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Binuclear diphenyltin(IV)dithiocarbamate complexes bearing functionalized linkers: Synthesis, spectral characterization, DFT and in vitro anticancer activity

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Abstract

A new series of diphenyltin(IV)dithiocarbamate complexes of the type $[(Ph_2Sn)_2$-μ^2-bis{(κ^2S,S-$S_2CN(R)CH_2CONHC_6H_4)_2SO_2$}] {R = Cy (**1**), ^{i}Pr (**2**), ^{n}Bu (**3**)} and $[(Ph_2Sn)_2$-μ^2-bis{(κ^2S,S-$S_2CN(R)CH_2CONH)_2C_6H_4$}] {R = Cy (**4**), ^{i}Pr (**5**)} has been efficiently synthesized and characterized by the relevant spectroscopic (^{1}H, ^{13}C, ^{1}H DOSY, ^{119}Sn NMR, ESI MS, UV–visible absorption, IR) and thermogravimetric methods. Density functional theory level calculations have been carried out to reinforce the experimental data. Compounds have been screened for their *in vitro* anticancer ability against a malignant human tumor HepG2 (hepatoma) cell line by MTT assay. Remarkably, the anticancer activities of binuclear organotin(IV)dithiocarbamate complexes **1–5** are evidently boosted as high as 22-fold in **1** (3.32 ± 0.14 μM), 44-fold in **2** (1.77 ± 0.11 μM), 37-fold in **3** (2.02 ± 0.47 μM), 8 fold in **4** (8.72 ± 0.19 μM) and 29-fold in **5** (2.60 ± 0.67 μM), compared with the reference drug cisplatin (75.67 ± 0.51 μM). Morphological proofs like shrinking of cells specifies the induction of apoptosis as part of the mechanism of action of these compounds, which is further reinforced by the individual staining of the cells by acridine orange/ethidium bromide.

Keywords: dithiocarbamate; thermogravimetric; hepatoma; acridine;thermogravimetric