SYNTHESIS AND CHARACTERIZATION OF SIMPLE ORGANIC COMPOUND

Thesis submitted

in partial fulfilment of the requirements

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BACHELOR OF SCIENCE IN CHEMISTRY

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BONAFIDE CERTIFICATE/*

This is to certify that this Project Report is the bonafide work of A.AnitaEsther (38030003) R.Prabhavathy(38030011) and V.Suchitra (38030016) who carried out theprojectentitled **"SYNTHESIS AND CHARACTERIZATION OF SIMPLE ORGANIC COMPOUND"**under my supervision from December 2020 to April 2021.

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INTERNAL EXAMINER **EXTERNAL EXAMINE**

DECLARATION

We **A.ANITA ESTHER, R.PRABAVATHY and V.SUCHITRA**, hereby declare that the Project Report entitled **"SYNTHESIS AND CHARACTERIZATION OF SIMPLE ORGANIC COMPOUND"** done by us under the guidance of **Dr. J. KARTHIKEYAN Ph.D.,** Associate Professor Department of Chemistry,Sathyabama Institute of Science and Technology is submitted in partial fulfilment of the requirements for the award of Bachelor of Science degree in Chemistry.

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ABSTRACT

Semicarbazones are compounds obtained by condensation of Semicarbazides with suitable aldehydes or ketones. They are potent intermediates for the synthesis of pharmaceutical and bioactive materials and thus, they are used extensively in the field of medicinal chemistry. The new semicarbazone was made by combining semicarbazide.HCl with N, N-bis (2-chloroethyl) amino benzaldehyde in 10ml of ethanol. For 1 hour, the mixture is stirred until it is fully dissolved and add 2 drops of Concentrated HCl. The structures of the compounds have been characterized on the basis of their IR and UV-Visible spectroscopic data.

CONTENTS

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Coordination compounds have been a challenge to the inorganic chemist since they were identified in the nineteenth century. After the profound studies done by Alfred Werner, inorganic chemistry witnessed a great outflow of coordination compounds, with unique structural characteristics and diverse applications. The stereochemistry of coordination compounds is one of the major interests of the coordination chemist. The development of instrumental techniques provides methods of investigating thermal, spectral and magnetic properties of metal complexes. Coordination compounds can have a wide variety of structures depending on the metal ion, coordination number and denticity of the ligands used. The presence of more electronegative nitrogen, oxygen or sulfur atoms on the ligand structure is established to enhance the coordination possibilities of ligands. Coordination compounds are widely used as potential drugs, in the field of catalysis and in biological fields. This includes a number of important biological materials such as vitamin B12 and haemoglobin. The chemistry of transition metal complexes of semicarbazones and thiosemicarbazones has been receiving considerable attention primarily because of their bioinorganic relevance. A semicarbazone is a derivative of imines formed by a condensation reaction between a ketone or aldehyde and semicarbazide. They are classified as imine derivatives because they are formed from the reaction of an aldehyde or ketone with the terminal NH_2 group of semicarbazide, which behaves very similarly to primary amines. Semicarbazone, themselves are of much interest due to a wide

spectrum of anti-fungal and anti-bacterial activities.A new semicarbazone (E)-2-(4-bis(2-chloroethyl) amino) benzylidene) hydrazine-1-carboxamide with the molecular formula $C_{12}H_{16}C_{l2}N_4O$ is synthesized by Schiff base reaction. TheUV-Visible and FT-IR spectroscopy is used to identify the functional groups of the synthesized compound.

CHAPTER 2

LITERATURE SURVEY

Interestingly, semicarbazones show a variety of coordination modes with transition metals. The coordination mode is influenced by the number and type of substituent. This is because the active donor sites of the ligand vary depending upon the substituent. According to the reports, the coordination mode of the semicarbazone is very sensitive towards minor variations in the experimental conditions, some of the reports related to semicarbazones are listed here.

*Chandra Mohan et al., (*2009)demonstrated new series of Schiff bases derived from semicarbazones and thiosemicarbazones were synthesized by the reaction of 2 – acetyl thiophene and thiophene - 2 – aldehyde in ethanol. Metal complexes of these Schiff bases has also been derived with Cu(II), Pb(II), Zn(II), Co(II), Ni(II) and Mg(II) metal salts. Such compounds and metal complexes were characterized by different physic – chemical technique like melting point, elemental analysis, multinuclear NMR and IR studies. All the complexes were found to have good agreement with the analytical data received. The possible geometries of the complexes were assigned on the basis of electronic and infrared spectral studies.

*Venkatachalam, taracad K; bernhardtPaulV,(*2016)*et al.,* demonstrated semicarbazones/thiosemicarbazones and their copper complexes have been prepared and several single crystal structures examined. The copper complexes of these semicarbazone/thiosemicarbazones were prepared and several crystal

structures examined. The single crystal X-ray structure of the pyridyl-substituted semicarbazone showed two types of copper complexes, a monomer and a dimer. We also found that the p-nitrophenyl semicarbazone formed a conventional 'magic lantern' acetate-bridged dimer. Electron Paramagnetic Resonance (EPR) of several of the copper complexes was consistent with the results of single crystal X-ray crystallography. The EPR spectra of the p-nitrophenyl semicarbazone copper complex in dimethyl sulfoxide (DMSO) showed the presence of two species, confirming the structural information. Since thiosemicarbazones and semicarbazones have been reported to exhibit anticancer activity, we examined the anticancer activity of several of the derivatives reported in the present study and interestingly only the thiosemicarbazone showed activity while the semicarbazones were not active indicating that introduction of Sulphur atom alters the biological profile of these thiosemicarbazones.

*Kishore babu. A and Selvaraj. K(*2018) *et al.,* explained about the semicarbazone are the important constituent of many natural sources and have a wide variety of biological activities. Following Claisen – Schmidt condensation reaction, a number of chalcones were prepared by the reaction between derivatives of acetophenones with variously substituted benzaldehydes in sodium hydroxide solution and ethanol medium at 25 -30℃. The synthesized chalcones were confirmed by IR, NMR and mass studies. The above chalcones were checked for their antibacterial and antifungal activities.

*Elham Hariri, ArashMahboubi and Farzad(*2016)*et al.,* synthesized a series of hydroxy semicarbazone derivatives of substitutes diaryl ketones and acetophenones were synthesized and their structures were confirmed by analytical and spectroscopic methods including elemental analysis, infrared and nuclear magnetic resonance spectroscopy. The derivatives were prepared by a condensation reaction between N-hydroxy semicarbazide and substituted diaryl ketones or acetophenone leading to the desired hydroxysemicarbazones with excellent purity. The synthesized hydrazones were the evaluated for their inhibitory activity against bacterial strains including S. aureus, E. Coli, P. aeruginosa, K. pneumonia and M. luteus. Among the tested derivatives,

compounds 2,6 and 7 exhibited the highest bioactivity data suggests that hydrophilicity is an important factor for the bioactivity of compounds 2 and 6 and also their selectivity over the gram-negative bacteria.

*Mahamed jawed Ahsan, jeyabalangovindasamy, Habibullah Khalilullah, ShiviNormani(*2011)*et al.,* are synthesized by the condensation of semicarbazide and aldehyde/ketones. The literature survey revealed that semicarbazones had been emerged as ac compound with broad range of activities including anticonvulsant, antitubercular, anticancer and antimicrobial activity. Dimmock et al., reported an extensive series of semicarbazones and reported 4-(4-fluorophenoxy) benzaldehyde semicarbazone as potential anticonvulsant. Preclinical evaluations have been completed and an IND has been filed for this potential compound. In the present study we have focused on the biological activity of semicarbazone analogues.

*Mehnaz Kamal, Talha Jawaid(*2013)*et al.,* prepared anticonvulsants, which are a diverse group of pharmaceuticals used in the treatment of epileptic seizures. The goal of an anticonvulsant is to suppress the rapid and excessive firing of neurons that start a seizure. The use of current antiepileptic drugs has been questioned due to the non-selectivity of the drugs and the undesirable side effects posed by them. This led to the search for antiepileptic compounds with more selective activity and lower toxicity continues to be an area of investigation in medicinal chemistry. Semicarbazones are compounds which are synthesized by the condensation of semicarbazide and aldehydes/ketones. The literature survey revealed that semicarbazones had been emerged as a compound with broad range of activities including anticonvulsant, antitubercular, anticancer and antimicrobial activity. In this review chemistry and anticonvulsant activity of semicarbazone analogues are discussed.

*Laila Jafri, saimakalsoom, Sanaqureishi(*2012) et al., finding potential therapeutic agents, a variety of biologically significant semicarbazones were synthesized by the reaction of different carbonyl compounds with phenyl semicarbazides through microwave irradiation. Initially, 18 semicarbazones were studied for their antimicrobial, antitumor, and antioxidant potential. None of the tested compounds showed any antibacterial activity; however, some compounds showed significant antifungal activity. Interestingly, all compounds showed antitumor activity when tested against tumours grown on potato discs. These compounds were also tested

for their effect on OH radical-induced oxidative DNA damage. All the compounds showed DNA protection to varying extent. Based on the promising results of antitumor and antioxidant activities, another set of 24 semicarbazones was synthesized, and all of these semicarbazones were evaluated for their antioxidant potential. The results showed that the semicarbazones derived from 2-nitrobenzaldehyde and acetophenone were the most active 2,2-diphenyl-1-picrylhydrazyl 9 (DPPH) free radical scavengers. The overall results have led to the identification of some interesting compounds which seem to have great potential to be developed into effective anticancer drugs.

Tripti Verma, Chandra Shekhar Sharma, Hemendra Pratap Singh et al., Semicarbazones are compounds which are synthesized by a condensation reaction between a ketone or aldehyde and semicarbazide. Semicarbazone have biological activity against many of the most common species of bacteria. The biological properties of semicarbazonesare often related to metal ion coordination. The literature survey revealed that semicarbazones had been emerged as a compound with broad range of activities including anti-fungal, anti-bacterial, anticonvulsant, anticancer, antimicrobial activity and anti-inflammatory activity. Semicarbazone also used as ligand as the cytotoxic agent, spectrophotometric agents as well for the analysis of metal ions and in qualitative organic analysis of carbonyl compounds. In the present study we have focused on the Pharmacological evaluation of semicarbazone analogues. As per activity there are different Pharmacological evaluation methods of synthesized compound.

*Manmoham Singhal (*2011) *et al.,* used pharmacophore hybridization technique of drug design and designed a pharmacophore model 2-methylphenylsemicarbazone which is having hydrogen acceptor site, hydrogen donor site, lipophilic site etc. using ligandscout-2.02 software. A series of 2-methylphenyl-semicarbazone was synthesized and evaluated for their antipyretic activity using boiled cow milk induced pyrexia in rabbits. Compound 11 was the most active compound. The possible metabolites of some selected synthesized chalconesemicarbazones were predicted by computational method using Pallas version-3.1 ADME-Tox prediction software. The major pathway of metabolism was found to be p-hydroxylation and amide hydrolysis.

CHAPTER 3

AIM AND SCOPE

3.1 AIM:

The aim of the project is to synthesis and characterize semicarbazone derived from 4-bis(2-cholro ethyl)amino)benzaldedhye.

3.2 SCOPE:

In organic chemistry, a semicarbazone is a derivative of imines formed by a condensation reaction between a ketone or aldehyde and semicarbazide. They are classified as imine derivatives because they are formed from the reaction of an aldehyde or ketone with the terminal -NH2 group of semicarbazide, which behaves very similarly to primary amines.Some semicarbazones, such as nitrofurazone, and thiosemicarbazones are known to have anti-viral and anti-cancer activity, usually mediated through binding to copper or iron in cells. Many semicarbazones are crystalline solids, useful for the identification of the parent aldehydes/ketones by melting point analysis some semicarbazones, such as nitrofurazone, and thiosemicarbazones are known to have anti-viral and anti-cancer activity, usually mediated through binding to copper or iron in cells. Many semicarbazones are crystalline solids, useful for the identification of the parent aldehydes/ketones by melting point analysis. Despite the fact that there are many medicines on the market, the need to find a new medication with a better pharmacokinetic profile and lower toxicity has become critical for obvious reasons as well as the rapid growth of microbial resistance to established molecules. As a result, several novel semicarbazone have been synthesized in this study for biological activities.

CHAPTER 4

EXPERIMENTAL METHODS

4.1 MATERIALS:

The starting material4-(bis(2-chloroethyl)amino)benzaldehyde, hydrazine carboxamide, ethanol was used in the synthesis process. The purity of the compounds was routinely checked by thin layer chromatography (TLC).

4.2 MEASUREMENTS:

The instrument used for FT-IR was shimadzu, IR tracer-100 using standard KBr mode for spectra in the range 4000-500 cm^{-1}. Infrared spectroscopy is effectively used to identify the functional groups todetermine the molecular structure of the synthesized compounds. For UV-Vis spectra shimadzu, UV 3600 plus was used to find the reflection or absorption of the sample taking place in the range of 200-900 nm.

4.3 Preparation of (E)-2-(4-(bis(2-chloroethyl)amino)benzylidene)hydrazine-1-carboxamide:(HL1)

The title compound was synthesized by taking 0.246 g of 4-(bis (2-chloroethyl) amino) benzaldehyde into 10ml of ethanol and 0.115 g of hydrazine carboxamide into 10ml of ethanol. Both the mixture is stirred for 1 hour until it is completely dissolved. Now transfer both the solution into a 250ml RB flask and add 2 drops of Concentrated HCl. The mixture was reflexed for 2-3 hours and transferred into a beaker and dried until the water gets evaporated. The solid product formed was separated by filtration, washed several times with 50% ethanol and dried.

CHAPTER 5

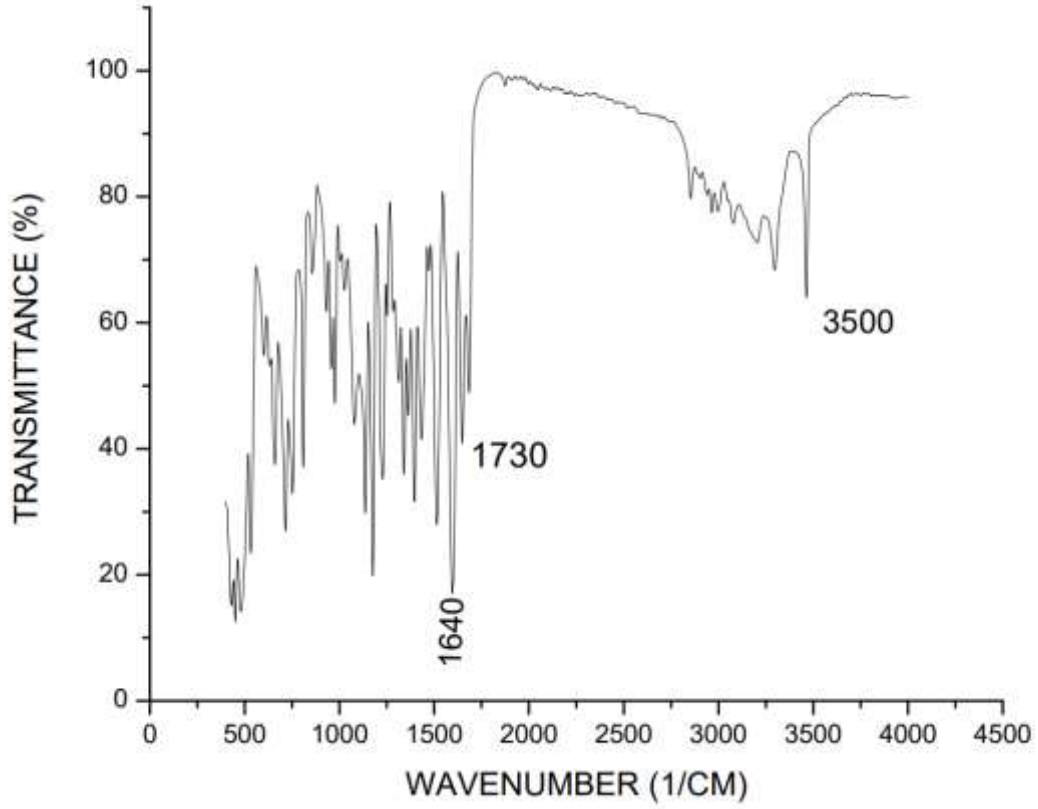
RESULTS AND DISCUSSION

5.1 IR SPECTRAL STUDIES:

The measurement of infrared radiation's interaction with matter through absorption, emission, or reflection is known as infrared spectroscopy (IR spectroscopy or vibrational spectroscopy). It's used to research and classify chemical compounds or functional groups that occur in solid, liquid, or gaseous forms. The compound gives the characteristic IR peak that proved the presence of C=O and N=C functional group.

The characteristic IR bands of the semicarbazones provide significantinformation regarding the various functional groups present in them. Frequencies of the carbonyl group of the semicarbazones drew interest ratherearly. It was observed that the IR frequency of the carbonyl of thesemicarbazones is normally found at *ca*.1690 cm^{-1} (in KBr), which appearedabnormally high as compared to those of amides and urea [15]. This shift ofIR frequency can be explained by the combined inductive effect of nitrogenatoms, which would pull the π cloud of carbonyl closer to the carbon,diminishing the polar character of the C=O. This would cause a rise in theIR frequency of the C=O [16]. The presence of band at 1740 $cm^{-1}$of HL1

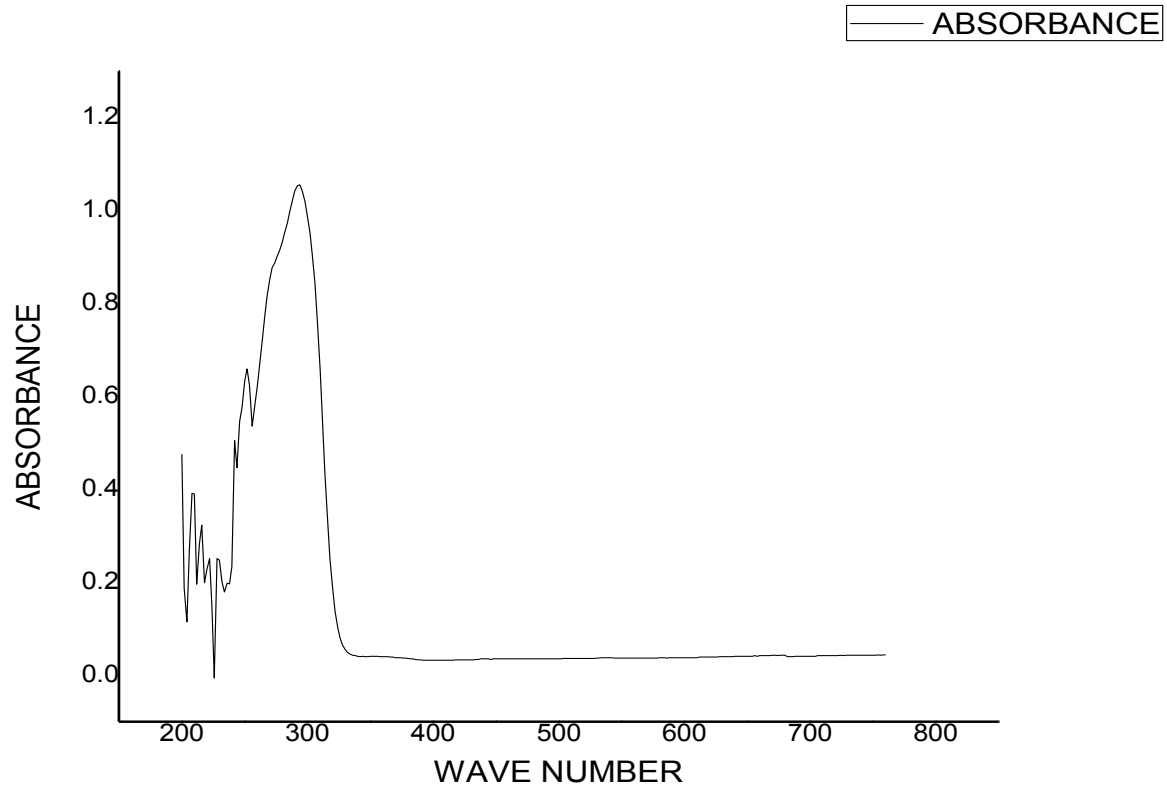
assigned to *v*(C=O) stretching vibrations whichreveal the presence of keto form in the solid state. Medium bands observedat 3500 cm^{-1} are assigned to the *va*(NH) of the imino group ofsemicarbazones, HL1 and this also suggest that HL1 exist in keto form in the solid state. The azomethine stretchingvibrations are observed at 1640 cm^{-1} for HL1 which are in agreement with earlier reports of *N*4-substituted semicarbazones. The IR spectral bands of HL1 observed at 1129 and 1153 cm-1correspond to *v*(N–N). Presence of bands at 1535 and 1526 cm^{-1} forthe ligands HL1 are due to the interactions between N–H bending and C–N stretching vibrations of the C–N–H group of the amidefunction. Weak bands at 1265 and 1269 cm^{-1} also result from the N–Hbending and C–N stretching interactions.



5.2 UV SPECTRAL STUDIES:

In contrast to the infrared spectrum, the electronic spectrum is not used primarily for the identification of individual functional groups, but rather to show the relationship between functional groups, chiefly conjugation. The UV-visible spectra of organic compounds are associated with the electronic transition between energy levels, and at wavelengths above 200 nm, excitation of electrons from the π-orbitals usually giving rise to informative spectra. Electronic spectrum of semicarbazone HL1 shows absorption maxima at 26315 cm^{-1}, which are attributed

to π→π* transition of the imine function of the semicarbazone moiety and n→π* transition of azomethine and carbonyl groups respectively.



CHAPTER 6

SUMMARY AND CONCLUSION

Semicarbazone is the condenzation product of semicarbazide andaldehyde or ketone. The compound HL1 is formed by the condenzation of semicarbazide hydrochloride and 4-bis(2-cholro ethyl)amino)benzaldedhye in the molar ratio 1:1 The condensation reaction is catalyzed by an HCl. Ethanol is used as the solvent. The elemental analysis data obtained are ingood agreement with the stoichiometry of 4-bis(2-cholro ethyl)amino)benzaldedhyesemicarbazone (HL1) The semicarbazones HL1 can exist in keto or enol form or anequilibrium mixture of two tautomers since it has an amide, –NH–C=O function.

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