

## SYNTHESIS CHARACTERIZATION AND BIOLOGICAL SCREENING OF ORGANOTIN (IV) COMPLEXES OF HETEROCYCLIC THIOAMIDES

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### ABSTRACT

Synthesis and characterization of some novel di- and triphenyltin(IV) complexes of methyl substituted 1-phenyl tetrazoline-5-thione at various locations in phenyl ring are reported. On the basis of spectroscopic and analytical data pentagonal bipyramidal and octahedral geometry is proposed for the synthesized compounds. The ligands and complexes have been tested for their antibacterial and antifungal activity against various micro organism. The results obtained show that the synthesized compounds have moderate activities against various pathogenic strains like E.coli and S. aureus and poor inhibition against fungi, A. Flavus, A. Parasiticus and C. albicans.

**Key words:** Thioamides, organotin(IV) complexes; Activity; Spectra.

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### INTRODUCTION

The Organotin(IV) complexes are known to possess anti-tumor properties<sup>1-3</sup> and analogous to carboplatin<sup>4-6</sup>. Many di- and tri-phenyl organotin(IV) complexes exhibit maximum anti-tumor activity combined with low toxicity<sup>7-8</sup>. The survey of the literature reveals that little work treating complexes of organotin(IV) with heterocyclic thioamide ligands were since reported<sup>9</sup>. Our interest in this category of ligands is justified by their already reported biological implications<sup>10-13</sup>. The physiologically active tetrazoles (Fig.-1) having thioamide group substituted at various locations with methyl group to correlate the electronic effect of such substituents on the magnitude of the bio activity is reported here in. The new organotin (IV) compounds were screened against gram-negative bacteria Escherichia Coli and, gram-positive bacteria staphylococcus aureus and fungi A. Flavus, A. Parasiticus and C. albicans.

### EXPERIMENTAL

All the reagents and solvents were dried before use. The diphenyltin (IV) dichloride and Triphenyltin (IV) hydroxide(Merck) were commercially available and used without any further purification. The ligands were prepared by the method of Lieber et. al<sup>13</sup> and their sodium salt was prepared by the method of Moore and Robinson<sup>14</sup>.

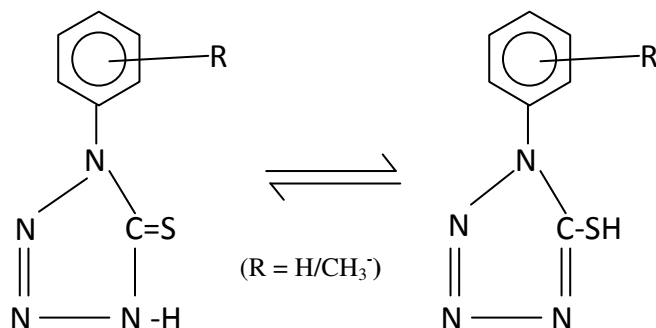


Fig.-1

### Preparation of Complexes

All complexes were prepared using a general method.

The equimolar mixture of diphenyltin(IV) dichloride/ or triphenyltin(IV) hydroxide and ligand were suspended in acetone (150 ml)/ or in methanol(150 ml) containing sodium salt of ligand and the mixture was heated under reflux for two hours. A clear yellow solution was isolated by filtration and concentrated to ~10 ml and kept in a covered beaker for few days. The yellow crystals were collected and dried over anhydrous  $\text{CaCl}_2$  in a vacuo desiccators (yield = 65-67%).

Carbon, hydrogen and nitrogen analysis were done at the micro analytical section of CDRI, Lucknow. The IR Spectra of ligands and complexes were recorded with Perkin Elmer models 577 Spectrophotometer in the range of  $4000\text{--}200\text{ cm}^{-1}$  as KBr pellets. The electronic spectra were recorded with zeiss (Jena) model and molar conductance of complexes were measured in DMF using Wiss-Werkstatter Weithelm obb type LBR conductivity meter.  $^1\text{H}$  NMR Spectra of ligands and complexes were recorded with 90 MHZ NMR Spectrophotometer in  $\text{CDCl}_3$  solution using TMS as the internal indicator in the range of 0-10 PPM.

### RESULTS AND DISCUSSION

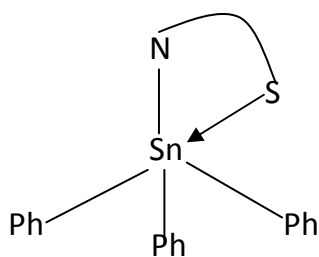
Elemental analysis data suggest 1:1 or 1:2 metal:ligand stoichiometeries having general formula  $[\text{SnPh}_3\text{L}]$  and  $[\text{SnPh}_2\text{L}_2]$  (L= deprotonated ligand) respectively (Table-1). The complexes were isolated as Sparingly soluble, coloured products from the reaction medium. The chelates are stable towards air and moisture. They decompose above  $200^\circ\text{C}$  and are insoluble in most common organic solvents but soluble in DMF and DMSO. The conductivity values for the complexes in DMF ( $6.5\text{--}8.9\ \Lambda^{-1}\text{cm}^2\text{mol}^{-1}$ ) indicate that the complexes are non- electrolyte nature<sup>15</sup>.

The UV/visible spectra of the complexes exhibit broad band at 405-410 nm may be due to charge transfer from filled ligand orbitals to the vacant metal orbitals. The absorption maxima around 265 nm and 305 nm of ligands are shifted to 255-262 nm and 297-300 nm on chelation indicating the presence of coordinated ligand to metal centre.

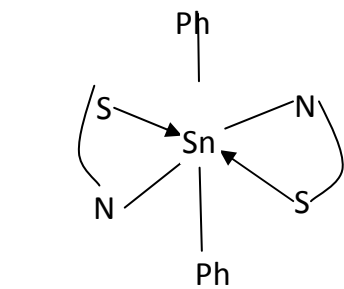
### IR Spectra

The IR bands of free ligands are elaborated and elucidated for comparison. A close examination of spectra of ligands and corresponding complexes indicates simultaneous formation of Sn-N and Sn-S bonds considering our previous observations<sup>16-18</sup> and in earlier assignments reported in literature<sup>19,20,21</sup>. The red shift of thioamide bands I Band III and band IV of ligands and blue shift of thioamide band II confirms bonding through both N and S atoms of thioamide moiety. This is also supported by new bands of medium intensity observed at  $485\text{--}790\text{ cm}^{-1}$  and at  $350\text{--}390\text{ cm}^{-1}$  due to Sn-N and Sn-S stretching modes<sup>22</sup> respectively.

Complexes (S.No.1 to S.No.4) have trigonal bipyramidal structure (Fig.-1) with more electronegative Nitrogen atom at axial position and carbon atoms at equatorial position and others six coordinated complexes have probably trans- octahedral structure (Fig.-3).



Proposed PBP Fig. of  $[\text{SnLPh}_3]$   
(Fig.-2)



Proposed Oh. Fig. of  $[\text{SnL}_2\text{Ph}_2]$   
(Fig.-3)

**<sup>1</sup>H NMR Spectra**

Supplementary data have been obtained by <sup>1</sup>H-NMR Spectroscopy recorded for the ligands and for their metal chelates.

All chelates display broad multiplet in the region  $\delta$ 7.45 -7.77 PPM due to phenyl protons and the signal at  $\delta$ 2.4-2.6 PPM due to methyl protons of coordinated ligand. The broad nature of peak may be due to large quadrupole resonance broadening effect of tetrazole nitrogen atom<sup>23</sup>. The resonances due to imino proton in the ligand observed at  $\delta$ 1.25 PPM is absent in the spectra of the complexes suggesting Sn-N bond and deprotonation of N-H group on complexation. This behaviour is in good agreement with IR spectra of complexes.

Table-1 : Analytical, physical and electronic spectral data of complexes

Complexes/ (Empirical formula)	Colour	Analysis (%) Found/ (Calculated)				$\lambda_{\text{m}}^{\text{2}}$ cm <sup>-1</sup> n
		C	H	N	Sn	
[SnPh <sub>3</sub> L] (C <sub>25</sub> H <sub>20</sub> N <sub>4</sub> S Sn)	Yellow	57.02 (56.95)	3.80 (3.90)	10.62 (10.63)	22.62 (22.53)	6.32
[SnPh <sub>3</sub> (O-CH <sub>3</sub> -L)] (C <sub>26</sub> H <sub>22</sub> N <sub>4</sub> S Sn)	Yellow	57.82 (57.70)	4.11 (4.06)	10.45 (10.35)	22.10 (21.95)	7.25
[SnPh <sub>3</sub> (m-CH <sub>3</sub> -L)] (C <sub>26</sub> H <sub>22</sub> N <sub>4</sub> S Sn)	Yellow	57.77 (57.70)	4.22 (4.06)	10.50 (10.35)	22.16 (21.95)	6.50
[SnPh <sub>3</sub> (P-CH <sub>3</sub> -L)] (C <sub>26</sub> H <sub>22</sub> N <sub>4</sub> S Sn)	Faint yellow	57.80 (57.70)	4.2 (4.06)	10.45 (10.35)	22.22 (21.95)	8.40
[SnPh <sub>2</sub> L <sub>2</sub> ] (C <sub>26</sub> H <sub>24</sub> N <sub>8</sub> S <sub>2</sub> Sn)	Yellow	49.56 (49.46)	3.86 (3.85)	17.88 (17.75)	18.90 (18.82)	8.32
[SnPh <sub>2</sub> (O-CH <sub>3</sub> -L) <sub>2</sub> ] (C <sub>28</sub> H <sub>24</sub> N <sub>8</sub> S <sub>2</sub> Sn)	Dull Yellow	51.42 (51.32)	4.28 (4.27)	17.22 (17.10)	18.44 (18.33)	7.40
[SnPh <sub>2</sub> (m-CH <sub>3</sub> -L) <sub>2</sub> ] (C <sub>28</sub> H <sub>24</sub> N <sub>8</sub> S <sub>2</sub> Sn)	yellowish brown	51.52 (51.32)	4.35 (4.27)	17.35 (17.10)	18.50 (18.30)	6.80
[SnPh <sub>2</sub> (P-CH <sub>3</sub> -L) <sub>2</sub> ] (C <sub>28</sub> H <sub>24</sub> N <sub>8</sub> S <sub>2</sub> Sn)	Brick Colour	51.48 (51.32)	4.35 (4.27)	14.41 (17.10)	18.45 (18.30)	5.40

**Microbiological studies**

All ligands and the synthesized organotin(IV) complexes were examined for their antimicrobial activity against bacteria viz. *E. coli* and *S. aureus* using disc diffusion method<sup>24</sup>. The standard streptomycin was used under similar conditions at 37°C for 48 hours.

The complexes exhibited slightly higher activity than free ligands (Table-3). The increased activity of complexes can be explained on the basis of Tweedys chelation theory<sup>25</sup>. The para-position of benzene of 1-phenyl tetrazoline-5-thione is more active than ortho and meta- positions.

The antifungal activity of ligands and complexes were done by serial dilution method<sup>26</sup> in DMF solvent between 25-200  $\mu\text{g mL}^{-1}$  against fungi *A. Flavus*, *A. Parasiticus* and *C. albicans* using Griscofulvin as standard drug. All synthesized compounds showed very poor inhibition.

Table-2 : IR Spectral data(cm<sup>-1</sup>) of ligands and complexes.

Compds.	Thioamide Bands				VS <sub>Sn-N</sub> / VS <sub>Sn-S</sub> )	$\nu_{\text{NH}}$
	Band I	Band II	Band III	Band IV		
LH (ligand)	1512 s	1280 s	1058 s	785 m	-	3050 mb
[SnPh <sub>3</sub> L]	1480 m	1320 m	1020 m	770 m	495 m (350 m)	-
[SnPh <sub>2</sub> L <sub>2</sub> ]	1485 m	1325 m	1030 m	75 m	485 m (345 m)	
O-CH <sub>3</sub> -LH(ligand)	1500 m	1300 m	1055 m	810 m	-	3090 sb

[SnPh <sub>3</sub> (O-CH <sub>3</sub> -L)]	1885 m	1330 m	1020 m	790 m	490 m (355 m)	-
[SnPh <sub>2</sub> (O-CH <sub>3</sub> -L) <sub>2</sub> ]	1890 m	1325 m	1025 m	795 m	480 m (350 m)	
m-CH <sub>3</sub> -LH (ligand)	1500 s	1285 m	1052 m	790 m	-	3070 sb
[SnPh <sub>2</sub> (m-CH <sub>3</sub> -L) <sub>2</sub> ]	1475 s	1320 m	1020 m	755 m	500 m (380 m)	-
[SnPh <sub>3</sub> (m-CH <sub>3</sub> -L)]	1480 m	1330 m	1025 m	765 m	505 m (385 m)	
P-CH <sub>3</sub> -LH (ligand)	1500 m	1280 s	1044 m	810 m	-	3050 (sb)
[SnPh <sub>3</sub> (P-CH <sub>3</sub> -L)]	1480 m	1310 m	1010 m	785 m	485 m (390 m)	-
[SnPh <sub>2</sub> (P-CH <sub>3</sub> -L) <sub>2</sub> ]	1485 m	1320 m	1020 m	780 m	500 m (400 m)	-

Table-3 : Antibacterial activity of ligands and organotin(IV) complexes at different concentration.

Compounds	Diameter if inhibition(mm)					
	S. aureus			E. Coli		
	.25%	0.5%	1%	.25%	0.5%	1%
LH (ligand)	-	-	+	-	-	-
[SnPh <sub>2</sub> L <sub>2</sub> ]	-	+	++	-	-	+
O-CH <sub>3</sub> -L (ligand)	+	+	++	-	+	+
[SnPh <sub>2</sub> (O-CH <sub>3</sub> -L) <sub>2</sub> ]	+	++	++	+	++	+++
m-CH <sub>3</sub> -L (ligand)	-	+	+	-	-	+
[SnPh <sub>2</sub> (m-CH <sub>3</sub> -L) <sub>2</sub> ]	-	+	++	-	-	+
P-CH <sub>3</sub> -L (ligand)	-	+	++	-	-	+
[SnPh <sub>2</sub> (P-CH <sub>3</sub> -L) <sub>2</sub> ]	+	++	++	-	+	++
Streptomycin (stand.)	++	+++	+++	NT	NT	NT

inhibition diameter in mm; (+) 10-15; (++) 15-20; (+++) 20-30; (-) inactive &lt; 10mm; NT = not tested

## REFERENCES

1. M. Gielen, *Appl. Organomet Chem.*, **16**, 481 (2002).
2. L. Pellerit and L. Nagy, *Coord. Chem. Rev.* **224**, 111(2002).
3. M.J. Clarke, F. Zhu and D.R. Frasca, *Chem. Rev.*, **99**, 2511(1999).
4. R.B. Weiss and M.C. Christian, *Drugs*, **46**, 360(1993).
5. B. Rosenberg, V. van camp, J.E. Trosko and V.H. Mansour, *Nature*, **222**, 385(1969).
6. P.J. Loehrer and L.H. Einhorn, *Ann. Int. Med.*, **100**, 704 (1984).
7. S. David and S. Hanessian, *Tetrahedron*, **41**, 643 (1985).
8. A.J. Crowe, *Appl. Organomet. Chem.*, **1**, 331(1987).
9. M.N. Xanthopoulou, S.K. Hadjikakou, N. Hadjiliadis, E.R. Milaeva, J.A. Gracheva, V. Yu. Tyurin, N. Kourkoumelis, K.C. Christofridis, A.K. Metsios S. Karkabounas and K. Charalabopoulos, *European J. Med. Chem.*, **43**, 327(2008).
10. R.N. Pandey, S.S. Kumar, Pramila Sharma and Renu Kumari, *Int. J. Chem. Sc.*, **11**(1), 665(2013).
11. R.N. Pandey, Pramila Sharma and Renu Kumari, *J. Ultra Chem.*, **9**(1), 49(2013).
12. R.N. Pandey, Pramila Sharma and Manoj Kumar, *J. Ultra Chem.*, **9**(2), 279(2013).
13. E. Leiber, and J. Ramchandran, *Can. J. Chem.*, **37**, 101(1959).
14. C.A. Moore and T.A. Robinson, *Anal. Chim. Acta*, **23**, 533(1960).
15. A. Kriza and C. Parnau, *Acta Chim. Sol.*, **48**, 445(2001).
16. R.N. Pandey, Renu Bala and Anil Kumar Sinha, *Oriental J. Chem.*, **27**(1), 293(2011)
17. R.N. Pandey, A.K. Nag and D.K. Sharma, *Oriental J. Chem.*, **28**(4), 1809(2012).

18. R.N. Pandey, Abhijeet Anand, Rajnish Kr. Singh and Amaresh Kumar, *Asian J. Chem.*, **22**(7), 5601(2010).
19. C.N.R. Rao, R. Venkataraghavan and T.R. Kasturi, *Can. J. Chem.*, **42**, 36(1964).
20. B. Singh, R. Singh, R.V. Choudhary and K.P. Thakur, *Indian J. Chem.*, **11**, 174(1973).
21. U. Agarwala and B. Singh, *Indian J. Chem.*, **7**, 726(1969).
22. A. Finch, R.C. Poller and D. Steele, *Trans. Faraday. Soc.*, **61**, 2628(1965).
23. R.N. Pandey and Sheo Shankar Kumar, *J. Ultra Chem.*, **7**(2), 271(2011).
24. B.A. Arthington, S. Kaggs, M. Motley and C.J. Morrison, *J. Clin. Microbiology*, **38**, 2254(2000).
25. T. Seeworth, H.L.K. wah Bhowon and K. Babooram, *Synth. React., Inorg Het. Org. Chem.*, **30**, 1023(2000)
26. R. Cruickshank, J.P. Marmion and R.H.A. Swain, *Medical Microbiology*, **2**, 190(1970).

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