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SYNTHESIS, CHARACTERIZATION, AND ANTIBACTERIAL PROPERTIES OF ORGANOTIN(IV) POLYNUCLEAR COMPLEXES CONTAINING DIVERGENT ORGANIC LINKERS

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Introduction

Organotin(IV) complexes are of great interest due to their structural diversity, as well as catalytic and biological properties. Sn(IV) atoms form stable complexes with unique structures. The organotin(IV) halides, an important class of precursors, are used to prepare organotin complexes, which can be obtained by replacing halogen atoms with nucleophilic groups, such as RCOO-, NCO-, OH-, RS- etc. A new series of coordination compounds with different organotin(IV) subunits as nodes and fumarate or succinate anions as spacers were prepared.
The influence of the organotin(IV) nodes on the structural properties of the new systems was investigated. The ligands, metal precursors, and their corresponding organotin(IV) complexes have also been screened for antibacterial activities.

Materials and methods

Starting from different organotin(IV) halides, such as Ph_3SnCl, Me_3SnCl, and Bu_3SnCl, along with fumarate or succinate anions as divergent spacers, five new organotin polynuclear coordination compounds were obtained.
Spectral measurements. The IR spectra of the samples were recorded in the range 4000-400 cm^{-1} using a Tensor 27 spectrophotometer with Fourier transform (FTIR) from Bruker, OPUS software and KBr pills as a reference.
Single crystal X-ray diffraction. The structures of the compounds were determined by single-crystal X-ray diffraction with a STOE IPDS II diffractometer, using the ShelX-97 and Diamond 3 softwares for calculations and graphical representations.
Magnetic resonance spectroscopy. The ^{1}H and $^{13}C\{^{1}H\}$ NMR spectra were recorded with a 400 MHz and 600 MHz Bruker Avance III instruments, while the ^{119}Sn NMR spectra were recorded with a 400 MHz Bruker Avance III apparatus.
Biological activity. Antimicrobial activities of the ligand and complexes were tested against bacteria (*Escherichia coli*, *Bacillus subtilis*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*), as well as fungi (*Candida albicans*) by disc diffusion method and minimum inhibitory concentration (MIC).

Results and conclusions

A new series of coordination compounds with different organotin(IV) knots and dicarboxylate anions as spacers were prepared and characterized. The structural characterization was performed via X-ray diffraction on single-crystal. Compound **1**, $[(Ph_3SnCl)_2(\mu_4\text{-fumarate})[(Ph_3Sn\text{-bipy})_2]$, a 0-D complex, contains a tetranuclear triphenyltin(IV) fumarato-cluster. The tin atoms have trigonal bipyramidal geometry, with the phenyl groups in equatorial positions and an oxygen atom from the fumarate ligand in one axial position. The second axial position is occupied at two opposing tin atoms by the monodentate 4,4'-bipyridyl ligand, and at the other two tin atoms by chlorine atoms maintained from the starting reagent. Complex **2**, $^1{}_\infty\{[Ph_3Sn(CH_3OH)]_2(\mu_4\text{-fumarate})[(Ph_3Sn)_2(\mu_2\text{-fumarate})]\cdot CH_3OH\}$, is a coordination chain in which the tetranuclear triphenyltin(IV) fumarato-clusters from compound **1** are linked by bidentate fumarate linkers. Replacing the starting reagent Ph_3SnCl with Me_3SnCl and Bu_3SnCl, respectively, two new compounds have been obtained, $^2{}_\infty[(Me_3Sn)_2(\mu_2\text{-fumarate})]$, (**3**), and $^3{}_\infty[(Bu_3Sn)_2(\mu_2\text{-fumarate})]$, (**4**). Compound **5**, $^3{}_\infty[(Bu_3Sn)_2(\mu_2\text{-succinate})]$ is a tetranuclear complex consisting of 4 organotin knots with equivalent atoms, connected by deprotonated organic acid - succinate dianion - coordinated as tetradentate bridge. The 3-D extended structure of **5** is depicted in Figure 1.

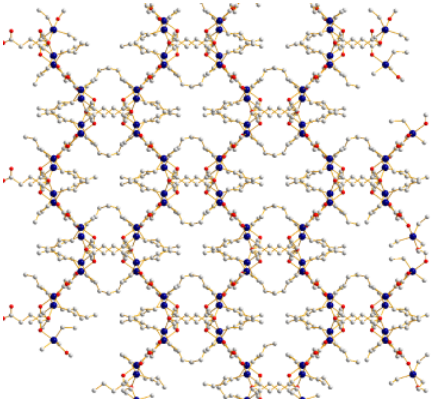

Fig.1. Molecular structure of compound **5**

The obtained compounds were analyzed by elemental analysis, IR spectroscopy, as well as nuclear magnetic resonance spectroscopy. As methods for analyzing the biological activity of organotin compounds (IV) were used qualitative and quantitative testing of antimicrobial activity. Following quantitative screening, good results were obtained for complex 2 on *Staphylococcus aureus* and *Candida albicans* strains, with a minimum inhibitor concentration of 31.25 µg / mL and 62.5 µg / mL, respectively.