Synthesis and Characterization of Schiff's Bases Derived from 2-Aminopyridines

AKSHAYA.L
(21PCH002)

Thesis Submitted to
Avinashilingam Institute for Home Science and Higher Education for Women,
Coimbatore- 641043

In Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE IN CHEMISTRY

MAY - 2023

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Signature of the Supervisor

Signature of the Head of the Department

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AKSHAYA L

CONTENTS

LIST OF ABBERIVATION

FTIR	**Fourier Transfer Infrared Radiation**
1 H NMR	**Proton Nuclear Magnetic Resonance**
SEM	**Scanning Electron Microscope**
TGA	**Thermal Gravimetric Analysis**
ESR/EPR	**Electron Spin Resonance/Electron Paramagnetic Resonance**
XRD	**X-ray Powder Diffraction**
MTCC	**Microbial Type Culture Collection**
mmol	**Millimole**
ppm	**Parts Per Million**

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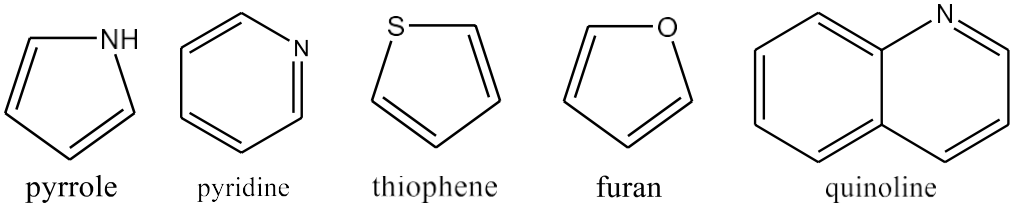
INTRODUCTION

1. INTRODUCTION

1.1 Heterocycles and their application

In recent years, the design and development of multitasking heterocyclic compounds has became the major vital field in research. In cyclic systems if any heteroatoms such as N, O and S is present then it is referred to as heterocyclic compounds**[Marcos *et al., 1998*., Al-Mulla, 2017*]*.** Compounds with a heterocyclic moiety have shown to be significant in an array of biological, industrial, and human systems. Heterocyclic compounds play an essential role in many elements of human life, including amino acids, vitamins, haemoglobin, alkaloids, pigments, antibiotics, and many synthetic medications. Heterocyclic compounds have several applications, including medicines, agrochemicals, dyes, pigments, and polymers. It has been demonstrated that heterocyclic compounds play a vital role in the development of novel materials class of structural entities for therapeutic purposes**[Zhang, *et al.,* 1999].**

The heterocyclic compounds comprising nitrogen, oxygen, and sulphur are regarded as the most important building blocks for the development of physiologically or medicinally significant molecules**[Tighineanu *et al.*, 1980].** Heterocyclic compounds have a great structural variety and have proven to be widely and economically helpful as medicinal agents. The chemistry of heterocycles has played an important role in the treatment of many severe diseases. Organic chemicals can interact with enzymes and other bio molecules due to the existence of heteroatoms. For all of these reasons, studying and understanding heterocyclic chemistry is extremely beneficial. Furthermore, they have the ability to function as semiconductors, organic conductors, light-emitting diodes, photovoltaic cells, light-harvesting devices, and liquid crystalline compounds**[Vitaku *et al.*, 2014].** Some of the common heterocycles have been listed.

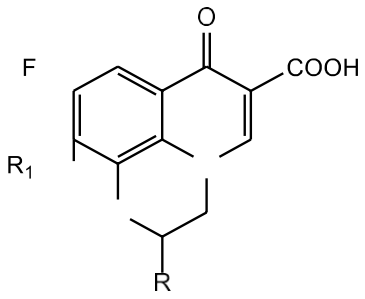


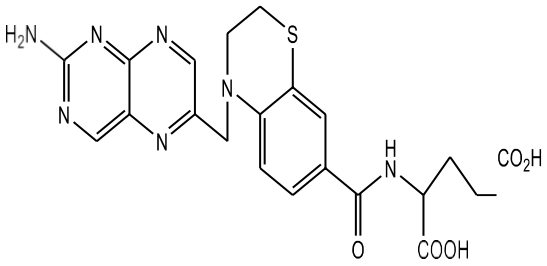
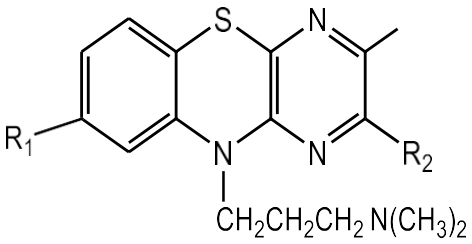
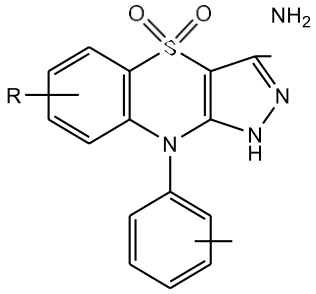
pyrrole pyridine thiophene furan quinoline

1.2 N-HETEROCYCLES

Nitrogen-containing heterocycles are among the most prominent pharmacological structural entities. According to the US 'FDA' pharmaceuticals, a rigorous analysis of the N-heterocycles revealed that nitrogen heterocycles are present in 59% of small-molecule medications, making them the most significant and preferred structures among heterocycles**[Franz *et al.*, 2013].** A series of nitrogen heterocycles been synthesized with distinct structural changes exhibit a wide range of biological activities**[Liu *et al.*, 2020].** Biological evaluation of ribofuranoside derivatives of certain nitrogen heterocycles revealed, increased antioxidant activity compared to conventional compounds, implying that ribosylation is primarily responsible for the anti-oxidant property and the pharmacophore is the heterocyclic ring-bearing sugar moiety. Some of the biological activities exhibited by certain N-heterocycles are given**[Pantaine *et al.*, 2019*].***

Table I: Biological Activities Of Certain Nitrogen Heterocycles

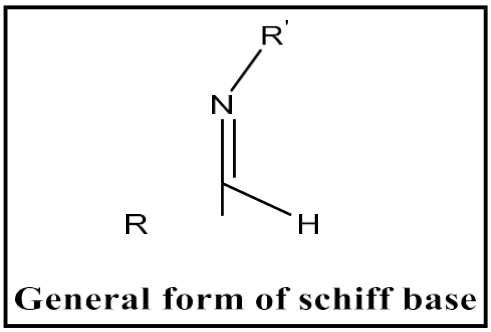
Nitrogen Heterocycles	Biological Activity
	Antibacterial

	Anti-rheumatic
	Central nervous activity
	Anti-malarial

1.3 Schiff base

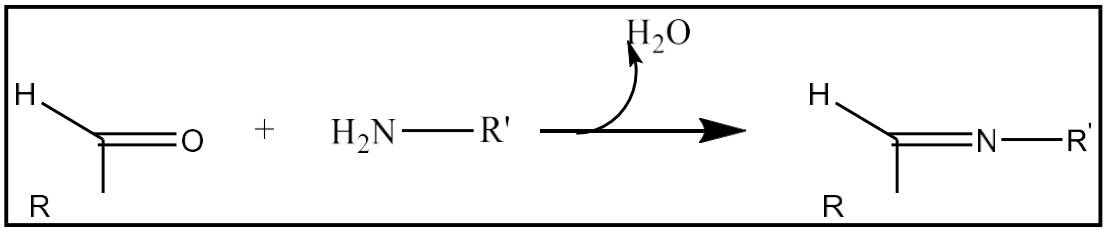
The great potential for producing novel materials with interesting useful functions(with desirable properties) has led to the rational design and synthesis of metalorganic polymeric networks which has become an intensely studied subject. The rational construction of metal-organic supramolecular frame works involves a cooperation between the metal first-coordination sphere and the second-sphere non-covalent active sites. Enantioselective synthesis has gained importance in the last few years, and the development of the chiral ligands has become an important field. Hence chiral coordination polymers have received much attention because of their wide application in enantioselective synthesis,asymmetric catalysis, assembly of chrial supermolecular structure, and advanced

material preparation. Schiff bases have been, for decades, among the most fundamental chelating systems in coordination chemistry, and exploitation of this group of compounds in material science is currently a rapidly developing field**[Adesina,2022].** A schiff base is a compound with the general structure $R_1R_2C=NR'$ They can be considered a sub-class of imines, being either secondary ketimines or secondary aldimines depending on their structure. The term is often synonymous with **azomethine** which refers specifically to secondary aldimines(i.e.R-CH=NR'). Hugo Schiff, a German physicist, developed the first Schiff bases (imines) in 1869. Typically, primary amines and carbonyl substances (aldehydes or ketones) are combined to create Schiff bases (imines). The bond created by an aldehyde reaction is known as azomethine or aldimine. While the bond created by a ketone reaction is known as an imine or ketimine. The (-HC=N-) group is particularly suited for binding to metal ions via the N atom lone pair (-N:) and when contain one or more donor atoms in addition to (C=N) group they act as[polydentate ligands or macrocycles].



General form of schiff base

It is common to condense a primary amine with an aldehyde or ketone to create schiff bases. An analogue of an aldehyde or ketone with an imine or azomethine group in place of the nitrogen's carbonyl group is a Schiff base. Among the most popular organic compounds are schiff bases. They function as stabilisers for polymers, catalysts, pigments and dyes, chemical synthesis intermediates**[Berber, 2020].** Schiff base is typically formed through acid or base catalysis or through the application of heat. The most common Schiff bases are crystalline solids that are weakly basic but form insoluble salts with strong acids. Schiff bases are used as intermediates in the synthesis of amino acids or as ligands in the preparation of metal complexes with various structures.



Ketones or aldehydes Primary amines Schiff bases

General route for synthesis of a Schiff base

Aromatic aldehydes, notably when conjugated effectively, form stable Schiff bases, whereas aliphatic aldehydes are unstable and readily polymerize. As Schiff base compounds have such a flexible and varied structure, a large range of Schiff base compounds and their behaviour have been explored. Schiff bases are typically made from extremely stable complexes containing bi, tri, or tetra-dentate chelate ligands. Numerous researchers have studied their chemical and physical properties in a variety of fields, including preparation, identification, protection, and determination of aldehydes and ketones, purification of carbonyl and amino compounds, and production of these compounds in difficult or sensitive reactions**[Xavier & Srividhya, 2014].**

1.4 Importance of Schiff bases

In organic chemistry, there are numerous synthetic applications for schiff bases. Acid anhydrides, acid chlorides, and acyl cyanides can acylate Schiff bases by attacking the nitrogen atom, which results in a total addition of the acylation agent to the carbon-nitrogen double bond. This kind of reaction has been helpful in the synthesis of natural products. Varieties of enzymatic processes that include the interaction of an enzyme with an amino or a carbonyl group of the substrate appear to involve the use of Schiff bases as a key intermediate. The biochemical process that includes the condensation of a main amine in an enzyme, often a lysine residue, with a carbonyl group of the substrate to generate an imine or Schiff base is one of the most significant types of catalytic mechanisms.

A stereochemical investigation using a molecular model revealed that a Schiff base formed between methylglyoxal and the amino group of the lysine side chains of proteins can bend back towards the N atom of peptide groups, allowing a

charge transfer between these groups and the oxygen atoms of the Schiff bases. In this regard, biological studies have been conducted on pyridoxal Schiff bases made from pyridoxal and amino acids.

Several investigations have shown that salicylaldehyde can be condensed with various heterocyclic compounds to produce derivatives that have strong antibacterial and antifungal properties. **Osman** created a salicylaldehyde thiadizole derivative drug, which tested highly effective against the bacteria *Bacillus cereus* and the fungus *Aspergillus niger*
[Bedi *et al.*, 2022].

1.5 Application of Schiff base in various aspects and distinct properties

Azomethines have drawn significant attention from researchers because of their wide range of applications in various fields of chemistry. Azomethines have been proven to be excellent complexing agents. Azomethines also have antibacterial, antifungal, anti-inflammatory, analgesic, antihelmintic, anticancer, antifertility, antihypertensive, anticonvulsant, antitumor, antimicrobial, antidepressant, antidyslipidemia, antiparasitic, antiproliferative, antitubercular, herbicidal, and insecticidal properties. They are also excellent intermediates in a variety of synthetic processes. Azomethine applications include magnetic chemistry, photophysical processes, nonlinear optics, catalysis, chemical analysis, oxygen absorption, and transport.

Azomethines are also applied as corrosion inhibitors as they suppress corrosion by quickly forming a single layer on the surface to be protected. Currently, azomethines are applied for designing versatile chemo/biosensors and as cytoplasm staining dyes**[Trivedi *et al., 2015].*** Bioactivity of Azomethines are increased due to the presence of certain molecules such as amino pyridine, thiodiazoles., etc., It keep the interest to synthesize a heterocyclic base azomethine to improve the activity**[Tobriya, 2014].**

1.6 Application in medicine and pharmaceuticals aspects

Imine complexes exhibit a variety of biological activities, including antibacterial, antiviral, antifungal, and anticancer effects. AIDS and diabetes are

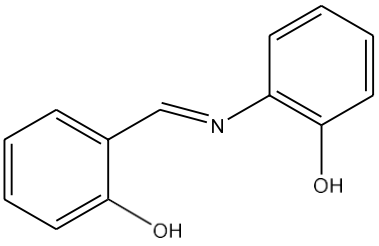
both treated with them as well. They aid in understanding the structure of biomolecules and the biological processes that take place in living things as biological models. They help organisms transfer oxygen and engage in photosynthesis, among other activities. They frequently undergo antimalarial testing and are used in the treatment of cancer medication resistance. Additionally, it could be utilised to immobilise enzymes.

1.6.1 Biological activity

The imine group -N=CH- that distinguishes schiff bases contributes to the understanding of the biological system's transamination and racemization reactions.Its biological features demonstrate an antibacterial and an antifungal action. The use of metal-imine complexes as herbicides and anticancer agents has generated extensive research. They can serve as examples for critically important species in biology.

1.6.2 Antibacterial properties

The rise in infectious disease-related mortality is strongly correlated with the prevalence of antibiotic-resistant bacteria. There is a pressing medical need for the creation of novel antibacterial medications with inventive and more potent modes of action. Schiff bases are recognized as potential antibacterial compounds. For instance, N-(Salicylidene)-2-hydroxyaniline has anti-Mycobacterium tuberculosis activity.



N-(Salicylidene)-2-hydroxyaniline as the example of bioactive Schiff base

Effective suppression of bacterial growth also involves Schiff bases with 2,4-dichloro-5-uorophenyl moieties. On the other hand, *Escherichia coli, Staphylococcus aureus, Bacillus subtilis, and Proteus vulgaris* are all susceptible to the antibacterial properties of compounds derived from furylglyoxal and p-

toluidene. Schiff bases produced from isatin have anti-HIV and antibacterial properties. Benzimidazole, thiazole, pyridine, glucosamine, pyrazolone, hydrazide, thiazolidiones, indole, thiosemicarbazone, and p-uorobenzaldehyde are further Schiff base derivatives with antibacterial action**[Sundriyal *et al.,* 2006].**

1.6.3 Antifungal properties

Fungal infections not only affect the tissue surface and it also affect the interior. The prevalence of systemic fungal infections, which have the potential to be fatal, has significantly increased recently. The individual Schiff bases are thought to be promising antifungal medications, and research and development of more powerful antifungal drugs is required. Some of them, such quinazolinone imine derivatives, have antifungal characteristics that are effective against *Candida albicans, T. mentagrophytes*, *Aspergillus niger,* and *Microsporum gypsum.* Schiff bases and their metal complexes with different amines have antifungal activity against *Helminthosporium gramineum,* which causes barley leaf stripe, *Syncephalostrum racemosus,* which contributes to tomato fruit rot, and *Colletotrichum capsici,* which causes anthracnose in chillies**[Rehman *et al., 2004.,* Chandra *et al.,* 2009].**

1.6.4 Biocidal properties

The biocidal application of Schiff bases against *S. epidermidis*, *E. coli*, *B. cinerea,* and *A. niger* was discovered by the production of o-aminobenzoic acid and -keto esters. On the other hand, parasites and protozoa are destroyed using Schiff bases of isatin derivatives**[Magalhães *et al.,* 2013].**

1.6.5 Antiviral properties

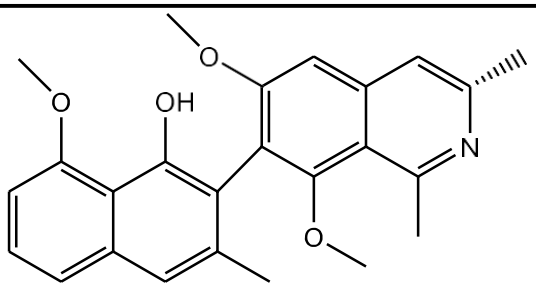
The use of vaccines may result in the eradication of recognised viral infections including rubella, poliomyelitis (polio), and smallpox. Although there are numerous treatment approaches to combat viral infections, the antiviral medications that are now on the market are not completely successful, which is likely to result in a high incidence of viral mutation and the potential for adverse effects. For the creation of novel antiviral medicines, 1-amino-3-hydroxyguanidine

tosylate-derived salicylaldehyde Schiff bases are a promising starting product. Antiviral activity is one of the features of isatin Schiff base ligands, which is extremely helpful in the treatment of HIV [19]. Additionally, it was discovered that these substances had anticonvulsant properties and may be used in anti-epileptic medications.

High antiviral activity is also observed in gossypol derivatives. Gossypol is increasingly being replaced by its derivatives, which have a substantially lower toxicity and are frequently employed in medical therapy. With a 74.7% efficacy estimate, Schiff bases' results for the cucumber mosaic virus were satisfactory**[Sridhar *et al.*, 2002].**

1.6.6 Antimalarial activity

Malaria is a condition that, if left untreated, can lead to major health concerns. Human malaria is primarily caused by four Plasmodium species (*Plasmodium falciparum*, *P. vivax*, *P. ovale*, and *P. malariae*). The development of novel medications, vaccines, and insecticides for the prevention and treatment of this disease is a top priority. Schiff bases are intriguing chemicals that could be used in antimalarial medications. Ancistrocladidine (Fig. 3), for example, is a secondary metabolite generated by plants of the Ancistrocladaceae and Dioncophyllaceae families and containing an imine group in a molecular chain. Cryptolepine, an authentic indolchinoline alkaloid identified from the African plant *Cryptolepis sanguinolenta* and used in the treatment of malaria, is the result of a multi-stage reaction involving Schiff base**[Dutta *et al.*, 2006., Brodowska *et al.*, 2015].**



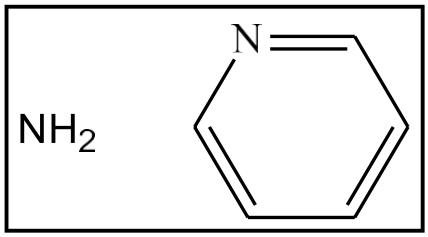
Ancistrocladaceae – antimalarial activity of bioactive Schiff base

1.6.7 Anticancer properties

Some Schiff bases are extremely antitumor. Imine derivatives of *N*-hydroxy-*N*′-aminoguanidine inhibit ribonucleotide reductase in tumour cells and are used to treat leukaemia. The Schiff bases of PDH [*N*-(1-phenyl-2-hydroxy-2-phenyl ethylidine)-2′,4′-dinitrophenyl hydrazine], [*N*-(1-phenyl-2-hydroxy-2-phenyl ethylidine)-2′-hydroxy phenyl imine], and [*N*-(2-hydroxy benzylidine)-2′-hydroxy phenyl imine] are all available reduce the average tumour weight (reduction in tumour growth increases with increasing dose) and cancer cell proliferation in mice EAC cells. Furthermore, they have the potential to replenish depleted haematological characteristics such as haemoglobin, red blood cells (RBC), and white blood cells (WBC). They also have a protective impact on the hematopoietic system**[Jose & Mohan, 2006].**

1.7 Amino pyridines

An organic substance called amino pyridine consists of an amino group and an aromatic heterocyclic pyridine which possess hydrogen bond interactions. It has three isomers: 2-aminopyridine, 3-aminopyridine, and 4-aminopyridine**[Al-Mulla, 2017].** The 2-Amino pyridine are White leaf lets or large colourless crystals in their appearance.



2-Amino pyridine

1.8 Application of Amino Pyridines

An essential family of chemicals known as amino pyridines was employed in studies to categorise diverse potassium channel subtypes. The drug 4-aminopyridine, sometimes referred to as fampridine, is utilised to treat the multiple sclerosis symptoms in individuals who have the disease's many forms and is believed to improve walking**[Asif, 2017].**

Piroxicam, a non-steroidal anti-inflammatory medicine (NSAID) used to treat the symptoms of severe, inflammatory disorders such arthritis, is made from the

colourless solid 2-Amino Pyridine. Pharmaceutical compounds including sulfapyridine, tenoxicam, and tripelennamine have all been synthesised using it as an intermediary. Followed by pyridine derivatives, the pyridine-based compound 2-amino-5-methyl pyridine (2A5MP) has a nitrogen atom that works as both a proton acceptor and an electron donor. 2A5MP has a structure similar to 2-amino-5-chloro pyridine, with alternating hydrogen-bonded and van der-Waals bonded zones[**Chavan *et al.*,2010].** In the view of above said reasons, the present work was carried out with the following objectives.

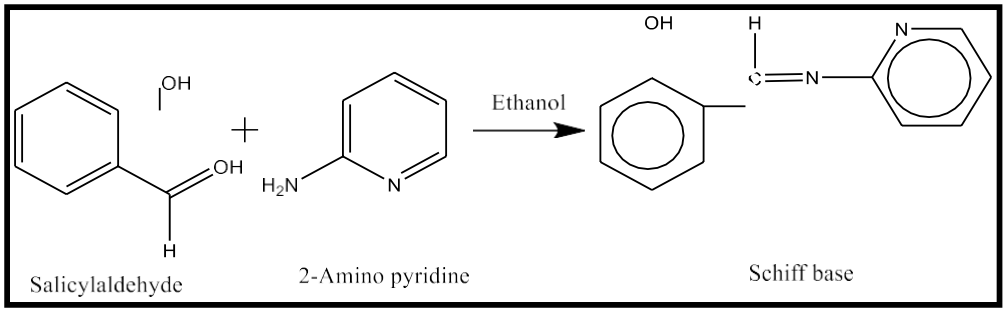
OBJECTIVES

- The main stimulating factor in the study of nitrogen heterocyles is the search for compounds of therapeutic importance. Schiff's bases derivatives of 2-amino pyridine is one such compound exhibit vast range of biological and pharmacological activity**[Yelwa *et al.*, 2020].**
- Hence the present work aimed to synthesize the Schiff base from amino pyridine and from 3, 4, 5 trimethoxy benzaldehyde.
- To characterize & confirm the structure of compounds by
    - FTIR
    - ^{1}H NMR technique.

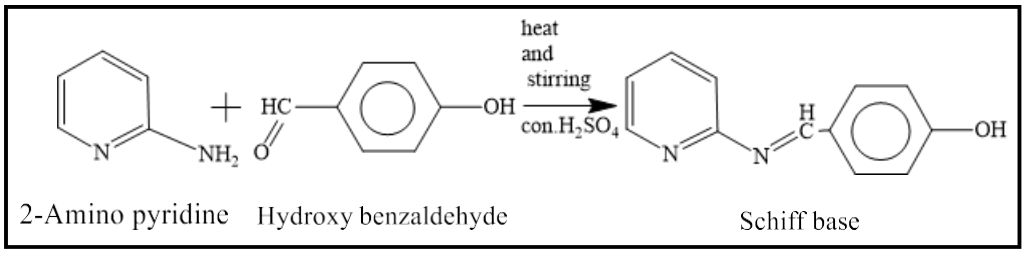
REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

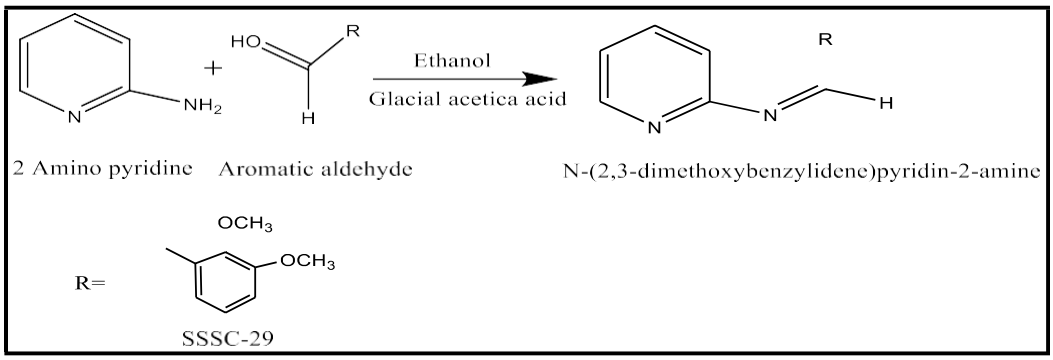
Md. Motahar Hossain *et al.,* (2018) synthesized a Schiff base by the condensation of salicylaldehyde and 2-Amino pyridine. A Schiff base from salicylaldehyde and 2-Amino pyridine, combined that product of Schiff base with metal complexes of Ni(ll), Co(ll), Cu(ll) and Cd(ll). By using the diffusion technique the *in vitro* evaluation was carried out for testing antimicrobial activities to the Synthesized ligand metal complexes and reported that these compounds has shown very good antimicrobial activities against gram-positive and gram-negative bacteria. The scheme reaction for the preparation of Schiff base ligand was shown.

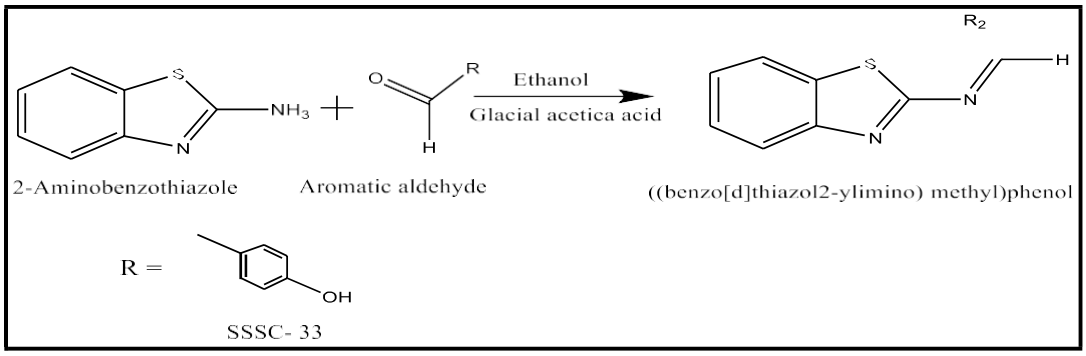


M. S. Hossain *et al.,* (2016) synthesized a Schiff base from condensation of 2-Amino pyridine with 4–hydroxy benzaldehyde. The synthesis and coordination chemistry of novel Schiff base ligands made from the condensation of 2-amino Pyridine with 4-hydroxy benzaldehyde with Mn(II), Fe(II), Co(II), and Cd(II) complexes. According to physiochemical examination, Six coordinated metal complexes were found to be formed. N and O atoms was coordinated to the main metal atom, according to IR spectrum analysis. The suggested octahedral structure of metal complexes was supported by magnetic moment, UV-Visible, and thermogravimetric analyses. TGA evaluation showed that the stability of the Fe(II) complex was higher than the Cd(II) complex's. When compared to the gold standard antibiotic (*Amphicillin)*, biological activity showed that the ligand and its metal complexes exhibited strong antibacterial activity. The scheme reaction for the synthesis of Schiff base has shown.

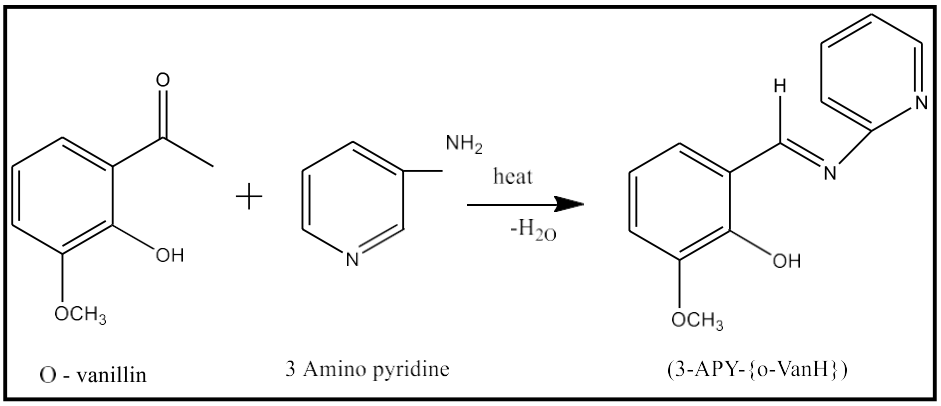


Shinu Chacko *et al.*, (2016) Synthesized and evaluated the Schiff base analogues of 2-amino pyridine and 2-aminobezothiazole against heptacellular carcinoma. The 2-amino pyridine and 2-aminobenzothiazole Schiff's bases were synthesized, and tested for antioxidant activity using the DPPH method and antihepatocellular carcinoma activity using a rat model of DEN-induced hepatocellular cancer. According to the *in silico* pharmacokinetic, rule of five and toxicity studies each lead has great intrinsic qualities and the necessary structural elements for an oral activity. When compared to ascorbic acid (IC50-55.27), the 1, 1-diphenyl-2-picrylhydrazil (DPPH) scavenging investigation revealed that SSSC-29 (IC50-63.60) and SSSC-33 (IC50-60.32) had good antioxidant capacity. Rats were tested for hepatocellular carcinoma caused by diethylnitrosamine(DEN) were used to further assess the anti-cancer potential of SSSC-33. All of these results suggested that SSSC-33-((benzo[d]thiazol2-ylimino) methyl)phenol) could be a promising drug to treat the oxidative damage to liver cells that results from the development of hepatocellular carcinoma brought on by the chemical carcinogen DEN. The scheme reactions for the synthesis of Schiff bases were shown.

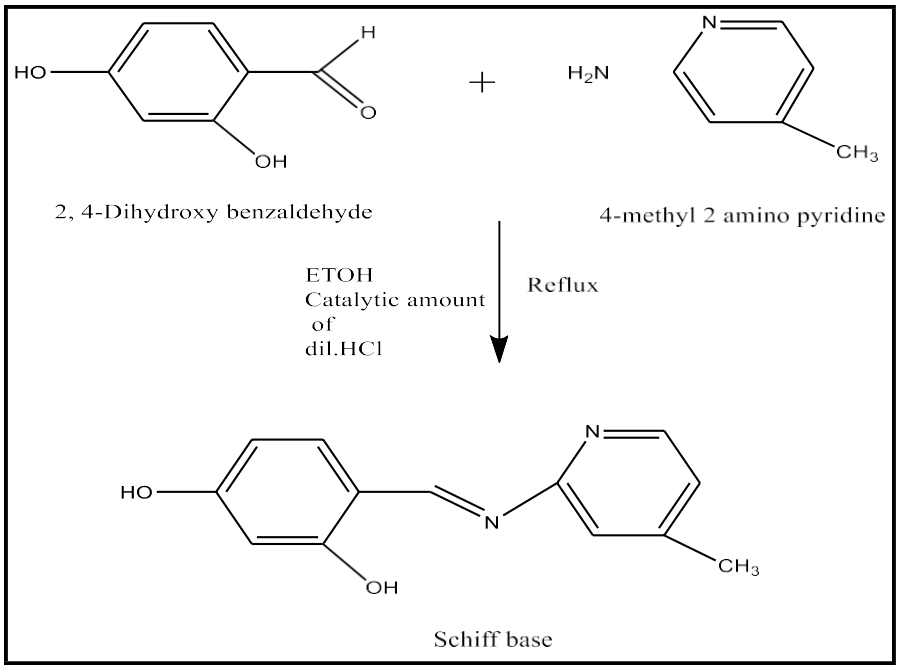




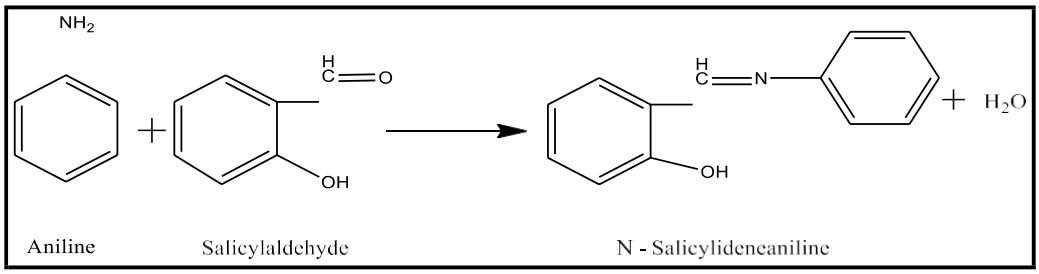
Malik A *et al.*, (2017) Synthesized a compound using a monobasic ON bidentate Schiff base ligand, seven novel organyltellurium(IV) complexes has been designed. Condensation of o-vanillin and 3-aminopyridine produced the Schiff base ligand (3-APY-o-VanH) which was then combined with organyltellurium(IV) complexes to yield corresponding organyltellurium(IV) complexes. The Schiff base (3-APY-{o-VanH}) and newly Synthesized organyltellurium(IV) Schiff base complexes were screened *invitro* antimicrobial potential against Gramme +ve bacteria (*S. aureus* MTCC 96 and *S. pyogenes* MTCC 442), Gram-ve bacteria (*P. aeruginosa* MTCC 1688 and *E. coli* MTCC 443) strain; fungal strains C. *albicans* MTCC 227, *A. niger* MTCC 282 and *A. clavatus* MTCC 1323 by "Broth Dilution Method".. A comparison of the MIC values for tellurium(IV) complexes with Schiff base (3-APY-o-VanH) revealed that some complexes have greater antibacterial activity than Schiff base alone. It has been noted that against *A. niger* and *A. Clavatus*, complex number VI [R2TeCl(3-APY-o-Van)], where R=4-hydroxyphenyl, exhibits greater antifungal action than Schiff base alone. The scheme reaction of synthesis of Schiff base was shown.



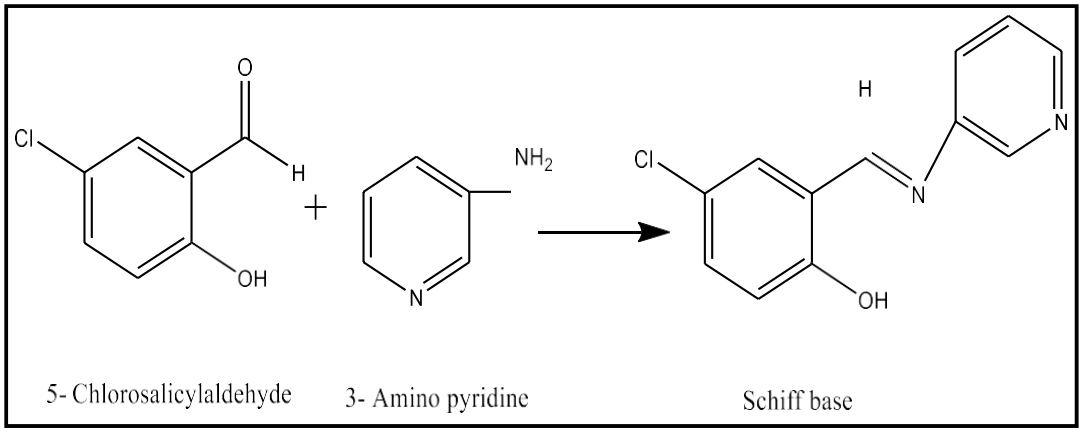
Jitendra N. Borase *et al.*, (2020) Synthesized the Schiff base by condensation of 4-methyl - amino pyridine with 2, 4-Dihydroxy benzaldehyde and treated with acetate metal salts of Fe(III), Co(III), Cu(II), and Ni(II). The design and synthesis of novel heterocyclic methyl-substituted pyridine Schiff base transition metal complexes of Fe(III), Co(III), Cu(II), and Ni(II) by reacting metal acetate or metal salts ($FeCl_3$, CoOAc, CuOAc, and NiOAc) with substituted heterocyclic ligand were made. All manually synthesized metal complexes were spectroscopically characterized and tested for elemental analysis, FT-IR, ESR, magnetic susceptibility, and TGA. The electronic spectra and magnetic susceptibility studies revealed that the complexes' square planer and octahedral geometry also suggested a structure in which the (N, O) group works as a bidentate ligand. The thermal stability, the decomposition rate, and thermodynamic characteristics of metal complexes synthesized were calculated using the Freeman Carroll technique. The antimicrobial studies were carried out and shown good activity against gram-negative and gram-positive bacteria. The scheme reaction for the synthesis of Schiff base was shown.



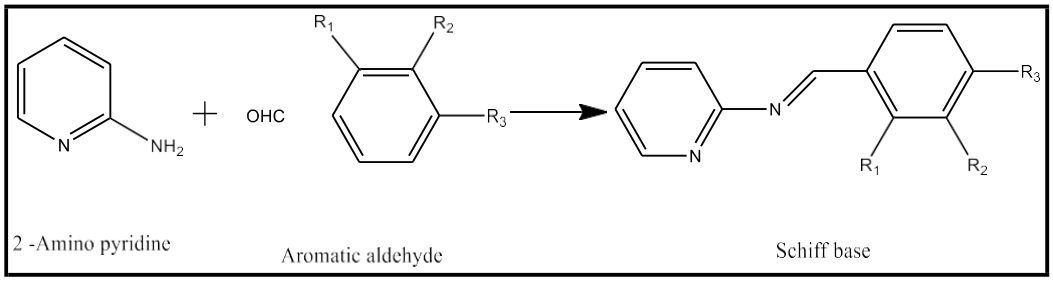
Ejelonu BC *et al.*, (2018) Synthesized ligand metal complexes of *N* – Salicylideneaniline and Sulphadiazine. A series of novel Cu(II), Mn(II), Fe(II) and Zn(II) metal complexes of Schiff bases were synthesized from the condensation reaction between salicylaldehyde and aniline (L1) and sulphadiazine (L2). These Synthesized compounds were scharacterized by FTIR and UV-Visible spectroscopy. Conductivity, melting point and solubility measurements were also carried out. The results were found that the involvement of the azomethine nitrogen in coordination with the metals. In the antimicrobial studies, L1 gave better inhibitory potentials than mycotine against all the fungi except against *Rhizopus stolonifer* and *Mternaria infectoria*. L2 gave better inhibitory potentials than mycotine against all the fungi. The scheme reaction for synthesis of these Schiff base ligands was shown.



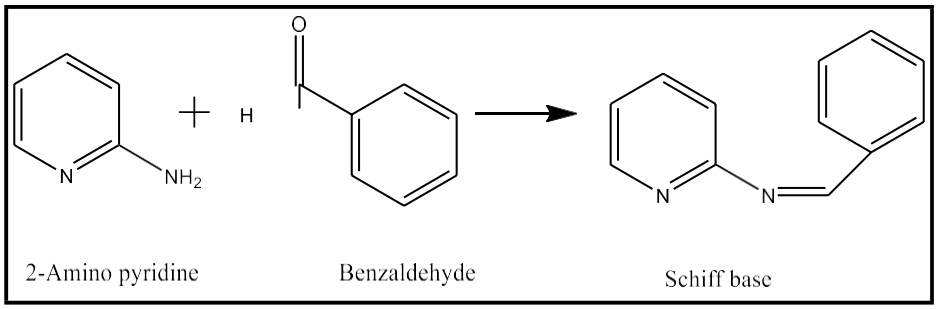
Jitendra N. Borase *et al.*, (2022) Synthesized a distinct types of heterocyclic Schiff base ligands by the condensation of 2-methoxy benzaldehyde and 2- amino 4-methyl pyridine in 100% ethanol in the presence of a catalytic quantity of dilute HCl. When this novel class of heterocyclic ligand was treated with metal salt or acetate, it formed Fe (III), Co (III), Ni (II), and Cu (II) complexes. Elemental analysis and FTIR, Magnetic susceptibility, antimicrobial, antioxidant, ESR spectra for Copper complex in DMF solvent recorded at room temperature were used to characterize all promptly Synthesized ligands and metal complexes. The electronic spectra and magnetic susceptibility studies reveal that the complexes' square planer and octahedral geometry also suggest a structure in which the (N, O) group works as a bidentate ligand. The thermal stability and decomposition behavior were studied using thermo gravimetric analysis at a heating rate of 10°C per minute in a nitrogen atmosphere, and there and kinetic parameters were computed using the Freeman Carroll technique. The transition metal complexes were tested for antimicrobial activity, specifically antibacterial and antifungal activity, using the disc diffusion approach. Copper was the most potent antimicrobial agent, inhibiting the development of microorganisms more than predicted for the bacterium *Staphylococcus aureus* and approximately 75% for gram-negative bacteria *Escherichia coli.* The scheme reaction for the synthesis of Schiff base ligand have been shown.



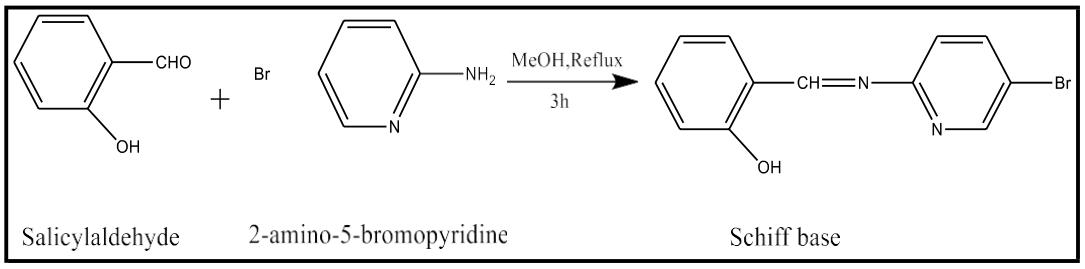
Bijo Mathew *et al.*, (2010) synthesized the Schiff base of 2-amino pyridine with various aromatic aldehydes by condensation. It was then treated with chloro acetyl chloride to yield corresponding azetidinones. All the synthesized compounds were subjected to spectral and elemental analysis for their structural confirmation. All the analytical structures show satisfactory result and have confirmed the formation of 2-azetidinones. The antimicrobial activities also carried out against various Gram-positive and Gram-negative bacteria and antifungal activity against various fungal strains compared with standard drug (Gentamycin and Griseofulvin) using solvent control. Out of the synthesized compounds, some shows very significant activity against microbial organisms. The scheme reaction for the synthesis of Schiff base was shown.

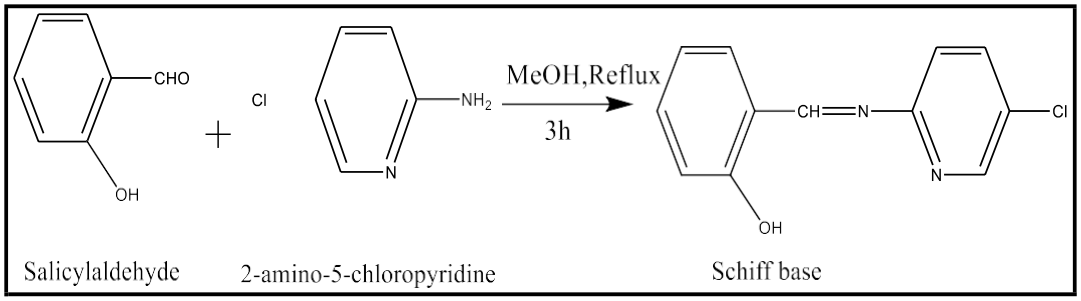


Jibrin M Yelwa *et al., (2020)* synthesized metal ligand complexes of Schiff base and Sulfamethaxazole Salt Metal(ll). Schiff base from 2 amino pyridine and benzaldehyde, which then treated with Sulfamethaxazole Salt Metal(ll) formed the metal ligand complexes of sulfamethazole. The newly synthesized compound was subjected to spectral analysis, (FT-IR and UV-Visible) for their structural confirmation, the physiochemical analysis like solubility test, colour and texture, melting point and conductivity test have been also carried out. The ligand and the complexes were coloured, non-hygroscopic and air stable. The conductivity measurement data revealed that the complexes are non-electrolytes. The infrared data indicated the bidentate nature of tsshe Schiff base ligand coordinated with the metal ions via the nitrogen atom of the azomethine(CH=N) and oxygen atom of the hydroxyl group after deprotonation. The scheme reaction for the synthesis of Schiff base was shown.

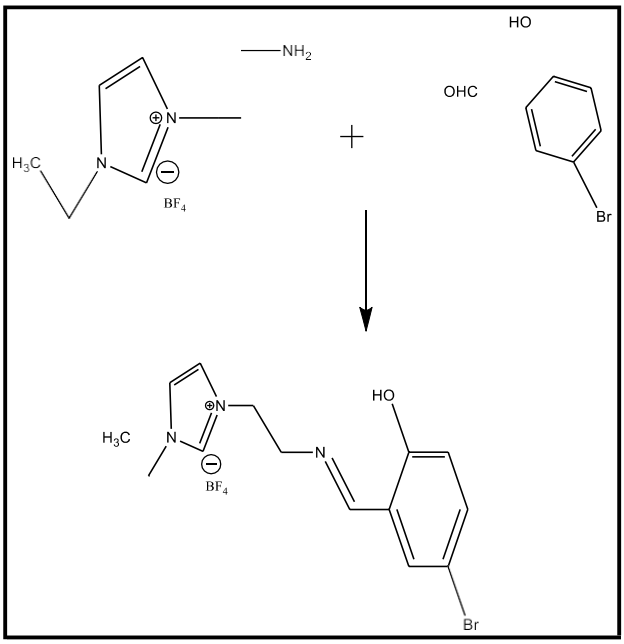


İsmet Kaya *et al.,* (2021) Synthesized a condensed product of Schiff base from 2-amino-5-bromopyridine and 2-amino-5-chloropyridine with salicylaldehyde, the treated with metals salts of two different $Co(OAc)_2 \cdot 4H_2O$ and $Cu(OAc)_2 \cdot 2H_2O$ to form metal complexes. In this study, Schiff base ligands were derived from of two different compounds of 2-amino-5-bromopyridine and 2-amino-5-chloropyridine with salicylaldehyde and the Schiff base reacts with $Co(OAc)_2 \cdot 4H_2O$ and $Cu(OAc)_2 \cdot 2H_2O$ to form metal complexes. For the structural illumination of the synthesized compounds, the analyses of UV–Vis, FT-IR and NMR were accomplished and TGA, fluorescence, and conductivity measurements were taken to characterize the compounds. The solubility of synthesized compounds in organic solvents such as DMSO and DMF was quite good. The scheme reaction for the synthesis of Schiff base was shown

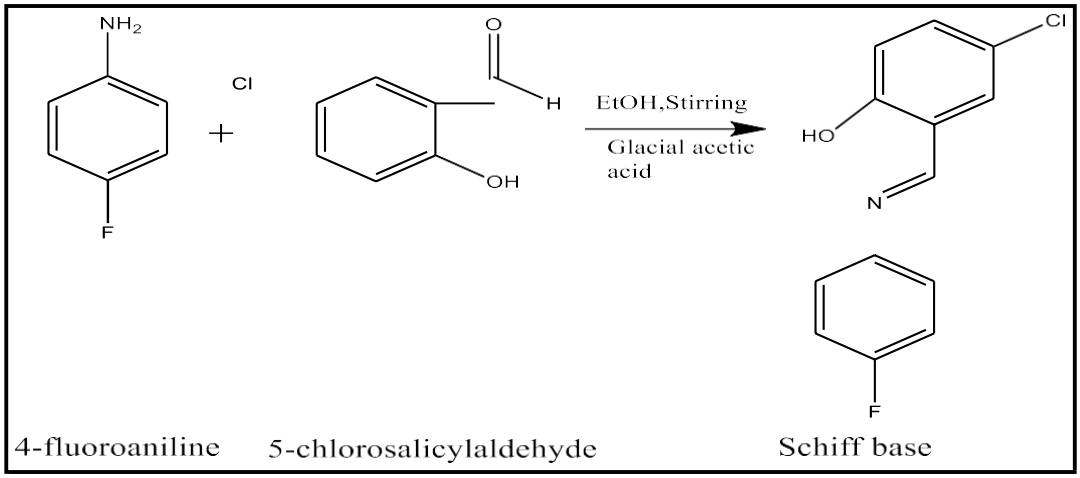




S. Shekhawat *et al.*, 2022, synthesized one of the significant types of ligands by the condensation of amine and aromatic aldehyde, where the Schiff's based metal complexes were highly regarded because of their great biological activity such as antibacterial, antifungal, anticancer, and antimicrobial properties. This investigations focused on the synthesis and characterization of Schiff's base transition metal complexes with general formula (ML) where M and L were Co(II) and Cu(II) and L was the Schiff's base ligand made of hydroxy trizene and aromatic aldehydes. FTIR, ^{1}HNMR, and XRD were used in the physical and spectral investigation to characterize the Synthesized complexes.. They were also tested *in vitro* biological activities. The Schiff base behaves as a bidentate ligand with O and N donors and binds to metal ions via hydroxy group oxygen and azomethane nitrogen. The Schiff's base ligands and Metal complexes' structure was confirmed by modern instrumental techniques viz, FTIR and 1H NMR. The *in vitro* antibacterial studies were carried out against *S. aureus*, *E. coli,* and *P. Aeruginosa* and anti-fungal activities *C.albicans*, *A. clavatus.* The result showed that the complexes have excellent biological activities. The scheme reaction for the synthesis for the synthesis of Schiff base was shown.

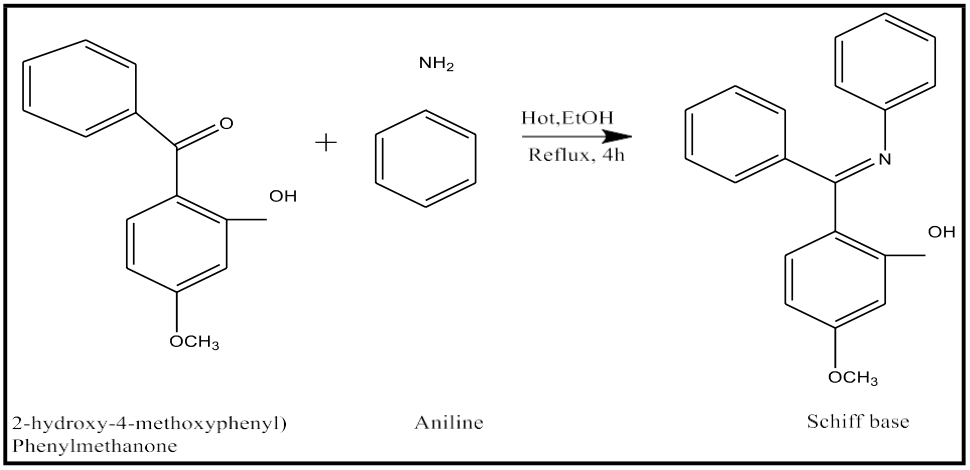


F. K. Ommenya *et al.*, (2019) complexes of the Schiff base ligand, 4-chloro-2-(E)-[(4-fluorophenyl) imino]methylphenol of Mn(II), Co(II), Ni(II), Cu(II), and Zn(II) were synthesized. The Schiff base was formed by condensing 5-chlorosalicylaldehyde and 4-fluoroaniline at room temperature. The Schiff base and metal complexes were characterized using elemental analysis, FT-IR, UV-Vis, and NMR spectrum data, molar conductance measurements, and melting points. The metal complexes generated have the general formulae $[M(L)_2(H_2O)_2$ based on the elemental analysis data, where L = Schiff base ligand (and M = Mn, Co, Ni, Cu, and Zn. Based on FT-IR, electronic spectra, and NMR data, the "O" and "N" donor atoms of the Schiff base ligand participated in coordination with the metal (II) ions, resulting in a six coordinated octahedral geometry for all of these complexes. Using the disc diffusion method, the Schiff base ligand and its metal (II) complexes were evaluated *in vitro* for bactericidal activity against Gram-negative bacteria *(Escherichia coli and Pseudomonas aeruginosa*) and Gram-positive bacteria *(Bacillus subtilis and Staphylococcus typhi).* The antibacterial evaluation results demonstrated that the metal (II) complexes were more effective than the free Schiff base. The scheme reaction for the synthesis of Schiff base has been shown.



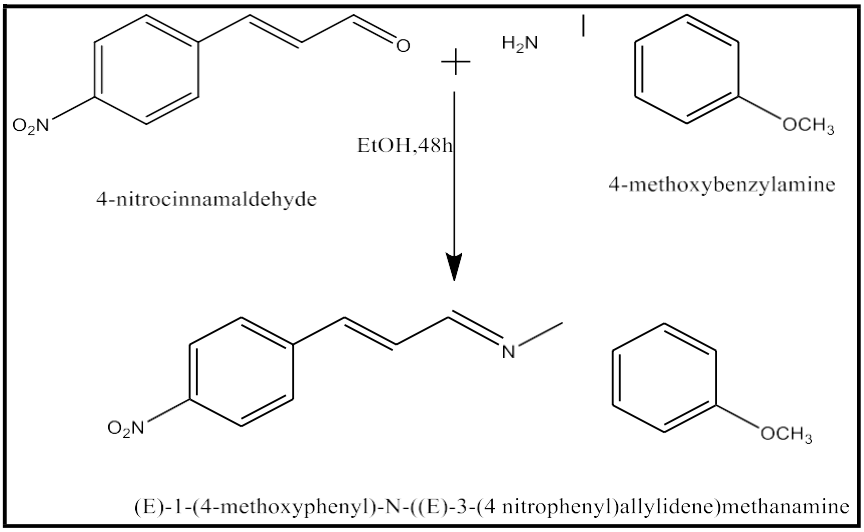
P. Subbaraj *et al.*, (2014) Synthesized a novel bidentate NO type Schiff base ligand (HL) by combining 2-hydroxy-4-methoxyphenyl)phenylmethanone with aniline and its metal(II) complexes [M = Mn, Co, Ni, Cu, and Zn]. Analytical, spectral (FT-IR, UV-vis., ^{1}HNMR, TGA, and EPR) as well as molar conductance

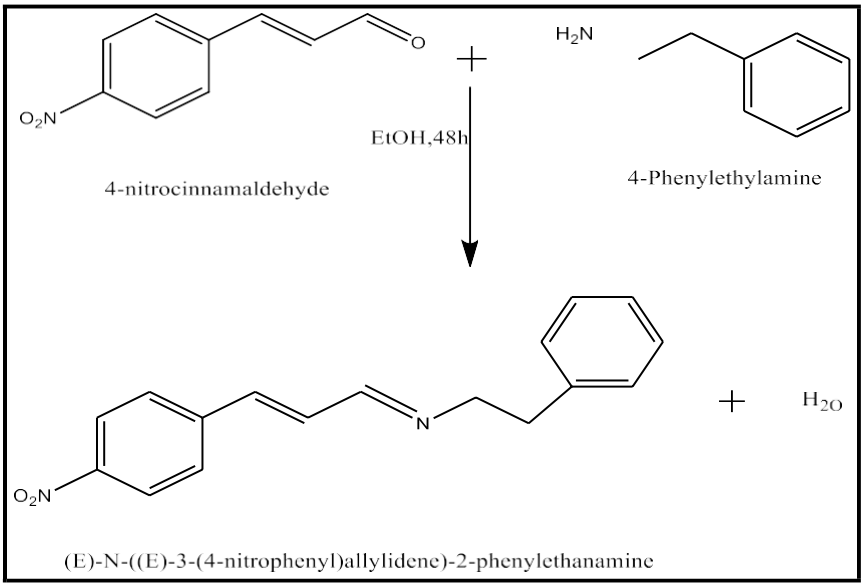
and magnetic studies were used to characterize the Synthesized ligand and metal(II) complexes. Tetrahedral and octahedral geometry was adopted. The thermal behavior of metal(II) complexes demonstrated the loss of coordinated water molecules in the first stage, followed by the disintegration of ligand moieties in a sequential manner, which results in the formation of an air stable metal oxide as the final residue. Powder XRD, SEM, and thermal studies confirmed the microcrystalline nature and the presence of coordinated water molecules. The ligand and its complexes are bio-effective in terms of DNA binding and cleavage. The scheme reaction for the synthesis of Schiff base was shown.



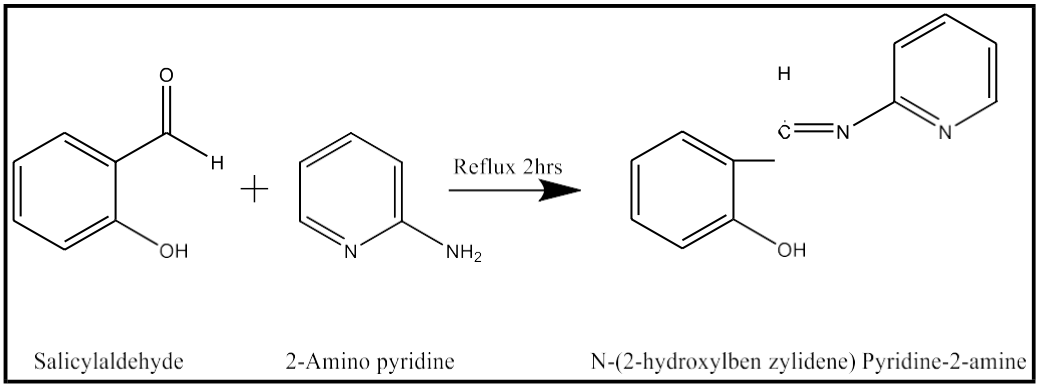
Friday E.Ani *et al.*, (2021) two different Schiff base was synthesized from 4-nitrocinnamaldehyde and 4-methoxybenzylamine and 2-phenylethylamine. Two different Schiff base was synthesized one from, 4-nitrocinnamaldehyde and 4-methoxybenzylamine, other from 4-nitrocinnamaldehyde and 2-phenylethylamine and to this newly synthesized Schiff base spectral and crystallographic studies were carried out. . DFT computations were used to rationalize the structural and photo physical properties of the examined systems. According to the structural examination of the crystallographic data, the compounds were produced as monoclinic crystals. The structural differences between the two compounds were determined by NMR analysis and confirmed by single crystal X-ray crystallographic data. The experimentally determined bond lengths and bond angles nearly match the predicted values. Similarly, the energy gaps derived from the

electronic spectra of the substances associated with transitions were comparable to those obtained theoretically. The compounds' photoluminescence capabilities were explored, and the emission spectra obtained are attributed to conjugated -bond interaction, which was defined by significant intramolecular charge transfer and leads to system stabilization. . The low ΔE, high polarizability (α) and the first hyper polarizability (β) values obtained in this study suggested that the studied compounds were good candidates for the development of NLO materials. The scheme reaction for the synthesis of two different Schiff bases from 4-nitrocinnamaldehyde was shown.

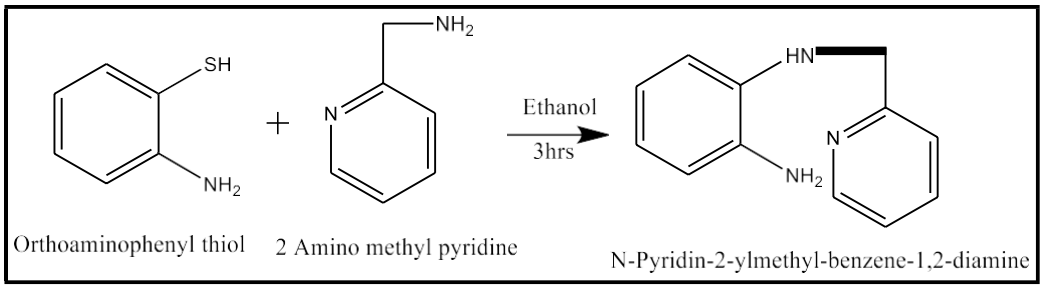




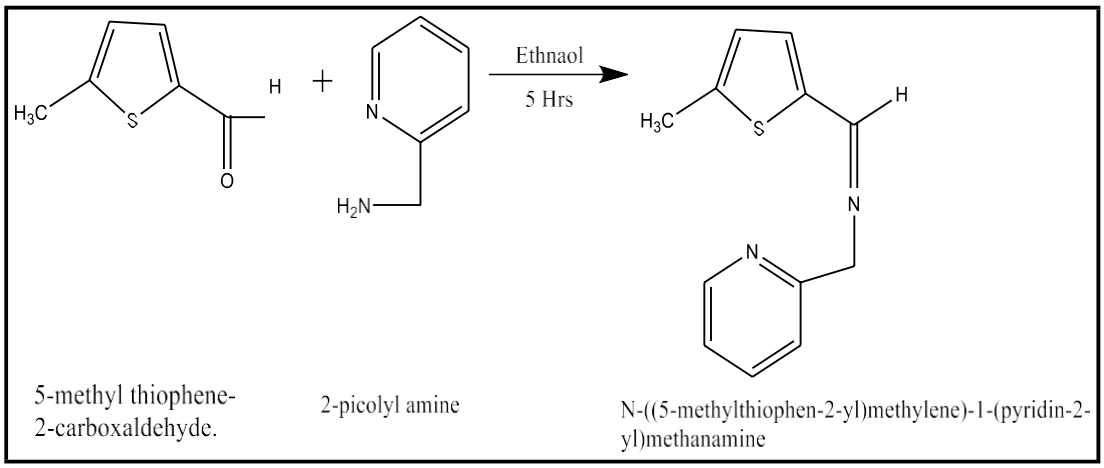
U. Sani *et al.*, (2017) Synthesized the Schiff base of *N*-(2-hydroxylben zylidene) Pyridine-2-amine from 2 Amino pyridine and salicylaldehyde by using methanol as solvent. The Schiff base of *N*-(2-hydroxylben zylidene) Pyridine-2-amine was Synthesized as ligand and the M(ll) complexes were treated with the ligand and formed metal ligand complexes. The formed compex were screened by *invitro* antimicrobial and antioxidant activities The compounds demonstrated antibacterial and antifungal activity. The ligand's lower IC50 value from the DPPH radical scavenging study implies that it has the potential for future antioxidant activity exploration. The reaction scheme for the synthesis of ligand(Schiff base) was shown.



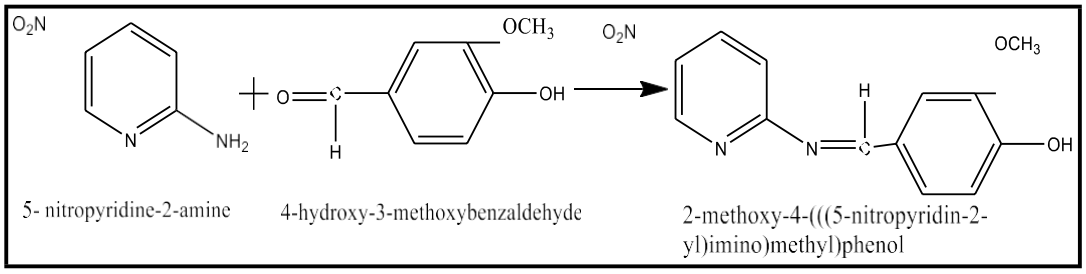
Shaymaa H. Naji *et al.*, (2012) Synthesized a series of complexes of Cr^{+3} ,Co^{+2}, Ni^{+2} ,Cu^{+2} ,Pd^{+2} ,Cd^{+2} ,Hg^{+2} ,Pb^{+2} with *N*-Pyridin-2-ylmethyl-benzene-1,2-diamine (L) and characterized and screened biological activity. In this they Synthesized a Schiff base ligand named *N*-Pyridin-2-ylmethyl-benzene-1,2-diamine (L) and treated this variety of metals and prepared a new complexes which were characterized by using FT-IR, UV-vis spectra, conductivity tests, atomic absorption, and magnetic susceptibility was some of the techniques used. Except for the Pd complexes, the complexes exhibited typical octahedral geometry around the metal ions and the (N,N,N) ligand coordinated in tridentate mode. The biological activity of the ligand (L) and its complexes against *Staphylococcus aureus* and *E.coli* was studied and showed good activity. The scheme for the synthesis of Schiff base was shown.



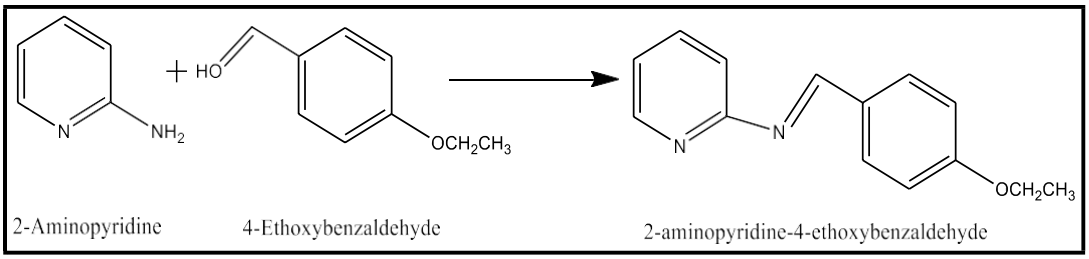
K. M. Prasuna *et al.,* (2018) developed a novel Schiff base, *N*-((5-methylthiophen-2-yl)methylene)-1-(pyridin-2-yl)methanamine, using 2-picolyl amine and 5-methyl thiophene-2-carboxaldehyde. Cu(II) and Zn(II) complexes of *N*-((5-methylthiophen-2-yl)methylene)-1-(pyridin-2-yl)methanamine were also produced. FT-IR, 1H and 13C NMR spectroscopy were used to characterize the Schiff base and metal complexes. The Synthesized ligand and its metal complexes have been investigated for antibacterial activity against gram-positive bacteria such as *Staphylococcus aureus* and *Bacillus subtilis,* as well as gram-negative bacteria such as *Escherichia coli* and *Pseudomonas aeruginosa*. When compared to raw Schiff base, the Schiff base metal complexes exhibited more antibacterial activity. The results exhibited that the Schiff base metal complexes were found to have higher biological activity than the bare Schiff base ligand. The scheme reaction for the synthesis of the Schiff base was shown.

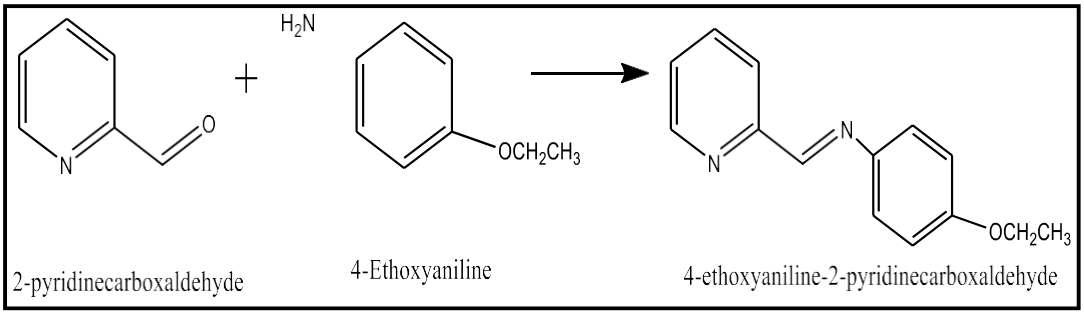


P. Deepika *et al.*, (2022) Synthesized a Schiff base complexes with Cu(II) and Zn(II), characterised and investigated the biological activity. The Schiff base from 5- nitropyridine-2-amine and 4-hydroxy-3-methoxybenzaldehyde was synthesized and it was made to prepare the complexes with Cu(II) and Zn(II). The various spectral analysis were made to elucidated its structure and The free radical scavenging potential for compounds was assessed using a series of *in vitro* assays, including DPPH, ABTS, and Superoxide, with BHA served as a positive controller. *In vitro* α -glucosidase inhibitory activities revealed that complexes had significantly more inhibitory capacity than the ligand. The synthesis of Schiff base ligand of 2-methoxy-4-(((5-nitropyridin-2-yl)imino)methyl)phenol has been shown.

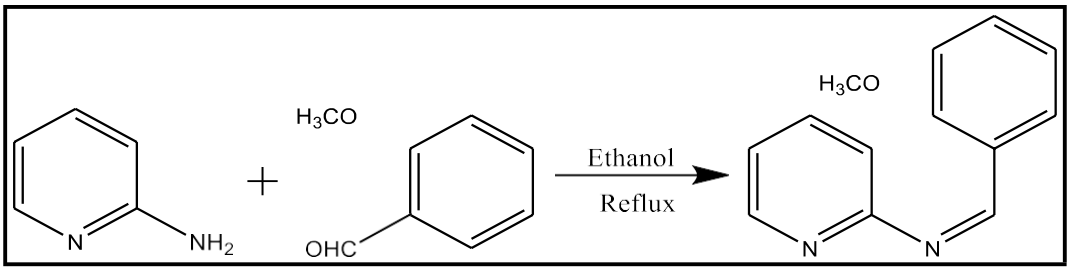


E. Ogbonda-Chukwu *et al.*, (2021) Synthesized a two Schiff bases ligand from 2-aminopyridine and 4- ethoxybenzaldehyde and 2-pyridinecarboxaldehyde and 4-Ethoxyaniline to give 2-aminopyridine-4-ethoxybenzaldehyde and 4-ethoxyaniline-2-pyridinecarboxaldehyde and it was subjected to react with $ZnCl_2$ and $CrCl_3$ to yield corresponding Schiff base metal complexes. The Synthesized metal complexes were subjected to various spectral analysis to evaluate the structural properties. The IR data for metal complexes revealed variations in absorption bands when compared to ligands, and with a focus on imino group absorption, it revealed that chelation happened at the imino nitrogen for all metal complexes. Furthermore, only the chromium complex of 4-ethoxyaniline-2-pyridinecarboxaldehyde shown antifungal activity against *Saccharomyces cerevisiae,* with zones of inhibition of 15 mm and 11 mm, respectively. All other chemicals were ineffective against all pathogen strains tested. The scheme reaction for the synthesis of Schiff base was shown.

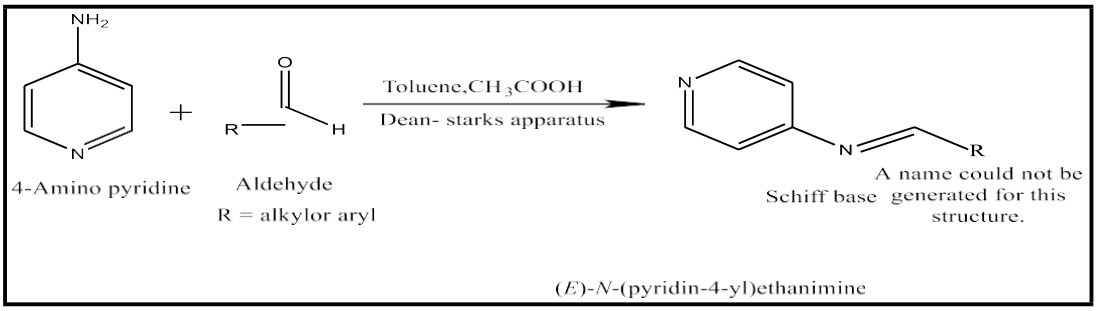




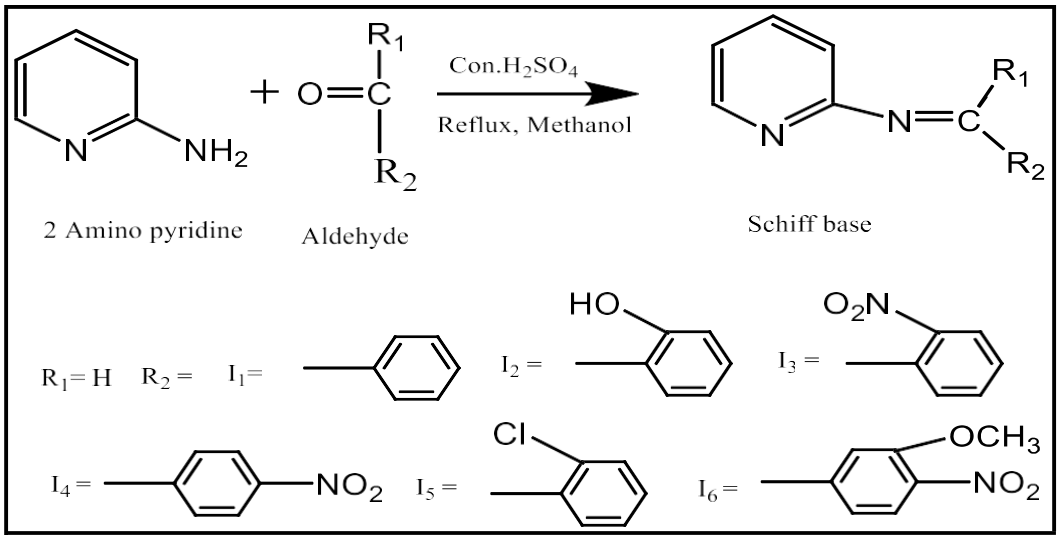
Sani U *et al.*, (2018) synthesized a Schiff base by the condensation of 2-methoxybenzaldehydes. The Schiff base and metal (II) chlorides of cobalt and nickel were combined in ethanol to form metal complexes. The compound was rinsed and dried after being isolated. The Schiff base was a pale yellow color, but the cobalt and nickel complexes were blue and light green, respectively. Solubility, melting and breakdown, FTIR, magnetic susceptibility, molar conductance gravimetric analyses, and UV spectroscopy were used to characterize the Schiff base and its metal (II) complexes. Solubility test was also carried out and the complex was soluble in solvents like DMSO and DMF, insoluble in water. The biological investigations were made and Schiff base are inactive against *Staphylococcus aureus* while the complexes were active and the activity increases with increase in concentration. At all concentrations, the Schiff base and its complexes are active against *E. coli*. The antifungal study found that the Schiff base and its complexes are active against *Candida albican* at all concentrations but inert against Mucor specie. The scheme reaction for the synthesis of Schiff base was shown.

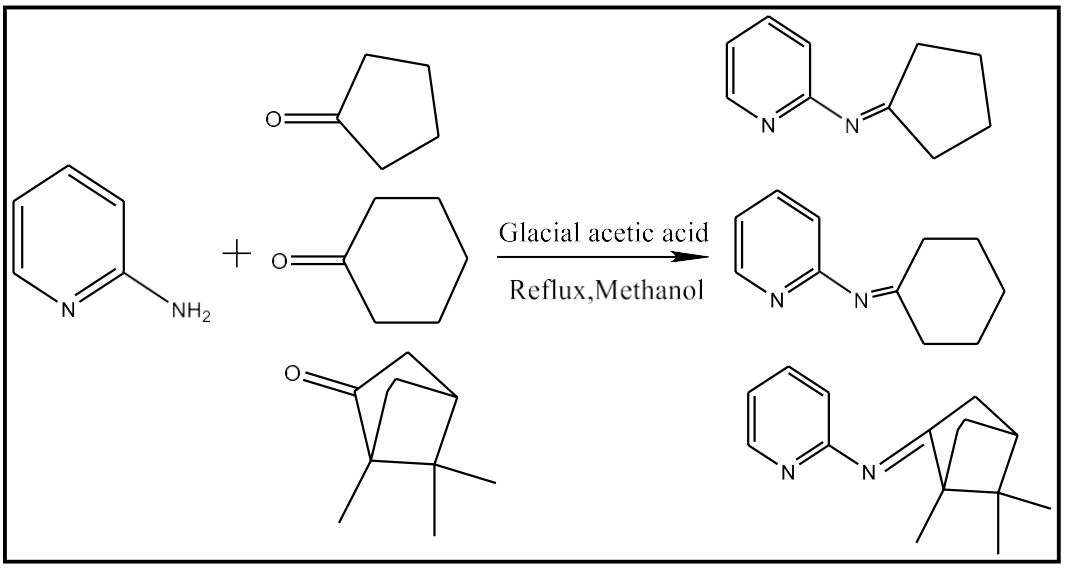


Jayita Nandi *et al.*, (2012) synthesized the Schiff base from 4 Amino pyridine and aromatic aldehydes by using toluene as solvent and under Dean's Stark conditions and docking studies were carried out. The structural elucidation was done using FT-IR, NMR and Mass Spectroscopic studies. The docking results were found to be compared with standard drug isoniazid and showed good docking score and significant results. The Synthesized compound from 4-Amino pyridine served as a stable antitubercular drug. The synthesis of the Schiff base were shown.

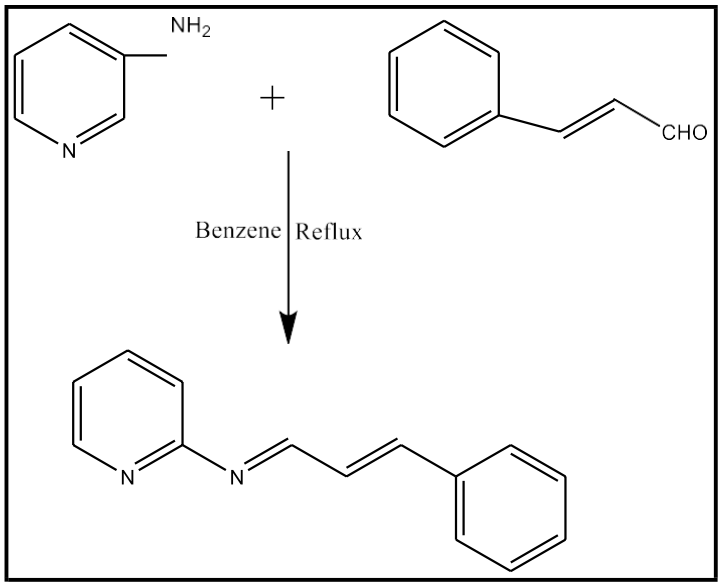


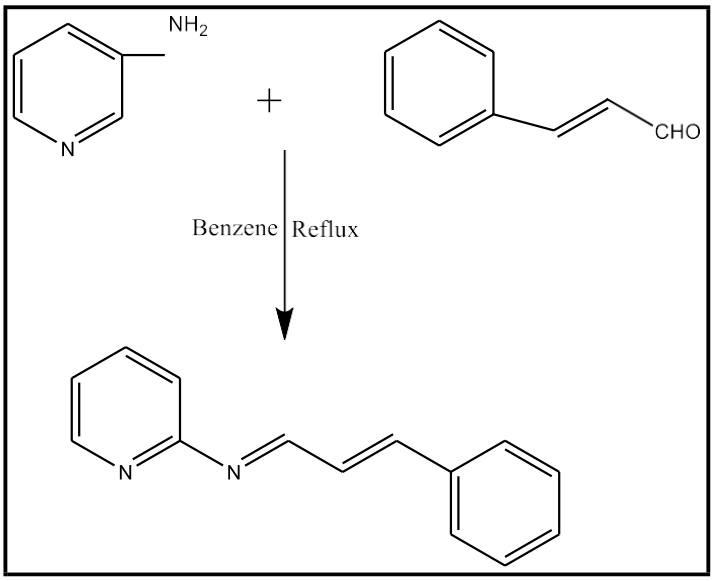
Shailendra Pandey *et al.*, (2009) Synthesized Schiff bases and investigated for anticonsultant activity. Schiff bases of 2-Amino pyridine was prepared by condensing 2-aminopyridine with various aldehydes, ketones, and cyclic ketones. The Synthesized Schiff bases were subjected to elucidate the structural evidences using FT-IR, elemental analysis and ^{1}H NMR. Three primary convulsant tests, the maximum electro shock (MES), subcutaneous pentylenetetrazole (Sc.-PTZ), subcutaneous strychnine (Sc.-STY), and a neurotoxicity screen (using the mouse rotorod technique), were used to perform the preliminary anticonvulsant screening of the Synthesized compounds. The Synthesized Schiff bases exhibit greater selectivity towards the MES & Sc.-PTZ seizure screens than the Sc.-STY screen. The scheme reaction for the synthesis of Schiff base were shown.





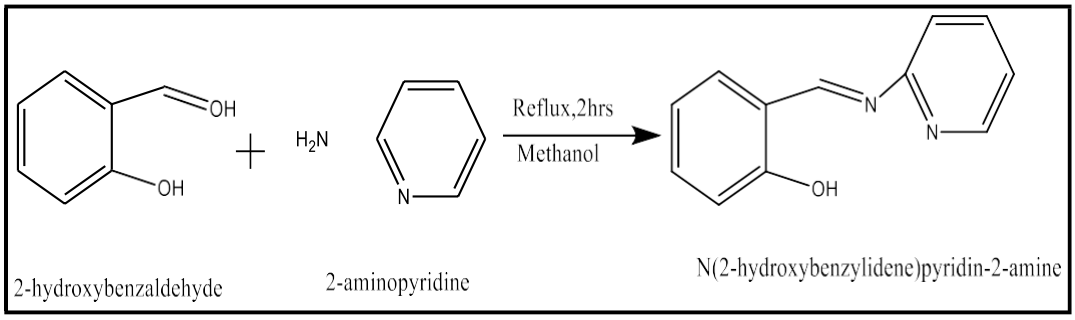
A. A. Jarrahpour *et al.*, (2006) Synthesized two new Schiff bases derived from 2-aminopyridine, 3-aminopyridine and cinnamaldehyde and yielded 1-(2-aminopyridine)-4-phenyl-1-azabuta-1,3-diene and 1-(3-aminopyridine)-4-phenyl-1-azabuta-1,3-diene. These compounds fits good for iron carbonyl complexes. The Synthesized compounds were characterized for their structural elucidation by using FT-IR, ^{1}H- NMR AND ^{13}C- NMR. The scheme reaction for the synthesis of Schiff base has shown.



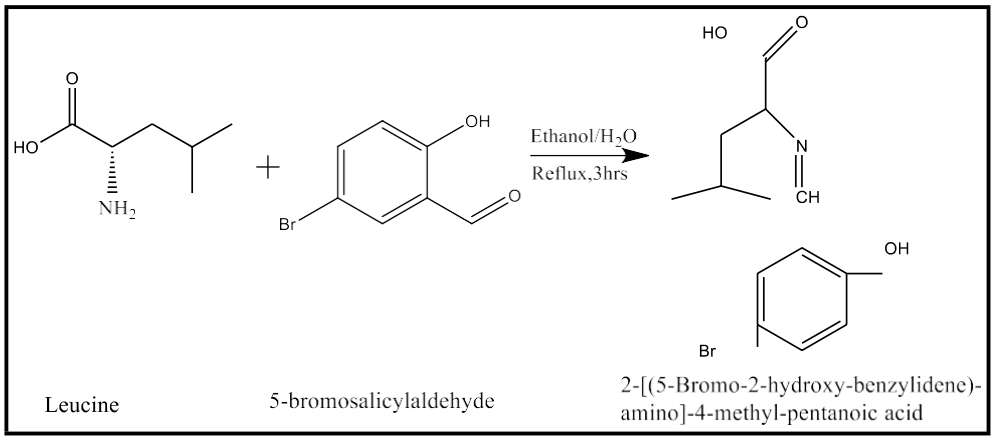


S.B. Gnjegaonkar *et. al.*, (2022) Synthesized a Schiff base from 2-hydroxybenzaldehyde and 2-Amino pyridine and complexes with Co, NI, Cu, and Zn metals also produced and characterized, biological activities were also examined. The Schiff base was synthesized from 2-hydroxybenzaldehyde and 2-amino pyridine, and its complexes with Co, NI, Cu, and Zn metals are characterized. The obtained complexes were evaluated for infrared, nuclear magnetic resonance, elemental analysis, and antibacterial activity. Complexes with Co (II), Ni(II), and Cu(II) were identified to be high spin tetrahedral complexes, while Zn(II) is found

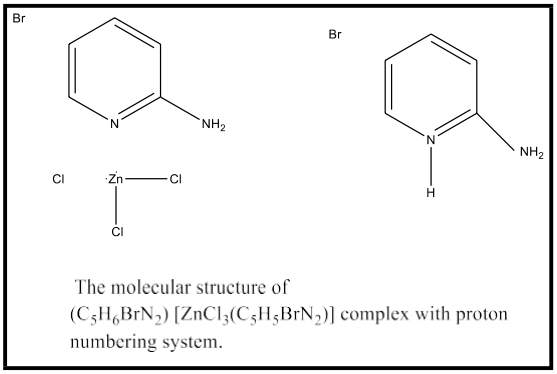
to be low spin with the same geometry. The scheme reaction for the synthesis of Schiff base has shown.



Lekha L *et al.*, (2013) Synthesized a Schiff base by condensing leucine with 5-bromosalicyaldehyde, a Schiff base ligand 2-[(5-Bromo-2-hydroxy-benzylidene)-amino]-5-methyl-pentanoic acid. The aforementioned ligand's complexes with Cu(II), Co(II), and Ni(II) were also created. The ligand and complexes created after preparation were examined for structural information using IR, UV, 1H NMR, and EPR spectrum methods. The complexes' analytical data demonstrate the production of a 1:2 metal to ligand ratio with the formula [ML2], where M stands for the respective Schiff base ligands and Cu(II), Co(II), and Ni(II) ions. The ligand was tridentately coupled to the metal ions through the azomethine-N, phenolic-oxygen, and carboxylic oxygen groups, according to IR spectra. Using the disc diffusion method, the ligand and their metal chelates had examined for their antibacterial properties against the chosen bacteria and fungi. The scheme reaction for the synthesis of Schiff base was shown.



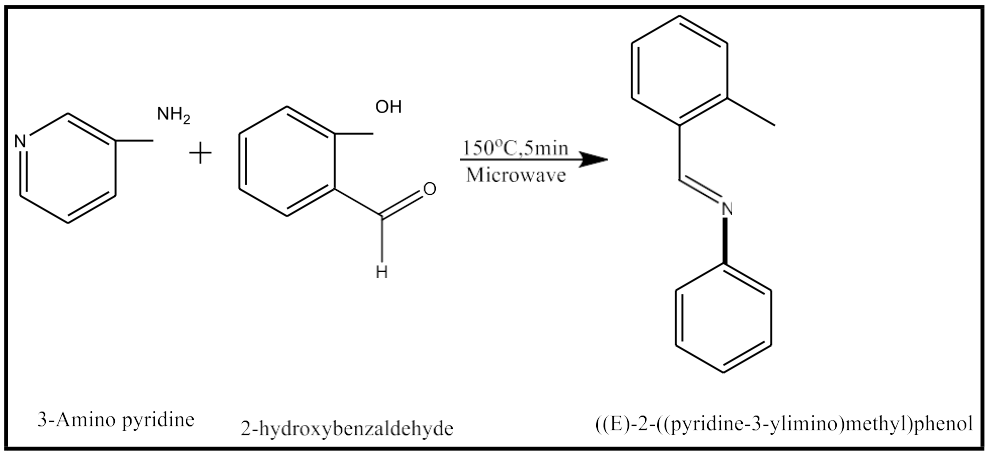
Fitriani, *et al.*, (2013) synthesized a Schiff base and it's Zn complexes were described, the spectral, biological activity were screened and reported. The production and characterization of zinc(II) complexes with 2-amino-5-bromopyridine ligands had been published. The complex's structure was determined using X-ray crystallography in the title compound, (2-amino-5-bromopyridinium) [$ZnCl_3$(2-amino5-bromopyridine)]. Three Cl atoms and one imine N-atom of the 2-amino-5-bromopyridine ligand coordinate the Zn(II) atom, giving a distorted tetrahedral coordination geometry. Elemental analysis, 1H NMR, IR spectroscopy, and UV-Visible absorption were also performed on the compound. The behavior of protonation during coordination was explored.



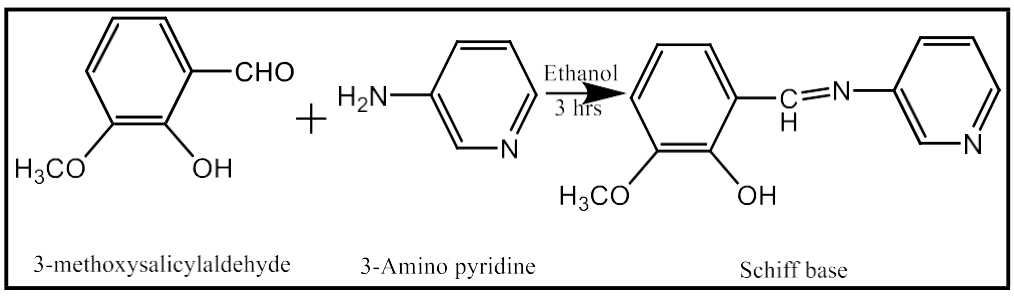
The molecular structure of ($C_5H_6BrN_2$) [$ZnCl_3$($C_5H_5BrN_2$)] complex with proton numbering system.

Yousef M. Hijji *et al.*, (2022) synthesized a Schiff base from 3-amino pyridine and 2 hydroxy salicylaldehyde and it was combined with metals of Al, Fe and Cu. The salicylidene 3-aminopyridine Schiff base was efficiently (95% yield) and swiftly (5 min) Synthesized using MW, and its selectivity towards different metal cations was assessed. It demonstrated great selectivity for Al(III) and Fe(III) ions using fluorescence and high selectivity for Cu(II) using UV-VIS in H_2O-ACN (9:1). In contrast to Al(III) and Fe(III), and Cu(II) were discovered to have a 2:1 stoichiometric ratio. The lowest detection limits for the ions under test were in the micromolar range, which was below the recommended threshold for safe drinking water. The probe was used to fluorimetrically detect aluminium in a solution, in over-the-counter deodorants, and in alum crystals. Additionally, the sensor was used for secretive writing. The scheme reaction for the synthesis of Schiff base has

shown.



U. Saleth Prabhakar *et al.*, (2019) Synthesized a Schiff base and linked with Co(II), Ni(II), Cu(II) and Zn(II) ions and their coordination ability were shown. In medicinal chemistry, the Schiff base molecules were very important. The 3-methoxysalicylaldehyde and 3-aminopyridine condensation that produced the Schiff base ligand, which was used to synthesise the metal complexes of Co (II), Ni (II), Cu (II), and Zn (II), was studied. The Synthesized compounds have been identified by FTIR, UV-Vis, ^{1}HNMR, molar conductance, magnetic susceptibility, and elemental analyses. The FTIR spectrum demonstrates that O, N, the electron-donor site of the azomethine group, was responsible for the bidentate coordination of metal ions with the ligand. Structure and geometry of the complexes were anticipated from the analytical methodologies. The predicted coordination of the ligand by azomethine linkage was confirmed by measurements of the ligand and its complexes using the FTIR, UV-Vis, ^{1}H NMR, and magnetic fields. These findings had led to a proposal for an octahedral structure for all complexes. The scheme reaction for the synthesis of Schiff base was shown.



MATERIALS & METHODS

3. MATERIALS AND METHODS

3.1 GENERAL

- All the organic solvents and the chemicals were purchased from Sigma-Aldrich and the 2-Amino pyridine and 2-Amino-5-Methyl pyridine, 2-Amino-4-Methyl pyridine were used with purification. Melting Points were determined using Safire melting point apparatus, and were uncorrected.
- Infrared spectra of the synthesized compounds were recorded by using Shimadzu, (FT-IR) spectrophotometer in the range of (4000-400) cm^{-1}. Absorption frequencies were quoted in reciprocal centimeter.
- Nuclear Magnetic Resonance (^{1}H-NMR) spectra were determined by Bruker modern 400MHz NMR instrument in $CDCL_3$ as solvents, with tetramethyl silane as the internal reference. Chemical shift were quoted in parts per million(ppm).
- Thin Layer Chromatography (TLC) was performed using glass plates coated with silica gel G to monitor and check the completion of each reaction. Hexane and Dichloromethane were used as the developing solvents. Spots were detected with iodine.
- The solvents and reagents used for the synthesis were of reagent grade and were purified by standard methods.

3.2 PREPARATION OF SCHIFF BASES

3.2.1 (Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine:

Equimolar ratio of 2-amino pyridine 0.10083g(0.03mol) and 3,4,5 trimethoxy benzaldehyde 0.21021g(0.03mol) was weighed and dissolved in separate round bottomed flask with (10ml) of ethanol solution and the reaction mixture was refluxed with condenser in a water bath for about 7 hours at 70° C. The completion of the reaction was checked with TLC of appropriate solvents and ratio (hexane and DCM). After the completion of the reaction, the reaction mixture was poured into ice cold water & the product was separated from the water by separatory funnel by using ethyl acetate as solvent. The yield was 42%

and the melting point was found to be 115°C.

3.2.2 (Z)-N-(4-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine:

Equimolar ratio of 2-amino 4-methyl pyridine 0.10814g (0.03mol) and 3,4,5 trimethoxy benzaldehyde 0.19624Sg (0.03mol) was weighed and dissolved in separate round bottomed flask with (12ml) of ethanol solution and the reaction mixture was refluxed with condenser in a water bath for about 8 hours at 70°C. The completion of the reaction was checked with TLC of appropriate solvents and ratio (hexane and DCM).). After the completion of the reaction, the reaction mixture was poured into ice cold water & the product was separated from the water by separatory funnel by using ethyl acetate as solvent. The yield was 48% and the melting point was found to be 125°C.

3.2.3 *(Z)-N-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine*:

Equimolar ratio of 2-amino 5-methyl pyridine 0.21628g(0.03mol) and 3,4,5 trimethoxy benzaldehyde 0.3924g(0.03mol) was weighed and dissolved in separate round bottomed flask with (12ml) of ethanol solution and the reaction mixture was refluxed with condenser in a water bath for about 8 hours at 70°C. The completion of the reaction was checked with TLC of appropriate solvents and ratio (hexane and DCM).). After the completion of the reaction, the reaction mixture was poured into ice cold water & the product was separated from the water by separatory funnel by using ethyl acetate as solvent.The yield was 54% and the melting point was found to be 133°C.

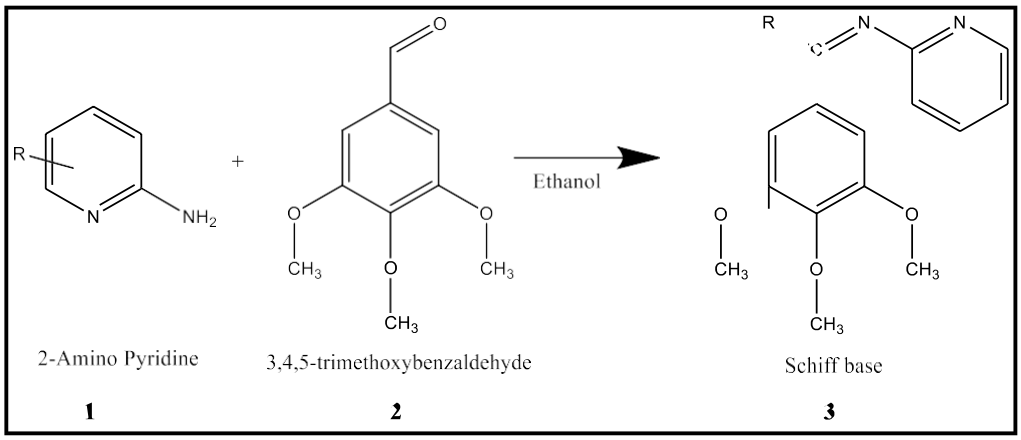
RESULTS AND DISSCUSSION

4. RESULTS AND DISCUSSION

- The reaction of amino pyridine with several aldehydes has been reported by few authors with the different types of products as Schiff bases**[Hossain *et al.*, 2017., Kaya *et al.*, 2021].**
- In the present work the Schiff bases were derived from amino pyridine and its methyl derivatives with 3, 4, 5 trimethoxy benzaldehyde.
- The reaction was carried out by refluxing the mixture of 0.03mmol of amino pyridine solution and 0.03mmol of 3, 4, 5 trimethoxybenzaldehyde for 6-8 hours, in a water bath fitted with condenser. After formation of the product, the contents were poured into ice cold water.
- The contents obtained was separated as organic layer using separating funnel and dried. The yield of the products were given in the Table – II.

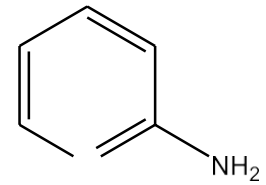
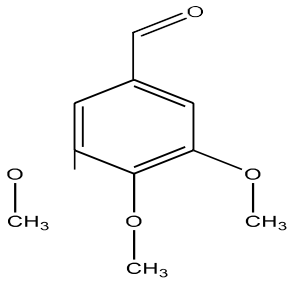
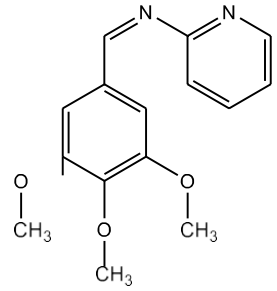
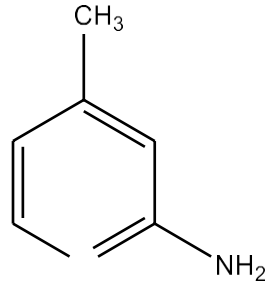
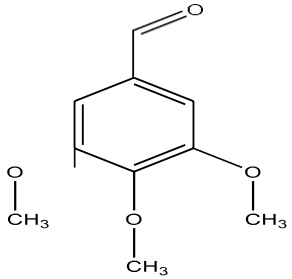
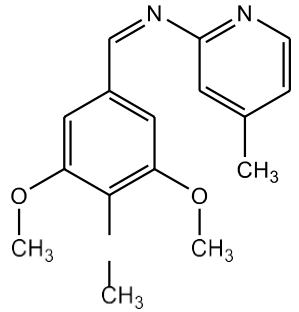
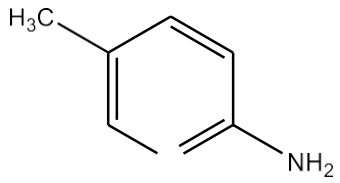
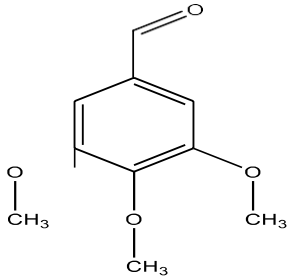
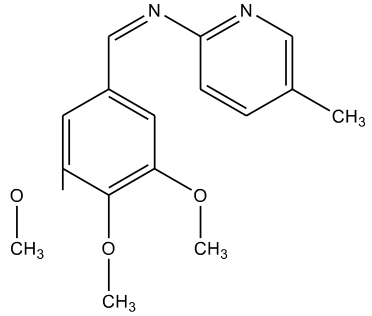
4.1 Preparation of Schiff base

Scheme I



R	Compound
H	3a
4Me	3b
5Me	3c

TABLE II: THE YIELDS OF PRODUCT

REACTANT I	REACTANT II	PRODUCT	YIELD
			**42%**
			**48%**
			**54%**

4.2 SPECTRAL CHARACTERIZATION OF THE SYNTHESIZED COMPOUND

The synthesized Schiff bases are characterized using FTIR, NMR and the melting point was determined.

4.2.1 FT-IR Analysis of (Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3a)

- The FT-IR spectrum of Schiff base, (Z)-N-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine was shown in the **(Figure 1).**
- The compound exhibited medium absorption band at 1681 cm^{-1} which was assigned to azomethine moiety ν(C=N) stretching mode.
- The characteristic ring vibrations at 1500–1400, 1100–1050 and 900–700 cm^{-1} have identified the presence of aromatic rings.
- The ν(C–O) stretching vibrations appeared at the 1118 cm^{-1} as strong bands.
- The characteristic ν(O-H) modes of ring residues were observed near 3055cm^{-1}.
- The ν(C=C) stretching vibrations appeared at 1581 cm^{-1} as strong bands.
- The characteristic methoxy group stretching vibrations appeared between2860-2800cm^{-1}.
- The disappearance of absorption band of ν(C=O) and primary amine ν(NH) confirmed the formation of the proposed Schiff base.

Table III: IR spectral data of synthesized compounds in cm^{-1}.

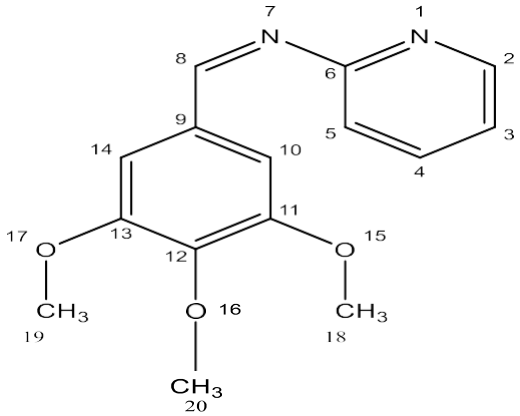
COMPOUND	**C=N**	**C-O**	**O-CH_3**	**C=C**
3a	1681	1118	2839	1581
3b	1681	1234	2839	1581
3C	1681	1118	2839	1581

4.2.2 ^{1}H NMR Analysis of (Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3a)

- The 1H NMR spectrum of Schiff base (Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine was shown in the(**FigureII,III).** The azomethine hydrogen (-CH=N-) was observed as a singlet equivalent to one hydrogen(H^{8}) at 10.09.
- A doublet integrating for two protons, at δ8.58, associated for the H^{2} . The aromatic ring hydrogen's were observed as triplet & singlets at δ7.34(H^{4}), 7.23($H^{14,10}$) and 7.03(H^{3}) .
- The singlets at 3.93 and 3.73 ppm were due to the hydrogens of the -OCH3($H^{18,19,20}$). All these confirmed the formation of the following proposed structure**.**

Table IV: ^{1}H NMR-J values of 3a in Hz

^{1}H Shift in ppm	Multiplicity/No. of ^{1}H	J VALUE(Hz)
10.09	H^{8}/s	
8.58	H^{2}/d	16.0
7.34	H^{4}/t	4.0
7.23	H^{14},H^{10}/s	
7.03	H^{3}/t	4.0
6.93	H^{5}d	4.0
3.93	H^{18},H^{19}/s	
3.73	H^{20}/s	



(Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine(3a)

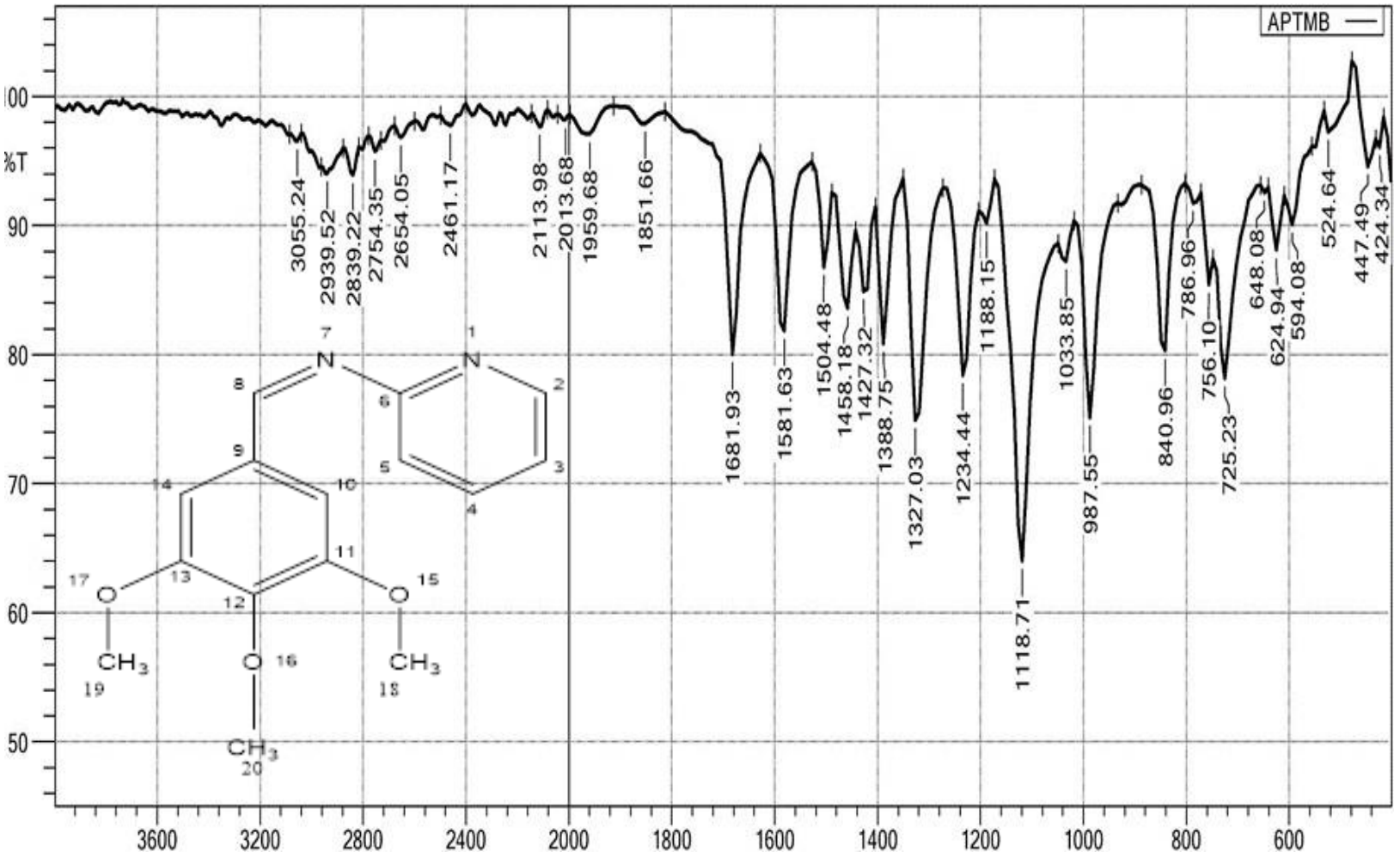


Figure I: FT-IR Spectrum (Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine

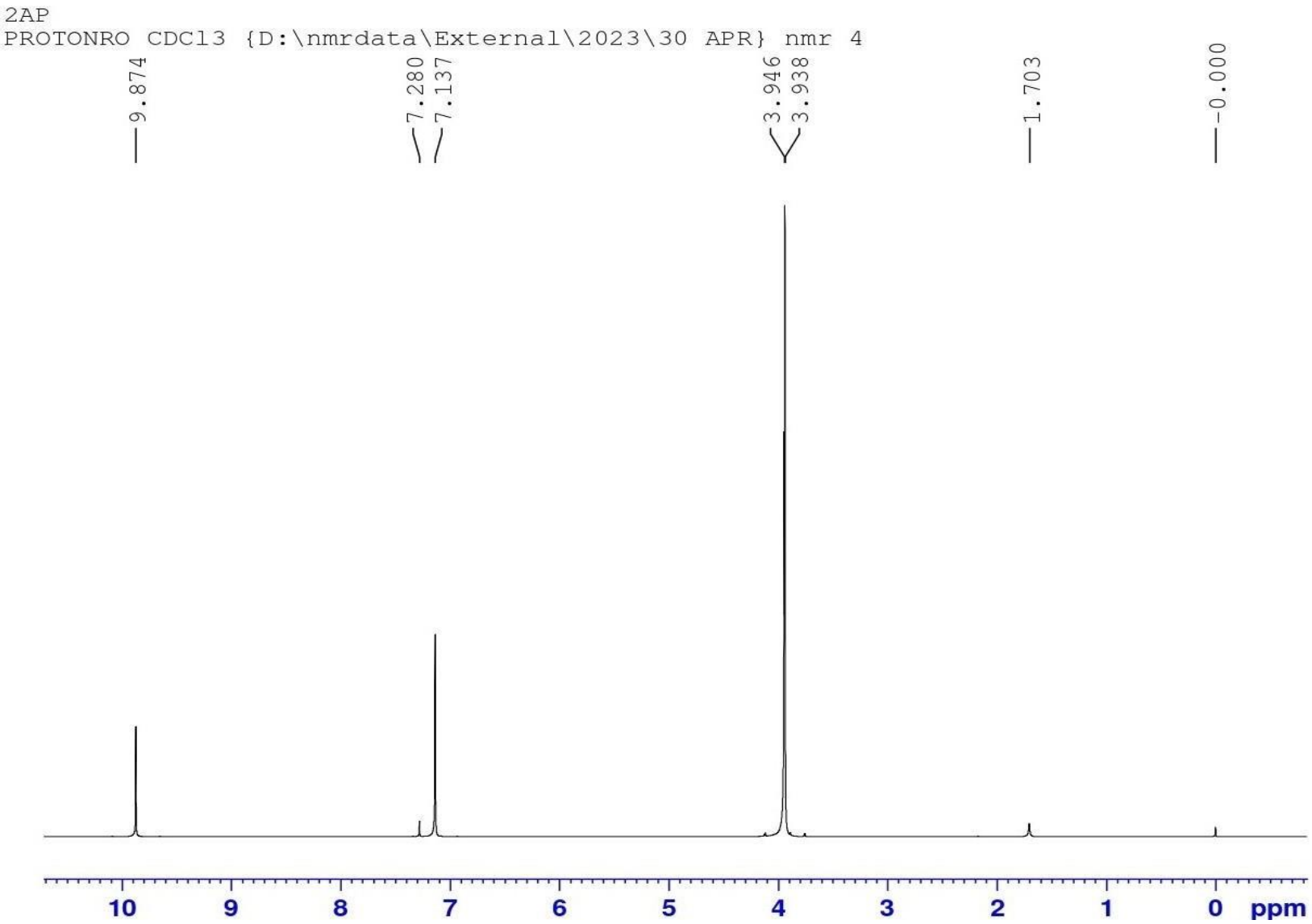


Figure II: ^{1}H-NMR Spectrum of (Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine

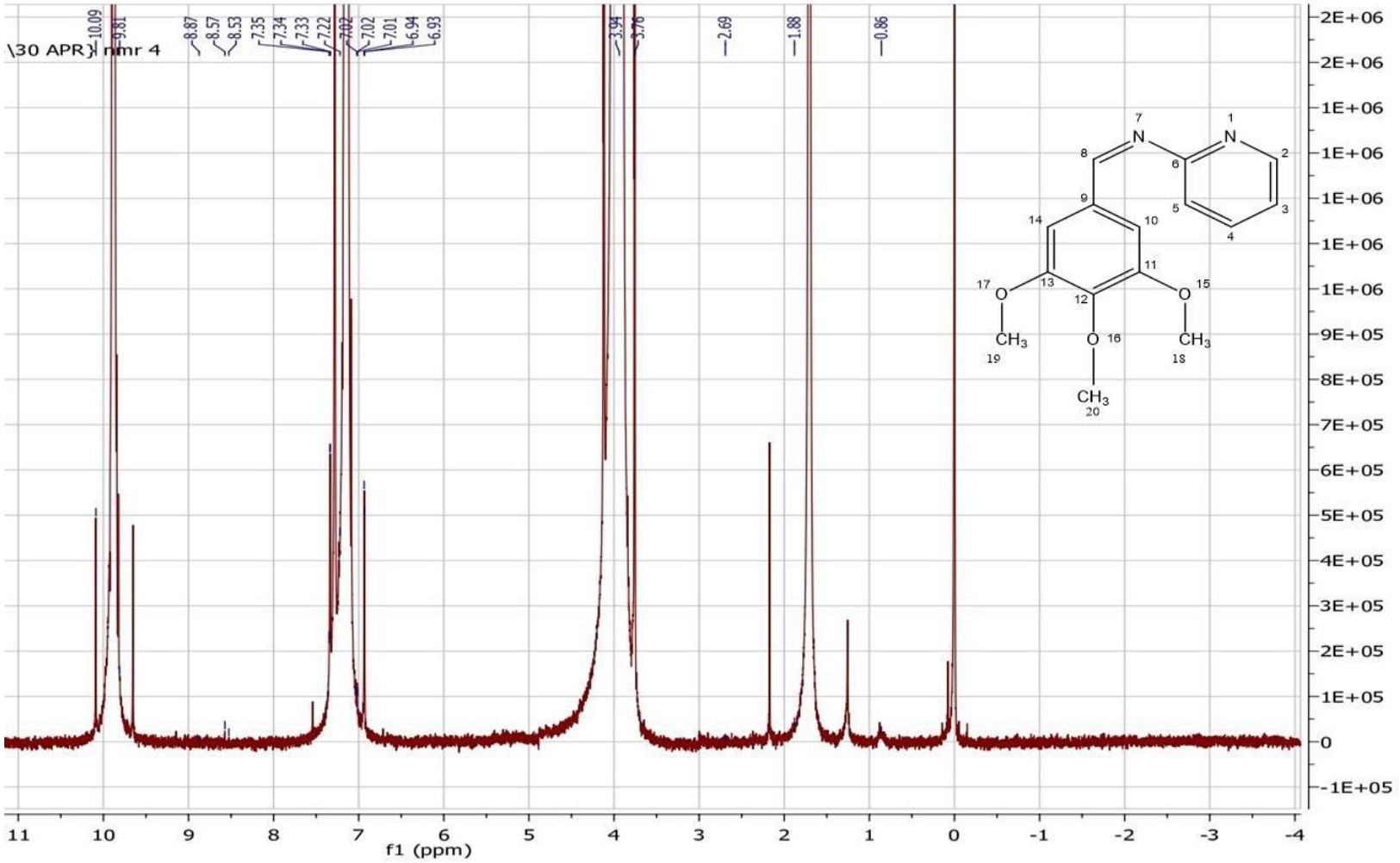


Figure III: Expansion of ^{1}H-NMR Spectrum (Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine

4.2.3 FT-IR analysis of (Z)-*N*-(4-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3b)

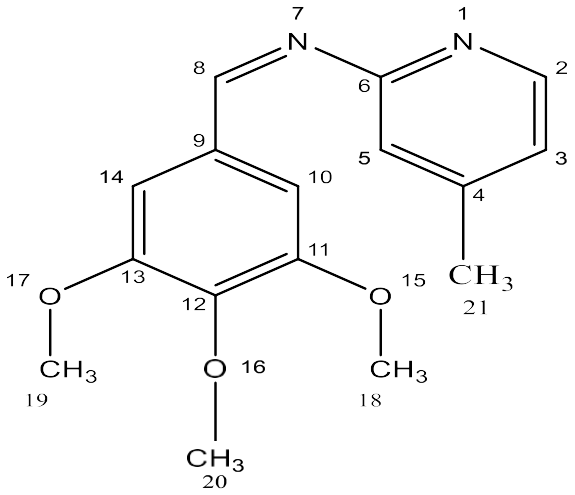
- The FT-IR spectrum of Schiff base, (Z)-*N*-(pyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine was shown in the**(Figure IV).**
- The compound exhibited a medium absorption band at 1681 cm^{-1} which was assigned to azomethine moiety ν(C=N) stretching mode.
- The characteristic ring vibrations at 1500–1400, 1100–1050 and 900–700cm^{-1} have identified the presence of aromatic rings.
- The ν(C–O) stretching vibrations appeared at 1118 cm^{-1} as strong bands.
- The characteristic ν(C-H) modes of ring residues were observed at near 3363cm^{-1}.
- The Methoxy group stretching vibrations appeared between 2830-2815 cm^{-1}.
- The disappearance of absorption band of ν(C=O) and primary amine ν(NH) confirmed the formation of the proposed Schiff base.

4.2.4 ^{1}H NMR Analysis of (Z)-*N*-(4-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3b)

Table V: ^{1}H NMR-J values of 3b in Hz.

^{1}H Shift in ppm	Multiplicity/No. of ^{1}H	J VALUE(Hz)
9.65	H^{8}/s	
8.57	H^{2}/d	4.0
7.90	H^{5}/s	
7.42	H^{3}/d	8.0
7.06	H^{14},H^{10}/s	
3.83	H^{18},H^{19}/s	
3.55	H^{20}/s	
2.83	H^{21}/s	

- The 1H NMR spectrum of Schiff base (Z)-*N*-(4-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine is shown in the **(Figure V**).
- The azomethine hydrogen (-CH=N-) was observed as singlet equivalent to onehydrogen(H^8) at 9.65.
- A doublet integrating for two protons, at δ 8.57, associated for the H^2.
- The aromatic ring hydrogen's were observed as a singlets and doublet δ7.90(H^5),δ7.06(H^{14} , H^{10}) and δ7.42(H^3).
- The singlets at 3.83 and 3.55 ppm were due to the hydrogen's of the -OCH3($H^{18,19,20}$).
- The peak at δ2.83 represented the presence of methyl group protons (H^{21}).
- All these confirmed the formation of the following structural compound.



(Z)-*N*-(4-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3b)

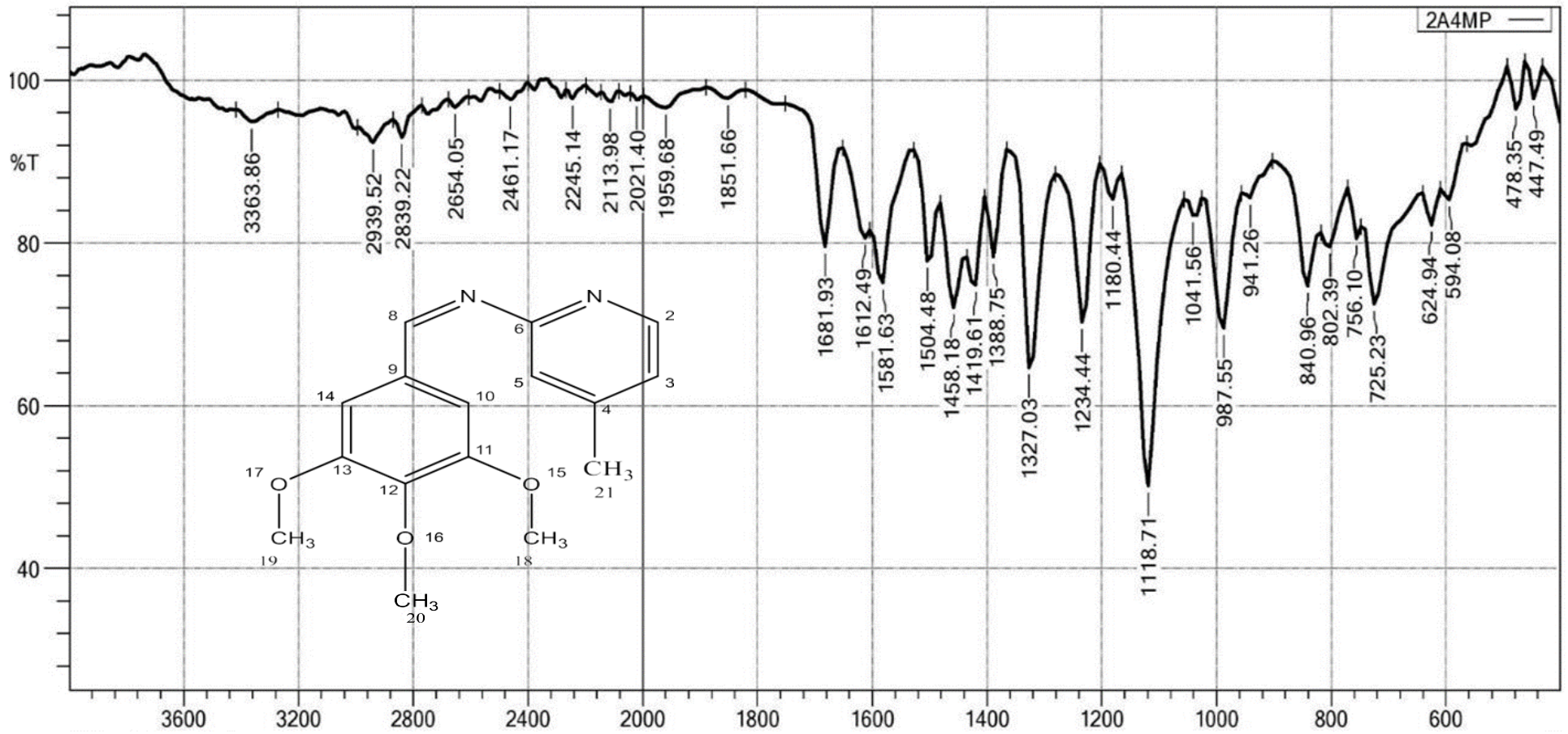


Figure IV:FT-IR Spectrum of (Z)-*N*-(4-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3b)

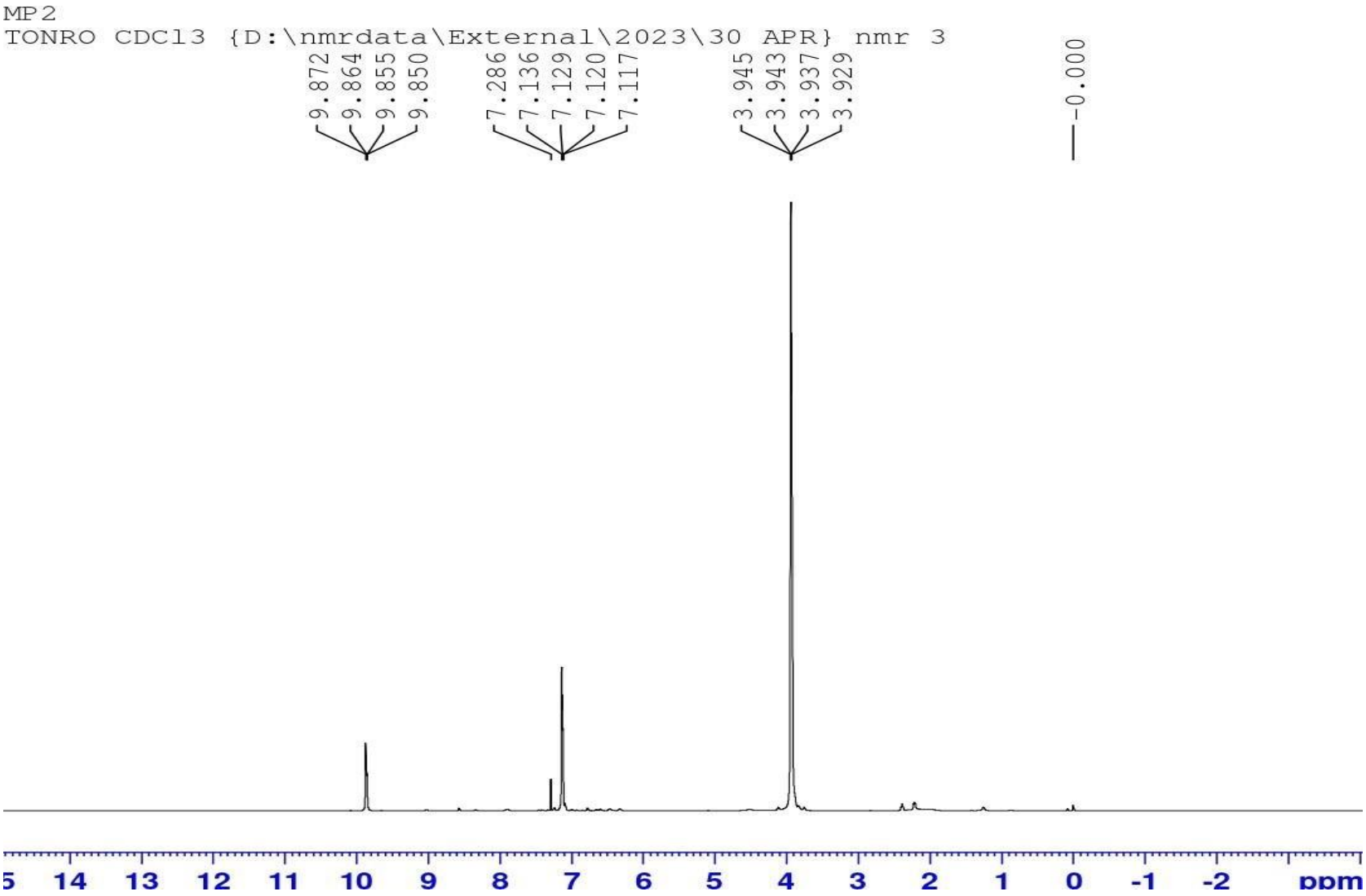


Figure V: ^{1}H-NMR Spectrum of (Z)-*N*-(4-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3b)

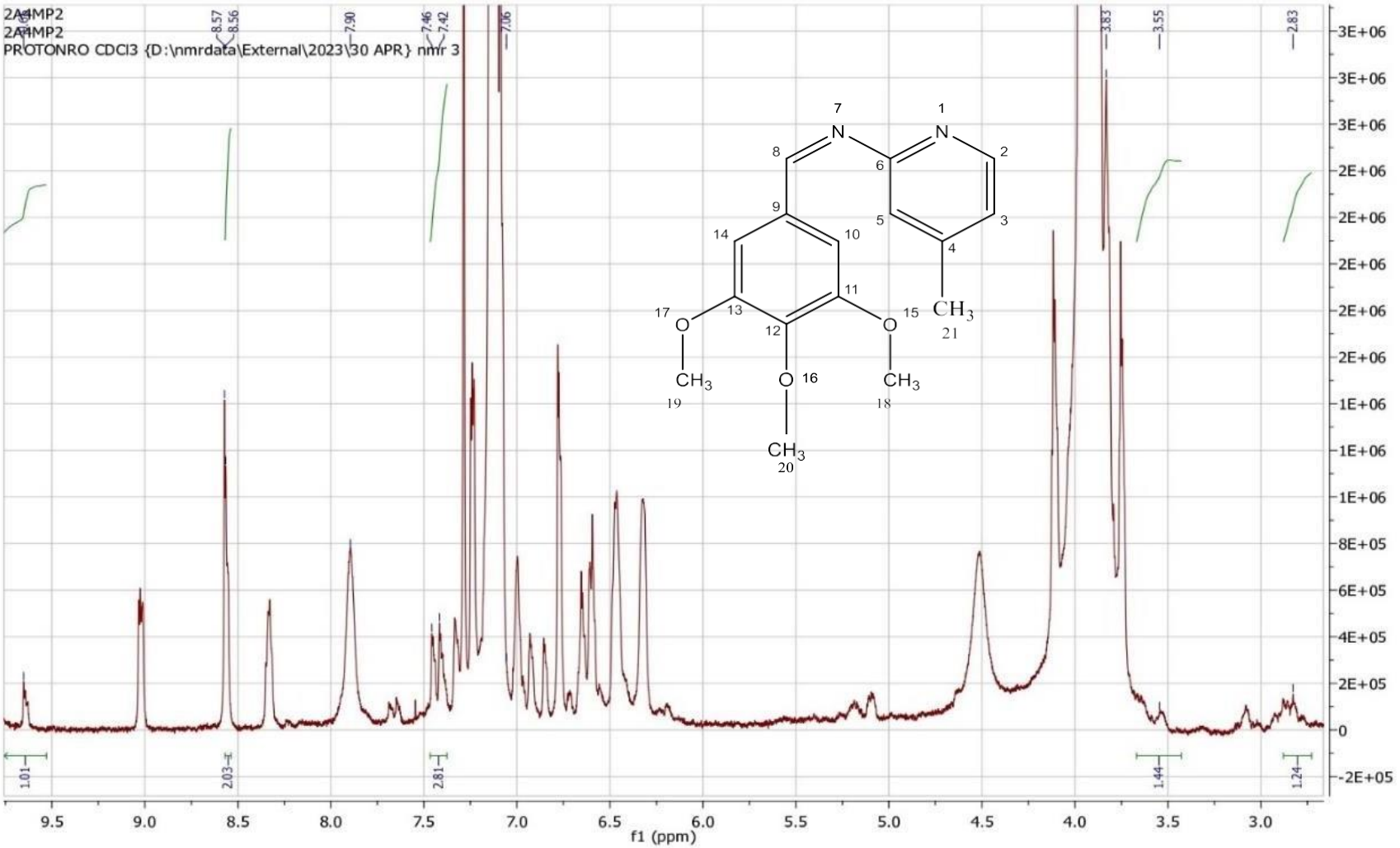


Figure VI: Expansion of ^{1}H-NMR Spectrum of (Z)-*N*-(4-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3b)

4.2.5 FT-IR analysis of *(Z)-N*-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3c)

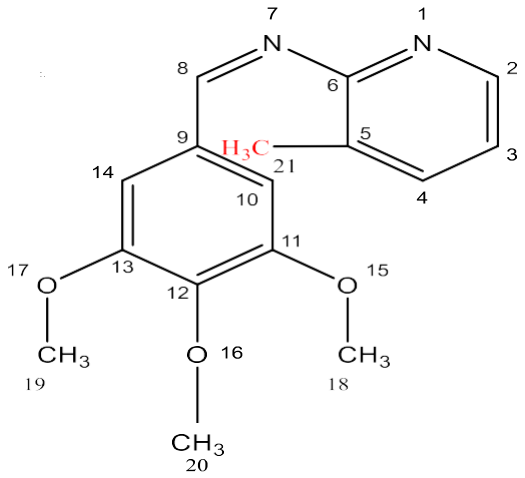
- The FT-IR spectrum of Schiff base, *(Z)-N*-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine(3c) was shown in the **(Figure VII).**
- The compound exhibited a medium absorption band at 1681 cm^{-1} assigned to azomethine moiety ν(C=N) stretching mode.
- The characteristic ring vibrations at 1500–1400, 1100–1050 and 900–700cm^{-1} had identified the presence of aromatic rings.
- The ν(C–O) stretching vibrations appeared at 1118 cm^{-1} as strong bands. The characteristic ν(C-H) modes of ring residues were observed near 2939 cm^{-1}.
- The Methoxy group stretching vibrations appeared between 2830-2815 cm^{-1}.
- The disappearance of absorption band of ν(C=O) and primary amine ν(NH) confirmed the formation of the proposed Schiff base.

4.2.6 ^{1}H NMR Analysis of *(Z)-N*-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3c)

Table VI: ^{1}H NMR-J Values of 3c

^{1}H Shift in ppm	Multiplicity/No. of ^{1}H	J VALUE(Hz)
9.04	H^{8}/s	
8.31	H^{2}/d	4.0
7.57	H^{4}/d	8.0
7.25	H^{3}/t	12.0
6.53	H^{14},H^{10}/s	
3.84	H^{18},H^{19}/s	
3.70	H^{20}/s	
2.17	H^{21}/s	

- The 1H NMR spectrum of Schiff base *Z)-N*-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3c) was shown in the **(Figure VIII)**.
- The azomethine hydrogen (-CH=N-) was observed as a singlet equivalent to one hydrogen(H^8) at 9.04.
- A doublet integrating for two protons, at δ 8.31, associated for the H^2.
- The aromatic ring hydrogen's were observed as doublet, triplet and singlet of δ7.57(H^5), δ7.25(H^3) and δ6.53(H^{14}, H^{10}).
- The singlets at 3.84 and 3.70 ppm are due to the hydrogens of the -OCH3($H^{18,19,20}$).
- The peak at δ2.17 represented the presence of methyl group protons (H^{21}).
- All these confirmed the formation of the following structural compound.



***(Z)-N*-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3c)**

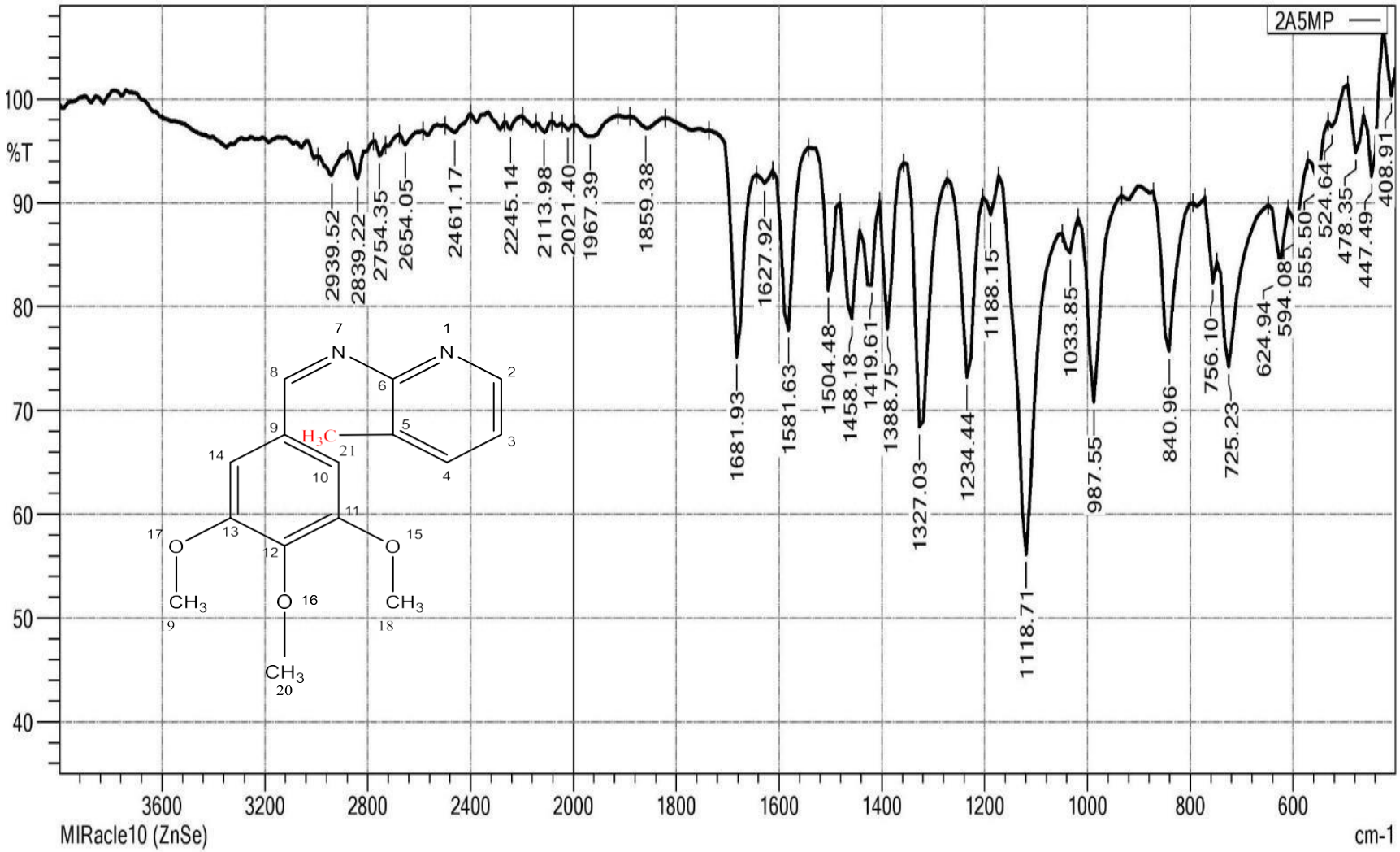


Figure VII: FT-IR Spectrum of *(Z)-N*-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3c)

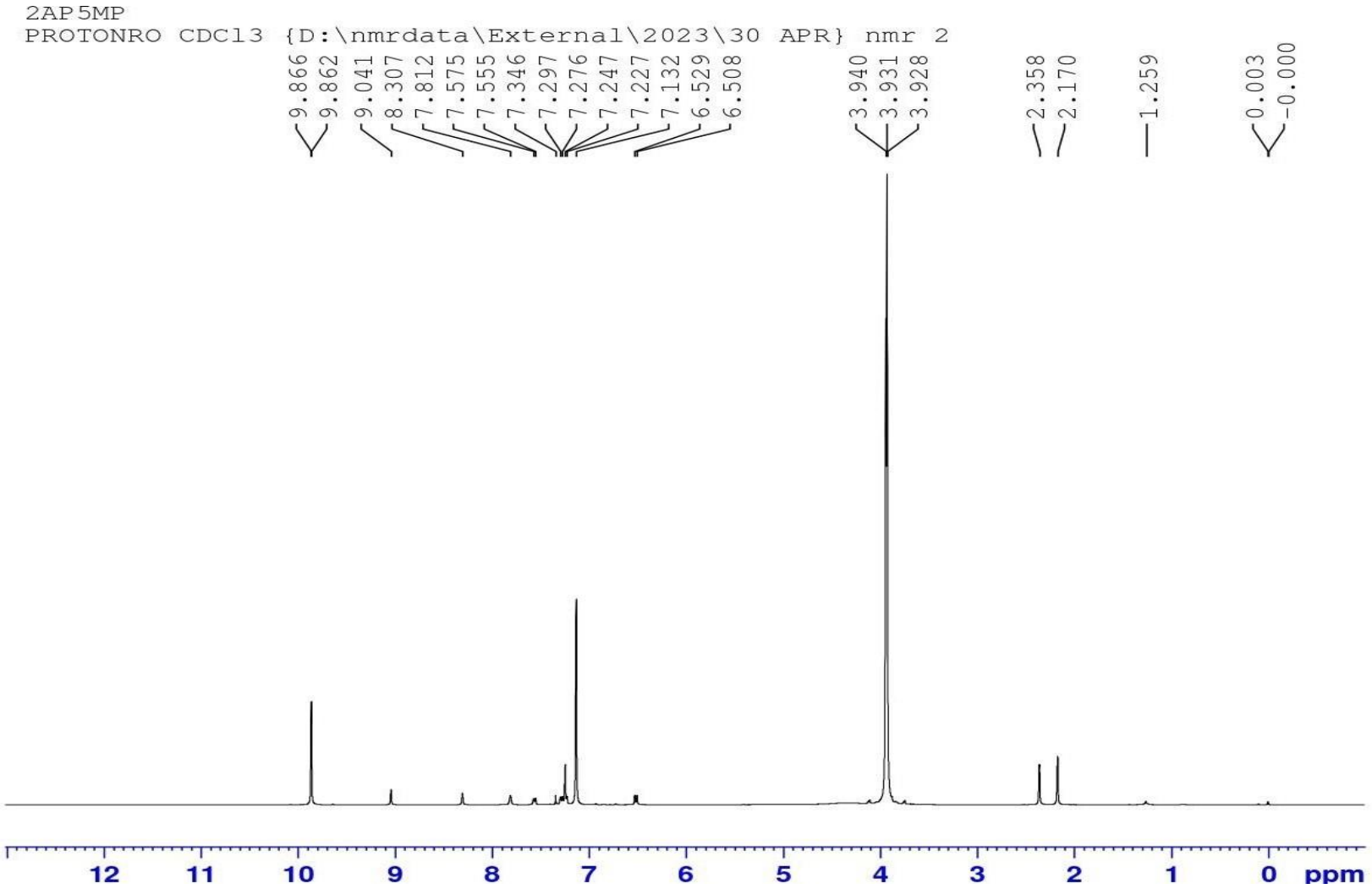


Figure VIII: ^{1}H-NMR Spectrum of *(Z)-N*-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3c)

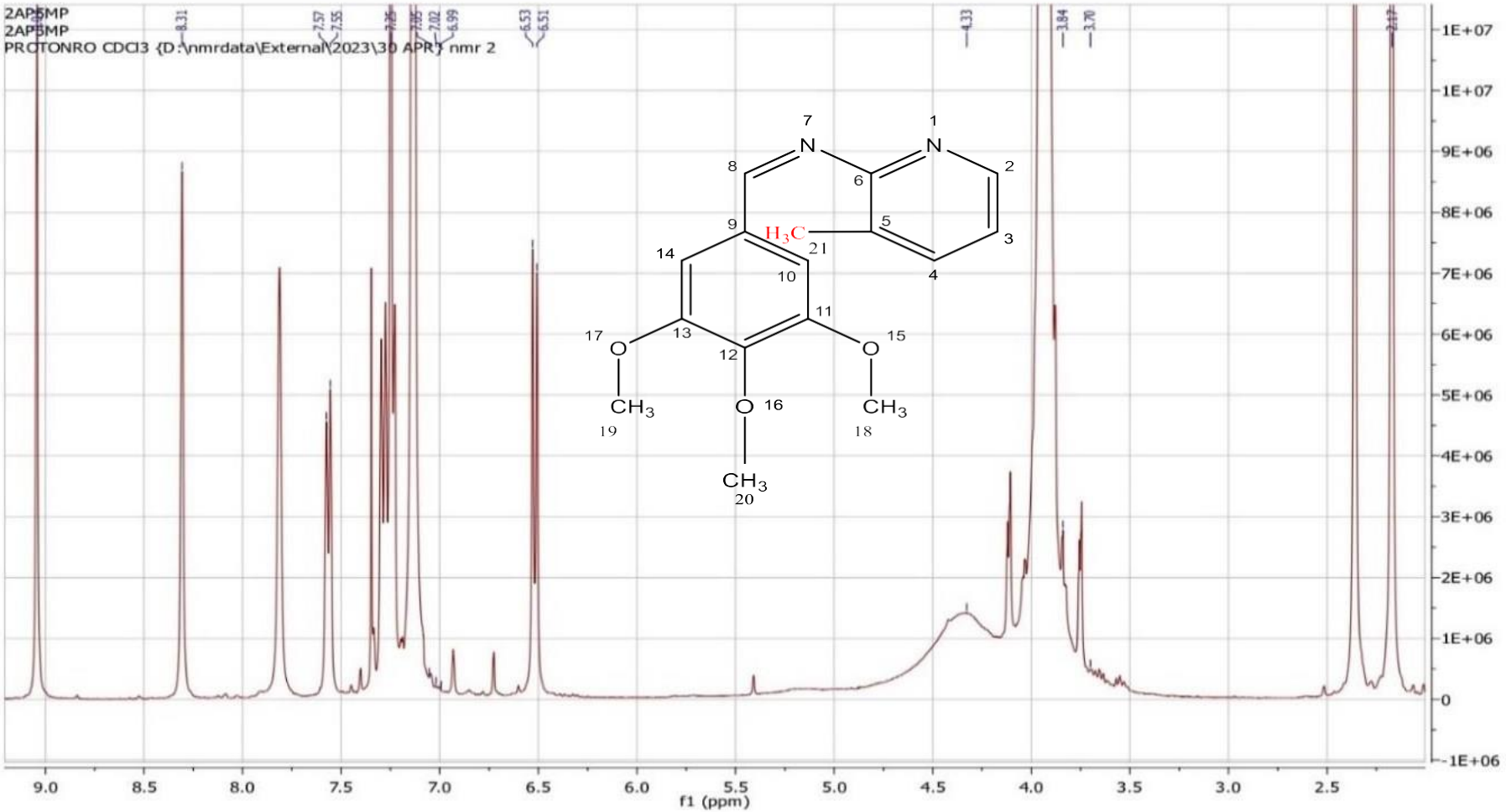


Figure IX: Expansion of ^{1}H-NMR Spectrum of *(Z)-N*-(5-methylpyridin-2-yl)-1-(3,4,5-trimethoxyphenyl)methanimine-(3c)

CONCLUSION AND SUMMARY

5. SUMMARY AND CONCLUSION

The results of the reaction of 2-amino pyridine with 3, 4, 5- trimethoxy benzaldehyde are summarized below:

- The reaction of 2-amino pyridine with trimethoxy benzaldehyde yielded the azomethine in an excellent yields at room temperature.
- The reaction was carried out using ethanol, as solvent under reflux in a water bath to yield (3a, 3b and 3c) .The yield of the compounds was moderate.
- The synthesized compounds were characterized by IR and ^{1}HNMR spectral studies.
- The IR and ^{1}H NMR data showed good correlation with the proposed structure.
- This successful reaction may be an important aspect in the synthesis of Schiff bases of amino pyridine derivatives which can serve as lead compounds in medicinal chemistry.

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