

الآيه

بسم الله الرحمن الرحيم

قال تعالى:

(لَقَدْ أَرْسَلْنَا رُسُلَنَا بِالْبَيِّنَاتِ وَأَنْزَلْنَا مَعَهُمُ الْكِتَابَ وَالْمِيزَانَ
لِيُقُومَ النَّاسُ بِالْقِسْطِ وَأَنْزَلْنَا الْحَدِيدَ فِيهِ بَأْسٌ شَدِيدٌ وَمَنَافِعُ
لِلنَّاسِ وَلِيَعْلَمَ اللَّهُ مَنْ يَنْصُرُهُ وَرُسُلَهُ بِالْغَيْبِ إِنَّ اللَّهَ قَوِيٌّ
عَزِيزٌ)

صدق الله العظيم

سورة الحديد الآية (25)

Dedication

To

My parents,

Brothers

And sisters.

Acknowledgment

First of all my sincere thanks to Allah Almighty for helping me to complete this work.

It is a pleasure to record my deep appreciation, and thanks to Dr. Mohamed Sulieman Ali Altoum for his wise guidance, which helped me to present this project in this shape. I am very grateful to the staff of the Department of Chemistry- Sudan University of Science and Technology & Department of Microbiology- International University of Africa & Khartoum College of Medical Sciences for all facilities.

Thanks to my family for their continual support.

Abstract

The Cr (III), Co (II), Ni (II) and Cu (II) complexes of the ligand salicylaldehyde thiosemicarbazone (STSC) were prepared and different analytical techniques such as Atomic Absorption Spectroscopy (AAS), Ultra Violet Spectroscopy (UV) and Infra-Red Spectroscopy (IR) were used to characterize the obtained products. The obtained result of the ligand alone and the metals as complexes indicate the existence of monoanionic tridentate nature of ligand, which undergo coordination to metal ions with oxygen, nitrogen and sulfur (ONS) donor atom sets.

The antimicrobial activity of the ligand salicylaldehyde thiosemicarbazone and its Cr (III), Co (II), Ni (II) and Cu (II) complexes were conducted against various microbes like the species *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans*, effect of the investigated compounds have been tested by the disc diffusion method. A comparative study of inhibition values of the Schiff base ligands and their complexes indicated that the biological activity for the ligand alone was lower than the complexes form.

The ligand have no activity against *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans*, the complexes have highly activity against *Staphylococcus aureus*, *Escherichia coli*, complex of Ni (II) have activity against *Escherichia coli*, and complex of Cr (III) have activity against *Staphylococcus aureus*, the complex of Co(II) has no activity against *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans*.

المستخلص

معقدات الكروم (III)، الكوبالت (II)، النيكل (II) والنحاس (II) مع اللاقط سالسالدهيد ثيوسيمكاربازون تم تحضيرها وبتقنيات تحليلية مختلفة مثل جهاز الامتصاص الذري، جهاز الأشعة فوق البنفسجية وجهاز الأشعة تحت الحمراء استخدمت لتشخيص الناتج المتحصل عليه. اللاقط الناتج لوحده ومعقداته تشير إلى وجود احادية الشحنة السالبة وثلاثية المنح للاقط والتي تمنح عن طريق مواقع ذرات الاوكسجين، النيتروجين والكبريت .ONS

نشاط مضادات الميكروبات للاقط سالسالدهيد ثيوسيمكاربازون ومعقداته من الكروم (III)، الكوبالت (II)، النيكل (II) والنحاس (II) تم فحص المعقدات ضد الميكروبات المختلفة مثل استفلوكوكس اورييس، اشريشيا كولاي و الكانديدا البيكان، التحقق من تأثير المركبات اختبرت بطريقة الانتشار القرصي. وأشارت الدراسة مقارنة بقيم التثبيط بين قواعد شيف والمعقدات ان اللاقط لوحده اقل نشاطيه من المعقد المتكون.

اللاقط لم يعطي نشاط مع بكتريا استفلوكوكس اورييس واشريشيا كولاي وفطر الكانديدا البيكان، اما معقد النحاس اعطي نشاط عالي مع بكتريا استفلوكوكس اورييس واشريشيا كولاي وفطر الكانديدا البيكان ، معقد النيكل اعطي نشاط مع بكتريا اشريشيا كولاي ،ومعقد الكروم اعطي نشاط مع بكتريا استفلوكوكس اورييس ،اما معقد الكوبالت لم يعطي اي نشاط مع بكتريا استفلوكوكس اورييس واشريشيا كولاي وفطر الكانديدا البيكان.

Contents

| | |
|---------------------------|-------------|
| الآية | i |
| Dedication | ii |
| Acknowledgement | iii |
| Abstract (English) | iv |
| Abstract (Arabic) | v |
| Contents | vi |
| List of Tables | viii |
| List of Figures | ix |

Chapter One

| | | |
|-----------------|---|----|
| 1.1. | Introduction | 1 |
| 1.1.1. | General Introduction of Schiff Base | 1 |
| 1.2. | Literature review | 2 |
| 1.2.1. | Schiff's Base Complexes | 2 |
| 1.2.2. | Antimicrobial activities | 3 |
| 1.2.2.1. | Antibacterial activities | 3 |
| 1.2.2.2. | Antifungal activities | 6 |
| 1.2.2.3. | Antimalarial activity | 8 |
| 1.2.2.4. | Pesticidal activity | 9 |
| 1.2.3. | Thiosemicarbazones and their transition metal complexes | 10 |
| 1.2.3.1. | Bonding and stereochemistry | 12 |
| 1.2.4. | Spectrophotometric uses of Thiosemicarbazone complexes | 16 |
| 1.3. | Aim of the study | 21 |

Chapter Two

| | | |
|-----------------|--|----|
| 2. | Experimental | 22 |
| 2.1. | Materials and Methods | 22 |
| 2.1.1. | Materials | 22 |
| 2.1.1.1. | Solvents | 22 |
| 2.1.1.2 | Chemicals | 22 |
| 2.1.2 | Instruments and Equipment | 22 |
| 2.1.3. | Glass wares | 23 |
| 2.1.4. | Methods | 23 |
| 2.1.4.1. | Ligand preparation | 23 |
| 2.1.4.2. | Complexes preparation | 23 |
| 2.1.4.3. | Complexes preparation in pH 4 | 24 |
| 2.1.4.4. | Complexes preparation in pH 8 | 24 |
| 2.1.4.5. | Antimicrobial Assay | 24 |
| 2.1.5. | Characterization of the formed ligand and ligand metal complexes | 25 |
| 2.1.5.1. | Fourier Transform Infrared Spectroscopy (FT-IR) | 25 |
| 2.1.5.2. | Ultra Violet Spectroscopy UV | 25 |
| 2.1.5.3. | Atomic Absorption Spectroscopy | 26 |
| 2.1.5.4. | Melting Point (M.P.) | 26 |

Chapter Three

| | | |
|-------------|--------------------------------------|----|
| 3. | Results and Discussion | 27 |
| 3.1. | IR spectra | 28 |
| 3.2. | Electronic absorption spectral bands | 32 |
| 3.3. | Antimicrobial activity | 37 |
| 3.4. | Conclusion | 39 |
| 3.5. | Recommendation | 40 |
| | References | 41 |

List of Tables

| | | |
|-------------|---|----|
| Table (3.1) | Characteristic bands of the ligands and their complexes | 29 |
| Table (3.2) | Absorption bands of lamda max | 32 |
| Table (3.3) | Absorption bands | 36 |
| Table (3.4) | Antimicrobial activity | 37 |

List of Figures

| | | |
|-----------|---|----|
| Fig 1.1. | A five-membered chelate ring | 11 |
| Fig 1.2. | Ligands in both neutral (HL) and anionic (L ⁻) forms | 11 |
| Fig 1.3. | The canonical form I, II and III of ligand in the Z-configuration | 12 |
| Fig 1.4. | IUPAC numbering scheme of the ligand | 12 |
| Fig 1.5. | Tautomerize of thione and thiol | 13 |
| Fig 1.6. | Additional donor site D to a five-membered chelate ring | 13 |
| Fig 1.7. | Isomeric forms of 2-formylpyridine thiosemicarbazone | 14 |
| Fig 3.1. | Preparation of ligand | 27 |
| Fig 3.2. | Preparation of metals (II) complexes | 28 |
| Fig 3.3. | Preparation of Cu (II) complexes | 28 |
| Fig 3.4. | Preparation of metals (III) complexes | 28 |
| Fig 3.5. | IR Spectrum of Ligand (STSC) | 30 |
| Fig 3.6. | IR Spectrum of Cobalt (II) Complex | 30 |
| Fig 3.7. | IR Spectrum of Chromium (III) Complex | 30 |
| Fig 3.8. | IR Spectrum of Chromium (III) Complex (f) | 31 |
| Fig 3.9. | IR Spectrum of Copper (II) Complex | 31 |
| Fig 3.10. | IR Spectrum of Copper (II) Complex (f) | 31 |
| Fig 3.11. | IR Spectrum of Nickel (II) Complex | 32 |
| Fig 3.12. | U.V. spectrum of ligand | 33 |
| Fig 3.13. | U.V. spectrum of Co (II) complex | 33 |
| Fig 3.14. | U.V. spectrum of Cr (III) complex | 34 |
| Fig 3.15. | U.V. spectrum of Cr (III) f complex | 34 |
| Fig 3.16. | U.V. spectrum of Cu (II) complex | 35 |
| Fig 3.17. | U.V. spectrum of Cu (II) f complex | 35 |
| Fig 3.18. | U.V. spectrum of Ni (II) f complex | 36 |
| Fig 3.19. | <i>Staphylococcus aureus</i> | 38 |
| Fig 3.20. | <i>E.Coli</i> | 38 |
| Fig 3.21. | <i>Candida albicans</i> | 38 |