athshala पाठशाला MHRD Govt. of India

Paper : 05 Metabolism of Lipids
Module: 12 Anabolism of Lipids

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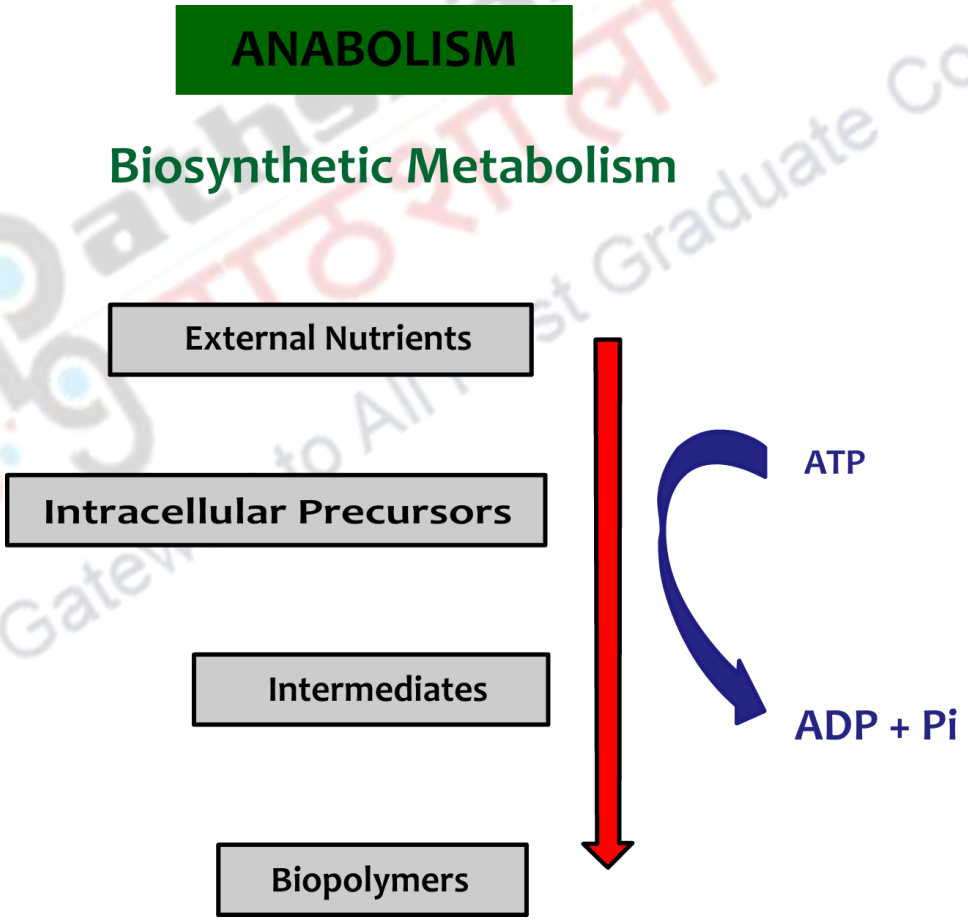
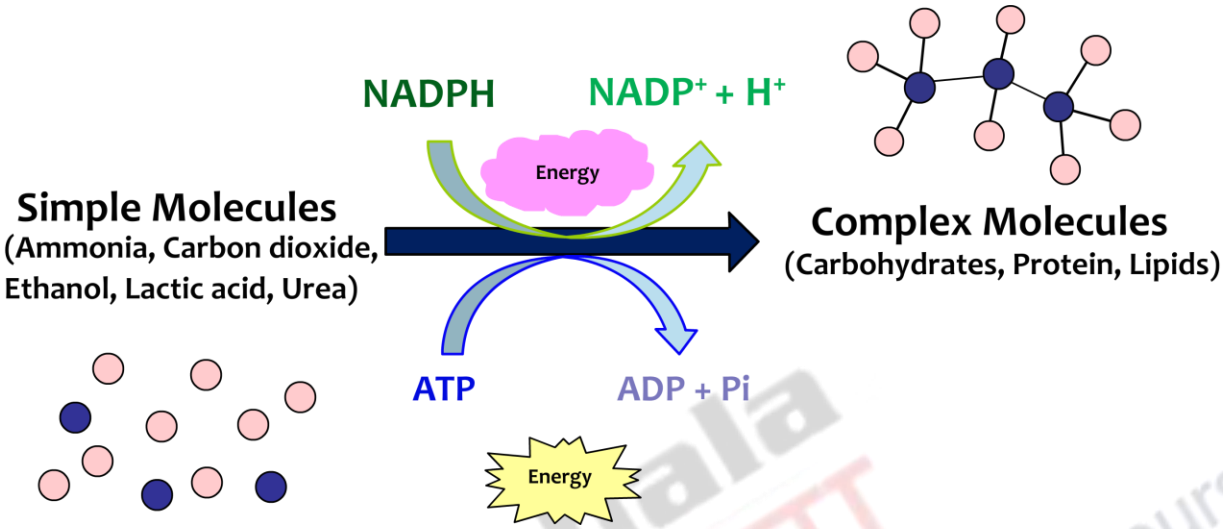
DESCRIPTION OF MODULE	
Subject Name	Biochemistry
Paper Name	05 Metabolism of Lipids
Module Name/Title	12 Lipids-Anabolism

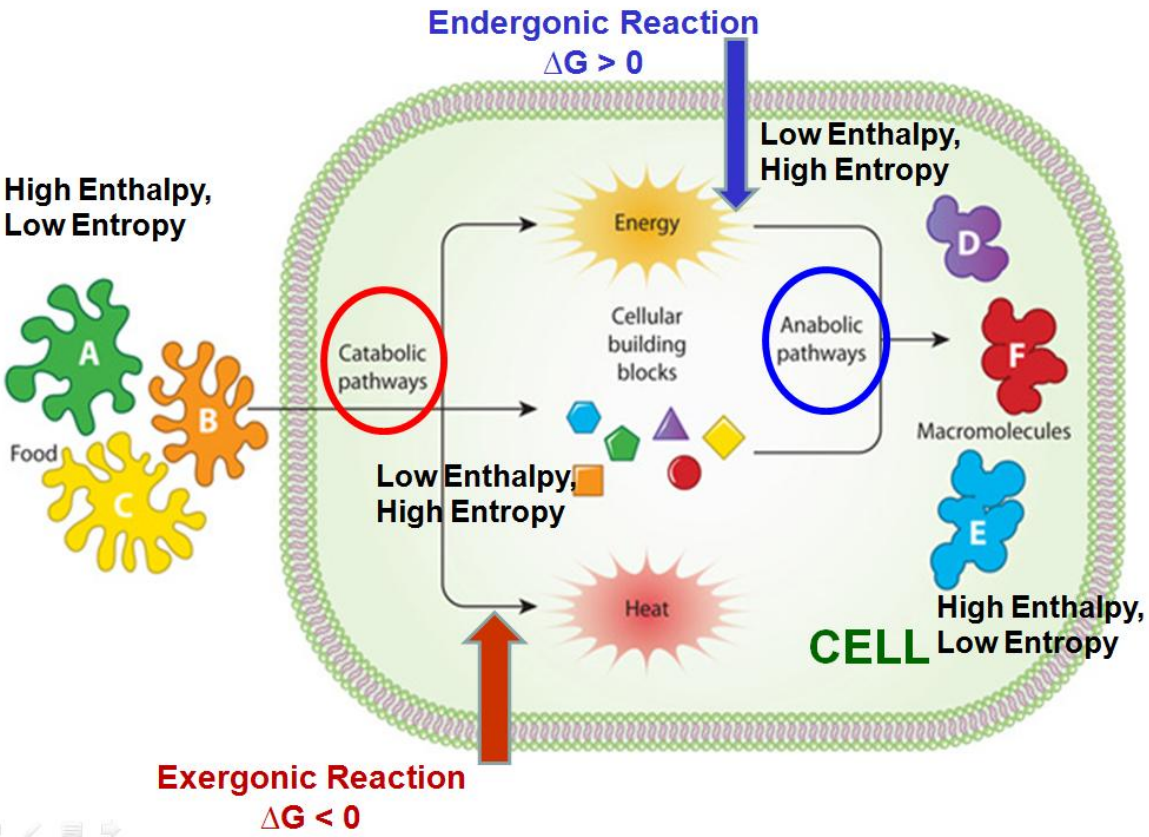
1. Objectives

- To understand the anabolism of lipids
- What are the implications of lipid anabolism

2. Concept Map







3. Description

Anabolism is the word derived from the Greek (Ana-upward and Bolism-to throw) meaning a process that have a propensity to build up tissues and organs. It is an array of metabolic pathways that assemble molecules from smaller units and the process engender differentiation and growth of cells and augmentation in body size (e.g. growth and mineralization of bone and increase in muscle mass). The reactions in anabolism entail and utilize energy released by catabolism to synthesize complex molecules which further employed to form cellular

structures from simple and small precursors that act as building blocks. Numerous anabolic processes are power-driven by the hydrolysis of adenosine triphosphate (ATP).

Following are the fundamental defined stages of anabolism.

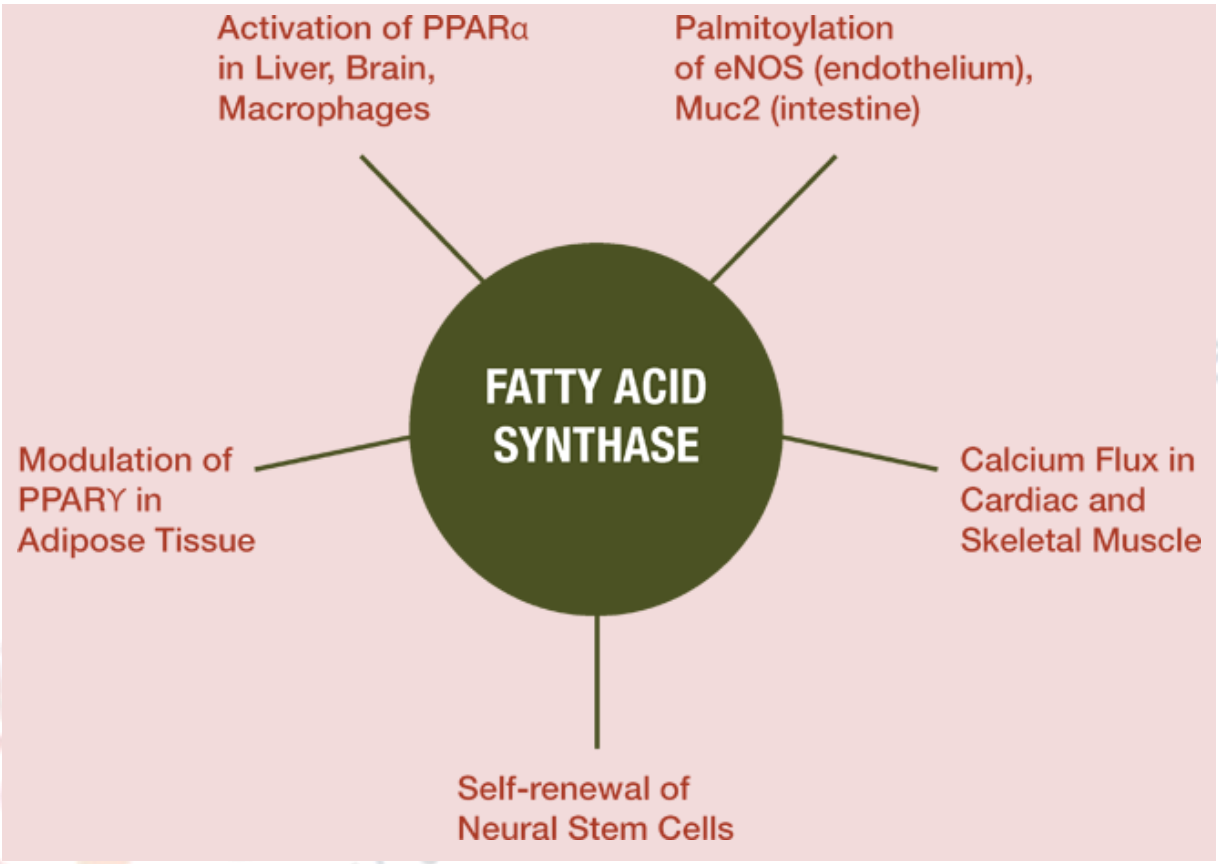
1. Assembly of precursors such as fatty acids, amino acids, isoprenoids, monosaccharides and nucleotides.
2. Activation of these predecessors into reactive forms using ATP as an energy source.
3. Congregation of these precursors into complex molecules such as lipids, polysaccharides, proteins and nucleic acids.

A variety of the species of different organisms rely on diverse sources of energy. For example autotrophs (plants) can make the complex organic molecules (polysaccharides and proteins) in cells from simple molecules like carbon dioxide and water using sunlight as energy. On the other hand, heterotrophs necessitate a source of more complex substances (monosaccharides, amino acids) to produce these building blocks. Likewise, photoautotrophs and photoheterotrophs acquire energy from light while chemoautotrophs and chemoheterotrophs accomplish energy from inorganic oxidation reactions.

The anabolism of lipid is a vital component of metabolism. Lipids are essential and ought to be synthesized for numerous biologic processes including cell structure, production of hormone and storage of excess calories. The metabolism of nutrient is composed of both anabolic and catabolic reactions. The anabolic reactions blend molecules whereas catabolic reactions break down molecules.

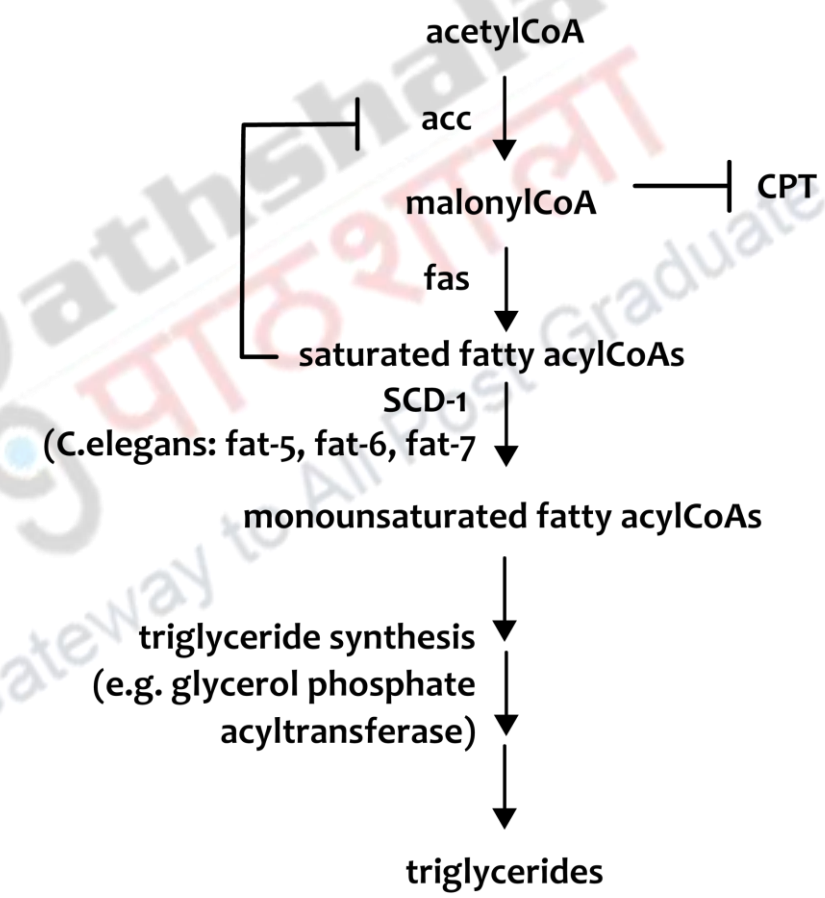
Anabolism of Fatty Acids (FAs)

FAs are a type of lipid poised of chains of carbon atoms. The starting material for FA synthesis is a two-carbon molecule called acetyl CoA that originates from carbohydrate, lipid and protein metabolism. The formation of a FA engages the repetitive sequence of seven biochemical reactions that modify acetyl CoA allowing covalent bond formation amid the carbons in different acetyl CoA molecules. Moreover, FAs are synthesized via Fatty Acid Synthases (FAS, an enzyme complex) which polymerizes and subsequently lessen acetyl CoA units. They include acyl chains that are unmitigated by a series of reactions that append the acetyl group, reduce it to an alcohol, desiccate it to an alkene group and then diminish it again to an alkane group. Members of FAS complex comprise the condensing enzyme, acyl carrier protein, a synthase, two reductases and a dehydratase. The enzyme complex is present throughout the body especially active in the adipose tissue and liver. With each round of enzyme activity, the FA molecule is amplified in size by two carbons. The product of FA synthesis is palmitate (16-carbon molecule). In animals and fungi, all the FAS reactions are relayed by a single multifunctional type I protein. In plants and bacteria, a separate type II enzymes perform each step in the pathway. Other lipids like isoprenoids and terpenes outline the largest class of plant natural products. These compounds are prepared by the assemblage and variation of isoprene units contributed from the reactive precursor's isopentenyl pyrophosphate (IPP) and dimethylallyl pyrophosphate (DMPP). In animals and archaea, the mevalonate pathway (MVP) fabricates these compounds from 2 carbon acetyl-CoA units. In addition to its role in lipid biosynthesis, acetyl CoA is central to the cellular energy metabolism.


Activation of PPARα in Liver, Brain, Macrophages
Palmitoylation of eNOS (endothelium), Muc2 (intestine)
FATTY ACID SYNTHASE
Modulation of PPARγ in Adipose Tissue
Calcium Flux in Cardiac and Skeletal Muscle
Self-renewal of Neural Stem Cells

Anabolism of Triglycerides (TGs)

FAs are the substrates for supplementary anabolic reactions to form TGs. The enzyme acyltransferases covalently bond three FAs molecule to a glycerol molecule to silhouette a TG. TGs are the principal storage form of lipid in the body. The anabolic processes of FAs and TGs inception are hormonally regulated by insulin, and the progression is favored when caloric intake exceeds energy expenditure.



4. Summary

In this lecture we learnt about:

- The anabolism of the lipids