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On the Reasons and Conditions of Occurrence of Optical Activity of Natural Compounds

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It is known that α-amino acids occurring in natural proteins–enzymes belong to the L-series; at the same time, compounds subjected to oxidation (carbohydrates, sugars, *etc.*) belong to the D-series. The origin of the optical activity of these compounds is not clear, however the difference in catalytic activity of L- and D-amino acids could permit the selection of optically active catalysts at early stages of development, since according to the theory of evolutional catalysis [1], the main criterion for selection of catalytically active systems is absolute catalytic activity.

The study of the oxidation of an optically active substrate (L-cysteine) in a static system in the presence of complexes of iron with L- and D-alanine over a wide range of pH values (6–11.5) enabled us to determine the difference in catalytic activity of the complexes under study. It was found that the catalytic activity of complexes of iron with D-alanine was higher in the 6–9.2 pH range than the respective value for complexes with L-alanine, while in the 9.2–11.5 pH range the relationship reversed (see Fig. 1). At pH = 7 the catalytic activity of the iron complex with D-alanine was 7 times higher than the catalytic activity of the complex with L-alanine.

To ascertain the composition of complex compounds taking part in the catalytic process the complex formation of Fe(II, III) with L- and D-alanine has been studied over a wide range of pH values (1–12) by the oxidative potential technique [2]. It was found that the processes of complex formation of Fe(III)–Fe(II) with L- and D-alanine in aqueous solution differ from each other and the composition of the complexes prevailing in certain pH ranges was different. Thus the difference in catalytic activity of complexes of iron with L- and D-amino acids is associated with the different composition of complexes formed at different pH values. This means that selection of optically active catalysts and substrates in the early stages of chemical evolution could be determined by the differences in complex formation between L- and D-amino acids and iron ions, leading to a different catalytic activity of the systems based on them, and the value of catalytic activity, as has been shown in [1], serves as a parameter of natural selection for self-developing catalytic systems. Such a process could occur in aqueous solution only at definite pH values, for example at pH *ca.* 6–8, where the difference in catalytic activity is sufficiently high.

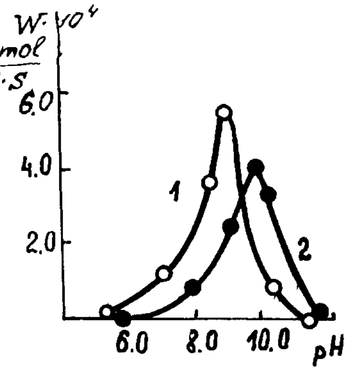

Fig. 1. Rate of oxidation of 0.2 *M* aqueous solution of L-cysteine *vs.* pH, 40 °C, $C_{Fe^{3+}} = 10^{-4}$ mol/l, $C_{ala} = 0.5$ mol/l: 1, D-Alanine; 2, L-alanine.

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