

*Co-ordination of metal ions with indole-3-acetic acid;
synthesis, characterization and biological screening*



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IN

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BY

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SESSION: 2016-2017

**DEPARTMENT OF CHEMISTRY
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DECLARATION

I **Kiran Nazia Sikandar** D/O **Zulqarnain Bhatti** ID: S2016140025, Session 2016-2017 hereby declare that the matter printed in the thesis titled “*Co-ordination of metal ions with indole-3-acetic acid; Synthesis, Characterization and Biological screening*” is my own work and has not been printed, published and submitted as research work, thesis or publication in any form in any university, research institution etc. in Pakistan or abroad.

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Certified that the research work contained in this thesis titled, “*Co-ordination of metal ions with indole-3-acetic acid; Synthesis, Characterization and Biological screening*” has been carried out and completed by Kiran Nazia Sikandar, **ID: S2016140025**. The quantum and the quality of the work contained in this thesis is adequate for the award of degree of MS.

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***Dedicated to the Memory of
My Beloved Father
Who Passed Away
on 13 Sept. 2010.***

May Allah rest his soul in eternal peace.

To Allah We Belong

and to Him

We Do Return

Sacrifices his life best moments for me and for my sisters,

He was always waiting for this day and wishing to live

For seeing and sharing with me this moments,

But, Allah did that what he had ordered to do.

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Abstract

Metal carboxylates play a very important role in various biological reactions. Significance of drugs and their complexes have been desired to synthesize and characterize some ternary inner transition metal complexes with carboxylate and their derivative. In this work, five mononuclear metal complexes such as zinc, copper and vanadium have been synthesized with indole-3-acetic acid as primary ligand and 2,2'-bipyridine, 1,10-phenanthroline and 8-hydroxy quinoline as secondary ligands by reflux method. The synthesized transition metal complexes have been analyzed by FT-IR, $^1\text{H-NMR}$, UV-Visible spectroscopy and conductance measurement. The FT-IR spectroscopy revealed that nitrogen atom of ligand does not coordinate with metal ions. The vibrational frequency of NH was not shifted to a considerable extent in complexes 3–8 as compared to the free ligand (IAA). As a result, the indole-3-acetic acid works as simple carboxylic acid ligands even in the synthesis of chelate complexes. The outcomes of $^1\text{H-NMR}$ showed that the -COOH resonance of IAA at 12.19 ppm was absent in Na-IAA and in complexes, which suggests the replacement of the carboxylic proton by the metal moiety. The synthesized complexes have distorted tetrahedral geometry in case of zinc complex and octahedral geometry in copper and vanadium due to the attachment of co-ligands. The molar conductance data of synthesized complexes revealed that the ligand and complexes are non-electrolyte. Antibacterial screening was performed by the well diffusion method against gram negative (*Klebsiella pneumoniae*, *Escherichia coli* and *Pseudomonas aeruginosa*) and gram-positive (*Staphylococcus aureus*) bacteria. All complexes exhibited higher antimicrobial potential than ampicillin (standard reference drug). It was confirmed by inhibition zones that metal complexes are efficient antibiotic agents.

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List of Abbreviations

IAA	Indole-3-acetic acid
DMSO	Dimethyl sulfoxide
PBS	Phosphate buffer saline
en	Ethylenediamine
bpy	2,2'-bipyridine
phen	1,10-phenanthroline
8-HQ	8-hydroxyquinoline
MLCT	Metal-to-ligand charge transfer
TON	Turn over number
LED	Light emitting diode
ZBS	Zinc basic hydroxide salt
ZALDH	Zinc aluminum layered double hydroxide
MIC	Minimum inhibition concentration
NAA	Naphthalene acetic acid
2,4-D	2,4-dichlorophenoxy acetic acid
FT-IR	Fourier Transform Infrared Spectroscopy
UV-Vis	Ultraviolet-visible
λ_{\max}	Maximum wavelength
NMR	Nuclear magnetic resonance
mS	Milli Siemens



Introduction

Metal carboxylates have been a fascinating field of research because the carboxylate group demonstrates diverse modes of coordination and exhibits non-identical bonding towards metal cations, like monodentate chelate and bridging such as anti anti, syn anti, and syn syn conformations (Jennifer, 2013). In spite of the fact that various carboxylate based coordination compounds are known, however, the coordination behavior may change based on the size of organic moiety attached to the metal, nature of solvent, concentration of solution and the difference of electronegativity values between the carboxyl group and the remaining part of the ligand (Hussain, 2016).