

## Study of some properties of cyanopyridine derivatives in solutions

Shipra Baluja<sup>1</sup>, Jagdish Movalia

Department of Chemistry, Saurashtra University, Rajkot- 360 005, Gujarat, India.

<sup>1</sup>E-mail: shipra\_baluja@rediffmail.com.

Recibido para evaluación: 25 de julio de 2015.

Aceptado para publicación: 8 de septiembre de 2015.

### SUMMARY

Some new cyanopyridine derivatives have been synthesized and their characterization was done by IR, <sup>1</sup>H NMR and mass spectral data. Further, some physicochemical properties such as density, refractive index, conductance etc. have been studied for these synthesized compounds, in different solvents at 308.15 K.

*Key words:* Cyanopyridine derivative, conductance, refractive index, density.

### RESUMEN

#### Estudio de las propiedades de algunos derivados de cianopiridina en solución

Se sintetizaron algunos derivados de cianopiridina y se caracterizaron mediante IR, RMN <sup>1</sup>H y espectrometría de masa. Además, para los mismos compuestos se determinaron algunas propiedades fisicoquímicas tales como densidad, índice de refracción y conductancia, en diferentes solventes a 308,15 K.

*Palabras clave:* derivados de cianopiridina, conductancia, índice de refracción, densidad.

### INTRODUCTION

The pyridine ring is an integral part of various natural products of therapeutic importance. It plays an important role in catalyzing both biological and chemical reactions [1].

Substituted cyanopyridines are known to act as intermediates in the pharmaceutical, dye, photo and agrochemical industries [2-4]. Further, Many fused cyanopyridines have drawn attention due to their wide spectrum biological activities [5-9]. Therefore, the synthesis of cyanopyridine derivatives continues to attract much interest in organic chemistry. However, best of our knowledge, very little work is known for their physicochemical properties.

In view of these observations and with a view to study physicochemical properties of this class of compounds, the present study includes synthesis and studies of some physicochemical properties such as density, refractive index and conductance of synthesized cyanopyridines in solutions.

## EXPERIMENTAL

### Equipments and Reagents used

1-naphthyl amine, acetic anhydride,  $\text{POCl}_3$ , malono nitrile, ammonium acetate and different substituted acetophenone used for the synthesis, were supplied from Spectrochem Pvt. Ltd. (Mumbai, India) and were used without any treatment.

The DMF and DMSO used were of AR grade supplied by Spectrochem Pvt. Ltd. (Mumbai, India) and were purified according to the standard procedure [10]. The distilled solvents were stored over molecular sieves. The purity of solvents were confirmed by GC-MS (SHIMADZU-Model No.-QP-2010) equipped with column (DB-5MS, 25 m in length, 0.20 mm internal diameter and 0.33  $\mu\text{m}$  film) and was found to be about 99.99%.

The pycnometer and Abbe refractometer were used for the measurement of density and refractive index of solutions of compounds respectively. For the measurement of conductance of solutions, Equip-tronics conductivity meter (Model No. 664) was used.

### Synthesis

[A] *Synthesis of N-(naphthalene-1-yl)acetamide*: Equimolar mixture of 1-naphthyl amine and acetic anhydride in methanol was refluxed in water bath for 2-3 hrs using acetic acid as catalyst. The crude product was isolated and crystallized from absolute ethanol.

[B] *Synthesis of 2-chloro benzo[h]quinoline-3-carbaldehyde*: N-(naphthalene-1-yl) acetamide was added in a mixture of Vilsmeier-Haack reagent (prepared by drop wise addition of 6.5 ml  $\text{POCl}_3$  in ice cooled 2 ml DMF) and refluxed for 27 hrs. The reaction mixture was poured into ice and kept for overnight followed by neutralization using sodium bicarbonate. The crude product was isolated and crystallized from ethanol.

[C] *Synthesis of 3-(2-chlorobenzo[h]quinolin-3-yl)-1-(4-methoxy-phenyl)prop-2-en-1-one*: To a well stirred solution of 2-chloro benzo[h]quinoline-3-carbaldehyde and p-methoxy-acetophenone in binary mixture of ethanol + DMF, 40% NaOH was added till the solution became basic. The reaction mixture was stirred for 48 hrs and the contents were poured into ice, acidified, filtered and crystallized from ethanol.

[D] *Synthesis of 2-amino-4-(2-chlorobenzo[h]quinolin-3-yl)-6-(4-methoxy-phenyl)pyridine-3-carbonitrile(CP-1)*: A mixture of 3-(2-chlorobenzo[h]quinolin-3-yl)-1-(4-methoxy-phenyl) prop-2-en-1-one, malononitrile and ammonium acetate in ethanol was refluxed for 10-12 hrs. The content was poured on crushed ice. The product obtained was filtered, washed with water and crystallized from DMF.

Similarly, other substituted cyano pyridines have been prepared.

Figure 1 shows the reaction scheme. The structures of all the synthesized compounds were confirmed by IR, <sup>1</sup>H NMR and mass spectral data. The IR spectra were recorded by SHIMADZU-FTIR-8400 Spectrophotometer in the frequency range of 4000-400 cm<sup>-1</sup> by KBr powder method. The NMR spectra were recorded by BRUKER Spectrometer (400 MHz) using internal reference TMS and solvent CDCl<sub>3</sub>/DMSO. The Mass spectra were recorded by GCMS-SHIMADZU-QP2010.

Table 1 shows the physical parameters of synthesized cyanopyridine compounds.

Table 1. Physical constants of synthesized Cyanopyridine compounds.

Sr. No.	Comp. Code	Mol. Wt. (g/mol)	M.F.	R	R <sub>f</sub> * Value	M.P. (°C)	Yield %
1	CP-1	436.8	C <sub>27</sub> H <sub>17</sub> ClN <sub>4</sub> O	4-OCH <sub>3</sub> -C <sub>6</sub> H <sub>4</sub> -	0.59	221	70
2	CP-2	420.8	C <sub>26</sub> H <sub>17</sub> ClN <sub>4</sub>	4-CH <sub>3</sub> -C <sub>6</sub> H <sub>4</sub> -	0.56	180	68
3	CP-3	485.7	C <sub>25</sub> H <sub>14</sub> BrClN <sub>4</sub>	4-Br-C <sub>6</sub> H <sub>4</sub> -	0.63	214	71
4	CP-4	421.8	C <sub>25</sub> H <sub>16</sub> ClN <sub>5</sub>	4-NH <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> -	0.69	208	65
5	CP-5	451.8	C <sub>25</sub> H <sub>14</sub> ClN <sub>5</sub> O <sub>2</sub>	4-NO <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> -	0.64	187	69
6	CP-6	422.8	C <sub>25</sub> H <sub>15</sub> ClN <sub>4</sub> O	3-OH-C <sub>6</sub> H <sub>4</sub> -	0.70	235	67
7	CP-7	441.3	C <sub>25</sub> H <sub>14</sub> Cl <sub>2</sub> N <sub>4</sub>	4-Cl-C <sub>6</sub> H <sub>4</sub> -	0.72	234	72
8	CP-8	451.8	C <sub>25</sub> H <sub>14</sub> ClN <sub>5</sub> O <sub>2</sub>	3-NO <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> -	0.62	201	63
9	CP-9	422.8	C <sub>25</sub> H <sub>15</sub> ClN <sub>4</sub> O	4-OH-C <sub>6</sub> H <sub>4</sub> -	0.67	229	65
10	CP-10	406.8	C <sub>25</sub> H <sub>15</sub> ClN <sub>4</sub>	H-C <sub>6</sub> H <sub>4</sub> -	0.49	162	73

\*Ethyl acetate : Hexane: 3:7.

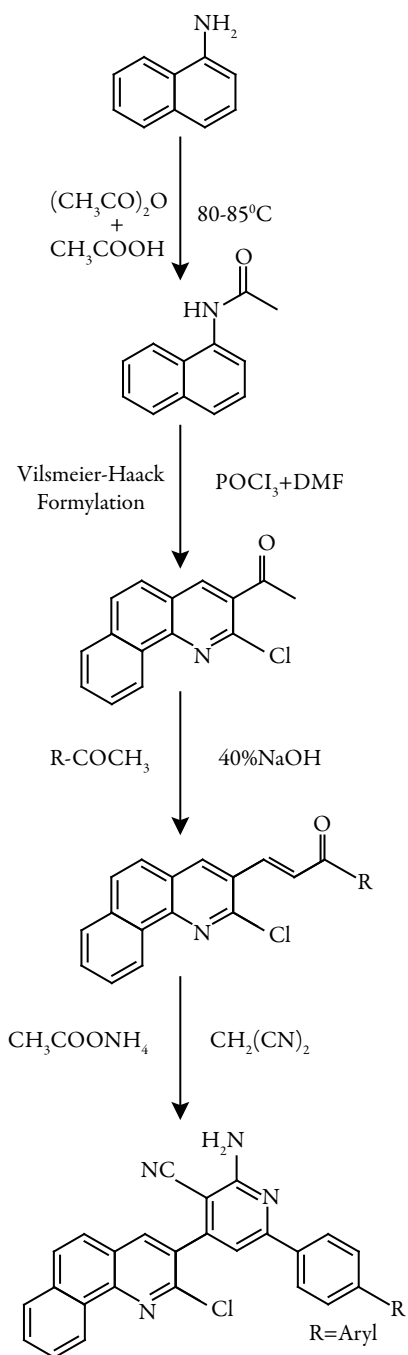


Figure 1. Reaction Scheme.

### Physicochemical studies

*Density and refractive index:* The density and refractive index of all the synthesized cyanopyridine derivatives have determined in dimethylformamide and dimethyl sulfoxide solutions at 298.15 K. The density and refractive index were measured at definite temperature by pycnometer and Abbe refractometer respectively. The temperature was maintained by circulating water through jacket around the prisms of refractometer from an electronically controlled water bath (NOVA NV-8550 E). The uncertainty of temperature was  $\pm 0.1$  °C and that of density and refractive index was  $\pm 0.0001$  g/cm<sup>3</sup> and 0.0005 respectively.

*Conductance:* For all the synthesized compounds, conductance is measured in dimethylformamide and dimethylsulfoxide solutions at 298.15 K. The conductance of each solution was measured by using Equip-tronics conductivity meter (Model No. 664) having a cell constant 0.98 cm<sup>-1</sup> at 298.15 K.

## RESULTS AND DISCUSSION

In all 10 compounds were synthesized and IR, NMR and mass spectral data analysis confirmed their molecular structure. The IR, NMR and mass spectra of CP-1 are shown in Figures 2, 3 and 4 respectively. The spectral data are given below:

CP1: IR (KBr, cm<sup>-1</sup>): N-H: 3314, C=C: 1514, C≡N: 2195, C-Cl: 690.

<sup>1</sup>H NMR (δ ppm): 3.83(s, 3H), 3.49 (s, 2H), 7.09-7.12(d, 2H), 7.5-7.54(t, 1H), 7.66-7.76(dd, 2H), 7.83-7.99(m, 2H), 8.07-8.10(m, 2H), 8.37(s, 1H), 8.51(d, 2H).

m/z: 436.8, 422, 402, 385, 357, 338, 295, 247, 226, 218, 151, 108, 92, 78.

CP2: IR (KBr, cm<sup>-1</sup>): N-H: 3348, C=C: 1518, C≡N: 2201, C-Cl: 699.

<sup>1</sup>H NMR (δ ppm): 2.75 (s, 3H), 3.55 (s, 2H), 7.08-7.16(d, 2H), 7.59-7.63(t, 1H), 7.81-7.85(dd, 2H), 8.04-8.08(m, 2H), 8.15-8.19(m, 2H), 8.34(s, 1H), 8.63(d, 2H).

m/z: 420.8, 386, 369, 341, 295, 247, 218, 151, 108, 92, 78.

CP3: IR (KBr, cm<sup>-1</sup>): N-H: 3332, C=C: 1512, C≡N: 2198, C-Cl: 709.

<sup>1</sup>H NMR (δ ppm): 3.66 (s, 2H), 7.18-7.22(d, 2H), 7.51-7.67(t, 1H), 7.82-7.86(dd, 2H), 8.14-8.18(m, 2H), 8.38-8.44(m, 2H), 8.51(s, 1H), 8.63(d, 2H).

m/z: 485.7 470, 451, 433, 406, 295, 218, 151, 108, 92, 78.

CP4: IR (KBr, cm<sup>-1</sup>): N-H: 3318, C=C: 1524, C≡N: 2212, C-Cl: 718.

$^1\text{H NMR}$  ( $\delta$  ppm): 3.41 (s, 2H), 3.59(s, 2H), 7.01-7.06(d, 2H), 7.21-7.24(t, 1H), 7.61-7.64(dd, 2H), 7.83-7.94(m, 2H), 8.17-8.25(m, 2H), 8.31(s, 1H), 8.44(d, 2H).

$m/z$ : 421.8, 407, 387, 370, 323, 295, 247, 218, 151, 108, 92, 78.

CP5: IR (KBr,  $\text{cm}^{-1}$ ): N-H: 3321, C=C: 1504, C $\equiv$ N: 2208, C-Cl:695.

$^1\text{H NMR}$  ( $\delta$  ppm): 3.49 (s, 2H), 7.25-7.31(d, 2H), 7.59-7.61(t, 1H), 7.69-7.72(dd, 2H), 7.88-7.94(m, 2H), 8.17-8.23(m, 2H), 8.41(s, 1H), 8.56(d, 2H).

$m/z$ : 451.8, 437, 435, 419, 417, 400, 353, 295, 247, 218, 151, 108, 92, 78.

CP6: IR (KBr,  $\text{cm}^{-1}$ ): OH: 3405, N-H: 3307, C=C: 1530, C $\equiv$ N: 2226, C-Cl: 702.

$^1\text{H NMR}$  ( $\delta$  ppm): 3.33(s, 2H), 4.05(s, 1H), 7.15-7.18(d, 2H), 7.59-7.61(t, 1H), 7.63-7.67(dd, 2H), 7.78-7.81(m, 2H), 8.12-8.17(m, 2H), 8.30(s, 1H), 8.39(d, 2H).

$m/z$ : 422.8, 408, 405, 387,371, 295, 212, 247, 218, 151, 108, 92, 78.

CP7: IR (KBr,  $\text{cm}^{-1}$ ): N-H: 3319, C=C: 1522, C $\equiv$ N: 2206, C-Cl: 698.

$^1\text{H NMR}$  ( $\delta$  ppm): 3.21(s, 2H), 7.29-7.33(d, 2H), 7.49-7.51(t, 1H), 7.55-7.59(dd, 2H), 7.69-7.75(m, 2H), 8.20-8.25(m, 2H), 8.39(s, 1H), 8.59(d, 2H).

$m/z$ : 441.3, 408, 406, 390, 343,295, 247, 218, 151, 108, 92, 78.

CP8: IR (KBr,  $\text{cm}^{-1}$ ): N-H: 3311, C=C: 1515, C $\equiv$ N: 2221, C-Cl: 712.

$^1\text{H NMR}$  ( $\delta$  ppm): 3.30(s, 2H), 7.33-7.37(d, 2H), 7.66-7.69(t, 1H), 7.75-7.80(dd, 2H), 7.77-7.83(m, 2H), 8.14-8.19(m, 2H), 8.27(s, 1H), 8.44(d, 2H).

$m/z$ : 451.8, 438, 435, 419, 417, 353, 295, 247, 218, 151, 108, 92, 78.

CP9: IR (KBr,  $\text{cm}^{-1}$ ): OH: 3410, N-H: 3321, C=C: 1526, C $\equiv$ N: 2208, C-Cl: 689.

$^1\text{H NMR}$  ( $\delta$  ppm): 3.32(s, 2H), 4.44(s, 1H), 7.31-7.34(d, 2H), 7.65-7.68(t, 1H), 7.71-7.75(dd, 2H), 7.81-7.86(m, 2H), 8.04-8.08(m, 2H), 8.23(s, 1H), 8.40(d, 2H).

$m/z$ : 422.8, 408, 405, 371, 297, 213, 247, 218, 151, 108, 92, 78.

CP10: IR (KBr,  $\text{cm}^{-1}$ ): N-H: 3309, C=C: 1521, C $\equiv$ N: 2218, C-Cl: 701.

$^1\text{H NMR}$  ( $\delta$  ppm): 3.23(s, 2H), 7.34-7.36(d, 2H), 7.60-7.63(t, 1H), 7.68-7.71(dd, 2H), 7.74-7.79(m, 2H), 8.09-8.13(m, 2H), 8.29(s, 1H), 8.39(d, 2H).

$m/z$ : 406.8, 392, 371, 355, 308, 295, 247, 151, 108, 92, 78.

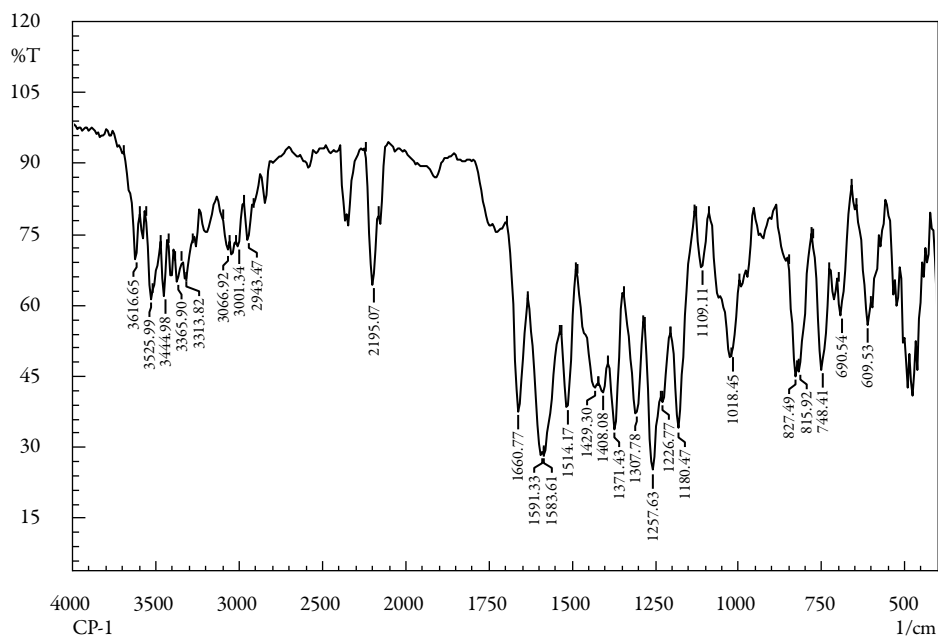
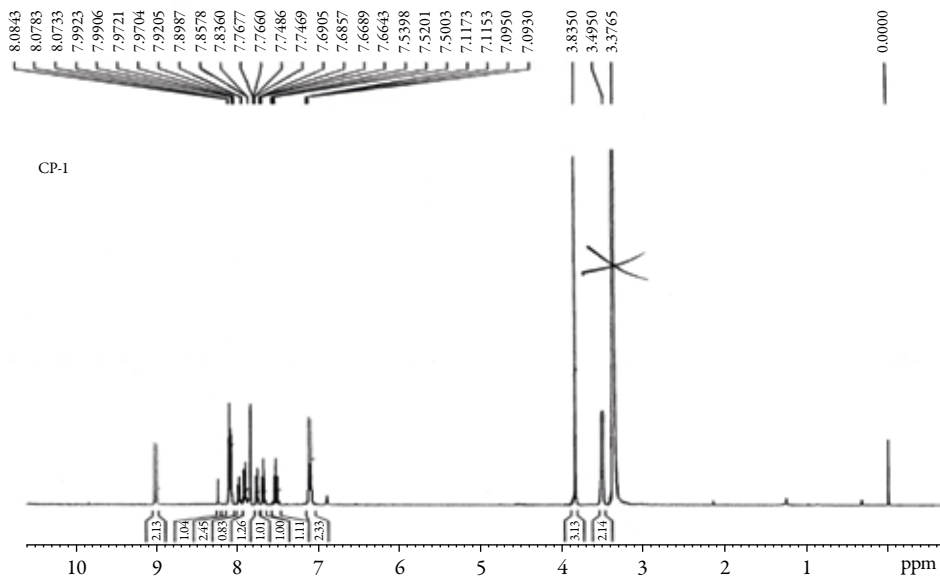


Figure 2. IR spectrum of CP-1.

Figure 3. NMR spectrum of CP-1. (*It continues*)

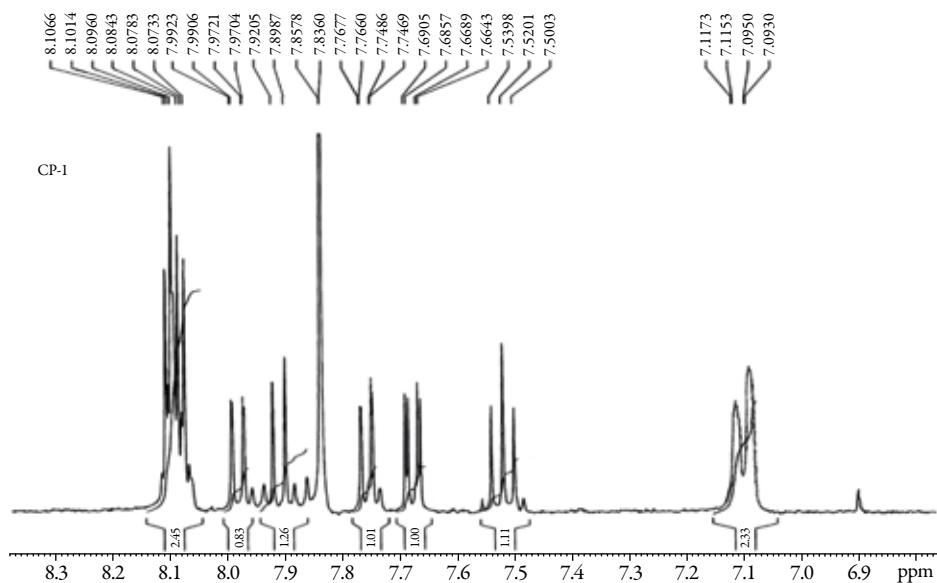


Figure 3. NMR spectrum of CP-1. (Continued)

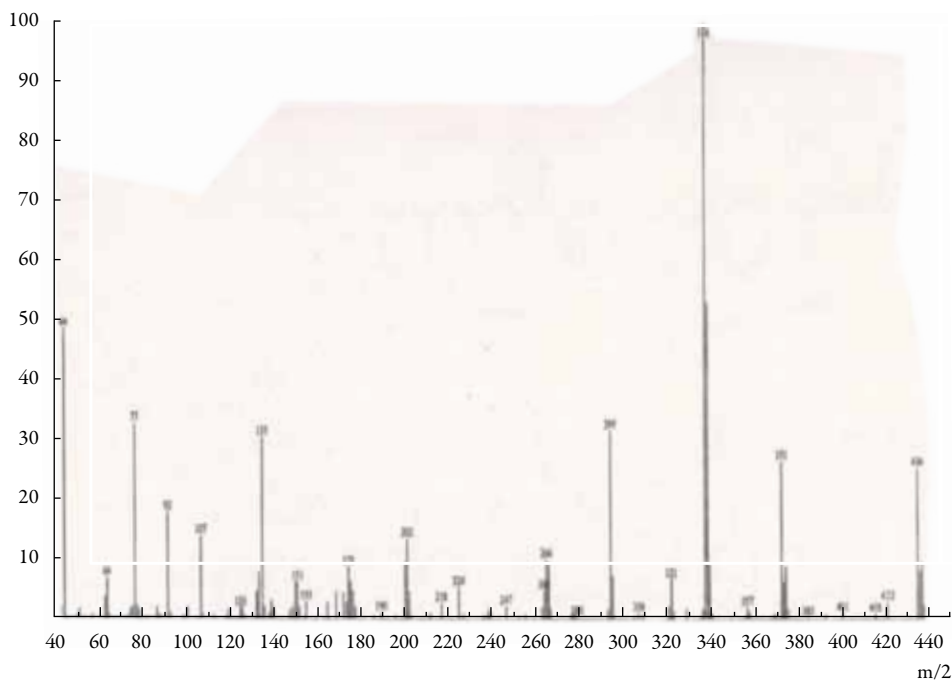


Figure 4. Mass spectrum of CP-1.



The molecular formula, molecular weight, melting point, % yield and  $R_f$  values along with the solvent systems of all the compounds are given in Table 1.

### Density and Refractive index

The density of solution is related to density of pure solvent, pure solute (i.e., synthesized compound) and their weight fractions by the following equation:

$$1/\rho_{12} = g_1/\rho_1 + g_2/\rho_2$$

where  $\rho_1$ ,  $\rho_2$  and  $\rho_{12}$  are the density of pure solvent, pure solute (i.e., synthesized compound) and solution respectively.  $g_1$  and  $g_2$  are the weight fractions of solvent and solute respectively. The plot of  $1/g_1\rho_{12}$  versus  $g_1/g_2$  is shown in Figure 5 for CP-1. The slope of straight line gives  $1/\rho_2$ .

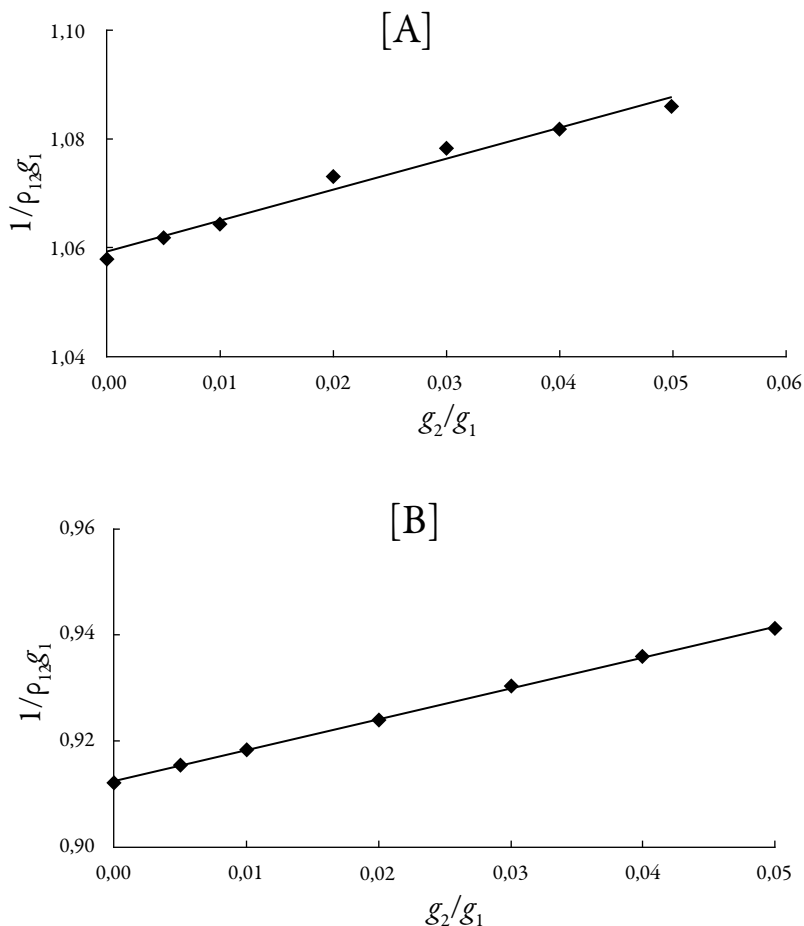


Figure 5. The plot of  $(1/g_1\rho_{12})$  versus  $(g_1/g_2)$  for CP-1 in [A] DMF and [B] DMSO.

Further, the density of these compounds was also calculated using the following theoretical equation [11]:

$$\rho = KM/N_A \sum \Delta V_i$$

where  $\rho$  the density of the compound,  $K$  is packing fraction (0.599),  $M$  is the molecular weight of the compound,  $N_A$  is the Avogadro's number and  $\Delta V_i$  is the volume increment of the atoms and atomic groups present in the compound. Table 2 shows the experimental and theoretical values of density. It is observed that there is deviation between experimental and theoretical density values and in different solvents, different density values are observed. This difference can be explained on the basis of interactions in solutions. In different solvents, different types of interactions exist with different solutes. This may change the volume thereby affecting the molecular weight of the compound, which ultimately affects the density. Thus, different density values in different solvents and deviation between experimental and theoretical density values suggest the presence of intermolecular interactions between solute and solvent molecules.

Table 2. Experimental and calculated densities of compounds in DMF and DMSO solutions at 298.15 K.

Compounds	Experimental Density (g/cm <sup>3</sup> )		Theoretical Density (g/cm <sup>3</sup> )
	DMF	DMSO	
CP-1	1.3641	1.2347	1.1673
CP-2	1.4624	1.3201	1.1517
CP-3	1.7806	1.3168	1.2990
CP-4	1.2361	1.3006	1.1928
CP-5	1.5218	1.3355	1.2354
CP-6	1.4378	1.3029	1.9530
CP-7	1.8005	1.2999	1.2162
CP-8	1.7737	1.3186	1.2350
CP-9	1.4689	1.2204	1.1884
CP-10	1.3939	1.1790	1.1665

The molar refraction of pure liquid and solutions can be determined according to Lorentz and Lorentz equations [12].

For pure liquid:

$$(MRD) = [(n^2 - 1)/(n^2 + 2)].M/\rho$$

where  $n$ ,  $M$  and  $\rho$  are refractive index, molecular weight and density of pure liquid respectively.

For solutions:

$$(MRD)_{12} = [(n_{12}^2 - 1)/(n_{12}^2 + 2)].(X_1M_1 + X_2M_2)/\rho_{12}$$

where  $n_{12}$  and  $\rho_{12}$  are refractive index and density of the solution respectively.  $X_1$  and  $X_2$  are the mole fractions and  $M_1$  and  $M_2$  are the molecular weight of the solvent and solute respectively.

Using these equations, the  $(MRD)_2$  and refractive index of compounds in 0.1 M solutions were calculated and are given in Table 3.

Table 3. Calculated molar refraction and refractive index of 0.1 M solution of compounds in DMF and DMSO at 298.15 K.

Compounds	Solvents			
	DMF		DMSO	
	$(MRD)_2$	$n$	$(MRD)_2$	$n$
CP-1	113.42	1.4360	145.92	1.4857
CP-2	115.88	1.4341	150.18	1.4868
CP-3	118.99	1.4361	132.03	1.4855
CP-4	142.00	1.4365	149.70	1.4864
CP-5	116.07	1.4331	134.83	1.4833
CP-6	111.32	1.4324	137.24	1.4824
CP-7	97.24	1.4322	127.63	1.4833
CP-8	104.98	1.4329	130.48	1.4831
CP-9	106.49	1.4321	135.37	1.4827
CP-10	90.99	1.4308	134.54	1.4838

## Conductance

The measured conductance of all the compounds in DMF and DMSO was corrected by subtracting the conductance of pure solvent and are given in Tables 4 and 5 respectively. It is observed that conductance increases with concentration for both the solvents. Further, conductance is higher in DMF than that in DMSO.

Table 4. The measured conductance ( $\kappa$ ) of synthesized compounds in DMF at 298.15 K.

Conc. (g/l)	$\kappa \cdot 10^5 (\Omega)^{-1}$				
	CP-1	CP-2	CP-3	CP-4	CP-5
0.000	2.40	2.40	2.40	2.40	2.40
0.001	4.00	4.10	4.40	8.50	6.90
0.002	4.30	4.30	4.90	8.80	8.10
0.004	4.80	4.50	5.40	9.30	9.20
0.006	5.30	4.90	6.00	9.80	9.90
0.008	5.90	5.60	6.80	10.50	11.20
0.010	6.80	6.30	7.60	11.40	12.80
0.020	8.30	7.00	9.90	13.70	14.60
0.040	10.80	8.50	17.50	16.70	24.90
0.060	19.60	10.30	24.00	22.50	36.00
0.080	25.00	13.30	29.90	26.70	47.40
0.100	30.00	15.50	35.30	31.50	57.90
	CP-6	CP-7	CP-8	CP-9	CP-10
0.001	5.60	6.50	8.40	5.50	4.50
0.002	5.90	6.80	8.50	5.80	5.10
0.004	6.90	7.20	8.70	6.60	5.70
0.006	7.60	8.00	9.10	7.30	6.40
0.008	9.50	9.10	9.50	8.80	7.90
0.010	10.30	10.60	11.60	9.90	8.60
0.020	14.20	15.10	12.80	13.70	11.10

(It continues)

Table 4. The measured conductance ( $\kappa$ ) of synthesized compounds in DMF at 298.15 K.

(Continued)

Conc. (g/l)	$\kappa \cdot 10^5 (\Omega)^{-1}$				
	CP-6	CP-7	CP-8	CP-9	CP-10
0.040	18.10	28.30	27.30	17.90	21.50
0.060	21.70	31.70	35.10	21.40	29.70
0.080	27.70	38.30	46.70	27.80	36.90
0.100	35.00	44.50	53.00	35.10	43.10

Table 5. The measured conductance ( $\kappa$ ) of synthesized compounds in DMSO at 298.15 K.

Conc. (g/l)	$\kappa \cdot 10^5 (\Omega)^{-1}$				
	CP-1	CP-2	CP-3	CP-4	CP-5
0.000	0.20	0.20	0.20	0.20	0.20
0.001	2.70	2.50	2.70	3.50	5.30
0.002	2.90	3.00	3.70	3.80	5.60
0.004	3.20	3.10	4.69	4.20	6.30
0.006	3.70	3.20	4.10	4.70	7.40
0.008	4.30	3.30	5.90	5.30	9.90
0.010	5.10	4.10	6.90	5.80	11.20
0.020	7.90	5.60	8.30	6.20	13.50
0.040	9.50	7.20	9.80	7.50	15.90
0.060	11.30	8.30	12.40	9.70	17.30
0.080	13.60	9.80	14.80	11.20	19.60
0.100	16.30	12.00	17.90	13.90	21.90
	CP-6	CP-7	CP-8	CP-9	CP-10
0.001	5.30	6.30	7.60	5.10	4.30
0.002	5.50	6.60	7.90	5.40	4.90
0.004	5.90	7.20	8.40	5.90	5.70

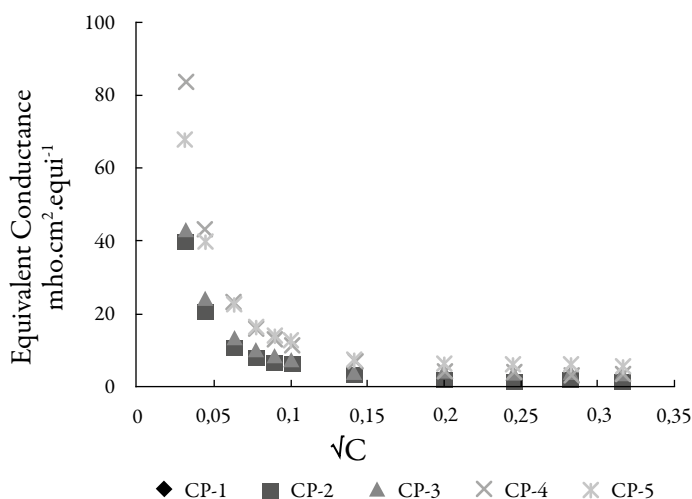
(It continues)

Table 5. The measured conductance ( $\kappa$ ) of synthesized compounds in DMSO at 298.15 K.

(Continued)

Conc. (g/l)	$\kappa \cdot 10^5 (\Omega)^{-1}$				
	CP-6	CP-7	CP-8	CP-9	CP-10
0.006	6.50	7.90	9.10	6.50	6.50
0.008	7.50	8.80	10.50	7.80	7.80
0.010	9.30	9.60	12.10	9.10	9.60
0.020	12.20	11.70	13.80	12.70	12.10
0.040	14.10	13.50	15.10	17.90	21.50
0.060	20.10	15.70	18.70	20.90	30.10
0.080	25.70	18.60	20.70	26.80	37.00
0.100	31.00	20.50	24.30	33.90	42.90

From these conductance values, equivalent conductance was calculated which are shown in Figures 6 and 7 for DMF and DMSO respectively. It is obvious from these figures that for all the compounds, the equivalent conductance increases uninterruptedly with decreasing concentration. However, the nature of plots suggests that the studied compounds behave as weak electrolytes in studied solvents.

Figure 6. The equivalent conductance ( $\lambda_c$ ) versus  $\sqrt{C}$  of compounds in DMF. (It continues)

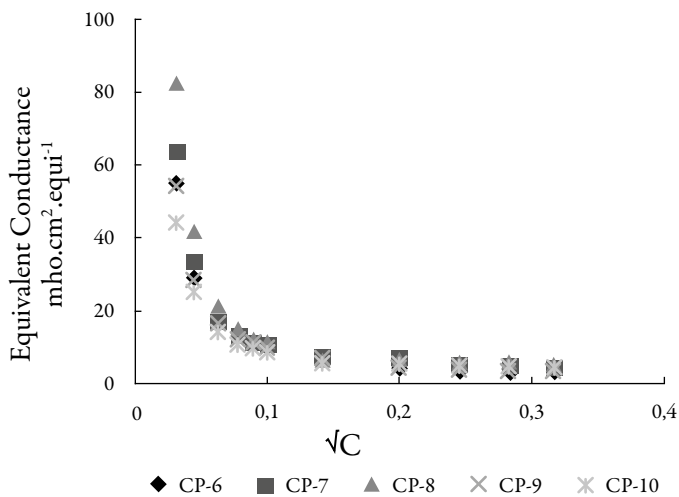


Figure 6. The equivalent conductance ( $\lambda_c$ ) versus  $\sqrt{C}$  of compounds in DMF. (Continued)

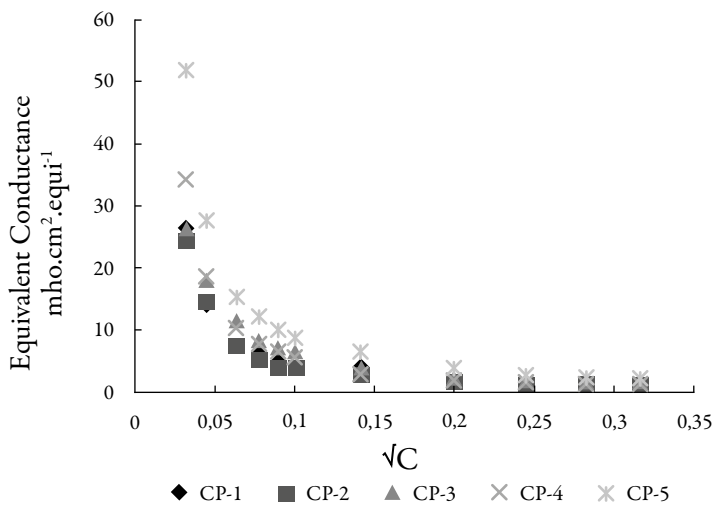


Figure 7. The equivalent conductance ( $\lambda_c$ ) versus  $\sqrt{C}$  of compounds in DMSO. (It continues)

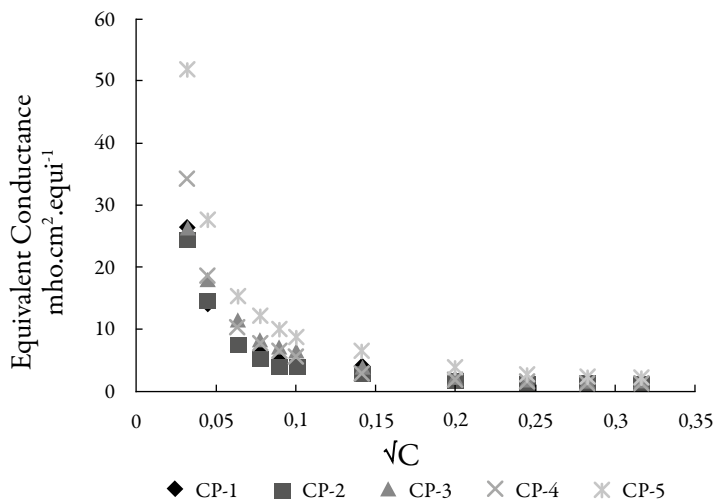


Figure 7. The equivalent conductance ( $\lambda_c$ ) versus  $\sqrt{C}$  of compounds in DMSO. (*Continued*)

## CONCLUSION

The different density values in different solvents and deviation between experimental and theoretical density values suggest the presence of intermolecular interactions between solute and solvent molecules. The refractive index of 0.1 N solutions of all the derivatives is found to be different in both the solvents. The conductance increases with concentration for both the solvents for all the compounds. Further, conductance is higher in DMF than that in DMSO. In both the selected solvents, compounds behave as weak electrolytes.

## ACKNOWLEDGMENT

Authors are thankful to Head of Chemistry Department, Saurashtra University, Rajkot, India for providing necessary facilities.

## REFERENCES

1. X. Zou, Sh. Tu, F. Shi, J. Xu, An efficient synthesis of pyrazolo[3,4-*b*]pyridine derivatives under microwave irradiation, *ARKIVOC*, 2006(2), 130 (2006).



2. J. You, S.L. Lai, W. Liu, T.W. Ng, P. Wang, C.S. Lee, Bipolar cyano-substituted pyridine derivatives for applications in organic light-emitting devices, *J. Mater. Chem.*, **22**, 8922 (2012).
3. M.D. Bowman, M.M. Jacobson, H.E. Blackwell, Discovery of fluorescent cyanopyridine and deazalumazine dyes using small molecule macroarrays, *Org. Lett.*, **8**(8), 1645 (2006).
4. J. Aleu, A.J. Bustillo, R. Hernández-Galán, I.G. Collado, Biocatalysis applied to the synthesis of agrochemicals, *Curr. Org. Chem.*, **10**(16), 2037 (2006).
5. Y. Mao, W. Zhu, X. Kong, Z. Wang, H. Xie, J. Ding, N.K. Terrett, J. Shen, J. Shen, Design, synthesis and biological evaluation of novel pyrimidine, 3-cyanopyridine and *m*-amino-*N*-phenylbenzamide based monocyclic EGFR tyrosine kinase inhibitors, *Bioorg. Med. Chem.*, **21**(11), 3090 (2013).
6. M.J. Márquez, M.B. Márquez, P.G. Cataldo, S.A. Brandán, A comparative study on the structural and vibrational properties of two potential antimicrobial and anticancer cyanopyridine derivatives, *Open J. Syn. Theory Appl.*, **4**, 1 (2015).
7. P.N. Kalaria, S.P. Satasia, J.R. Avalani, D.K. Raval, Ultrasound-assisted one-pot four-component synthesis of novel 2-amino-3-cyanopyridine derivatives bearing 5-imidazopyrazole scaffold and their biological broadcast, *Eur. J. Med. Chem.*, **83**, 655 (2014).
8. V. Reddy, S.R. Gogireddy, P.K. Dubey, M. Reddy, B. Veeresh, Design, synthesis and characterization of 1 *H*-pyridin-4-yl-3,5-disubstituted indazoles and their anti-inflammatory and analgesic activity, *J. Chem. Sci.*, **127**(3), 433 (2015).
9. S.M. Sondhi, S. Jain, M. Dinodia, A. Kumar, Synthesis of some thiophene, imidazole and pyridine derivatives exhibiting good anti-inflammatory and analgesic activities, *Med. Chem.*, **4**(2), 146 (2008).
10. J.A. Riddick, W.B. Bunger, T. Sakano, "Organic solvents-physical properties and methods of purification, techniques of chemistry", 4<sup>th</sup> edition, Vol II, Wiley-Interscience Publication, John Wiley, New York, 1989.
11. G.L. Slonimskii, A.A. Askadshii, A.I. Kitaigorodskii, The packing of polymer molecules, *Vysokomol. Soyed*, **12A**, 494 (1970).
12. H.A. Lorentz, "Theory of electronics", Leipzig, 1906.