript No. BEG-23-19671 (R); **Published:** 02-Feb-2023, DOI: 10.35248/2167-7662.23.11.191

Citation: Abigoli M (2023) Significance of Tricarboxylic Acid Pathway in Glucose Metabolism. J Bio Energetics.11:191.

and the subsequent production of glutamate, which turns into glutamine, there is a reduction in the amount of ATP produced.