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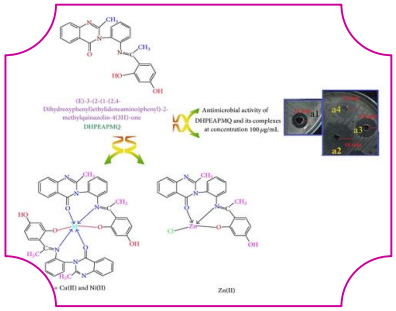
STUDY OF ANTIFUNGAL ACTIVITY AND ANTIBACTERIAL ACTIVITY OF SCHIFF BASE TRANSITION METAL COMPLEXES



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ABSTRACT

The fungi represents important kingdom of living organism and continue a very large and diverse group of living things. The biotic component of the world includes vast variety of living organisms. The biotic component which includes all the living organisms belonging to five kingdoms and abiotic component represented by physical environment are interrelated and interact with each other in the ecosystem.

The kingdom fungi included some of the most important organisms, both in terms of their ecological and economic role. By breaking down dead organic material, they continue the cycle of nutrients through ecosystems. In addition, most vascular plants could not grow without the symbiotic fungi, or mycorrhizae, that inhabit their roots and supply essential nutrients. Other fungi provide numerous drugs (such as penicillin and other antibiotics), foods like mushrooms, truffles and morels, and the bubbles in bread, champagne, and beer. Fungi absorb their food while animals ingest it, also unlike animals, the cells of fungi have cell walls. For these reasons, these organisms are placed in their own kingdom, Fungi, or Eumycota. The external factors such as the composition of the medium used for fungal cultivation, pH value and the temperature influence and the composition of fungal cell walls[1"2].Fungi also cause a number of plant and animal diseases: in humans, ringworm, athlete's foot, and several more serious diseases are caused by fungi. Because fungi are more chemically and genetically similar to animals than other organisms, this makes fungal diseases very difficult to treat. Plant diseases caused by fungi include rusts, smuts, leaf rots and stem rots and may cause severe damage to crops.

KEYWORDS: *living organism and vascular plants , truffles and morels.*

INTRODUCTION

In the present study three fungi were used (1) *Aspergillus niger (A.niger)* (2) *Trichoderma viride* 3) *Fusarium oxysporum,* because of their immense economic importance in industry, agriculture, medicine, food, and nutrition.

1. Aspergillus niger (A.niger)

Aspergillus niger is a fungus and one of the most common species of the genus aspergillus, because of its immense economic importance in industry, agriculture, it has been selected for the present study. Over forty species of genus *Aspargillus* have recorded so far in India. Thorn and Raper[3] recognized more than seventy eight species *o f Aspargillus.* It causes a diseases called as black mold.[4]The genus is widely distributed in nature. The fungus is always associated with food grains, fruits and vegetables during storage and causes spoilage to these stored products. The *Aspergillus niger* commonly grow on fruits, vegetables, pickles, jams, jellies and other food stuffs and produce some toxic substances like aflatoxins which are

carcinogenic in nature. *Aspergillus niger* grow on leather, timber and cloth/fabrics and reduce their commercial value. *Aspergilli* are troublesome as they impart musty odor to shoes and clothing. Aspergillosis is a disease caused due to *Aspergillus fumigatus, Aspergellus flavus, Aspergillus niger* and other species. The Aspergillossis of the lung is common in cattle, sheep, horses and occurs rarely in human being[5] and is much more prevalens in birds. *A.niger* is less likely to cause human disease than some other species. Aspargillossis is frequent among horticultural workers. *A.niger* is one of the most common causes of otmycosis which can cause pain, temporary hearing loss and damage to ear.

2. Trichodermra viride

Trichodermra viride is a fungus and biofungicide Over 32 species of *Trichoderma* have been recorded. Some important species of *Trichodermra Tviride, T.harzianiinu T.hamatum. T.atrovirde, T alamethicins, T beauveha* and *T. metarrhizium* etc. *Trichoderma sp.,* are common in soil ,root ecosystems and are free living fungi. They are highly interactive in root, soil and foliar environments. They produce or release a variety of compounds that induce localized or systemic resistance responses in plants. *Trichoderma* strains have long been recognized as biological agents, for the control of plant disease and for their ability to increase root growth and development, crop productivity, resistance to abiotic stresses, and uptake and use of nutrients, with four different species of *Trichoderma* identified as causes of human disease. Although only rarely pathogenic in humans.

3. Fusarium Oxysporum:-

Fusarium is a large genus of filamentous fungi widely distributed in soil and in association with plants. Most species are harmless saprobes, and are relatively abundant members of the soil microbial community. Some species produce mycotoxins in cereal crops that can affect human and animal health if they enter the food chain. The main toxins produced by these *Fusarium* species are fumonisins and trichothecenes. The name *o f Fusarium* comes from Latin *fusus^* meaning a spindle. *Fusarium oxysporum f.sp. cubense* is a fungal plant pathogen that causes Panama disease of banana *(Musa* spp.), also known as fusarium wilt of banana. Panama disease affects a wide range of banana cultivars, which are propagated asexually from offshoots and therefore have very little genetic diversity. Panama disease is one of the most destructive plant diseases of modern times, and caused the commercial disappearance of the once dominant Gros Michel cultivar.

1) Factors affecting on Fungal Growth -

1. **Temperature :** For any particular organism the minimum and maximum temperatures are the lowest and highest at which growth occurs. The optimum temperature at which the growth rate is high is 20 - 30°C
2. **pH of the Medium :** Enzyme activity is also known to be conditioned **by** the composition of the medium, although different enzymes have different P^H optima for their activity. The general favorable range lies between $P^H = 4$ to $P^H = 8$.
3. **Humidity :** Generally 95 to 100% relative humidity supports best growth of most fungi and those below 80-85% are inhibitory for them.
4. **Concentration:** A few workers have studied the effect of concentration of essential trace elements on the growth of fungi. They recorded that different fungi required different concentrations of trace elements for their optimum growth. Concentrations of essential trace elements higher than the optimum have been found to be inhibitory for the growth of different fungi studied by them.[6]

Experimental:- Antifungal Activity

In the present investigation, free ligands, newly synthesized metal complexes and *Bavistine* were screened for antifungal activity against fungi, *Aspergillus niger, Trichoderma* and *Fusarium oxysporus* at 0.25mg/mL and .50mg/mL concentrations separately. The cultures of the fungi were purified by single spore isolation technique. The concentrations of 0.25mg/mL and .50 mg/mL of each compound in DMSO were

prepared. The fungi toxicity of Schiff bases and metal complexes in liquid medium was studied by the well diffusion method [7]in vitro against *Aspergillus niger, Trichoderma* and *Fusarium.* The Potato dextrose Agar (PDA) medium was used for the growth of fungi.

Preparation of Potato dextrose Agar (PDA) medium

The Potato dextrose Agar (PDA) medium required for the growth of fungi was prepared by dissolving 200 gm of potato 6 gm dextrose, 15 gm agar and 0.5 gm of MgSCU H2O in one liter of sterile distilled water. The Potato dextrose Agar medium are the sources of carbohydrate and nitrogen, they are activators for growth respectively.

Preparation of Sets of Test Samples and Petri plates

All the ligands and the complexes of each Hgand with five different metal ions and antifungal *Bavistine* used for testing their fungi toxicity separately at two different concentration levels i.e. 0.25 mg mL and .50 mg/mL. For each concentration level, there were eleven petri plates each petri plates contain three sample and *Bavistine* taken in single petri plate.

Inoculation and Incubation

The autoclaved petri plates were transferred aseptically to the inoculation chamber where they were exposed to UV light. The stock culture of fungi *A. niger, Fusarium* and *Trichoderma* were collected from the culture unit of the department of Botany, Adarsh college, Omerga itself where these tests were undertaken. The suspension of each microorganism was added to a stirable PDA media then poured into sterile petri plates and left to solidification well was dug in the agar media using sterile metallic borer in each plate. The test solution was prepared by dissolving the compound in DMSO and the w[r]ell was filled with test solution using micro pipette. The plate were incubated for 72 hours at 35°C during this period the test solution diffused and affected the growth the inoculated microorganism. The activity was determined by showing complete inhibition(mm).The growth inhibition was compared with the control.

Antibacterial Activity:

The microorganism are the cause of many infectious diseases. The organism involved many bacteria causing many diseases. The microorganism capable of producing diseases in animal or human beings. The Danish chriantion gram, discovered strain known as gram strain which divide all bacteria u\into two classes [Ci]Gram positive"-and "Gram negative". The biological and medical potency of coordination compound has been established by various microbial activity. The characteristic property has been related to the ability of the metal ion form complex [8].

1.Escherichia coli (E. coli)

The disease causing microorganisms are called pathogens. The growth of pathogens and other harmful bacteria is controlled by antibacterial agents which is essential for survival of the mankind. *Escherichia coli* is a gram-negative rod shaped bacteria is one of the main species of bacteria living in the lower intestines of mammals known as gut flora. When located in the large intestine it actually assists with waste processing vitamin K production and food absorption. *E. coli* discovered in 1885 by Theodor Eschench a German pediatrician and bacteriologist.[9] The *E. coli* strain 0157:H7 is one of hundreds of strains of the bacterium that causes illness in humans.[10] As with all Gram-negative organisms *E.* ***coli*** are unable to sporulate. The enteric *E. coli* are divided on the basis of virulence properties into enterotoxigenic (ETEC causative agent of diarrhea in humans pigs sheep goats cattle dogs and horses) enteropathogenic (EPEC causative agent of diarrhea in humans rabbits dogs cats and horses); enteroinvasive (EIEC found only in humans) verotoxigenic (VTEC found in pigs cattle dogs and cats); enterohaemorrhagic (EHEC found in humans cattle and goats attacking porcine strains that colonize the gut in a manner similar to human EPEC strains) and enteroaggregative *E. coli* (EAEC found only in humans). *E. coli* can generally cause several

intestinal and extra-intestinal infections such as urinary tract infections meningitis peritonitis mastitis septicemia and Gram-negative pneumonia. The antibacterial agents are natural as well as synthetic molecules. The antibacterial agents which are obtained from natural sources are termed as antibiotics. The antibacterial agents may be biotic just inhibiting the growth of bacteria or biocidal and kill the bacteria. Thus treatments which kill all active bacteria such as pasteurization or simple boiling are effective for their eradication without requiring the more rigorous sterilization which also deactivates spores. As a result of their adaptation to mammalian intestines *E. coli* grow best *in vivo* or at the higher temperatures characteristic of such an environment rather than the cooler temperatures found in soil and other environments.

2. *Staphylococcus aureus*

Staphylococcus aureus is spherical bacteria and most common cause of staph infection. *Staphylococcus* is genus of gram -positive bacteria. They appear round form in grape like cluster.[11] *Staphylococcus aureus* is the most common cause of infections. *Staphylococcus aureus* is a spherical bacterium frequently living on the skm or in the nose of a healthy person that can cause a range of illnesses from minor skin infections (such as pimples, boils and cellulitis) and abscesses to life-threatening diseases such as *pneumonia* meningitis endocarditis Toxic shock syndrome (TSS) and *septicemia. S. aureus* was discovered in Aberdeen Scotland in 1880 by the surgeon Sir Alexander Ogston from surgical abscesses.' *S. aureus* when viewed through a microscope and has largened round golden-yellow colonies often with (3-hemolysis when grown on blood agar plates. The golden appearance is the etymological root of the bacteria's name: *aureus* means "golden" in Latin. *S. aureus* is catalase-positive (meaning that it can produce the enzyme catalasc) and able to convert hydrogen peroxide (H2O2) to water and oxygen, which makes the catalase test useful to distinguish staphylococci from enteroeocei and streptococci. *S pseudlntermedius* inhabits and sometimes infects the skin of domestic dogs and cats. This organism, too, can carry the genetic material that imparts multiple bacterial resistance. It is rarely implicated in infections in humans, as a zoonosis. *S. epidermidis,* a coagulase-negative species, is a commensal of the skin, but can cause severe infections in immune-suppressed patients and those with central venous catheters. *S saprophytics*, another coagulase-negative species that is part of the normal vaginal flora, is predominantly implicated in genitourinary tract infections in sexually-active young women. In recent years, several other *Staphylococcus* species have been implicated in human infections, notably *S. lugdunensis, S. schleiferi,* and *S. caprae.* Common abbreviations for coagulase-negative staphylococcus species are CoNS and CNS.It was a wide varity of diseases in human and other animal through either production of penetration staphalaoccol toxin are a common cause of food poisioning, as they can be produced by bacteria growing in improperly stored food items. The most common sialadenitis is caused by staphylococci as bacterial infections.[12]

Test Sample

The antibacterial activity of ligands and metal complexes was tested *myitro* against bacteria such as *staphylococcus aureus* and *Escheria coli,* by well diffusion method.[13] . The compounds were tested at the concentration 0.5mg/mL and 1.00 mg/mL in DMSO and compared with *Cefpodoxime.* The suspension of each microorganism was added to a stirable Nutrient Agar media then poured into sterile petri plates and left to solidification well was dug in the agar media using sterile metallic borer in each plate. The test solution was prepared by dissolving the compound in DMSO and the well was filled with test solution using micro pipette. The plates were incubated for 24 hours at 35°C during this period the test solution diffused and affected the growth the inoculated microorganism. The activity was determined by showing complete inhibition (mm).The growth inhibition was compared with the control. The results obtained were compared with known antibiotics, *Cefpodoxime.* The average value is given in (Table 5).

Preparation of Media

The nutrient agar prepared by dissolving bacteriological peptone (1 g/L), beef extract (5 g/L), sodium chloride (5 g/L) in distilled water and the pH of the solution adjusted to 7.4 by sodium hydroxide (1M) or hydrochloric acid (1M). These solutions were filtered and agar (20 g/L) were added. Then it was sterilized for 30 minutes at 15 lb pressure.

Test organism:

The culture of human pathogenic bacteria *Escherichia coli* and *Staphylococcus species* were collected from department of Microbiology , Adarsh college, Omerga Aseptic techniques [42,4j] were employed to prepare the culture medium of all the test microorganism and the strains were maintained on Nutrient Agar slant at 4 °C.

Medium for Growth: The Nutrient Agar medium was used«for screening the antibacterial activity of *E. coli* and *Staphylococcus species*

Inoculation and Incubation:

Antibacterial activities were studied by the well diffusion method.[13] The nutrient agar medium and petri plates were used. The compounds were dissolved in DMSO making known stock solution. The petri plates fill with nutrient agar media seeded with of *E. coli* and *Staphylococcus species* separately and left to solidification well was dug in agar media using sterile metallic borer in each plate, the test solution filled using micropipette. The plate were incubated 24 hours at 35 C.The inhibition zones were recorded in terms of diameter of zone of inhibition of growth of bacteria. The antibacterial activity of a common standard drug *Cefpodoxime* was also recorded maintaining the same protocol at the same concentrations and solvent.

Table 1

Antifungal Activity of Ligand L_1 and their metal complexes by well diffusion method (%inhibition)

Compound	Aspergillus niger		Fusarium		Trichoderma viride	
	250 ppm	500 ppm	250 ppm	500 ppm	250 ppm	500 ppm
Bavistine	34	41	32	42	35	45
Ligand L_1	12 (35.29)	14 (34.14)	13 (40.42)	15 (35.71)	11 (31.42)	15 (33.33)
$Cu(L_1)_2$	25 (73.52)	29 (70.73)	26 (81.25)	31 (70.80)	26 (74.28)	30 (66.66)
$Ni(L_1)_2$	23 (67.64)	26 (63.41)	25 (78.12)	29 (69.04)	24 (68.27)	27 (60.00)
$Co(L_1)_2$	21 (61.76)	23 (56.09)	21 (65.62)	26 (61.90)	21 (60.00)	24 (53.33)
$Mn(L_1)_2$	17 (50.00)	20 (58.82)	20 (62.50)	24 (51.14)	20 (57.14)	22 (48.88)
$Fe(L_1)_2$	16 (47.05)	19 (46.34)	14 (43.75)	21 (50.00)	16 (45.71)	21 (46.66)

Table 2

Antifungal Activity of Ligand L_2 and their metal complexes by well diffusion method (%inhibition)

Compound	Aspergillus niger		Fusarium		Trichoderma viride	
	250 ppm	500 ppm	250 ppm	500 ppm	250 ppm	500 ppm
Bavistine	34	41	32	42	35	45
Ligand L_2	10 (29.41)	13 (31.78)	11 (34.37)	14 (33.33)	10 (28.57)	14 (31.11)
$Cu(L_2)_2$	21 (61.76)	26 (63.41)	23 (71.87)	26 (61.90)	21 (60.00)	25 (55.55)
$Ni(L_2)_2$	19 (55.88)	23 (56.09)	19 (59.37)	21 (50.00)	20 (57.14)	23 (51.11)
$Co(L_2)_2$	17 (50.00)	23 (54.09)	17 (53.12)	19 (45.53)	17 (48.57)	21 (46.66)
$Mn(L_2)_2$	16 (47.05)	21 (52.31)	16 (50.00)	19 (45.53)	15 (45.85)	18 (40.00)
$Fe(L_2)_2$	12 (35.29)	15 (36.58)	16 (50.00)	17 (40.47)	15 (42.85)	17 (37.77)

Table 3

Antifungal Activity of Ligand L_3 and their metal complexes by well diffusion method (%inhibition)

Compound	Aspergillus niger		Fusarium		Trichoderma viride	
	250 ppm	500 ppm	250 ppm	500 ppm	250 ppm	500 ppm
Bavistine	34	41	32	42	35	45
Ligand L_3	07 (20.28)	08 (19.51)	06 (18.75)	07 (16.66)	07 (20.00)	09 (25.71)
$Cu(L_3)_2$	14 (41.17)	15 (36.58)	13 (40.62)	15 (35.71)	13 (37.14)	16 (35.55)
$Ni(L_3)_2$	12 (35.29)	15 (36.58)	12 (37.50)	14 (33.33)	11 (31.42)	15 (33.33)
$Co(L_3)_2$	11 (32.50)	13 (31.70)	10 (31.25)	13 (54.60)	11 (31.42)	14 (31.11)
$Mn(L_3)_2$	10 (29.41)	12 (429026)	09 (28.12)	12 (28.37)	09 (25.71)	13 (28.88)
$Fe(L_3)_2$	09 (26.47)	11 (26.82)	08 (25.00)	11 (26.19)	08 (22.85)	12 (26.66)

Table 4

Antifungal Activity of Ligand L_4 and their metal complexes by well diffusion method (%inhibition)

Compound	Aspergillus niger		Fusarium		Trichoderma viride	
	250 ppm	500 ppm	250 ppm	500 ppm	250 ppm	500 ppm
Bavistine	34	41	32	42	35	45
Ligand L_4	07 (20.28)	08 (19.51)	07 (21.87)	08 (19.04)	06 (17.14)	07 (15.55)
$Cu(L_4)_2$	13 (38.23)	15 (36.58)	13 (40.62)	15 (35.171)	13 (37.14)	17 (32.77)
$Ni(L_4)_2$	11 (32.50)	15 936.58)	12 (32.50)	15 (35.71)	11 (31.42)	14 (31.11)
$Co(L_4)_2$	09	12	09	12	08	12

	(26.47)	(29.26)	(28.12)	(54.60)	(22.85)	(26.66)
$Mn(L_4)_2$	08 (23.52)	11 (26.82)	08 (25.00)	12 (28.57)	07 (20.00)	11 (24.44)
$Fe(L_4)_2$	08 (23.52)	10 (24.39)	08 (25.00)	12 (28.57)	08 (22.85)	10 (22.22)

Table 5
Antibacterial activity of ligands and their metal complexes (% inhibition)

Compound	Diameter of inhibition zone (mm)			
	Escherichia coli		*Staphylococcus aureus*	
	500 ppm	1000 ppm	500 ppm	1000 ppm
L_1	**10 (25.00)**	**13 (28.90)**	**11 (26.82)**	**15 (31.90)**
$Cu(L_1)_2$	**22 (55.00)**	**25 (54.34)**	**21 (51.21)**	**27 (57.54)**
$Ni(L_1)_2$	**11 (27.50)**	**15 (32.60)**	**13 (31.70)**	**! 20 (42.55)**
$Co(L_1)_2$	**20 (50.00)**	**23 (50.00)**	**21 (51.21)**	**23 (48.93)**
$Mn(L_1)_2$	**20 (50.00)**	**24 (52.17)**	**19 (46.34)**	**22 (46.80)**
$Fe(L_1)_2$	**16 (40.00)**	**18 (23.91)**	**16 (39.02)**	**19 (40.42)**
L_2	**09 (22.50)**	**14 (30.43)**	**10 (24.39)**	**12 (25.73)**
$Cu(L_2)_2$	**18 (45.00)**	**21 (45.65)**	**17 (41.46)**	**22 (46.80)**
$Ni(L_2)_2$	**11 (27.50)**	**14 (30.43)**	**12 (29.26)**	**13 (27.65)**
$Co(L_2)_2$	**17 (42.50)**	**19 (41.30)**	**16 (39.02)**	**18 (38.29)**
$Mn(L_2)_2$	**16 (40.00)**	**17 (36.95)**	**15 (32.60)**	**17 (36.17)**
$Fe(L_2)_2$	**12 (30.00)**	**16 (34.78)**	**12 (29.26)**	**15 (31.90)**
L_3	**11 (27.50)**	**15 (32.60)**	**12 (29.26)**	**IS (38.29) -**
$Cu(L_3)_2$	**23 (57.50)**	**25 (54.34)**	**22 (53.65)**	**28 (59.57)**
$Ni(L_4)_2$	**12 (30.00)**	**16 (34.78)**	**14 (34.14)**	**21 (44.68)**
$Co(L_5)_2$	**21 (52.50)**	**24 (52.17)**	**20 (48.78)**	**24 (50.46)**
$Mn(L_5)_2$	**20 (50.00)**	**24 (52.17)**	**18 (43.90)**	**23 (48.93)**
$Fe(L_5)_2$	**17 (42.50)**	**19 (41.30)**	**15 (32.60)**	**19 (40.42)**
L_4	**10 (25.50)**	**13 (28.26)**	**10 (24.39)**	**13 (27.65)**
$Cu(L_4)_2$	**19 (47.50)**	**22 (47.82)**	**18 (43.90)**	**24 (50.46)**
$Ni(L_4)_2$	**1 1 (27.50)**	**15 (32.60)**	**12 (29.26)**	**14 (29.78)**
$Co(L_4)_2$	**18 (45.00)**	**20 (43.47)**	**17 (41.46)**	**20 (42.55)**
$Mn(L_4)_2$	**17 (42.50)**	**19 (41.30)**	**17 (41.46)**	**20 (42.55)**
$Fe(L_4)_2$	**13 (32.55)**	**15 (32.60)**	**11 (26.82)**	**17 (36.17)**
CEFPODOXIME	**40**	**46**	**41**	**47**

RESULTS AND DISCUSSION

The biological activity of all Schiff bases and their metal complexes were tested against fungi and bacteria.The activity of Schiff bases may arises from the presence of chlorro, nitro, hydroxyl, methoxy group and as well the presence of imine group which import in elucidating the mechanism of transformation reaction in biological system. [14]

In the present investigation all the complexes showed enhanced inhibitory effect against bacteria than the parent Schiff base ligands against the same organism under identical conditions. The increased activity of metal chelates can be explained on the basis of overtone's concept and the Tweedy chelation theory[15.] According to overtone concept of cell permeability, the lipid membrane surrounding the cell favors the passage of only lipid soluble materials which means the lipophillicity is an important factor controlling

antimicrobial activity.[16] The increase in lipophillicity enhance the penetration of metal complex into lipid membrane and block the metal binding sites in enzymes of microorganisms.[17.] 0n chelation, the polarity of metal ion will be reduced to a greater extent due to the overlap of the ligand orbital and partial sharing of its positive charge of metal ion with donor groups. In addition it is also due to the derealization of the ***7c***-electrons over the whole chelating ring enhancing the penetration of the complexes into lipid membrane and blocking the metal binding sites on the enzymes of microorganisms.

These complexes also disturb the respiration process of the cell and thus block the synthesis of proteins which restrict further growth of the organism. Due to these reasons the biological activity of chelating agent is enhanced in presence of the metal.[17] This is a consequence of the increased lipid solubility of the metal complex as compared to the parent ligand. Transport of both metal and ligand across lipophilic membranes to vital intramolecular sites is favored by chelation. The Cu (II)complexes of all ligands shows higher activity. This may be because of the high stability of Cu(II) chelate, than the other complexes. The Co(II) and Mn(II) chelates also show the activity comparable to Cu(II) complex. However, Ni(II) and Fe(III)complex show lowest activity.

The biological activity of free ligands are lower than their respective complexes. Also the activity increases with the increasing concentration of complexes. However the activities are lower than standered antibiotic Cefpodoxime. The toxicity of metal chelates follow the order Cu (II) > Co (II) > Mn (II) > Fe (III) > Ni(II) indicates that the activity is not in accordance with stability order of metal ions.

It is seen that the antifungal activity is susceptible to the concentration of the compound used for inhibition and greatly enhanced at higher concentration. The metal complexes showed better activity than the corresponding ligands. The DMSO has negligible activity at the concentration of 0.5mg/ml.The average value is given in the (Table 1-4). The antifungal activity of these complexes follow the order Cu>Ni>Co>Fe>Mn . Comparison of activities of the ligands and their metal chelates showed that the copper complex is found more active than the ligand, against A.niger. Activity of-ligand against Trichoderma is found to increase after chelation. However the extent of increase is less than that of Aspergillus Niger. Investigation of antifungal activity of the ligands and their metal complexes revealed that all metal chelates were more fungi toxic than their parent ligands. The antifungal activity of the ligand is found to enhance several times on being coordinated with metal ions.

The previous studies show that the presence of nitro, methoxy and halogen groups increases the activity[18]. S.M. Jadhav et.al.[19] studied that chlorine containing compounds with high antifungal activity. Ishwar Patel et.al.[20]showed that presence of nitro, methoxy, halogen group in phenyl ring increase the biological activity. It is also known that hydroxy groups, amino groups, and aromatic rings are particularly important functionalities in biologically active compounds.

In the present study it is clear that the activity of metal complexes depends upon the substituted group. Ligand L_1 containing chloro group shows higher activity than other ligands. Sakina Bootwala et al[21]studied that the high antifungal activity of ligand and its complex may be attributed to chloro substituent. The ligand L_4 and their complexes show lower activity than L_1 . These ligands containing nitro substituent group which is electron withdrawing enhancing the activity of compounds.3-4. L_4 and their complex as show weak activity as they contain weak substituent group. The result evidently shows that the activity of ligand becomes more pronounced and significant when coordinated to metal ion. This enhancement in activity may he due to an efficient diffusion of the metal complex in to the cell and interaction with the cell From the literature survey it is observed that the halogen substituted ligands and their metal complexes show more activity than non substituted ligands and their metal complexes.

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