# SPECTROPHOTOMETRIC,CONDUCTOMETRIC STUDY OF STABILITY CONSTANT OF SUBSTITUTED 1,3-DIARYL CARBAMIDES WITH TRANSITION METAL IONS.

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**A B S T R A C T**

**Substituted 1,3Diarylcarbamides were synthesized by green chemistry technique . Structures were confirmed by spectral & CHN Analysis. These compounds were further implemented for complexometric study with $Cu^{2+}$,$Ni^{2+}$,$Co^{2+}$ transition metal ions by Spectrophotometric and conductometric techniques. Conductometric involved modified Job's method for the study Comparative results obtained by both techniques were used to judge the nature of complexes.**

**Keywords: 1,3-Diaryl carbamides , Conductometry, Spectrophotometry, Stability Constant.**

## Introduction

Heterocyclic compounds have wide applications in pharmaceutical chemistry, medicinal chemistry etc.The nitrogen containing heterocyclic compounds exhibits antimicrobial, anticancer, antiviral activity[1,2] etc. The heterocyclic compounds selected for the study where 1,3-diaryl carbamides. i.e. 1,3-di-o-tolyl carbamide (Ia), 1,3-di-m-tolyl carbamide (IIa) and 1,3-di-p-tolyl carbamide (IIIa). These were synthesized by green chemistry techniques i.e. microwave synthesis[3] by known method[4]. Structures were confirmed by spectral analysis and CHN analysis.

The compounds were further implemented for complex metric study by analytical techniques spectrophotometry and conductometry[5].

## Experimental

Themetal ions use for study were $Co^{2+}$,$Ni^{2+}$,$Cu^{2+}$.The ligands used were Ia,IIa,IIIa.

## Spectrophotometric Study

We work relate comparative study of two techniques. Equimolar solution of $Cu^{2+}$ and ligand 1,3-diaryl carbamide($1 \times 10^{-2}$) were mixed in different proportions to prepare Job's solutions. Final volume of each solution was fixed upto 10ml after adjusting appropriate pH and maintaining ionic strength μ = 0.1 M constant. $\lambda_{max}$ was selected as proposed by Vasburgh and Robert Gold[6] Job's curves were constructed from which metal ligand stability constant was calculated by Job's method and same procedure was repeated for remaining metal ions.

## Conductometric Study

Similar solutions as in spectrophotometric study were prepared. These serves as Job's solution for which conductance was recorded. Corrected conductance may be determined by using the formula

Corrected Conductance = [ (V+v) / V] x observed conductance.

V – Initial volume of ligand

v – Volume of metal. The curves were constructed between metal ligand ratio and corrected conductance Turner and Anderson's[7] by modified Job's method for determination of stabilityconstant

$$K = x/((a-x)(b-x))$$

a,b – initial concentration of metal ion and ligand concentration.

x-is concentration of complex can be calculated for Job's curved.

**Table 1:Spectrophotometric study**

| Sr. No. | Composition M : Ia | Optical Density $Cu^{2+}$ Temperature | | Optical Density $Ni^{2+}$ | | Optical Density $Co^{2+}$ | |
|---|---|---|---|---|---|---|---|
| | | a | B | a | b | a | b |
| **1** | 1 : 9 | 0.099 | 0.091 | 0.108 | 0.058 | 0.186 | 0.138 |
| **2** | 2 : 8 | 0.091 | 0.096 | 0.129 | 0.097 | 0.238 | 0.215 |
| **3** | 3 : 7 | 0.082 | 0.072 | 0.204 | 0.180 | 0.284 | 0.198 |
| **4** | 4 : 6 | 0.062 | 0.052 | 0.357 | 0.309 | 0.371 | 0.331 |
| **5** | 5 : 5 | 0.321 | 0.216 | 0.417 | 0.388 | 0.469 | 0.421 |
| **6** | 6 : 4 | 0.291 | 0.121 | 0.400 | 0.360 | 0.484 | 0.428 |
| **7** | 7 : 3 | 0.121 | 0.142 | 0.341 | 0.287 | 0.389 | 0.343 |
| **8** | 8 : 2 | 0.141 | 0.136 | 0.249 | 0.182 | 0.271 | 0.228 |
| **9** | 9 : 1 | 0.022 | 0.012 | 0.140 | 0.107 | 0.247 | 0.194 |
| | **M :IIa** | | | | | | |
| **1** | 1 : 9 | 0.412 | 0.321 | 0.106 | 0.084 | 0.188 | 0.109 |
| **2** | 2 : 8 | 0.516 | 0.141 | 0.186 | 0.137 | 0.256 | 0.217 |
| **3** | 3 : 7 | 0.516 | 0.511 | 0.217 | 0.180 | 0.387 | 0.328 |
| **4** | 4 : 6 | 0.821 | 0.612 | 0.297 | 0.280 | 0.352 | 0.301 |
| **5** | 5 : 5 | 0.912 | 0.821 | 0.356 | 0.340 | 0.467 | 0.407 |
| **6** | 6 : 4 | 0.321 | 0.221 | 0.304 | 0.281 | 0.502 | 0.510 |
| **7** | 7 : 3 | 0.121 | 0.099 | 0.285 | 0.263 | 0.314 | 0.258 |
| **8** | 8 : 2 | 0.141 | 0.131 | 0.219 | 0.186 | 0.251 | 0.108 |
| **9** | 9 : 1 | 0.101 | 0.066 | 0.210 | 0.138 | 0.260 | 0.307 |
| | **M :IIIa** | | | | | | |
| **1** | 1 : 9 | 0.220 | 0.140 | 0.108 | 0.087 | 0.284 | 0.227 |
| **2** | 2 : 8 | 0.200 | 0.120 | 0.194 | 0.161 | 0.304 | 0.278 |
| **3** | 3 : 7 | 0.190 | 0.111 | 0.280 | 0.239 | 0.381 | 0.321 |
| **4** | 4 : 6 | 0.420 | 0.340 | 0.316 | 0.281 | 0.457 | 0.389 |
| **5** | 5 : 5 | 0.550 | 0.420 | 0.382 | 0.329 | 0.529 | 0.492 |
| **6** | 6 : 4 | 0.370 | 0.381 | 0.383 | 0.330 | 0.488 | 0.421 |
| **7** | 7 : 3 | 0.210 | 0.201 | 0.326 | 0.321 | 0.417 | 0.374 |
| **8** | 8 : 2 | 0.410 | 0.281 | 0.254 | 0.218 | 0.380 | 0.318 |
| **9** | 9 : 1 | 0.320 | 0.268 | 0.119 | 0.101 | 0.307 | 0.256 |

a = Concentration of M & L = 0.01 N b = Concentration of M & L = 0.005 N

**Table 2: Conductometric study**

Temperature : 3

| Sr. No. | Composition M : Ia | Corrected Conductance $Cu^{2+}$ | | Corrected Conductance $Ni^{2+}$ | | Corrected Conductance $Co^{2+}$ | |
|---|---|---|---|---|---|---|---|
| | | a | B | a | b | a | b |
| **1** | 1 : 9 | 0.1551 | 0.0814 | 0.0924 | 0.0682 | 1.001 | 0.781 |
| **2** | 2 : 8 | 0.1224 | 0.1224 | 0.1200 | 0.984 | 0.972 | 1.068 |
| **3** | 3 : 7 | 0.1703 | 0.1573 | 0.2496 | 0.1963 | 0.988 | 0.806 |
| **4** | 4 : 6 | 0.4774 | 0.2828 | 0.2548 | 0.2072 | 0.714 | 0.672 |
| **5** | 5 : 5 | 0.1830 | 0.7890 | 0.4815 | 0.6315 | 1.08 | 0.465 |
| **6** | 6 : 4 | 0.8512 | 0.6112 | 1.1424 | 0.8336 | 0.336 | 0.336 |
| **7** | 7 : 3 | 0.6465 | 0.4097 | 0.5797 | 0.6987 | 1.972 | 1.683 |
| **8** | 8 : 2 | 0.5156 | 0.4878 | 0.7416 | 0.5778 | 0.738 | 0.810 |
| **9** | 9 : 1 | 0.3629 | 0.3439 | 0.2204 | 0.3059 | 0.418 | 0.038 |
| | | **M :IIa** | | | | | |
| **1** | 1 : 9 | 0.199 | 0.112 | 0.1551 | 0.1419 | 1.331 | 1.089 |
| **2** | 2 : 8 | 0.238 | 0.169 | 0.1452 | 0.1188 | 1.668 | 0.744 |
| **3** | 3 : 7 | 0.405 | 0.261 | 0.2574 | 0.1846 | 1.846 | 0.663 |
| **4** | 4 : 6 | 1.247 | 0.897 | 0.3374 | 0.2072 | 2.086 | 0.686 |
| **5** | 5 : 5 | 0.9315 | 0.808 | 1.1415 | 0.7935 | 2.58 | 0.480 |
| **6** | 6 : 4 | 0.657 | 0.387 | 1.2932 | 0.8544 | 3.072 | 2.064 |
| **7** | 7 : 3 | 0.409 | 0.159 | 1.0404 | 0.6957 | 1.734 | 1.666 |
| **8** | 8 : 2 | 0.217 | 0.111 | 0.9576 | 0.3978 | 1.80 | 1.278 |
| **9** | 9 : 1 | 0.199 | 0.079 | 0.8949 | 0.7638 | 1.178 | 1.178 |
| | | **M :IIIa** | | | | | |
| **1** | 1 : 9 | 0.177 | 0.167 | 0.5291 | 0.3091 | 1.122 | 1.10 |
| **2** | 2 : 8 | 0.214 | 0.181 | 0.3852 | 0.2568 | 2.304 | 2.052 |
| **3** | 3 : 7 | 0.166 | 0.222 | 0.2873 | 0.2483 | 2.613 | 2.457 |
| **4** | 4 : 6 | 0.198 | 0.282 | 0.3486 | 0.2086 | 2.688 | 2.534 |
| **5** | 5 : 5 | 0.480 | 0.417 | 1.2285 | 1.143 | 2.160 | 1.830 |
| **6** | 6 : 4 | 0.355 | 0.206 | 1.2176 | 0.6912 | 3.536 | 3.200 |
| **7** | 7 : 3 | 0.214 | 0.171 | 1.0523 | 0.8704 | 2.907 | 2.574 |
| **8** | 8 : 2 | 0.237 | 0.217 | 0.7542 | 0.5796 | 2.898 | 2.772 |
| **9** | 9 : 1 | 0.277 | 0.248 | 1.9599 | 1.1799 | 3.268 | 2.850 |

a = Concentration of M & L = 0.01 N b = Concentration of M & L = 0.005 N

**Table: 3 Comparative results of Spectrophotometric & Conductometric techniques**

| Sr. No. | Name of metal & ligand | K ( Spectrophotometrically) | K (Conductometrically) |
|---|---|---|---|
| **1** | $Cu^{2+}$-IIIa | 3.552836 | 3.914672 |
| **2** | $Cu^{2+}$-IIIb | 3.650884 | 3.707479 |
| **3** | Cu2+-IIIc | 3.511124 | 4.121786 |
| **4** | $Ni^{2+}$-IIIa | 4.396321 | 4.425126 |
| **5** | $Ni^{2+}$-IIIb | 3.702002 | 2.947378 |
| **6** | $Ni^{2+}$-IIIc | 3.415491 | 2.899086 |
| **7** | $Co^{2+}$-IIIa | 4.121786 | 2.728824 |
| **8** | $Co^{2+}$-IIIb | 0.540394 | 2.441148 |
| **9** | $Co^{2+}$-IIIc | 3.665822 | 4.1633761 |

## Results & Discussion

The spectrophotometric technique using the formula of $K = [ML]/[M][L]$ Theconditional stability constant log K was determined by Job's variation method. By considering the concept of ionic changes occurring during complex formation, the conductance of solution may be used as a basis for the Conductometric study and applied modified Job's method for determination of stability constant. By considering same aspect, Conductometric determination of stability constant of 1,3-di-o-tolyl carbamides, 1,3-di-m-tolyl carbamides, 1,3-di-p-tolyl carbamide with transition metal ions Cu,Co,Ni was carried out.

The transition metal ions shows variables oxidation states and 2+ oxidation state is common for them.These metal ions great tendency to form complexes with several ligands like neutral molecules like $NH_3$,$H_2O$,$CN^-$,$Cl^-$etc.These ligands possess lone pair of $e^-$ which they donate to transition metal ion in the formation of complex compound. These metal ions have small size and high positive charge density which makes them easy to accept lone pair of electrons from ligands.They form stable complexes with N,O and F donors and have strong metal ligand orbital interaction. The values of stability constant by spectrophotometry and cunductometry are presented in table 3. The data revels that the values of conditional stability constants obtained by both techniques represents good agreement with each other which reflects the stable complex formation between transition metal ions and ligands

## Conclusion

Results obtained from Spectrophotometric and cunductometric techniques are in good agreement with each other indicating 1:1 complex formation.

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