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SENSITIVITY STUDIES OF COMPLEXES OF HEAVY RARE EARTH METAL ION WITH SULPHONANILIDES AGAINST EUBACTERIA

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ABSTRACT

Sensitivity of Dy(III) – sulphonanilide systems against gram positive (Staphylococcus aureus) and gram negative (Pseudomonas aeruginosa and Escherichia coli) bacteria have been carried out in the present study. Maximum sulphonanilide systems of Dy(III) showed a remarkable activity against Staphylococcus aureus and Pseudomonas aeruginosa.

Key words: Heavy rare earth metal ion, Dysprosium, Sulphonanilides**,** Eubacteria**.**

I. Introduction

The kingdom Monera includes eubacteria (true bacteria), cyanobacteria (blue green algae) and archaebacteria (ancient bacteria). True bacteria constitute a large domain of prokaryotic micro-organism and display a wide diversity. They are single-celled organisms lacking a distinct nucleus and inhabit virtually in all environments, including soil, water, organic matter, animals and human beings. Gram positive and gram negative bacteria is distinguishes by the method of gram staining, which is a differential staining technique. The bacterial growth is influenced by various factors. In *in vitro* conditions, nutrition requirements as well as physical environment are essential to determine the cultivation of bacteria.

Drug[1,2] is a natural and synthetic substance which affects its functioning or structure and often used for therapeutic purposes like diagnosis, mitigation, treatment or prevention of a diseases or relief of discomfort. The mechanism of drug action is a biochemical interaction, which is the outcome of a complex series of events. A successful drug is that which is less toxic to human cells as compared to the high level of toxicity for the exhibited parasites.

The rare earth metals (lanthanides) are subdivided into light and heavy rare earth elements (LREE & HREE). Lanthanide (III) ion is a subject of increasing interest in bioinorganic and coordination chemistry. Due to the special electronic configuration, physical and biological properties of lanthanide complexes, make them useful in the area of clinical chemistry and molecular biology[3]. The sulphur containing ligands, especially sulphonanilide derivatives have versatile pharmacological activity, which increases on complexation with metal ions[4]. The utilization of lanthanide and their complexes in biological and biochemical studies have been reviewed by many workers[5-8].

In the present investigation, anti-bacterial screening of some sulphonanilide systems with Dy(III) ion (heavy rare earth metal ion) was assayed *in-vitro* against gram positive cocci (*Staphylococcus aureus*) and gram negative bacilli (*Pseudomonas aeruginosa* and *Escherichia coli*).

II. Experimental

$DyCl_3.6H_2O$ and various sulphonanilides (Table-1) were used in the present study. Total 19 systems were prepared in the DMF solvent for Dy(III) ion by using standard and appropriate method[9]. Spread plate method has been applied for the culture of bacteria. This technique typically used to separate microorganisms contained within a small sample volume, which is spread over the surface of an agar plate.

In the present study, agar solid media with peptone ingredient was used. The components of the media i.e. both nutrient broth (NB) and nutrient agar (NA) were dissolved in double distilled water and their pH were adjusted to 7.2 ± 0.2 with 1N HCl or NaOH. The Petri dishes were used for the disc diffusion assay. The complex systems have been screened using Kirby-Bauer disc diffusion technique[10]. The discs of 6 mm diameter were labeled and kept in a petri dish and sterilized by autoclaving at 121 °C for 15 min. 10 µl/disc (disc potency) of each sample of Dy (III) - sulphonanilide were carefully loaded onto the respective labeled discs and after incubation at 37 °C for overnight (around 12 hrs), the plate were observed for growth of bacteria. After incubation, the degree of sensitivity was

determined by measuring the inhibition zone in mm. The presence or absence of an inhibitory area around the disc identifies the bacterial sensitivity to the systems.

III. Results and Discussion

Present study deals the sensitivity of Dy(III)-sulphonanilide systems against gram positive cocci and gram negative bacilli. Results of antimicrobial screening for various systems have been presented in following manner (Table- 2 & Figure-1).

1. Screening of *Staphylococcus aureus* against sulphonanilide systems

The decreasing order of sensitivity of the *Staphylococcus aureus* against Dy (III) - sulphonanilide systems is given below:

Dy (III)-L_4 > Dy (III)-L_{18} > Dy (III)-L_9 > Dy (III)-L_{13} > Dy (III)-L_{11} > Dy (III)-L_3 = Dy (III)-L_8 = Dy (III)-L_{14} > Dy (III)-L_2 = Dy (III)-L_7 = Dy (III)-L_{12} > Dy (III)-L_1 = Dy (III)-L_{15} = Dy (III)-L_{16} > Dy (III)-L_{10} > Dy (III)-L_6 = Dy (III)-L_{19} > Dy (III)-L_5 > Dy (III)-L_{17}.

Significant activity was observed in L_5 and L_{17} sulphonanilide systems. Appreciable activity was observed in L_1, L_6, L_{10}, L_{15}, L_{16} and L_{19} whereas L_2, L_3, L_4, L_7, L_8, L_9, L_{11}, L_{12}, L_{13}, L_{14} and L_{18} sulphonanilide systems were found to be highly active.

2. Screening of *Pseudomonas aeruginosa* against sulphonanilide systems

The decreasing order of sensitivity of *Pseudomonas aeruginosa* against Dy(III) – sulphonanilide systems is given below:

Dy (III)-L_7 = Dy (III)-L_{11} > Dy (III)-L_2 = Dy (III)-L_4 > Dy (III)-L_{12} > Dy (III)-L_9 > Dy (III)-L_6 = Dy (III)-L_{13} = Dy (III)-L_{18} > Dy (III)-L_3 = Dy (III)-L_{10} > Dy (III)-L_{19} > Dy (III)-L_5 = Dy (III)-L_{16} > Dy (III)-L_8 = Dy (III)-L_{17} > Dy (III)-L_1 > Dy (III)-L_{14} > Dy (III)-L_{15}.

Significant activity was observed in L_{15} sulphonanilide system. Appreciable activity was reported in L_1, L_8, L_{14} and L_{17} whereas L_2, L_3, L_4, L_5, L_6, L_7, L_9, L_{10}, L_{11}, L_{12}, L_{13}, L_{16}, L_{18} and L_{19} sulphonanilide systems were exhibited highly active during the antimicrobial study.

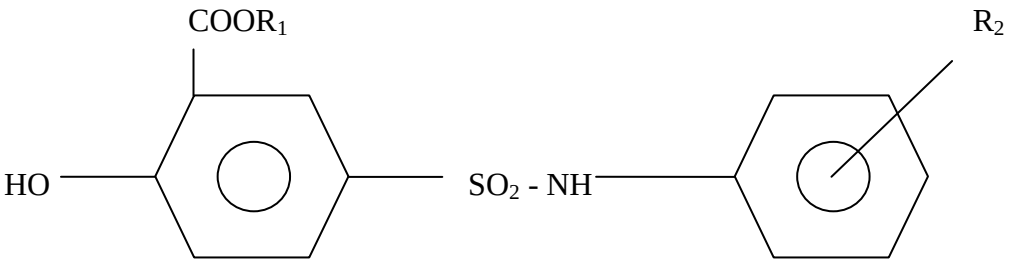
3. Screening of *Escherichia coli* against sulphonanilide systems

The decreasing order of sensitivity of E.Coli against Dy(III) – sulphonanilide systems is given below:

Dy (III)-L_4 = Dy (III)-L_6 = Dy (III)-L_{10} > Dy (III)-L_1 = Dy (III)-L_3 = Dy (III)-L_5 = Dy (III)-L_7 = Dy (III)-L_{12} = Dy (III)-L_{13} = Dy (III)-L_{14} = Dy (III)-L_{16} = Dy (III)-L_{17} = Dy (III)-L_{19} > Dy (III)-L_2 = Dy (III)-L_9 = Dy (III)-L_{15} = Dy (III)-L_{18} > Dy (III)-L_8 = Dy (III)-L_{11}.

Insignificant activity was observed in L_2, L_8, L_9, L_{11}, L_{15} and L_{18} sulphonanilide systems. Moderate activity was observed in L_1, L_3, L_4, L_5, L_6, L_7, L_{10}, L_{12}, L_{13}, L_{14}, L_{16}, L_{17} and L_{19} sulphonanilide systems. No system has significant and high activity.

Table – 1: A Simplified representation of sulphonanilides



Sulphonanilide	Groups and their Position	
	R^1	R^2
L_1	H	o-NO_2
L_2	H	m-NO_2
L_3	H	p-NO_2
L_4	CH_3	o-NO_2
L_5	CH_3	m-NO_2
L_6	CH_3	p-NO_2
L_7	C_2H_5	o-NO_2
L_8	C_2H_5	m-NO_2
L_9	C_2H_5	p-NO_2
L_{10}	H	o-NH_2
L_{11}	H	p-NH_2
L_{12}	CH_3	o-NH_2
L_{13}	CH_3	p-NH_2
L_{14}	C_2H_5	o-NH_2
L_{15}	C_2H_5	p-NH_2
L_{16}	-CH_2-CH_2-CH_3	o-NH_2
L_{17}	-CH_2-CH_2-CH_3	p-NH_2

L_{18}	$-CH(CH_3)_2$	o-NH_2
L_{19}	$-CH(CH_3)_2$	p-NH_2

Table- 2: Inhibition zone and Sensitivity of Different bacteria against Dy (III) - sulphonanilide systems

S. No.	*Staphylococcus aureus*		*Pseudomonas aeruginosa*		*Escherichia coli*	
	Inhibition zone (mm)	**Sensitivity**	**Inhibition zone (mm)**	**Sensitivity**	**Inhibition zone (mm)**	**Sensitivity**
1.	15	++	14	++	9	±
2.	16	+++	23	+++	8	-
3.	17	+++	19	+++	9	±
4.	34	+++	23	+++	10	±
5.	12	+	16	+++	9	±
6.	13	++	20	+++	10	±
7.	16	+++	25	+++	9	±
8.	17	+++	15	++	7	-
9.	20	+++	21	+++	8	-
10.	14	++	19	+++	10	±
11.	18	+++	25	+++	7	-
12.	16	+++	22	+++	9	±
13.	19	+++	20	+++	9	±
14.	17	+++	13	++	9	±
15.	15	++	12	+	8	-
16.	15	++	16	+++	9	±
17.	11	+	15	++	9	±
18.	28	+++	20	+++	8	-
19.	13	++	18	+++	9	±

*Sensitivity (on the basis of size of inhibition zone in diameter); Disc potency-10 µl/disc

- zone size 7mm - 9mm (insignificant)

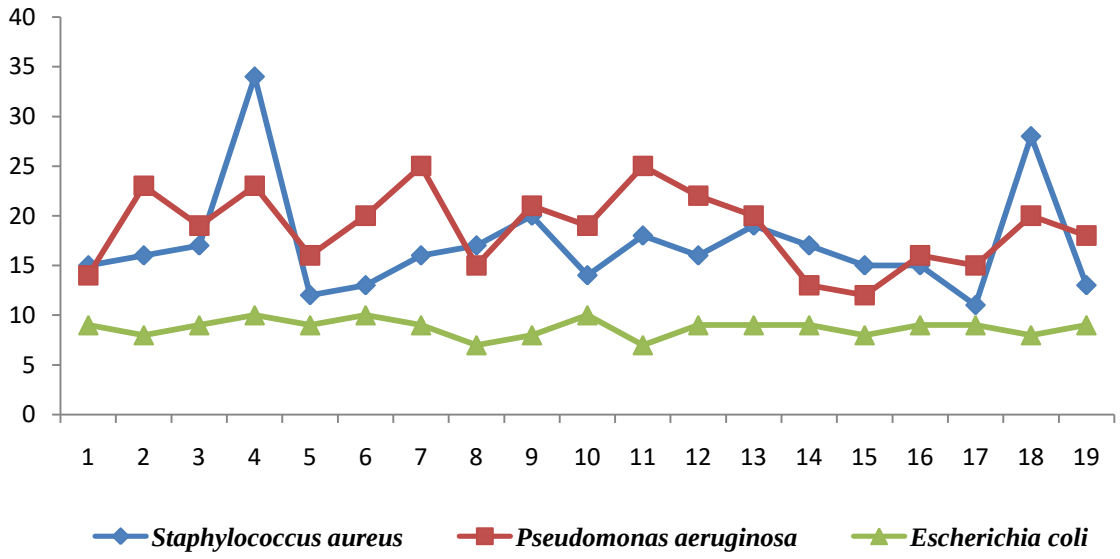
± zone size 9mm -11mm (moderate)

\+ zone size 11mm – 13mm (significant)

++ zone size 13mm – 15mm (appreciable)

+++ zone size 16mm and more (high activity)

Figure-1. Comparative Antimicrobial activity of Dy(III) - Sulphonanilide systems



IV. Conclusion

- Sulphonanilide systems of Dy(III) were observed with remarkable activity.
- Maximum systems of Dy(III) were found to be appreciable and highly active against *Staphylococcus aureus* and *Pseudomonas aeruginosa* but found to be moderate to insignificant active against *E.coli*.
- Introduction of nitro and amino group at ortho position of benzene ring, increase the activity of Dy(III) sulphonanilide systems.
- Dy(III)-L_4 sulphonanilide system are very highly sensitive to *Staphylococcus aureus* containing methyl group in ester moiety and nitro group as substituent group at ortho position.
- Sensitivity order for Dy(III) systems against three micro -organisms was found as- *Pseudomonas aeruginosa* > *Staphylococcus aureus* > *Escherichia coli*

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