



Short Communication

Antibacterial and antifungal studies of some derivatives of Tributyltin (IV) of salicylic acid

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Abstract

The organotin compounds are widely used as biocidals. Some derivatives of Tributyltin (IV) of salicylic acid have been synthesized in different molar ratios. The synthesized products were analyzed by elemental analyses and various instrumental techniques. The antibacterial studies of the synthesized derivatives have been evaluated through their Minimum Inhibitory Concentration values both on gram +ve (*Staphylococcus aureus*) and gram -ve (*Escherichia coli*). The antifungal studies of the synthesized compounds have been evaluated through their Minimum Inhibitory Concentration values both on *Aspergillus niger* and *Candida albicans* fungi. These derivatives have shown increased antibacterial and antifungal activities than the ligand.

Keywords: Tributyltin, IR, PMR, antibacterial, antifungal, salicylic acid.

Introduction

The organo-metallic compounds of tin are known to be used as biocidals^{1,2} and pesticides³⁻¹⁰. The organotin hydrides have been used as reducing agent in organic chemistry to reduce alkyl fluorides¹¹ and other halides. Tin can exhibit the covalency higher than four, which is the characteristic of organotin compounds. The research work emphasizes with the antibacterial and antifungal studies of few derivatives of tributyltin of salicylic acid.

Materials and Methods

Synthesis of Tributyltin isopropoxide¹² (TBTIP): 1.6 ml (0.02 M) isopropyl alcohol was taken in a R. B. flask and mixed with 0.46 g (0.02 M) sodium metal with thorough stirring until solution is cleared. 6.5 ml (0.02 M) tributyltin chloride added drop-by-drop to the solution with thorough stirring. The content present in R.B. flask was condensed for two and half hours, a white crystalline precipitate was separated immediately. The filtrate of formed precipitate was undergone vacuum distillation, which prepared a colourless liquid and it was converted to light brown after some time.

Synthesis of Tributyltin (IV) derivatives: TBTIP {1.4 mL (0.004 M)/ 1.4 mL (0.004 M)} and salicylic acid (2-hydroxy benzoic acid) {0.55 gm (0.004 M)/ 0.27 gm (0.002 M)} was dissolved in 15 mL of solvent i.e. dry benzene. The reaction content was condensed for twelve to fourteen hours on wax bath. The product i.e. creamish - brown sticky solid / greenish - yellow liquid was prepared by using the process of azeotropic distillation. The product (solid) so obtained was filtered and

recrystallized with dimethyl formamide solvent. After recrystallization, it was dried in a vacuum desiccator having anhydrous calcium chloride.

Physico-chemical and Spectral Studies: The purity of synthesized products was determined by using thin layer chromatography. The elemental analyses of such derivatives were taken by Carlo Erba Micro Analyser-1108 at the Regional Sophisticated Instrumentation Centre, Central Drug Research Institute, Lucknow. Sn (IV) metal was analyzed by the reaction of the compound with concentrated HNO₃ and concentrated H₂SO₄ followed by reaction with liquid NH₃ to form tin oxide¹³. Infra-Red spectra of obtained derivatives have recorded by Perkin Elmer RX-1 spectrometer and PMR (Proton Magnetic Resonance) spectra have taken by PMR Bruker AC300MHz spectrometer at Regional Sophisticated Instrumentation Centre, Central Drug Research Institute, Lucknow. The molar conductance measurements of these derivatives were taken by Systronics conductivity meter-306.

Results and discussion

The physico-chemical studies of Tributyltin isopropoxide (TBTIP) and the obtained derivatives are shown in the Table-1. The compounds so obtained were stable at room temperature. These are hygroscopic in nature.

These compounds are found soluble in dimethyl formamide and dimethyl sulphoxide, however these are insoluble in water. The molar conductance of compounds is in the range of 4.7 – 5.9 ohm⁻¹cm²mol⁻¹ which indicate their behaviour as non-electrolytes¹⁴.

Infra-red spectral data: TBTIP: Bands (w) at 2905 cm^{-1} and 2865 cm^{-1} owing to C-H stretching vibrations of $-\text{CH}_2-$ and $-\text{CH}_3$ regarding $-\text{C}_4\text{H}_9$ group^{15,16}, band (s) at 1380 cm^{-1} owing to the C-H bending vibration of $(\text{CH}_3)_2\text{C}-$ of the iso-propoxy group¹⁷, band (w) at 1145 cm^{-1} owing to C-O vibration of the iso-propoxy group¹⁷, band (m) at 630 cm^{-1} and band (w) at 615 cm^{-1} correspond to $\nu \text{ Sn} - \text{C}$ ¹⁸, band (w) at 545 cm^{-1} and band (s) at 465 cm^{-1} correspond to $\nu \text{ Sn} - \text{O}$ ¹⁹.

Tributyltin (IV) Derivatives: Band (m) at 3040 cm^{-1} owing to C-H stretching vibrations regarding benzene ring^{15,17}, bands (w) at 2915 cm^{-1} and 2840 cm^{-1} due to C-H stretching vibrations regarding $-\text{CH}_2-$ and $-\text{CH}_3$ of the butyl group^{15,16}, band (s) at 1240 cm^{-1} due to the C-O of the hydroxy group¹⁷, band (s) around at 1430 cm^{-1} owing to $\nu_{\text{as}}\text{COO}$ stretching vibrations, band (s) at 1640 cm^{-1} due to $\nu_{\text{as}}\text{COO}$ stretching vibrations²⁰, $\Delta\nu\text{COO}$ of about 210 cm^{-1} owing to bridged carboxylate group²¹, peak (m) at 640 cm^{-1} and peak (w) at 625 cm^{-1} owing to $\nu \text{ Sn} - \text{C}$ ¹⁸, peak (w) at 545 cm^{-1} and peak (s) at 450 cm^{-1} owing to $\nu \text{ Sn} - \text{O}$ ¹⁹.

The broad band around 3500-3200 cm^{-1} shown in 2:1 derivative was absent due to $-\text{OH}$ group which indicates possible bonding of oxygen of $-\text{OH}$ group to tin, however, this band was present in corresponding 1:1 product at 3495 cm^{-1} .

PMR spectral data: TBTIP: A multiplet is appeared between 1.09 – 1.55 ppm due to the protons of $-\text{C}_4\text{H}_9$ group²² bonded to tin and a multiplet in the region 0.80 – 1.40 ppm due to protons of iso-propoxy group.

Tributyltin (IV) derivatives: A multiplet is appeared in the region 7.10 – 7.80 ppm due to benzene ring, a multiplet between 0.95 – 1.40 ppm in 1:1 derivative and 1.00 – 1.30 ppm in 2:1 derivative due to $-\text{C}_4\text{H}_9$ group²² bonded to tin and a hump at 6.40 ppm in 1:1 compound due to hydroxy group and it was not shown in the corresponding 2:1 derivative.

Antibacterial and Antifungal Activities: The antibacterial studies of the synthesized derivatives have been evaluated through their Minimum Inhibitory Concentration values both on gram +ve (*Staphylococcus aureus*) and gram -ve (*Escherichia coli*). The antifungal studies of the synthesized compounds have been evaluated through their Minimum Inhibitory Concentration values both on *Aspergillus niger* and *Candida albicans* fungi. For this purpose, serial dilution method²³⁻²⁴ is used. A comparative study of antibacterial and antifungal studies (Table-2) indicates the enhancement of such activities of tributyltin (IV) derivatives as compared to ligand.

Table-1: Physico-chemical Data of Tributyltin (IV) compounds

Name of Compound (Molecular Formula) Ratio	Colour of compound	Melting point/ Boiling point ($\pm 2^\circ\text{C}$)	% Analysis Found/ (Calculated)		
			C	H	Sn
TBTIP ($\text{C}_{15}\text{H}_{34}\text{OSn}$)	Light brown liquid	126 at 5 mm	52.10 (51.62)	10.28 (9.75)	33.50 (34.04)
$\text{Bu}_3\text{Sn}(\text{LH})$ ($\text{C}_{19}\text{H}_{32}\text{O}_3\text{Sn}$) 1:1	Creamish- brown sticky solid	--	53.70 (53.43)	7.78 (7.49)	27.22 (27.82)
$(\text{Bu}_3\text{Sn})_2\text{L}$ ($\text{C}_{31}\text{H}_{58}\text{O}_3\text{Sn}_2$) 2:1	Greenish- yellow liquid	--	52.42 (52.00)	8.50 (8.11)	32.95 (33.18)

Note: Melting point/boiling point of derivatives (2, 3) could not be determined due to their decomposition.

Table-2: Antibacterial and Antifungal Activities (MIC in molar concentration $\times 10^{-5}$) of TBTIP and Tributyltin (IV) Derivatives of Salicylic Acid.

Compound	Bacteria		Fungi	
	<i>Staphylococcus aureus</i>	<i>Escherichia coli</i>	<i>Aspergillus niger</i>	<i>Candida albicans</i>
TBTIP	3.58	7.16	7.16	3.58
$\text{Bu}_3\text{Sn}(\text{LH})$ 1:1	1.46	1.46	1.46	1.46
$(\text{Bu}_3\text{Sn})_2\text{L}$ 2:1	0.43	0.43	0.43	0.43

Conclusion

The discussion shows that the compounds so obtained were found stable at room temperature. The antibacterial and antifungal activities of tributyltin(IV) derivatives of salicylic acid are greater than their corresponding ligands.

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