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Synthesis and Characterization of a H-Bonded Charge-Transfer Complex Formed Between 1,10-Phenanthroline Monohydrate with Some Π-Acceptors in Different Solvents

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1,10 phenanthroline monohydrate, charge transfer complexes, fluorescence, conductivity, FT-IR, TGA-DTA

Abstract

The charge-transfer complexes of the 1,10-phenanthroline monohydrate with m-dinitrobenzene, p-hydroxybenzoic acid, 3,5-dinitrosalicylic acid, and 3,5-dinitrobenzoic acid have been prepared and characterised by using different techniques like the ^{1}H NMR, TGA-DTA, XRD, and FT-IR Fluorescence and Conductivity data indicate a charge-transfer interaction and as far as complexes are concerned, this interaction is associated with a H bonding and the transfer of H^+ from the acceptor to the donor molecules. The FT-IR and ^{1}H NMR spectroscopic data also indicated a charge-transfer interaction associated with a proton migration from the acceptor to the donor followed by intermolecular H bonding.

1. Introduction

For a long time, it was believed that Charge-transfer complexes (CTC) would play an important role in biological systems, such as the transfer of charge from one molecule to another [1]. CT interaction is utilized for the assay of different pharmaceuticals and related analyses [2, 3]. Many large biomolecules are good semiconductors [4, 5]. The formation of CTC between π and n-donors with π acceptors has been previously investigated [6, 7]. The protonic CTC was first introduced by Matsunaga and his coworkers [8]. Pauling regarded the H- bond as a special case of CT interaction [9], while Atkins claims that a proton-transfer complex is a manifestation of dipole–dipole (or electrostatic) forces [10-11]. In terms of its coordination properties, phenanthroline is like 2,2-bipyridine. Proton-transfer could sometimes, be nothing more than a case of conventional H-bonding, but in many cases, the concurrent transfer of an electron and a proton produce a new type of adduct and complex formation may indeed be dramatic [12]. π→ π* and n→ π* molecular complexes of 1,10 phenanthroline derivatives with chloranil, picric acid, and chlorsnilic acid were investigated spectrophotometrically. 1,10-phenanthroline and its derivatives show high catalytic activities [13,14]. In connection with such studies, 1,10-Phenanthroline is an inhibitor of metallopeptidases, with one of the first observed instances reported in carboxy peptidase [15]. 1,10-Phenanthroline targets mainly zinc, metallopeptidases with a much lower affinity for Ca [16,17]. The ability of CTC to cause critical cellular disruptions in cancer cells, hence demonstrating anti-cancer action, highlights their relevance in medicinal chemistry [18]. The solvent chosen was methanol because it has a high dielectric constant and both acceptors and donors were soluble in it. The formation of CTC between π and n-donor with π acceptor has been widely investigated [19]. In this article we have investigated the molecular complexes formed during the reaction of 1,10-phenanthroline monohydrate as an electron donor with electron acceptors, which are m-dinitrobenzene, p-hydroxybenzoic acid, 3,5-dinitrosalicylic acid, and 3,5-dinitrobenzoic acid.

2. Structure Materials

All high-grade chemicals were used. P-hydroxy benzoic acid from (BDH England), 1,10phenanthroline monohydrate, p-nitrophenol, and m-dinitrobenzene from (MERCK), acetone, methanol, ethanol, double distilled water, and DMSO also, from (MERCK) were of the highest purity and used without further purification.

2.1 Synthesis of CT Complexes

2.1.1 Synthesis of CT Complex of 1,10 Phenanthroline (phMH) with P-hydroxybenzoic Acid (PHB)

By mixing a saturated solution of phMH (0.594 g, 3mmol) in 30 ml of acetone with a saturated solution of PHB (0.5143 g, 3mmol) in 30 ml acetone, a white coloured ppt. was formed by stirring for 2 hours, and a solid CTC was prepared. The ppt was filtered off, washed with hexane, and dried in a vacuum over $CaCl_2$. The melting factor of CT complicated becomes measured at 183-185 °C. The white powder becomes soluble in methanol, acetone, DMSO, and partly soluble in $CHCl_3$; however, it is insoluble in Hexane and double-distilled water.

2.1.2 Synthesis of CT Complex of 1,10-Phenanthroline (phMH) with M-dinitrobenzene (MDNB)

The solid CTC was prepared by mixing a saturated solution of (phMH) (0.59469 gm, 3 mmol) in 30 ml of acetone with a saturated solution of MDNB (0.50436 gm, 3mmol) in 30 ml acetone. A yellow to white coloured ppt. was formed by stirring for around 1 hour. The ppt was filtered and washed several times with hexane and dried under vacuum over $CaCl_2$. The melting point of the CTC was measured as 123-125 °C. The yellow white crystal was soluble in methanol, acetone, DMSO, and $CHCl_3$, but insoluble in Hexane and double-distilled water.

2.1.3 Synthesis of CT Complex of 1,10 Phenanthroline (phMH) with 3,5-dinitrosalicylic Acid (DNSA)

The solid CTC was prepared by mixing a saturated solution of phMH (0.59469 g, 3mmol) in 30 mL of acetone with a saturated solution of DNSA (0.68436 g, 3 mmol) in 35ml acetone. A bright yellow coloured ppt was formed by stirring for 1 hour. The precipitate was filtered and washed with hexane and dried under vacuum over $CaCl_2$. The melting point of the CTC was measured as 287 - 289 °C. The bright yellow powder was soluble in methanol, acetone, DMSO, partially soluble in $CHCl_3$, and double-distilled water, but insoluble in Hexane.

2.1.4 Synthesis of CT Complex of 1,10 Phenanthroline (phMH) with 3,5-dinitrobenzoic Acid (DNBA)

The solid CTC was prepared by mixing a saturated solution of phMH (0.594 g, 3mmol) in 30 mL of acetone with a saturated solution of DNBA (0.636 g, 3mmol) in 40 mL of acetone. An orange coloured ppt was formed by stirring for about 2 hours. The ppt was filtered off, washed with hexane, and dried under vacuum over $CaCl_2$. The melting point of the CTC was measured as 209-211°C. The dark orange powder was soluble in methanol, acetone, DMSO, partially soluble in $CHCl_3$, double-distilled water, but insoluble in Hexane.

3. Results and Discussion

Reactions between phMH with MDNB, DNSA, PHB, and DNBA resulted in the formation of stable CTCs [(phMH) (MDNB), [(phMH) (DNSA)], [(phMH) (PHB)] and [(phMH) (DNBA)] with a donor–acceptor molar ratio of 1:1. The electronic absorption spectra were recorded in the region of 800-200nm using UV–visible spectrophotometer. The IR spectra of the reactants and complexes were recorded using KBr discs on Interspec FT-IR Spectrometer. X ray diffraction using Cu-Kα radiation (λ = 1.5418 Å) in 2θ range from 20º to 80º. The proton NMR spectra of the reactants and the formed CTC were measured in DMSO using NMR spectrometer.

3.1 FT- IR Spectra:

The observations of IR bands of donor phMH and acceptors MDNB, PHB, DNSA and DNBA in their respective complex spectra support formation of CTCs by intermolecular H bonding. However, as shown in Scheme 1. And their band assignments are given in Table 1 and the characterized bands of phMH -PHB, phMH -MDNB, phMH -DNSA and phMH-DNBA are shown in Fig 1.

- The C=O stretching vibration appearing at 1680 cm^{-1} in the IR spectrum of PHB is shifted to 1688 cm^{-1} in the IR of the CTC of PHB with phMH.

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- The C=O stretching vibration appearing in DNBA at 1628 cm^{-1} shifted to 1620 cm^{-1} in IR of the CTC of DNBA with phMH.
- The C=O stretching vibration appearing in DNSA at 1672 cm^{-1} shifted to 1620 cm^{-1} in IR of the CTC of DNSA with phMH.
- The IR Spectra of CTCs show NH bands at 2860, 2816, 2800, 2810 cm^{-1} for phMH-DNSA, DNBA, PHB, and MDNB Complexes, confirming the formation of H-bonded proton transfer between OH of PHB and H in ortho position to two NO_2 of MDNB, DNBA, and DNSA and N in the ring of phMH.
- The phMH ring vibrations appearing at 1585,1516 and 1509 cm^{-1} of donor (phMH) are shifted to 1575,1545,1509 cm^{-1}; 1593,1541,1505 cm^{-1}; 1589,1545, 1505; and 1525,1512,1497 cm^{-1} in CTCs of phMH with DNSA, DNBA, PHB, and MDNB, respectively [20].

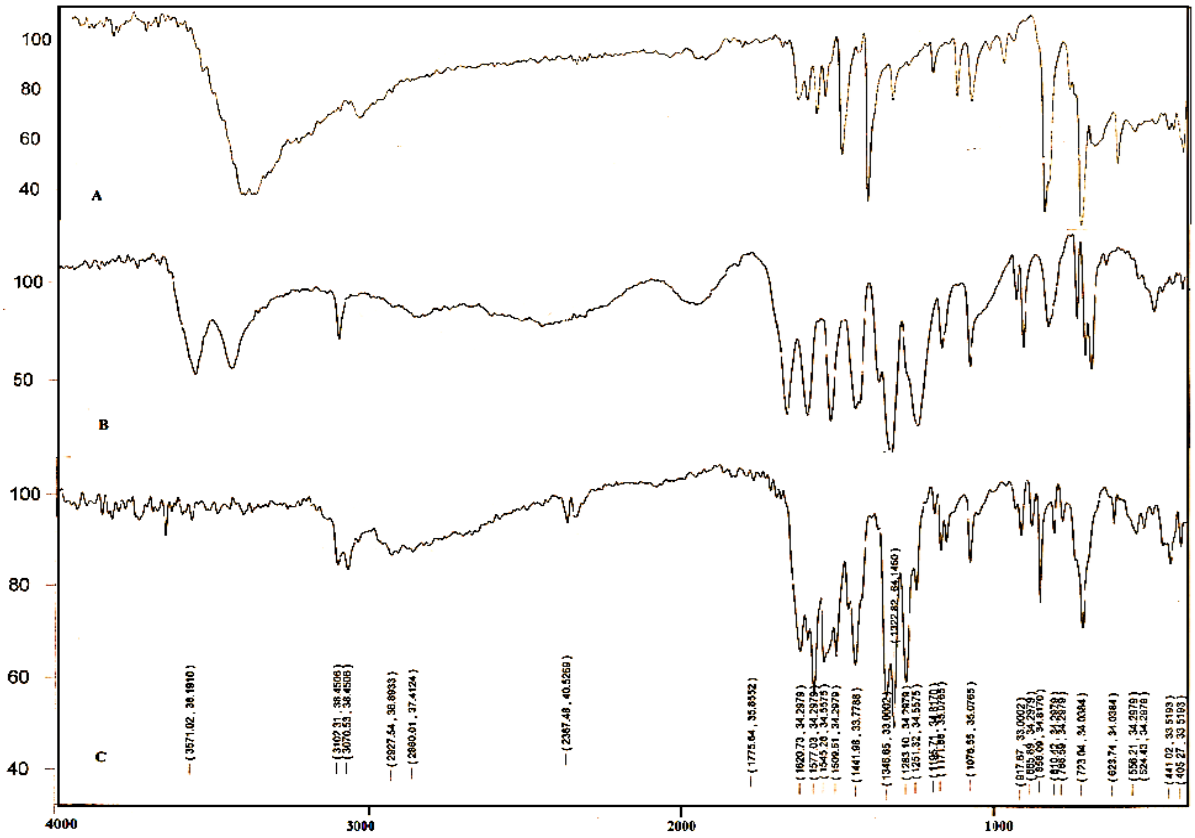
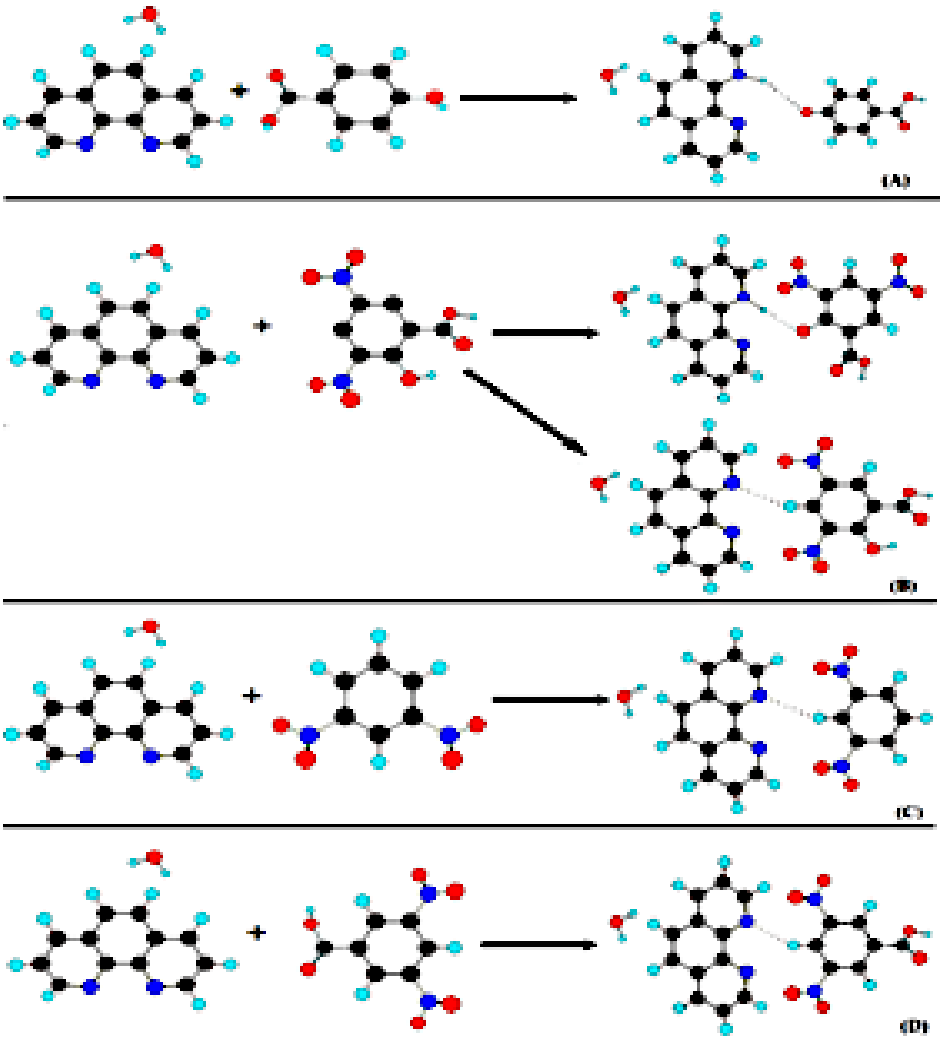


Fig. 1 *FT- IR spectrum of (a) phMH; (b) DNBA; (c) CTC of PhMH and DNBA*



Scheme 1. *Shows optimised structures (a) phMH & DNBA; (b) phMH & MDNB; (c) phMH & PHB; (d) phMH & DNBA [Black: C atom; Light cyan: H atoms; Red: O atom; Dark Blue: N atom; Dotted Line: H bonding*

Table 1 *IR frequencies and tentative assignments for phMH, PHB, MDNB, DNSA, DNBA and their H bonding CTCs*

phMH	PHB	MDNB	DNSA	DNBA	CTC of phMH-DNSA	CTC of phMH-DNBA	CTC of phMH-PHB	CTC of phMH-MDNB	Assignment
3436	3380	3408	3567	3094	3571	3098	3169	3114	V(O-H), v(N-H), H-bonded
3396	3197	3106	3451						
3261	3062	3046	3106		3102	3050			
3058	2955			2828	3070		2800		
2820	2832	2871	2922	2677	2927	2816	2673	2810	V(C-H),aromatic
	2720			2542	2860				
2333	2661	2420	2321	2371	2367	2371	2300	2367	-C=C-H
1958	2546	2002	1954						
1827	1926	1950	1672	1704	1775	1894	1688	1616	-C-N
1700	1787	1890		1628	1620		1589		
1648	1680	1827	1608	1596	1577	1700	1545	1525	$V(NO_2)$

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phMH	PHB	MDNB	DNSA	DNBA	CTC of phMH-DNSA	CTC of phMH-DNBA	CTC of phMH-PHB	CTC of phMH-MDNB	Assignment
1616	1596	1767	1449	1541	1545	1620	1505	1512	-(C=C)
1585	1509	1704		1418	1509	1593	1469	1497	
1516	1449	1652	1400	1350	1441	1541	1422	1414	(C-H) mono def.
1509	1418	1612	1378	1287	1346	1505	1350	1342	-(C-C),-NO_2
1422	1366	1537	1338	1183	1251	1462	1318	1259	-(C-N)
1342	1318	1350	1259	1080	1195	1338	1271	1203	
1219	1283	1271	1171	921	1076	1275	1239	1132	(C-H)plane bending
1136	1235	1171	1084	810	917	1176	1168	1092	V(C-NO_2)
1092	1128	1180	941	774	858	909	1144	1064	
1037	1100	1096	909	723	723	886	1100	901	CH_2 rock skeletal vibration
989	1013	1068	830	691	623	842	937	845	C-H out of plane
957	929	1005	746	635	556	778	846	798	-NO_2 wag vibration
850	854	909	695	528	524	719	794	770	
753	770	838	647	452			762	707	
695	695	810		417	441	520	715	647	

3.2 Powder X-Ray Diffraction

To further confirm the crystalline structure of phMH- MDNB, phMH- DNBA, phMH-DNSA and phMH- PHB Powder X- Ray Diffraction measurement was performed using Cu-Kα radiations (λ = 1.5418 Å) in 2θ range from 20º to 80º. The XRD spectra for all the reactants and products are shown in Fig 2-5.

- The XRD spectrum of phMH (Fig. 2 A) gave Co characteristic peaks at 2θ= 20, 23, 25, 31, 37, 42, 78; DNSA (Fig 2 B) gave 7,13,17,24,36,44,76; and CTC of phMH and DNSA (Fig2 C) 8, 9, 18, 25, 36, 44 and a new peak at 75 corresponding to a new compound formed and indicating crystal structure of the phMH-DNSA complex.
- The XRD spectrum of phMH (Fig 3 A) gave Co characteristic peaks 2θ= 20, 23, 25, 31, 37, 42, 78; DNBA (Fig 3 B) gave 23, 25, 26, 32, 38, 43, 78; and of CTC of phMH and DNBA (Fig 3 C) gave 8, 10, 15, 20, 25, 36, and a new peak at 44 corresponding the new compound formed and indicating the crystal structure of phMH-DNBA complex.
- The XRD spectrum of phMH (Fig4 A) gave Co characteristic peaks at 2θ= 20, 23, 25, 31, 37, 42, 78; PHB (Fig 4 B) gave 21, 23, 26, 29, 37, 43, 78; and of CTC of phMH and PHB (Fig 4 C) gave 17, 36, 44, and new peak at 75 corresponding new compound formed and indicating crystal structure of phMH- PHB complex.
- The XRD spectrum of phMH (Fig 5A) gave Co characteristic peaks at 2θ= 20, 23, 25, 31, 37, 42,78 MDNB (Fig 5B) gave 23, 24,37, 43,78; and of CTC of phMH and MDNB (Fig 5C) gave 7,14,19,26,36 and new peak at 39 corresponding new compound formed and indicating crystal structure of phMH-MDNB complex [21].

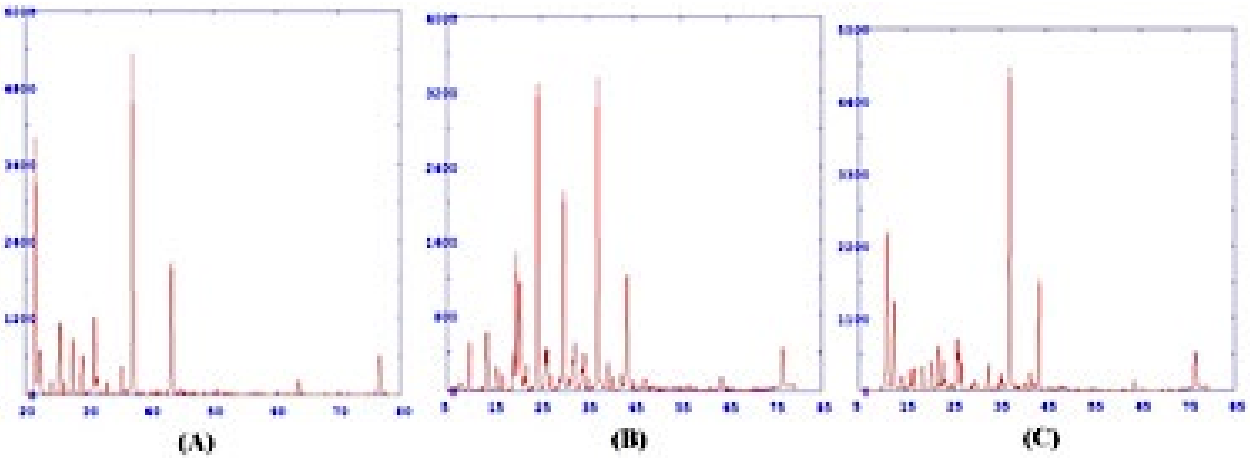

Fig. 2 *XRD spectrum of (a) phMH; (b) DNSA; (c) CTC of PhMH and DNSA*

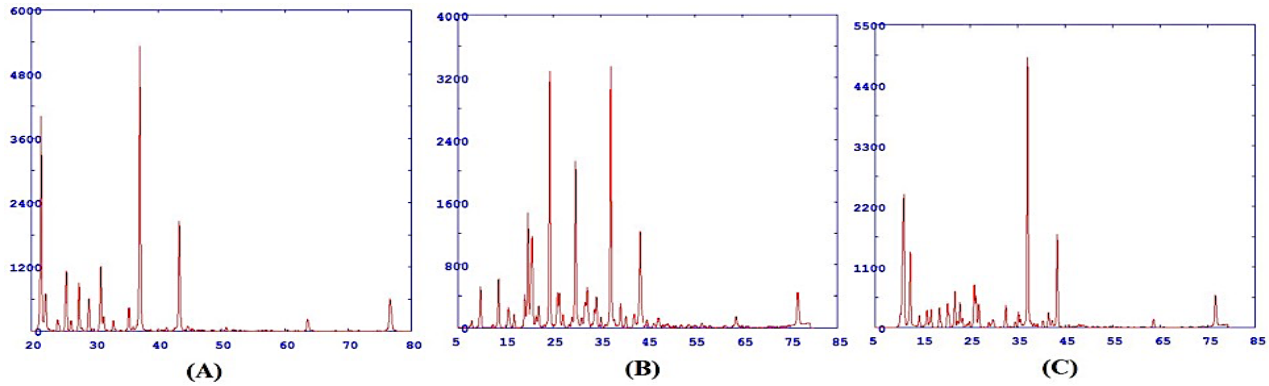

Fig. 3 *XRD spectrum of (a) phMH; (b) DNBA; (c) CTC of PhMH and DNBA*

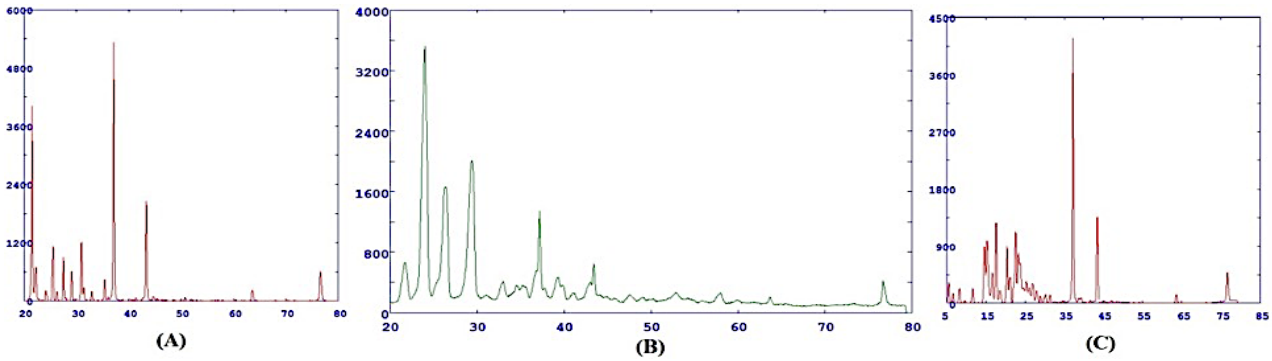

Fig. 4 *XRD spectrum of (a) phMH; (b) PHB; (c) CTC of PhMH and PHB*

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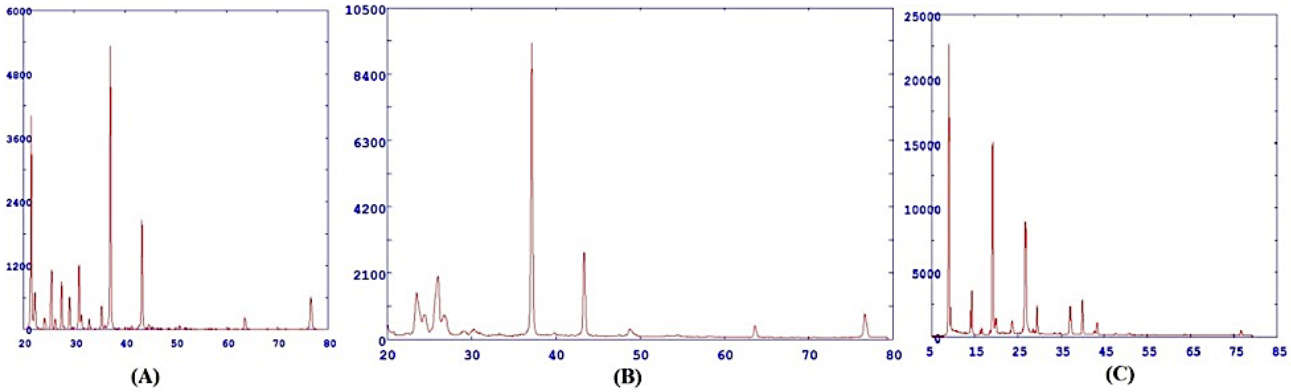

Fig. 5 *XRD spectrum of (a) phMH; (b) MDNB; (c) CTC of PhMH and MDNB*

3.3 Thermo gravimetric Analysis (TGA-DTA)

TGA and DTA of samples were performed at a constant heating rate of 10 °C/min over the temperature range 20-850 °C using α-alumina powder (10mg) as reference material. A sample of about 1-10 mg was uniformly spread. TGA and DTA of phMH, DNBA, DNSA, MDNB and PHB and their complexes are shown in Table 2 and the curves in Fig 6-9. The decomposition of CTC of phMH and PHB, as well as of phMH, occurs in two stages [22-25]. In the first stage, the range of temperature is 180.11 to 280.12 °C with a weight loss of about -4.194 mg, -99.290 %; while in the second stage, the range was 260.21 to 318.23 °C. The decomposition of the CTC of phMH-MDNB occurs in two stages. In the first stage, the range of temperature is 130.79 to 147.50 °C with a weight loss of about -4.569 mg, -96.555 %; and in second stage, the range of temperature is 264.81 to 298.55 °C with a loss of remaining weight. For CTC of phMH and DNSA. It happens in one stage with weight loss of –1.77 mg, -94.93% in temperature range of 256.33 to 267.94 °C, decomposition of CTC of phMH-DNBA, happens in two stages; first stage occurs with weight loss of -3.621 mg, -95.743%, in temperature range of 179.52 to 200.33 °C while the second stage occurs in temperature range of 285.14 to 334.22 °C with loss of remaining weight [26-27].

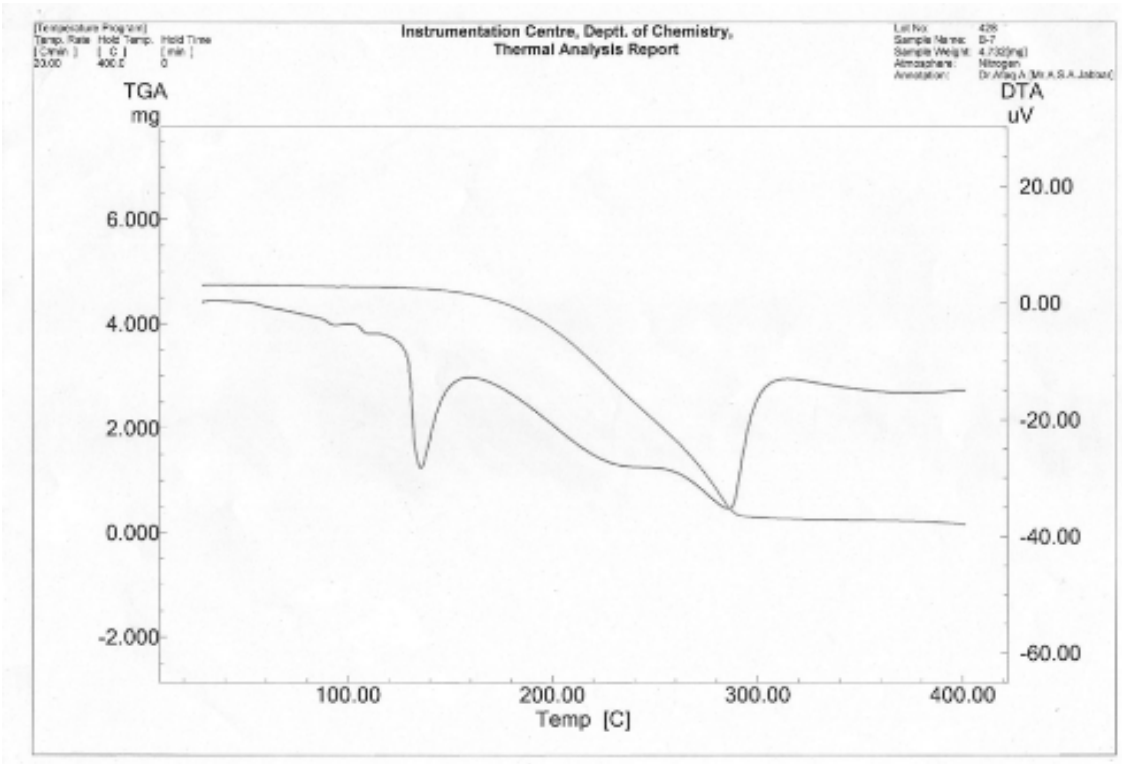

Fig. 6 *CTC of PHMH- MDNB*

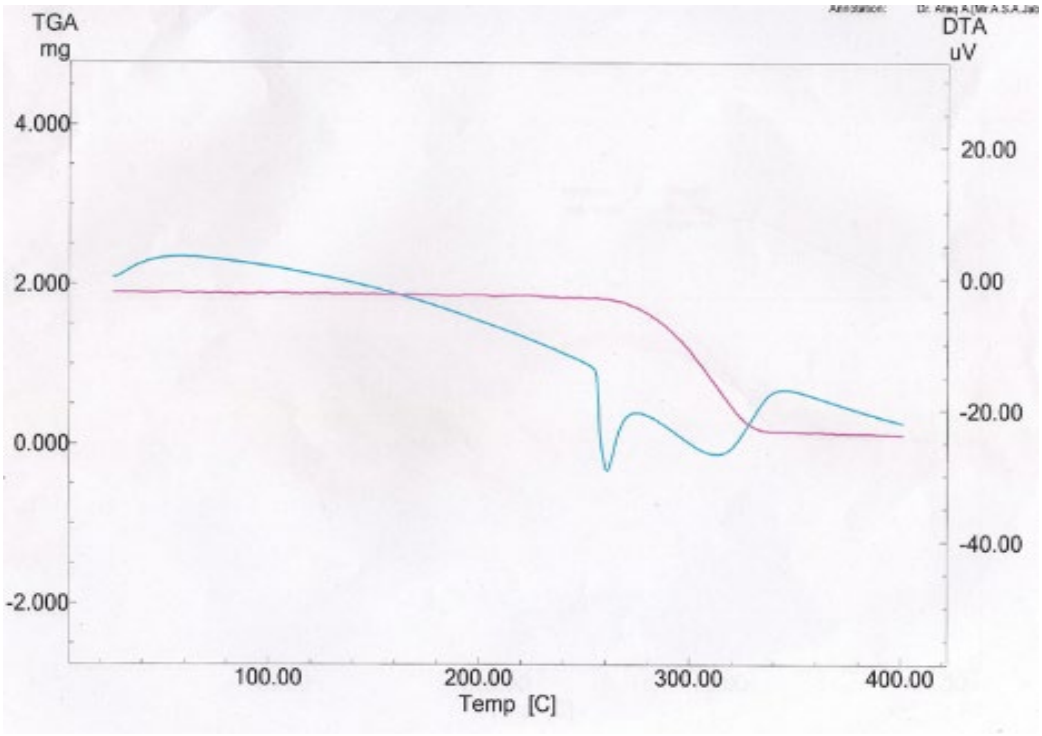

Fig. 7 *CTC of PHMH – DNSA*

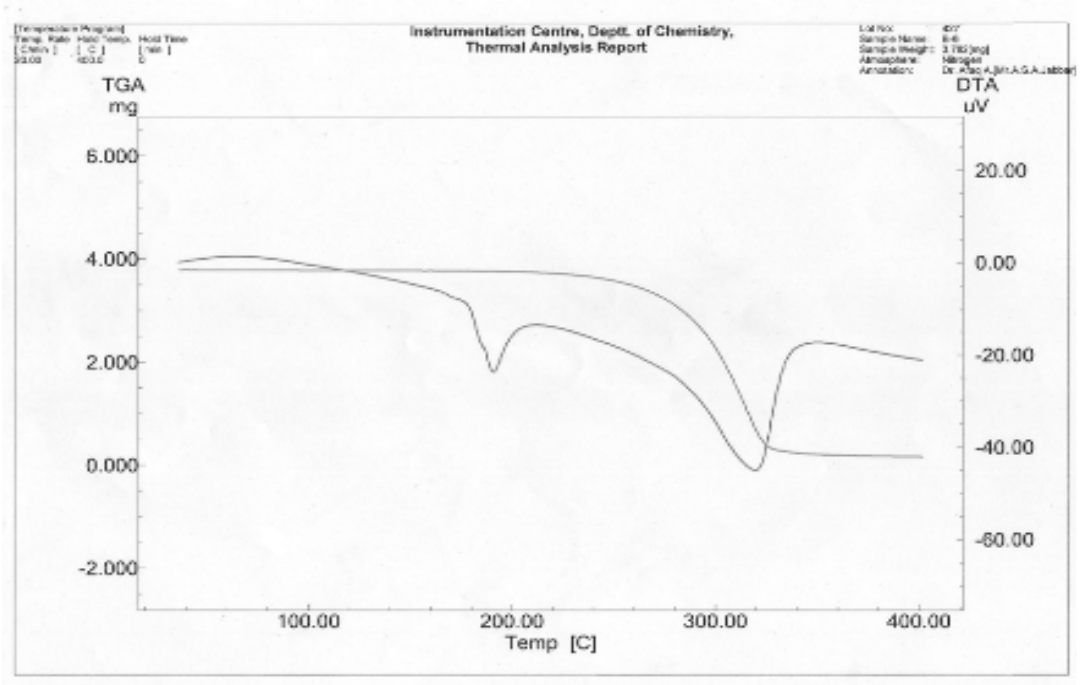

Fig. 8 *CTC of PHMH - DNBA*

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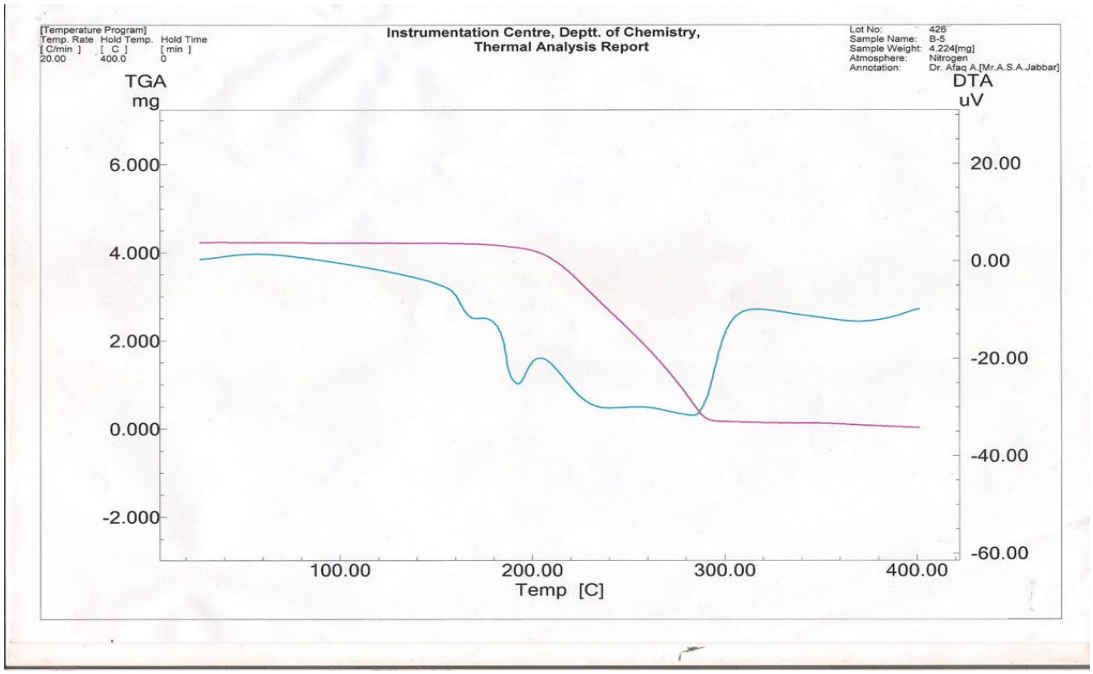

Fig. 9 *CTC of PHMH- MDNB*

Table 2 *Thermal analysis data of phMH, DNBA, DNSA, MDNB, PHB, and their complexes*

Compound	Range of temperature (°C)	Stage	TGA			DTA
			Midpoint (°C)	Weight loss (mg)	% Wt loss	Peak (°C)
phMH	94.82-130.12	First	97.06	-0.703	-10.0790	106.77
	245.00-323.28	Second	286.04	-5.892	-84.473	307.19
PHB	215-232	First	254.14	-6.07	-91.628	221.69
	243.06-291.48	Second	375.24	-0.539	-8.131	268.76
MDNB	88.97-107.57	First	206.20	-6.715	-100.075	95.25
	172.18-239.27	Second				222.93
DNBA	204.61-222.49	First	277.78	-6.065	-92.440	211.21
	255.77-311.66	Second	-	-	-	296.95
DNSA	66.72-104.72	First	73.10	-0.491	-8.366c	83.32
	172.56-192.85	Second	-	-	-	179.92
CTC of phMH & DNSA	256.33-267.94	First	304.98	-1.77	-94.93	260.99
CTC of phMH & DNBA	179.52-200.33	First	304.33	-3.621	-95.743	190.79
	285.14-334.22	Second	-	-	-	319.61
CTC of phMH & MDNB	130.79-147.50	First	237.03	-4.569	-96.555	135.69
	264.81-298.55	Second	-	-	-	285.96
CTC of phMH & PHB	180.11-215.12	First	251.00	-4.194	-99.290	195
	260.21-318.23	Second	-	-	-	294

3.4 ^{1}H NMR

In Table 3, the chemical shifts (δ) of different types of CTCs are listed. By using an NMR spectrometer, the ^{1}H NMR spectra of reactants and formed CTCs were measured in DMSO. There are some changes in chemical shift values of CTCs rather than free donors and acceptors in the ^{1}H NMR spectrum [28]. In the ^{1}H NMR spectrum of the complexes formed by interactions between phMH as an electron donor with π acceptors such as DNBA, DNSA, PHB and MDNB, one or two of the N atoms from the donor interact to make intermolecular H bonding with the H atom to ortho position related to two N groups in MDNB and DNBA, which makes that H more liberate, in PHB with proton of OH group and may be with proton of -COOH group and in DNSA may be with H atom between two NO_2 groups or with OH group.

The aromatic H^+ in phMH, DNBA, DNSA were assigned in the regions 8-9.1 ppm, following the previously known in literature [28] while the phenolic protons of PHB were assigned at 10.2 and 12.1 ppm and at 8.9 ppm in MDNB. The ^{1}H NMR spectra of the complexes reveals several observations. All the observed peaks in spectra of the individual components are also present in the complexes spectra's suggesting their formation. The proton signals of the donor phMH are downfield shifted to higher ppm values indicating a charge migration from the donor towards the acceptors. The ^{1}H NMR signal due to the phenolic H^+ in two acceptors (PHB) disappeared in the complex's spectra indicating deprotonation and in the MDNB a new peak is observed in the complex's spectra in the region 2.0–3.0 ppm and assigned to N+–*H* protons indicating protonation of the donor phMH. Finally, suggested that interaction of phMH as a donor with PHB, DNBA, DNSA and MDNB in a molar ratio of 1:1 according to the following equations in **Scheme 2**.

Table 3 *^{1}H NMR spectral data of phMH, DNBA, MDNB, DNSA, PHB, and their CT complexes*

Compound	^{1}H NMR chemical shift δ ppm	Assignments	Compound	^{1}H NMR chemical shift δ ppm	Assignments
PHB	6.9	D, 2H; Ar- H	CTC of phMH & DNSA	2.1	S; H-NH-Ar
	7.9	D, 2H; Ar- H		2.7	M; 2H-ph
	10.2	Br, 1H; Ar- OH		8.1	M; 2H-ph (3,8), 2H-Ar
	12.1	Br, 1H; Ar- COOH		8.3	S; 2H-ph (5,6)
DNBA	8.7	S, 2H; Ar- H		9.0	Q; 2H-ph (4,7), 1H-OH-Ar
	9.01	S, 1H; Ar- H		9.4	Q; 2H-ph (2,9), 1H-COOH-Ar
	13.8	Br, 1H; Ar- COOH	CTC of phMH & MDNB	2.2	S; NH-ph-Ar
MDNB	7.7	D, 1H; Ar- H		2.5	T; 1H-ph
	8.5	D, 1H; Ar- H		3.5	S; OH-ph
	8.6	D, 1H; Ar- H		7.7	Q; 2H-ph(3,8), 1H-Ar-H
	8.9	S, 1H; Ar- H (between two NO_2 groups)		7.9	Q; 2H-ph(5,6)
DNSA	8.3	S; 2H- Ar		8.5	Q; 2H-ph(4,7), 1H-Ar
	8.9	S; 1H- Ar		8.6	Q; 2H-ph (2,9)
	10.9	Br; OH- Ar		9.1	Q; 1H-Ar

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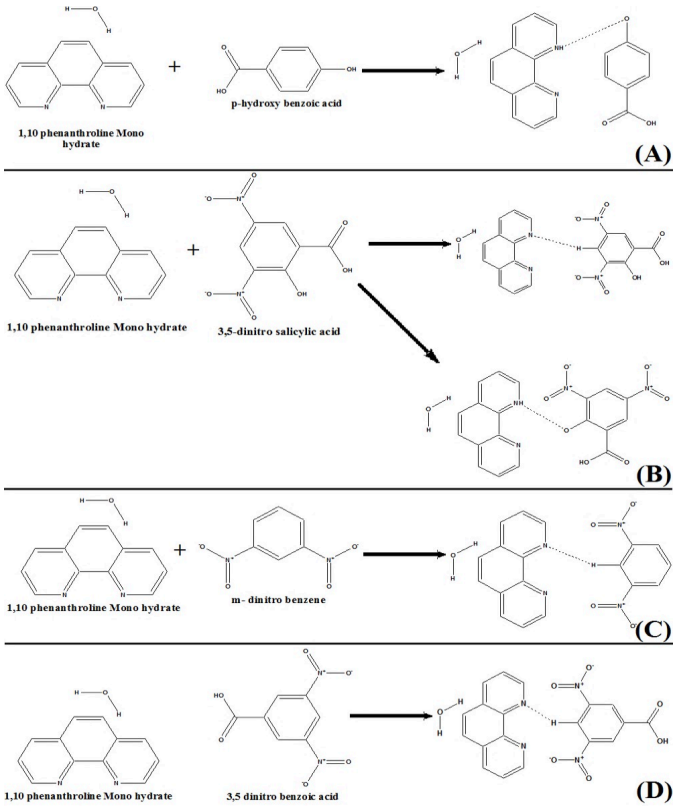
Compound	^{1}H NMR chemical shift δ ppm	Assignments	Compound	^{1}H NMR chemical shift δ ppm	Assignments
	12.6	Br; COOH- Ar	CTC of phMH & DNBA	2.2	S; 1H-NH-ph-Ar
1,10 phMH	2.6	S; H-ph		2.8	Q; 1H-ph
	3.4	S; OH-ph		3.1	Br; 1H-OH-ph
	7.9	Q; 2H-ph(3,8)		7.7	M; 2H-ph(3,8), 2H-Ar
	8.0	S; 2H-ph(5,6)		7.9	M; 2H-ph (5,6)
	8.6	Q; 2H-ph(4,7)		8.1	S; 2H-ph(4,7)
	9.1	S; 2H-ph(2,9)		8.9	S; 2H-ph(2,9)
CTC of phMH & PHB	2.1	S; NH-O-Ar		9.5	Q; 1H-COOH-Ar
	2.7	Q; 1H-ph			
	3.5	Br; OH-ph			
	6.9	M; 2H-Ar, 2H-ph (3,8)			
	7.8	M; 2H-Ar, 2H-ph (5,6)			
	8.2	S; 2H-ph (4,7)			
	8.3	S; 2H-ph (2,9)			
	11.8	Br; 1H-COOH-Ar			

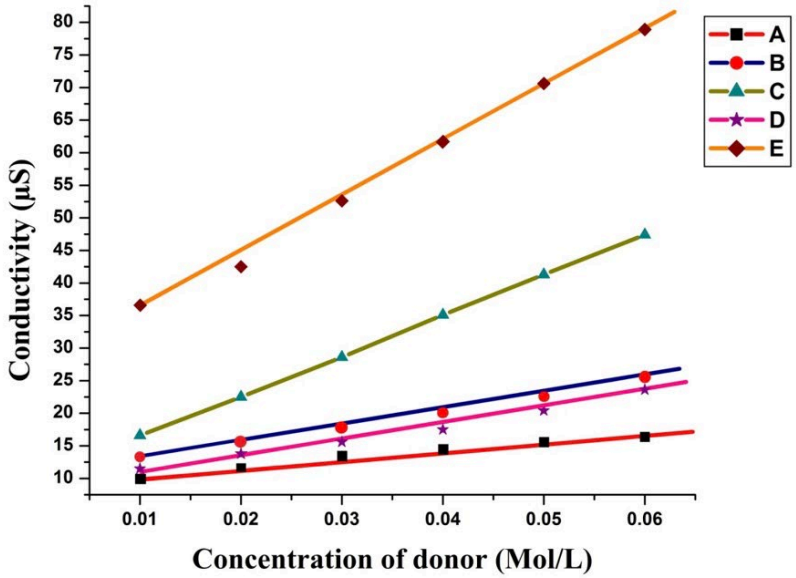
3.5 Conductivity

The conductivity of phMH (0.01, 0.02, 0.03, 0.04, and 0.05 molL^{-1}) with 0.01 molL^{-1} acceptors (PHB, DNSA, DNBA, and MDNB) in methanol and acetone was obtained by Systronics 306, and by plotting different concentrations of donor against conductivity at 35.0 °C. They are shown in Fig.10(a). It was obtained that the conductivity of 0.01 phMH in acetone equals 10 µS, but when we mixed it with 0.01 M MDNB, the conductivity became 13.2 µS, and when we increased the concentration of phMH and left the concentration of MDNB constant at 0.01 M, the conductivity increased to 25.5 µS (at a concentration of donor 0.06 M). For mixing between phMH and DNBA, the values obtained in Table 4 increased from 16.6 µS at 0.01 M phMH to 47.4 µS at 0.06 M phMH. For the CTC of phMH and PHB, shown in Fig 5 and obtained in Table 4, the conductivity increased from 11.5 µS at 0.01 M phMH with 0.01 PHB (Ratio 01:1) to 23.6 µS at 0.01 M PHB with 0.06 M phMH (Ratio 1:6). For mixing between phMH and DNSA, as obtained in Fig10 (a) and (9), conductivity increased from 36.6 µS at 0.01 M phMH to 78.9 µS at 0.06 M phMH. The resulting donor–acceptor solution in methanol exhibited appreciable conductivity, which may be explained by the possible formation of CTCs between the donor and acceptor in solution [30-33]. It has been observed that the conductivity of CTCs in solvents increases with an increase in polarity of the solution and with an increase in concentration of donor; it also depends on the type of acceptor and solvents. Moreover, this increase in conductivity is because dative structure D+ -A- should be stabilised in less polar solvents. we obtained that the conductivity of 0.01 M phMH in methanol equals 14 µS, but when we mixed it with 0.01 M MDNB, the conductivity (Ratio 1:1) became 19 µS, and when we increased the concentration of phMH and left the concentration of MDNB constant at 0.01 M, the conductivity increased to 43.1 µS (at a concentration of donor equal to 0.06 M). We obtained a similar increment in the conductivity of CTCs of phMH with DNBA, PHB, and DNSA, as shown in Fig.10(b).

Finally, suggested that the interaction of phMH as a donor with PHB, DNBA, DNSA, and MDNB in a molar ratio of 1:1 according to the equations in **Scheme 2** and Fig.10.



Scheme 2: *Shows the reaction and the intermolecular H bonding between (a) phMH & PHB, (b) phMH & MDNB, (c) phMH & DNSA, and (d) phMH & DNBA*



(a)

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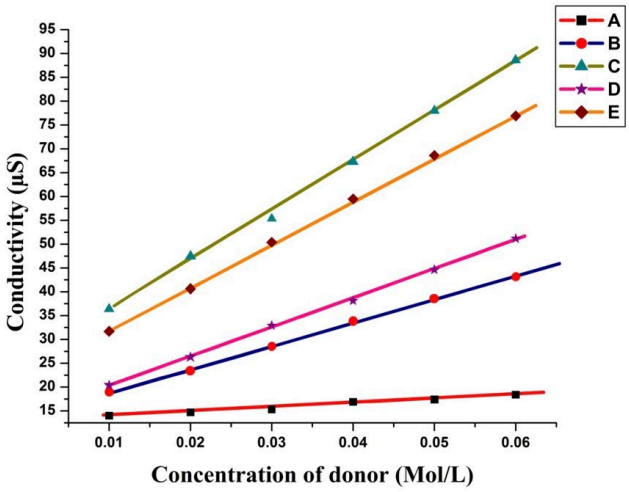

(b)

Fig. 10 (a) *Spectrum showing conductivity and the concentration of the donor in the acetone solution (A) phMH, (B) CTC of phMH & MDNB, (C) CTC of phMH & DNBA, (D) CTC of phMH & PHB, (E) CTC of phMH & DNSA;* ***(b)*** *Spectrum between the conductivity and the concentration of the donor (A) phMH, (B) CTC of phMH & MDNB, (C) CTC of phMH & DNBA, (D) CTC of phMH & PHB, (E) CTC of phMH & DNSA in methanol solution*

4. Conclusion

The UV–Visible spectrophotometric method for the study of CTC of p-hydroxy benzoic acid (PHB), 3,5 dinitro benzoic acid (DNBA), 3,5 dinitro salicylic acid (DNSA) and m-dinitrobenzene(MDNB) with 1,10 Phenanthroline (phMH) reveals that it forms 1:1 H-bonded H^+ transfer complex of phMH with PHB, DNBA, DNSA and MDNB, which has been attributed to an extensive H-bonding network between aromatic donor and acceptors in its crystal structure due to transfer of H^+ of acceptors moiety to donor moiety ($-NH^+$). The interaction between donors and acceptors was found to be π-π*transitions by the formation of radical ion pairs. The FT-IR spectrum shows that the complex formed between donor and acceptors by transferring a H^+ from acceptor p-hydroxy benzoic acid (PHB), 3,5 dinitrobenzoic acid (DNBA), 3,5 dinitro salicylic acid (DNSA), and m-dinitrobenzene (MDNB) to donor 1,10 phenanthroline (phMH). The XRD spectrum shows that in CT complexes of donors & acceptors, new bands corresponding to new compounds formed, indicating the crystal structures of phMH- MDNB, phMH-DNBA, phMH, DNSA, and phMH-PHB. From the conductivity of CT Complexes, we obtained that the concentration of the donor is affected when it reacts with acceptors, and that when we increase the concentration of the donor, conductivity increases. From the data and graph of conductivity, we obtained that conductivity increases in charge transfer complexes with an increase in concentration of donor, and that it depends upon the type of acceptor and solvent. The results of this work may contribute to the development of new medications by improving our knowledge of the structural and functional characteristics of the hydrogen-bonded charge-transfer complex and opening the door for additional vitro and vivo analyses. As well as the importance of conductimetric studies of charge transfer complexes is increasing rapidly on account of their use as semiconductors.

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Conflict of Interest

We declared that there is no conflict of interest regarding this publication of the paper.

Author Contribution

We take public responsibility for the content of the work submitted for review study conception and design: The authors confirm contribution to the paper as follows: ***study conception and design:*** *Urfi Ishrat, Abdulsatar Abduljabbar Rzokee;* ***data collection:*** *Abdulsatar Abduljabbar Rzokee, Urfi Ishrat;* ***analysis and interpretation of results:*** *Abdulsatar Abduljabbar Rzokee;* ***draft manuscript preparation:*** *Urfi ishrat.*

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