

THE STUDY OF MODELS FOR ZINC(II) METALLOENZYMES IN AQUEOUS
SOLUTION

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ABSTRACT

Model compounds have been of great importance in elucidating the mechanism of action of many metalloenzymes, particularly those containing the Zn(II) ion. Of particular importance has been the acidity of water molecules coordinated to Zn(II) in metalloenzymes. The coordination number (C.N.) of the zinc is lowered from the C.N. of 6 found for the aquo ion to, usually, 4 in these situations, which leads to greater acidity of the coordinated water molecule. This is essential for such metalloenzymes to function at biological pH. Of particular interest has been the pK_a of the complexes of N_2S type ligands, which resemble the coordination environment of peptide deformylase (PD). A major question is whether the presence of the strongly binding negative sulfur of the cysteine group would greatly lower the acidity of the coordinated water in the active site as compared with other metalloenzymes where, for example, three neutral nitrogen donors are coordinated. The model complex for PD, a N_2S ligand (PATH) first studied by Goldberg, is studied to answer this question. Glass electrode potentiometry and differential pulse voltammetry are used to show that the acidity of the coordinated water is quite high, showing that the mercapto group of PATH, and also in PD, does not cause a decrease in acidity. The Zn complex of cyclen, as well as other nitrogen donor macrocycles, are studied by glass electrode potentiometry and differential pulse voltammetry to determine the acidity of coordinated water molecules, as well as the formation constants of small ligands with the Zn(II) complex. It is shown that the cyclen complex of Zn(II) has strong binding with ligands such as chloride, bromide, iodide and thiourea, indicating that the Zn center has become 'softer' in the HSAB classification of Pearson than is the case for the Zn(II) aquo ion. The acidity of a variety of Zn(II)

complexes with nitrogen donor ligands is discussed in relation to factors that control such acidity.

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