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Reverse mutarotation of poly-L-proline*

The mutarotation of poly-L-proline I ($[\alpha]_D^{25} = +40°$) into poly-L-proline II ($[\alpha]_D^{25} = -540°$) has been described by Kurtz, Berger and Katchalski[1]. Further work on this subject has been published since[2,3]. In the present note the reconversion of poly-L-proline II into poly-L-proline I is reported.

When a 5 % solution of polyproline II in formic acid is diluted 10-fold with *n*-propanol, the specific rotation of the polymer changes within a week from $[\alpha]_D^{25} = -415°$ to $[\alpha]_D^{25} = -25°$. The polyproline precipitated by ether at this stage shows $[\alpha]_D^{25} = +50°$ (concn., 0.35 % (w/v) in glacial acetic acid), and it mutarotates into polyproline II in this solvent. Like polyproline I, it is very sparingly soluble in water, and its infrared spectrum is identical with that of polyproline I, differing significantly from that of polyproline II[2] (see Fig. 1).

Reverse mutarotation of poly-L-proline II into poly-L-proline I occurs equally well when *n*-butanol is used instead of *n*-propanol. In the case of methanol and ethanol, reverse mutarotation

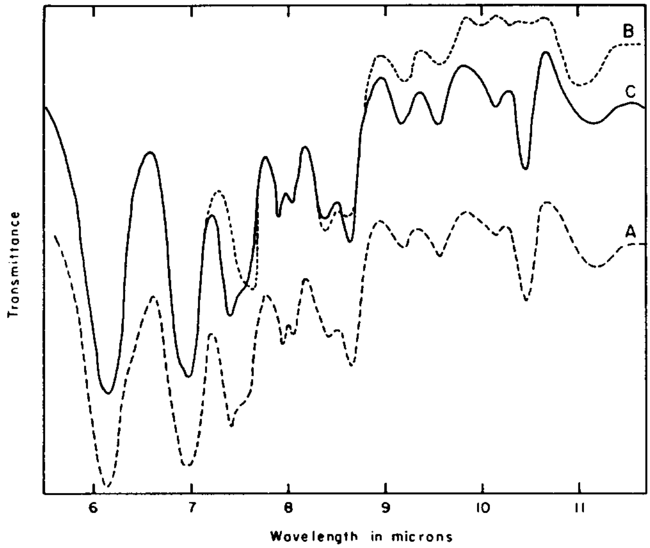

Fig. 1. The infrared spectrum of poly-L-proline I ($[\alpha]_D^{25} = +40°$), — — — (A); poly-L-proline II ($[\alpha]_D^{25} = -540°$), - - - - - - (B); and poly-L-proline obtained from poly-L-proline II after reverse mutarotation ($[\alpha]_D^{25} = +50°$) ———— (C). All spectra were taken from KBr pellets.

does proceed initially, but the polymer precipitates out of solution when an $[\alpha]_D^{25}$ of about —250° is reached (Fig. 2). The possibility of mutarotation in aliphatic alcohols in the absence of acid could not be tested as they do not dissolve polyproline II.

The effect of the acid present in the solvent mixture can be seen from Figs. 3 and 4. Reverse mutarotation is slower in the presence of formic acid than in the presence of acetic acid. Higher acid concentration causes the reverse mutarotation to proceed at a lower rate.

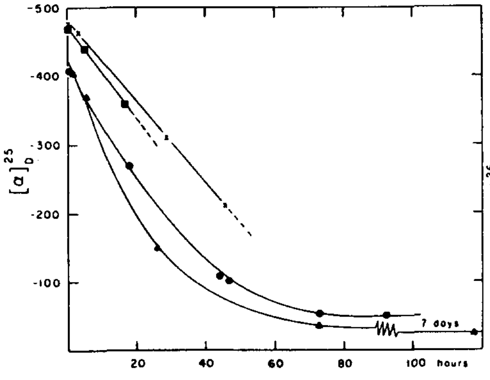

Fig. 2.

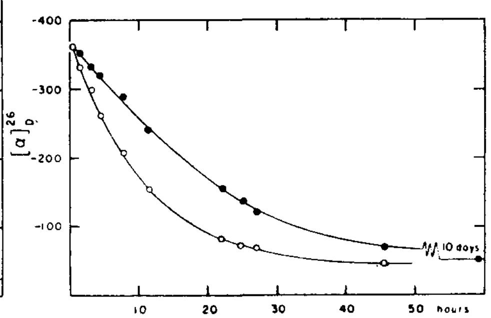

Fig. 3.

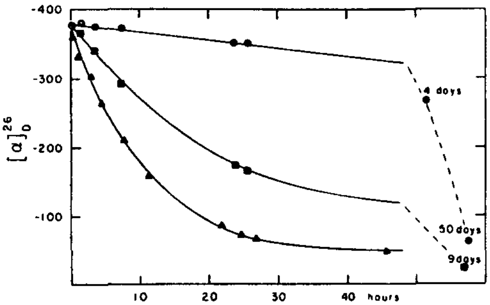

Fig. 4.

Fig. 2. Reverse mutarotation of poly-L-proline II. The solutions contained 10% formic acid and 90% of methanol (■), ethanol (×), *n*-propanol (▲) and *n*-butanol (●), (v/v).

Fig. 3. Reverse mutarotation of poly-L-proline II. The solutions contained 90% (v/v) of *n*-propanol and 10% of formic acid (●), acetic acid or propionic acid (○).

Fig. 4. Reverse mutarotation of poly-L-proline II. The solutions contained acetic acid and *n*-propanol in the ratios 1:9 (▲), 2:8 (■) and 4:6 (●) (v/v).

It is worth while noting that the reverse mutarotation cannot be attributed solely to the effect of the alcoholic hydroxyl group. Benzyl alcohol, for example, does not bring about reverse mutarotation. On the contrary, poly-L-proline I dissolved in benzyl alcohol or in 2-chloroethanol[2] mutarotates into poly-L-proline II.

The reversibility of the mutarotation of poly-L-proline suggests strongly that no chemical change is involved during the process, and that the change is of a configurational nature. It indirectly gives weight to the proposed occurrence of a *cis-trans* isomerization at the peptide bond.

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