Thermochimica Acta, 79 (1984) 383–384
Elsevier Science Publishers B.V., Amsterdam – Printed in The Netherlands

Note

THERMODYNAMIC FUNCTIONS AND STABILITY CONSTANTS OF L-LYSINE MONOHYDROCHLORIDE

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(Received 28 March 1984)

Work on L-lysine monohydrochloride has been recently undertaken in this laboratory with particular reference to the binding sites of L-lysine monohydrochloride with metal ions [1–6].

Considering the biological significance of amino acids, a study of the complexing ability of L-lysine monohydrochloride with different metal ions [6], and the distribution of these complexes as a function of pH is of importance. The present study was undertaken to gain some insight into metal–ligand interactions, which could help in understanding the role of metal ions in general and particularly in coordination compounds. It was further felt that to the complexes of L-lysine monohydrochloride would also be interesting for biological systems.

In the present communication, the stability constants, stoichiometry, thermodynamic functions,and X-ray study of chelates of L-lysine monohydrochloride are described.

EXPERIMENTAL

All chemicals and apparatus used were as previously described [1].

The usual method of synthesising these chelates has also been described earlier [1].

RESULTS AND DISCUSSION

The conductance and pH measurements of the resulting solution revealed that all the metals studied form complexes with the ligand in ligand/metal ratios 1 : 1 and 1 : 2.

The percentage of carbon, hydrogen, nitrogen and metal were related to calculated figures.

The respective values of ΔG, ΔH and ΔS of the complexation reaction have been evaluated at 30 and 40 °C by employing the Gibbs–Helmholtz and isobar equations [7] and are given in Table 1.

TABLE 1

Stability constants and thermodynamic functions at 30 and 40 °C (Lys = L-lysine monohydrochloride)

Composition of complexes	log K		$-\Delta G$ (kcal mol^{-1})	$-\Delta H$ (kcal mol^{-1})	ΔS (cal K^{-1} mol^{-1})
	30 °C	40 °C			
Pd(II) – Lys					
1 : 1	1.64	1.55	2.28	3.39	−4.01
1 : 2	3.17	3.10	9.30	2.57	8.33
Rh(III) – Lys					
1 : 1	1.99	1.89	2.75	3.48	−2.21
1 : 2	3.47	3.40	5.70	3.40	−2.40
Pt(IV) – Lys					
1 : 1	1.88	1.86	2.65	3.38	−2.41
1 : 2	3.50	3.39	5.12	2.52	−8.58

The results (Table 1) reveal that stability constant values decrease with increasing temperature. This indicates that a lower temperature is favourable for the complexation reaction to proceed spontaneously and that it is an exothermic process. This also explains the decrease in the values of log K with increasing temperature; the overall entropy change being positive for Pd(II), Rh(III) and Pt(IV) with L-lysine monohydrochloride.

The X-ray powder photographs of the complexes have been studied by Bragg's equation

$$\lambda = 2d \sin \theta$$

The grazing angle, θ, lattice spacing value, d, and relative intensity have been calculated using a value of 1.5418 Å for λ. This study indicates that they are all crystalline in nature.

ACKNOWLEDGEMENT

The author thanks U.G.C., New Delhi, for granting the award of a Research Associateship.

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