

Principal Nutrients (Lipids and Fatty acids)

Lipids

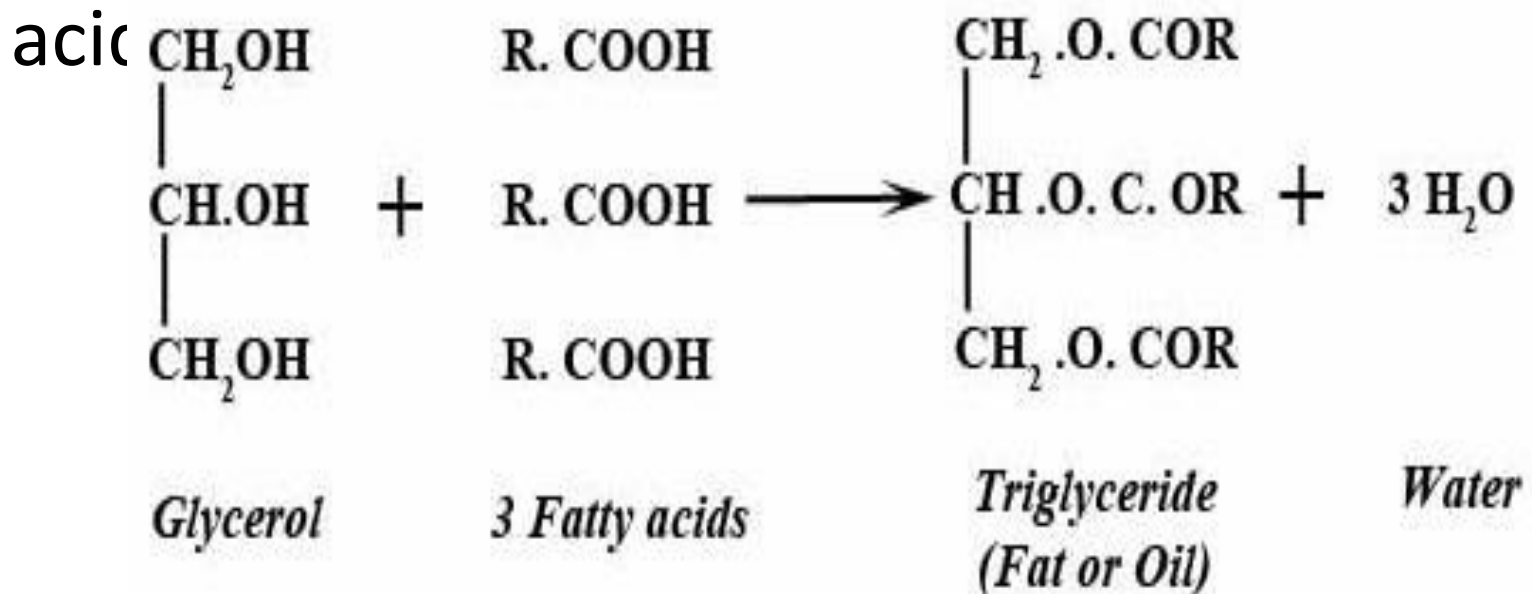
- The lipids are a heterogeneous group of substances found in plant and animal tissues, which share the property of being relatively insoluble in water, and soluble in organic solvents, such as ether, chloroform and benzene etc.
- Lipids are high energy nutrients that can be utilized to partially spare (substitute) protein in aquaculture feeds.
- Lipids supply about twice the energy as proteins and carbohydrates
- Lipids exhibit high calorific value (8-9.5 Kcal/g) than proteins and CHO.

Function of lipids(Fat)

- Serve as a biological carriers for the absorption of the fat soluble vitamins A, D, E and K.
- As a source of essential fatty acids (EFA)
- As a source of essential steroids which play an important role in biological function
- Act as lubricants for the passage of feed through pellet diets which reduce the dustiness of feeds
- Play a role in feed palatability

STRUCTURE AND COMPOSITION

- Fats and oils normally occur in foodstuffs and in the fat deposits of most animals in the form of triglycerides, which are esters of fatty



Naturally occurring fats and oils are composed of mixed triglycerides where glycerol is esterified with different types of fatty acids, i.e. fatty acid R1, R2 and R3.

Classification of lipids

- Simple lipids
- Compound lipids
- Derived lipids

Simple Lipid: These are esters of fatty acids with various alcohols

EX: Fats, oil, waxes

Compound Lipids: These are esters of fatty acids with alcohol and possess additional group also

Ex: Glycolipids, galactolipids and Phospholipids (Lecithins, cephalins)

Derived Lipids: These are the substances derived from simple and compound lipids by hydrolysis

EX: Fatty acids, alcohols, monoglycerides, steroids, carotenoids

Fatty acids

- Fatty acids(FA) are components of lipids
- Over 40 different fatty acids are known to occur in nature.
- They all can be represented by the general formula;
- $\text{CH}_3 (\text{CH}_2)_n \text{COOH}$
- where $n = 0$ in acetic acid, $n = 1$ in propionic acid, $n = 2$ in butyric acid, etc. up to $n = 24$ (where n is usually an even number)

Classification

- **Saturated Fatty acid:** Fatty acids without any double bond

Example: Butyric acid, Lauric acid, Caproic acid, Capric acid

- **Unsaturated Fatty acid:** Fatty acids with double bond.

- Unsaturated Fatty acids are of three major types

- **Mono Unsaturated Fatty acid:** Those with only one double bond

- Example: Oleic acid and Palmitoleic acid

- **Poly Unsaturated Fatty acid:** Those with more than one double bond

- Example: Arachidonic and Linoleic acid

- Highly Unsaturated Fatty Acid: Members of this group which have many (4 or more) double bonds
- Example: EPA and DHA

Phospholipids

- Within the animal body the phospholipids represent the second largest lipid component after the triglyceride fats and oils.
- All phospholipids are yellow greasy solids and share the property of being soluble in lipid solvents with the exception of acetone
- According to the nitrogenous base present, phospholipids may be divided into two groups: lecithins (choline) and cephalins (ethanolamine).

Glycolipids

- **Glycolipids** are lipids with a carbohydrate attached by a glycosidic (covalent) bond.
- Their role is to maintain the stability of the cell membrane and to facilitate cellular recognition, which is crucial to the immune response and in the connections that allow cells to connect to one another to form tissues.

waxes

- The waxes are esters of fatty acids with high molecular monohydric alcohols.
- Like fats, natural waxes occur as mixtures of different esters, which are usually solid at room temperature.
- Waxes are widely distributed in both plants and animals, where they generally perform protective roles.
- Among the better known animal waxes are lanolin (obtained from wool), beeswax (an insect secretion), and spermaceti from the sperm whale.

Steroids

- **Steroids** are lipids because they are hydrophobic and insoluble in water
- **Cholesterol** is the most common **steroid** and is the precursor to vitamin D, testosterone, estrogen, progesterone, aldosterone, cortisol, and bile salts

Cholesterol

- **Cholesterol** (from the Ancient Greek *chole-* (bile) and *stereos* (solid), followed by the chemical suffix -ol for an alcohol is an organic molecule.
- It is a sterol, a type of lipid.
- Cholesterol is biosynthesized by all animal cells and is an essential structural component of animal cell membranes.
- It is also a precursor molecule for all steroid hormones and vitamin D.
- Cholesterol is widely distributed in the animal body, being particularly abundant in the brain and nervous tissue, blood, bile, liver and the skin.

Bile acids

- The bile acids are formed and concentrated by the liver, and are excreted by the liver into the bile and pass to the gastro-intestinal tract (duodenum) via the bile duct, where they act as important biological emulsifiers.
- They help to solubilise fat globules from the food so that the water soluble enzymes or lipases can react with the fat molecules and split them to facilitate fat absorption.