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# Synthesis, spectral characterization and biological activities of Organotin(IV) complexes with *ortho*-vanillin-2-hydrazinopyridine (VHP)

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## ABSTRACT

**Five new organotin(IV) complexes of *ortho*-vanillin-2-hydrazinopyridine hydrazone with formula [$R_nSnCl_{4-n}$(VHP)] [R = $Me_2$, n = 2 (2); R = $Ph_2$, n = 2 (3); R= $nBu_2$, n = 2 (4); R = *n*Bu, n = 2 (5) and R = 1, n = 0 (6)] have been synthesized by direct reaction of *ortho*-vanillin-2-hydrazinopyridine hydrazone [(VHP), (1)], base and organotin(IV) chloride(s) in absolute methanol. The hydrazone ligand [(VHP), (1)] and its organotin(IV) complexes (2-6) have been characterized by UV-Visible, FT-IR and $^1$H NMR spectral studies. Spectroscopic data suggested that in the complexes (2-4), the ligand (1) acted as a neutral bidentate ligand and is coordinated to the tin(IV) atom *via* the azomethine nitrogen and pyridyl nitrogen atoms, whereas the ligand (1) acted as a uninegative tridentate ligand and coordinated to the tin(IV) atom through phenolic-O, azomethine-N and pyridyl-N atoms in complexes (5-6). The toxicity of the ligand (1) and its organotin (IV) complexes (2-6) were determined against *Artemia salina.* Organotin(IV) complexes showed moderate activity against *Artemia salina*. The ligand (1) and its organotin(IV) complexes (2-6) were also tested against four types of bacteria namely *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli* and *Enterobacter aerogenes.* All organotin(IV) complexes and the free ligand (1) showed better antibacterial activities against bacteria. Among the organotin(IV) complexes (2-6), diphenyltin(IV) complex (3) showed higher activity against the four types of bacteria.**

**Keywords:** Hydrazone; Organotin(IV) Complexes; Spectral Analyses; Toxicity; Antibacterial Activity

## 1. INTRODUCTION

*Ortho*-vanillin is an organic compound which can be found in the extracts and essential oils of many plants (**Figure 1**) [1]. This type of vanillin is differing from ordinary vanillin (4-hydroxy-3-methoxybenzaldehyde) where the hydroxyl group is in the *para*-position.

Many researches have been used 4-hydroxy-3-methoxybenzaldehyde (vanillin) to synthesize of transition metal complexes with hydrazone ligands but less research using *ortho*-vanillin. The *ortho*-vanillin Schiff base derivative and its Cu(II) complexes were conducted by Nives Galić *et al*. [2]. They studied the tautomeric and protonation equilibria of *ortho*-vanillin Schiff base derivative and its Cu(II) complexes. Vanillin-thiosemicarbazone and its organotin(IV) complexes have been synthesized by Singh *et al*. [3]. The author found that all organotin(IV) complexes showed higher activity toward tested bacteria (*Bacillus cereus*, *Nocardia sp*. and *Enterobacter aerogenes*) than the free ligand. Thiyagarajan *et al*. [4] also were synthesized novel hydrazones from piperidine-4-carboxylic acid methyl ester coupled with 2-chloro pyrimidine along with other vanillin derivatives. They stated that the hydrazone derivatives of vanillin possess antibacterial activities.

To the best of our knowledge, no work has been done on the synthesis of organotin(IV) complexes with *ortho*-vanillin-2-hydrazinopyridine ligand. Therefore, the authors are interested to synthesize, characterize and also to study the biological activities of organotin(IV) complexes of *ortho*-vanillin-2-hydrazinopyridine derivatives against *Artemia salina* and different types of bacteria.

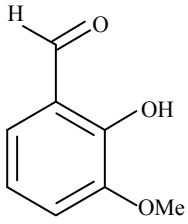


**Figure 1.** Structure of *ortho*-vanillin (2-hydroxy-3-methoxy- benzaldehyde).

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## 2. EXPERIMENTAL

### 2.1. Materials and Methods

2-hydrazinopyridine, 2-hydroxy-3-methoxybenzaldehyde (*ortho*-vanillin) and organotin(IV) salts were purchased from Fluka, Aldrich, Merck and used without further purification. All solvents were purified according to standard procedures [5]. The melting point was measured using open capillary in Stuart MP3. UV-Vis spectra studies were measured using Perkin Elmer Lambda 25 ranging 200 - 800 in DMF. The molar conductance values of all compounds were measured using Jenway 4510 conductivity meter. The FT-IR spectra were obtained on KBr discs using a Perkin Elmer Spectrum GX Fourier-Transform spectrometer (4000 - 370 $cm^{-1}$). $^1H$ NMR spectra were recorded in DMSO-$d_6$ solution on a JEOL 500 MHz NMR spectrophotometer.

### 2.2. Synthesis of *Ortho*-vanillin-2-hydrazinopyri-dine $[C_{13}H_{13}N_3O_2]$ (1)

2-hydrazinopyridine (0.546 g, 5 mmol) was dissolved in 20 mL of absolute ethanol before mixing it with 20 mL of ethanolic solution of *ortho*-vanillin (0.761 g, 5 mmol). Then, 2 - 3 drops of glacial acetic acid was added in the reaction mixture. The mixture was heated under reflux for 5 h (**Scheme 1**). The solution was allowed to cool to room temperature for 30 minutes. White light precipitate formed was filtered off and washed several times using absolute ethanol. The white precipitates obtained were purified by recrytallization from hot ethanol and dried *in vacuo* over silica gel. Yield: 1.95 g, 75%, mp: 165˚C - 166˚C; UV-Visible (DMF) $\lambda_{max}$: 335 nm; IR (KBr, $cm^{-1}$) $\nu_{max}$: 3446 (br, OH), 3191 (s, NH), 1603 (s, C=N), 991 (w, N-N), 728 (s, pyridine in plane); $^1H$ NMR (DMSO-$d_6$) $\delta$: 10.89 (s, 1H, OH), 9.98 (s, 1H, NH), 8.29 (s, 1H, HC=N), 8.12 (d, 1H, Py-H6), 7.65 (t, 1H, Py-H5), 6.77 - 7.20 (m, 5H, pyridine-H/aromatic-H), 3.80 (s, 3H, CH3) ppm.

### 2.3. Synthesis of $[Me_2SnCl_2(C_{13}H_{13}N_3O_2)]$ (2)

The ligand [(VHP), (1)] (0.486 g, 2 mmol) was dissolved in 20 mL of absolute methanol in a Schlenk round bottom flask. Then, 10 mL of methanolic solution of potassium hydroxide (0.11 g, 2 mmol) was added dropwise and the colour of the solution changed to light yellow. The resulting solution was refluxed for 1 h under a nitrogen atmosphere. Then, a methanolic solution of dimethyltin(IV) dichloride (0.440 g, 2 mmol) was added dropwise. The solution colour change from light yellow to darker yellow and immediately formed yellow precipitate. The resulting solution was refluxed for 3 hours (**Scheme 2**) and allowed to cool to room temperature. The yellow precipitates obtained were filtered off, washed with pentane, and dried *in vacuo* over silica gel. Yield: 0.62 g, 60% mp: 128˚C - 130˚C; Molar conductance (DMF) 2.56 Ω-1 $cm^2$ $mol^{-1}$; UV-Visible (DMF) $\lambda_{max}$: 335, 470, 497 nm; IR (KBr, $cm^{-1}$) $\nu_{max}$: 3370 (br, OH), 3193 (m, NH), 1604 (s, C=N), 1011 (w, N-N), 730 (s, pyridine in plane), 497 (m, Sn-N); $^1H$ NMR (DMSO-$d_6$) $\delta$: 10.90 (s, 1H, OH), 10.00 (s, 1H, NH), 8.29 (s, 1H, HC=N), 8.14 (d, 1H, Py-H6),7.63 (t, 1H, Py-H5), 6.75 - 7.20 (m, 5H, pyridine-H/aromatic-H), 3.80 (s, 3H, CH3), 1.034 (s, 3H, Sn-CH3) ppm.

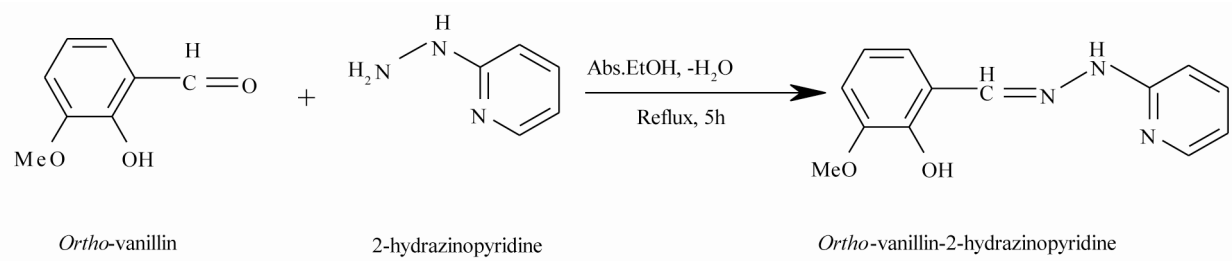
The other complexes (3-4) were synthesized using a similar procedure to organotin(IV) complexes (2) using appropriate organotin(IV) chloride (s).

### 2.4. Synthesis of $[Ph_2SnCl_2(C_{13}H_{13}N_3O_2)]$ (3)

Yield: 0.83 g, 65% mp: 223˚C - 225˚C; Molar conductance (DMF) 13.36 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$; UV-Visble (DMF) $\lambda_{max}$: 339, 459, 484 nm; IR (KBr, $cm^{-1}$) $\nu_{max}$: 3445 (br, OH), 3217 (m, NH), 1623 (s, C=N), 1009 (m, N-N), 733 (s, pyridine in plane), 457 (s, Sn-N); $^1H$ NMR (DMSO-$d_6$) $\delta$: 10.90 (s, 1H, OH), 9.97 (s, 1H, NH), 8.30 (s, 1H, HC=N), 8.15 (d, 1H, Py-H6), 7.64 (t, 1H, Py-H5), 6.56 - 7.54 (m, 15H, aromatic-H/pyridine-H/Sn-C6H5 protons), 3.80 (s, 3H, CH3) ppm.

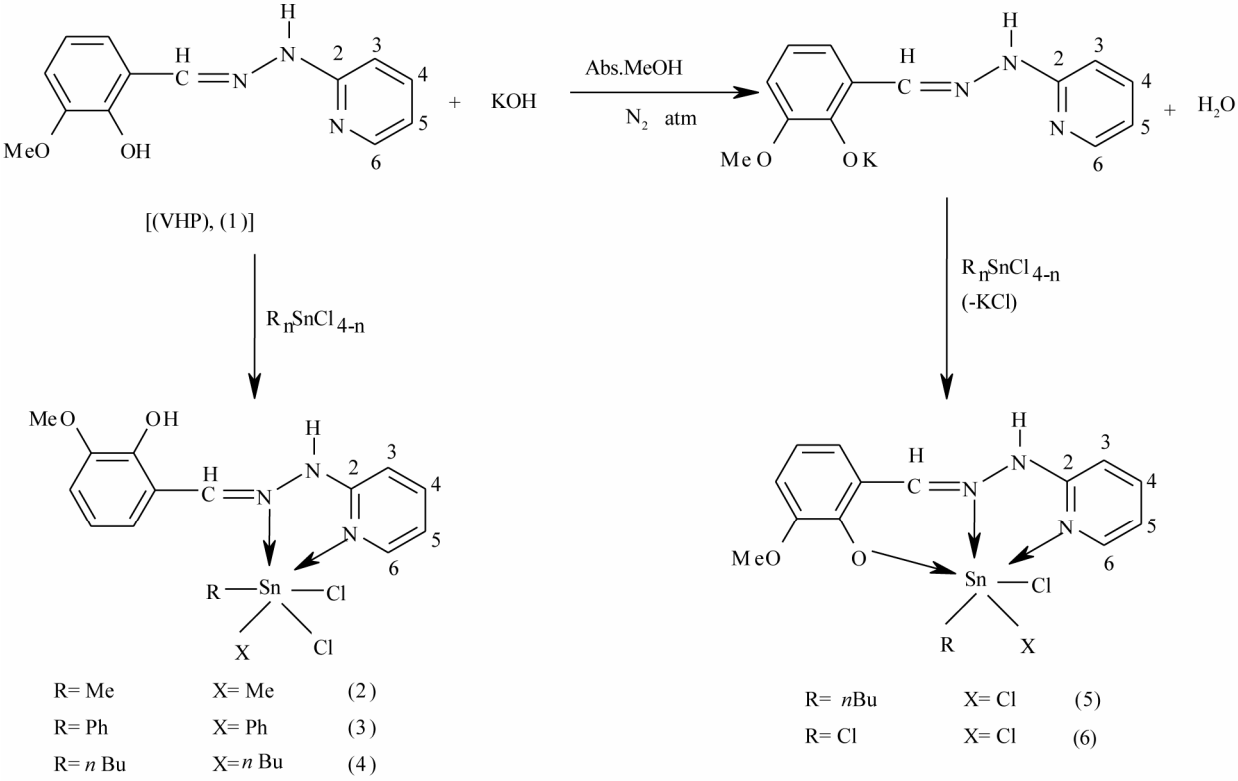
### 2.5 Synthesis of $[n Bu_2SnCl_2 (C_{13}H_{13}N_3O_2)]$ (4)

Yield: 0.59 g, 58% mp: 151˚C - 153˚C; Molar conductance (DMF) 16.67 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$; UV-Visible (DMF) $\lambda_{max}$: 338, 485 nm; IR (KBr, $cm^{-1}$) $\nu_{max}$: 3445 (m, OH), 3188 (m, NH), 1627 (s, C=N), 1013 (w, N-N), 732




**Scheme 1.** Synthesis pathway of hydrazone ligand (1).




**Scheme 2.** Synthesis pathway of organotin(IV) complexes (2-6).

(s, pyridine in plane), 499 (w, Sn-N); $^1$H NMR (DMSO-$d_6$) $\delta$: 10.86 (s, 1H, OH), 9.95 (s, 1H, NH), 8.39 (s, 1H, HC=N), 8.19 (d, 1H, Py-H6), 7.61 (t, 1H, Py-H5), 6.73 - 7.17 (m, 5H, pyridine-H/aromatic-H), 3.78 (s, 3H, CH3), 0.82 - 1.61 (m, 18H, *n*Bu$_2$-Sn) ppm.

## 2.6 Synthesis of [*n*BuSnCl$_2$(C$_{13}$H$_{12}$N$_3$O$_2$)] (5)

The ligand [(VHP), (1)] (0.486 g, 2 mmol) was dissolved in 20 mL of distilled methanol in a Schlenk round bottom flask. Then, 10 mL of methanolic solution of potassium hydroxide (0.11 g, 2 mmol) was added dropwise and the colour of the solution changed to light yellow. The resulting solution was refluxed for 1 h under a nitrogen atmosphere. A solution o f butyltin(IV) trichloride (0.564 g, 2 mmol) in distilled methanol (10 mL) was added dropwise. The solution colour change from light yellow to darker yellow and immediately formed yellow precipitate. The resulting solution was refluxed for 3 hours and allowed to cool to room temperature. The precipitated potassium chloride was removed via filtration and the filtrate was evaporated to dryness. The yellow microcrystals formed were filtered off, washed with pentane, and dried *in vacuo* over silica gel. Yield: 0.75 g, 65% mp: 241˚C - 243˚C; Molar conductance (DMF) 10.65 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$; UV-Visible (DMF) $\lambda_{max}$: 341, 452, 480 nm; IR (KBr, $cm^{-1}$) $\nu_{max}$: 3449 (br, lattice $H_2O$/OH), 3217 (m, NH), 1626 (s, C=N), 1012 (w, N-N), 733 (s, pyridine in plane), 562 (m, Sn-O), 439 (m, Sn-N); $^1$H NMR (DMSO-$d_6$) $\delta$: 9.86 (s, 1H, NH), 8.38 (s, 1H, HC=N), 8.19 (d, 1H, Py-H6), 8.00 (t, 1H, Py-H5), 6.74 - 7.10 (m, 5H, pyridine-H/aromatic-H), 3.81 (s, 3H, CH3), 0.82 - 1.94 (m, 9H, *n*Bu-Sn) ppm.

The complexes (6) were synthesized using a similar procedure to organotin(IV) complexes (5) using stannic(IV) chloride.

## 2.7 Synthesis of [SnCl$_3$(C$_{13}$H$_{12}$N$_3$O$_2$)] (6)

Yield: 0.78 g, 69% mp: 318˚C - 320˚C; Molar conductance (DMF) 5.04 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$; UV-Visble (DMF) $\lambda_{max}$: 352, 450, 479 nm; IR (KBr, $cm^{-1}$) $\nu_{max}$: 3436 (br, lattice $H_2O$/OH), 3221 (m, NH), 1630 (s, C=N), 1020 (m, N-N), 730 (s, pyridine in plane), 563 (w, Sn-O), 451 (m, Sn-N); $^1$H NMR (DMSO-$d_6$) $\delta$: 9.73 (s, 1H, NH), 8.47 (s, 1H, HC=N), 8.42 (d, 1H, Py-H6), 8.10 (t, 1H, Py-H5), 6.40 - 7.89 (m, 5H, pyridine-H/aromatic-H), 3.82 (s, 1H, CH3) ppm.

## 2.8. Brine Shrimp Bioassay

The procedures for the brine shrimp bioassay were followed the established method [6] with some modifications. A pinch of brine shrimp eggs (*Artemia salina*) were hatched in treated seawater collected from Pantai

Puteri (Kuching, Sarawak) using a beaker by incubation under a lamp, providing direct light and warmth (24˚C - 26˚C). The seawater was filtered, placed in autoclave and the salinity measured is 20 psu for hatching.

#### 2.8.1 Sample Preparation

Samples were prepared by dissolving 6 mg of the compounds (1-6) in 6 mL of methanol (stock solution). Mycotoxin solutions were prepared with different concentrations: 1, 5, 10, 50, 100, 150 300 and 500 (μg/mL) by transferring 2, 10, 20, 100, 200, 300, 600 and 1000 μL of stock solution into multiwell plates and air-dried overnight for 24 hours. 50 μL of DMSO and 1 mL of treated seawater were added in each well. About 20 nauplii was pipetted into each well. Then, t he multiwell plates were incubated for 24 hours under direct light at 24˚C -26˚C. There were one negative control and three replicates per concentration for each of HDMDP ligand (1) and its organotin(IV) complexes (2-6).

#### 2.8.2 $LC_{50}$ Determination

After 24 hours of incubation, a number of dead nauplii in each well were counted. The percentage of death for each concentrations and controls (DMSO, methanol and treated seawater) were determined. If the control death occurred, the mortality was corrected using Abbott's formula [4]. The $LC_{50}$ was determined for each samples from a plot of log samples concentrations versus percentage of death.

### 2.9 Antibacterial Test

The antibacterial activity was determined using the agar well diffusion method [7]. Grampositive bacteria (*Bacillus cereus* and *Staphylococcus aureus*) and Gramnegative bacteria (*Escherichia coli* and *Enterobacter aerogenes*) were cultivated in nutrient agar on petri dishes. The well was dug in the media with a sterile borer and 18 - 24 h bacterial inoculums containing 0.168 OD was spread on the surface of the nutrient agar using a sterile cotton swab. The samples in the concentration of 200 mg/mL in DMSO, was introduced into respective wells. Other wells containing DMSO and the reference antibacterial drug (Doxycycline) served as negative and positive controls respectively. The plates were incubated immediately at 37˚C for 18 - 24 h. The activity was determined by measuring the diameter of inhibition zone (in mm). The results were compared with the control (Doxycycline).

## 3. RESULTS AND DISCUSSIONS

The VHP ligand (1) was synthesized by the condensation reaction of *ortho*-vanillin and 2-hydrazinopyridine in absolute ethanol (**Scheme 1**). Organotin(IV) complexes (2-6) have also been synthesized by the direct reaction of the ligand, KOH and organotin(IV) chloride(s) in 1:1:1 (ligand:KOH:metal) mole ratio in absolute methanol (**Scheme 2**). The addition of KOH in the reaction mixture was used for the deprotonation of the ligand (1). The physical and analytical data of the ligand (1) and its organotin(IV) complexes (2-6) are given in the experimental section. The molar conductance values of the organotin(IV) complexes are in the range 2.56 - 8.81 $ohm^{-1}\cdot cm^{2}\cdot mol^{-1}$ indicating non-electrolytic nature [8]. The compounds are stable in $N_2$ atmosphere, soluble in common organic solvents. In organotin(IV) complexes (2-6), the central tin(IV) atom is six coordinated.

### 3.1 Electronic Absorption Spectra

The electronic spectra analyses of hydrazone ligand (1) and its organotin(IV) complexes were carried out in DMF ($1 \times 10^{-4}$ M) at room temperature. VHP ligand (1) showed one band at 335 nm which is assigned to the $\pi$-$\pi^*$ transition of imino (>C=N) group. After complexation, the $\lambda_{max}$ value of the imino group were shifted to 338 - 352 nm, due to the coordination of ligand (1) to the tin(IV) ion. New peak in the range 450 - 497 nm in the complexes (2-6) is attributed to the n-$\pi^*$ transition of band which is referred to ligand metal charge transfer (LMCT) [9].

### 3.2 Infrared Spectroscopy

Several characteristics bands were observed in the free VHP ligand (1) at 3446, 3191, 1603, 991 and 728 $cm^{-1}$ which assigned to $\nu$(OH), $\nu$(NH), $\nu$(C=N), $\nu$(N-N) and $\nu$(pyridine in plane), respectively. The OH group of the ligand (1) was absent in the complexes (5-6) due to the deprotonation of the ligand (1). This shows that the phenolic oxygen is coordinated to the Sn(IV) ion after deprotonation. However, the OH group was still present in the complexes (2-4) indicating that the phenolic oxygen is not coordinated to the tin(IV) ion. Furthermore, the stretching vibration of azomethine (C=N) value is shifted to higher frequency in all the complexes spectra (2-6) indicating that azomethine nitrogen is involved in the coordination with the Sn(IV) ion [10]. The $\nu$(N-N) stretching vibration also shifted to higher frequency which is 1009 - 1020 $cm^{-1}$ compared to the free VHP ligand (1) further supporting that azomethine nitrogen is coordinated to Sn(IV) ion. The infrared spectrum of the free ligand (1) showed band at 728 $cm^{-1}$ which is assigned to the $\nu$(pyridine in plane). This band is shifted to the higher frequencies at 729-733 $cm^{-1}$ in all the organotin(IV) complexes (2-6) [11], indicating that the pyridyl ring nitrogen is coordinated to the Sn(IV) ion. A new band observed at 447 - 499 $cm^{-1}$ in the IR spectra is attributed to the $\nu$(Sn-N) [12]. This observation indicated that the

free ligand (1) is coordinated to the Sn(IV) ion via azomethine nitrogen in all the complexes (2-6). Another a new band at 562 - 563 $cm^{-1}$ in the complexes (5-6) is assigned to the *v*(Sn-O) indicating that the phenolic oxygen of ligand (1) is coordinated to the Sn(IV) ion.

### 3.3. $^1$H NMR Spectra

The $^1$H NMR data of the VHP ligand (1) and its all organotin(IV) complexes (2-6) were recorded in DMSO-$d_6$ solution and interpreted based on the atom-labeling in **Scheme 2**. The ligand (1) showed the resonance signals at 10.89, 9.98, 8.29, 8.11 - 8.12, 6.77 - 7.65, 3.80 ppm are attributed to OH, NH, HC=N, Py-H6, Py-H5, Py-H/aromatic-H and $CH_3$ protons, respectively. The absence of OH proton signal in the $^1$H NMR spectra of the organotin(IV) complexes (5-6) indicated that the phenolic oxygen is coordinated to the Sn(IV) atom after deprotonation [13]. However, the OH proton signal is still present in the diorganotin(IV) complexes (2-4) due to the less Lewis acidic character of diorganotin(IV) chlorides compare to the monoorganotin(IV) chlorides. For this reason, the diorganotin(IV) chlorides are less reactive compare to the monoorganotin(IV) chlorides. Therefore, the phenolic oxygen is not coordinated to the central Sn(IV) ion in the complexes. The NH resonance signal for the complexes (2-6) shifted to the upfield region (9.86 - 9.95 ppm) compared to the free ligand (1), indicating that the complexation of C=N-NH nitrogen atom to the Sn(IV) ion.

After complexation, the HC=N resonance signal is shifted slightly downfield to 8.29 - 8.47 ppm in all the organotin(IV) complexes (2-6) indicating that the azomethine nitrogen is coordinated to the Sn(IV) ion [14]. The pyridine-H6 proton signal is shifted to downfield at 8.14 - 8.42 ppm in all the complexes (2-6) compared to the free ligand (1) indicating that the pyridyl ring nitrogen atom is also coordinated to the Sn(IV) ion. The multiplet signals of the complexes (2-6) were at 6.73 - 7.60 ppm are due to pyridine-H protons, aromatic-H protons and SnC6H5 protons (3), respectively. The O-$CH_3$ group proton is assigned at 3.78 - 3.82 ppm in all the organotin(IV) complexes (2-6). The $^1$H NMR spectra analysis also supported the IR spectra analysis of the organotin(IV) complexes (2-6) and attempts were made to grow the single crystals but were unsuccessful.

### 3.4. Brine Shrimp Bioassay

Brine shrimp bioassay is a preliminary test to screen the potential antitumor activity of hydrazone ligand (1) and its organotin(IV) complexes (2-6). The toxicity of VHP (1) and its organotin(IV) complexes (2-6) are listed in **Table 1**.

All organotin(IV) complexes (2-6) are more toxic than the free ligand (1). Among the organotin(IV) complexes (2-6), the diphenyltin(IV) complex (**3**) shows higher toxicity compare to the other complexes. This might be due to the presence of bulky phenyl groups can dissociate the complex to form ionic compounds and increase the permeability of the compound into the cell [15].

### 3.5. Antibacterial Activity

The antibacterial test was carried out using the disc diffusion method [7]. Two types of Gram-positive bacteria, *Bacillus cereus* and *Staphylococcus aureus*, as well as two types of Gram-negative bacteria, *Escherichia coli* and *Enterobacter aerogenes*, were used to test the ligand (1) and its organotin(IV) complexes (2-6). The antibacterial activity of VHP (1) and its organotin(IV) complexes (2-6) are listed in **Table 2**.

All organotin(IV) complexes (2-5) show moderate and higher activity against four types of bacteria *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli* and *Enterobacter aerogenes*. Diameter of inhibition zone which is less than 10 mm are considered as weak; larger than 10 mm but less than 16 mm are considered as moderate and finally larger than 16 mm and above are active [16]. Based on the results, the ligand (1) shows moderate activity towards the bacteria. Among the four complexes, diphenyltin(IV) complex (3) and butyltin(IV) complex (5) were more active than the others. The diphenyltin(IV) complex was most active towards *Staphylococcus aureus*. This might be due to the phenyl ring and the phenolic-OH group because the hydrogen of the phenolic group can enhance the toxicants to combine with constituents of living tissues [17] and the presence of the phenyl ring in the complex (3) bonded with the tin

**Table 1.** The $LC_{50}$ of the VHP ligand (1) and its complexes (2-6).

| Complexes | $LC_{50}$ (ppm) |
|---|---|
| VHP (1) | 138.03 |
| [$Me_2SnCl_2$(HDMDP)](2) | 100.00 |
| [$Ph_2SnCl_2$(HDMDP)](3) | 36.31 |
| [$n$Bu$_2$SnCl$_2$(HDMDP)(4) | 95.50 |
| [nBuSnCl$_2$(HDMDP)](5) | 70.79 |
| [$SnCl_3$(HDMDP)](6) | 97.72 |

**Table 2.** Results of antibacterial test.

| Bacteria | Diameter of Inhibition Zone (mm) | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Doxycycline |
| *Bacillus cereus* | 12.7 | 9.7 | 11.7 | - | 12.3 | 17.0 |
| *Staphylococcus aureus* | 15.0 | - | 18.0 | 11.0 | 12.3 | 30.0 |
| *Escherichia coli* | 12.3 | 9.3 | 13.7 | 10.3 | 11.7 | 14.7 |
| *Enterobacter aerogenes* | 9.0 | - | 9.7 | - | - | 14.3 |

atom can raise the antibacterial activity [18]. The Cl ion in the complex can enhances the antibacterial activity due to the killing mi- crobes or inhibiting their multiplication by blocking their active site [19].

## 4. CONCLUSION

*Ortho*-vanillin-2-hydrazinopyridine ligand [(**VHP**), (1)] and its organotin(IV) complexes (2-6) have been synthesized and fully characterized. The ligand (1) acted as a neutral bidentate nature in complexes (2-4) whereas acted as a mononegative tridentate nature in complexes (5-6). All organotin(IV) complexes (2-6) showed better toxicity compare to the free ligand (1) against *Artemia salina*. However, the free ligand and all the organotin(IV) complexes (2-5) showed moderate and high activity against four types of bacteria (*Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli* and *Enterobacter aerogenes*). Diphenyltin(IV) complexes (3) shows higher biological activity towards *Artemia salina* and the four types of bacteria compare to the free ligand (1) and other complexes.

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