International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 5.46 Volume 5, Issue 4, April 2018

Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

ANTIMICROBIAL ACTIVITY OF THE LIGANDS, METAL COMPLEXES AND THEIR ADDUCTS WITH BASES AGAINST PHYTOPATHOGENIC FUNGI

Dr. Anita
Assistant Professor
Deptt. of Chemistry Govt. College Dujana ,Jhajjar, - (Haryana)

Abstract

The ligands, metal complexes and their adducts with bases namely, pyridine, 2-methylpyridine and 4-methyl-pyridine were evaluated for their antimicrobial activity against three phytopathogenic fungi viz., Alternaria alternata, Fusarium lycolpersici and Rhizoctonia bataticola and two bacteria viz., Escherichia coli and Xanthomonas compestris Pv. compestris. Stock solutions were prepared by dissolving the compounds in dry DMSO and two fold serial dilution technique (Donald and Williams, 1955) was employed to evaluate the antimicrobial activity. The results obtained were expressed in terms of minimum inhibitory concentration (MIC) values.

The concentration at which complete growth inhibition occurred, was taken as the minimum inhibitory concentration (MIC) value expressed in perimeters.

The results were plotted (concentration vs. compounds) for comparing the activity pattern of different ligands, metal complexes and their adducts and are given in figures

Introduction

Macrocyclic compounds derived from biguanide viz., cyclo(1,2)-dibiguanidinyl bis! 2-hydroxy-w+(benzoy1/4-chlore benzoyl /3-nit robenzoyl/3 ,5-dinitrobenzoyl)acetophenone] (Ly-Lyy) exhibited promising activity against all the test organisms. The compounds could control the growth of microorganism at concentrations ranging from >100 ug ml^{-1} to 12.5 pe ml^{-1}.

Among the fungi, Fusarium lycopersici was the most affected organism as evidenced by the lowest MIC value of 12.5 ug ml^{-1} in this case. 'The ligands were found to be more active against the fungi than the bacteria since the MIC values for the latter varied from >100 to 100 ug ml^{-1}.

Cyclo(1,2)-dibiguanidinyl bis[2-hydroxy-w (benzoyl) acetophenone) (Ly) was most active against Rhizoctonia bataticola with MIC value of 25 ug ml^{-1}, The MIC. values against Aliternaria alternata and Fusarium lycopersici were, 50 and 100 ug ml^{-1}, respectively, whereas the same against bacteria Escherichia coli and Xanthomonas compestris Pv. compestris were >100 ug ml^{-1} each.

Cyclo (1,2)-dibiguanid-inyl bis[2-hydroxy-w-(4-chlorobenzoyl) acetophenone] (Ly y) was most active against Fusarium lycopersici having minimum inhibitory concentration value of 12.5 ug ml^{-1} moderately active against Rhizoctonia bataticola with MIC values of 25 ug ml^{-1} and least active against Alternaria alternate (MIC 50 ug ml^{-1}), The compound exhibited MIC value of 100 ug ml^{-1} against Escherichia coli and Xanthomonas compestris Py. compestris.

Cyclo(1,2)-dibiguanidinyl bis [2-hydroxy-wW-3-nitrobenzoyl) acetophenone] (Lyyy) and cyclo (1,2)-dibiguanidinyl — bisl 2-hydroxy-wW=(3,5-dinitrobenzoyL)

acetophenone) (Lyy) exhibited MIC value of 25 ug ml^{-1} against Alternaria alternata and Rhizoctonia bataticola while the same against Fusarium lycopersici was 50 and 25 ug ml^{-1} in case of L_{III} and L_{IV} respectively.

The compounds L_{III} and L_{IV} were found to be active at 100 ug ml^{-1} against Escherichia coli and Xanthomonas compestris Py. compestris.

The side chain length and the presence of various substituent's on the main nucleus and on the side chain(s) have pronounced impact on the nature and the magnitude of the biological activities (Mitchinson, 1983). Consequently substituting various nuclei of biological importance has emerged as one of the important aspects in the development of new compounds with potential antimicrobial activity.

In the present investigation the macrocyclic ligands were obtained by the condensation of biguanide with diketones substituted at phenyl ring.

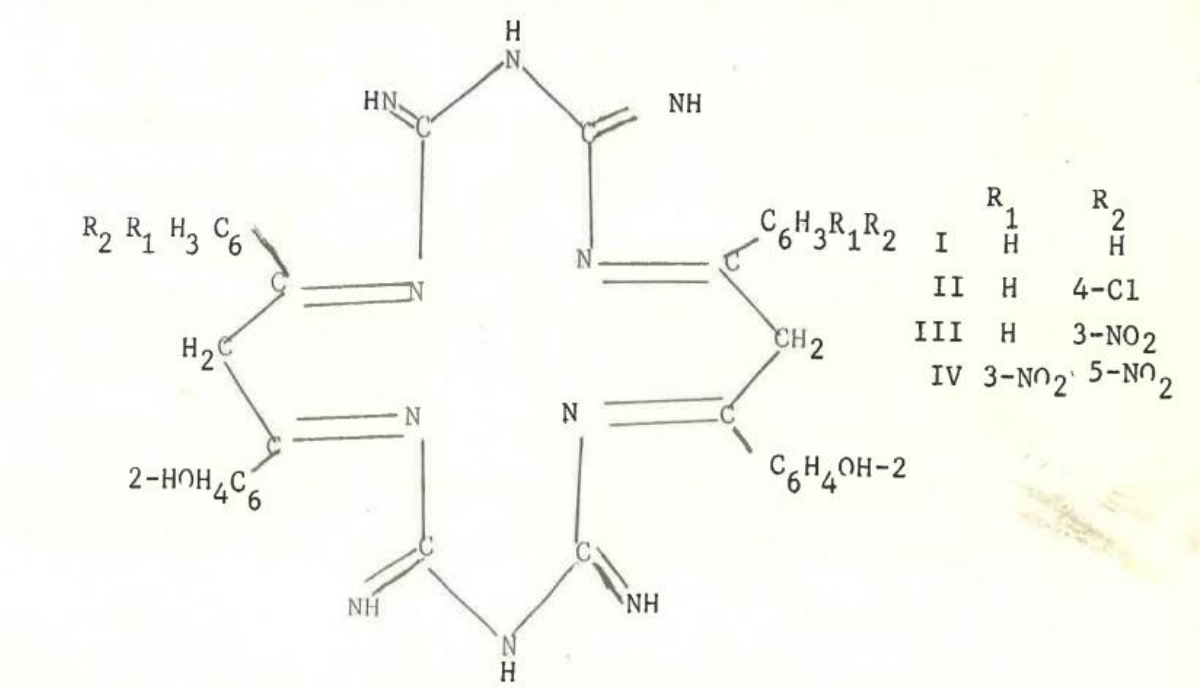


Fig. a

As an outcome, the ligands proved to be quite Promising antimicrobials. However, a comparative study on the effect of substitutions at the phenyl ring did not reveal any significant alteration in the biological activity of the compounds L_I-L_{IV}. No definite structure-activity relationship could, therefore, be established for these compounds.

In addition to the structural modifications, coordination of the bioactive ligands with suitable metal ions significantly alters their activity' pattern (Theorell et al, 1969, Lumme et al., 1984).

ANTIMICROBIAL ACTIVITY OF THE LIGANDS, METAL COMPLEXES AND THEIR ADDUCTS WITH BASES AGAINST PHYTOPATHOGENIC FUNGI

The present investigation was aimed at preparing and screening the antimicrobial activity of the ligands, their complexes with oxovanadium(IV), manganese(II), cobalt(II), nickel(II), copper(II) and zinc(II) and their respective base adducts.

The transition metal complexes of L_I-L_{IV} exhibited MIC values ranging from >100 to 25 ug ml^{-1} against Alternaria alternatia as compared to the free ligands for which the MIG values ranged from 50 to 25 ug ml^{-1}.

The activity of ligand L_I against Alternaria with nickel(II) and copper(II) but no significant alteration was observed on its complexation with oxovanadium(IV), manganese(II), cobalt(II) and zinc(II).

No enhancement in activity of ligand L_{III} and L_{IV} was observed on coordination with transition metal ions. Adducts of the transition metal complexes of ligands showed MIC values in the PES of >100 to 25 ug ml^{-1}.

The pyridine adducts of some of the complexes of cobalt (II), Nickel(II) and zinc(II) exhibited increased antifungnal activity as compared to the free ligands whereas there was no enhancement in the activity of the adducts of oxovanadium(IV), manganese(II) and copper(II) complexes.

The 2-methylpyridine and 4-methylpyridine adducts of cobalt(II) and zinc(II) complexes with cyclo(1,2)-dibiguanidinyl pis[2-hydzoxy-W- (benzoyl) acetophenone exhibited higher activity than the parent ligand.

The Transition metal complexes of ligand L_I-L_{IV} exhibited MIC values varying from >100 to 12.5 mg against Fusarium lycopersici. The activity of ligands LI and LIII was enhanced on coordination with oxovanadium(IV) , manganese(II) and copper(II).

There was no increase in the activity pattern of L_{II} and L_{IV} on coordination with metal ions. Base adducts of oxovanadium(IV), manganese(II);cobalt(II), nickel(IT), copper(II) and zinc(II) complexes of ligands L_I-L_{IV}

exhibited minimum inhibitory concentration values in the range >100 to 12.5 ug ml^{-1} against Fusarium lycopersici.

There was a significant increase in the activity of pyridine and 2-methylpyridine adducts of nickel(II) complexes of cyclo(1,2)-dibiguanidinylbis[2-hydroxy-w-(benzoyl) acetophenone and cyclo(1,2) dibiguanidinyl bis[2-hydroxy-w-(3-nitrobenzoyl) acetophenone(L_{III}) as compared to L_I and L_{III}.

The complexes of cyclo(1,2)-dibiguanidinyl bis[2-hydroxy –w- benzoyl) /4~chlorobenzoy1/3-nitrobenzoyl/3,5-dinitr-obenzoyl) acetophenone] with oxovanadium(IV), manganese(II), cobalt(II) nickel(II), copper(II) and zinc(II) gave minimum |inhibitory

concentration values in range > 100 to 12.5 ug ml^{-1} against Rhizoctonia bataticola. The activity of L_I and L_{II} was significantly enhanced on coordination with manganese(II).

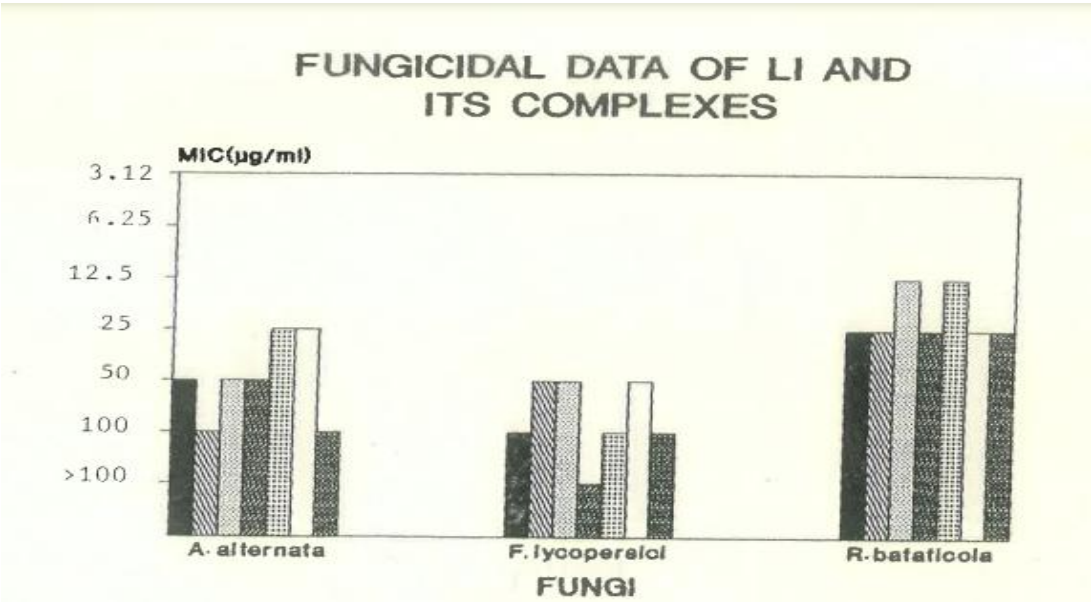
The 2-methyl pyridine and 4-methylpyridine adducts of manganese(II), cobalt(II), nickel(II) and copper(II) complexes showed enhanced activity as compared to parent ligand L_I. The pyridine adducts of the complexes of oxovanadium(IV) and copper(II) with ligand L, also exhibited improved activity. Antifungal activity of the base adducts of manganese(I1) and copper (II) complexes with cyclo(1,2)-dibiguanidinyl bis{2-hydroxy-w- (4-chlorobenzoyl) acetophenone] L_{IV} was higher than that of the parent ligand.

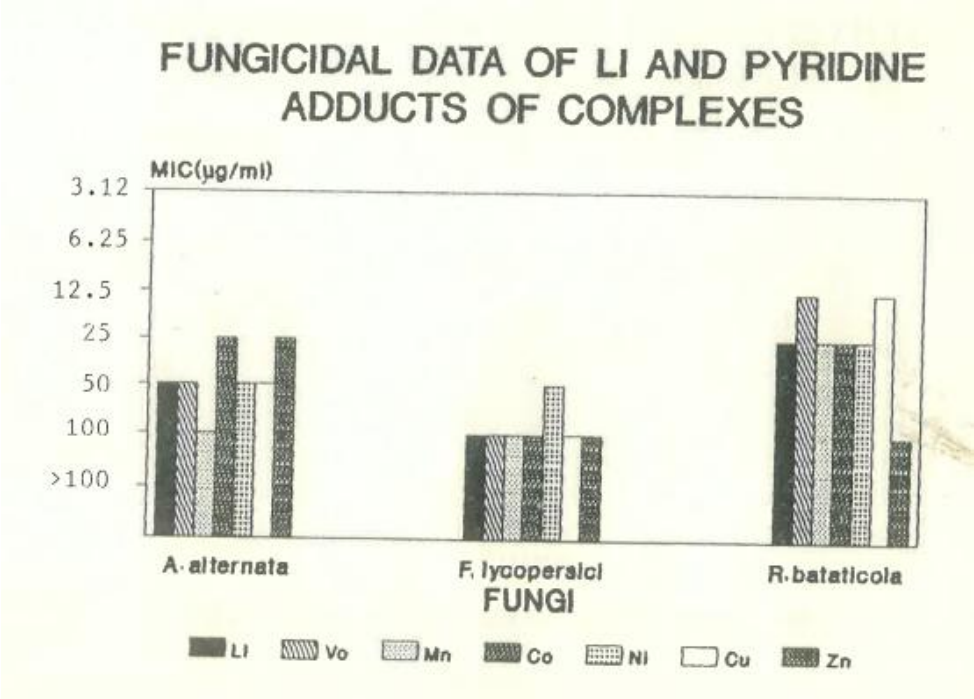
All the metal complexes of ligands L_I-L_{IV} and their respective base adducts were active at 100 to 50 ug ml^{-1} against Escherichia coli and at 100 ug ml^{-1} against Xanthomonas compestris Pv. compestris whereas the values for the parent ligands ranged from >100 to 100 ug ml^{-1} against both the bacteria.

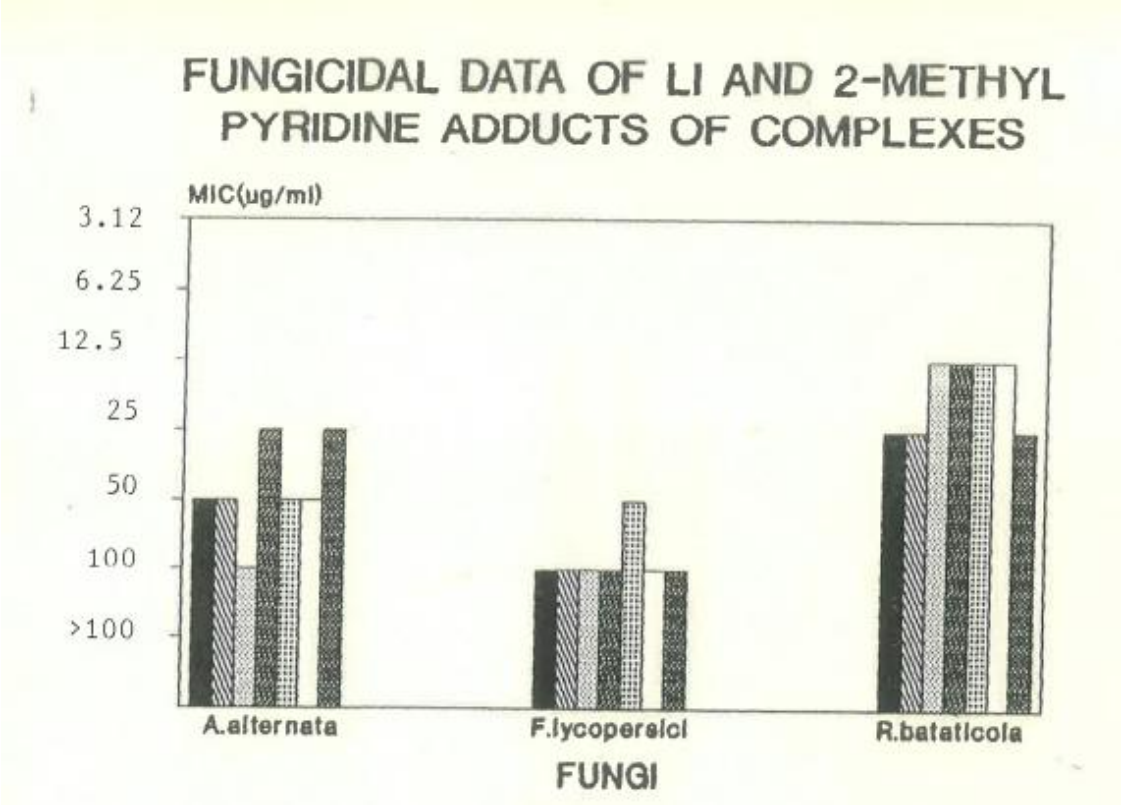
Escherichia coli was more affected organism by the coordination compounds and adducts as compared to Xanthomonas compestris Py. compestris.

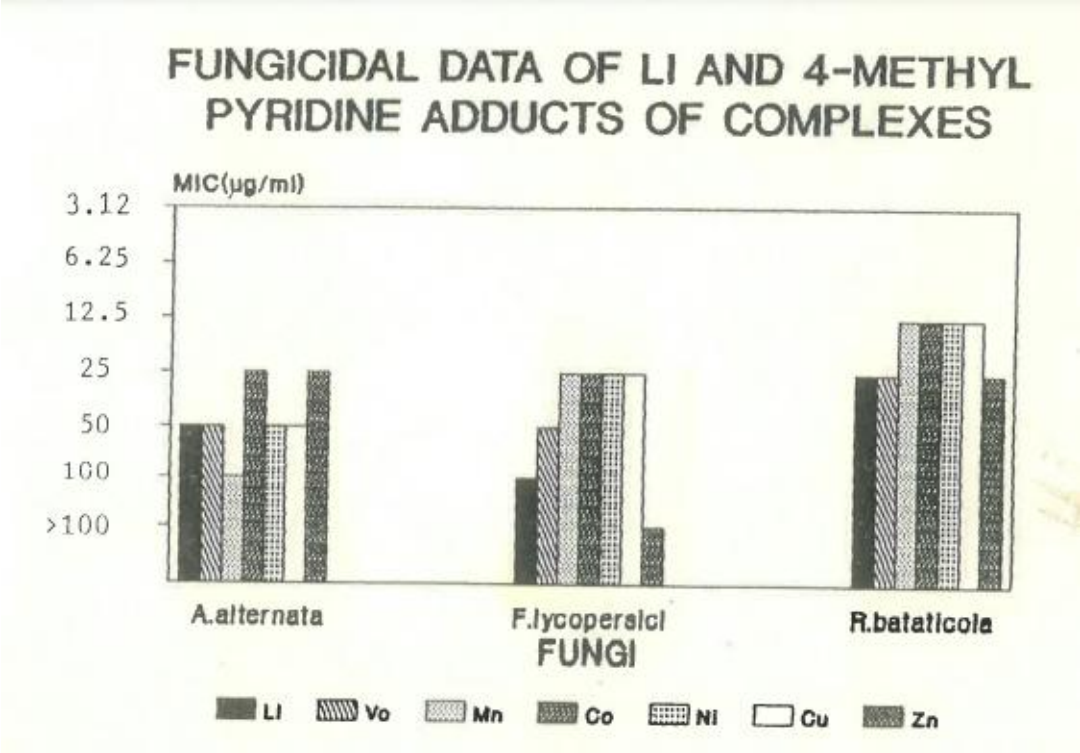
All the ligands, metal complexes and their adducts were less effective fungicides and bactericides than Bavistin [2-(methyoxycarbamoyl) benzimidazole] (MIC value <1.5 ug ml^{-1}) and streptopenicillin (MIC value < 1.5 ug ml^{-1}) which were used as reference fungicide and bactericide, respectively.

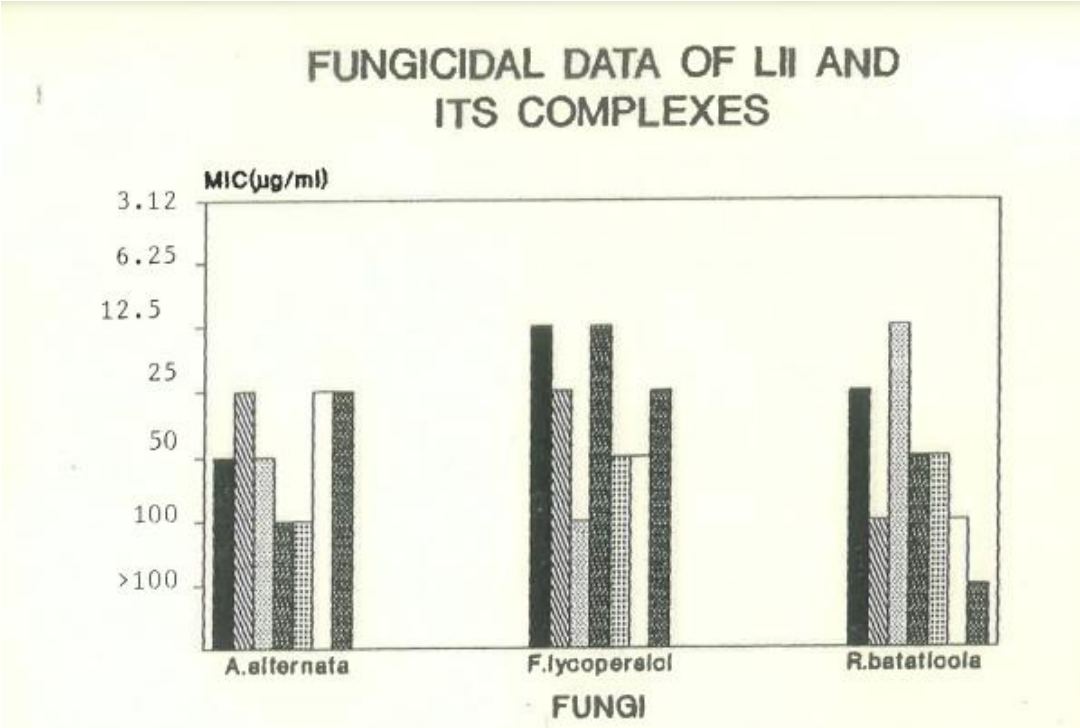
RESULTS

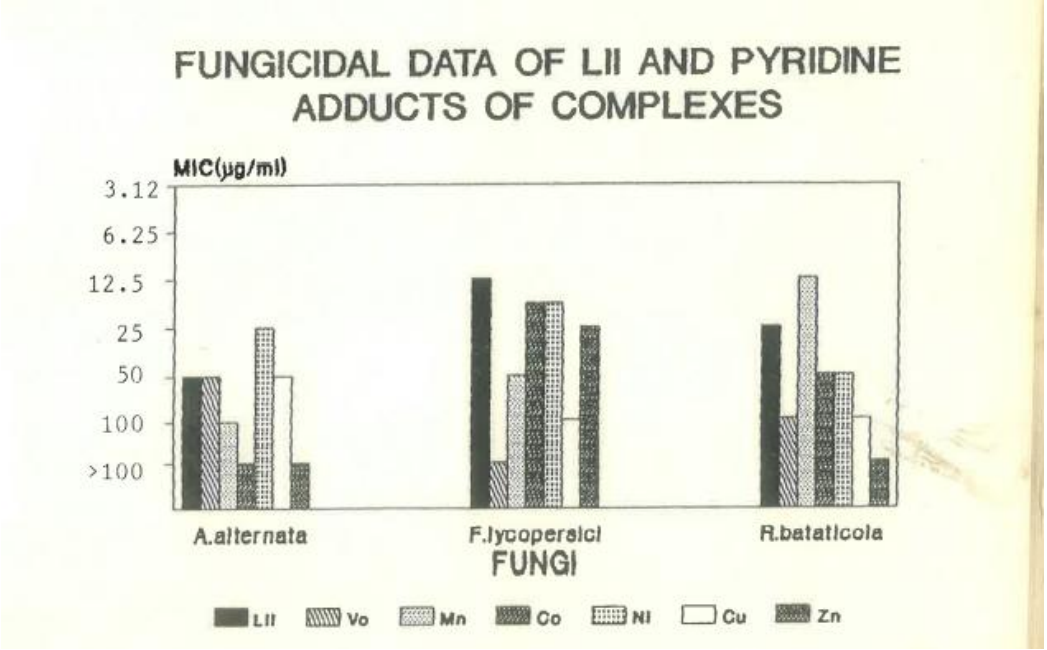



FUNGICIDAL DATA OF LI AND PYRIDINE ADDUCTS OF COMPLEXES
MIC(µg/ml)
3.12
6.25
12.5
25
50
100
>100
A. alternata
F. lycopersici
R. bataticola
FUNGI
LI
Vo
Mn
Co
NI
Cu
Zn


FUNGICIDAL DATA OF LI AND 2-METHYL PYRIDINE ADDUCTS OF COMPLEXES
MIC(µg/ml)
3.12
6.25
12.5
25
50
100
>100
A.alternata
F.lycopersici
R.bataticola
FUNGI


FUNGICIDAL DATA OF LI AND 4-METHYL PYRIDINE ADDUCTS OF COMPLEXES
MIC(µg/ml)
3.12
6.25
12.5
25
50
100
>100
A.alternata
F.lycopersici
R.bataticola
FUNGI
LI
Vo
Mn
Co
Ni
Cu
Zn


FUNGICIDAL DATA OF LII AND ITS COMPLEXES
MIC(µg/ml)
3.12
6.25
12.5
25
50
100
>100
A.alternata
F.lycopersici
R.bataticola
FUNGI



CONCLUSION

Higher activity exhibited by some of the metal complexes as compared to the free ligands may be due to the effect of metal ions on the normal cell process. The polarity of the metal ion is considerably reduced on chelation because of partial sharing of its positive charge with the donor atoms of the ligand and pie-electron delocalization over the whole chelate ring. The chelation increases the lipophilic character of the metal complexes which may lead to the breakdown of permeability barrier of the cell wall resulting in interference with the normal cell process.

REFERENCES

- Curd, F.H.S., Hendry, J.A., Kenny, T.S., Murray, A.G. and Rose, Pot. (1948). Synthetic antimalarials Pare (XXVITI). An 1_ary1-n>-alkyldiguanides. J.
- Das, A., Bagchi, A. and Saha, S.R. (1990). Complexes of the alternaive route to N Chem. Soc., 1630. Shiff base derived from phenylbiguanide and diacetyl-monoxime with copper(II) and nickel(II). Indian J. Chem. 29A: 361-365.
- Donald, G.C. and Williams, A.R. (1955). "Assay Methods of Anti-biotics: A Laboratory Manual". Medical Encyclopedia Inc.
- Drago, R.S. (1971). "Physical Methods in Inorganic Chemistry", Eastwest Press, New Delhi.

- Dudeja, M., Malhotra, R. and Dhindsa, KS.(1993). Synthetic and biocidal studies on novel coordination compounds of substituted 4,5-dihydropyrazoles, Synth. React. Inorg. Met.-Org. Chem., 23(6): 921-935.
- Dutta, R.L, and Bhattacharya, A. (1980). Mixed ligand complexes Part IX Methioninatobis (biguanide) cobalt(III) salts. 429-30. J. Indian Chem. Soc., 57(4).
- Dutta, Rel. and Ray, RK. (1979). Studies in copper(II) chelates-XI. Picolinato mono (biguanide) copper(II). J. Inorg. Nucl. Chem., 41(5): 755.
- Dyer John, R. (1978). "Applications of Absorption Spectroscopy of Organic Compounds", Printice-Hall, New Delhi, 31.
- Ellis, V.M., Vagg, R.S. and Walton, E.c. (1975). J. Inorg. Nucl. Chem., 36: 1031.