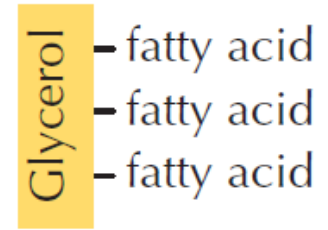


Fat

- Composition
- Function
- Metabolism

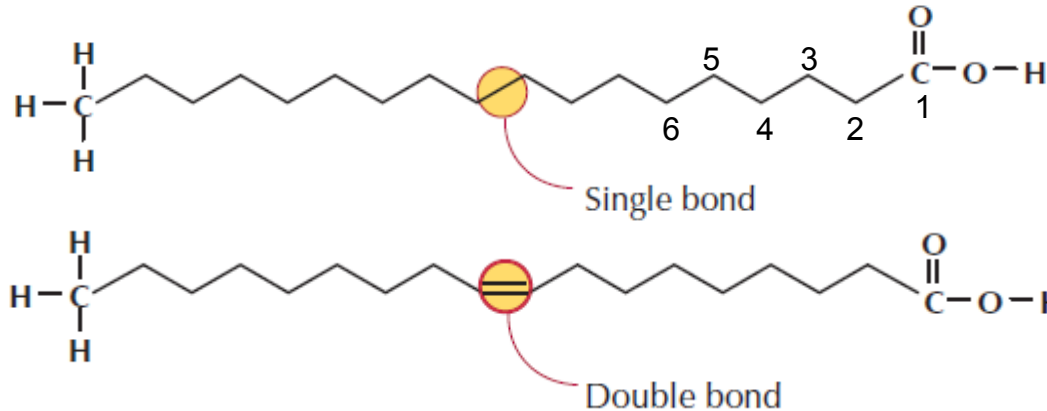


Fat - Composition



Structure of a triglyceride

- Fats include **lipids** (triglycerides, phospholipids & sterols), oils & fat-like substances.
- **Triglycerides** are the primary form of lipids in the diet & make up nearly 90% of all fat calories ingested.
 - A Triglyceride is composed of a **glycerol backbone** & **3 fatty acid chains**.
- Fatty acids can be **saturated** or **unsaturated**



Saturated fatty acid (no double bond in the structure)

Unsaturated fatty acid (1 or more double bond in the structure)

- Monounsaturated fatty acids (MUFA), found in high amounts in olive oil, have only one double bond
- Polyunsaturated fatty acids (PUFA), found in nuts & seeds, have two or more double bonds
- Triglycerides are also categorized as **long chain** (LCTs, 12–24 carbons), **medium chain** (MCTs, 6–12 carbons, C8 and C10 are the most common ones), or **short chain** (SCTs < 6 carbons).


Fat – Functions & Metabolism



Biological role:

- **Fundamental components** of cellular & subcellular membranes
- Precursors of bioactive molecules (e.g. hormones)
- **Store and supply** of chemical **energy** (1g fat = 9 kcal);
- Stored in **adipose tissue** in unlimited amounts.

Lipid Metabolism:

- Lipid absorption & metabolism are quite complex; in general triglycerides are **broken down into fatty acids & glycerol**. The length of the fatty acid chain determines how they will be absorbed by the body.
- In clinical nutrition, **MCTs are a preferred energy source** because they can be more rapidly absorbed and metabolized compared to LCTs. 

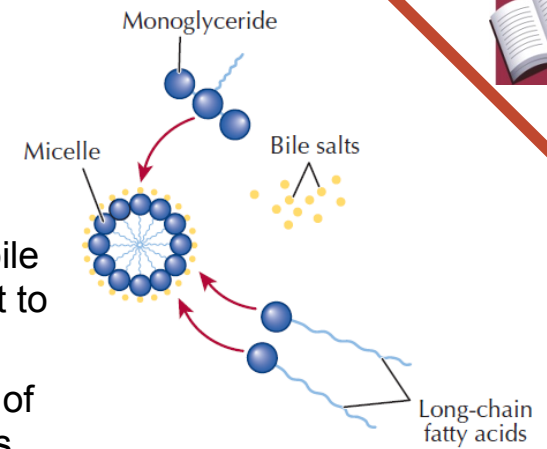
Role in nutrition:

- A typical daily diet should have less than 20-35% of calories from fat and as few as possible calories from saturated fats.

Fat digestion & absorption

Digestion:

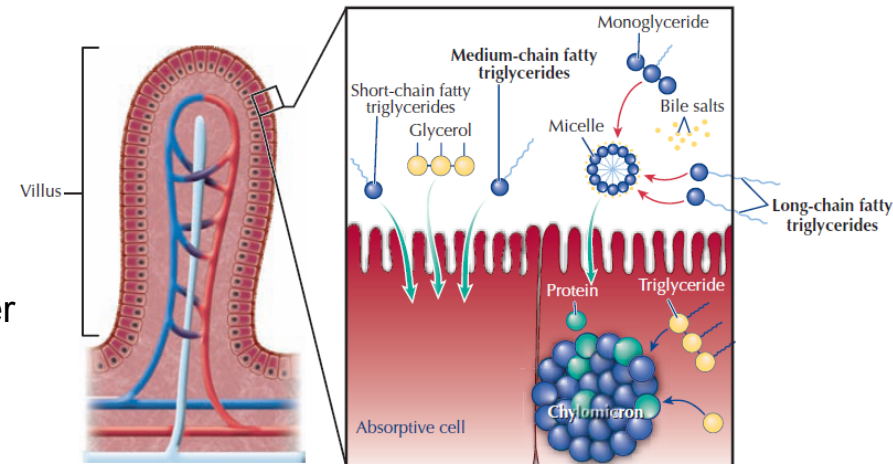
- When LCT fats enter the small intestine, emulsification takes place with bile salts. Bile salts coat the fat droplets created in the stomach and allows fat to be mixed in water **forming micelles**.
- The micelles **transport fat to the border of the intestinal mucosa**, where 2 of the 3 fatty acids are removed from the glycerol backbone. These products can then be absorbed into the mucosal epithelial cells.



The digestion of fats, mainly LCTs, occurs in 2 phases: 1) lipolysis & emulsification, and 2) micelle formation.

Absorption:

- Once digested LCTs enter the epithelial cells, then are reassembled into triglycerides. They then combine with cholesterol and proteins to form large, **water-soluble droplets called chylomicrons**.
- These chylomicrons are too large to enter the bloodstream and are **instead absorbed into the lymph vessels**. They travel through the lymphatic system, enter via the subclavian vein, and then circulate to the heart before reaching the liver to be metabolized.
- MCTs & SCTs can be absorbed directly into the bloodstream by intestinal mucosal cells and then directly transported to the liver to be metabolized.



Digestion and absorption of lipids: emulsification and chylomicron formation.



ω -6 & ω -3 fatty acids are essential fatty acids that must be supplied by the diet

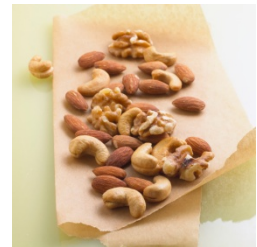
Two **essential** fatty acids that must be supplied by the diet are

- Linoleic acid - an ω -6 fatty acid
- Alpha-linolenic acid - an ω -3 fatty acid



Products intended to be used as sole source of nutrition should contain at least:

- 2-5% of the energy intake coming from linoleic acid
- 0.5-1% of the energy intake coming from alpha-linolenic acid



Omega-3 fatty acids (first double bond on carbon 3)

- Have **anti-inflammatory, antithrombotic, antiarrhythmic, vasodilatory & triglyceride lowering properties**.
- Found in oily fish, walnuts, soybeans, canola oil, and soybean oil.

Omega-6 fatty acids (first double bond on carbon 6)

- Have **proinflammatory, prothrombotic properties and create high blood viscosity, vasoconstriction & short bleeding time**.
- Found in leafy vegetables, vegetable oils, seeds, nuts, and grains.