Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Pelagia Research Library

Advances in Applied Science Research, 2016, 7(3):120-126

Advances in Applied Science Research
Pelagia Research Library
ISSN: 0976-8610
CODEN (USA): AASRFC

Determination of refractive index, density, molar refraction and polarizability constant of substituted N,N'-bis(salicyliden)-arylmethanediamines in different binary mixture refractometrically

A. S. Chandami, P. P. Choudhari and M. P. Wadekar*

Applied Chemistry Division, Govt. Vidarbha Institute of Science and Humanities, Amravati, (MS), India

---

ABSTRACT

The molecular interactions in the solution are studied with the help of refractometric measurements. The densities and refractive index measurement of substituted N,N'-bis(salicyliden)-arylmethanediamines in two different solvents were performed. The experimental data so obtained used in the determination of molar refraction (Rm) and polarizability constant (α) of substituted-N,N'-bis(salicyliden)-arylmethanediamines drug.

Keywords: substituted N,N'-bis(salicyliden)-arylmethanediamine, densites, refractive index, molar refraction and polarizability constant.

INTRODUCTION

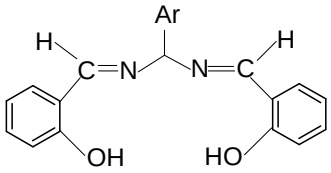
The refractive index or index of refraction (n_D) is one of the physicochemical properties of substances (optical medium). The refractive index can provide information for us about the behavior of light. Thomas Young was presumably the person who first used, and invented, the name "index of refraction", in 1807. When light passes through the different substances its velocity decreases by increasing of the refractive index of these substances. It can be due to interaction between molecules of components in substrate and effect of these interactions on light. Also in the most substrates, the refractive index decreases by increasing of the temperature. The interaction between molecules decreases as the temperature increases. The refractive index of different substrates measures with refractometers.

The refractometric study of substituted aminopyrimidine in polar solvents were performed[1].The refractive index increment (dn/dc) of molecule and macromolecule solutions by surface plasmon resonance was determined[2]. Measurements of the refractive indices and refractive index increment of a synthetic polymethyl-methacrylate (PMMA) solutions at 488 nm were reported[3].Certain report was published on the interferometric measurements of refractive index increment of polymer solutions[4]. Refractive index, density, molar refraction and polarizability constant of substituted 2,3-dihydroquinazolin-4(1H)-ones in different binary mixtures were published[5]. Several reports were available on the refractomtric study of many compounds [6-9]. Density and refractive index for substituted-2,3-dihydroquinazolin- 4(1H)-ones have been measured in binary mixtures with different composition , percentage, and at constant ligand concentration of 0.01M was known[10].

The molecular interactions of human mixtard insulin with an antibiotic was performed by viscometric, ultrasonic and refractometric studies[11].

The ligand N,N'-bis(salicyliden)-arylmethanediamines having imine linkage. The organic molecules, having azomethine linkage (C=N), are prevalently known as Schiff bases after Hugo Schiff[12]. Schiff's bases are flexible ligands, also known as imine or azomethine, having spacious applications in various fields of human interests. They are widely used for industrial purposes and also exhibit a broad range of biological activities[13]. The physical characterization and biological evaluation of some Schiff base complexes with metals including Co, Cu, Ni were reported[14]. It is reported that azomethines show signs of a number of biological activities and plays an important role in the regulation of many biochemical processes[15]. Compounds having imine linkage posses the antimalarial properties[16].The antimicrobial activity of Schiff bases were also mentioned[17].There are many reports were presented on the anti-inflammatory properties of compounds having imine linkage[18].Some Schiff bases were found to posses anti-inflammatory as well as analgesic properties[19]. Schiff base derivatives have attracted continuing interest because of their varied applications to controlled paste and insect[20]. Cis-Dioxomolybdenum(VI) Schiff base Complex shows the potent insecticidal activity[21].

The present investigation deals with the determination of refractive index, density, molar polarisation and polarisability constant of substituted N,N'-bis(salicyliden)-arylmethanediamines in two different solvents in various percentage.



Ligand A (L_A) = *N,N'-bis(salicyliden)-arylmethanediamine*
Ligand B (L_B) = *N,N'-bis(salicyliden)-furylmethanediamine*
Ligand C (L_C) = *N,N'-bis(salicyliden)-nitroarylmethanediamine*
Ligand D (L_D) = *N,N'-bis(salicyliden)-anisylmethanediamine*
L_A : Ar = $-C_6H_5$
L_B : Ar = $-C_4H_4O$
L_C : Ar = $-C_6H_5NO_2$
L_D : Ar = $-C_6H_5OCH_3$

MATERIALS AND METHODS

The refractive indices of solvent mixture and solutions were measured by Abbe's refractometer (±0.001). Initially, the refractometer was calibrated with glass piece (n=1.5220) provided with the instrument. For evaluating the molar refraction and polarizability constant of the compounds, prepared the solution of 20%, 40%, 60%, 80% and 100% in DMF-Water, Ethanol-Water, mixture by adding accurately weighed substituted N,N'bis(salicyliden)-arylmethanediamine at, 27± 0.1^0C . The temperature was maintained by using the thermostat. The data obtained was used to compute intermolecular interactions. The refractrometric readings were taken as described in literature[22]. The substituted bis schiff bases ligands used for the study were synthesized by standard method[23].

RESULTS AND DISCUSSION

The molar refraction of solvent - water mixtures are determined from-

$$R_{S\text{-}W} = X_1R_1 + X_2R_2 \quad (1)$$

Where,
R_1 and R_2 are molar refractions of solvent and water respectively.

The molar refraction of solutions of ligand in solvent-water mixtures are determined from-

$$R_{Mix} = \frac{(n^2-1)}{(n^2+2)} + \left\{\frac{[X_1M_1+X_2M_2+X_3M_3]}{d}\right\} \quad (2)$$

Where,
'n' is the refractive index of solution, 'd' is the density of solution, X_1 is mole fraction of solvent, X_2 is mole fraction of water and X_3 is mole fraction of solute, M_1, M_2 and M_3 are molecular weights of solvent, water and solute respectively.

The molar refraction of ligand is calculated as –

$$R_{lig} = R_{mix} - R_{s-w} \quad (3)$$

The polarizability constant (α) of ligand is calculated from following relation-

$$R_{lig} = 4/3\ \pi No\alpha \quad (4)$$

Where, No is Avogadro's number.

Table 1: Values of molar refraction of different composition of solvents

% of solvent mixture	Molar Refraction [Rm]	
	DMF	Ethanol
20%	17.0959	12.4983
40%	16.4094	11.5390
60%	15.1196	10.1181
80%	11.7214	7.8878
100%	4.5214	4.2067

Table 2: The values of refractive index (n), density (d), molar refraction (Rm) and polarizability constant (α) at 300K in DMF

Conc. in %	Constant ligand concentration system(0.01M) with change in DMF percentage			
	Refractive index (n)	Density (d) gm/cm^3	Rm x10^3 cm^3/mol	α x10^{-23} cm^3
Ligand L_A				
20	1.356	0.9861	60.2102	2.3877
40	1.377	0.9870	70.6268	2.8008
60	1.385	0.9892	74.7753	2.9653
80	1.391	1.0053	76.1804	3.0210
100	1.423	1.0213	81.5767	3.2350
Ligand L_B				
20	1.355	0.9849	55.3196	2.1938
40	1.378	0.9955	64.7046	2.5659
60	1.381	0.9960	67.8135	2.6892
80	1.410	1.0066	73.1110	2.8993
100	1.427	0.9907	77.9739	3.0922
Ligand L_C				
20	1.357	0.9844	68.4108	2.7129
40	1.378	0.9949	79.7411	3.1622
60	1.392	0.9960	85.7059	3.3988
80	1.414	0.9972	91.7476	3.6384
100	1.425	0.9895	95.8443	3.8008
Ligand L_D				
20	1.356	0.9822	65.8723	2.6122
40	1.378	0.9924	76.9773	3.0526
60	1.393	0.9927	82.9808	3.2907
80	1.414	1.0063	87.5379	3.4714
100	1.428	0.9895	92.8448	3.6819

In the present study the molar refraction, polarizability constant and refractive indices of above mentioned ligands in the different percentage i.e 20%, 40%, 60%, 80%, 100% of DMF and ethanol solvents were performed at 300K. The experimental data so obtained showed that the molar refraction (Rm), increases as the percentage of organic solvent increases. The Rm values of DMF and ethanol are summarized in table 1. The same trend was observed for the polarizability constant(α) of compound; the values of polarizability constant found to increases as the percentage of solvent increases. This may happened due to increase in dielectric constant of medium with concentration and also considerable dipole association (intermolecular attraction) take place, which would be accompanied by increases in polarizability. The refractive index, density, molar refraction and polarizability constant of substituted-N,N'-

bis(salicyliden)-arylmethanediamine drugs are mentioned in table 2 and 3 for DMF and ethanol solvent respectively. Fig.1-10 represent plot of Rm vs percentage of both the solvents.

Table3: The values of refractive index (n), density (d), molar refraction (Rm) and polarizability constant (α) at 300K in Ethanol

Conc.in %	Constant ligand concentration system(0.01M) with change in Ethanol percentage			
	Refractive index (n)	Density (d) gm/cm^3	Rm x10^3 cm^3/mol	α x10^{-23} cm^3
Ligand L_A				
20	1.346	0.9619	59.6151	2.36
40	1.356	0.9374	70.1312	2.78
60	1.361	0.9115	76.0281	3.02
80	1.363	0.8807	80.7499	3.20
100	1.364	0.8516	84.7841	3.36
Ligand L_B				
20	1.345	0.9297	56.7455	2.25
40	1.359	0.9255	65.9743	2.62
60	1.361	0.9064	70.4693	2.79
80	1.363	0.8873	73.8582	2.93
100	1.364	0.8560	77.7305	3.08
Ligand L_C				
20	1.345	0.9624	67.4107	2.67
40	1.355	0.9404	79.1665	3.14
60	1.360	0.9095	86.3253	3.42
80	1.363	0.8859	91.1820	3.62
100	1.365	0.8538	96.3038	3.82
Ligand L_D				
20	1.354	0.9255	69.1031	2.74
40	1.360	0.9198	78.9246	3.13
60	1.361	0.8935	84.8163	3.36
80	1.364	0.8709	89.5181	3.55
100	1.365	0.8491	93.2284	3.70

Graphical representation of molar refraction (Rm) versus change in DMF solvent percentage at constant concentration (0.01M) of ligand

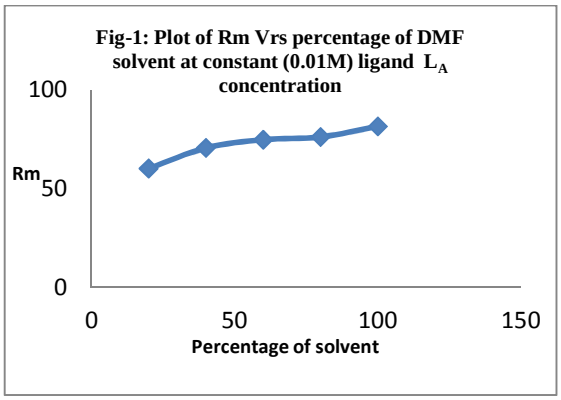


Fig-1: Plot of Rm Vrs percentage of DMF solvent at constant (0.01M) ligand L_A concentration

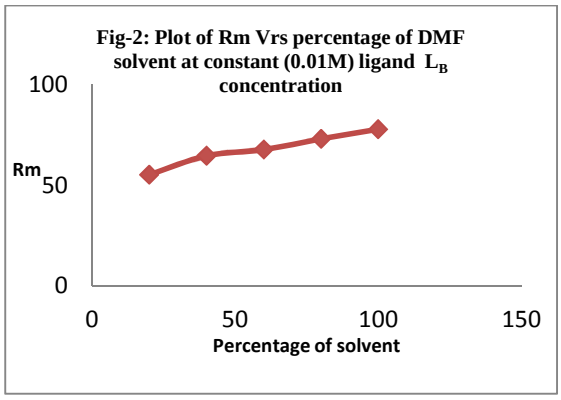
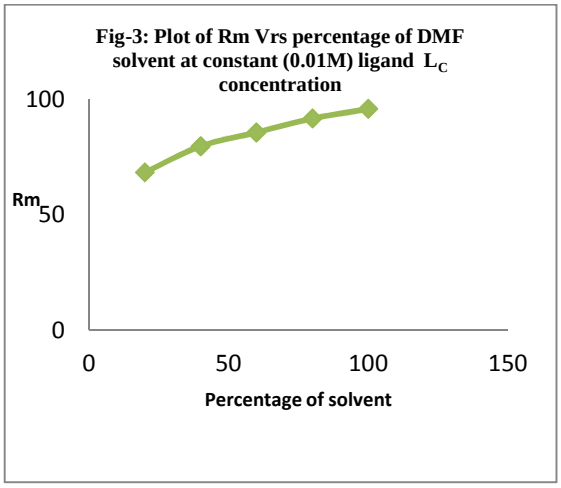
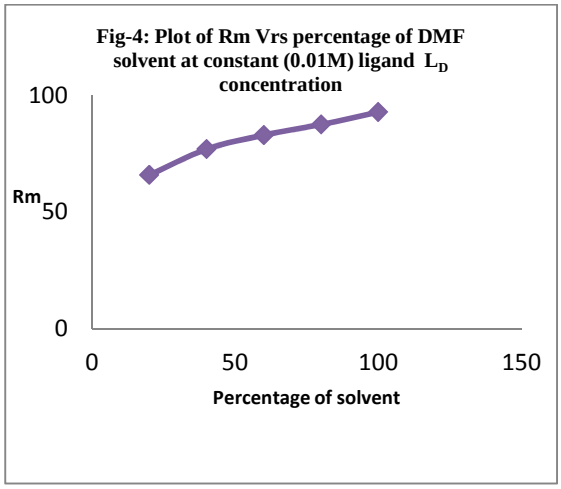
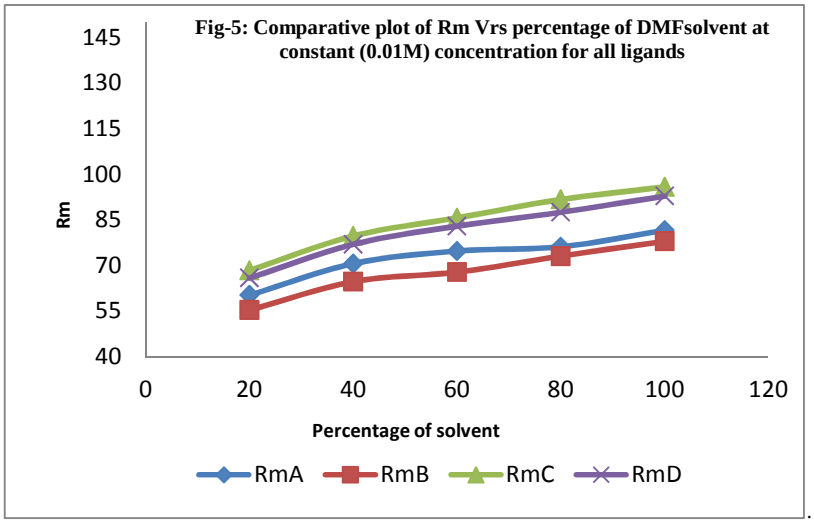


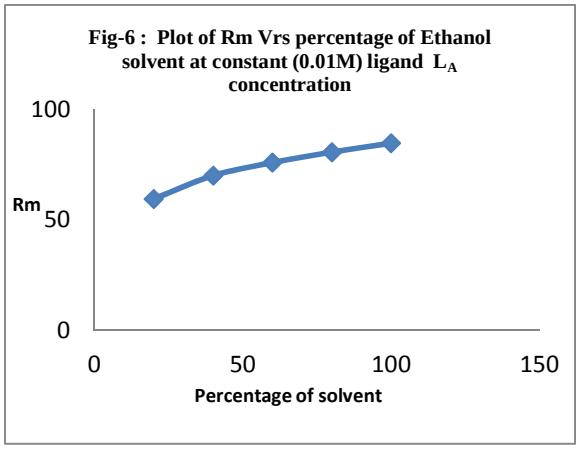
Fig-2: Plot of Rm Vrs percentage of DMF solvent at constant (0.01M) ligand L_B concentration

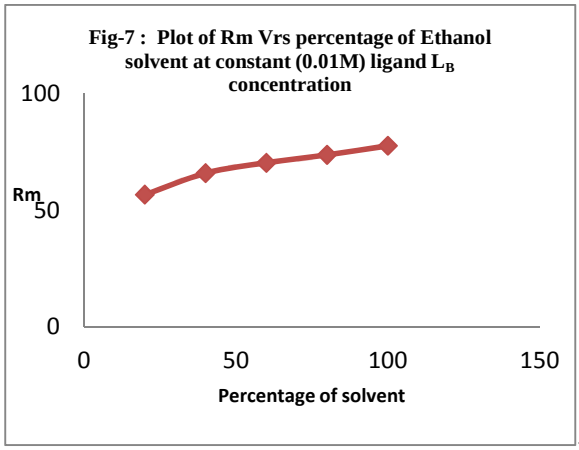


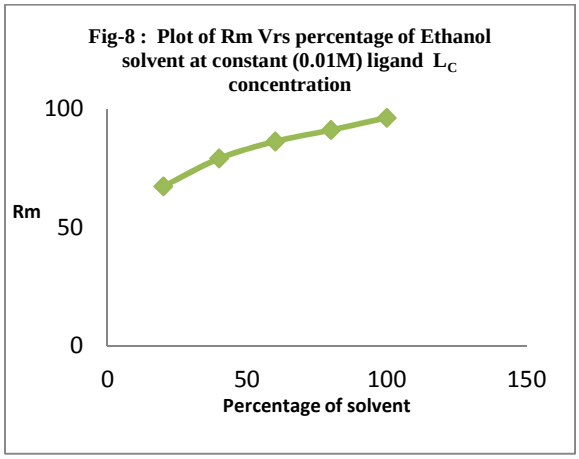


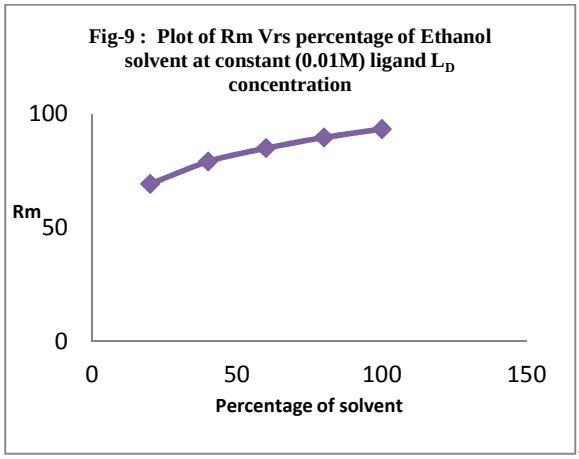


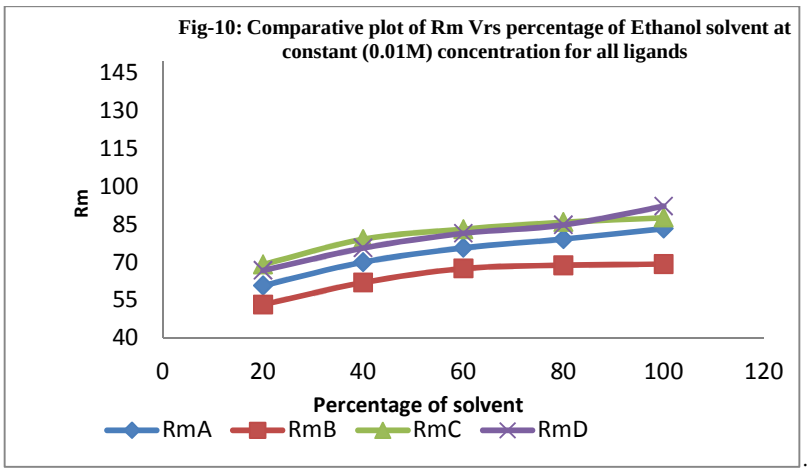
Graphical representation of molar refraction (Rm) versus change in Ethanol solvent percentage at constant concentration (0.01M) of ligand











CONCLUSION

The values of molar refraction and polarizibility constant of substituted N,N'-bis(salicyliden)-arylmethanediamine by using 20%, 40%, 60%, 80% and 100% solvent water mixture are examined . It is concluded, that the molar refraction and polarizibility constant of substituted N,N'-bis(salicyliden)-arylmethanediamine decreases in the concentration of substituted N,N'-bis(salicyliden)-arylmethanediamine. This may be due to the increase in percentage of organic solvent which causes decreases in dielectric constant of medium and there is intermolecular attraction take place.

Acknowledgement
The authors appreciatively acknowledge The Director; Head, Department of Chemistry, Govt. Vidarbha Institute of Science and Humanities, Amravati for providing necessary facilities and help when needed for the work.

REFERENCES

[1] M.M. Kalaskar, H.S.Chandak, M.P.Wadekar, *Der Pharma Chemica*, **2015**, 7(9), 261.
[2] T. Tumolo, Lankness, M.S. Baptista, *Anal. Biochem.*, **2004,** 333(2), 273.
[3] R. Ghazy, B. El-Baradie, A. El-Shaer, F. Elmekawey, *Opt. Laser Technol.*, **1999,** 31(5), 335.
[4] I. Baltog, C. Ghita, L. Ghita, *Eur.Polym.J.*, **1970,** 6(9), 1299.
[5] D.S.Hedaoo, M.M.Kalaskar, M.P.Wadekar, *J. Chem. Pharm. Res*., **2015**, 7(6), 242.
[6] M.S.Santosh, D.K.Bhat, A.S.Bhatt, *J. Chem. Eng. Data.*, **2010**, 55, 4048.
[7] V.H.Alvarez, S.Mattedi, M.Aznar, *Ind. Eng. Chem. Res.*, **2012,** 51, 14543.
[8] E.M.Schmidt, A.C.Paulillo, *Int. J. Pol. Sci.*, **2008**, 7(7), 672.

[9] Y.Zhang, H.Dong, C.Wu, L.Yu, J.Xu, *J. Chem. Thermodyn*., **2015**, 81, 16.
[10] D.S.Hedaoo, M.M.Kalaskar, M.P.Wadekar, *Der Chemica Sinica*, **2015**, 6(6), 7.
[11] R. Kumar, P.E. Akilandeswari, S. Jayakumar, *J.Mol. Liq.*, **2010,**154(2–3), 69.
[12] H.Schiff, *Justus Liebigs Ann Chem*., **1864**, 131(1),118.
[13] C.M.Silva, D. L.Silva, A Fatima, *J. Adv. Res*., **2011,** 2(1**),** 1.
[14] M.Alias, H.Kassum, C.Shakir, *J. Assoc. of Arab Universities for Basic Appl. Sci*.,**2014**,15, 28.
[15] P.Przybylski, A.Huczynski, F. Bartl, *Curr. Org. Chem.*, **2009,** 13(2), 124.
[16] Y. Li, Z.S. Yang, F.D. Wang, *Bioorg. Med. Chem.*, **2003**, 11, 4363.
[17] S.A.Matar, W.H.Talib,M.A. AlDamen , *Arabian J. Chem***., 2015,** 8(6), 850.
[18] M.S.Alam, J.H. Choi, D.U. Lee, *Bioorg.Med.Chem*., **2012**, 20(13), 4103.
[19] S.A.Khan, S.W.Haque, M.Imran, N.Siddiqui, *J. Pharm.Res.*, **2006**, 5, 61.
[20] N.S.Kozlov, G.P.Korotyshova, C*hem. Abstract.,***1987**, 106, 155955.
[21] Q.Liu, Y.Yang, L.Zhu, *IERI Procedia***.,** International Conference on Agricultural and Natural Resources Engineering, **2013,** 5,178 **.**
[22] A.I.Vogel, *Practical Organic Chemistry*, 3rd Edition, Longman, **1974**,171.
[23] H.Naeimi, K.Rabiei, F. Salimi, *Bull. Korean Chem. Soc*., **2008**, 29(12), 2445.