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Antimicrobial Activity of Pentaamminecobalt(III) Complexes of α-Amino Acids

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Pentaamminecobalt(III) complexes of α-amino acids were synthesized. The antimicrobial activity of these complexes were tested with bacteria like *E. coli, S. aureus, Salmonella, Pseudomonas, Klebsiella* and fungi like *A. niger, Penicillium*. The minimum inhibitory concentration of these complexes against microorganism were estimated by turbidity methods.

Key Words: α-Aminoacids, Pentamminnecobalt(III) complexes, Antimicrobial activity.

INTRODUCTION

Pentamminnecobalt(III) complexes of α-aminoacids have been used so far in kinetic studies[1-3]. The present study attempts to utilize these compounds as antimicrobial agents. The study assumes importance as global concern has emerged due to the entering of a post antibiotic era with a reduced capability to combat microbes and the development of novel therapeutic approaches to the treatment of bacterial infections becomes a global emergency in the management of infectious diseases. Few cobalt(III) complexes having biological activities were already explored[4-6].

EXPERIMENTAL

Antibacterial activity of pentaamminecobalt(III) complexes of α-amino acids by Pour plate method

Effect of concentration on antibacterial activity: The glycinatopentaamminecobalt(III) complexes was sterilized by filteration method using microfilter and 0.25 g/100 mL was added to the sterile nutrient agar medium and the pH was adjusted to 7.2. The medium was poured on sterile petri plate for solidification. After solidification, the plate was divided into 4 or 5 quadrants and inoculated with 4 or 5 test organisms *viz.*, *E. coli, S. aureus, Salmonella, Pseudomonas* and *Klebsiella* were streaking in each quadrant. The plate was incubated at 37 ºC for 24 h[7,8]. After incubation, the results

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were observed and tabulated. Similarly, the antibacterial properties of N-acetyl glycinato pentaamminecobalt(III) and N-benzoyl glycinatopentaamminecobalt(III) complexes were also tested at the same concentration *i.e.*, 0.25 g/100 mL using the above mentioned test organisms. The same procedures were followed for a higher concentration of *i.e.*, 0.5 g/100 mL and the results were recorded.

Effect of pH on antibacterial activity: As the test, compounds are acidic in nature. The antibacterial property was tested using slightly acidic pH *viz.*, 6.8. Similar procedures as described for concentration were followed also at pH of 6.8 and lower.

Antifungal activity of pentaamminecobalt(III) complexes of α-amino acids by Pour plate method

Effect of concentration on antifungal activity: The glycinatopentaamminecobalt(III) complexes was sterilized by filteration method using microfilter and 0.25 g/100 mL was added to the sterile SDA medium and the pH was adjusted to 5.5. The medium was poured on sterile petri plate for solidification[7,8]. After solidification, the test organisms *viz.*, *Aspergillus niger* and *Penicillium* were streaked on separate sterile SDA plates. The streaked plates were incubated for 24-48 h at 27-37 ºC. After incubation, the plates were observed for growth.

The same procedure was followed for 0.5 g/100 mL of N-acetyl glycinatopentaamminecobalt(III) and N-benzoyl glycinatopentaamminecobalt(III) complexes at the same concentration *i.e.*, 0.25 g/100 mL using the above mentioned test organisms. The same procedures were followed for a higher concentration *i.e.*, 0.5 g/100 mL.

Effect of pH on antifungal activity: As both the fungi and test compounds were acidic in nature, it was necessary to check for the antifungal property at different pH. The pH of the compound *viz.*, 4.3 was selected for further studies. The same procedures were followed using 0.25 g/100 mL of glycinatopentaamminecobalt(III) complex with pH adjusted to 4.3.

Minimum inhibitory concentration of glycinatopentaamminecobalt(III) complex: Seven sterile test tubes were taken and 10 mL of sterile nutrient broth was added to the first tube. To each of the remaining 6 tubes, 9 mL of nutrient agar was added. 0.025 g of sterile N-acetyl glycinatopentaamminecobalt(III) complex was added to the first tube and mixed well. This gave a dilution of 10^{-1}. 1 mL from the tube of 10^{-1} dilution was added to the second tube and mixed well to give 10^{-2} dilution. The step was repeated till 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} dilutions were obtained. The seventh tube served as control, to which one mL of sterile distilled water was added. One loopful of *S. aureus* culture was added into each tube, except the seventh test tube that acted as a control tube. The tubes were incubated 37 ºC for 24 h[9,10]. After the incubation period the minimum inhibitory concentration rate was

estimated by turbidity method. Similarly the same procedure was followed by N-benzoyl glycinatopentaamminecobalt(III) complex.

RESULTS AND DISCUSSION

The results of antimicrobial activity tests of three synthesized cobalt(III) complexes of α-amino acids at different concentrations and different pH against human pathogenic microorganism, are shown in (Tables 1 and 2).

TABLE-1
ANTIMICROBIAL ACTIVITY OF THREE PENTAAMMINECOBALT(III) COMPLEXES OF α-AMINO ACIDS IN TWO DIFFERENT CONCENTRATIONS

Organisms	Compd. A (conc.)		Compd. B (conc.)		Compd. C (conc.)	
	0.25 (g/mL)	0.25 (g/mL)	0.25 (g/mL)	0.25 (g/mL)	0.25 (g/mL)	0.25 (g/mL)
E. coli	–	–	–	–	–	–
S. aureus	–	–	–	–	–	–
Pseudomonas	+	+	+	+	+	+
Salmonella	+	+	+	+	+	+
Klebsiella	–	–	–	–	–	–
Aspergillus niger	±	±	±	±	±	±
Penicillium	±	±	±	±	±	±

A = Glycinatopentaamminecobalt(III) complex
B = N-Acetyl glycinatopentaamminecobalt(III) complex
C = N-Benzoyl glycinatopentaamminecobalt(III) complex
– = inhibition; + = No inhibition; ± = Slight inhibition

TABLE-2
ANTIMICROBIAL ACTIVITY OF THREE PENTAAMMINECOBALT(III) COMPLEXES OF α-AMINO ACIDS AT TWO DIFFERENT pH VALUES

Organisms	Compd. A		Compd. B		Compd. C	
	pH	pH	pH	pH	pH	pH
E. coli	–	–	–	–	–	–
S. aureus	–	–	–	–	–	–
Pseudomonas	+	+	+	+	+	+
Salmonella	+	+	+	+	+	+
Klebsiella	–	–	–	–	–	–
Aspergillus niger	±	±	±	±	±	±
Penicillium	±	±	±	±	±	±

A = Glycinatopentaamminecobalt(III) complex
B = N-Acetyl glycinatopentaamminecobalt(III) complex
C = N-Benzoyl glycinatopentaamminecobalt(III) complex
– = inhibition; + = No inhibition; ± = Slight inhibition.

Three species of bacteria *viz.*, *E. coli, S. aureus* and *Klebsiella* were highly sensitive to all the three complexes of cobalt. Their growth being totally inhibited in both low and high concentrations and pH values. The other two species *Salmonella* and *Pseudomonas* were not sensitive to any of the three complexes. The antifungal activity of the three complexes were tried against fungal species *viz.*, *Aspergillus niger* and *Penicillium* were showed that slightly effective in inhibiting the growth of the two fungi.

The minimum inhibitory concentration of N-acetyl glycinatopenta-amminecobalt(III) and N-benzoyl glycinatopentaammine(III) complexes inhibited *S. aureus* at a concentration of 0.25 g/100 mL. At a concentration of 0.25 g/100 mL, the bacteria was completely destroyed by the complexes.

Conclusion

The antibacterial activity of pentaamminecobalt(III) complexes of α-amino acids were found to be effective against *E. coli*, *S. aureus* and *Klebsiella* and not effective against *Salmonella* and *Pseudomonas*. The antifungal activity of the complexes were found to be less significant against *Aspergillus niger* and *Penicillium*.

The results obtained in this study suggests that the three synthesized complexes of cobalt have the potency to the develop into effective antimicrobial agents. However, it must be noted with caution that further detailed study is required before recommending these complexes as antimicrobial agents against specific bacteria (or) fungus.

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