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Antimicrobial Activity of Tin (IV) Complexes

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ABSTRACT: Tin (IV) phenoxides of composition $SnCl_{4-n}(OC_6H_4\text{-}OMe\text{-}4)_n$ (where n=1,2) have been synthesized by the reaction of $SnCl_4$ and 4-methoxy phenol in benzene under reflux. The complexes have been characterized by elemental analysis, molar conductance measurement, molecular weight determination, IR, ^1H NMR and mass spectral studies. The antibacterial and antifungal activity of these complexes and ligand have been assayed by screening them against bacteria B. subtilis, E.coli and S. aureus and fungi C. albicans and A. niger. In the present work, activities of the synthesized complexes were evaluated by minimum inhibitory concentration (MIC) method using sabouraud agar as nutrient medium. It has been observed that complexes have greater antimicrobial activity than ligand.

Keywords: Tin phenoxide; minimum inhibitory concentration; antibacterial; antifungal activity.

INTRODUCTION: There is a considerable scope for systematic investigation on the synthesis and biochemical applications of the complexes of non transition elements particularly that of tin with biologically active ligands [1-3]. Gielen and co-workers have reported antitumor activity of organo tin (II) and tin(IV) complexes [4]. Survey of literature reveals many works on antimicrobial activity of tin and organotin and their complexes with various ligands [5,6]. Interesting biological properties with important industrial and agricultural application is another interesting feature of tin complexes. These complexes have been extensively studied as wood preservative, fungicides, environmental disinfectant and as an additives in the production of varnishes for ship hulls (antifouling paints) due to their high biological activity [7]. Encouraged by these reports on inorganic tin complexes, it is worthwhile to undertake the synthesis of new complexes of composition $SnCl_{4-n}(OC_6H_4\text{-}OMe\text{-}4)_n$ (where n=1,2) and investigate their biological properties.

EXPERIMENTAL: The synthesis and characterization of complex of composition composition $SnCl_{4-n}(OC_6H_4\text{-}OMe\text{-}4)_n$ has already been reported [8]. The newly synthesized complexes were screened for their antimicrobial activity by using the pyrex glass ware. The cleaned glassware such as test tube, conical flask, pipettes, petridishes, glass rod were placed in an autoclave for sterilization at 121^oC for half an hour under 15 Ibs pressure. The culture media used for slant and broth was sterilized by moist heat sterilization method [9]. The inoculation process was carried out in a well cleaned inoculation chamber.

Preparation of Sample Solution: The solutions of test compound were prepared by dissolving 1.0mg of the sample in 1ml of DMSO. Different dilutions were prepared from the sample solution and testing was carried out using two fold serial dilution techniques [10].

Antibacterial Assay: In order to undertake the antibacterial activities of parent phenol and synthesized complexes, they were tested against pathogenic bacteria such as B. subtilis, S. aureus and E. coli. In the present studies the antimicrobial activity were evaluated by minimum inhibitory concentration (MIC) method using Sabouraud agar as nutrient medium.

The fresh cultures were obtained by inoculation of respective bacteria in double strength broth I.P for 24 hours followed by incubation at 37 ^oC. The stock solution of compounds were serially diluted to get a concentration of 50 to 3.12µg/ml and then inoculated with 100µl of suspension of respective organisms (B. subtilis, S. aureus and E. coli.) in sterile saline. The inoculated tubes were incubated at 37 $^oC$for 24 hours and minimum inhibitory concentration (MIC) were determined i.e the lowest concentration of compound which resulted in complete inhibition of the visible mycelium growth (except for bacteria B. subtilis, which was seen under microscope) after incubation was recorded as MIC values. For antibacterial studies tetracycline, chloramphenicol, kanamycin, cefazoline sodium and cefotaxime were used as standard.

Antifungal Assay: 4-methoxy phenol and complexes were screened for their antifungal activity against two pathogenic fungi, C. albicans and A. niger by MIC method.

Preparation of Medium: The nutrient medium used in present studies consists of following

ingredients 40g/l dextrose, 10g/l peptone, 20g/l agar at pH 5.6. These ingredients were weighed and dissolved in 500ml of distilled water by gentle heating. After complete dissolution more distilled water was added to make the solution 1litre. The medium was heated in an autoclave for half an hour and then transferred in 25 ml portions in previously sterilized conical flasks fitted with cotton plugs. The solution in conical flask was again autoclaved for one hour and then poured in to sterilized petriplates and allowed to solidify. The spores of fungi were placed on the medium spread on petriplates with the help of sterilized inoculum needle and finally placed in the incubator at 25^{o}C.

The results of antifungal activity were compared with standard drug cycloheximide, carbendazim and Fluconazole.

Table 1: Antibacterial activity of 4-methoxy phenol and its complexes with $SnCl_4$ (MIC values in µg/ml)

Compound	B.subtilis	S.aureus	E.coli
4-methoxyphenol	12.50	25.00	25.00
$SnCl_3(OC_6H_4OMe\text{-}4)$	6.25	25.00	12.50
$SnCl_2(OC_6H_4OMe\text{-}4)_2$	12.50	6.25	25.00

Table 2: Antifungal activity of 4-methoxy phenol and its complexes with $SnCl_4$ (MIC values in µg/ml)

Compound	C.albican	A.niger
4-methoxyphenol	25.00	12.50
$SnCl_3(OC_6H_4OMe\text{-}4)$	12.50	6.25
$SnCl_2(OC_6H_4OMe\text{-}4)_2$	6.25	12.50

RESULTS AND DISCUSSION: The results of antifungal and antibacterial activity are shown in Tables 1 and 2. The results of these studies showed that in most of cases complexes have higher activities than free phenol. This may be due to the fact that complexation imparts important characteristics to the ligand which are helpful in its antibacterial and antifungal activity. The enhanced activity of complexes can also be explained on the basis of basicity and structural compatibility. From above Tables it is clear that in most of cases the complexes are more effective than parent phenol and in some cases the complex and phenol has almost same activity. This may be due to their similar liposolubility.

CONCLUSIONS: Complexes of tin are more effective against various bacteria and fungi than phenol.

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