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Influence of the concentration of the dispersed phase and the acidity of the medium on the colloidal properties of aqueous solutions of egg albumin and human serum albumin

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Abstract

Albumin is one of the most important proteins in the human body, as it performs the functions of binding and transporting various substances, including medicinal substances, across human blood. Apart from serum albumin contained in blood serum albumin contained in egg white have a similar structure. The pH of the medium, its concentration affects the albumin functions. If crystalline albumin dissolves, its conformation is changing and intermolecular bonds are forming or breaking down depending on the phase contact time. In this connection, the effect of concentration, pH and time of phase contact on the surface tension, viscosity and turbidity of aqueous solutions of both egg and serum albumin has been explored in this investigation. The determination of the surface tension of the liquid has been carried out by the method of detachment of the ring. The rheological properties of protein solutions have been explored by the method of capillary viscometry. The processes of albumin aggregation in aqueous solutions have been investigated by the photometric method. It is established that during the time, gradual structuring of albumin's solutions takes place. It is established that during the time, gradual structuring of albumin's solutions takes place. It is shown that the protein structuring and its surface properties increase with time and depend on the pH of the solution itself and the pH of the isoelectric point: a significant increase in the turbidity of solutions and a reduction in their viscosity is observed near the isoelectric point of albumin, which is due to the minimal energy of electrostatic repulsion between the side chains of molecules and the molecules themselves and the formation of denser and compact aggregates of a larger size, which have less effect on the flow of liquid and significantly increase light scattering. Nonlinear change in turbidity and viscosity as a function of protein concentration caused by the processes of structuring solutions is observed also. A significant surface activity of albumin is found, which increases by increasing proton concentration. This is probably due to the fact that in an acidic environment more nonpolar groupings come on the surface of the molecule than in a neutral or slightly alkaline media, therefore albumin molecules at physiological pH values will have the lowest surface activity.

References

[1] E.V. Pashina, M.L. Zolotavina. Albumin in the assessment of endogenous intoxication. *Science and modernity*. **2014.** Vol.33. P.23-28. (russian)
[2] M.M. Sozarukova, E.V. Proskurnina, Yu.A. Vladimirov. Serum albumin as a source of and a target for free radicals in pathology. *Bulletin of Russian State Medical University.* **2016**. Vol.1. P.61-67. (russian)
[3] The human albumin. *State Pharmacopoeia XIII.* **2015**. FS.3.3.2.0006.15. (russian)
[4] J.A. Huntington, P.E. Stein. Structure and properties of ovalbumin. *Journal of Chromatography B: Biomedical Sciences and Applications.* **2001**. Vol.756(1-2). P.189-98.
[5] N.N. Pshenkina. Serum albumin: structure and transport function (literature review). *Medline.ru.* **2011**. Vol.12. P.1067-1091.
[6] I.B. Dmitrieva, A.A. Kergentsev, A.S. Chukhno. The determination of the dissociation constant for the carboxyl and amino groups on the albumin by potentiometric titration. *Butlerov Communications.* **2015**. Vol.41. No.3. P.141-146. DOI: 10.37952/ROI-jbc-01/15-41-3-141

[7] A.A. Kergentsev, I.B. Dmitrieva, A.S. Chukhno. Determination of the point of zero charge of albumin molecules in aqueous dispersions at various concentrations of potassium chloride. *Young Scientist*. **2014**. No.18. P.123-126. (russian)
[8] A.S. Chukhno, I.B. Dmitrieva, A.N. Bankina, E.Yu. Brilliantova. Investigation of interaction of proteins with bioactive nitrogenated heterocyclice compounds at various pH. *Butlerov Communications.* **2015**. Vol.34. No.5. P.91-99. DOI: 10.37952/ROI-jbc-01/15-34-5-91
[9] A.S. Chukhno, I.B. Dmitrieva, D.V. Martynov. Isoelectric point of proteins in aqueous solutions of azoles. *Bulletin of St. Petersburg University. Physics and Chemistry.* **2011**. Vol.2. P.124-133. (russian)
[10] E.Y. Rodionova, I.B. Dmitrieva, A.S. Chukhno. Electro-kinetic properties of hemoglobin in aqueous solution of 1-, 2- and 3-charged ions. *Butlerov Communications*. **2013**. Vol.34. No.6. P.135-140. ROI: jbc-02/13-34-6-135.
[11] A.S. Chukhno, S.V. Gurina, E.P. Ananeva, A.N. Bankina, E.Y. Brilliantova, I.B. Dmitrieva. Investigation of the properties of colloidal mycelium of basidiomycetes with the aim of using it as a carrier of BAS. *Butlerov Communications*. **2014**. Vol.39. No.10. P.76-82. ROI: jbc-02/14-39-10-76
[12] A.S. Chukhno, I.B. Dmitrieva, D.S. Silaeva, A.S. Senina, A.S. Koshevenko, A.R. Nazipova. Sorption of H^+ and OH^- on chlorophyll, the effect of pH on the stability of aqueous dispersions of chlorophyll. *Butlerov Communications.* **2013**. Vol.34. No.5. P.124-130. ROI: jbc-02/13-34-5-124
[13] E.Y. Rodionova, I.B. Dmitrieva, A.S. Chukhno. Electrokinetic properties of hemoglobin in aqueous solutions of HCl and KCl. *Butlerov Communications.* **2012**. Vol.30. No.6. P.103-107. ROI: jbc-02/12-30-6-103