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Optical and Chemical Properties of Schiff Bases of Basic Polypeptides in Solution

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Summary Ordered polypeptide matrices in solution induce changes in the optical and chemical properties of anchored Schiff bases.

It has been reported that the chemical reactivity of certain molecules in solution changes when they are anchored to polymeric matrices.[1] Some of the new reactions were found to be stereoselective.

These effects may be of interest in work on the particular reactivity of prosthetic groups in the active site of enzymes. We have investigated the structural properties of Cu^{II} and Co^{II} polychelate derivatives of polypeptide ligands. From the optical properties of Cu^{II} salicylaldimino derivatives of poly-L-lysine, poly-L-ornithine, and poly-L-α,γ-diaminobutyric acid we were able to show that the complexation reaction on the polypeptide in the ordered α-helical conformation in methanol is highly stereospecific.[2]

We have now investigated the optical and chemical properties of the Schiff bases of the polypeptides with salicylaldehyde in a range of methanol-water mixtures.

These were prepared by mixing the stoicheiometric amount of salicylaldehyde and polypeptides in pure methanol where the formation of the Schiff bases is practically quantitative; methanol and water were added in order to investigate the whole range of composition. Circular dichroism (c.d.) spectra did not show appreciable variations for excess aldehyde within several weeks.

In the Figure the spectra of the poly-L-α,γ-diaminobutyric acid derivative at different solvent compositions are shown. Strong Cotton effects characterize the benzenoid electronic transitions of the Schiff bases as well as the peptide regions. The percent variations of ellipticity at

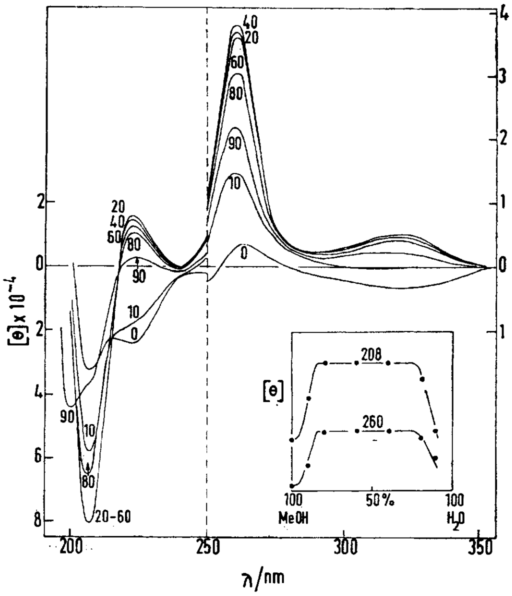

FIGURE. Circular dichroism spectra of the salicylaldimino derivative of poly-L-α,γ-diaminobutyric acid in methanol-water solutions at different percentage (by vol.) of water, pH (apparent) = 7, room temperature. Insert; variation of ellipticity at 208 and 260 nm as a function of solvent composition.

two wavelengths, typical of benzenoid transitions at 260 nm and of the exciton parallel component of the peptide transition at 207 nm, show very steep and simultaneous changes at 15% water (see insert to Figure) The spectra do not change significantly as the water content increases until about 90% water. From 90% to pure water the peptide transition shows the typical c.d. spectrum of the coil and the benzenoid dichroism at 260 nm goes down. Similar results were obtained with poly-L-lysine derivatives.

We thus conclude that the Schiff bases anchored to the polypeptide matrices do not show appreciable hydrolysis until *ca.* 90% water although the monomeric model compound undergoes very quick hydrolysis; *e.g.* the salicylaldimine derivative of methylamine has a hydrolysis constant $K = 2{\cdot}7 \times 10^5$ and a rate constant $K_{obs} = 1$ at pH 7.[3] It is suggested that the Schiff base anchored to the polypeptide is strongly coupled with the peptide group by dipole–dipole interaction and hydrophobic forces so that the equilibria for the formation and subsequent hydrolysis of the carbinolamine intermediate, are not normally established.

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