



## STUDIES ON BIOLOGICAL ACTIVITY OF VANADIUM METAL COMPLEXES DERIVED FROM NOVEL HYDRAZONE DERIVATIVES

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**ABSTRACT**

A new series of vanadium metal complexes were prepared by treating vanadyl sulphate with different hydrazone derivatives which was obtained by condensation of 2-hydroxy benzoyl hydrazide with various aldehydes viz. benzaldehyde, p-methylbenzaldehyde,  $\alpha$ -naphthaldehyde, p-methoxybenzaldehyde and p-bromobenzaldehyde. The vanadium metal complexes have been characterized by elemental analysis and various physicochemical techniques such as IR, electronic absorption, molar conductance, magnetic susceptibility and TG-DTA analysis. The vanadium metal complexes showed biological activity against some fungi and bacteria.

**KEYWORDS**

2-hydroxy benzoyl hydrazide; Aldehydes; Vanadyl sulphate; characterization; antimicrobial activities.

### INTRODUCTION

Coordination compounds have been a challenge to inorganic chemist since they play vital role in our lives. Transitions metal complexes with soft or hard donor groups have been used extensively in coordination and organometallic chemistry. The coordination chemistry of vanadium is of great current interest<sup>2-5</sup> because of the tendency of vanadium to exhibit a range of oxidation states, affinity for a variety of ligands, structural novelties, complexities and physiological effects. The potential applications of vanadium complexes as pharmacological agents antimicrobial, antitumor, catalytic activities in organic synthesis and material science have drawn the special attention of inorganic chemists<sup>6-12</sup>.

Hydrazone belonging to the class of NNO donor Schiff bases containing highly reactive azomethine group (-CO-NH-N=CH-), which is derived by condensation of substituted hydrazide with aldehydes and ketones. Considering these facts a new series of vanadium metal complexes were prepared by treating vanadyl sulphate with different hydrazone derivatives which was obtained by condensation of 2-hydroxy benzoyl hydrazide with various aldehydes.

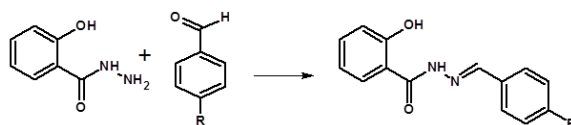
### EXPERIMENTAL

#### Materials:

All the chemicals and solvents used were of analytical grade and of highest purity. The solvents used are dried using appropriate reagents and purified according to standard methods<sup>13</sup>. The 2-hydroxy benzoyl hydrazide was prepared by reported method<sup>13</sup>. The ester like methyl salicylate and hydrazine hydrate were obtained from HIMEDIA while aldehydes like benzaldehyde, p-methylbenzaldehyde,  $\alpha$ -naphthaldehyde, p-methoxybenzaldehyde, p-bromobenzaldehyde and vanadyl sulphate were obtained from THOMAS BAKER.

#### Methods:

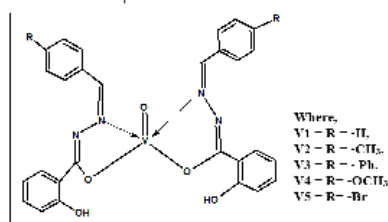
**Synthesis of hydrazones:** The solution (0.01 M) of 2-hydroxy benzoyl hydrazide in ethanol was taken in a two neck round bottom flask fitted with water condenser. Stirred for 10 min and heated gently in heating mantle till to get clear solution. The solution of aromatic aldehyde (0.01 M) in ethanol was added slowly to this stirred solution. This reaction mixture was further refluxed on water bath for 3hrs. When this solution was cooled to room temperature, precipitate formed was separated by filtration and purified by recrystallisation from ethanol (yield 80%).



Where, L1 = R = -H,  
L2 = R = -CH<sub>3</sub>,  
L3 = R = -Ph,  
L4 = R = -OCH<sub>3</sub>,  
L5 = R = -Br

**Synthesis of vanadium metal complexes:** To a hot suspension of ligand (0.01M) in ethanol, a ethanolic solution (0.01M) of the metal salt vanadyl sulphate was added dropwise with constant stirring with the help of rotametal and refluxed for 3hrs. The resulting reaction mixture was cooled to room temperature and pH adjusted between 7.8 - 7.9 by using NH<sub>3</sub> then refluxed it further for 30min. The resultant product was filtered, repeatedly washed with ethanol and dried at room temperature.

The hydrazone derivatives and vanadium metal complexes thus formed were characterized<sup>14, 15</sup> by elemental analysis and various physicochemical techniques.



Where,  
V1 - R = -H,  
V2 - R = -CH<sub>3</sub>,  
V3 - R = -Ph,  
V4 - R = -OCH<sub>3</sub>,  
V5 - R = -Br

**Fig: Proposed structure of the vanadium metal complexes**

#### Biological studies:

The in vitro antimicrobial screening effects of the synthesized compounds were tested against four bacterial strains namely *Bacillus*, *E.coli*, *Klebsiella* and *S.aureus* and three fungal strains namely *Aspergillus*, *Candida* and *Penicillium* by paper disc diffusion method using nutrient agar medium for antibacterial activity and Sabouraud's dextrose agar for antifungal activity.

**Paper Disc Diffusion Method for antimicrobial activity:** The antimicrobial activity of the hydrazone ligands and their vanadium metal complexes was studied using this method against *Bacillus*, *E.coli*, *Klebsiella* and *S.aureus* pathogenic bacteria. The 0.1 ml of inoculums of the test organism was spread uniformly on the

surface of the agar medium in a petri plate by using a spreader. The sterile Whatmann filter paper discs of 5mm diameter were dipped into the 1% solution of hydrazone ligands in DMSO and metal complexes in water. Discs were placed on the surface of the agar in each plate.

The plates were incubated at 37°C for 24 hours. During incubation, the hydrazone ligands and metal complexes diffuse from the filter paper into agar. The activity of the hydrazone ligands and metal complexes was assessed by measuring the diameter of the inhibited zone in millimeter (mm). The control (Tetracycline) was screened simultaneously along with the hydrazone ligands. The results of all the hydrazone ligands and metal complexes are shown in table-1. DMSO solvent used as blank was also run to know its activity.

**Paper Disc Diffusion Method for antifungal activity:** The antifungal activity of the hydrazone ligands and their vanadium metal complexes was studied using this method against *Aspergillus*, *Candida* and *Penicillium* pathogenic fungi. The 0.1 ml of inoculum spore suspension of the test organism was spread uniformly on the surface of the agar medium in a petri plate by using a spreader. The sterile Whatmann filter paper discs of 5mm diameter were dipped into the 1% solution of hydrazone ligands in DMSO and metal complexes in water. Discs were placed on the surface of the agar in each plate.

The plates were incubated at 37°C for 24 hours. During incubation, the hydrazone ligands and metal complexes diffuse from the filter paper into agar. The activity of the hydrazone ligands and metal complexes was assessed by measuring the diameter of the inhibited zone in millimeter (mm). The control (Amphotericin) was screened simultaneously along with the hydrazone ligands and the results of all the hydrazone ligands and metal complexes are shown in table-1. DMSO solvent used as blank was also run to know its activity.

## RESULT AND DISCUSSIONS

**Table-1: Biological activity of hydrazone derivatives and their vanadium metal complexes**

Compound	Antibacterial activity (Zone of inhibition in mm)				Antifungal activity (Zone of inhibition in mm)		
	<i>Bacillus</i>	<i>E.coli</i>	<i>Klebsiella</i>	<i>S.aureus</i>	<i>Aspergillus</i>	<i>Candida</i>	<i>Penicillium</i>
L1	-	-	6	-	-	-	-
L2	-	-	-	-	-	-	-
L3	-	8	8	-	-	7	-
L4	-	-	-	-	-	7	-
L5	-	10	-	-	-	10	-
[VO (L1)2] (V1)	-	-	-	-	-	-	-
[VO (L2)2] (V2)	-	-	-	15	-	14	-
[VO (L3)2] (V3)	-	-	12	16	-	17	-
[VO (L4)2] (V4)	-	-	-	13	-	18	-
[VO (L5)2] (V5)	-	-	-	-	-	13	-
Tetracycline	18	18	20	30	-	-	-
Amphotericin	-	-	-	-	14	20	15

The *in vitro* antimicrobial screening results are given in table-1. The antimicrobial activity of all the hydrazone ligands and their vanadium metal complexes is less than that of standard tetracycline and amphotericin. On the basis of observed zone of inhibition, it was found that vanadium metal complexes are more active than their respective hydrazone ligands. Hydrazone ligand L1 exhibit antibacterial activity against *Klebsiella* sp., L3 exhibit antibacterial activity against *E.coli* and *Klebsiella* sp. and antifungal activity against *Candida* sp. L4 exhibit antifungal activity against *Candida* sp. L5 exhibit antibacterial activity against *E.coli* and antifungal activity against *Candida* sp. Vanadium complexes V2, V3, V4 and V5 exhibit good antibacterial activity against *Klebsiella*, *S.aureus* and antifungal activity against *Candida* sp. The ligands and complexes are not active against *Aspergillus* and *Penicillium* antifungal strain.

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