Journal of the Serbian Chemical Society
JSCS-info@shd.org.rs • www.shd.org.rs/JSCS
J. Serb. Chem. Soc. 79 (7) 793–804 (2014)
JSCS–4627
UDC 542.913+546.48+542.9+547.571+547.551+543.552:615.281/.282
Original scientific paper

Synthesis, characterization, electrochemical behavior and antibacterial/antifungal activities of $[Cd(L)X_2]$ complexes with a new Schiff base ligand

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(Received 20 May, revised 8 October, accepted 18 October 2013)

Abstract: A new symmetrical bidentate Schiff base ligand (L) was applied for the synthesis of some new cadmium coordination compounds having the general formula $[Cd(L)X_2]$, in which X is a halide or a pseudo-halide. The ligand and all the cadmium complexes were characterized by elemental analysis, FT-IR, ^{1}H-NMR, ^{13}C-NMR and UV–Vis spectroscopy and by molar conductance measurements. Electrochemical behavior of ligand and Cd(II) complexes were investigated by the cyclic voltammetry method. The morphology and shape of the $[Cd(L)Cl_2]$ particles were depicted by SEM. Antimicrobial properties, such as antibacterial and antifungal activities, of the complexes as compared with ligand were checked against three Gram-negative bacteria: *Escherichia coli* (ATCC 25922), *Pseudomunase aeroginosa* (ATCC 9027) and *Salmonella* Spp. two Gram-positive bacteria: *Staphylococcus aureus* (ATCC 6538) and *Corynebacterium renale* and three fungal strains, including *Aspergillus niger*, *Penicillium chrysogenum* and *Candida albicans*. The results revealed appropriate antibacterial and antifungal activities for all compounds, and it was found that coordination of the ligand to Cd(II) lead to an increase in the antimicrobial activities in most of cases.

Keywords: Schiff base; complex; bidentate; voltammetry; antibacterial; antifungal.

INTRODUCTION

Nowadays, facile and simple syntheses of Schiff base ligands and their metal complexes is consequential and comprehensive in coordination chemistry.[1] The Schiff base compounds have a wide range of applications including their usage as dyes and pigments, catalysts, stabilizers of polymers, antibacterial, antifungal, anticancer, antimalarial, antivirus and herbicidal compounds.[2–8] Irregular consumption of clinical drugs has caused a resistance in biological systems against

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doi: 10.2298/JSC130520110M

routine antibacterial and antifungal drugs; hence, the synthesis of novel drugs is a necessity.[9–11] Some Schiff base complexes of cadmium containing ligands such as 1,10-phenanthroline-2,9-dicarboxaldehyde-di-2-hydroxybenzoylhydrazone, (*E*)-2-((pyridin-2-yl)methyleneamino) benzoic acid and *N*,*N*′-(bis(pyridine-2-yl)benzylidene)-1,4-butanediamine possessing various properties, such as structural and chemo-luminescence, have been reported in the literature.[12–15] Some other cadmium Schiff base complexes with the ligands 2-[3-(2-aminophenoxy) naphthalen-2-yloxy]benzenamine and a Schiff base derived from naphthofuran--2-carbohydrazide and cinnamaldehyde were found to show biological properties, such as antibacterial and antifungal activities.[16,17] A literature survey showed that in most of them, the ligand had lower activities in comparison to those of its complexes.[18–21] In the present research, in continuation of previous reports,[22–26] the synthesis, characterization and electrochemical behavior of some Cd(II) complexes of a new bidentate Schiff base are described. The biological activities of these complexes were evaluated and compared with those of the free ligand.

EXPERIMENTAL

Materials and methods

2,2-Dimethyl-1,3-diaminopropane, 3-(2-nitrophenyl)-1-propenal and the employed Cd(II) salts were provided by Merck, Aldrich or BDH. Cadmium thiocyanate and azide were prepared according to previously reported methods.[22,26] The FTIR spectra were recorded on a JASCO-FT/IR 680 instrument between 4000–400 cm^{-1} using the potassium bromide pressed pellets technique. The Ultraviolet-Visible spectra were obtained at room temperature using a JASCO-V570 spectrometer in chloroform and/or dimethylfomamide solution. The ^{1}H- and ^{13}C-NMR spectra were recorded using an Avance III 400 MHz NMR spectrometer in $(CD_3)_2SO$ and/or $CDCl_3$. Microanalysis was realized using a CHN analyzer. Molar conductance of each compound was evaluated by a Metrohm-712 conductometer at a concentration of 10^{-3} M solution of the Schiff base ligand and cadmium complexes in chloroform and/or DMF at room temperature. Electrochemical behavior of ligand and its cadmium complexes were studied at room temperature using a SAMA500 Electro-Analyzer at a scan rate of 0.1 V s^{-1} in dry acetonitrile (10^{-3} mol dm^{-3}) under a deoxygenated atmosphere (by blowing argon gas into the solution for about 2 min). The supporting electrolyte was *n*-$Bu)_4NPF_6$(TBAHFP). The three electrodes used in this technique were a GC working electrode, Pt-disk supporting electrode and silver wire reference electrode.

Synthesis of the ligand (L)

The bidentate Schiff base ligand was prepared by the gradually addition of 2,2-dimethyl--1,3-diaminopropane (1 mmol) to 3-(2-nitrophenyl)-1-propenal (2 mmol) in ethanol according to a previous report.[27] The resultant honey-colored precipitate was filtered and washed twice with ethanol.

Synthesis of [Cd(L)X_2] type complexes (X = Cl^-, Br^-, I^-, NCS^- or N_3^-)

The cadmium complexes were prepared by the dropwise addition of the ligand (1 mmol in 10 mL) to an ethanolic solution of the required cadmium salt (1 mmol in 10 mL) under vigorous stirring of reaction mixture over 2–3 h at room temperature. Then the cream or milky

precipitate was filtered and washed twice with ethanol. Purification of the metal complexes was realized by recrystallization from dichloromethane/ethanol 1:1 mixture.

*Antibacterial activity (*in vitro*)*

The Schiff base ligand and its cadmium complexes were tested for their antibacterial activities against three Gram-negative bacteria, *i.e*., *Escherichia coli* (ATCC 25922), *Pseudomunas aeroginosa* (ATCC 9027) and *Salmonella* Spp. and two Gram-positive bacteria, *i.e*., *Staphylococcus aureus* (ATCC 6538) and *Corynebacterium renale* using the disk diffusion method.[28] Thus, disinfected plates were filled with 12 mL of sterilized Muller–Hinton agar medium (Merck, Germany). Afterwards, 100 µL of particular bacterium which contained of 0.5×10^6 CFU mL^{-1} (tantamount to 0.5 McFarland standards) was dispersed on the plate surfaces using a sterile swab for about 10 minutes for suitable adsorption.[29,30] Different active disks (6 mm in diameter) of ligand and cadmium complexes (with 2.5, 1.25, 0.5 mg of compound per disk) were constructed and placed on distinctive positions on the agar plates. Prepared plates were incubated at 37 °C for 24 h. The inhibition zone diameter (mm) of each compound was measured using a caliper. DMSO, as the solvent, showed no effect on the biological tests. Disks with the antibacterial drugs amoxicillin, penicillin and cephalexin were applied as positive controls.

*Minimum inhibitory concentration (*MIC*)*

The *MIC* values were determined as the second applicable test for the investigation of antibacterial properties of ligand and its complexes by serial dilution of each compound (16000 to 3.9 µg mL^{-1}).[31] For this means, after preparation of various concentrations of compounds, 650 µL of sterile Muller–Hinton broth medium (Scharlab) and 100 µL of a specific bacterium were added to sterile sample tubes that were then incubated at 37 °C for 24 h. The lowest concentration that inhibited the ocular growth of bacteria (absence of turbidity in the test tubes after incubation for 24 h) was considered as the *MIC* value.

Minimum bactericidal concentration (MBC)

The intrinsic turbidity of compounds in solution necessitated the application of the MBC test as the third method for the investigation of antibacterial activities. A loop full of broth of dilution used for the MIC tests in Muller Hinton broth medium was spread on agar plates and then incubated at 37 °C for 24 h.[32] In this method, observation of bacterial growth on the surface of agar medium became possible and therefore recognition of antibacterial activities of compounds was easier with respect to the *MIC* test.

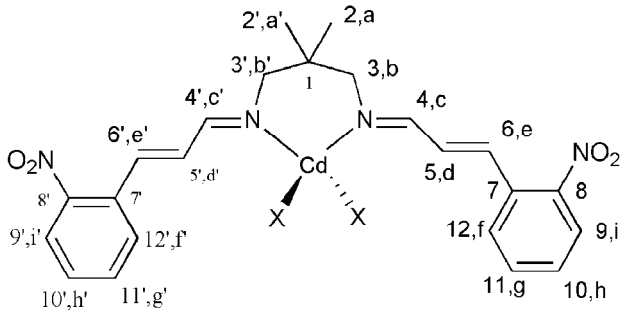
Antifungal activity

Antifungal activities of cadmium complexes as compared with free ligand were checked against three fungal strains, *i.e*., *Aspergillus niger*, *Penicillium chrysogenum* and *Candida albicans* (local isolates). For estimation of the antifungal properties of compounds, blank sterile disks (6 mm in diameter) were saturated with the test compounds and then the constructed disks with 5, 2.5, 1.25 mg of active compound per disk were situated on distinctive locations of Petri plates containing Sabouraud dextrose agar (SDA) medium (Oxoid, Basingstoke, UK) and impregnated with 100 µl of fungal spore suspensions (10^5 CFU mL^{-1}). The prepared plates were incubated at 32 °C for 7 days for *A. niger* and *P. chrysogenum*, and at 37 °C for 24 h for *C. albicans*.[32]

RESULTS AND DISCUSSION

Physical and analytical data

Some important physical and analytical data attributed to the ligand and the cadmium complexes are given in the Supplementary material to this paper. Low values of the molar conductance (0.009–0.031 S m^2 mol^{-1} in $CHCl_3$ and 49.20––74.64 S m^2 mol^{-1} in DMF) indicate that the cadmium complexes are non-electrolytes.[33,34] The results of microanalysis showed a 1:1 ratio of ligand to metal and thus the general structural formula of the complexes is suggested to be $[Cd(L)X_2]$ (X is halide or pseudo-halide, *i.e.*, thiocyanate or azide) (Scheme I). All the compounds were soluble in DMSO and DMF but insoluble in alcohols. The solid compounds were stable at room temperature. In order to obtain information on the morphology of the solid complexes, an SEM image of the cadmium chloride complex was recorded, as shown in Fig. 1. The microphotograph illustrates a rod-like nano-structure for this complex.



Scheme 1. Structural formula of $[Cd(L)X_2]$ complexes (X is Cl^-, Br^-, I^-, NCS^- or N_3^-).

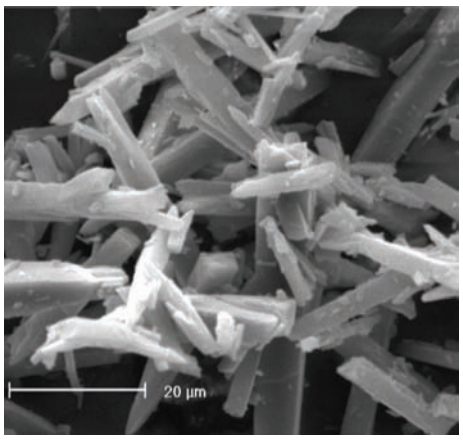


Fig. 1. SEM appearance of the $[Cd(L)Cl_2]$ complex.

Spectral investigation

IR and electronic spectra. Preliminary characterization of the ligand and its cadmium complexes was performed by IR spectroscopy and some characteristic signals are given in the Supplementary material to this paper. The absence of peaks attributed to the parent aldehyde and amine functional groups at 1680 and 3200–3300 cm^{-1}, respectively, and the appearance of new strong signals at 1636 and 1614 cm^{-1} confirmed azomethine (C=N) formation.[27,32] After coordination of ligand *via* azomethine nitrogens, the C=N signals shifted to lower wavenumbers by 4–6 cm^{-1}. The weak signal at 2869 cm^{-1} in the ligand spectrum was ascribed to azomethine C–H groups. Two strong signals at 1529 and 1338 cm^{-1} were assigned to the asymmetric and symmetric vibrations of the NO_2 groups of the ligand, respectively. These signals shifted to lower and higher wave numbers by 2 to 10 cm^{-1} after binding of the ligand to the cadmium center.[33] In the complex spectrum of cadmium thiocyanate, a new sharp signal at 2059 cm^{-1} was observed that could be safely assigned to the *N*-coordinated mode of the thiocyanate ion. In addition, a new signal at 2041 cm^{-1} in the cadmium azide complex was appointed to coordinated azide ions.[34,35]

As reported in the Supplementary material to this paper, the absorption band at 295 nm and a shoulder band at 328 nm in the electronic spectrum of the ligand may be assigned to internal ligand electronic transitions (π–π^*) of the aromatic, olefinic and azomethine π-systems. In the cadmium complexes, some red or blue shifts by 3–10 nm occurred due to coordination of the ligand to the metal centers *via* azomethine groups.

^{1}H- and ^{13}C-NMR spectra. A ^{1}H- and ^{13}C-NMR spectral study could be considered as a powerful technique for proving a suggested structure. Accordingly, the ^{1}H- and ^{13}C-NMR spectra of the ligand and its Cd(II) complexes were recorded and the data are presented in the Supplementary material to this paper. The detailed assignments of the proton and carbon atoms of the ligand and its cadmium complexes (based on Scheme 1) confirmed the proposed structure. The ^{1}H-NMR spectra of the ligand and the cadmium iodide complex as typical spectra are illustrated in Figs. 2 and 3. Characteristic signals of the ligand ^{1}H- and ^{13}C-NMR spectra attributed to azomethine protons ($H_{cc'}$) and carbons ($C_{4,4'}$) atoms appeared at 8.09 ppm (as a doublet with J = 8.76 Hz) and 162.69 ppm respectively.[22–27,36] After coordination of the ligand to cadmium center *via* azomethine nitrogens as suggested in Scheme 1, the above-mentioned signals were found downfield shifted in the range 8.15–8.26 ppm and 162.96–169.75 ppm in the spectra of the cadmium complexes, except for the azomethine carbon signal in the spectrum of the cadmium thiocyanate complex that appeared at upfield chemical shifts. The chemical shifts (δ) assigned to the aromatic hydrogens $H_{ii'}$, $H_{gg'}$, $H_{hh'}$ and $H_{ff'}$, the olefin hydrogens $H_{dd'}$ and $H_{ee'}$ of the ligand were found downfield shifted in the spectra of all complexes except for cadmium chloride,

thiocyanate and azide. The aliphatic hydrogens of the ligand were upfield shifted except for the cadmium bromide and iodide complexes. Similar to the ^{1}H-NMR signals, the coordination of the ligand to cadmium ion led to up or downfielded chemical shifts in the ^{13}C-NMR signals in the spectra of the cadmium complexes. It be noted that in the spectrum of [Cd(L)(NCS)$_2$], one additional signal appeared at 135.51 ppm that may be ascribed to the carbon of the *N*-coordinated thiocyanate.

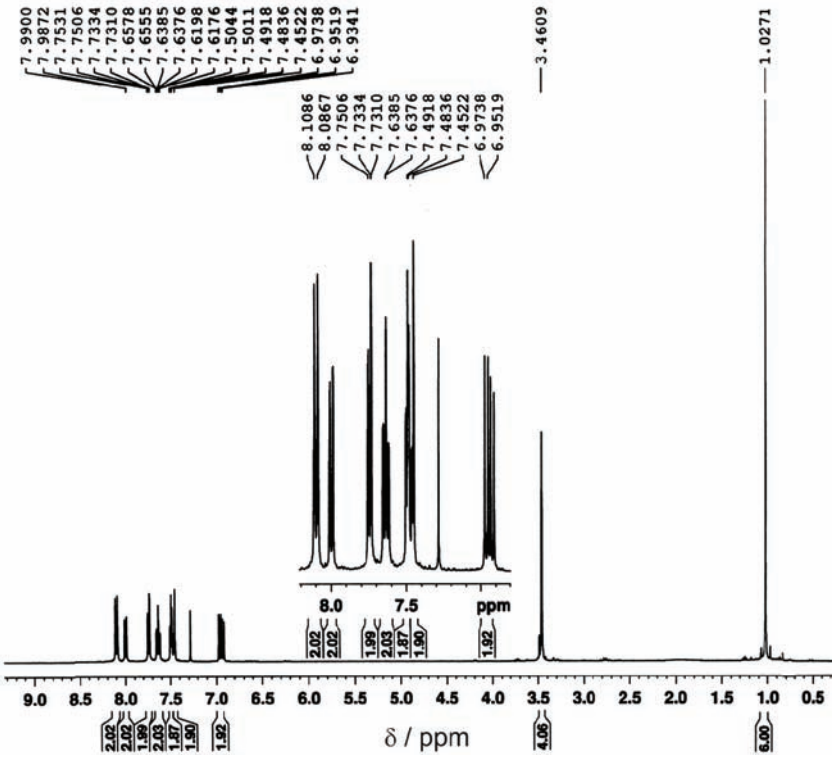


Fig. 2. The ^{1}H-NMR spectrum of the ligand.

Electrochemical investigation

Cyclic voltammetry was used as a technique for the study of the redox properties of the ligand and its cadmium complexes, as depicted in Fig. 4. The important electrochemical data are collected in Table I. The cyclic voltammogram of TBAHFP as the supporting electrolyte shows no notable redox activity in acetonitrile under an argon atmosphere at a scan rate of 0.1 V s^{-1} in the potential range 0.5 to –2.0 V. The voltammogram of the ligand demonstrated two cathodic waves (at –0.87 and –1.40 V) and in the contrary potential sweep, it was oxidized reversibly and irreversibly at –0.80 and –0.56 V, respectively. The first

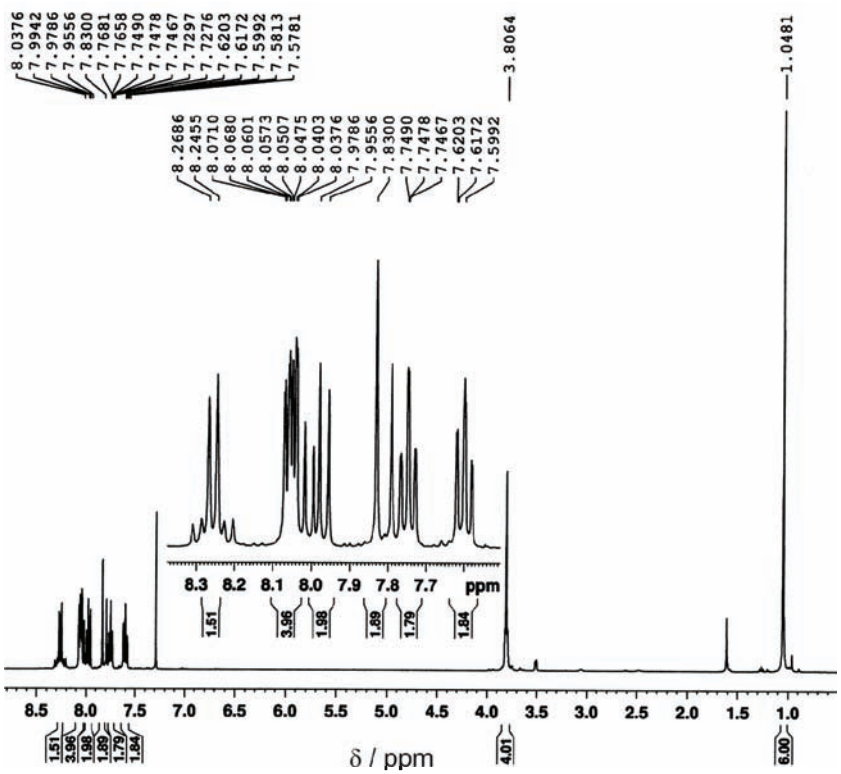


Fig. 3. The ^{1}H-NMR spectrum of the cadmium iodide complex.

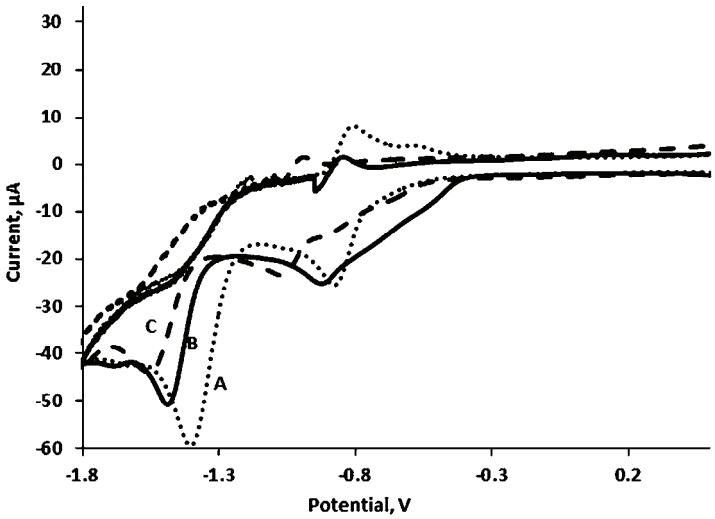


Fig. 4. Cyclic voltammograms of A) the ligand, B) the cadmium iodide complex and C) the cadmium azide complex.

TABLE I. Anodic and cathodic potentials of ligand and its Cd (II) complexes in the voltammograms; Pa and Pc refer to the anodic and cathodic potentials, respectively

Compound	* E_{Pa1}, E_{Pa2} / V	* E_{Pc1}, E_{Pc2} / V
Ligand	–0.80, –0.56	–0.87, –1.40
$[Cd(L)Cl_2]$	–0.97, –0.73	–1.07, –1.64
$[Cd(L)Br_2]$	–0.96	–1.02, –1.57
$[Cd(L)I_2]$	–0.85	–0.92, –1.48
$[Cd(L)(NCS)_2]$	–1.03	–1.09, –1.62,
$[Cd(L)(N_3)_2]$	–1.0	–1.06, –1.55

redox pair may be assigned to the reversible one-electron redox of the nitro group, *i.e.*, the nitro/nitro radical anion couple, and the second redox may be assigned to the irreversible three-electron redox *via* the hydroxylamine/nitroso pair.[37] All the complexes were found to be redox active under the same conditions due to the behavior of the ligand. The cathodic and anodic waves of the coordinated ligand in the cadmium complexes were shifted to more negative potentials as compared with the respective waves for the free ligand, which maybe a result of coordination. As compared with the free ligand, the cadmium chloride complex was oxidized and reduced in a similar manner to the ligand but with a negative shift in the potential values. In the other complexes, only one anodic wave with a negative shift in the range –0.85 to 1.03 V was observed, indicating easier oxidation of the coordinated ligand, while they were reduced in a manner similar to that seen for the free ligand but at more negative potentials, suggesting harder reduction of the ligand after coordination. It should be noted that the maximum negative shift of the potential values was related to the cadmium thiocyanate complex, which maybe due to the strongest binding of the ligand to the cadmium ion in this complex.

*Antibacterial bioassay (*in vitro*)*

Regarding the fact that finding an application for each novel compound seemed to be useful, it was decided to explore the biological activity of the ligand and its new cadmium complexes. Fortunately, these compounds showed acceptable results from the antibacterial point of view. The antibacterial activities of these compounds were closely checked against three Gram-negative bacterial strains, *i.e.*, *E. coli* (ATCC 25922), *P. aeroginosa* (ATCC 9027) and *Salmonella* Spp., and two Gram-positive bacterial strains, *i.e.*, *S. aureus* (ATCC 6538) and *C. renale* (Tables II and III). In an overall view, the results revealed the low efficiency for the compounds as compared with standard antibiotics (amoxicillin, penicillin and cephalexin) under the chosen conditions, except against *P. aeruginosa* bacterium, the growth of which was suitably inhibited by all the compounds where as the antibiotics had no effect. The results showed that $[CdLCl_2]$ was a powerful compound against *E. coli*, *P. aeroginosa* and *Salmonella* Spp.

bacteria. [Cd(L)Br_2] was an effective compound against *S. aureus* bacterium. [Cd(L)I_2] exhibited a significant effect (with an inhibition zone of 36.5 mm) against *C. renale*. The ligand showed the minimum effect against some kinds of bacteria in this research, *i.e.*, *E. coli*, *Salmonella* Spp. and *C. renale* and had a medium effect (with an inhibition zone of 16 mm) against *S. aureus* and a poor effect after complexation of [Cd(L)$(NCS)_2$] against *P. aeroginosa* bacterium. The *MIC* and *MBC* values revealed that $CdLBr_2$ (3.9 μg ml^{-1}) had the maximum activity against *E. coli*, while the complex [Cd(L)$(NCS)_2$], with the same value, was the effective compound against *P. aeroginosa* bacterium. The [Cd(L)Br_2] and [Cd(L)I_2] complexes exhibited maximum antibacterial activities against *C. renale*. In the case of *S. aureus* bacterium, all the compounds had nearly the same effect (125 μg ml^{-1}) according to the *MIC* and *MBC* results.

TABLE II. Antibacterial activities of prepared disks saturated at 5, 2.5 and 1.25 mg per disk of ligand or its Cd(II) complexes, established from the diameter of the inhibition zone, mm, against different bacterial strains

Compound	Gram-negative bacteria									Gram-positive bacteria					
	E. coli			*P. aeroginosa*			*Salmonella* Spp.			*C. renale*			*S. aureus*		
	2.5	1.25	0.5	2.5	1.25	0.5	2.5	1.25	0.5	2.5	1.25	0.5	2.5	1.25	0.5
Ligand	9	7.8	7	17.1	13.7	7.3	9.3	9.0	8.6	14.4	12.0	10.0	16.0	14.0	11.0
[Cd(L)Cl_2]	18.7	14.6	12.9	27.2	20.5	12.6	17.5	14.3	12.5	35.7	29.8	24.0	15.8	13.3	11.4
[Cd(L)Br_2]	12.5	10.5	7.4	18.8	18.1	17.0	17.0	15.3	12.6	33.2	29.0	24.4	17.9	14.6	10.5
[Cd(L)I_2]	15.7	12.7	11.5	24.3	20.2	15.5	15.8	15.2	14.9	36.5	34.5	31.6	13.1	11.3	10.0
[Cd(L)$(NCS)_2$]	11.5	11.1	10	16.9	14.0	10.0	14.8	13.3	12.6	35.0	32.0	30.0	12.8	11.2	9.3
[Cd(L)$(N_3)_2$]	16.0	14.0	10.5	19.5	17.6	16.0	15.3	14.6	12.7	24.5	22.4	20.0	16.4	15.3	12.9

TABLE III. *MIC* and *MBC* (μg/mL) inhibitory results of Schiff base ligand and its cadmium complexes; N.D.: not possible to detect

Compound	*E. coli*		*P. aeroginosa*		*Salmonella* Spp.		*C. renale*		*S. aureus*	
	MIC	*MBC*	*MIC*	*MBC*	*MIC*	*MBC*	*MIC*	*MBC*	*MIC*	*MBC*
Ligand	N.D	31.2	N.D*	1000	N.D	16000	N.D	500	N.D	125
[Cd(L)Cl_2]	N.D	31.2	125	250	N.D	250	N.D	15.6	N.D	125
[Cd(L)Br_2]	3.9	3.9	31.2	125	N.D	1000	N.D	3.9	N.D	125
[Cd(L)I_2]	N.D	15.6	62.5	62.5	N.D	2000	N.D	3.9	N.D	125
[Cd(L)$(NCS)_2$]	62.5	125	N.D	3.9	N.D	1000	N.D	15.6	N.D	125
[Cd(L)$(N_3)_2$]	250	250	N.D	62.5	N.D	250	125	125	N.D	125

*Antifungal bioassay (*in vitro*)*

The antifungal properties of the compounds were tested against *A. niger*, *P. chrysogenum* and *C. albicans* fungal strains and the diameters of the zone of inhibition (in mm) of the compounds are listed in Table IV. The [Cd(L)Br_2] complex significantly prevented the growth of *A. niger* (inhibition zone of 29.7

mm) and the $[Cd(L)(N_3)_2]$ and $[Cd(L)(NCS)_2]$ complexes showed the same acceptable activities, while the free ligand had the minimum antifungal property. The $[Cd(L)Br_2]$ and $[Cd(L)(N_3)_2]$ complexes had similar zones of inhibition of the growth of *P. chrysogenum* (23.9 and 24 mm, respectively). The $[Cd(L)I_2]$ and $[Cd(L)(NCS)_2]$ complexes exhibited similar but lower activities than the $[Cd(L)Br_2]$ and $[Cd(L)(N_3)_2]$ complexes, while the free ligand showed the minimum effect on *P. chrysogenum*. The $[Cd(L)I_2]$ complex was found to be the best anti-*C. albicans* agent in this research. $[Cd(L)(N_3)_2]$ and $[Cd(L)Br_2]$ complexes exhibited a medium effect against *C. albicans*. The lowest activity against *C. albicans* was evaluated for the $[Cd(L)(NCS)_2]$ complex.

TABLE IV. Antifungal activities of the prepared disks saturated with 5, 2.5 and 1.25 mg per disk of ligand or its Cd(II) complexes, established from the diameter of the inhibition zone, mm, against different fungi

Compound	*A. niger*			*P. chrysogenum*			*C. albicans*		
	5	2.5	1.25	5	2.5	1.25	5	2.5	1.25
Ligand	0.9	0.8	0.65	16.7	15	14	21	19.2	18.0
$[Cd(L)Cl_2]$	18.6	17.5	17.2	21.3	18	15.3	20.7	20	19.4
$[Cd(L)Br_2]$	26.4	29.7	19.0	25.4	23.9	18.0	24.2	21.6	19.0
$[Cd(L)I_2]$	14.9	12.6	10.4	25.4	20.8	15.4	25.8	23.1	20.7
$[Cd(L)(NCS)_2]$	21.0	19.8	16.3	22.2	20.5	18.0	21.0	17.5	15.3
$[Cd(L)(N_3)_2]$	22.5	19.7	16.0	28.2	24.0	20.0	27.4	22.0	17.0

CONCLUSIONS

In this paper, the synthesis method of a new Schiff base ligand is presented and some of its cadmium complexes are introduced. Some spectral specifications, the electrochemical behavior and antibacterial/antifungal activities of the synthesized compounds are described. The results of elemental analysis confirmed a 1:1 ratio of ligand to metal salt perfectly. Based on physical and spectral (IR, UV–Vis and NMR) data, a pseudo-tetrahedral geometry was proposed for the cadmium coordination compounds. The solid compounds were stable for a long duration at room temperature. The redox behavior of the ligand and its complexes were investigated using the cyclic voltammetry technique. The voltammogram of ligand showed two redox steps as reversible and irreversible behavior. The related waves of the coordinated ligand were shifted to negative potentials in the voltammograms of all complexes because of its binding to cadmium ions. Antimicrobial investigations demonstrated that all compounds are antibacterial/antifungal active. In most of cases, complexation increased the ligand activity as compared with the free ligand. Generally, all the compounds showed more activity against *C. renale* than against the other bacteria. The $[Cd(L)Br_2]$ complex exhibited the best activity against *A. niger*.

SUPPLEMENTARY MATERIAL

Physical, analytic and spectral data for the ligand and its Cd(II) complexes are available electronically from http://www.shd.org.rs/JSCS/, or from the corresponding author on request.

Acknowledgement. Partial support of this research by Yasouj University is acknowledged.

И З В О Д

СИНТЕЗА, КАРАКТЕРИЗАЦИЈА, ЕЛЕКТРОХЕМИЈСКО ПОНАШАЊЕ И АНТИБАКТЕРИЈСКА И АНТИФУНГАЛНА АКТИВНОСТ $[Cd(L)X_2]$ КОМПЛЕКСА СА ШИФОВОМ БАЗОМ КАО ЛИГАНДОМ

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У овом раду су синтетизовани нови комплекси кадмијума(II) опште формуле $[Cd(L)X_2]$ (X је халогенид или псеудохалогенид), полазећи од нове Шифове базе, као симетричног бидентатног лиганда (L). Применом елементалне микроанализе, FT-IR, ^{1}H-, и ^{13}C-NMR, UV–Vis методе и мерењем моларне проводљивости окарактерисани су полазни лиганд и сви синтетизовани комплекси кадмијума(II). Применом цикличне волтаметрије испитивано је електрохемијско понашање лиганда и Cd(II) комплекса. Испитивана је антибактеријска активност лиганда и синтетизованих комплекса на три Грам-негативне бактерије, *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 9027) и *Salmonella spp.*, на две Грам-позитивне бактерије, *Staphylococcus aureus* (ATCC 6538) и *Corynebacterium renale*, као и антифунгална активност на три врсте гљива, *Aspergillus niger*, *Penicillium chrysogenum* и *Candida albicans*. Добијени резултати су показали да, у већини случајева, комплекси имају већу антимикробиолошку активност од самог лиганда.

(Примљено 20. маја, ревидирано 8. октобра, прихваћено 18. октобра 2013)

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