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A Study of Metal Complexes of (E)-N'-{(2-hydroxynaphthalen-1-yl) methylene} Furan-2-Carbohydrazide

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Abstract: ***Three mononuclear metal complexes ofCo^{2+}, Ni^{2+} and Cu^{2+} metal ions with(E)-N'-{(2-hydroxynaphthalen-1-yl) methylene} Furan-2-carbohydrazide (SBL) were synthesized by condensation reaction. All the newly compounds are characterized by spectroscopically using IR spectroscopy, UV-Vis spectroscopy, mass spectroscopy, ^{1} H &^{13}C NMR, micro elemental analysis, magnetic susceptibility and conductivity measurements. The spectral data suggested that SBL acted as monobasic tridentate towards central metal ions with ONO donor atoms. The result of molar conductance values and magnetic susceptibility apparent 1:2 metal to ligand stoichiometry and octahedral geometry for all metal complexes. All the synthesized compounds were also screened for antimicrobial activity against Staphylococcus aureus (ATCC 25923), Staphylococcus aureus (ATCC 3160) bacterial species and Candida albicans (227) and Staphylococcus cereviscae (361) fungal species.***

Keywords: Mononuclear Complexes, Spectroscopic studies, antimicrobial study

1. Introduction

Schiff bases ligands are an important class of ligands that coordinate to Transition metal ions via azomethine group. Due to high electron density on nitrogen atom of azomethine group (-CH=N-) makes them good chelating [1]. The azomethine group of transition metal complexes have been reported remarkable properties like microbial activities, anticancer, antimalarial, antipyretic, antiproliferative and anti diabetic activities etc [2-5].These complexes are also applicable any branch of Chemistry and technology. Schiff base ligands containing of azomethine groups especially when -OH groups are present increases their coordination ability. Schiff base ligands and their transition metal complexes are used as pigments industry, drug developments industry, dyes industry and polymer stabilizers industry [6, 7].Although a huge number of Schiff base ligand and transition metal complexes have been found out, identical studies on coordinated ligands are cooperatively hard to reach [8].The most metal complexes of Schiff base have been containing O-donor and N-donor ligands are well familiar [9]. They have the most interested among the chemists due to their applications in catalysis and their relevance to bioinorganic systems [10]. During last twenty years there havebeen demand owing to interaction with deoxyribonucleic acid. This interaction has been broadly studied to development of new chemical compounds in the field of medicine and biotechnology [11, 12].

In the present study, we synthesized and characterized by spectroscopically of cobalt, nickel and copper metal complexes containing (E)-N'-{(2-hydroxynaphthalen-1-yl) methylene} Furan-2-carbohydrazide (SBL) which are derived from Furan-2-carbohydrazide and 2-hydroxynaphthaldehyde. The newly synthesized compounds also investigated with antibacterial and antifungal species [13-15].

2. Material and Methods

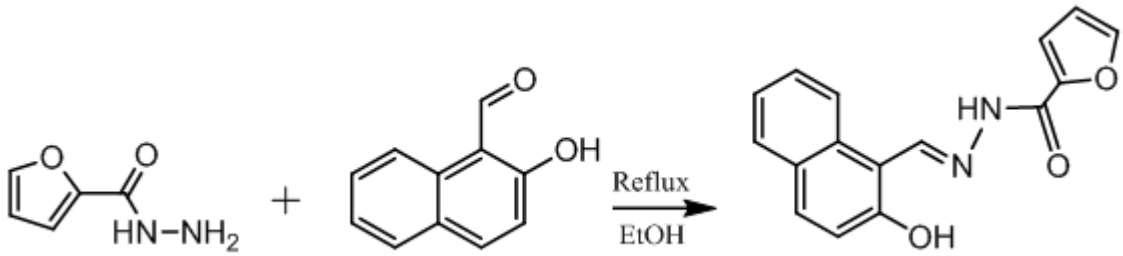
Furan-2-carbohydrazide (Sigma) and 2-hydroxynaphthaldehyde (Sigma) were of reagent grade and used as received. Metals chloride of (Co^{2+}, Ni^{2+} and Cu^{2+}) and all solvents were purchased from Merck. All the reactions were carried out at room temperature25 ± 1 ℃ .

Instrumentation and methods

The elemental analysis was recorded at Regional Sophisticated Instrumentation Centre, Central Drug Research Institute, Lucknow.IR spectra were recorded as KBr pellets on Perkin-Elmer 783 IR spectrophotometer in the range of 4000-400 cm^{-1}. Mercury plus 300 MHz NMR spectrometer was used TMS as reference solvent to record ^{1}H and ^{13}C NMR spectra. UV/vis spectra of the complexes were recorded on a Shimadzu UV-1601 spectrophotometer. At 10^{-3} M solution concentration molar conductance was recorded on ELICO Digital conductivity meter at room temperature. Gouy balance with Hg [Co(SCN)4] as calibrant was used to find out the magnetic susceptibility measurements. Open capillary tubes were used to determine melting points.

Synthesis of (E)-N'-{(2-hydroxynaphthalen-1-yl) methylene} Furan-2-carbohydrazide

Furan-2-carbohydrazide (0.126 g) and 2-hydroxynaphthaldehyde (0.172 g) were heated under refluxed in ethanol (20 mL) until a solid precipitate was formed (2 hrs). The mixture was allowed to cool at 25 ^{0}Cand washed with ethanol, filtered under reduced pressure. Yellowish product was obtained (**Scheme 1**) and monitored by TLC.



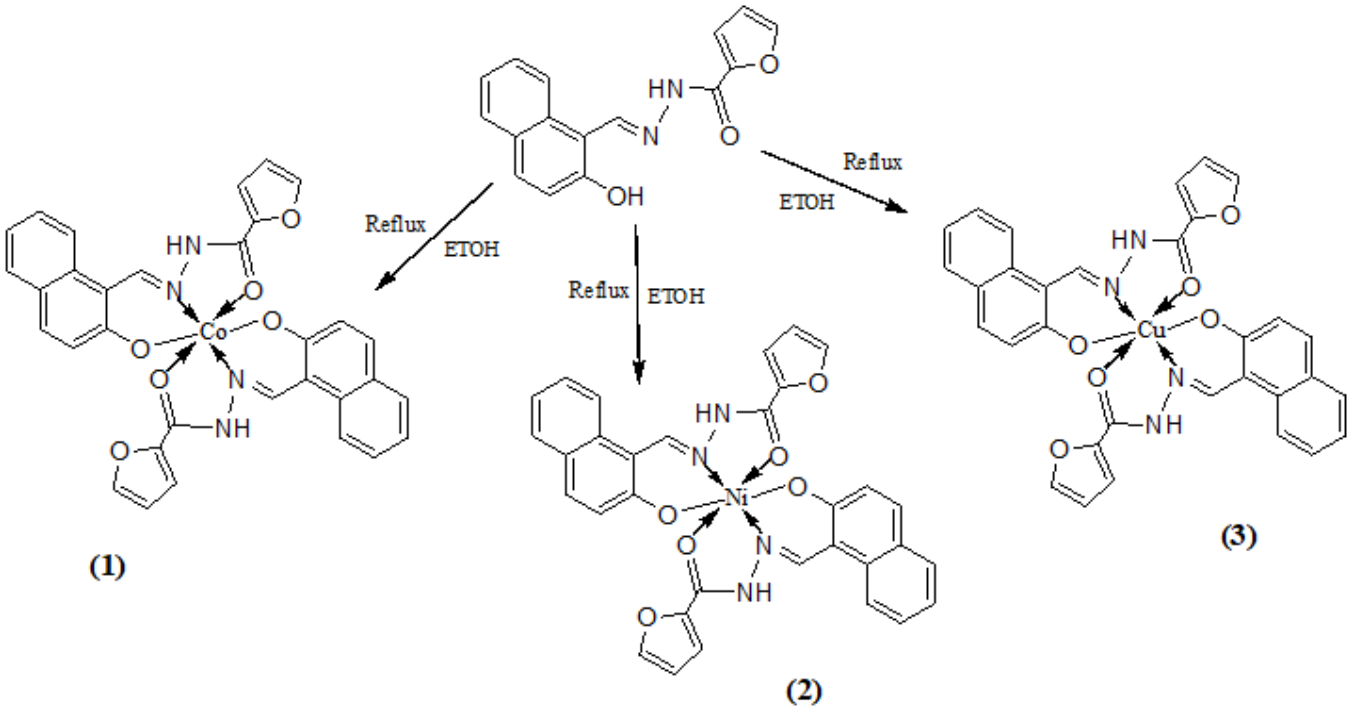
Scheme 1: Synthesis of SBL

Table 1: Represent

Chemical Formula	$C_{16}H_{12}N_2O_3$
Yield	87%
Melting point	240 ^0C
Critical temperature	1022.85 ^0K
Critical pressure	31.63 Bar
Exact Mass	280.08
Molecular Mass	280.28
Mass to charge ratio (m/z)	280.08 (100%), 281 (17.3%), 282.09 (1.4%)
Elemental Analysis Found (calc.)	C, 68.56 (67.74); H, 4.32 (4.12); N, 9.99 (9.50)
IR (KBr) cm^{-1}	3370 (OH), 3156 (NH str.), 1658 (C=O), 1600 (N=C), 1562 (Ar-C-C), 1308 (C-N), 1213 (C-O)
^{1}H NMR (400 MHz, DMSO-d_6) δppm	12.78 (s, 1H, Ar. C-OH), 10.0 (s, 1H, NH), 7.1 (s, 2H, aromatic ring), 7.3 (1H, OCH, furan ring), 7.1 (1H, furan ring), 6.8 (1H, aromatic ring)
^{1}C NMR (400 MHz, DMSO-d_6) δppm	154.7 (C=O), 151.4 (C=N), 149.4 (OCCH, furan ring), 126.6, 122.9, 115.8, 112.4, 108.3 (aromatic and furan rings)

Synthesis of Cobalt, Nickel and Copper metal (II) complexes

All the metal (II) complexes were synthesized by following general method as following 50 mL ethanolic solution of SBL (0.002 mmol, 0.560 g) was added dropwise into 20 mL ethanolic solution of corresponding metal (II) chloride salts (0.001 mmol) in 1:2 M ratio. Colourful products were obtained (**Scheme-2**). The compound was washed with hot water and then with acetone, filtered under reduce pressure and monitored by TLC.



Scheme 2: Synthesis of metal complexes

Analytical Data of the Metal Complexes 1, 2 and 3

Complex 1

Chemical formula: $C_{32}H_{22}CoN_4O_6$; Yield: 75%; MP: 270℃; Mol. wt. 617.47; colour: red; analytical data found (calc.): C, 62.24 (62.15); H, 3.59 (3.11); N, 9.07 (8.99); Co, 9.54 (9.97); IR (KBr, cm^{-1}): 3216 (NH), 1620(C=O), 1580(C=N), 3315 (OH), ^{1} H NMR (DMSO-d6) $\delta\delta$ ppm: 11.60 (s, 1H, OH-Ar), 7.18-7.93 (m, 8H, Ar), 8.12 (s, 1H, CH=N). 13C

NMR (DMSO-d6) $\delta\delta$ ppm: 117.53-101.07 (11C, CH-Ar.), 133.65 (1C, C=O), 144.85 (1C, CH=N).

Complex 2

Chemical formula: $C_{32}H_{22}NiN_4O_6$; Yield: 88%; MP: 270℃; Mol. wt. 617.23; colour: blue; analytical data found (calc.): C, 62.27 (62.15); H, 3.59 (3.21); N, 9.08 (8.99); Ni, 9.51 (9.48); IR (KBr, cm^{-1}): 3211(NH), 1615(C=O), 1586(C=N), 3335 (OH), ^{1}H NMR (DMSO-d6) δ ppm: 11.60 (s, 1H, OH-Ar), 7.18-7.63 (m, 8H, Ar), 8.02 (s, 1H, CH=N). ^{13}C NMR (DMSO-d6) δ ppm: 117.03-101.02 (11C, CH-Ar.), 133.15 (1C, C=O), 144.15 (1C, CH=N).

Complex 3

Chemical formula: $C_{32}H_{22}CuN_4O_6$; Yield: 75%; MP: 270℃; Mol. wt. 622.08; colour: green; analytical data found (calc.): C, 61.78 (61.55); H, 3.56 (3.21); N, 9.01 (8.87); Cu, 10.21 (10.19); IR (KBr, cm^{-1}): 3219(NH), 1625(C=O), 1583(C=N), 3320(OH), ^{1}H NMR (DMSO-d6) δ ppm: 11.80 (s, 1H, OH-Ar), 7.28-7.04(m, 8H, Ar), 8.02 (s, 1H, CH=N). ^{13}C NMR (DMSO-d6) δ ppm: 119.13-111.21 (11C, CH-Ar.), 135.12 (1C, C=O), 141.21 (1C, CH=N).

Antimicrobial activities

To determine the antibacterial and antifungal activities of SBL and metal complexes of cobalt, nickel and copper was used Disc diffusion method [16].Nutrient agar and potato dextrose agar were used to grow bacterial and fungal strains, respectively. Formation of inhibition zones around the discs were confirmed the activity of newly synthesized compounds and recorded in millimetres (Table 1).

Table 1: Bactericidal Screening data of the Complexes

Compounds	Bacteria		Fungi	
	ATCC 25923	ATCC 3160	*Candida albicans*	*Staphylococcus cereviscae*
Complex 1	45	42	51	55
Complex 2	65	76	66	72
Complex 3	58	62	60	52
Imipenem	100	100	100	100

Excellent activity (90-100% inhibition), Good activity (60-70% inhibition), Significant activity (30-50% inhibition), *Staphylococcus aureus* (ATCC 25923), *Staphylococcus aureus* (ATCC 3160) Imipenem = Standard drug.

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