



## Synthesis, Structure and Biological

### Activity of Some Diorganotin(IV) with Benzamidomethionine

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#### Abstract

New series of diorganotin(IV) complexes of the type  $\text{Ph}_2\text{SnL}_2$ ,  $\text{Bu}_2\text{SnL}_2$  and  $\text{Me}_2\text{SnL}_2$  of the ligand benzamidomethionine ( $\text{L}_\text{H}$ ). Ligand formed by reaction of benzoyl chloride with methionine in presence of sodium hydroxide. The prepared complexes were characterized by elemental analysis, infrared, conductance measurements and nuclear magnetic resonance ( $^1\text{H}$ NMR and  $^{13}\text{C}$ NMR) spectral data. From the spectral measurements, monomer structures for the complexes were proposed. Bidentate and Octahedral geometry was proposed for the complexes prepared. Preliminary in vitro tests for fungicidal activity show that all prepared compounds display good activity to *Gibberela*, *Cercospora arachidicola*, *Physalospora piricola* and *Fusarium oxysporum*. Moreover, the  $\text{Ph}_2\text{SnL}_2$  show a higher inhibition percentage than diorganotin carboxylate.

**Keywords:** Diorganotin(IV), Carboxylate, Spectral studies, Biological activity

#### 1. Introduction

The chemistry of organotin(IV) complexes has developed considerably during the last 30 years, organotin compounds in general and organotin carboxylates in particular continues to grow because of their biological activity and potential antineoplastic and antituberculosis agents (Zhang et al., 2007; Tian et al., 2005; Nathm et al., 2005), PVC stabilizers (Arks et al., 2005; Thoonen et al., 2004; Kuzelova and Vymazal 1999) and anti-tumour drugs (Tabassum and Pettinari 2006) as well as polymer catalysts (Angiolini et al., 2008).

Vast studies have been focused on organotin carboxylates and many of them have been characterized recently either by single crystal structure determination or by spectroscopy (Katsoulakou et al., 2008; Baul et al., 2007). This paper describe the preparation and characterization of benzamidomethionine ( $\text{L}_\text{H}$ ) and its complexes, Diphenyltin(IV) bis(benzamidomethionine) ( $\text{Ph}_2\text{SnL}_2$ ), Dibutyltin(IV) bis(benzamidomethionine) ( $\text{Bu}_2\text{SnL}_2$ ) and Dimethyltin(IV) bis(benzamidomethionine) ( $\text{Me}_2\text{SnL}_2$ ).

#### 2. Materials and methods

##### 2.1 Synthesis of benzamidomethionine

A one gram of methionine was dissolved in (25ml) of 5% NaOH solution in a conical flask. To this mixture benzoyl chloride (2.25ml) was added in a five portions and shaken vigorously until all the chloride has reacted. Acidified with diluted hydrochloric acid and the crude product was washed with cold ether. Finally, the desired product was recrystallized from Ethanol.

##### 2.2 Preparation of Complexes

Complexes were synthesized by dissolving the free ligand (2 mmol) in hot toluene and adding the diorganotin salts (1 mmol) to the solution. The solution was refluxed for 6 hours with magnetic stirrer and then cooled and filtered. The filtrate was reduced under vacuum to a small volume and solid was precipitated by the added of petroleum ether, dried at 60 °C and recrystallized from Ethanol.

#### 3. Instrumentation

Elemental C, H and N analysis were carried out on a Fison EA 1108 analyzer, the FTIR spectra in the range (4000-370)  $\text{cm}^{-1}$  cut were recorded as potassium bromide discs using a Perkin-Elmer spectrophotometer GX, molar conductance measurements were made in anhydrous DMF at 25 °C using Inolop-Cond Level 1 WTW, atomic absorption measurements of the prepared complexes were obtained using Shimadzu 680cc-flame. The  $^1\text{H}$  and  $^{13}\text{C}$  nuclear magnetic

resonance spectra were recorded on a jeol 400 MHz spectrometer, relative to the internal standard tetramethylsilane (TMS). Melting points were determined in open capillary tubes using an electrothermal 9300 digital melting point apparatus.

#### 4. Results and discussion

The ligand was prepared by the reaction of benzoyl chloride with methionine in presence of sodium hydroxide. Table (1) shows the physical data for the ligand and the prepared complexes. The purity of the ligand and its complexes were checked by TLC using silica gel-G as adsorbent. The conductance of these complexes has been recorded in DMF at room temperature in the range 8-20  $\text{ohm}^{-1} \text{cm}^2 \text{mol}^{-1}$ , suggesting their non-electrolytic nature. The data of CHNS and Tin analysis were obtained using flame atomic absorption technique. The calculated values were in a good agreement with the experimental values.

##### 4.1 Infra-Red Spectroscopy

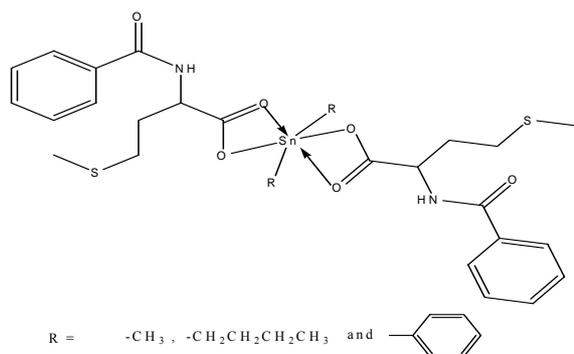
The FTIR spectrum of the ligand, shows a characteristic stretching absorption bands at  $3784 \text{ cm}^{-1}$ ,  $3334 \text{ cm}^{-1}$ ,  $1732 \text{ cm}^{-1}$ ,  $1021 \text{ cm}^{-1}$  and  $800 \text{ cm}^{-1}$  assigned to hydroxyl, N-H, carbonyl, C-O and C-S group respectively. The reaction between this ligand with Diorganotin(IV) gave different types of complexes. In the free ligand, the bands at  $1732 \text{ cm}^{-1}$  and  $1021 \text{ cm}^{-1}$  were assigned to the stretching of C=O and C-O of the hydroxyl in the carboxylate group. On complexation these bands were shifted to a lower frequency region (Masood et al., 2004). This shift is probably due to the complexation of the metal to the ligand through oxygen of the carbonyl group, the disappearance of the hydrogen from hydroxyl group on complexation indicate the complexation is through the oxygen atom. The bands for  $\nu(\text{Sn-C})$  and  $\nu(\text{Sn-O})$  are assigned in the range of (551-573) and (445-494)  $\text{cm}^{-1}$  respectively (Shahid et al., 2002). The IR data of the complexes are shown in Table (2). The Table lists the stretching frequency ( $\nu$ ) for some of the characteristics groups exhibited by the ligand and complexes.

##### 4.2 Nuclear magnetic resonance

The  $^1\text{H}$ NMR spectra for all compounds were recorded in  $[\text{D}_2\text{H}_6]$  DMSO using tetramethylsilane as the internal standard. The data are compiled in Table 3. The conclusion drawn from  $^1\text{H}$ NMR studies of a few compounds lend further support to suggested formation of benzamidomethionine chelate. Ligand ( $\text{L}_\text{H}$ ) give a single resonance near  $\delta$  8.69 ppm attributable to the N-H proton. The spectra also exhibit a singlet -OH peaks at 9.21 ppm due to hydroxy group. The hydroxy resonances is absent in the spectra of the complexes indicating deprotonation and coordination of Tin to the oxygen. There is a small upfield shift of the aromatic protons resonances of the ligand upon chelation with the diorganotin(IV) moiety (Shahid et al., 2002).

Table 4 shows the most relevant  $^{13}\text{C}$  NMR data. Due to scant solubility of the ligand and its complexes, their spectra were recorded in  $[\text{D}_2\text{H}_6]$  DMSO. The C=O resonance group of the complexes at (159.64-160.64) ppm where shifted downfield compared with the position in the free ligand which appeared at 169.64 ppm. It is most likely that shift is due to the decrease of electron density at carbon atoms when oxygen is bonded to metal ion (Masood et al., 2004). This observation lends further evidence that the complexation occurred through the oxygen atoms of the carboxylate group.

On the basis of the preceding discussion, the structure of the complexes suggested as follows:



##### 4.3 Biological activity

Preliminary in vitro tests for fungicidal activity of ligand and complexes have been carried out by the fungi growth inhibition method (Junich et al., 1991). These compounds are dissolved in DMF at a concentration of 50 ppm. The data are summarized in Table 5, and show that all compounds display certain activity to *Physalospora piricola* at a low concentration. Moreover, the  $\text{Ph}_2\text{SnL}_2$  are more active than the other diorganotin derivatives. In addition,  $\text{Ph}_2\text{SnL}_2$  shows the highest inhibition percentage for *Physalospora piricola* (88.4%) in vitro.

## 5. Conclusion

The ligand benzamidoacetic acid was successfully synthesized. The ligand was treated to different diorganotin(IV) oxide metal salts to afford the corresponding complexes. It may be concluded that the ligand coordinated through carboxylate to the Tin atom leading to the formation of four membered ring chelate. Octahedral geometry was proposed for the prepared complexes. Biological activity data have shown that the reported complexes have a significant biological activity against *Gibberella*, *Cercospora arachidicola*, *Physalospora piricola* and *Fusarium oxysporum*.

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Table 1. Physical data for preparation ligand and the complexes prepared.

compound	Color	%Yield	M.P, °C	Found(Calcd.)%				
				C	H	N	S	Sn
L <sub>H</sub>	White	77	178-179	59.56 (56.90)	5.87 (5.97)	5.76 (5.53)	12.54 (12.66)	-
Ph <sub>2</sub> SnL <sub>2</sub>	White	87	130-132	56.12 (55.61)	4.93 (4.93)	4.54 (4.20)	8.43 (8.25)	15.75 (15.17)
Bu <sub>2</sub> SnL <sub>2</sub>	White	86	114-116	51.32 (52.11)	6.25 (6.29)	3.865 (3.80)	9.21 (8.96)	15.96 (16.10)
Me <sub>2</sub> SnL <sub>2</sub>	White	83	121-123	47.55 (47.79)	4.89 (5.24)	4.33 (4.29)	9.74 (9.81)	18.21 (18.17)

Table 2. Characteristic absorption bands of benzamidomethionine and its complexes

compound	O-H	N-H	C=O	C-O	C-S	C-H aromatic	Sn-C	Sn-O
L <sub>H</sub>	3784	3334	1732	1021	800	3071	-	-
Ph <sub>2</sub> SnL <sub>2</sub>	-	3330	1719	1018	800	3074	573	491
Bu <sub>2</sub> SnL <sub>2</sub>	-	3301	1720	1017	801	3069	551	445
Me <sub>2</sub> SnL <sub>2</sub>	-	3325	1721	1016	802	3073	570	494

Table 3. <sup>1</sup>H NMR spectral data (δ,ppm) of the ligand and complexes

compound	O-H	N-H	C-H aromatic	C-(2)H aliphatic
L <sub>H</sub>	9.11	8.69	7.46-7.85	3.92
Ph <sub>2</sub> SnL <sub>2</sub>	-	8.68	7.41-7.78	3.81
Bu <sub>2</sub> SnL <sub>2</sub>	-	8.68	7.39-7.79	3.87
Me <sub>2</sub> SnL <sub>2</sub>	-	8.65	7.36-7.81	8.88

Table 4. <sup>13</sup>C NMR spectral data (δ,ppm) of the ligand and complexes

compound	C=O amide	C=O acid	C-H aromatic	C-H <sub>2</sub> aliphatic
L <sub>H</sub>	163.49	169.64	124.77-130.43	43.44
Ph <sub>2</sub> SnL <sub>2</sub>	163.24	161.75	126.70-133.56	41.07
Bu <sub>2</sub> SnL <sub>2</sub>	164.29	158.75	124.34-131.75	42.31
Me <sub>2</sub> SnL <sub>2</sub>	161.30	162.24	127.35-132.54	41.54

Table 5. Fungicidal activities of prepared compounds

Compound	Inhibition Ratio (%) (50ppm)			
	L <sub>H</sub>	Me <sub>2</sub> SnL <sub>2</sub>	Bu <sub>2</sub> SnL <sub>2</sub>	Ph <sub>2</sub> SnL <sub>2</sub>
<i>Gibberela</i>	14.3	24.4	30.2	33.4
<i>Cercospora arachidicola</i>	12.4	54.2	67.5	41.3
<i>Physalospora piricola</i>	31.5	66.4	76.5	88.4
<i>Fusarium oxysporum</i>	10.5	33.6	40.3	65.3