LIPOPROTEINS

Lipoproteins are special particles made up of droplets of fats surrounded by a single layer of phospholipid molecules. Phospholipids are molecules of fats which are attached to a phosphorus-containing group. They are distinctive in being amphipathic, which means they have both polar and non-polar ends.

In a lipoprotein, the polar ends of all the phospholipid molecules face outwards, so as to interact with water, itself a polar molecule. This enables the lipoprotein to be carried in the blood rather than rising to the top, like cream on milk. The non-polar fat balled up inside the phospholipid layer, at the centre of the lipoprotein, is thus transported to the place where it must be stored or metabolized, through the bloodstream, despite being insoluble in blood. Thus lipoproteins are molecular level trucks to carry fats wherever they are required or stored.

Types of lipoproteins

Different lipoproteins are differentiated based on specific proteins attached to the phospholipid outer layer, called the apolipoprotein. This also helps to make the fatty molecule more stable, and also binds to cell surface receptors in some cases, to enable the cell to take up the lipoprotein by receptor-mediated endocytosis.

The types of lipoproteins with their function are as follows:

- Chylomicrons – these are the largest and least dense of the lipoproteins, with the highest triglyceride content. They consist of a protein component synthesized in the liver, which wraps around diet-derived cholesterol and fats. It travels from the intestinal lymphatics to the large veins, and sticks to the inner surface of the tiny capillary blood vessels inside the muscles and the fat storage cells in various parts of the body. There the fat is digested, while the cholesterol remains. This is now called the chylomicron remnant. It travels to the liver, where the cholesterol is metabolized. Thus chylomicrons deliver fats and cholesterol from the intestines to the muscles, fat cells and the liver.
- VLDL, very low density lipoprotein – this is composed of protein, fats and cholesterol synthesized in the liver. It is associated with 5 different apoproteins, namely , B-100, C-I, C-II, C-III and E. It is converted to IDL and LDL by removal of the apoproteins, except for one called apoprotein B100, along with esterification of the cholesterol. They are second only to chylomicrons in the percentage triglyceride content.
- IDL – intermediate density lipoprotein, is created by the metabolism of VLDL.
- LDL, low density lipoprotein – this is the last VLDL remnant, and contains chiefly cholesterol. The only apoprotein associated with it is apoB-100. Thus all these forms carry fats and cholesterol produced in the liver to the tissues.
- HDL, high density lipoprotein – this has the highest protein: lipid ratio, and so is the densest. It has the apoprotein A-1. This is also called ‘good cholesterol’, because it carries cholesterol away from the tissues to the liver, lowering blood cholesterol levels. High HDL levels are associated with lowered risk of cardiovascular disease. HDL levels are higher with exercise, higher estrogen levels, with alcohol consumption, and weight loss.

Lipoproteins show varying patterns that correlate with the risk of having a fatal cardiovascular event. High LDL, VLDL and triglyceride levels are associated with a high risk of atherosclerosis and heart disease. High HDL is correlated with reduced cholesterol levels, and a lower cardiovascular risk. Thus a high measurement of apo-A-1 correlates with a low atherosclerosis risk. HDL levels drop with cigarette smoking, and rise with regular exercise, alcohol use, estrogen levels and weight loss.

A diet high in saturated fat is associated with a high cholesterol level. However, if it contains plenty of fish oils, which are rich in omega-3 unsaturated fats, the cholesterol and triglyceride levels drop dramatically. Monounsaturated and polyunsaturated fatty acids, as in olive oil and peanut or sunflower oils, respectively, also reduce the blood cholesterol.

Cholesterol is required in our body to perform various biological functions. but abnormal cholesterol levels lead to cardiovascular diseases. Total fat intake plays an important role in determining the blood cholesterol levels in our body. That is also affected by the changes in the quantity of cholesterol and lipoprotein that are synthesised by body Saturated, mono saturated and Poly saturated facts have been shown increase HDL best cholesterol levels. However saturated fats also increase LDL bad cholesterol levels. Trans fats have been shown to reduce levels of HDL and increase levels of LDL. Higher concentrations of LDL and lower concentration of functional HDL are strongly associated with cardiovascular disease because these promote atheroma development in arteries (atherosclerosis).

Atherosclerosis refers to the buildup of fats, cholesterol and other substances in and on your artery walls (plaque), which can restrict blood flow. The plaque can burst, triggering a blood clot.

this disease process leads to myocardial infarction (heart attack), stroke and peripheral vascular disease. Since higher blood LDL contributes to this process more than cholesterol content of the HDL particles , LDL particles are often termed as bad cholesterol because they have been linked to atheroma formation. On the other hand, high concentrations of functional HDL, which can remove cholesterol from cells and atheroma, offers protection and referred to as good cholesterol. These balances he can be changed by body-build medications food choices and other factors.

Cholesterol is insoluble in the blood, and so it must be bound to lipoproteins in order to be transported. Two types of lipoprotein are involved in this function: low-density lipoproteins (LDLs) and high-density lipoproteins (HDLs). LDLs transport cholesterol from its site of synthesis in the liver to the body’s cells, where the cholesterol is separated from the LDL and is then used by the cells for various purposes. HDLs probably transport excess or unused cholesterol from the body’s tissues back to the liver, where the cholesterol is broken down to bile acids and is then excreted. About 70 percent of all cholesterol in the blood is carried by LDL particles, and most of the remainder is carried by HDLs. LDL-bound cholesterol is primarily responsible for the atherosclerotic build-up of fatty deposits on the blood vessel walls, while HDL particles may actually reduce or retard such atherosclerotic build-ups and are thus beneficial to health.

Body cells extract cholesterol from the blood by means of tiny, coated pits (receptors) on their surfaces; these receptors bind with the LDL particles (and their attached cholesterol) and draw them from the blood into the cell. There are limits to how much cholesterol a body cell can take in, however, and a cell’s capture of LDL particles inhibits the making of more LDL receptors on that cell’s surface, thus lowering its future intake of cholesterol. Fewer receptors on the body cells means that less cholesterol is ingested by the cells and that more remains in the bloodstream, thus increasing the risk of cholesterol accumulating in the interior walls of blood vessels.

Several hereditary genetic disorders, called hyperlipoproteinemia, involve excessive concentrations of lipoproteins in the blood. Other such diseases, called hypolipoproteinaemia, involve abnormally reduced lipoprotein levels in the blood.

Elevated levels of lipoprotein, LDL and VLDL are regarded as atherogenic i.e. they are prone to cause atherosclerosis. Levels of these fractions, rather than the total cholesterol, are responsible for the progress of atherosclerosis. Even if the total cholesterol in the normal limits having high levels of LDL result in the atheroma growth rates however if LDL is low and higher percentage of HDL then atheroma grow rates are low. The actual cholesterol level itself is not the most important risk factor for determining cardiovascular disease potential. It is actually the ratio between HDL "good cholesterol" and total cholesterol which is very important risk factor. In adults the HDL good cholesterol /total cholesterol ratio should be higher than 0.24 . The accepted HDL/total cholesterol ratio of 0.24 or higher is considered ideal under 0.24 is considered low risk and anything less than 0.1 is considered very dangerous it is much better to have high ratio which means you have lower risk of cardiovascular disease . Elevated cholesterol levels are treated with diet consisting of low saturated fat and trans free fat low cholesterol foods, followed by one of the various hypolipidemic agent such as statins, fibrates or cholesterol absorption inhibitors. Studies have also found that statins reduce atheroma progression as a result people with history of cardiovascular disease may derive benefit from statins respective of their cholesterol levels.

LIPOSOMES

Introduction

When membrane phospholipid are disrupted, they can reassemble themselves into tiny spheres, smaller than normal cell , either as bilayers or monolayers. The bilayer structures are liposomes. The monolayer structures are micelles. Thus liposome is a tiny vesicle made out of the same material as a cell membrane. They are stable structure based on a lipid bilayer that form a spherical vesicle These vesicles can be filled with therapeutic agents on the inside then used to deliver agent to target tissue.

We have seen that possible phospholipids are molecules that has polar head groups and long nonpolar tails of hydrocarbon chains. Under suitable conditions, a double layer arrangement is formed so that the polar head groups of many molecules face the aqueous environment, while nonpolar tails are in contact with each other and are kept away from aqueous environment. These bilayers form three dimensional structures called liposomes. Liposomes can be filled with drugs and used to deliver for cancer and other diseases.

Properties of liposomes

The name liposome is derived from two Greek words, Lipos meaning fat Soma meaning body. A liposome can be formed at a variety of sizes as unilameller or multi lamellar construction and its structural building blocks, phospholipids, and not to its size. Liposomes, usually contain core of aqueous solution; Lipid spheres that contain no aqueous material are called micelles.

Liposomes are spherical, selfclosed vesicles of colloidal dimensions. Due to their structure chemical composition and colloidal size, all of which can be well controlled by preparation methods , liposomes exhibit several properties which may be useful in various applications . The most important properties are colloidal size and special membrane and surface characteristics. They include bilayers phase behaviour and mechanical properties and permeability charge density etc.

Due to their amphiphilic character liposome act as a powerful solubilizers for a wide range of compounds.

Liposome also exhibit many special biological characteristics including interaction with biological membranes and various cells.

These properties point to several possible applications with liposome acting as solubilizers for difficult to dissolve substances, dispersant, sustained release systems, delivery systems for many substances, stabilizers, and protective agents.

Liposomes can be entirely made from naturally occurring substances and are therefore nontoxic biodegradable and immunogenic.

Applications of Liposomes

1. **Liposomes in Medicine**
   Liposomes act as drug delivery vehicles in medicine, adjuvants in vaccination, signal and enhancers/ carriers in medical diagnostics and analytical biochemistry, solubilizers for various ingredients and penetration enhancers in cosmetics.
   The therapeutic concentrations of many drugs is not much lower than the tissue one. In such cases the toxicity of the drug can be reduced, or efficacy enhanced by use of liposomes which act as a drug carriers. They change the temporal and spatial distribution of the drug. The benefits and limitations of liposomes drug carriers depend on the interaction of liposomes with cells and their fate in vivo after administration.
   Liposomes are used for drug delivery due to their unique properties. A liposome encapsulates a reason on aqueous inside a hydrophobic membrane dissolved hydrophobic solutes cannot readily pass through the lipids hydrophobic chemicals can be dissolved into the membrane and in this way liposomes can carry both hydrophobic molecules and hydrophilic molecule. To deliver the molecules to a site of action, the lipid bilayer can fuse with other bilayer such as cell membrane and thus deliver the liposome contents. By making liposomes in a solution of DNA or drugs, which would normally be unable to diffuse through the membrane, they can be delivered fast the lipid bilayer. The use of liposomes for transformation or transaction of DNA into host cell is known as lipofection.
2. **Liposomes in Cosmetics**
   The use of liposomes in nano cosmetology, also has many benefits. These are improved penetration and diffusion of active ingredients, selective transport of active ingredients, longer release time, greater stability of active substances, reduction of unwanted side effects and high biocompatibility.
3. **Use in Textiles**
   In addition and roughly application liposomes can be used as carriers for the delivery of dyes to textiles , pesticides to plants , enzymes and nutritional supplements to food and cosmetics to the skin.
4. **Diagnostic Application**
   The diagnostic applications include their use as a model tool or reagent in basic studies of cell interaction, recognition processes and mode of action of certain substances.
5. **Other uses**

In addition to these applications which have significant Impact in several industries, the properties of liposomes offer a very useful model system in many fundamental studies from topology, membrane biophysics, photo physics and photochemistry, colloid interactions and many other.

IMPORTANCE OF TRIGLYCERIDES

We consume oils and fats daily never diet. They are triglycerides of fatty acids, we've seen that carbohydrates act as ready source of energy i.e., energy can be released by catabolic breakdown of carbohydrates in aerobic and anaerobic processes. in animals energy is stored in the form of glycogen. However, lipids represent a more efficient way of storing chemical energy.

Triacylglycerols are the main storage form of chemical energy of lipids . The bond between fatty acid and rest of the molecule can be hydrolysed by suitable enzymes call lipases. Also when there are excess calories, Fatty acids synthesised and stored in the fat cells. When energy demands are great fatty acids are catabolized to liberate energy. Long chain fatty acyl groups are converted into acetyl Co A, which is subsequently oxidised in the citric acid cycle to provide energy that is temporarily stored as ATP.

We observe triglycerides are essential for good health because our tissues rely on triglycerides. They are formed in the liver from the fats you eat or from the body own synthesis of fat . When triglycerides are in eggs is, they circulate in the blood. Like high cholesterol, elevated triglycerides have also been implicated in arterial disease.

recent studies and evidences have strengthened the connection between high triglycerides and heart disease. Triglycerides levels can range from 150-200 mg/dl.

Researchers have stated that HDL “good Cholestrol is closely related to triglycerides. Generally people with high triglycerides have a tendency to have low HDL levels. The triglyceride/HDL ratio should be below 2. In a nut shell the triglyceride HDL ratio which is considered ideal is 2 or less; 4 is high and 6 or greater is considered too high.The lower your triglycerides or higher your HDL , it is better for your health. Research has been shown that people with highest ratio triglycerides to HDL has 16 time risk of heart attack as those with lowest ratio of triglycerides to HDL.

Elevated try glycerides can be a strong indicator of biliary function, fat metabolism the function of the liver and hereditary. There's sugar handling issues with elevated triglycerides or adult onset diabetes .