Drug Intoxication & Detoxication: Novel Approaches

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Impact of Genetic Variability on Drug Metabolism and Personalized Medicine

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INTRODUCTION

Metabolism refers to the complex network of chemical reactions that occur within living organisms to sustain life. These processes enable cells to obtain and use energy, synthesize essential molecules, and eliminate waste products. Broadly, metabolism is categorized into two main components catabolism and anabolism. Catabolism involves the breakdown of molecules to release energy, while anabolism uses energy to build complex molecules necessary for growth and maintenance. Energy Currency ATP Adenosine Triphosphate (ATP) is the primary energy currency in cells. It captures chemical energy derived from the breakdown of food molecules and supplies it to fuel other cellular processes. ATP stores energy in its high energy phosphate bonds, which release energy when broken down into Adenosine Diphosphate (ADP) and inorganic phosphate. Enzymes and Metabolic Pathways Metabolic processes are driven by enzymes, specialized proteins that catalyze chemical reactions. Each enzyme is highly specific to its substrate and operates within a larger network of metabolic pathways. These pathways, such as glycolysis or the citric acid cycle, are sequences of enzymatic reactions that convert substrates step by step into end products. Regulation of Metabolism is tightly regulated to meet the energy demands of the organism and maintain homeostasis. Regulation occurs at multiple levels, including enzyme activity, gene expression, and signaling pathways.

DESCRIPTION

Hormones like insulin and glucagon play critical roles in coordinating metabolic responses to nutrient availability. Catabolic reactions degrade complex molecules like carbohydrates, fats, and proteins into simpler forms. This process releases energy that is harnessed to form ATP. The primary pathway for carbohydrate breakdown is glycolysis, where glucose is converted into pyruvate, yielding a small amount of ATP and NADH, an electron carrier. Pyruvate enters the mitochondria, where it is oxidized in the citric acid cycle (Krebs cycle), producing more NADH and $FADH_2$. Electrons from NADH and $FADH_2$ are transferred to the electron transport chain in oxidative phosphorylation, generating a significant amount of ATP. Fats are broken down into glycerol and fatty acids. Fatty acids undergo beta-oxidation in the mitochondria, producing acetyl-CoA, which enters the citric acid cycle. The oxidation of fats is highly efficient and yields more ATP per gram compared to carbohydrates. Proteins are degraded into amino acids. The amino group is removed in a process called deamination, producing ammonia, which is excreted as urea.

CONCLUSION

Gluconeogenesis synthesizes glucose from non-carbohydrate precursors like lactate and amino acids, primarily during fasting. Glycogenesis converts glucose to glycogen for storage in liver and muscle cells. Lipids are synthesized through pathways like lipogenesis, where acetyl CoA is converted into fatty acids. These fatty acids are combined with glycerol to form triglycerides, the primary storage form of energy in adipose tissue. Amino acids are joined together in specific sequences to form proteins, guided by genetic information from DNA. Protein synthesis is crucial for cell structure, enzyme function, and regulatory processes. Metabolism is a finely tuned system essential for life. It reflects a dynamic balance between energy production, storage, and utilization, ensuring organisms adapt to their environmental and physiological needs.

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CONFLICT OF INTEREST

The author declares there is no conflict of interest.

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