

Research Article

Synthesis and Characterization of Pyridine Transition Metal Complexes of Ni (II), Cu (I) and Ag (I)

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Abstract

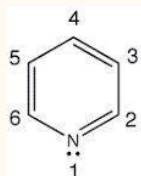
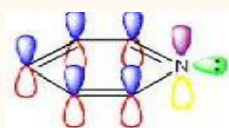
The complexes of Ni (II), Ag (I) and Cu (I) have been synthesized using pyridine as ligand. The three complexes have been characterized by melting point determination, solubility test in different solvents, physical state, colour and molar conductance. Pyridine is a mono-dentate ligand. The structure of the complexes has been confirmed by elemental analysis, its study revealed that the metal complexes seem not to undergo any form of decomposition when stored for a long period in the reagent bottles except for Ag (I) complex which is photosensitive while the other complexes Ni (II) and Cu (I) were not air sensitive and were handled with ease. The melting point of the complexes was relatively high ranging from 80 – 172 °C and the reason for its high melting point may be due to the formation of a stable oxidation state as in the case of Ni (II) with a d8 configuration. The Coordination compounds were prepared by the reaction of pyridine ligand with metal salts and the compositions of the complexes by the elemental analysis are recorded together in tables.

INTRODUCTION

Pyridine is a basic heterocyclic organic compound with the chemical formula C₅H₅N. It is structurally related to benzene, with the methyl group (=CH-) replaced by a nitrogen atom as displayed in figure 1. The pyridine may occur in many important compounds, including azines and the vitamins niacin and pyridoxal (Figure 1 and 2).

Pyridine was discovered in 1849 by the Scottish Chemist, Thomas Anderson as one of the constituents of bone oil. Two years later, Anderson isolated pure pyridine through fractional distillation of the oil. It is colourless, highly flammable, weakly alkaline, water soluble liquid with a distinctive fish like odour.

Pyridine is used as a precursor to agrochemical and

**Figure 1** Structure of pyridine.**Figure 2** Orbital structure of pyridine.

pharmaceuticals and is also an important solvent and reagent. Pyridine is added to ethanol to make it unsuitable for drinking. It is used in the Vitro Synthesis of DNA, in the synthesis of sulpha-pyridine (a drug against bacterial and viral infection), antihistaminic, drugs tripeleennamine and mepyramine, as well as water repellents, bactericides and herbicides. Some chemical compounds although not synthesized from pyridine, contain its ring structure. They include B vitamins niacin and pyridoxal and other nitrogen containing plant products [1].

Historically, pyridine was produced from coal tar as a by-product of the coal gasification. However, increased demand for pyridine resulted in the development of more economical methods of synthesis from acetaldehyde and ammonia, and more than 20,000 tons per year are manufactured worldwide [2].

Pyridine is miscible with water and virtually all organic solvents. It is weakly basic, and with hydrochloric acid it forms a crystalline hydrochloride salt that melts at 145-147 °C. Most chemical properties of pyridine are typical of a hetero aromatic compound. In organic reactions, pyridine behaves both as a tertiary amine, undergoing protonation, alkylation, acylation and N-oxidation at the nitrogen atom, and as an aromatic compound, undergoing nucleophilic substitutions.

Because of the electronegative nitrogen in the pyridine ring, the molecule is relatively electron deficient. Is therefore, enters less readily electrophilic aromatic substitution reactions, which are characteristics of benzene derivatives. However, unlike benzene and its derivatives, pyridine is more prone to nucleophilic substitution and metalation of the ring by strong organometallic bases [3].

The reactivity of pyridine can be distinguished for three chemical groups, with electrophiles; the electrophilic substitution takes place where pyridine expresses aromatic properties. With nucleophilic, pyridine reacts via its 2nd and 4th carbon atoms and thus behaves similar to Imines and carbonyls. The reaction with many Lewis acids results in the addition to the nitrogen atom of Pyridine, which is similar to the reactivity of tertiary amines. The ability of pyridine and its derivatives to oxidize, forming amine oxides, is also a feature of tertiary amines. The nitrogen center of pyridine features a basic lone pair of electrons, because this lone pair is not part of the aromatic ring. (Figure 3).

Pyridine has a conjugated system of six pi-electrons that are delocalized over the ring. The molecule is planar and thus, follows the Huckel criteria for aromatic systems. In contrast to benzene, the electron density is not evenly distributed over the ring, reflecting the negative inductive effects of the nitrogen atom. For this reason, pyridine has a dipole moment and weaker resonance stabilization than benzene (resonance energy 117 kJmol⁻¹ in pyridine vs 150 kJ mol⁻¹ in benzene). The electron localization in pyridine is also reflected in the shorter C-N ring bond (137 pm for C-C bond in benzene), whereas, the carbon-carbon bonds in the pyridine ring have the same 139 pm lengths as in benzene. These bond lengths lie between the values for the single and double bonds and are typical for aromatic compounds [4].

All the atoms in the pyridine ring molecule are SP²-hybridized and forms sigma bonds adjacent atoms having ~ 120° bond angle, each atom in pyridine has a p-orbital orthogonal to the ring, and they undergo delocalization to form a six-electron cyclic loop as in benzene. The lone pair of electrons on Nitrogen is in sp² orbital in the plane of the ring, and it is not part of the π system. (Figure 4).

The nitrogen atom "donates" its three hybridized electron pair lies in the molecule plane, projecting outward, in the plane of the ring. This lone pair does not contribute to the aromatic system but importantly influences the chemical properties of pyridine, as it easily supports bond formation via an electrophilic attack.

However, because of the separation of the lone pair from the

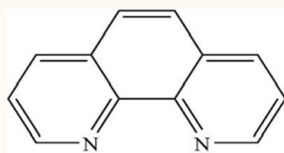


Figure 3 1, 10 - Phenanthroline.

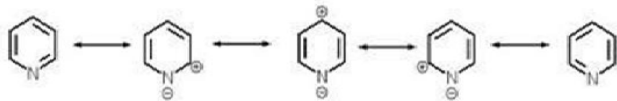


Figure 4 Resonance Structure of pyridine.

aromatic system of the ring effects, the nitrogen atom cannot exhibit a positive mesomeric effect [4].

In chemistry, a Coordination complex or metal complex consists of a central atom or ion, which is usually metallic and is called the coordination centre, and a surrounding array of bound molecules or ions, that are in turn known as ligands or complexing agents. Many metal containing compounds especially those of transition metals are coordination complexes [5].

As a ligand and Lewis Base, pyridine and its derivatives 2, 2'-bipyridine is widely used as ligand in coordination chemistry. A stronger Lewis base can easily replace it, this chemical property of pyridine as border-line soft base is exploited in catalysis of polymerization and hydrogenation reactions. In the studies of "Iridium" Compounds in catalysis, Crabtree, Robert found that the pyridine ligand replaced in the reaction is usually restored after the reaction is completed.

Generally, electrophilic substitutions on pyridine either do not proceed or if it does, it proceeds only partially. However, the hetero-aromatic character of pyridine can be activated by electron donating functionalization. Pyridine does not undergo common alkylation's and or acylation's reactions such as Friedel-Crafts alkylation or acylation reaction, because these only lead to addition at the nitrogen atom. Substitutions usually occur at the 3-positions (Ortho, Meta and Para).

Direct nitration of pyridine requires very harsh conditions and has very low yield. However, for our purposes here, survive it to note that in an attempt to nitrate pyridine, the first thing that will happen is that the strong acid, and thus, generate the pyridinium cation. The ring in the pyridinium cation is even more deactivated than the pyridine ring because of the full unit of positive charge on the nitrogen; but again, if we look at the possible resonance structures, we find that, meta-attack/substitution will be preferred. In this case the ring is so deactivated that extremely vigorous conditions must be used to nitrate the ring. (Figure 5).

As we have discussed in the electrophilic reaction that pyridine generally deactivated the aromatic ring towards electrophilic substitution reaction. The deactivation of the aromatic rings towards electrophilic substitution resulted due to the electron-withdrawing nature of the nitrogen atoms [6]. Due to such deactivation, Pyridine also gives nucleophilic substitution reaction. Nucleophilic substitution in pyridine ring occurs at position C-2. Approach of the nucleophilic at position C-2 leads

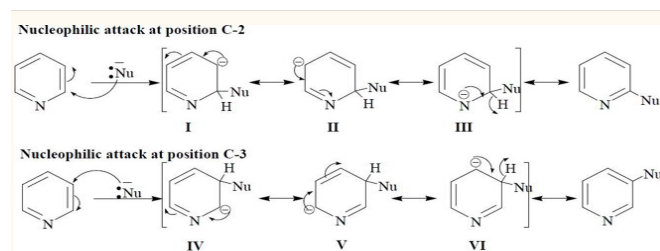


Figure 5 Structure of Nucleophilic substitution attack.

to the formation of three resonating structures (I, II and III); similarly, the approach of nucleophilic at position C-3 also leads to the formation of three resonating structures (IV,V and VI). The resonating structures for intermediate resulting from the attack of the nucleophile at position C-2 are more stable than those of position C-3 since more electronegative nitrogen atoms hold a -ve charge in one of the resonating structures (III) obtained from the attack of the nucleophile at position C-2. Hence, the nucleophilic substitution in pyridine at position C-2 is always favored. (Figure 6 and 7)

Transition metal have found noble applications related to human progress ranging from aerospace and electronics industries to health. Owing to their incomplete d-shells. Transition metals bond to a surrounding array of molecules or ions to form metal complexes of coordination compounds. In biological systems, metal ions bond and interact with important biological molecules and they are categorized into three general classes according to their enzymatic roles (that is when the metal acts as an enzymes co-factor and catalyses redox reactions), their structural roles (that is when the metal plays a role contributing to the stability of the biological molecule), and their reactive role when the metal plays a role in various functions such as the transportation of oxygen, hydrolysis and group transfer.

Since the discovery of cisplatin, a large number of metal complexes have been synthesized and applied in pharmacological fields as anticancer, anti-inflammatory, antibacterial, and anti-malarial drugs.

Since the discovery of novel antimicrobial agents active against different strains of bacteria continues. Resistance of bacterial pathogens to existed drugs over the past decade has become a major problem in the treatment of diseases caused by different strains of bacteria. Substituted Pyridines are known for their versatile biological profiles. Some pyridine derivatives are well known to possess antifungal, antibacterial, anti-inflammatory, antimicrobial and antitumor cancer activities.

For decades, transition metal complexes with solvents, as coordinated ligands, have been used.

Nitrogen containing ligands, as part of desired complexes, such as organamines and organitriles were one of the most

synthesized complexes ever. In these types of complexes, some ligands were chelating type ligands, giving a variety of choices for their synthesis and new doors were opened for many and diverse applications. In 2016, Azam et al. studied the synthesis of a Cu (II) salen complex with propylene linkage which showed significant anticancer activity and displayed potential antimicrobial biofilm activity. In vitro antimicrobial studies of Schiff base ligand derived from 1, 8-diaminonaphthalene and its Co (II), Ni (II), Cu (II) and Zn (II) complexes revealed that Cu (II) complex has the most significant antimicrobial activity.

In recent years, transition metals containing compounds attracted researcher's attention due to their antimicrobial properties. Islam et al, described the synthesis characterization and antimicrobial properties of Ni (II) complex with pyridine as a ligand. Badr et al [7]. Reported an antimicrobial study of three Ag (I) complexes-based pyridine ligands. Other Ag (I) complexes of pyridine and (Benz) imidazole derivatives were tested for their antibacterial activity and toxicity were reported. Other research groups studied the antibacterial and antimicrobial effect of Co (III), Fe (III) and Cu (II) complexes on different bacteria and fungi strains.

In general, Inorganic compounds play very important roles in biological processes and many organic compounds have been confirmed to be activated by the metabolism of metal ions. Some of Platinum in +2 oxidation state compounds possessed biological activity against different kinds of microbes. Newly, other groups reported new complexes containing Ni (II), Co (II) and Cu (II) metal ions with different Schiff bases as potential antimicrobial substances. These complexes showed different activities against different strains of microbes. Another group worked on the synthesis of oxovanadium (IV) complexes with dimedone derivatives that had promising antimicrobial properties using the disc-diffusion method.

Coordination complexes possessed a significant role due to their adaptability and wide range of applications, especially in industry, in their homo and heterogeneous phases. Weakly or non-coordinating anions play an important role in supporting the metal complexes interest. Lots of research has been conducted in many areas of chemistry to show the significant of these anions such as: aziridination, aldehyde and polymerization reactions.

In the past ten years, a particular research group works on the preparation of new and novel organometallic coordination complexes, to study their catalytic and antimicrobial properties include 1st row transition metals ligated to different N-containing ligands.

It was presented and describe in their work, the preparation of some Cu (I) complexes containing two different N-containing moieties (pyridine and propionitrile) with two different fluorinated counter anions ($B(C F) ^ -$ and $B\{C H (m-CF) \} ^ -$). The originality of their work rise from the

6 5 4 6 3 3 2 4

use of new type of complexes containing N-ligands as well as different fluorinated counter anions, which should enhance

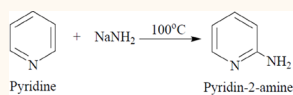


Figure 6 Reaction with Sodium amide: Pyridine reacts with sodium amide to give 2-aminopyridine via nucleophilic substitution.

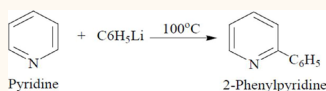


Figure 7 Reaction with Phenyllithium: Pyridine reacts with phenyl lithium (an organometallic compound) to give 2-phenyl pyridine.

the activity of the complexes under their investigation. Their synthesized complexes were fully characterized using different techniques, and their biological properties are studied against different bacterial isolates.

The brief coordination chemistry of Silver ($4d^{10}5s^1$) is widely distributed, and it occurs both as native metal and sulphite ore. Silver has the highest known thermal and electrical conductivities and it can exist in three oxidation state. Whereas, the author finds the chemistry of silver very interesting and attractive, further discussions of the geometry, coordination chemistry and orbital hybridization of Ag (I) is beyond the scope of this work and the knowledge base of this author. However, literature review of the work of [8], reveals that, although the soft Ag (I) ion has a relatively low affinity for O-donor variety of complexes containing carboxylates ions, DMSO, DMF and crown ethers are known. The work of Wan, Conyers, Combs and Mastertoni, shows that silver can be absorbed into the body through the lungs, muscle membrane and the skin and is found in human body at very low concentrations, silver can be eliminated from the body through urine and faces. It is believed that antimicrobial properties of Ag (I) complexes is dependent on the release of biologically active Ag (I) ions. However, the exact mode of action of Ag (I) is still unclear-silver sulfadiazine is the most commonly used medicinal product containing silver. It is used in the treatment of bums [6].

Copper has the electronic configuration of $[Ar] 3d^{10} 4s^1$ and it belongs to the first-row transition metals. Copper can form compounds in various oxidation states of +1, +2, and rarely in +3 and +4 which are highly unstable, but of particular interest is the +2 states. The +2 states are the most stable and have the electronic configuration of d^9 with an unpaired electron. Its compounds are typically coloured due to d-d transition spectra and are paramagnetic. The stereo chemical consequences of the d^9 configuration of Cu (I) if placed on a cubic environment (regular octahedral or tetrahedral), a wide range of stereochemistry exhibited by Cu (II) compounds with 415 and 6 coordinating number predominating in each structure variation from idealised geometries occur through bond length and bond angles distortion [9].

Nickel belongs to the first-row transition metals; the chemistry of Nickel is simplified by dominance of the Ni (II) state. Nickel has the electronic configuration of $[Ar] 3d^8 4s^2$.

The Ni (II) complexes exist as octahedral, square planar, tetrahedral and trigonal structures. It forms a large number of complexes with coordination numbers of four, five and six having all structural types. Formation of five and six coordinate complexes results from the addition of ligands to square planar complexes. The six coordinate complexes are usually octahedral while the five coordinate complexes usually have trigonal bipyramidal geometry but some are square pyramidal. Most of the four coordinate complexes are square planar [10-15].

EXPERIMENTAL METHODS

Apparatus/Equipments

Beakers, Whatman filter paper. Spatula, reagent bottles, reflux

condenser, Bunsen burner, capillary tubes, resort stand, tripod stand, wire gauze, a two neck round bottom flask, thermometer, electronic weighing balance (G and G^(R) JS 300) and hot plate with magnetic stirrer.

Chemicals/Reagents

Pyridine, Nickel (II) Chloride Penta hydrate ($NiCl_2 \cdot 6H_2O$), Silver nitrate ($AgNO_3$), Copper chloride ($CuCl$), ethanol, distilled water and paraffin oil.

Synthesis of NI (II) Complex with Pyridine

1.88 g (0.024 moles) of the ligand was turned into a warm solution of 5 mls ethanol and was heated for 5 minutes.

Also, 0.475 g $NiCl_2 \cdot 6H_2O$ was dissolves in 20 mls dry ethanol into a warmed solution of the ligand. It was reflux for 2 hours and stirred for 10 minutes and allowed to cool overnight at room temperature during a complex was formed.

The complex formed was filtered and recrystallized from ethanol. The complex was stored in a beaker and the percentage yield of the complex was obtained as shown below,

Therefore, the percentage yield of the complex obtained was 57%

Studies shows that synthesizing Ni (II) complex, pyridine with nickel chloride hex hydrate was mixed in an anhydrous solvent and heated the mixture. The product was then filtered and washed with the solvent to remove any impurities. The product was then dried under vacuum to remove any residual solvent. This resulted in a dark green solid that was identified as the Ni (II) complex by IR and NMR spectroscopy. The characterization of the Ni (II) complex using several techniques, including IR spectroscopy, mass spectroscopy, and X-ray crystallography, for IR spectroscopy, an observed absorption band at 1710 cm^{-1} which was indicative of a C=O bond.

Mass spectroscopy was expected to have a peak at the molecular weight of the complex. X-ray Crystallography was expected to have a square planar geometry around the Ni (II) atom. Furthermore, after the synthesis of the Ni (II) complex IR spectroscopy was used to confirm the presence of the pyridine ligands. The IR spectrum showed a characterization absorption band at 2130 cm^{-1} which was in the range expected for pyridine ligand and was absent in the spectrum of the starting materials confirming that pyridine was successfully bound to the Ni (II) ion while the NMR spectrum of the complex was reported to showed two distinct peaks corresponding to the two different environments of the pyridine ligands.

Synthesis of Ag (I) Complex with Pyridine

1.88 g (0.024 moles) of the ligand was turned into a warm solution of 5 mls ethanol and was heated for 5 minutes.

Also, 0.017 g $AgNO_3$ was dissolves in 20 mls dry ethanol into

a warmed solution of the ligand. It was reflux for 2 hours and stirred for 10 minutes and allowed to cool overnight at room temperature during a complex was formed.

The complex formed was filtered and recrystallized from ethanol. The complex obtained was stored in a beaker.

Therefore, the percentage yield of the complex obtained was 59%

The synthesis and characterization of this complex was very similar to that of Cu (I) complex which by discovery the IR Spectrum showed a strong absorption band at 2040 cm^{-1} , and the NMR spectrum showed three peaks corresponding to the three environments of the pyridine ligands. Talking about the x-ray analysis and implications of the Ag (I) complex showed a linear geometry with the two pyridine ligands coordinated in a Monodentate fashion. This is the expected geometry for an Ag (I) complex with two pyridine ligands. As with the Cu (I) complex, a halogen bond between the silver centre and the anion was observed and expected to be in agreement with the IR and NMR result.

Synthesis of Cu (I) Complex with Pyridine

1.88 g (0.024 moles) of the ligand was turned into a warm solution of 5 mls ethanol and was heated for 5 minutes.

Also, 0.098 g of CuCl was dissolved in 20 mls dry ethanol into a warmed solution of the ligand. It was reflux for 2 hours and stirred for 10 minutes and allowed to cool overnight at room temperature during which a complex was formed.

The complex formed was filtered and recrystallized from ethanol. The complex obtained was stored in a beaker and the percentage yield of the complex was obtained.

Hence, the percentage yield of this complex was obtained to be 41%.

Further synthetization studies of this complex with the reaction of pyridine with copper iodide in an aprotic solvent and the product obtained was then isolated and using the techniques as for the Ni (II) complex. The IR spectrum expected to show a strong absorption band a 2080 cm^{-1} which was characteristics of a pyridine ligand bound to a Cu (I) ion. The NMR spectrum showed three distinct peaks corresponding to the three different environments of the pyridine ligands. The X- ray crystal structure of the Cu (I) complex showed a tetrahedral geometry, with the pyridine ligands coordinated in a monodentate fashion and this was in agreement with the expected geometry of a Cu (I) complex with pyridine ligands. The bond lengths and angles were within the expected ranges for a Cu (I) complex while the IR and NMR data reported confirmed the identity of the copper center and the iodide anion known as a halogen bond. This interaction is not often observed, but it was clearly present in the crystal structure of the complex and this result implies that the tetrahedral geometry and monodentate coordination of the pyridine ligands suggest that the Cu (I) complex may have potential applications

in catalysis and sensing. The halogen bond may also be exploited for the development of new materials with unique properties. Finally, the high stability of the complex may make it useful for long term storage or transportation.

Solubility Test

The solubility of a compound is the weights in grams of the solute (complex formed) dissolve in 100 grams of solvent at a given temperature.

Small portion of each of the complexes were placed in test tubes and different solvents (about 2 mls) were added to the different test tubes, the mixture in the test tubes were shaken vigorously. If all the solute particles dissolved, we have a soluble solution; if some of it dissolves in the solvent, we have an insoluble solution. The same test was carried for all the complexes involved.

Melting Point Determination

Small quantities of each complex were fed into different capillary tubes. One end of the tube was sealed by exposing to flame. The capillary tube was tapped with finger in order for the sample to pack properly. The tube was tied to the thermometer using rubber band and suspended in paraffin oil, which was then heated till the melted and the temperatures at which the samples melted were observed and recorded.

RESULT/DISCUSSION

Physical Properties of the Ligand and Metal Complexes

As shown in table 1, the ligand Cu (I) and Ni (II) complexes were of various shades of deep green and mint green except for Ag (I) complexes which were colourless. All these complexes, except Ag (I) with a d^{10} configuration were expectedly coloured, which might be due to d-d transition. The physical properties of the ligand and metal complexes obtained changes from Granules state for Ni (II), Cu (I), Ag (I) to a physical crystalline state with various complexes colour and salts. (Table 1)

Solubility of Ligand and Metal Complexes in Various Solvent at Room Temperature

IS = insoluble

S = soluble

SS = sparingly soluble in the table above

The compounds were Insoluble in Acetone, Sparingly Soluble in Methanol, Soluble in ethanol and distilled water except Cu (I)

Table 1: Physical Properties of the Ligand and Metal Complexes

	Ligand/ Metal Salts	State	Colour of Salts	Colour of Complexes	Physical State
1	Pyridine Ligand	Liquid	Yellowish		Liquid
2	Copper (I) salt	Granules	Green	Deep green	Crystalline
3	Silver (I) salt	Granules	Colourless	Colourless	Crystalline
4	Nickel (II) salt	Granules	Lemon green	Mint green	Crystalline

due to its electrolytic nature. All the complexes were soluble in ethanol and sparingly soluble in methanol. (Table 2)

Melting Point of Ligand and Metal Complexes

The compounds Ag (I) complexes of the ligand have a distinct higher melting points compound compared to Cu (I) and Ni (II) as shown in the table 3 below. (Table 3)

Molar Conductance Value of the Metal Complexes

The molar conductivity values of the transition metal compounds were determined respectively and the composition of the elemental analysis is recorded together as shown in table 4 Ag (I) has a higher conductivity state which indicate its non-electrolytic character. (Table 4)

The physical properties of the ligand pyridine and its corresponding Ni (II), Cu (I) and Ag (I) complexes are compiled in table 1, 2, 3 and 4. The physical state of the complexes varies in color. The metal complexes seem not to undergo any form of decomposition when stored for a long period in the reagent bottles except for Ag (I) complex which is photosensitive i.e. Silver metal complex stored was carefully tape with a black Sell tape round it to avoid the exposure of light penetrating through it, the other complexes Ni (II) and Cu (I) were not air sensitive and were handled with ease. The melting point of the complexes was relatively high ranging from 80 – 172 °C. The reason for its high melting point may be due to the formation of a stable oxidation state.

The solubility data of the ligands and their complexes are summarized in table 2. All the complexes were sparingly soluble in ethanol, methanol and insoluble in acetone.

Pyridine is a mono-dentate ligand. Ni (II) has a d^8 configuration and shows strong preference for a four-coordinate square planar geometry. Cu (I) has a d^{10} configuration and forms complexes with coordination number four and six corresponding to a square planar, tetrahedral and octahedral geometry. Hence,

Table 2: Solubility of Ligand and Metal Complexes in Various Solvent at Room Temperature

Compounds	Ethanol	Distilled water	Acetone	Methanol
Ni (II) complex	SS	S	IS	SS
Cu (I) complex	SS	SS	IS	SS
Ag (I) complex	SS	S	ISS	SS

Table 3: Melting Point of Ligand and Metal Complexes

Compounds	Melting points	Units
Ni (II) complex	80	oC
Cu (I) complex	142	oC
Ag (I) complex	172	oC

Table 4: Molar Conductance Value of the Metal Complexes

Compounds	Results	Units
Ni (II) complex	0.37	Ohm-1 cm-1 mol-1
Cu (I) complex	0.46	Ohm-1 cm-1 mol-1
Ag (I) complex	0.56	Ohm-1 cm-1 mol-1

Ag (I) has d^{10} configuration and forms numerous complexes with coordination number of four and two corresponding to square planar, tetrahedral and linear geometry respectively.

Pyridine has several properties that make it a useful ligand, including its ability to affect the electronic properties of the complex. The synthesis and characterization of three pyridine-based shows that the high yields of the complexes method is effective, reproducible and further study of the IR spectra is expected to confirm the presence of its functional group, the results of this study on pyridine transition metal complexes are consistent with previous studies on pyridine transition metal complexes. In general, these complexes are paramagnetic, meaning they have unpaired electrons, they complexes were sparingly soluble in methanol an organic solvents which is expected to be isolated as crystals. These complexes can undergo a variety of redox reactions, including oxidation and reduction which is dependent on the metal, the ligands, and the solvent for example Cu (II) undergoes reduction reaction to form Cu (I) complexes.

CONCLUSION

Synthesis of pyridine with transition metal complexes of Ni (II), Cu (I) and Ag (I) has been obtain successfully and has been characterized using melting point determination, solubility test and molar conductance with report from other past work. Pyridine is a weak pi-acceptor ligand, substitution usually occurs at the 3-position which is the most electron-rich carbon atom in the ring and is therefore more susceptible to an electrophilic substitution. All these complexes are assigned to be in octahedral, tetrahedral and square planar geometry as revealed in their various and its Coordination compounds have important roles as industrial catalyst in controlling reactivity and they are essential in biochemical processes. Biological studies of these complexes will reveal better how these complexes show better activity compared to their respective ligands and further investigation in the area of transition metal complexes, it is recommended that NMR, U.V, IR should be used for the characterization of this complexes in order to obtain a better result.

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