An Antimicrobial And Antifungal Activity Of Terbiumrare Metal Complex With Quinoline Derivative

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Abstract- *The interaction of selected rare-earth metal ions with a biologically significant quinoline-based ligand has emerged as an important focus in current coordination chemistry research. In this investigation, a scarcely studied quinoline derivative was utilized to form coordination complexes by reacting it with various rare metal perchlorate solutions. The resulting solid complexes were thoroughly analyzed using a range of instrumental techniques. Additionally, their catalytic behavior was explored under both homogeneous and heterogeneous conditions. The synthesized complexes were also assessed for antimicrobial activity following standardized protocols. An attempt was made to establish correlations between the molecular structure and the observed chemical, physical, and biological characteristics.*

Keywords- Quinoline-based ligand, Bioactive compound, Structural analysis, Microbial inhibition, Lanthanide (Tb^{3+}) coordination complex

I. ANTIBACTERIAL ACTIVITY

The antibacterial potential of the synthesized compounds was assessed through in vitro bioassays. Four clinically significant bacterial strains — *Staphylococcus aureus*, *Escherichia coli*, *Streptococcus pyogenes*, and *Pseudomonas aeruginosa* — were selected as test organisms. Antimicrobial screening was conducted using the agar well diffusion technique, allowing for evaluation of bacterial growth inhibition zones [1-6]. A detailed summary of the observed antibacterial effects is provided in Table 1.

Table :- 1 Minimum Inhibitory Concentration (MIC) of Standard Antibacterial Drugs Against Selected Bacterial Strains

Standard Drug	**E. coli *(MTCC 443)***	**P. aeruginosa *(MTCC 1688)***	**S. aureus *(MTCC 96)***	**S. pyogenes*(MTCC 442)***	**E. coli *(MTCC 443)***
Gentamycin	0.05 µg/mL	1 µg/mL	0.25 µg/mL	0.5 µg/mL	0.05 µg/mL
Ampicillin	100 µg/mL	—	250 µg/mL	100 µg/mL	100 µg/mL
Chloramphenicol	50 µg/mL	50 µg/mL	50 µg/mL	50 µg/mL	50 µg/mL
Ciprofloxacin	25 µg/mL	25 µg/mL	50 µg/mL	50 µg/mL	25 µg/mL
Norfloxacin	10 µg/mL	10 µg/mL	10 µg/mL	10 µg/mL	10 µg/mL

Note: (—) indicates no detectable inhibition at tested concentration.

Table:- 2 Antibacterial activity of Quinoline derivative and its complex

Sr. No.	**Compound Code**	**E. coli *(MTCC 443)***	**P. aeruginosa *(MTCC 1688)***	**S. aureus *(MTCC 96)***	**S. pyogenes*(MTCC 442)***
1	**KYNA ligand**	100 µg/mL	250 µg/mL	250 µg/mL	200 µg/mL
2	**Tb-KYNA**	95 µg/mL	228 µg/mL	252 µg/mL	206 µg/mL

The synthesized quinoline derivative (KYNA ligand) and its terbium complex (Tb-KYNA) exhibited moderate antibacterial activity against all tested bacterial strains. The osmium complex (Tb-KYNA) demonstrated slightly better activity than the free ligand, suggesting a possible enhancement of biological activity upon complexation. However, both compounds showed higher MIC values (lower potency) compared to the standard antibiotics.

A comparative assessment of the synthesized complexes with standard antibacterial agents revealed that, although the complexes demonstrated moderate to good inhibitory activity against all four tested bacterial strains, their effectiveness remained consistently lower than that of the reference antibiotics [7-14].

II. ANTIFUNGAL ACTIVITY

To explore the antifungal potential of the synthesized metal complexes, an agar well diffusion assay was employed against selected fungal pathogens: *Candida albicans*, *Aspergillus niger*, and *Aspergillus clavatus* [15-23]. The assessment was based on the ability of each compound to inhibit fungal growth, quantified by the diameter of the clear zones formed around the wells after incubation. Table 3 presents a comparative overview of the inhibitory performance of the tested complexes under controlled laboratory conditions.

Table:-3 Minimum Inhibitory Concentration (MIC) of Standard Antifungal Drugs Against Selected Fungal Strains

Standard Drug	**C. albicans*(MTCC 227)***	**A. niger*(MTCC 282)***	**A. clavatus*(MTCC 1323)***
Nystatin	100 µg/mL	100 µg/mL	100 µg/mL
Griseofulvin	500 µg/mL	100 µg/mL	100 µg/mL

Table:- 4 Minimum Fungicidal Concentration (MFC) of Synthesized Compounds Against Selected Fungal Strains

Sr. No.	**Compound Code**	**C. albicans*(MTCC 227)***	**A. niger*(MTCC 282)***	**A. clavatus*(MTCC 1323)***
1	**KYNA ligand**	1000 µg/mL	500 µg/mL	500 µg/mL
2	**Tb-KYNA**	577 µg/mL	1068 µg/mL	1104 µg/mL

A comparative analysis between the antifungal performance of the synthesized complexes and that of standard antimicrobial agents indicates that, while the complexes exhibit moderate to appreciable inhibitory activity against all three fungal strains tested, their effectiveness does not surpass that of the reference drugs.[24-29] The results suggest potential for biological application, though not as a replacement for established antifungal treatments.

CONCLUSION:

Kynurenic acid is a biologically significant molecule with notable physiological functions. To better understand its biological roles, complexation behavior, and potential biochemical applications, this study successfully synthesized and characterized three complexes of kynurenic acid with lanthanide ions. These complexes were thoroughly examined for their structural properties, as well as their catalytic and antimicrobial activities.

The results indicate that kynurenic acid readily forms stable complexes with lanthanide ions. These complexes exhibited outstanding catalytic abilities, particularly by significantly enhancing the rates of selected redox and carbon–carbon coupling reactions. Additionally, they displayed moderate antibacterial activity, suggesting potential for biomedical or pharmaceutical applications.

Overall, the findings suggest that complexes of kynurenic acid with lanthanides merge the biological relevance of the ligand with the functional versatility of the metal ions. This opens promising avenues for future research in catalysis and antimicrobial agent development.

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