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INTERACTIONS OF BLOOD PROTEINS WITH FE_3O_4-BASED CORE-SHELL BIOCOMPATIBLE COMPOSITES

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A number of problems of modern medicine are solved by the use of nanomaterials as substrates for targeted delivery of therapeutic or diagnostic agents. Thus, on the basis of magnetosensitive nanomaterials, targeted drug delivery systems capable of responding to changes in the external magnetic field have been created. However, the use of such systems in the biological environment (living organism) requires a detailed study of the interaction of such materials with transported medicinal products, as well as with the components of the biological environment. This determines the biocompatibility of nanoparticles (NPs), their adsorption activity, residence time in the bloodstream and target area, etc.

One of the conditions for the use of nanomaterials in a living organism is their functionalization taking into account physicochemical properties, reactivity, hydrophilicity/hydrophobicity. The creation of a functional surface improves biocompatibility indicators, ensures the activity of targeting the system, the selectivity of binding NPs to certain chemicals or cells. A group of substances of biological origin, in particular protein components, are used as functionalizers. This coating makes it possible to create areas of specific binding of NPs to target cells, as well as to «mask» NPs from the negative (in this case) influence of the immune system, which contributes to prolonging the time spent in the body.

When using biologically active substances as functionalizers, the primary problem is the need to preserve the functional ability of the latter. After all, in the future, such systems can be used to separate biological mixtures, catalyze biochemical reactions, create effective biosensors, etc. Therefore, it is important to understand the process and mechanism of interaction of biological substances with the surfaces of NPs of different chemical composition[1] the nature and influence of interaction on the conformation of protein substances and their functionality.

A magnetically sensitive nanocomposite (NCs) based on magnetite with a modified SiO_2 surface functionalized with amino groups (Fe_3O_4/SiO_2-NH_2) was synthesized and a group of modern physical techniques (as FTIR, SEM-EDX, TEM, TGA and zeta potential measurements, etc.) was used to study synthesized NCs and investigated the adsorption properties nanocomposites in relation to normal human immunoglobulin (Ig).

The kinetics of Ig adsorption was studied and the experimental kinetic curves of Ig adsorption were analyzed in accordance with the logarithmic model, as well as the Langmuir and Freundlich models. The experimentally obtained results of the kinetic dependences indicate that the nature of the kinetics of Ig adsorption on the surface corresponds to the features of the interaction of proteins with hydrophilic surfaces without changing the conformation of the protein.

The analysis of kinetic curves and mathematical dependencies shows that the character of adsorption kinetics corresponds to the Langmuir model, but with an increase in the concentration of Ig in the solution, the correlation coefficient for the Freundlich model increases, which can be explained by the activation of new adsorption centers on the surface of NCs or due to protein-protein interactions.

Analysis of isotherm and mathematical analysis make it possible to make assumptions about the monomolecular adsorption mechanism (Langmuir model). Within the investigated concentrations of solutions (0.159 – 1.163 mg ml^{-1}) and time range (120 minutes) establishment of adsorption equilibrium is not observed.

References:

[17] N.Kusyak, A.Kusyak, A.Petranovska et al., *Appl Nanosci*, 12 (2022) 679