International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor- 5.46, Volume 4, Issue 12, December 2017
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

ANTIMICROBIAL SCREENING OF DOPED HO(III) METAL ION SYSTEMS WITH VARIOUS 'N' & 'O' DONOR ATOM LIGANDS AGAINST GRAM POSITIVE COCCI AND GRAM NEGATIVE BACILLI

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ABSTRACT

Antimicrobial activity of doped Ho(III) ion in the solution of nineteen sulphonanilide systems have been carried out against Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli bacterial species. A remarkable activity was found in maximum sulphonanilide systems of Ho(III) ion.

Key words: Antimicrobial, Holmium, Sulphonanilide**,** *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli.*

I. Introduction

Organisms of microscopic dimension, commonly known as micro organism are found all around us and even inside our bodies. These organisms[(1)] are too small to be clearly perceived by the unaided eye. The category microbes includes massive range of organism include bacteria, viruses, fungi, algae, archaea and protozoa. Bacteria[(2)] are extremely diverse and in term of number are by far the most successful organism on earth. *Staphylococcus aureus* is very important pathogenic bacteria and widespread on the skin and mucosal

surfaces of the respiratory, upper alimentary and uro-genital tracts of all humans and other warm blooded animals. *Pseudomonas aeruginosa,* one of the leading nosocomial pathogens worldwide, is a gram negative and non-sporogenous species. *Escherichia coli* are a gram-negative, non-spore forming and rod-shaped bacteria that are commonly found in the lower intestine of warm-blooded organisms.

A number of complex compounds play an essential role in numerous systems of chemical and biological importance[3-5]. Chlorophyll is a magnesium-porphyrin complex, hemoglobin is an iron-porphyrin complex and vitamin B_{12} is a cobalt complex. Many platinum and vanadium complexes have been reported as anti-cancer and anti-tumor agents[6-7]. Anti-inflammatory activities of some complexes of Schiff's bases with cobalt have also been reported[8]. Heterocyclic ligands, containing 'N' & 'O' as donor atoms when complexed with metal ions, exhibit enhanced antifungal and antimicrobial activities[9].

In present studies nineteen Ho(III) systems with 'N' & 'O' donor atom ligands, were prepared and screened against gram positive cocci (*Staphylococcus aureus*) and gram negative bacilli (*Pseudomonas aeruginosa* and *Escherichia coli*). Owing to poor complexing ability of lanthanides ion[10], doped model technique[11] was taken as systems in the present anti-bacterial screening.

II. Experimental

$HoCl_3.6H_2O$ and re-crystallized substituted sulphonanilides (Table-1) were used in the present study. Nineteen systems were prepared for Ho(III) ion by using standard and appropriate method[12]. The complex systems have been tested against *Staphylococcus aureus, Pseudomonas aeruginosa* and *Escherichia coli* bacteria with the help of Kirby-Bauer disc diffusion technique[13].

Solutions of all compounds were prepared in Dimethyl formamide (DMF) and their concentrations were taken as 10 µl/ disc. Activity was checked by measuring the zone of inhibition in mm.

III. Results and Discussion

In the present study of antimicrobial screening for sulphonanilide systems of Ho(III) ion against gram positive cocci and gram negative bacilli, following results have been observed (Table-2, Figure-1).

1. Screening of *Staphylococcus aureus* against various systems

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

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

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

2. Screening of *Pseudomonas aeruginosa* against various systems

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

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

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

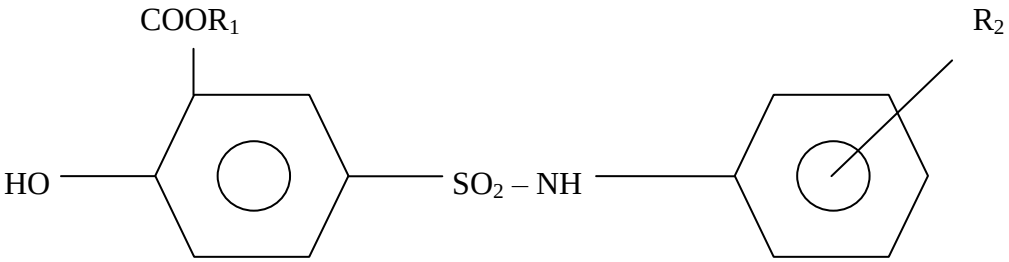
3. Screening of *Escherichia coli* against various systems

The decreasing order of sensitivity of *Escherichia coli* **(**E. coli) against Ho (III) – sulphonanilide systems is given below:

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

Insignificant activity was observed by L_7, L_{12} and L_{16} sulphonanilide systems. Moderate sensitivity was reported by the L_2, L_3, L_5, L_6, L_9, L_{10}, L_{11}, L_{13}, L_{14}, L_{17} and L_{19} whereas significant activity was observed in the L_4, L_8, L_{15} and L_{18} sulphonanilide systems.

Table – 1: 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 Ho (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	++	12	+	10	±
2.	23	+++	24	+++	9	±
3.	13	++	17	+++	10	±
4.	20	+++	20	+++	12	+
5.	13	++	16	+++	9	±
6.	24	+++	16	+++	9	±
7.	18	+++	18	+++	7	-
8.	13	++	19	+++	11	+
9.	12	+	20	+++	9	±
10.	17	+++	25	+++	9	±
11.	15	++	17	+++	10	±
12.	21	+++	20	+++	8	-
13.	16	+++	22	+++	9	±
14.	21	+++	21	+++	9	±
15.	15	++	20	+++	11	+
16.	19	+++	17	+++	8	-
17.	26	+++	15	++	9	±
18.	16	+++	14	++	11	+
19.	17	+++	13	++	9	±

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

- zone size 7mm - 9mm (insignificant)

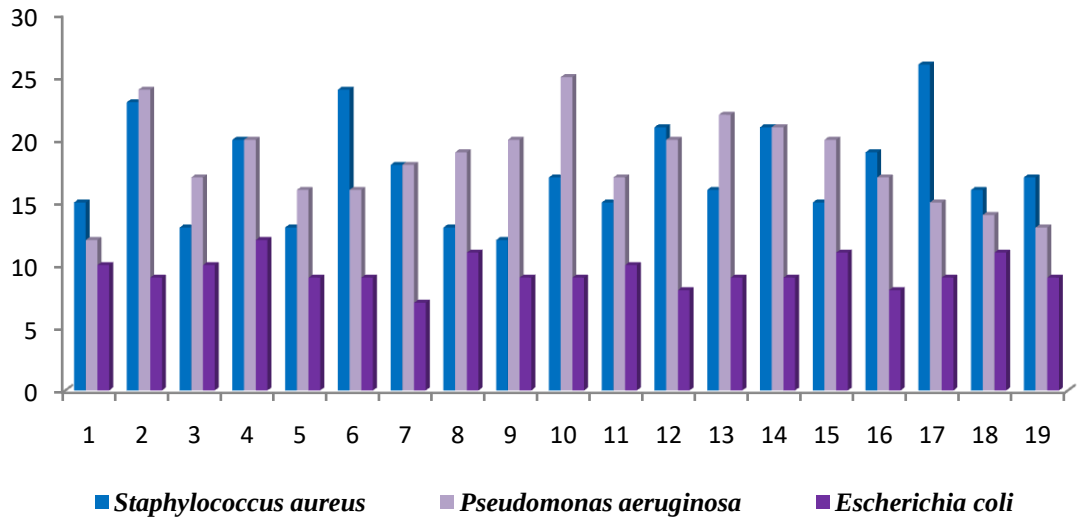
± zone size 9mm -11mm (moderate)

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

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

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

Figure-1. Comparative Antimicrobial activity among Ho(III) - Sulphonanilide systems with respect to *S. aureus*, *P. aeruginosa* and *E. coli*



IV. Conclusion

- Maximum sulphonanilide systems of Ho(III) were found to have remarkable activity.
- A very clear trend was found among antibacterial activity of sulphonanilides systems.
- Zone of inhibition was not reported with the pure solvent.
- Maximum systems of Ho(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*.
- The order of activity for Ho(III) systems against three micro -organisms was found as-

  Pseudomonas aeruginosa > *Staphylococcus aureus* > *Escherichia coli*

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