5-Chloro-7-iodo-8-quinolinol with Some Bivalent Metal ions - A pH Metric Study

B.S.Sekhon, Harvinder K.Sahai and H.S.Randhawa

Department of Chemistry, Punjab Agricultural University, LUDHIANA - 141 004, India

The formation constant of 5-chloro-7-iodo-8-quinolinol with some metal ions in dioxan-water (60:40% v/v) and ethanol-water (75:25% v/v) were determined using pH - metric technique in 0.15 M NaCl at 25°C. The stability constant values for different metal ion complexes follow the order: $Mn^{2+} < Co^{2+} < Ni^{2+} < Cu^{2+} > Zn^{2+}$ in both the media.

Quinoline derivatives were among the earliest synthetic compounds found active against amoebiasis [1] and are still being used in India in spite of their side-effects on mylo-optic nerves. 5-Chloro-7-iodo-8-quinolinol (CIQ) is effective against intestinal amoebiasis [2]. Recently we have synthesized and characterized the complexes of CIQ with some metal ions of biological importance [3]. A survey of literature shows that scanty data is available on the complex formation equilibria of CIQ in solution both by spectrophotometric and potentiometric methods [4,5]. In view of this, stability constants of metal-CIQ complexes are determined in ethanol-water and dioxan-water media and reported here (CIQ is insoluble in water).

EXPERIMENTAL

PH measurements were made with an EC digital pH meter with combined glass and calomel electrode assembly.

The purity of CIQ was checked (m.p.180°C). Stock solutions were prepared in ethanol and dioxan separately. All other reagents were of AnalaR grade and their solutions were prepared in double distilled water. The following solutions at ionic strength 0.15 M NaCl (20 ml each) were prepared for pH metric study in 75:25 v/v ethanol-water and 60:40 v/v dioxan-water medium:

(a) HCl 9.5×10^{-3}M,
(b) a + 1×10^{-3} M CIQ,
(c) b + 2×10^{-4}M metal ion.

The solutions were allowed to attain equilibrium at 25±0.1°C. All the above solutions were titrated pH-metrically with standard 0.106 N NaOH solution. Van Uitert and Haas correction was applied to the pH values [6]. A representative set of titration curves for metal-CIQ system are represented in Fig.1.

Protonation constant of ligand and stability constants of complexes were evaluated using Irving-Rossotti method [7].

RESULTS AND DISCUSSION

CIQ releases one proton in the pH range 6-11 (equilibrium 1); proton-ligand stability constant (pK_1^H) value has been computed in 75:25% v/v ethanol-water and 60:40% v/v dioxan-water (Table 1) and compared with the literature values. The results show that pK_1^H values in ethanol-water and

© E.C.S.I. Bangalore

Table 1

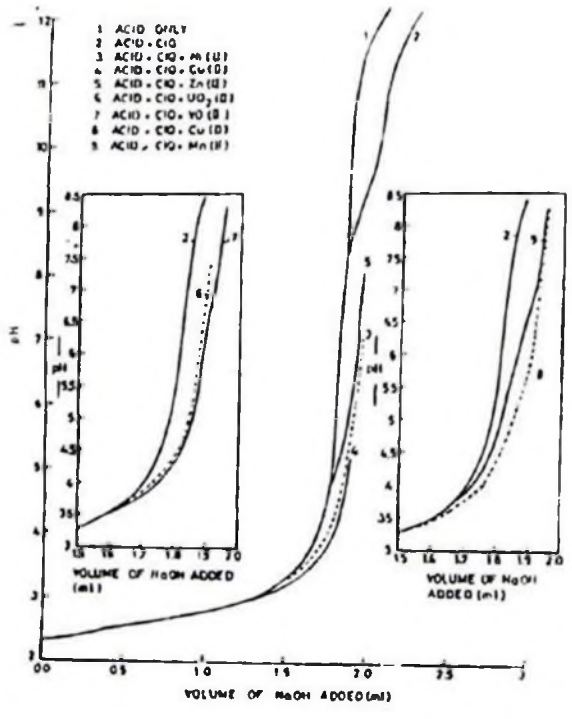
Proton-ligand and metal-ligand stability constants

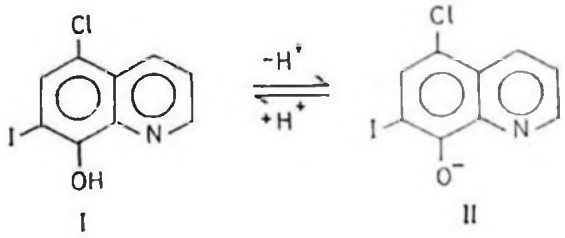
Ligand ClQ; Temperature 25°C, Ionic strength 0.15M NaCl

Cation	Ethanol-water pH range $\bar{n}$=2	75-25 v/v log K_1	log K_2	Dioxan-water pH range $\bar{n}$=2	60-40 v/v log K_1	log K_2
H^+		8.93 8.12 (50:50%) [ref 5] 9.94(100:0%) [ref 4]			9.02 9.07 (75:25%) [9]	
Mn^{2+}	5.0-7.0	6.62	5.31	3.5-6.6	8.13	6.06
Co^{2+}	3.4-4.7	8.37	8.07	3.3-4.9	8.51	7.66
Ni^{2+}	3.3-4.0	8.74	8.34	3.3-4.3	8.41	8.20
Cu^{2+}	2.8-3.5	9.20	8.70	3.0-3.6	8.93	8.79
Zn^{2+}	4.4-5.4	7.42	6.99	4.7-5.6	7.01	6.72
UO_2^{2+}	3.8.4.6	7.91	7.65	3.5-4.4	8.30	7.73
VO^{2+}	4.0=5.2	7.78	6.72	3.5-4.3	8.45	7.77

$\log B_2 = \log K_1 + \log K_2$
Limits of error in the constant: 0.04 log units

in dioxan-water media are in agreement with literature values within tolerable limits.





I II

The n values were calculated from the titration curves, the pH range for $\bar{n}$ to be between 0-2 is given in the table.

The stability constants for the metal complexes were evaluated from the curves of $\bar{n}$ vs pL. The values of log K_1 and log K_2 corresponding to the formation of 1:1 and 1:2 (M:L) complexes have also been listed in Table 1. The stability of the complexes based on log β_2 values (log K_1 + log K_2) follow the Irving-Williams order [8] in both the media i.e. $Mn^{2+} < Co^{2+} < Ni^{2+} < Cu^{2+} > Zn^{2+}$ for metal ions of the first transition series. In case of oxo cations,

the stability sequence observed in ethanol-water medium is $UO_2^{2+} > VO^{2+}$, while reverse order is noticed in dioxan-water medium. The value of log β_2 (14.41 in ethanol-water and 13.73 in dioxan-water) for Zn^{2+} - CIQ complex are lower as compared to Zn^{2+} complexes of 5-iodo-8-quinolinol (14.86) and 5-chloro-8-quinolinol (15.80); this is so because the latter drugs are more basic than CIQ. The pK_1 values of 5-chloro-8-quinolinol and 5-iodo-8-quinolinol are 10.47 and 10.27 respectively [9]. The low pK_1^{II} value of CIQ is due to the presence of electron attracting groups - chloro and bromo - in the ligand. Consequently CIQ becomes a poor donor resulting in the decrease in stability of CIQ complexes.

REFERENCES

1. H.H.Anderson and E.L.Hansen, *Pharmacol Rev.*, **2** (1950) 399.
2. *The Pharmacological Basis of Therapeutics*, 4th ed. L.S.Goodman and A.Gillman, (Eds.) **Macmillan, New York, N.Y.** (1972) pp 1137-1139.
3. B.S.Sekhon, H.K.Sahai and H.S. Randhawa, *Unpublished work*
4. R.Abu-Eittah, M.M.Seif El-Nasr and M.M.Amer, *J.Pharm.Sci.*, **63** (1974) 1866.
5. Y.K.Agarawal and D.R.Patel, *J.Pharm.Sci.*, **75** (1986) 190.
6. L.G.Van Uiterrt and C.G.Haas, *J.Amer.Chem.Soc.*, **75** (1953) 451
7. H.Irving and H.S.Rossotti, *J.Chem.Soc.*, **(1954)** 2904; **(1953)** 3397
8. H.Irving and R.J.P.Williams, *J.Chem.Soc.*, **(1958)** 3192.
9. J.G.Jones, J.B.Poole, J.C.Tomkinson and R.J.P.Williams, *J.Chem.Soc.*, **(1958)** 2001.