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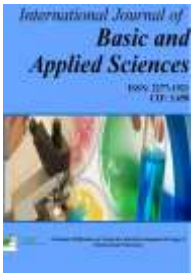

Full Length Research Paper

Synthesis and Antimicrobial Evaluation of Schiff base of 3 (4-Nitrophenyl) Ethylidene Amino Phenyl Ethanone.

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ARTICLE DETAILS

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ABSTRACT

This research work encompasses the synthesis, characterization, and evaluation of amino-based Schiff bases derived from various amines including 3-aminoacetophenone, 2-minobenzothiazole, 2-amino-3-hydroxypyridine, 2-amino-5-bromopyridine, 4-amino antipyrine, and isoniazid. The Schiff bases were synthesized by condensing the respective amines with aldehydes. The physical parameters of the synthesized Schiff bases were determined to assess their purity and characterization. Infrared spectroscopy (IR) was employed to investigate the presence of specific functional groups in the synthesized Schiff bases. and antimicrobial activity against bacteria and fungi provides a comprehensive understanding of these compounds and their potential applications in the field of medicinal chemistry. Infrared spectroscopic analysis confirmed the presence of imine groups and suggested a transformation from carbonyl to imine functional groups, while antimicrobial tests indicated promising activity against bacterial and fungal strains, highlighting the importance of structure-activity relationships.

1. Introduction

Schiff base compounds are formed by the condensation of a primary amine with an aldehyde or ketone, resulting in the formation of an imine linkage (-C=N-).[1-3] These compounds exhibit a wide range of biological properties, including antimicrobial, anti-inflammatory, anticancer, and antioxidant activities.[4-6] Schiff bases find wide applications in various fields such as the food industry, dye industry, analytical chemistry, catalysis, fungicidal and agrochemical industries, as well as in biological activities.[7] A Schiff base synthesized from indoline-2,3-dione and 2-aminobenzoic acid, along with its Tin complex, exhibited antibacterial activity against Staphylococcus aureus.[8] The Schiff bases derived from 2,6-diacetylpyridine and 2-pyridine carboxaldehyde with 4-amino-2,3-dimethyl-1-phenyl-3-pyrozolin-5-one form complexes with Co(II), Cu(II), Ni(II), Mn(II), and Cr(III) which exhibit antibacterial and antifungal activity against various bacteria. The antibacterial effect of the complexes is greater than that of the free ligand.[9] The enhanced activity in the organotin complexes can be attributed to the coordination and polarity of a tin(IV) atom with oxygen in the ligand.[10]

Antifungal activities were studied for N-(2-hydroxy-1-naphthalidene) phenyl glycine and its transition metal complexes. The results showed that complexation enhanced the activity of the ligand against fungi. Cu(II), Ni(II) and Co(II) complexes were found to have better antifungal activity compared to the ligand and corresponding metal salts.[11] The fungicidal effect of salicylaldimine containing formaldehyde and piperazine moiety and its metal polychelates were determined against Candida albicans and Aspergillus.[12] In summary, this work focuses on the synthesis, characterization, and evaluation of amino-based

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Schiff bases derived from various amines. The determination of melting points, solubility, Rf values, analysis of functional groups via infrared spectroscopy, and assessment of antimicrobial activities contribute to a comprehensive understanding of these compounds. The results obtained from this study hold promise for the development of novel antimicrobial agents and their potential applications in the field of medicinal chemistry.

2. Material and methods

All chemicals used in the experiments were of analytical grade and were purified using established methods. Melting points of the synthesized compounds were determined using open capillaries and were corrected accordingly. Infrared (IR) spectra of the compounds were recorded using Shimadzu FTIR 8400 (Model SI 118675 A) using KBr pellets. to analyse and identify the presence of specific functional groups. Thin-layer chromatography plates were prepared using silica gel slurry in chloroform or silica-coated aluminium foil TLC plates. The TLC was performed using a mobile phase of diethyl ether/petroleum ether, and detection was achieved using an iodine vapour chamber.

For evaluating the antimicrobial activity of the compounds, the synthesized Schiff base and standard antibiotics were tested against the antifungal strain Aspergillus Niger (A. Niger) and the antibacterial strain Escherichia coli (E. coli) Gram-negative microbial cultures were grown for testing. Sterile Petri dishes containing nutrient agar and potato dextrose agar were used. 70% ethanol was used for sterilisation purposes. Whatman filter paper discs with a diameter of 5mm were utilized. Sterile spreaders were employed for spreading the microbial cultures.

2.1 Experimental

Synthesis of [UA01] Schiff base: 3 (4-Nitrophenyl) ethylidene amino phenyl ethanone prepared by a known method.[13] Synthesis of [UA02 to UA06] Schiff base: Schiff base [UA02 to UA06] has been prepared from synthesised Schiff base [UA01] and was mixed in a 1:1 ratio with different amines in ethanol solvent. The resulting mixture is stirred for 2 to 2.5 hours at a temperature of 60°C. The antibacterial activity of a specific compound concentration is (100 µg/ml), as determined by the disc diffusion method. The compound diffuses out of the disc into the agar, creating a concentration gradient that inhibits the growth of the microorganism. The inhibition zone, characterized by a lack of visible growth around the disc, is measured to assess the compound's effectiveness. In the case of antibacterial activity, bacterial strains such as Escherichia coli (E. coli) or Staphylococcus aureus and in the case of antifungal activity, fungal strains such as Aspergillus niger or Candida albicans are commonly employed.

3. Result and discussion

This study explored the synthesis, characterization, and antimicrobial activity of Schiff bases derived from various amines. The results obtained provide valuable insights into the potential applications of these compounds in the field of medicinal chemistry. The infrared spectrum assignments of the ligand were made by simple inspection and by reference to generalized charts of characteristic group frequencies and based on analogous structures, known earlier. A notable absorption band at 1673 cm^{-1} was attributed to the stretching vibration of the C=N bond, confirming the presence of an imine group. Another band at 1749 cm^{-1} corresponded to the stretching vibration of the >C=O bond, indicating the presence of a ketone group. The in-plane bending vibrations of aromatic C-H bonds were observed within the 1250–950 cm^{-1} range, while characteristic frequencies for the out-of-plane bending vibrations of aromatic C-H bonds were detected between 600–900 cm^{-1}. This IR spectral analysis provides valuable information about the molecular structure and functional groups, including imine (>C=N), ketone (>C=O), and aromatic amine (C-N in an aromatic ring), with the aromatic C-H bond vibrations further confirming the presence of aromatic groups.

The infrared analysis of ligands UA02 to UA06 revealed important findings regarding the presence of functional groups. Specifically, the stretching frequencies associated with the C=N bond were observed in the typical range of 1650-1673 cm^{-1}. This confirms the presence of an imine group in these compounds. Furthermore, the stretching frequencies corresponding to the C-N bond in an imine group were found within the range of 1180-1350 cm^{-1}. This supports the identification of an additional imine linkage in the compounds, as evidenced by the presence of a second >C=N stretching frequency. Interestingly, the disappearance of keto frequencies suggests a transformation of the carbonyl group to an imine group. This indicates that the compounds underwent a chemical reaction involving the conversion of the carbonyl group (C=O) to an imine group (>C=N), contributing to the formation of the observed functional groups.

Overall, the infrared spectroscopic analysis provided evidence of the presence of multiple imine groups in ligands B, C, D, E, and F. The disappearance of keto frequencies further supports the structural transformation from a carbonyl group to an imine group. These findings contribute to a better understanding of the molecular composition and functional groups in the synthesized compounds. Furthermore, the antimicrobial activity of the Schiff bases was evaluated against both bacterial and fungal strains. These results suggest the potential of the synthesized Schiff bases as antimicrobial agents. The antimicrobial activity can be attributed to the presence of certain functional groups in the Schiff bases, which may interact with the

microbial cells, disrupting their growth and viability. The differences in antimicrobial activity among the compounds can be attributed to variations in their chemical structures and functional groups, highlighting the structure-activity relationship in antimicrobial properties.

Table 1: Physical Parameter of Synthesized Schiff base

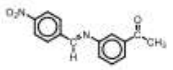
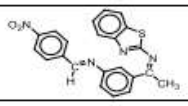
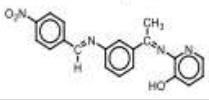
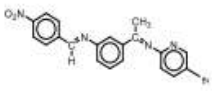
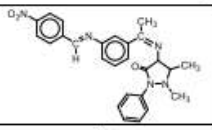
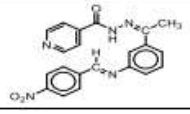
Comp.	Reaction time (hrs.)	Structure	Melting point	Images	Rf value (cm)	Colour
UA01	1 hr		118 -120°c		0.76	Yellow
UA02	2 hr		120 -125°c		0.73	Yellow
UA03	2 hr		150-155°c		0.78	Yellow
UA04	3hr		205-208°c		0.60	Yellow
UA05	2.5 hr		115 -120°c		0.66	Orange
UA06	2 hr		210 -215°c		0.36	Faint yellow

Table 2: Antimicrobial activity of Synthesized Schiff base

Zone of inhibition after 24 hrs. of incubation (in Cm)					
Antibacterial activity			Antifungal activity		
Compound	E. Coli		Compound	A. Niger	
UA-01 (100 µg/ml)	6		UA-01 (100 µg/ml)	2	
UA-02 (100 µg/ml)	6		UA-02 (100 µg/ml)	3	
UA-03 (100 µg/ml)	10		UA-03 (100 µg/ml)	11	
UA-04 (100 µg/ml))	11		UA-04 (100 µg/ml)	4	
UA-05 (100 µg/ml)	7		UA-05 (100 µg/ml)	6	
UA-06 (100 µg/ml)	8		UA-06 (100 µg/ml)	2	

4. Conclusion

Synthesis of Schiff Base derived [UA01 to UA06] was synthesised and characterized by IR. In the synthesis, the HC=N bond formed between the amine group of various amines including 3-aminoacetophenone, 2-aminobenzothiazole, 2-amino-3-hydroxypyridine, 2-amino-5-bromopyridine, 4-amino antipyrine, and isoniazid and the carbonyl group which IR Band confirmed in the 1650-1673 cm-1 range. Nearly all synthesised compounds [UA01 to UA06] are more active towards the antibacterial and antifungal strains which are shown in the results and discussion section.

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