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Refractometric study of substituted-N,N'-bis(salicyliden)-arylmethanediamine in different binary mixture

A. S. Chandami, D. S. Hedaoo and M. P. Wadekar*

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

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ABSTRACT

The refractive index measurement of substituted- N,N'-bis(salicyliden)-arylmethanediamine in different percentage of two different solvents were performed by using Abbe's refractometer. The densites and refractive index measurement used in the determination of molar refraction (Rm) and polarizability constant (α). The experimental data provides a valuable information regarding molecular interactions in the binary mixture.

Keywords: Substituted-N,N'-bis(salicyliden)-arylmethanediamine, densities, refractive index, molar refraction, polarizability constant and molecular interaction.

INTRODUCTION

Refractive index is one of the important properties of liquid. Its measurement finds the extensive applications in the various fields of human interest. Refractometric measurements directly gave information regarding solute-solvent, solvent-solvent interactions. The refractive index and the dipole polarizability are fundamental electrooptical properties of matter[1]. The use of measurements of index of refraction as a quick, convenient, and accurate way to estimate densities of liquid mixtures has been reported[2-4]. The refractive indexes of optical (BK7) glass, ethanol, hexan, cumene and aqueous solution of NaCl with different concentrations were measured[5]. Refractometric technique is considered as an important tool for for the measurement of glucose concentrations in body fluids such as blood and the intercellular fluid[6]. The refractometric method widely used as a field methods to assess antimalarial drug quality[7].Refractive index has the large number of applications. It is mostly applied for identify a particular substance, confirm its purity, or measure its concentration. Generally it is used to measure the concentration of a solute in an aqueous solution. For example in a solution of sugar, the refractive index can be used to determine the sugar content (Brix degree). It can be used also in determination of drug concentration in pharmaceutical industry.

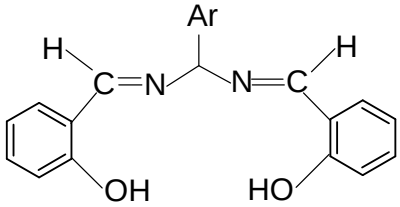
The molecular interactions of human mixtard insulin with an antibiotic was performed by viscometric, ultrasonic and refractometric studies[8]. Refractometric study of some substituted oxoimidazoline drugs, in different concentration of solute and solvent were reported[9].

The measurement of viscosity, refractive index and metal ligand stability constant of substituted benzofurones in different solvents were known[10]. Density and refraction index are two physical properties easy to measure and can be used to characterize an ionic liquid mixture[11]. Volumetric, ultrasonic, viscometric and refractive index measurement of binary mixtures of 2,2,4-trimethylpentane with aromatic hydrocarbons are studied[12]. Molecular

interactions in substituted azomethine drugs were studied refractometrically[13]. The use of molar refraction is proposed for the estimation of vapor pressure of pure hydrocarbons from C_1 to C_{100}[14]. Refractometric measurement have been studied for 2-chloro-4-amino phenol in ethanol-water system[15-16]. The Effect of change in concentration of solute and solvent on molar refraction and polarizability constant of some thiopyrimidine derivatives were studied[17].

Substituted-N,N'-bis(salicyliden)-arylmethanediamine having imine linkage posses the antimalarial properties[18]. The antimicrobial activity of Schiff bases were also mentioned[19].There are many reports were presented on the anti-inflammatory properties of compounds having imine linkage[20].Some Schiff bases were found to posses anti-inflammatory as well as analgesic properties[21]. The compounds having imine linkage are considered as a significant class of ligand in coordination chemistry, because of their coordinating properties.

The present investigation deals with the determination of refractive index, molar polarisation and polarisability constant of substituted-N,N'-bis(salicyliden)-arylmethanediamine s 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 substituted bis schiff bases ligands used for the study were synthesized by standard method[22].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 Methanol-Water, and Dioxane-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.

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]	
	Methanol	Dioxane
20%	8.5567	19.5510
40%	7.8236	18.7919
60%	6.8605	17.1890
80%	5.6834	13.6509
100%	4.0666	4.4548

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

Conc. in %	Constant ligand concentration system(0.01M) with change in Methanol percentage			
	Refractive index (n)	Density (d) gm/cm^3	Rm x10^3 cm^3/mol	α x10^{-23} cm^3
Ligand L_A				
20	1.342	0.9374	60.0795	2.3800
40	1.343	0.9160	68.8106	2.7300
60	1.350	0.8963	74.5294	2.9600
80	1.364	0.8659	81.5856	3.2400
100	1.371	0.8583	84.7884	3.3600
Ligand L_B				
20	1.342	0.9192	56.5112	2.24
40	1.343	0.9102	63.8324	2.53
60	1.350	0.8906	69.1272	2.74
80	1.368	0.8647	76.0299	3.02
100	1.370	0.8276	80.8263	3.21
Ligand L_C				
20	1.339	0.9239	68.5941	2.72
40	1.342	0.9135	78.1305	3.10
60	1.343	0.8891	83.7825	3.32
80	1.366	0.8681	92.8892	3.68
100	1.372	0.8263	100.2864	3.98
Ligand L_D				
20	1.343	0.9242	66.7473	2.65
40	1.344	0.9132	75.6521	3.00
60	1.347	0.8897	81.4704	3.23
80	1.350	0.8793	84.8184	3.36
100	1.352	0.8229	92.2617	3.66

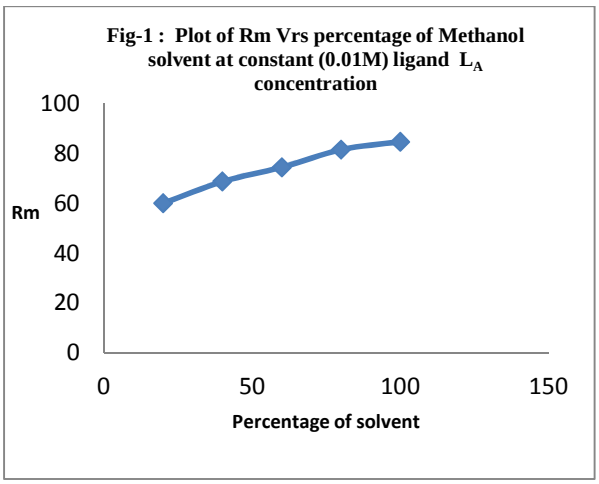
In the present study the molar refraction , polarizability constant and refractive indices of above mentioned ligands in the different percentage i .e 20%, 40%, 60%, 80%, 100% of Methanol and dioxane solvents were performed at 300K. The molar refraction of methanol and dioxane are mentioned in table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

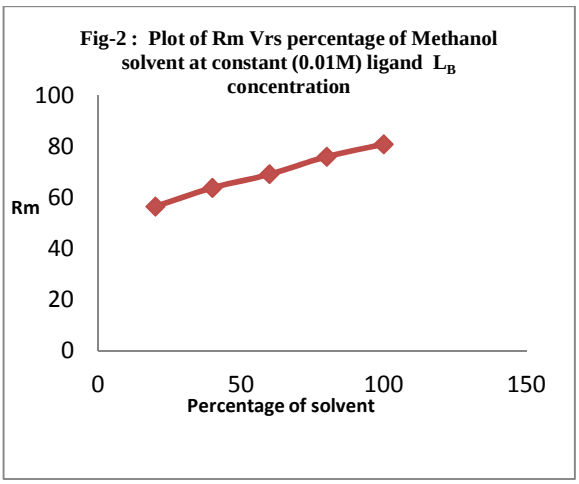
accompanied by increases in polarizability. Table 2 and 3, shows the values of the molar refraction, polarizability constant, and refractive index of substituted N,N'-bis(salicyliden)-arylmethanediamine drugs in different percentage of methanol and dioxane (Solvent + Water). The graphical representation of molar refraction (Rm) versus change in Methanol solvent percentage are shown in fig 1-5. Fig 6-10 represent the molar refraction (Rm) versus change in percentage of dioxane solvent. The data so obtained showed, the values of molar refraction and polarizability constant and refractive index of substituted- N,N'-bis(salicyliden)-arylmethanediamine drugs increases with increase in percentage of organic solvents.

Table 3: The values of refractive index (n), density (d), molar refraction (Rm) and polarizability constant (α) at 300K in Dioxane

Conc. in %	Constant ligand concentration system(0.01M) with change in Dioxane percentage			
	Refractive index (n)	Density (d) gm/cm^3	Rm x10^3 cm^3/mol	α x10^{-23} cm^3
Ligand L_A				
20	1.358	0.9822	60.7121	2.41
40	1.375	0.9924	70.0627	2.78
60	1.391	0.9927	75.7133	3.00
80	1.408	1.0063	79.2049	3.14
100	1.418	0.9895	83.3467	3.31
Ligand L_B				
20	1.355	1.0252	53.2486	2.11
40	1.375	1.0349	61.9314	2.46
60	1.392	1.0288	67.4842	2.68
80	1.399	1.0462	68.8319	2.73
100	1.405	1.0670	69.2709	2.75
Ligand L_C				
20	1.380	1.0326	69.0990	2.74
40	1.391	1.0349	79.1674	3.14
60	1.392	1.0288	83.1594	3.30
80	1.405	1.0468	85.9243	3.41
100	1.418	1.0689	87.6478	3.48
Ligand L_D				
20	1.358	1.0267	63.4554	2.52
40	1.372	1.0365	72.8084	2.89
60	1.393	1.0382	79.5209	3.15
80	1.406	1.0490	82.7334	3.28
100	1.419	1.0700	84.4762	3.35

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





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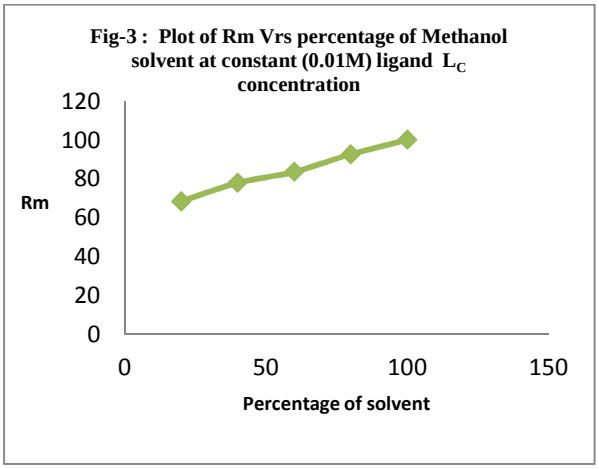
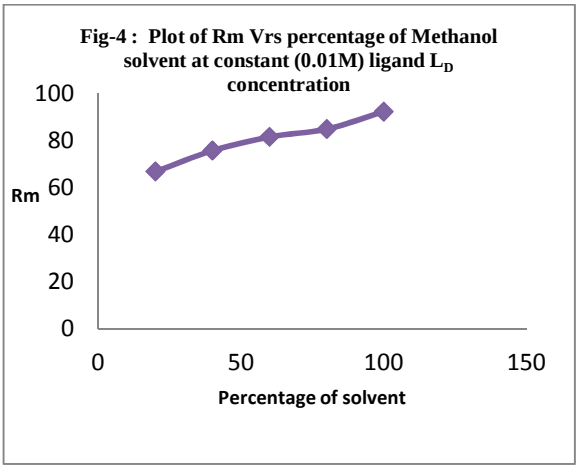
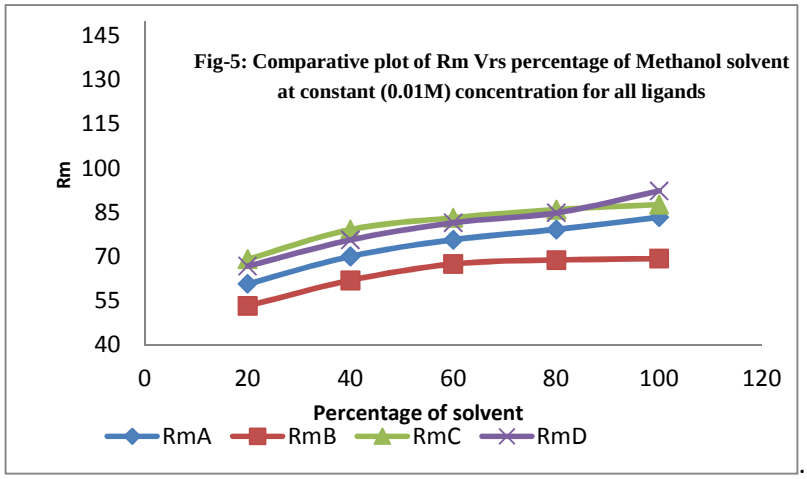
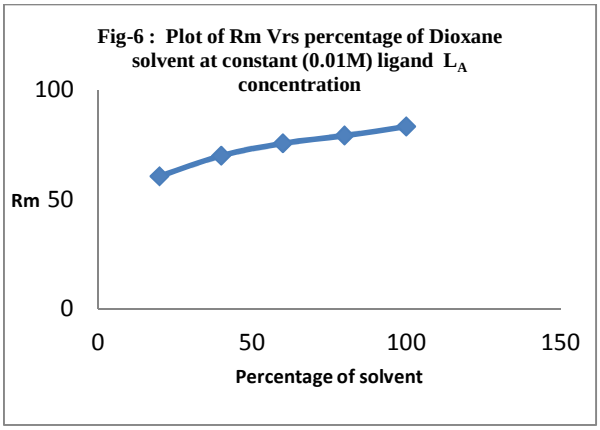
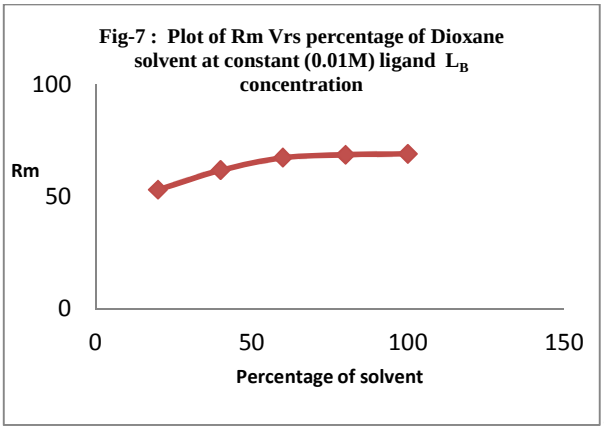






Graphical representation of molar refraction (Rm) versus change in Dioxane solvent percentage at constant (0.01M) ligand





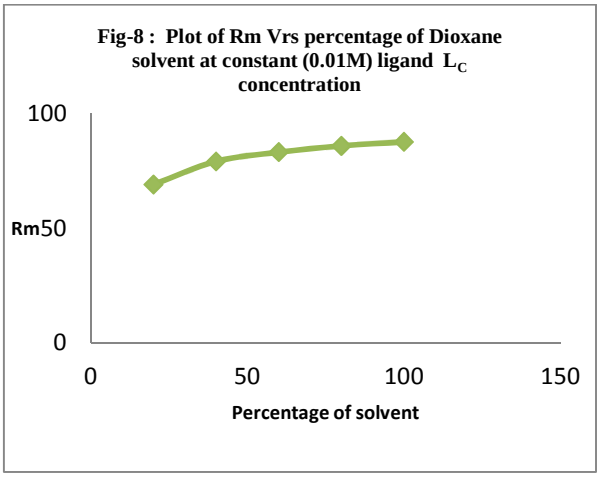


Fig-8 : Plot of Rm Vrs percentage of Dioxane solvent at constant (0.01M) ligand L_C concentration

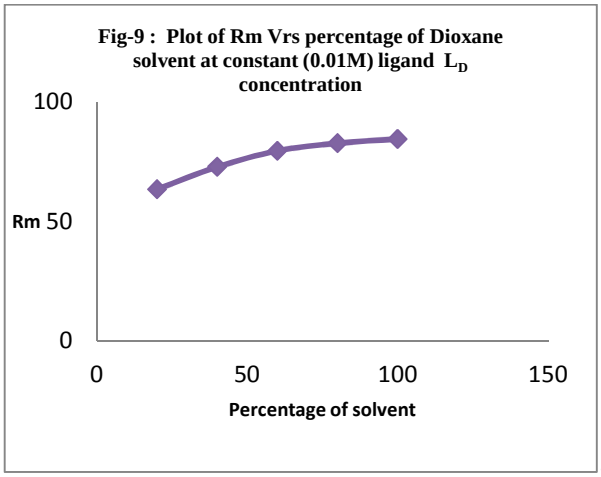


Fig-9 : Plot of Rm Vrs percentage of Dioxane solvent at constant (0.01M) ligand L_D concentration

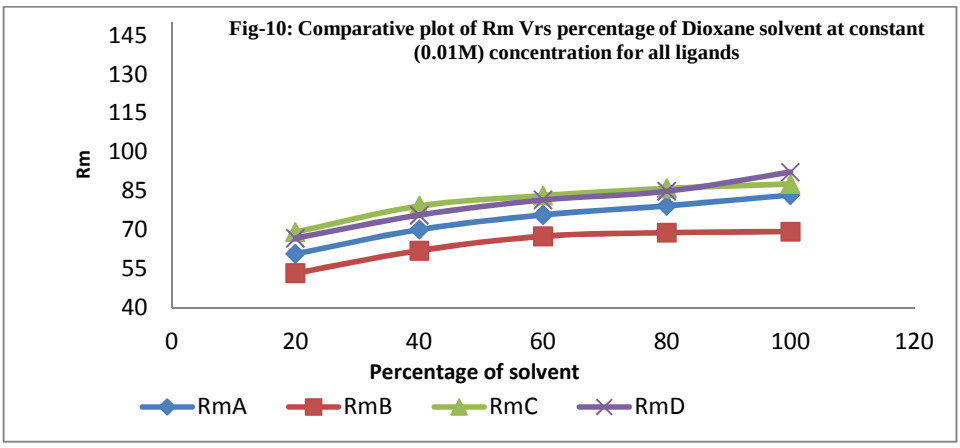


Fig-10: Comparative plot of Rm Vrs percentage of Dioxane solvent at constant (0.01M) concentration for all ligands

CONCLUSION

The values of molar refraction and polarizability 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 polarizability 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.

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