Biochem. Cell. Arch. Vol. 21, No. 2, pp. 4653-4660, 2021 | www.connectjournals.com/bca | *ISSN* 0972-5075
DocID: https://connectjournals.com/03896.2021.21.4653 | *eISSN* 0976-1772

SYNTHESIS AND CHARACTERIZATION OF SOME NEW METALS COMPLEXES OF 2-(3-ACETYLTHIOUREIDO)-3-PHENYLPROPANOIC ACID (APA)

Fatima T. Talib* and Basima M. Sarhan

Department of Chemistry, College of Education for Pure Sciences, Ibn-AL-Haitham, University of Baghdad, Iraq.
*e-mail : fatma.thair1205a@ihcoedu.uobaghdad.edu.iq

(Received 12 April 2021, Revised 30 May 2021, Accepted 14 June 2021)

ABSTRACT : A new ligand [2- (3-acetylthioureido)-3-phenylpropanoic acid (APA) is synthesized by reaction of acetyl isothiocyanate with phenylalanine (1:1). It is characterized by micro elemental analysis (C.H.N.S.), FT-IR, (UV-Vis) and ^{1}H and ^{13}CNMR spectra. Some metals ions complexes of this ligand were prepared and characterized by FT-IR, UV-Visible spectra, conductivity measurements, magnetic susceptibility and atomic absorption. From results obtained, the following formula [M(APA)$_2$] where M^{2+} = Mn, Co, Ni, Cu, Zn, Cd and Hg, the proposed molecular structure for these complexes as tetrahedral geometry, except copper complex is has square planer geometry.

Key words : Phenylalanine acetyl isothiocyanate, metal complexes.

How to cite : Fatima T. Talib and Basima M. Sarhan (2021) Synthesis and characterization of some new metals complexes of 2-(3-acetylthioureido)-3-phenylpropanoic acid (APA). *Biochem. Cell. Arch.* **21**, 4653-4660. DocID: https://connectjournals.com/03896.2021.21.4653

INTRODUCTION

L-phenylalanine (LPA) is an essential á-amino acid. It is classified as non-polar because of the hydrophobic nature of the benzyl side chain. It is an electrically neutral amino acid, one of the twenty common amino acids used to biochemically form proteins, coded for by DNA. It is used in the manufacture of food and drink products and sold as a nutritional supplement for its reputed analgesic and antidepressant effects. A non-food source of phenylalanine is the artificial sweetener aspartame. LPA is the starting compound used in the flavonoid biosynthesis (Dlnelson M M Cox *et al*, 2000). The genetic disorder phenylketonuria (PKU) is the inability to metabolize phenylalanine. Individuals with this disorder are known as "phenylketonurics" and must regulate their intake of phenylalanine. Phenylalanine uses the same active transport channel as tryptophan to cross the blood–brain barrier and, in large quantities, interferes with the production of serotonin. Individuals, who cannot metabolize phenylalanine must monitor their intake of protein to control the buildup of phenylalanine as their bodies convert protein into its component amino acids (Koley *et al,* 2010; Ali, 2020) aminoacids and their derivatives have been used for different purposes (Deepak *et al*, 2004) and some amino acid derivatives and some of their metal complexes have been evaluated as having antibacterial, antifungal properties (Chohan *et al*, 2006).

Different Schiff bases (L) ligands derived from the condensation reaction of 4-chlorobenzaldehyde and some amino acid (DL- Alanine, DL-Phenyalalinane and DL-valine) have been synthesized by using microwave irradiation. Their Ni (II), Zn (II), Cd (II), Cu (II) and Co(III) complexes have been prepared. The ligands are characterized based on elemental analysis, FT-IR, mass spectrometry and 1HNMR. Metal complexes are characterized by elemental analysis, FTIR, 1HNMR, molar conductance and thermogravemetric (TG/DG) analysis (Bushra K Al-salami *et al*, 2017).

The synthesis and characterization of Schiff base derived from phenylalanine and furfuraldehyde in the presence of 8-hydroxyquinoline: and its complexes (OzlenAltun *et al*, 2020). The aim of this work is preparation some new metal ions complexes of [2-(3-acetylthioureido)-3-phenylpropanoic acid] (APA).

MATERIALS AND METHODS

Acetyl chloride, Phenylalanine (Fluka), Manganese chloride tetrahydrate ($MnCl_2.4H_2O$), Cobalt chloride hexahydrate ($CoCl_2.6H_2O$), Nickel chloride hexahydrate ($NiCl_2.6H_2O$), Copper chloride dehydrate ($CuCl_2.2H_2O$), Zinc chloride ($ZnCl_2$ Cadmium chloride hydrate ($CdCl_2.H_2O$) and Mercury chloride ($HgCl_2$). All reagents were analar or chemical pure grade by BDH, Merck and Fluka.

Instruments

^1H and ^{13}C-NMR was recorded using Ultra Shield 300 MH_z Switzerland at sharif university of techonlg. Melting point was recorded by using Stuart- melting point apparatus. FT-IR spectra were recorded as KBr disc using 3800 Shimadzu in the range of 4000-400 cm^{-1}. Electronic spectra were obtained using UV-160 Shimadzu spectra photometer at 25°C in ($1x10^{-3}$) M DMSO. Conductivity was measured by using Philips Pw. Digital. Micro elemental analyses (C.H.N.S) were performed using acrlo Erba 1106 elemental analyzer. Magnetic susceptibility measurements were obtained by balance magnetic susceptibility by model MSB-MKI. Metal contents of the complexes were determined by atomic absorption technique by using Shimadzu (AA680G).

Preparation of (APA)

1. Preparation of the (Acetyl isothiocyanate) : Mixture of acetyl chloride (1.86 ml, 1mmol) and ammonium thiocyanate (2g, 1mmol) in (25ml) of acetone was stirred under refluxed for 3 hours and then filtered, the filtrate was used for further reaction (Kabbani *et al*, 2005).

2. Preparation of[[2-(3-acetylthioureido)-3-phenylpropanoic acid (APA) : 4.84g, 1mmol of phenylalanine in (20ml) acetone was rapidly added to the maintain vigorous reflux. After refluxing for 6 hours, the resulting solid was collected, washed with acetone and recrystallization from ethanol (Scheme 1), Yield (80%), (m.p =162-164) ºC, C% found (54.42) while calculate (54.13), H% found (5.506), while calculate (5.30), N% found (10.08) while calculate e (10.52), S% found (12.15) while calculate (12.03).

Synthesis of metal complexes

0.532g, 2 mmole of (APA) was dissolved in 25ml of ethanol containing (0.12g, 2mmole) of KOH, then the solution of following metal salts $MnCl_2.4H_2O$ (0.2g, 1mmole), $CoCl_2.6H_2O$ (0.24g, 1mmole), $NiCl_2.6H_2O$ (0.24g,1mmole), $CuCl_2.2H_2O$ (0.2g, 1mmole), $ZnCl_2$ $CdCl_2.H_2O$ (0.2g,1mmole), and $HgCl_2$ (0.3g,1mmole) in ethanol were added dropwise to the solution of APA^- K^+). The precipitate formed immediately after stirring the mixture at room temperature for 3hours. The precipitate was collected by filtration, washed with distilled water and ethanol and dried under vacuum. Physical properties were given in Table 1.

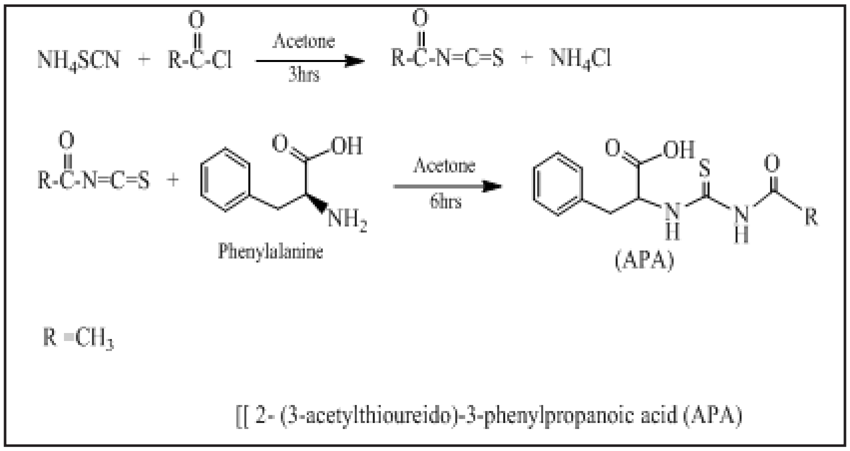
RESULTS AND DISCUSSION

The solid complexes were soluble in some common solvent such as dimethyl formamide, dimethyl sulphoxide, and relatively thermally stable. The molar conductivity of all complexes in DMSO were found to be non-electrolyte. Table 1 includes the physical properties for (APA) and its metal complexes.

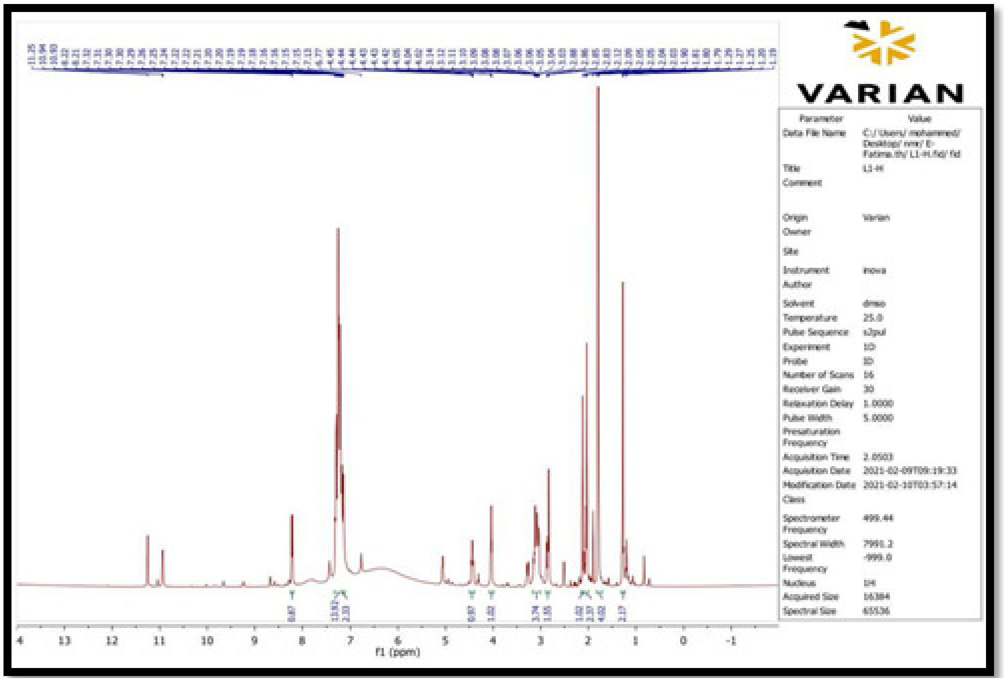
Spectral studies

^1H and ^{13}C-NMR spectra

1) ^1H-NMR spectrum for (APA) in DMSO as solvent, Fig. (1) showed the following signals: singlet at ä(1.81)ppm for ($3H,CH_3$), doubled at ä(3,10) ppm for ($2H, CH_2$), singlet at ä(2.12) ppm for DMSO, quartet at ä(3.14--3.12) ppm for (1H, CH), singlet at ä(7.31) ppm for (1H,NH sec.amine), multiplet at ä(7.13-7.19) ppm for (aromatic protons), singlet at ä(8.22) ppm for (1H, NH ec.amide), singlet at ä(10.91-11.35) ppm for (1H, COOH) (Gary *et al*, 2005).



Scheme 1 : Preparation of (APA).



Parameter	Value
Data File Name	C:/ Users/ mohammed/ Desktop/ nmr/ E-Fatima.th/ L1-H.fid/ fid
Title	L1-H
Comment	
Origin	Varian
Owner	
Site	
Instrument	inova
Author	
Solvent	dmso
Temperature	25.0
Pulse Sequence	s2pul
Experiment	1D
Probe	ID
Number of Scans	16
Receiver Gain	30
Relaxation Delay	1.0000
Pulse Width	5.0000
Presaturation Frequency	
Acquisition Time	2.0503
Acquisition Date	2021-02-09T09:19:33
Modification Date	2021-02-10T03:57:14
Class	
Spectrometer Frequency	499.44
Spectral Width	7991.2
Lowest Frequency	-999.0
Nucleus	1H
Acquired Size	16384
Spectral Size	65536

Fig. 1 : 1HNMR spectrum of (APA).

Table 1 : Physical properties of (APA) and its metal complexes.

Compund	M.wt (gm/mol)	Color	M.p °C or dec.	M% calculation (Found)	Molar condu. Ohm^{-1}Cm^{2}mol^{-1}	ì $_{eff}$ (B.M)
(APA)	266	Yellow	162-164	-	1.70	-
[Mn(APA)$_2$]	584.94	Deep brown	188-190	9.23(9.11)	9.41	5.99
[Co(APA)$_2$]	528.93	Deep blue	170-172	10.001(9.88)	4.6	4.82
[Ni(APA)$_2$]	528.71	Deep green	173-175	9.95(9.10)	4.96	3.22
[Cu(APA)$_2$]	593.54	green	178-180	10.60(10.25)	7.47	1.73
[Zn(APA)$_2$]	595	Yellow	195dec	10.9(10.13)	6.27	0
[Cd(APA)$_2$]	642	yellow	190-192	17.4(16.95)	6.02	0
[Hg(APA)$_2$]	730.6	yellow	182-184.	27.45(26.89)	7.462	0

Table 2 : ^{1}HNMR) Spectral data for ligand (APA).

Compound	Functional group	δ(ppm)
Ligand(APA)	(3H, CH$_3$) s	1.81
	d(2H, CH$_2$)	3.10
	qu(1H,CH)	3.14-3.12
	m (aromatic protonsn)	7.13-7.19
	s (1H,NH$_{ses.amide)}$	7.31
	s (1H,NH$_{ses.amide)}$	8.22
	s(1H,COOH)	10.94-11.35

Table 3 : ^{13}CNMR Spectral data for ligand (CPA).

Compound	Functional group	δ(ppm)
Ligand(CPA)	(CH$_3$) s	22.7
	s (CH$_2$)	36.6
	s (CH)	58.9
	s (ormatic carbons)	126-136
	s (C=0)	171
	s (COOH)	173
	s(C=S)	180

2) The ^{13}C-NMR spectrum for (APA) in DMSO, Fig. (2) showed the following signals: signals at ä(22.7) ppm for CH$_3$, signals at ä(36.3) ppm for (CH$_2$), signals at ä(39-40.11) ppm for DMSO, signal at ä(58.90) ppm for (CH), signals at ä(126-136) ppm for aromatic carbons, signal at ä(171) ppm for (C=O sec.amide), signal at ä(173) ppm for (COOH), signal at ä(180) ppm for (C=S).

Infrared spectra

FT-IR spectrum of the free(APA), Fig. (3), showed bands due to amido õ(NH), õ(C=O) and õ(C=S) which absorbed at (3421) cm^{-1}, (1616) cm^{-1} and (1234) cm^{-1} respectively, while another absorption band appeared at (1706) cm^{-1} could be explained as õ(COO)$_{asym}$ (Silverstein *et al*, 1981; Dyer, 1965), where the õ(OCO)$_{sym}$ was

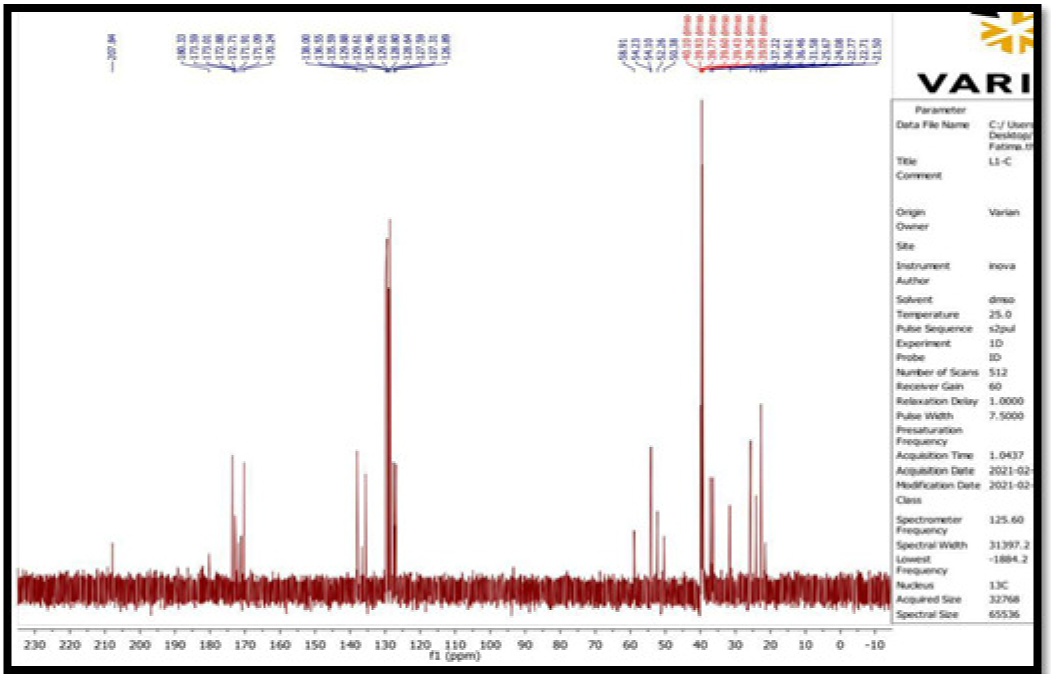


Fig. 2 : ^{13}CNMR spectrum of (CPA).

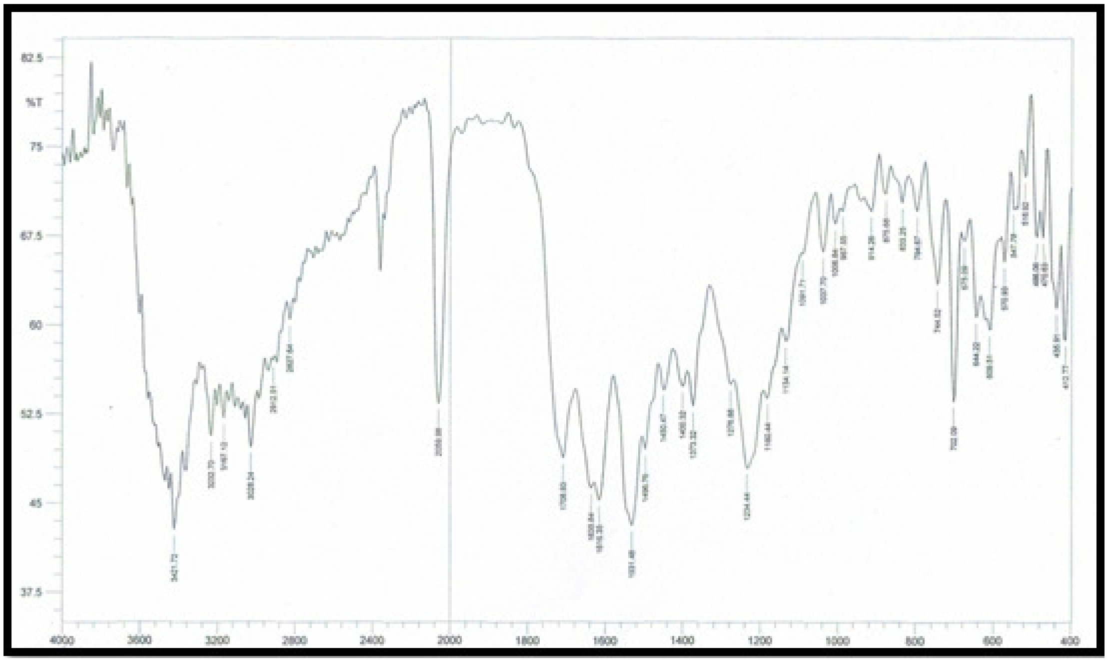


Fig. 3 : FT-IR spectrum of (APA).

noticed at (1373) cm^{-1}. The FT-IR spectra of complexes exhibited marked difference between bands belonging to the stretching vibration of õ(NH) of the amine group in the range between (3380-3303) cm^{-1} shifted lower frequencies by (41-118) cm^{-1} suggesting of the possibility of the coordination of (APA) through the nitrogen atom at the amine group (Nakamoto *et al*, 1967). Absorption assigned for õ(COO)$_{asym}$ was noticed at the range (1581 -1520) cm^{-1} shifted to higher fre frequencies by (125-186) cm^{-1}, while the band caused by õ(COO)$_{sym}$ appeared between (1419-1401) cm^{-1} shifted to lower frequencies by (46-28) cm^{-1}, which indicates to the coordination of the carboxylic group to the central ion (Nakamoto, 1996). The stretching vibration band õ(C=O) and õ(C=S) carbonyl group either shows no change or very little in their frequencies (1627-1604) cm^{-1} and (1228-1242) cm^{-1} respectively there for indicating do not coordinate to the metal ion (Fyadh *et al*, 2017). Metal-nitrogen and metal-oxygen bonds were confirmed by the presence of the stretching vibration of õ(M-O) and õ(M-N) around (496-456) cm^{-1} and (470-420) cm^{-1}, respectively. Table 2 describes the important bands and assignment for free

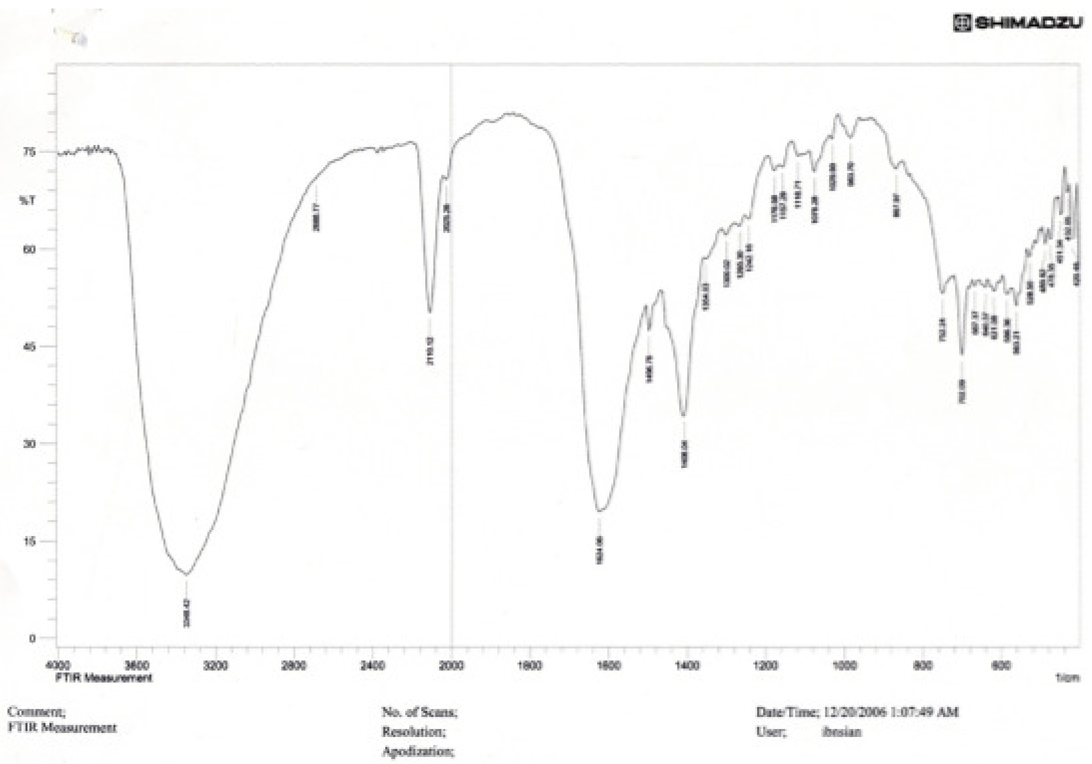


Fig. 4 : FT-IR spectrum of [Ni(APA)$_2$].

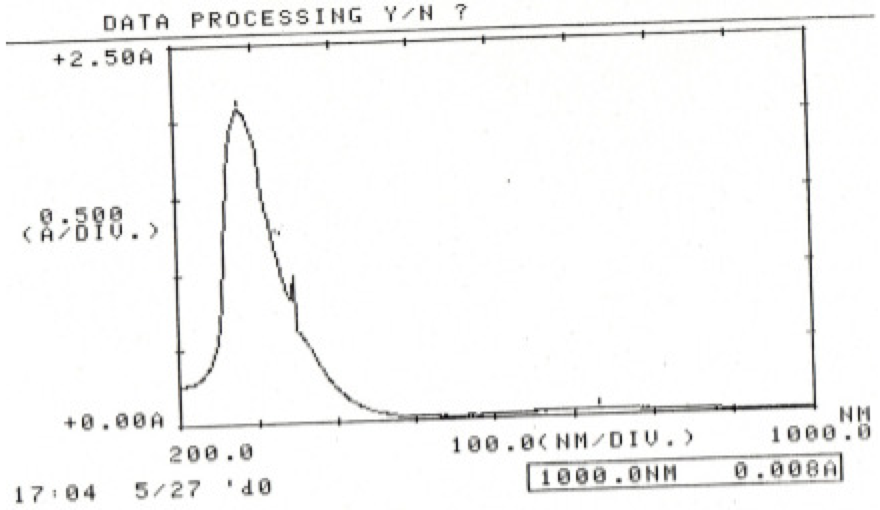


Fig. 5 : Electronic spectrum of ligand (APA).

(APA) and its complexes. The FTIR spectrum of Ni complex showed in Fig. 4.

Magnetic properties for the metal complexes

Magnetic moment (μ_{eff}) with regard to complexes related to Mn^{+2}(d^5), also Co^{+2}(d^7) have been indicated (5.99) B.M, also (4.82) B.M, that in anticipated spin-only values Higher value related to ìeff of Ni^{+2}(d^8) complex (3.22) B.M because of orbital contributions (Cotton *et al*, 1998). Magnetic moment μ_{eff} related to Cu^{+2}(d^9) complex indicated (1.73) B.M in expected value to one electro (Sanja *et al*, 2004). All data are indicated in the Table 1.

Electronic spectral

The UV-Visible spectra of (APA) and its complexes recorded in Table 3, the solution of (APA) in 10^{-3}M (DMSO) exhibited two peaks. Fig. 5 at (35587) cm^{-1} and (28985) cm^{-1} which are attributed to ð → ð* and n→ð* transition, respectively (Nichllis, 1984).

The spectra of complexes

[Mn(APA)$_2$] d^5: The deep brown complex of Mn (II) shows bands at (35714) cm^{-1} and (26954) due to ligand felid and charge transfer and another band at

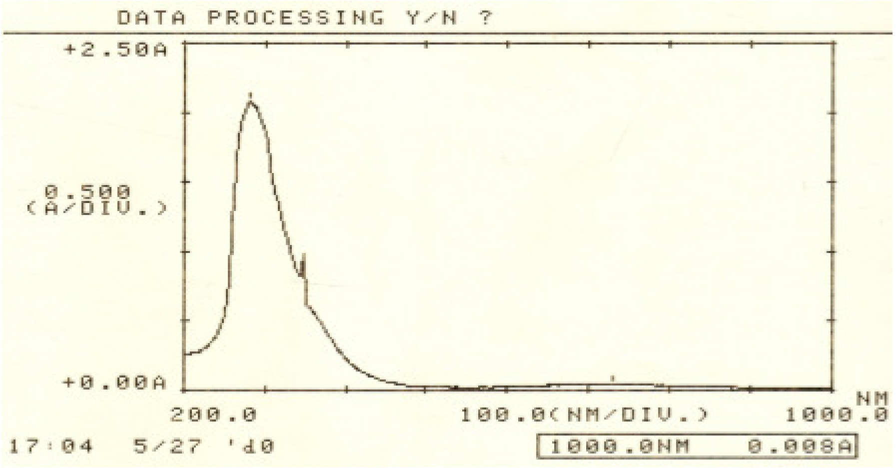


Fig. 6 : Electronic spectrum of [Cu$(APA)_2$].

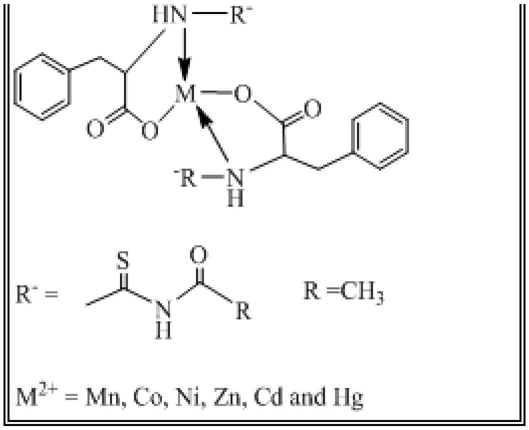


Fig. 7 : Suggested structure of complexes [M$(APA)_2$].

Table 4 : Some FT-IR frequencies in (cm^{-1}) for (APA) and its.

No.	Complex	$\nu(COO)_{asym}$	$\nu(COO)_{sym}$	COO ($\nu\Delta$)	ν(N-H) ν(O-H)	ν(C=O)	ν(C=S)	ν(M-N)	ν(M-O)	ν(V=O)
1	Ligand (APA)	**1706(S)**	**1373(M)**	—	**3421**(M) **3232**(M)	**1616(M)**	**1234**(S)	—	—	—
2	[Mn(APA)2]	**157**4(M)	1411(M)	**163**	**3**303(M)	**161**2(M)	**1**234(M)	**420**(w)	**457**(M)	—
3	[Co(APA)2]	1588(M)	**1411**(S)	**177**	**33**63(b)	**16**12(S)	**1234**(M)	**4**47(w)	456(M)	—
4	[Ni(APA)2]	**15**77(M)	1405(S)	**172**	**3345** (b)	**162**4(M)	1242(M)	420(w)	**489**(W)	—
5	[Cu(APA)2]	**1**581(M)	**1404**(M)	**176**	**333**5(S)	**16**27(M)	**1283**(M)	**4**47(w)	496(W)	—
6	[Zn(APA)2]	**15**20(M)	**1419** (S)	**161**	**33**13(M)	**16**04(S)	**12**42(S)	**443** (W)	**459** (w)	—
7	[Cd(APA)2]	**1573**(M)	**1408** (M)	**165**	3371(M)	**1620**(W)	**1230** (M)	**424** (W)	**489** (W)	—
8	[Hg(APA]	**1562** (w)	**1401** (M)	**161**	**3380** (b)	**1616**(M)	**1228** (M)	**420** (w)	**462** (w)	

b = browed, w = weak, s = strong, m = medium.

(12106) cm^{-1} which is caused by the electronic transfer $^6A_1 \rightarrow ^4T_{2(G}$ (Al-hashima *et al*, 2011).

[Co$(APA)_2$] d^7: The spectrum of the deep blue complex gave four bands at (34602) cm^{-1} (28818)cm^{-1}, (13175) cm^{-1} and (10330) cm^{-1} attributed to ligand felid, (C.T), $^4A_2 \rightarrow ^4T_{1(P)}$, $^4A_2 \rightarrow ^4T_{1(F)}$ and $^4A_2 \rightarrow ^4T_{2(F)}$ respectively and the rach interelectronic repulsion parameter (B$^-$) was found to be (733) cm^{-1}, from the relation â = B$^-$/B$_0$ was found to be a equal (0.75), these parameter are accepted to Co(II) tetrahedral complex (Lever, 1968).

[Ni$(APA)_2$] d^8 : The spectrum of deep green complex of Ni (II) has revealed the following electronic transfer ligand felid (C.T.), mix with $^3T_{1(F)} \rightarrow ^3T_{1(P)}$, $^3T_{1(F)} \rightarrow ^3A_{2(F)}$ and $^3T_1 \rightarrow ^3T_{2(F)}$, transition at (34722)cm^{-1}, (27932) cm^{-1}, (21276) cm^{-1} and (12820) cm^{-1} respectively, the (B$^-$) value found to be (716) cm^{-1}, while â was equal to (0.687) these are the characteristics for tetrahedral complexes of Ni (II) (Mukhlis *et al*, 2012).

[Cu$(APA)_2$] d^9 : The spectrum of green complex of Cu(II), Fig. 6 shows three bands at (35587) cm^{-1}, (26246) cm^{-1} and (13679) cm^{-1} caused to ligand felid, (C.T), mix with $^2B_{1g} \rightarrow ^2A_{1g}$ and $^2B_{1g} \rightarrow ^2B_{2g}$ transition, respectively (Arjmamd *et al*, 2012).

The complexes of **[Zn$(APA)_2$]**, **[Cd$(APA)_2$]** and

Table 5 : The peaks electronic transitions and structure geometries of (APA) and its complexes.

No	Complex	Ë$_{2max}$ (nm)	ABC	Wave number cm^{-1}	${}_{max}\in$ $L.mol^{-1}.cm^{-1}$	Transition
1	(APA)	281 345	2.085 1.735	35587 28985	2085 1735	ð → ð* n → ð*
3	[Mn(APA)$_2$]	280 371 826	1.862 1.041 0.024	35714 26954 12106	1862 1041 94	L.F C.T $^6A_1 \rightarrow {}^4T_2(G)$
4	[Co(APA)$_2$]	289 347 759 968	2.201 1.390 0.035 0.030	34602 28818 13175 10330	2201 1390 35 30	L.F $^4A_2 \rightarrow {}^4T_{1(p)}$ C.T mix $^4A_2 \rightarrow {}^4T_{1(f)}$ $^4A_2 \rightarrow {}^4T_2$
5	[Ni(APA)$_2$]	288 358 470 780	2.239 0.889 0.085 0.030	34722 27932 21276 12820	2239 889 85 30	L.F $^3T_{1(f)} \rightarrow {}^3T_{1(p)}$ C.T mix^3 $T_{1(f)} \rightarrow {}^3A_2$ $^3T_{1(f)} \rightarrow {}^3T_{2\,(f)}$
6	[Cu(APA)$_2$]	281 381 731	2.079 0.550 0.040	35587 26246 13679	2079 550 40	L.F C.T mix $^2B_{1(g)} \rightarrow {}^2A_{1(g)}$ $^2B_{1(g)} \rightarrow {}^2B_{2(g)}$
7	[Zn(APA)$_2$]	283 345	2.243 2.246	35335 28985	2243 2246	L.F C.T
8	[Cd(APA)$_2$]	281 348	2.040 1.002	35587 28985	2040 1002	L.F C.T
9	[Hg(APA)$_2$]	279 358	1.791 0.525	35842 27932	1791 525	L.F C.T

C.T = Charge transfer. L.F = Ligand felid

[Hg(APA)$_2$] shows only ligand felid and charge transfer of (ML) at (35335, 28985) cm^{-1}, (35587, 28735) cm^{-1} and (35842, 27932) cm^{-1} respectively (Huheey, 1983). All transition with their assignments are summarized in Table 3.

According to spectral data as well as those obtained from elemental analyses, the chemical structure of the complexes may be suggested as tetrahedral for [M(APA)$_2$], where M^{2+} = (Mn, Co, Ni, Zn, Cd and Hg), Fig. 6, while copper complex s has square planer.

CONCLUSION

The new ligand in the presented study was prepared through reaction from the Acetyl isothiocyanate with phenylalanine, ligand has been characterized through elemental micro analysis C.H.N.S., FTIR, UV Vis also ^1H,^{13}C-NMR spectra. Ligand's metal complexes have been prepared, also characterized through FTIR, UV Vis spectra, magnetic measurements, conductivity measurements, the suggested geometrical structure with regard to complexes have been tetrahedral geometry except for the copper complex that has square planer.

REFERENCES

Al-Hashimi S M, Sarhan B M and Jarad A J (2011) Synthesis and characterization complexes of 2-thiotolyurea with metal salts. *J. Edu*. **6**, 543-553.

Ali FJ (2020) Preparation and biological screening of the pladinum complex as anticancer and structural of some transition metal complexes with new Azo dye derived from Imidazole. *Biochem. Cell. Arch.* **20**(2), 6735-6742.

Arjmamd F, Parveen S and Mohapatra D K (2012) Synthesis, characterization of Cu(11) and Zn (II) complexes of proline-glycine and proline-leucinetetrapeptides: *In vitro* DNA binding and cleavage studies. *Inorg. Chem. Acta* **388**(15), 1-10.

Bushra K Al-salami, Raghed A Gata and Kahtan A Asker (2017) synthesis spectral, Thermal stability and Bacterial activity of Schiff bases derived from selective amino acid and their complexes. *Adv. Appl. Sci. Res.* **8**(3), 4-12.

Chohan Z H, Arif M, Akhtar M A and Supuran C T (2006) Metal based antibacterial and antifungal agents, synthesis, characterization and *in vitro* biological evaluation of Co(II), Cu(II), Ni(II) and Zn(II) complexes with amino acid derivatives compound. *Bioinorg. Chem. and Appl.* **2006**, Article ID 083131 | https://doi.org/10.1155/BCA/2006/83131

Cotton F A and Wllkinson G (1998) *Advanced Inorganic Chemistry.*

Dkoley A J Bard (2010)Triton X-100 concentration effects on membrane permeability of a single HeLa cell by scanning electrochemical microscopy (SECM). *Proc. Nat Acad. Sci. U.S.A.* **107**(39), 16783-16787.

Dlnelson M M Cox Lehninger (2000) *Principles of Biochemistry*. 3rd edn., New York: Worth Publishing.

Deepak M, Road F and Gunter H (2004) Highly efficient stero conserrative amidation and deamidion of amino acid. *Org. Lett.* **6**, 3675-3678.

Dyer R G (1965) Application of absorption spectroscopy of organic compounds. Prentice Hall. Inc., Engl. Wood Cliffs, N.J. London

Fyadh B M and Sarhan B M (2017) Synthesis and spectroscopic studies of some Divalcant metal Ion complexes of [3-(3 (2-chloro acetyl thiourido) pyrazine-2-carboxylic acids]. *Al-Qadisiyha J. Pure Sci.* **22**(2), 10-19.

Garey F A (2005) *Organic Chemistry*. 6th Ed, the M.C. Graw-Hill companies, Inc., New York

Huheey J E (1983) Inorganic chemistry, principles of structure and reactivity. 3th ed., Harper international SI Edition; Maryland.

Kabbani A T, Ramadan H, Hammuud H H and Hanuom A M G (2005) Synthesis of some metal complexes of N-[(benzoyl amino)-thioxomethyl] amino acid (HL). *J. Univ. Chem. Tech. and Meta*. **40**(4), 339-344.

Lever A B P (1968) *Inorganic Electronic Spectroscopy*. Elsevier Publishing Company, Amsterdam, London, New York.

Mukhlis A J, Sarhan B M and Rumez R M (2012) Synthesis and characterization of some new metal complexes of (5-C-dimethyl malonyl-pentulose-γ-lactone-2,3-endibenzoate. *Ibn AL- Haitham J. Pure And Appl. Sci.* **25**(2), 316-327.

Nakamoto K (1996) Infrared spectra of Inorganic and coordination compounds. 4th ed. John Wiley and Sons, New York.

Nakamoto K and K left J (1967) Infrared spectra of some platinum (ÉÉ) glycine complexes. *J. Inor. Nucl. Chem*. **29**, 2561-2567.

Nicholls D (1984) *Complexes and first Row transition elements*. Wiley-Inter Science, NewYork.

Özlen Altun and Melike Özge (2020) K, Pt(II) complex of Schiff base derived from L-phenylalanine and furfuraldehyde in the presence of 8-hydroxyquinoline: Structural analysis, composition of complex and biological activity. *Comptes Rendus Chimie* **23**(2), 127-142.

Silverstein, Bassler R M G C and Movrll T C (1981) *Spectroscopic Identification of organic compound*. 4th Ed, Wiley, New York.