

Biligand complexes of terbium with DTPA-alanine and phenylalanine

ABHILASHA ASTHANA , K. DWIVEDI and REETESH ASTHANA

School of Studies in Chemistry, Jiwaji University, Gwalior - 474 001 (India).

(Received: January 16, 2008; Accepted: February 23, 2008)

ABSTRACT

The interaction of Tb(III) ions with DTPA alanine and phenylalanine have been followed potentiometrically. The stability constants of the formed complexes were determined at three different ionic strengths.

Key words: Ternary complex, terbium, DTPA-alanine, phenylalanine.

INTRODUCTION

The studies on mixed ligand complexing equilibria have fascinated the chemists because of the fact such complexes are of much importance in industrial, analytical and biological filed¹⁻³. DTPA (Diethelene –triaminepenta acetic acid) is an important octadentate chelating ligand belongs to the class of aminopolycarboxylic acids and find many applications⁴⁻⁶.

In this paper we have reported the complexes of lanthanide metal ion with DTPA, alanine and phenylalanine.

EXPERIMENTAL

Following sets of titration mixtures were prepared and titrated against standard alkali solution at three different ionic strengths ($m = 0.05M, 0.10M$ and $0.15M$) maintained in each set was kept at 50.00ml.

1. HNO_3 ($2.0 \times 10^{-3}M$)
2. HNO_3 ($2.0 \times 10^{-3}M$) + ligand L ($1.0 \times 10^{-3}M$)
3. HNO_3 ($2.0 \times 10^{-3}M$) + ligand L ($1.0 \times 10^{-3}M$) + metal ion ($1.0 \times 10^{-3}M$)

4. HNO_3 ($2.0 \times 10^{-3}M$) + ligand L' ($1.0 \times 10^{-3}M$)
 5. HNO_3 ($2.0 \times 10^{-3}M$) + ligand L' ($1.0 \times 10^{-3}M$) + metal ion ($1.0 \times 10^{-3}M$)
- K_t^H HNO_3 ($2.0 \times 10^{-3}M$) + ligand L ($1.0 \times 10^{-3}M$) + ligand L' ($1.0 \times 10^{-3}M$) + Metal ion

RESULTS AND DISCUSSION

By plotting the formation curve, pH versus \bar{n} H, the P^k values of the ligand were calculated. These values were in agreement with the literature value. The value of K_{ML} can also be calculated considering by Bjerrums function and P^L .

$$K_{ML} = \frac{C_L - Y_1[L]}{[L]^2 Y_1}$$

where ,

C_L = Total ligand concentration
L = Ligand

$$Y_1 = \left[\frac{[H]^2}{K_1^H K_2^H} + \frac{[H]}{K_2^H} + 1 \right]$$

where and K_2^H are the proton dissociated constant of primary and secondary ligand respectively.

Table 1: Conditional and thermodynamic formation constant

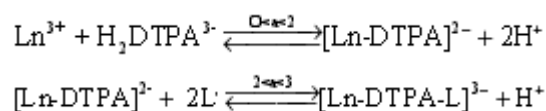
Mixed ligand complex system	$\mu=0.15M$ $\log K_{MLL'}^{ML}$	$\mu=0.10M$ $\log K_{MLL'}^{ML}$	$\mu=0.05M$ $\log K_{MLL'}^{ML}$	$\mu \rightarrow 0 M$ $\log K_{MLL'}^{ML}$
Tb(III)- H ₂ DTPA alanine	3.640	3.706	3.775	3.825
Tb(III)- H ₂ DTPA Phenylalanine	3.558	3.601	3.648	3.700

Further the value of formation constant of mixed ligand complex calculated by Thomsan and Loraas method⁷.

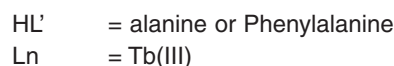
The plot of moles of alkali per mole of ligand metal (a) vs P^H were obtained for the system. It shows studies that the primary complex is formed at a lower P^H and is stable even at higher pH value. The primary complex curve [c] and mixed ligand curve [D] overlap each other upto P^H~5.2

This indicates that in this P^H range combination of secondary ligand with metal ion does not take place. The curve C and D diverge from each other after P^H ~5.2. At this P^H range combination of the secondary ligand with primary complex starts at "a" ≥ 2, the mixed titration curve is found to be displaced to the right of the theoretical composite curve, which provide the evidence for increased interaction in the presence of two ligand, which indicates the formation of 1:1:1 mixed ligand species. Non appearance of mixed ligand system supports the formation of ternary species.

From above discussion it is concluded that the formation of ternary complex take place by stepwise chelation in which DTPA acts as a primary ligand and alanine and phenylalanine act as a secondary ligand. The equilibria can be represented as



where ,



Thermodynamic stability constants of complex were obtained graphically by extrapolating to zero ionic strength [$\mu \rightarrow 0$]. The graphical extrapolation was obtained by plotting V_{μ} Vs logK.

The stability order of mixed ligand complexes w.r.t secondary ligand is found to be : alanine < phenylalanine which is the order of increasing P^K value of the secondary ligand.

REFERENCES

1. Block, S.S., *J. Agri. Food. Chem.* 3229 (1995).
2. Beck, M.T. and Nagypal, I, Chemistry of complex equilibria, Ellis Herwood limited, Chichester Hastald Press, New York (1990).
3. Abu-Baker, M.S. *J. Chem., Technol Biotechnical* (1993).
4. Kamble, K.K. jatkar, V.S. Tamhankar, S.S., Shahapure, G.D. Damodar, V-, *J. Inorg. Nucl. Chem.* 42(7) : 1067 (1980).
5. Verma, S. and Saxena, M.C., *Proc. Indian Acad. Sci., Chem. Sci.* 101 (2) : 93 (1989).
6. Maharani, A.V. and Arora Neealam, *J. Indian Chem. Soc.* 60(9) : 833 (1983).
7. Thompson, L.C. and Loraas, *J.A. Inorg. Chem.* 2: 89 (1963).