



Where,  $V^0$  = Initial volume of solution (50 ml)  
 $N$  = Normality of sodium hydroxide  
 $T^0_L$  = Concentration of ligand in 50 ml solution  
 $E^0$  = Initial concentration of free acid ( $HNO_3$ )  
 $\gamma$  = Number of dissociable proton from ligand  
 $V_1$  and  $V_2$  – Volume of alkali consumed by acid and ligand on same pH

**Metal- ligand formation number (n):-**

The deviation of (A + L +M) curve from (A +L) started at about pH 3.5, It indicate the commencement of complex formation

Metal – Ligand formation number (n) was calculated by following expression.

$$n = (E^0 + N) (V_3 - V_2) / (V^0 + V_2) (T^0_M) \times nA$$

$V^0$  = Initial volume of solution (50 ml)

$N$  = Normality of sodium hydroxide

$T^0_M$  = Concentration of the metal ions

$nA$  = Proton – ligand formation number

$E^0$  = Initial concentration of free acid ( $HNO_3$ )

Where,  $V_2$  and  $V_3$  – volume of NaOH consumed by ligand and metal ions at same pH.

Metal – Ligand Formation curves:-

Formation Curves were plotted between n and  $p^H$ . The metal-ligand stability constants were determination by half integral method

Half Integral Method:-The metal- ligand stability constants ( $\log, k_1$  values) are calculated from formation curves. The values of  $n = 0.5$  which corresponds to the values of  $Pk$ .

The values of metal – ligand stability constants i.e.  $\log k$  for all the systems were presented in tables.

**Table: Stability constants and thermodynamic parameters of  $Co^{2+}, Zn^{2+}$  with Ibuprofen**

System	Temperature	pKa	logK	$-\Delta H$ ( $KJmol^{-1}$ ) At $30^0C$	$-\Delta G$ ( $KJmol^{-1}$ )	$-\Delta S$ ( $KJmol^{-1} deg^{-1}$ ) At $30^0C$
Zn(II)Ibuprofen	25	5.7446	7.1956	8.852	41.057	0.10835
	30	5.7385	7.17		41.597	
	35	5.7215	6.9554		41.018	
Co(II)Ibuprofen	25	5.7446	7.2649	27.662	41.452	0.04627
	30	5.7385	7.1849		41.683	
	35	5.7215	7.1695		42.280	

**4. Conclusion**

The results obtained from the pH metric measurements, the values of pKa were found to decrease with increasing temperature. The values of the thermodynamic functions  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  were calculated. The values of stability constants reveal that the stability constants decrease with increasing temperature, along with the pKa value.

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**References**

[1] The American Society of Health-System Pharmacists. Retrieved Jan 2016.  
 [2] Joint Formulary Committee (2013). British National Formulary (BNF) (65 ed.). London, UK: Pharmaceutical Press. pp. 665, 671. ISBN 978-0-85711-084-8.  
 [3] Rossi, S, ed. (2013). Australian Medicines Handbook (2013 ed.). Adelaide: The Australian Medicines Handbook Unit Trust. ISBN 978-0-9805790-9-3.  
 [4] "Ibuprofen". The American Society of Health-System Pharmacists. Retrieved 3 April 2011.  
 [5] R. Senthilnithy, M.D.P. de Costa, and H.D. Gunawardhana. J. Natural Sci. Foundation Sri Lanka, 36: 191(2008).  
 [6] K. Ali, N. Fatima and Z.T. Maqsood, Scientia Iranica, 12: 311(2005).

[7] V.T.Chaudhari, M.B.Ubale and M.Farooqui. Journal of Ultra Chemistry, 5: 219(2009).  
 [8] M. Calvin and K. W. Wilson, J. of American Chemical Soc., 67: 2003(1945).  
 [9] J. Bjerrum, On the tendency of metal ions toward complex formation. In 6th Meeting of Scandinavian chemists, Lund, Sweden (1947).  
 [10] H.M. Irving and H.S. Rossotti, J. of the Chemical Society, 2904(1954).