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Geometrical restrictions of water diffusion in aqueous protein systems. A study using NMR field-gradient techniques

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Abstract

Geometrical restrictions of water diffusion in different aqueous protein systems were studied using two versions of the NMR field gradient technique. The samples were aqueous systems of bovine serum albumin, gelatin and horse myoglobin at concentrations ranging from diluted solutions to almost dry powders being only partly hydrated. Hydrated protein aerogels were produced by the aid of a special preparation procedure and studied in addition. The experiments referred to the, temperature and concentration dependences of the water diffusion coefficient above and below the free-water freezing temperature. The diffusion coefficient within clusters of overlapping hydration shells is reduced by one order of magnitude compared with that of bulk water. Geometrical restrictions manifest themselves (a) by the obstruction effect observed at low protein concentrations, (b) by the topologically two-dimensional diffusion in the network of overlapping hydration shells, (c) by the percolation threshold appearing at about 15%b.w. water and (d) by the anomalous diffusion behaviour concluded from the protein aerogel study. © 1993 Springer.

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