

STUDY OF (Cd II–8–HYDROXY QUINOLINE – MALATE/TARTRATE) SYSTEM AS A TOOL IN REMOVAL OF EXCESS CADMIUM FROM HUMAN BLOOD: A POLAROGRAPHIC APPROACH

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ABSTRACT

The excess of heavy metals such as Cadmium, Chromium, Lead etc. are highly injurious to health. With the assumption the heaviness and toxicity are interrelated, heavy metals also include metalloides, such as arsenic; that are able to induce toxicity. 8-Hydroxy Quinoline is used as complexing reagent with almost every metal to form un charged chelates . We have been studied mixed ligand complexes of 8-Hydroxy quinoline (8-HQ), malate (mal^{2-}) and tartrate (tar^{2-}) with Cd (II) which make Cd soluble and excrete it through urine. The stability constants of these soluble complexes $[Cd(8-HQ)(mal)]$, $[Cd(8-HQ)(mal)_2]^{2-}$, $[Cd(8-HQ)_2(mal)]$ and complexes $[Cd(8-HQ)(tart)]$, $[Cd(8-HQ)(tart)_2]^{2-}$, $[Cd(8-HQ)_2(tart)]$ are $\log \beta_{11} = 6.677$, $\log \beta_{12} = 7.243$, $\log \beta_{21} = 10.841$ and $\log \beta_{11} = 5.949$, $\log \beta_{12} = 6.883$, $\log \beta_{21} = 9.799$ respectively at pH 7.4 and $25 \pm 0.1^\circ C$. The value of stability constant is determined by polarographic method.

Keyword: Polarography, Mixed Ligand Complexes, Stability Constants, Equilibrium Constant Disproportion.

I. INTRODUCTION

The excess of some metals such as Cadmium, Chromium, Lead etc. are highly injurious to health. . With the assumption the heaviness and toxicity are interrelated, heavy metals also include metalloides , such as arsenic; that are able to induce toxicity¹. The main route of exposure to Cadmium is via inhalation of cigarette smoke and ingestion of food^{2,3}. Several studies have demonstrated that reactive oxygen species (ROS) production and oxidative stress play a key role in the toxicity and carcinogenicity of heavy metals such as cadmium and lead⁴⁻⁶. Hence it is imperative that the excess amount of Cadmium in the human blood excreted by means of complexes which make Cadmium soluble and excreted it through urine.

The present study is aimed at presenting complexes which make excess cadmium soluble. Hence it is highly useful for the health of children as well as for adults. It will have tremendous medicinal value in future. From the survey of literature⁷⁻²² it appears that polarographic studies of mixed complexes of Cd(II) with 8-HQ and malate and tartrate are still lacking. Hence the present work has been under taken. The communication deals with the studies of mixed ligand complexes of Cd(II) with 8-HQ, malate and tartrate.

II. EXPERIMENTAL

All reagents were analytical grade and their solutions were prepared in conductivity water. The ionic strength was maintained constant at $\mu=1.5$ M using NaNO_3 as supporting electrolyte. The concentration of Cd(II) was maintained at 1×10^{-3} M. NaNO_3 was used as supporting electrolyte and also to maintain a constant ionic strength ($\mu = 1.5$ M). Triton X-100 (2×10^{-3} %) was used as a maximum suppressor. All the measurements were made at $25 \pm 0.1^\circ\text{C}$ and pH 7.4. A saturated calomel electrode (S.C.E.) was used as reference electrode²³. The d.m.e. had the following characteristics (in 0.1 M NaNO_3 , open circuit): $m=2.219$ mg/sec., $t=3.5$ sec, $m^{2/3} t^{1/6} = 2.10$ $\text{mg}^{2/3} \text{sec}^{-1/2}$, $h_{\text{corr}} = 40$ cm.

The simple system of Cd(II) with 8-HQ, malate and tartrate were studied at different concentrations from 0.10 M to 0.60 M separately prior to the study of mixed system. In case of mixed systems 8-HQ concentration was varied from 1×10^{-4} M to 6×10^{-4} M and that of malate and tartrate was kept constant at 0.10 M. The system was repeated at another concentration of malate and tartrate (0.20 M)

III. RESULTS & DISCUSSION

The reduction of Cd(II) in β -picoline, malate, and tartrate were found to be reversible and diffusion controlled. The same was true for the mixed system. The slopes of linear plots of $\log i/i_d - i$ vs $E_{d.m.e.}$ were in the range 30-32 mv and the plots of i_d vs $h^{1/2}_{\text{corr}}$ were linear and passed through the origin with the addition of increasing amounts of 8-HQ it is seen that $E_{1/2}$ of Cd (II) is shifted, in each case, to more negative values there was showing the formation of complexes. The plots of $E_{1/2}$ Vs $\log [8\text{-HQ}]$ are smooth curves thereby indicating the formation of successive complexes. The composition and stability constants of the simple complexes have been determined by DeFord and Hume’s method²⁴. The results are detailed below:

Table: Composition and Stability constants

<u>System</u>	<u>Complex species</u>	<u>Stability constants</u>
Cd(II) – β -8-HQ	$[\text{Cd}(\beta\text{-8-HQ})]^{2+}$	$\log \beta_1 = 4.6919$
	$[\text{Cd}(\beta\text{-8-HQ})_2]^{2+}$	$\log \beta_2 = 8.5788$
	$[\text{Cd}(\beta\text{-8-HQ})_3]^{2+}$	$\log \beta_3 = 12.7427$
Cd(II) – mal^{2-}	$[\text{Cd}(\text{mal})]$	$\log \beta_1 = 1.7923$
	$[\text{Cd}(\text{mal})_2]^{2-}$	$\log \beta_2 = 2.8027$
	$[\text{Cd}(\text{mal})_3]^{4-}$	$\log \beta_3 = 3.3673$
Cd(II)– tart^{2-}	$[\text{Cd}(\text{tart})]$	$\log \beta_1 = 1.5947$
	$[\text{Cd}(\text{tart})_2]^{2-}$	$\log \beta_2 = 2.0280$
	$[\text{Cd}(\text{tart})_3]^{4-}$	$\log \beta_3 = 2.8102$

The method of Schaap and McMaster²⁵ was used to determine the values of the stability constants of mixed complexes. The results are detailed below:

Cd(II)- 8-HQ– Malate system

$[\text{Cd}(8\text{-HQ})(\text{mal})]$; $\log \beta_{11} = 6.6772$

IV. CONCLUSION

The value of the stability constant show that the soluble the mixed ligand complexes of Cd (II) with 8-HQ, malate and tartrate are stable. So 8-HQ, malate and tartrate can form the soluble complexes with the Cadmium present in the human blood and they can excrete it through urine.

V. ACKNOWLEDGEMENT

We thank Principal, Narain College, Shikohabad for provision of facilities. We also thank most sincerely to General Manager, HIND LAMPS LTD., Shikohabad for sparing us a nitrogen cylinder.

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