4- Lipoproteins

These are compound lipids formed of lipid part (which may be triglycerides, cholesterol or phospholipids) and protein part (which may be α or β globulin).

**Function of lipoproteins**

1- They enter in the structure of cell membrane.
2- They are important for lipid transport in the blood. Lipids are insoluble in water so they cannot be transported alone. Lipids bind to protein to make lipoproteins w` are watersoluble and can be transported in the blood.

**Classification of lipoproteins**

Lipoproteins are classified into 4 types according to the rate of floatation in sodium chloride solution after ultracentrifugation. These types are chylomicrons, very low-density lipoproteins (VLDL), low-density lipoproteins (LDL) and high-density lipoproteins (HDL). Also, lipoproteins are classified into 4 types according to migration in electric field (electrophoresis). These types are chylomicrons, pre-β lipoproteins, β lipoproteins and α lipoproteins.

1- Chylomicrons

**Structure**

They are formed mainly from triglycerides. They contain also a small amount of cholesterol phospholipids and proteins.

**Site of synthesis**

They are synthesized in the small intestine.

**Size**

Chylomicrons have the largest size in comparison with other lipoproteins.

**Floatation after ultracentrifugation**

Chylomicrons have the highest floatation rate in sodium chloride solution after ultracentrifugation.

**Migration in electric field**

They do not migrate in electric field because of their high content of triglycerides, which have high molecular weight and carry no charges.

2- Very low-density lipoprotein (VLDL)

**Structure**

They are formed principally from triglycerides. They contain also cholesterol, phospholipids and protein in proportions greater than chylomicrons.

**Site of synthesis**

They are synthesized in the liver.

**Size**

They have large size, but they are smaller in size when compare with chylomicrons.

**Floatation after ultracentrifugation**

They have the high floatation rate but not as high as that of chylomicrons.

**Migration in electric field**

They migrate just before B globulin and so; they are called pre-β lipoproteins.
3 - Low density lipoprotein (LDL)

Structure
They are formed mainly of cholesterol and appreciable amount of proteins, phospholipids and triglycerides.

Site of synthesis
They are synthesized in the blood.

Size
They are small in size.

Floatation after ultracentrifugation
They have low floatation rate.

Migration in electric field
They migrate with B globulin and so they are called β lipoproteins.

4- High density lipoproteins (HDL)

Structure
They are formed mainly of proteins and phospholipids, small amount of cholesterol and little amount of triglycerides.

Site of synthesis
They are synthesized in the liver.

Size
They are very small in size.

Floatation after ultracentrifugation
They have the lowest floatation rate.

Migration in electric field
They migrate with alpha globulin and so named α lipoproteins.

The following table shows the differences between the different types of lipoproteins

<table>
<thead>
<tr>
<th></th>
<th>Chyomicrons</th>
<th>VLDL</th>
<th>LDL</th>
<th>HDL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site of synthesis</strong></td>
<td>Small intestine</td>
<td>Liver</td>
<td>Blood</td>
<td>Liver</td>
</tr>
<tr>
<td><strong>Structure</strong></td>
<td>Mainly triglycerides, small amount of cholesterol, phospholipids and protein</td>
<td>Principally triglycerides, greater amount of cholesterol, phospholipids and protein</td>
<td>Mainly cholesterol and appreciable amount of proteins, phospholipids and triglycerides</td>
<td>Mainly of proteins and phospholipids, small amount of cholesterol and little amount of triglycerides</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>Largest</td>
<td>Large</td>
<td>Small</td>
<td>Smallest</td>
</tr>
<tr>
<td><strong>Rate of floatation</strong></td>
<td>Highest</td>
<td>High</td>
<td>Low</td>
<td>Lowest</td>
</tr>
<tr>
<td><strong>Electrophoresis</strong></td>
<td>Do not migrate because they have no charge</td>
<td>Migrate before β globulin</td>
<td>Migrate with β globulin</td>
<td>Migrate with α globulin</td>
</tr>
</tbody>
</table>

Separation of lipoproteins
Lipoproteins can be separated by:

1- Ultracentrifugation
In NaCl solution, lipoproteins are separated by ultracentrifugation, as they differ in the degree of floatation, into chylomicrons, VLDL, LDL and HDL.

2- Electrophoresis
As they differ in migration rate due to differences in molecular weight and charge, lipoproteins are separated b into chylomicrons, pre β, β and α lipoproteins.

3- Chromatography