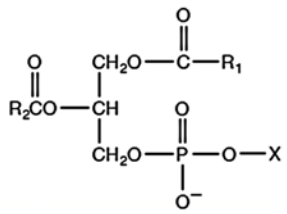
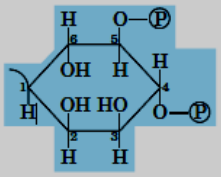
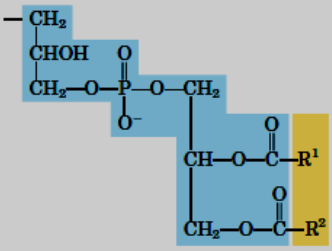
II. COMPOUND LIPIDS (COMPLEX LIPIDS)

They are esters of fatty acids with alcohol containing nitrogenous bases and additional groups. Based on alcohol compounds lipids are subdivided into ***Glycerophospholipids*** and ***Sphingolipids***. Compound lipids are also divided into phospholipids and glycolipids .

Table 2.1 Major Classes of Phosphoglycerides



Name of glycerophospholipid	Name of X	Formula of X	Net charge (at pH 7)
Phosphatidic acid	—	—H	−1
Phosphatidylethanolamine	Ethanolamine	—CH_2—CH_2—$\overset{+}{N}H_3$	0
Phosphatidylcholine	Choline	—CH_2—CH_2—$\overset{+}{N}(CH_3)_3$	0
Phosphatidylserine	Serine	—CH_2—$CH(\overset{+}{N}H_3)$—COO^-	−1
Phosphatidylglycerol	Glycerol	—CH_2—$CH(OH)$—CH_2—OH	−1
Phosphatidylinositol 4,5-bisphosphate	*myo*-Inositol 4,5-bisphosphate		−4
Cardiolipin	Phosphatidyl-glycerol		−2

Phosphatidyl choline (Lecithin)

Phosphoglycerol containing two fatty acids esterified to first and second OH group of glycerol. The third OH esterified to phosphoric acid to which second alcohol is also esterified. It is the major phospholipid of cell membrane. It is contain saturated fatty acid at C-1 and unsaturated fatty acid at C-2.

Phosphatidyl inositol The inositol is present in phosphatidyl inositol as the stereoisomer, myoinositol. **Phosphatidylinositol-4,5-bisphosphate** is an important constituent of cell membrane phospholipids; upon stimulation by a suitable hormone agonist, it is cleaved into **diacylglycerol** and **inositol trisphosphate,** both of which act as internal signals or second messengers.

Dipalmitoyl lecithin : The two fatty acid are palmitic acid. It is secreted in alveoli of lungs. It is involved in the maintenance of shape of alveoli. It acts as surfactant (surface-active agent) in the lungs. It prevents the collapse of alveoli due to high surface tension of water by reducing surface tension of water . It is synthesized only after 30 week of gestation. It is deficiency in the lungs of premature infants causes *Respiratory Distress Syndrome* (RDS) which account for 20% mortality in premature infants.

Cardiolipin: It is present in inner mitochondrial membrane. It is also present in heart muscle. It has immunological properties and used in the diagnosis of syphilis.

Lysophospholipids: They are from phospholipids by action of enzymes and during biosynthesis of phospholipids, they contain only one acyl group instead of two acyl groups. Lysolecithin is a component of cobra venom and strong hemolysing agent.

Plasmalogens: They are also glycerophospholipids contain unsaturated fatty alcohol in place of fatty acid at the C-1 position by ether linkage. Usually nitrogen bases are choline, serine and ethanolamine. They found in brain, heart and muscle. Plasmalogen content is more in cancer cells. Platelet activating factor, which cause aggregation of platelets is a plasmalogen.

Plasmalogens have an ether-linked alkenyl chain where most glycerophospholipids have an ester-linked fatty acid Platelet-activating factor has a long ether-linked alkyl chain at C-1 of glycerol, but C-2 is ester-linked to acetic acid, which makes the compound much more water-soluble than most glycerophospholipids and plasmalogens.

The head-group alcohol is choline in plasmalogens and in platelet-activating factor.

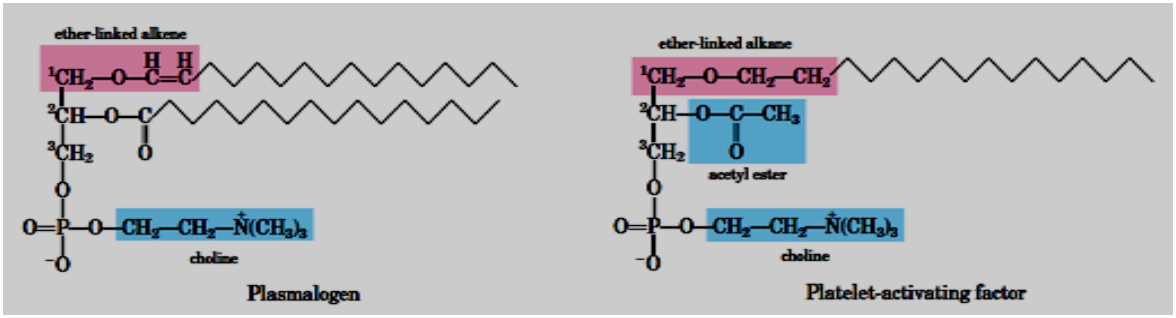


Figure 2.1 Ether lipids (Choline plasmalogens).

SPHINGOLIPIDS

They contain fatty acid, long chain amino alcohol sphingosine and bases or additional groups. They are subdivided into ***1. Sphingomyelins 2.Glycolipids***.

Sphingomyelins

Sphingomyelins are found in large quantities in brain and nerve tissue. They are also present in most of animal membranes. On hydrolysis, the sphingomyelins yield a fatty acid, phosphoric acid, choline, and a complex amino alcohol, sphingosine. No glycerol is present. In sphingomyelins, fatty acid is linked to sphingosine by an amide bond and phosphoryl choline is esterified to C-1 hydroxyl of sphingosine. The combination of sphingosine plus fatty acid is known as **ceramide,** a structure also found in the glycosphingolipids. Because of phosphorus, sphingomyelins are called as sphingophospholipids.

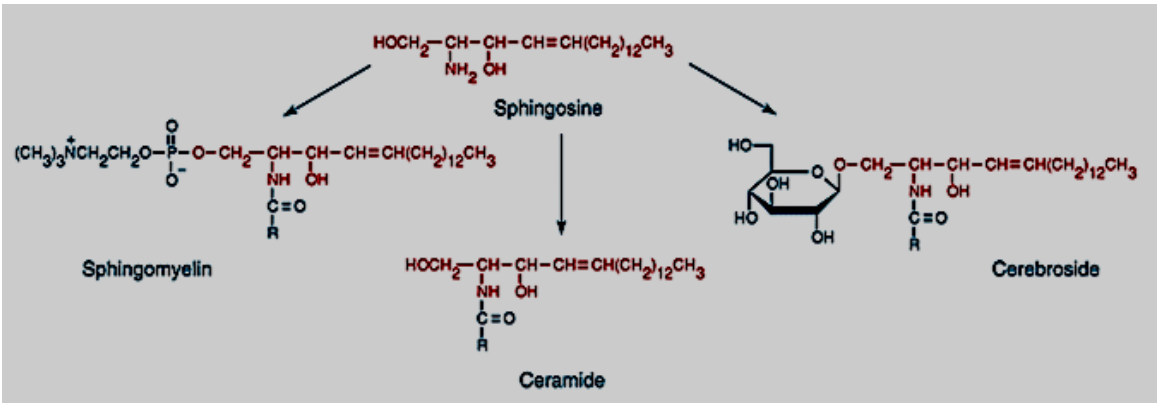


Figure 2.2 Sphingophospholipid and glycolipid structure

GLYCOLIPIDS

They are subdivided into : 1. Cerebrosides and 2. Gangliosides.

Cerebrosides

Structure

They contain sphingosine, fatty acid and sugar. Cerebroside differ in the type of sugar, they are named according to the sugar present. If the sugar is galactose then that cerebroside is called as *galactocerebroside* and if the sugar is glucose then is *glucocerebroside* . In some cerebroside, sulphate is attached to sugar then they are called as *sulfatides* or *sulfolipids* .

Functions

Cerebrosides occur in large amounts in white matter of brain and in myelin sheath of nerves. Some cerebrosides are present in non-neural tissue.

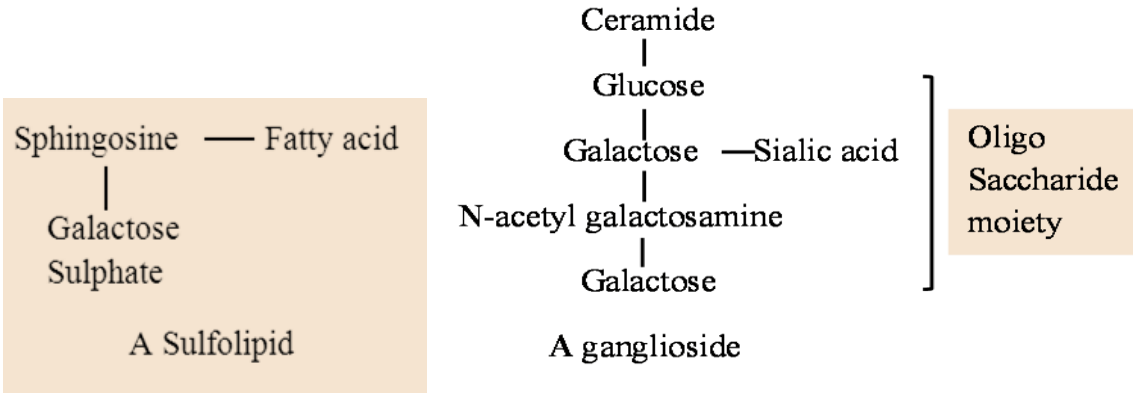


Figure 2.3 Structures of sulfolipids and Gangliosides

Gangliosides

Structure

They are highly complex sphingolipids. They contain ceramide, oligosaccharides and sialic acid. (Fig. 2.3)

Functions

1. They are abundant in grey matter of the brain.
2. They are also found in non-neural tissues.
3. They are component of hormonal receptors.
4. They also function as receptors for toxin of cholera, influenza and tetanus.
5. They are also involved in cell-cell recognition, growth, differentiation and carcinogenesis.