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Hydration of proteins: Excess partial volumes of water and proteins

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Abstract

High precision densitometry was applied to study the hydration of proteins. The hydration process was analyzed by the simultaneous monitoring of the excess partial volumes of water and the proteins in the entire range of water content. Five unrelated proteins (lysozyme, chymotrypsinogen A, ovalbumin, human serum albumin, and β-lactoglobulin) were used as models. The obtained data were compared with the excess partial enthalpies of water and the proteins. It was shown that the excess partial quantities are very sensitive to the changes in the state of water and proteins. At the lowest water weight fractions (w 1), the changes of the excess functions can mainly be attributed to water addition. A transition from the glassy to the flexible state of the proteins is accompanied by significant changes in the excess partial quantities of water and the proteins. This transition appears at a water weight fraction of 0.06 when charged groups of proteins are covered. Excess partial quantities reach their fully hydrated values at w1 > 0.5 when coverage of both polar and weakly interacting surface elements is complete. At the highest water contents, water addition has no significant effect on the excess quantities. At w1 > 0.5, changes in the excess functions can solely be attributed to changes in the state of the proteins.

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