Digestion, Absorption and Assimilation of Lipids

Lipids are organic compounds comprising fatty acids, which are insoluble in water. Fats are the most common examples of lipids. The insoluble property of lipids makes the digestion and absorption of fats a complicated process.Since they are hydrophobic, fats stick together as a large glob of insoluble mass after reaching the stomach. It is broken down with the help of bile juice, which contains bile salts. These broken molecules are then acted upon by pancreatic lipase, the major fat-absorbing enzymes in the body.

Lipids are digested starting in the mouth by lingual lipase, continuing in the stomach with gastric lipase, but primarily in the small intestine where bile emulsifies fats into smaller droplets, allowing pancreatic lipases to break triglycerides into fatty acids and monoglycerides. These products form micelles, which are absorbed by intestinal cells. Inside these cells, lipids are reassembled into chylomicrons and secreted into the lymphatics for transport throughout the body. Assimilation occurs when these absorb lipids reach the body's tissue and are utilized.

Digestion

- Due to their insoluble nature in water, fats are difficult to digest and absorb. The stomach and intestinal contents cannot mix with the fat
- Among the many lipids in our bodies are triglycerides, phospholipids, cholesterol, steroids and fat-soluble vitamins
- It is essential for lipid digestion to emulsify large lipid droplets in order to form tiny lipid droplets
- It decreases the droplet size of the lipid-exposed to digestion enzymes by emulsifying it

The enzymes involved:

1. Mouth: Digestion begins with lingual lipase in saliva, which starts the breakdown of triglycerides.

- As part of digestion, lingual lipases can transform some ingested triglycerides into monoglycerides and fatty acids
- The pancreatic lipases digest the majority of ingested lipids in the intestine

2. Stomach: Gastric lipase continues this process to a limited extent

    - The mixing increases the surface area for pancreatic enzymes to digest lipids in the stomach by breaking them into droplets

3. Small intestine

    - The small intestine is enriched with bile acids, which emulsify the lipids and increase the surface area in the digestive system. The bile acids dissolve hydrophobic products in micelles after the digestion of lipids
    - During the hydrolysis of lipids, pancreatic lipases produce fatty acids, cholesterol, lysolecithin and monoglycerides. Pancreatic lipase, phospholipase A2 and cholesterol ester hydrolase are the enzymes involved.
    - These digested lipid products, along with bile salts and other lipids like cholesterol, form micelles, which are water-soluble structures that transport lipids to the intestinal lining.

Absorption

- The absorptive surface of intestinal cells is in contact with the products of lipid digestion through micelles
- Over the luminal membrane, fatty acids, monoglycerides and cholesterol diffuse into the cells. Hydrophilic Glycerol does not form micelles
- The cholesterol ester, phospholipids and triglycerides are re-esterified from lipids in intestinal cells, along with apoproteins, forming chylomicrons
- Exocytosis is the process by which chylomicrons are transported from intestinal cells
- Due to the chylomicrons' size, they cannot enter capillaries. This causes them to bypass lymph nodes and enter the bloodstream through the thoracic duct

Micelle Dissociation:

The fatty acids and monoglycerides from the micelles diffuse across the unstirred water layer and then enter the intestinal cells (enterocytes).

Intracellular Reassembly:

Inside the enterocytes, the fatty acids and monoglycerides are reassembled into triglycerides in the endoplasmic reticulum.

Chylomicron Formation:

These reassembled lipids are then packaged with cholesterol, phospholipids, and proteins into large lipoprotein particles called chylomicrons.

Transport to Lymph:

The chylomicrons are released from the enterocytes into the lymphatic system.

Assimilation

Circulation:

From the lymphatics, the chylomicrons enter the bloodstream, where they travel to various tissues and organs.

Tissue Utilization:

In the tissues, the lipids carried by the chylomicrons are absorbed and used for energy, structural components, or stored for later use.