

STUDY OF MAGNETIC EFFECTS ON INTERACTIONS OF GLOBULAR PROTEINS: BOVINE SERUM ALBUMIN AND EGG ALBUMIN WITH WATER

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Abstract: Viscosities for 0.2, 0.4, 0.6, 0.8 and 1.0 milligram per 100 mL aqueous solutions of Bovine Serum Albumin (BSA) and Egg Albumin (EA) with 0.0, 1 and 2 magnetic fluxes at 298.15 K and one atmosphere were measured with Survismeter. An increase in viscosities inferred effect of magnetic flux on structural interaction on globular proteins. As compared to blank sample, the BSA and Egg Albumin showed 5 and 2.5 times increments in viscosities with the magnetic fluxes.

Keywords: viscosity, survismeter, magnetic flux, bovine serum albumin, egg albumin

Introduction

Currently biomacromolecules are at center stage for variety of roles being played in disease control, calorie enhancement, tissue repair and enzymatic activities. Natural proteins need their physicochemical characterization to define their activities in specific process for example Egg Albumin and Bovine Serum Albumin are useful for several biochemical and biophysiological cell processes [1]. Unfolding dynamics of proteins is most fascination and significant for hydrophilic and hydrophobic purposes. The protein molecules with temperature, pressure, electric etc, respond due to void spaces and coiling of peptide bonds [2] and property like viscosity become significant to elucidate structural changes. The present study illustrates a response of Egg Albumin and Bovine Serum Albumin molecules to doses of magnetic flux and the viscosity

changes are noted to gather useful information on action mechanism of proteins. The proteins with polar peptide bonds develop electrostatic, covalent and van der Waals forces which play key role in monitoring the conformational state of protein [1,2]. With the magnetic flux, the molecules have undergone reorientation with different flow pattern and protein-solvent interactions.

Material and method

The BSA (B4287) and Egg Albumin (A5253, sigma) were dried overnight storing in P_2O_5 vacuum desiccator. Dilute solutions were prepared, w/v, with Millipore water, and densities were measured with bicapillary pyknometer [2,3]. Weights of empty pyknometer, with solution and solvents were obtained with 0.01 mg Dhona Balance Model 100 DS, Calcutta, Instr. Pvt. Ltd. India, at constant temperature with $\pm 0.05^\circ\text{C}$ control. The solutions were flown through a uniform capillary of the Suvismeter (Fig. 1) [3] for flow times for a prescribed volume. The Survismeter was cleaned with freshly prepared chromic acid followed by Millipore water and acetone. The Millipore water was used for Suvismeter calibration, and then the solutions were used for viscous flow time without magnetic flux, and are referred to as blank condition. The shoe shaped magnets of required magnetic flux were fixed around bulb numbers 6 and 9 for prescribed time. The magnets of 1 flux were fixed around the bulb number 6 and 9 with opposite attractive poles and viscous flow times were noted. Similarly the double magnets of equivalent flux of 2 were bound on bulb number 6 and 9 and the flow times were noted. In both condition the position of magnets was reproducible.

Result

The viscosities were calculated with usual equation [1,2] and relative viscosities were fitted to an extended Jones-Dole equation [2]. The coefficient of Jones-Dole equation at zero

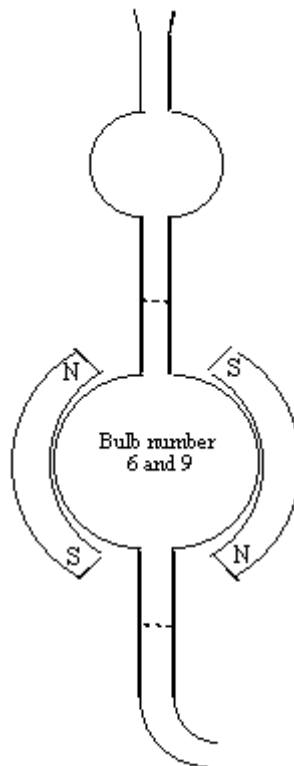


Fig. 1. The N and S depict north and south poles of a shoe magnetic bound around bulb 6 and 9. The bulb 6 and 9 are of the survismeter described elsewhere [3].

concentration obtained on extrapolation to derive intrinsic viscosities $[\eta]$ which are plotted in Fig. 2.

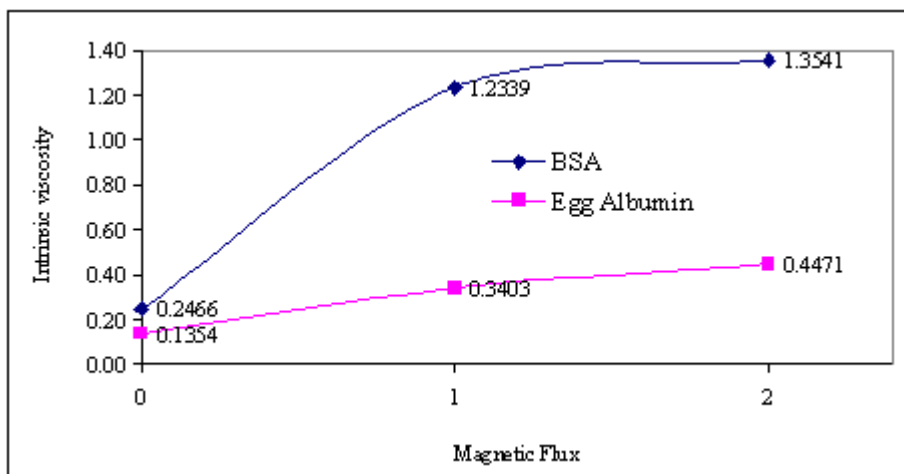


Fig. 2. Intrinsic viscosities of proteins with different doses of magnetic fluxes

Discussion

The $[\eta]$ values for BSA are higher than those of the Egg Albumin by 0.1113, 0.8936 and 0.9070 mg/dL with stronger water-BSA interactions than those of the water-Egg Albumin. The BSA showed stronger polyvalent character that developed stronger interactions with dipoles of the water that developed a higher strain on laminar flow with stronger frictional forces with higher velocity gradient than the Egg Albumin. When the proteins were exposed to 1 magnetic flux, the $[\eta]$ of both proteins were enhanced with 5 times higher increase with the BSA than the blank but it was 5.5 times than of the values when 1 to 2 fluxes used. Similarly the $[\eta]$ increased for Egg Albumin by 2.5 and 3.3 times from blank to 1 and from 1 to the 2 respectively. The magnetic fluxes caused stronger influence on BSA-water complex where a velocity gradient was increased from 5 and 5.5 times with BSA as compared to 2.5 and 3.3 times with Egg Albumin. This further inferred higher unfolding of the BSA than the Egg Albumin. The BSA caused stronger frictional forces with stronger interaction with water than the Egg Albumin. Thus the magnetic flux could be a useful model for monitoring the molecular structures of the biopolymers.

Conclusion

The magnetic force influences the globular protein interactions with polar solvent like water.

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REFERENCES

1. **Singh, M.** Physicochemical Study of Globular Proteins - Bovine Serum Albumin, Egg Albumin and Lysozyme – in Some Aqueous Iodide Salts Solutions of 1A Group and Cetyltrimethylammonium Bromide Systems. *J. Appl. Polym. Sci.* **110**, 2293-2304 (2008).
2. **Singh, M., H. Chand, K.C. Gupta.** The Studies of Density, Apparent Molar Volume, and Viscosity of Bovine Serum Albumin, Egg Albumin, and Lysozyme in Aqueous and RbI, CsI, and DTAB Aqueous Solutions at 303.15 K. *Chemistry & Biodiversity* **2**, 809-824 (2005).
3. **Singh, M.** Survisometer-type I and II for Surface Tension and Viscosity Measurements of Liquids for Academic, and Research and Development Studies. *J. Biochem. & Biophys. Methods* **67**, 151-161 (2006).

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