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Antibacterial Studies of Nickel(II) Complexes of Heterocyclic Schiff Bases

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The antibacterial activities of a series of nickel(II) complexes of heterocyclic Schiff bases have been carried out against different bacteria isolated from soil and prawn.

Key Words: Ni(II), Schiff bases, Complexes, Antibacterial activities.

INTRODUCTION

The antimicrobial activity of nickel(II) octahedral complexes have been studied against bacterial and fungal species[1]. In present paper, the antibacterial studies of nickel(II) complexes of five different ligands namely vanillin-2-amino pyridine, vanillin-2-aminothiazole, *o*-vanillin-2-aminopyridine, *o*-vanillin-2-aminothiazole and *o*-vanillin-L-histidine have been carried out.

EXPERIMENTAL

The ligands and complexes for the present study were synthesized and characterized as reported earlier[2–4]. Prawn samples for the present study were collected from an agriculture land.

Determination of antibacterial activity

The analyses of the antibacterial activity of the present complexes were done by paper disc method. Filter paper discs were cut from Whatman No. 1 filter paper sheet, using a standard paper punch (hole diameter = 5 mm). Sterilized the disc in a sample dish at 140°C for 2 h.

Ni(II) chelates of the five ligands were carefully and aseptically weighed and transferred in different sterile 150 mL conical flasks. 1% solutions of the complexes were prepared by dissolving them in suitable solvents. Sterile alcohol and sterile distilled water were used as solvents. From 1% solution three different dilutions (0.25, 0.2 and 0.1%) were made by adding the required solvent.

Preset antibiotic agar plates were prepared, the surface was dried at 56°C for 45 min and cooled to room temperature. Each plate was divided into four quarters by drawing lines on the bottom so as to get one plate for three different

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concentrations and one for blank. The sterile filter paper discs were dipped in different concentrations of the complex solutions taken in a sample dish, drained by pressing against inside wall of the dish and placed on the surface of the respective quarters of the agar plate. Each sterile filter paper disc dipped in 0.25, 0.2 and 0.1% solution of the complexes contained 12.5, 10 and 5 μg of the metallic complexes, respectively. The plates were then incubated without inverting for 24 h and examined for clear zones of inhibition around the discs using hand lens.

After 24 h of inhibition at 37°C, the zones of inhibition formed around each disc were measured in mm and the results of the growth inhibition of different bacterial cultures were recorded.

RESULTS AND DISCUSSION

The growth inhibition of the known bacterial genera by the five Ni(II) chelates were determined and presented in Tables 1–10.

TABLE-1
EFFECT OF $[NiL^{I}H(OAc)_2(H_2O)_3]$ ON BACTERIA ISOLATED FROM PRAWN

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	13	12	9
Bacillus	2	12	11	8
Lactobacillus	2	7	6	5
Maraxella	2	16	15	11
Micrococcaceae	2	11	10	7
Pseudomonas	2	14	12	8
Vibrio	3	15	14	10

$L^{I}H$: Vanillin-2-aminopyridine

TABLE-2
EFFECT OF $[NiL^{I}H(OAc)_2(H_2O)_3]$ ON BACTERIA ISOLATED FROM SOIL

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	11	9	8
Bacillus	4	7	6	5
Micrococcaceae	5	6	5	5
Pseudomonas	4	12	11	8

$L^{I}H$: Vanillin-2-aminopyridine

TABLE-3
EFFECT OF $[NiL^{II}H(OAc)_2(H_2O)_3]$ ON BACTERIA ISOLATED FROM PRAWN

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	12	11	9
Bacillus	2	9	8	7
Lactobacillus	2	7	6	5
Maraxella	2	10	9	6
Micrococcaceae	2	7	6	5
Pseudomonas	2	12	11	10
Vibrio	3	14	13	11

$L^{II}H$: Vanillin-2-aminothiazole

TABLE-4
EFFECT OF $[NiL^{II}H(OAc)_2(H_2O)_3]$ ON BACTERIA ISOLATED FROM SOIL

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	9	8	6
Bacillus	4	8	7	6
Micrococcaceae	5	7	6	5
Pseudomonas	4	9	8	6

$L^{II}H$: Vanillin-2-aminothiazole

TABLE-5
EFFECT OF $[NiL^{III}H(OAc)(H_2O)_3]$ ON BACTERIA ISOLATED FROM PRAWN

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	12	10	8
Bacillus	2	10	9	7
Lactobacillus	2	9	7	6
Maraxella	2	13	11	9
Micrococcaceae	2	11	9	8
Pseudomonas	2	15	13	11
Vibrio	3	15	14	10

$L^{III}H$: *o*-Vanillin-2-aminopyridine

TABLE-6
EFFECT OF $[NiL^{III}H(OAc)(H_2O)_3]$ ON BACTERIA ISOLATED FROM SOIL

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	7	6	5
Bacillus	4	8	7	6
Micrococcaceae	5	7	6	5
Pseudomonas	4	8	7	6

$L^{III}H$: *o*-Vanillin-2-aminopyridine

TABLE-7
EFFECT OF $[NiL^{IV}(OAc)(H_2O)_3]$ ON BACTERIA ISOLATED FROM PRAWN

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	10	9	7
Bacillus	2	9	8	6
Lactobacillus	2	8	7	5
Maraxella	2	13	12	8
Micrococcaceae	2	11	10	8
Pseudomonas	2	14	12	10
Vibrio	3	9	8	7

$L^{IV}H$: *o*-Vanillin-2-aminothiazole

TABLE-8
EFFECT OF $[NiL^{IV}(OAc)(H_2O)_3]$ ON BACTERIA ISOLATED FROM SOIL

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	10	7	6
Bacillus	4	9	7	6
Micrococcaceae	5	8	7	5
Pseudomonas	4	11	9	8

$L^{IV}H$: *o*-Vanillin-2-aminothiazole

Thirtytwo bacterial cultures were isolated from prawn and soil, sixteen from prawn and sixteen from soil. All the purified cultures are identified up to the generic level[5]. The cultures isolated from prawn include *Alcalgenes, Bacillus, Lactobacillus, Maraxella, Micrococcaceae. Pseudomonas* and *Vibrio* are found to be gram negative and the remaining bacteria listed above are gram positive.

TABLE-9
EFFECT OF $[NiL^{V}(H_2O)_3]$ ON BACTERIA ISOLATED FROM PRAWN

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	10	9	7
Bacillus	2	8	6	8
Lactobacillus	2	12	10	9
Maraxella	2	9	8	6
Micrococcaceae	2	13	11	9
Pseudomonas	2	15	14	12
Vibrio	3	13	11	9

$L^{V}H_2$: *o*-Vanillin-L-histidine

TABLE-10
EFFECT OF $[NiL^{V}(H_2O)_3]$ ON BACTERIA ISOLATED FROM SOIL

Bacteria (Genus)	Number of cultures tested	Average diameter of inhibited area at different concentrations of the complex (mm)		
		0.25%	0.2%	0.1%
Alcalgenes	3	13	12	10
Bacillus	4	7	6	5
Micrococcaceae	5	12	11	9
Pseudomonas	4	14	13	11

$L^{V}H_2$: *o*-Vanillin-L-histidine

Three cultures namely, *Bacillus, Pseudomonas* and *Micrococcaceae* were isolated from two sources *viz.*, prawn and garden soil and were common. Generally antibacterial activity of the chelates was more in isolates of biological origin namely prawn than from the soil.

All the five Ni(II) chelates showed moderate to good antibacterial activity. Of these $[NiL^{III}(OAc)(H_2O)_3]$ is more active towards prawn bacteria than the others whereas $[NiL^{IV}(H_2O)_3]$ is more active towards soil bacteria.

Chelates are more sensitive towards gram negative bacteria. For example, *Pseudomonas* is more sensitive in all cases.

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