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PHYSICO-CHEMICAL PROPERTIES OF BIOLOGICAL MEMBRANES, BIOPHYSICAL MECHANISMS OF MOVEMENT OF SUBSTANCES IN THE MEMBRANE.

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Abstract:

This article provides information on the physico-chemical properties of biological membranes, biophysical mechanisms of movement of substances in the membrane.

Key words: Biological membrane, chloroplasts, lysosome, nucleus, fat, carbohydrate, protein, mechanic, matrix, barrier.

Biological membranes are very small lipid-protein structures that surround the cell and its internal structures (mitochondria, chloroplasts, lysosome, nucleus, etc.). It has a selective effect and controls the amount of metabolic products in the cell and its components, their transfer and exchange.

According to modern concepts, biological membranes actively participate in ensuring the conversion of energy from one type to another, in controlling the activity of enzymes, in the transmission of nerve impulses and intercellular information, in the functional properties of hormones and in the implementation of other processes in the cell. The cell membrane consists of proteins, fats, carbohydrates and other organic and inorganic substances, which ensure the passage of substances into and out of the cell. Accordingly, biomembranes have their own physical and chemical properties. It is known that the lipid bilayer of the membrane forms a unique liquid phase in the cell.

Between the water and lipid phases there are many enzymes and their substrates, various proteins, receptors, glycolipids, glyco- and lipoproteins (more precisely, they "float"). The main properties of the membrane bilayer, such as viscosity, polarity, surface charge, are related to the activity of enzymes located in almost all membranes, as well as the activity of receptors.

The three main functions of biomembranes are mechanical, matrix and barrier functions depending on their properties. Mechanical function ensures the stability and autonomy of the cell and its organelles. The function of the matrix ensures mutual location and orientation of membrane proteins, which in turn is the basis for the optimal functioning of these protein systems.

For example, for the interaction of membrane enzymes, or the activity of polyenzyme systems in the membrane, the ensemble that makes up the respiratory chain, and other activities, the order of location in the membrane is definitely important.

Biomembranes have a barrier function, that is, the membrane does not pass foreign substances to the cell, only the necessary substances for the cell are selected, the entry of these substances into the cell is controlled, that is, depending on the functional state of the cell permeates the membrane.

Also, biomembranes have functions such as selective permeability, flexibility, excitability, phagocytosis, energy production, and receptors, these functions are provided by the unique properties of the membrane. Biomembranes are an active system that controls the interaction of the cell with the external environment, the selective entry or exit of various substances, including ions, from the external environment into the cell, the binding of hormones and other regulatory

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molecules, the passage of various reactions catalyzed by enzymes, the transmission of electrical impulses. ensures formation and transfer.

Each membrane performs its own function. In general, the structure of membranes is adapted to perform a certain task.

In the membrane, systems can be in two main phase states:

1) solid bilayer crystal state or gel state;

2) it is in liquid crystal state.

In both cases, the bilayer structure of the lipid phase is preserved.

When the temperature of the membrane is increased, the ratio of the solid phase to the liquid phase changes. The temperature at which half of the phospholipids that make up the membrane are solid and the other half is liquid is called the transition temperature. This temperature depends on the length of the hydrocarbon chain of lipids and its degree of saturation.

As the length of the hydrocarbon chains of phospholipids increases, the phase transition temperature also increases, and this temperature decreases as the degree of saturation decreases. Changes occurring during the phase transition are based on spatial changes of hydrocarbon chains of lipids.

During the interphase transition in the gel-liquid crystalline state, the transition of hydrocarbon chains from the trans state to the disordered state occurs. In this case, the value of the surface occupied by one lipid molecule increases and the thickness of the hydrocarbon layer decreases.

It was found that the outer layers are composed of protein molecules and the middle layer is composed of lipid molecules arranged in two rows.

Since the protein molecules located on the outer side of the membrane are not in a single state, the lipid molecules directly interact with hydrophobic substances that exist outside the cell. As a result, water-insoluble substances can easily pass through the membrane by dissolving in the layer of lipid molecules.

Various ions are transferred into the internal environment of the cell or expelled based on a special selectivity through the ion channels formed by the special conformation of the protein molecules located on the outside of the cell membrane.

At the same time, the protein molecules located on the outer part of the membrane form special molecular structures called receptors that selectively interact with enzyme systems, ion channels, and biologically active substances located on the inner and outer layers of the membrane.

Based on the activity of these structures, the cell receives the effects of the external environment. Measuring the mobility of biomembrane molecules and the diffusion of particles passing through the membrane indicates that the bilipid layer behaves like water. On the other hand, the membrane is an ordered structure. Living organisms are open systems. Therefore, the movement of substances through biological membranes is a necessary condition for life.

Cell metabolism processes, bioenergetic processes, generation of biopotentials and other processes are connected with the transfer of substances through membranes. If there are disturbances in the transfer of substances through biomembranes, various pathologies appear in the body.

The transport of substances through biological membranes can be divided into two main types: passive and active.

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Passive migration refers to the movement of a substance from a place with a high concentration or electrochemical potential to a place with a small one.

There are the following types of passive migration: 1) free diffusion; 2) facilitated diffusion.

In active migration, matter moves against an electrochemical potential gradient, which consumes energy.

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