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Potential of 1, 3, 5 tris - dichlorocyclophosphonitrile, $(PNCl_2)_3$ as fungitoxic and bactericidal agent

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ABSTRACT

Inhibition of certain fungi, *Aspergillus flavus, A. niger, Penicillium humicola, P.oxalicum, monila geophila, Mucor sp., Chaetomium indicum and bacteria, Staphylococus albus, S. aureus, E. coli and Pseudomonas* species have been tested at 100, 200, 500 and 1000 ppm of $(NPCl_2)_3$. Most of the microorganisms were totally inhibited at 500 ppm. The bacteria exhibited higher tolerance in comparison to fungi at all concentrations of $(PNCl_2)_3$.

1. Introduction

Heterocyclic chemistry is of great importance to the medicinal chemists because of their drug utility. Large number of organic heterocyclic compounds like pyrimidines, thienopyrimidines and N, N-diethyl-5, 6, 7, 8-tetrahydrol 1- benzothiene-2, 3-(dipyrimidine) 4-amine as antibacterial, antimalarial and antihyperlipidemic are well documented [1-3]. Only few inorganic heterocyclics like phosophonitriles containing ethylamino group has been evaluated pharmacologically for its anticarcinogenic activity[4-5]. Several phosphonitrile like hexachlorotriphosphonitrile and octachlorotetraphosphonitrile are negative anti carcinogenic agents; however, anticarcinogenic properties of phosphonitriles containing ethyleneimino group have been reported [6-7]. These compounds gave 95-100% tumor prevention in- vivo. In the present paper antibacterial activity of 1, 3, 5 Tris - Dichlorocyclophosphonitrile, $(PNC_{l2})_3$ were screened for four bacteria viz. *Staphylococus albus, S. aureus (*Gram positive), *Escherichia. coli* (Gram negative) and *Pseudomonas aeruginosa* (Gram negative) and certain types of fungi *Aspergillus flavus*, *A. niger*, *Penicillium humicola*, *P. oxalicum*, *monila geophila*, *Mucor sp*., *Chaetomium indicum*.

2. Experimental

Trimetric chlorophosphonitrile, $(NPCl_2)_3$ was prepared [8] by refluxing 0.5 mol each of PCl_5 and NH_4Cl in 80 ml S- tetrachloroethane for 72 h. The colourless mass formed was separated, followed by successive washings with distilled water and S-tetrachloroethane to remove unreacted NH_4Cl and PCl_5 if any. The colourless mass extracted with petroleum ether, was recovered. The formation of the trimer was confirmed by its m.pt (found 114^0C).

Seed samples of two important food plants, wheat (Triticum aestivum) and barley (Hordeum vulgare) and vegetable crop, radish (Raphanus sativus) were moistened and placed in petriplates. Certain fungi, *A. flavus, A. niger, P.homicola, P.oxalicum, monila geophila, mucor sp.* and *Chaetomium indicum* developed on seed surfaces in different plates were identified. Seeds of wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*) and vegetable crop, radish (*Raphanus sativus*) owing to maximum growth of different fungi were shifted to petriplates containing $(PNCl_2)_3$ solutions of different concentrations (100, 200,500 and 1000 ppm) at 30^0C during April, 2017. Different fungi treated with different concentrations solutions were examined at 24h interval for recording percent inhibition.

Trimetric chlorophosphonitrile, $(NPCl_2)_3$ was screened to in vitro test against gram positive bacteria *Staphylococcus albus*, *S. aureus* and gram negative bacteria such as *E. coli* and *Pseudomonas sp.* by employing cup plate agar diffusion method[9] at 100, 200, 500 and 1000 ppm concentrations using ethanol as solvent, after 24h of incubation at 37^0C the zone inhibition was measured in millimeters[10]. The average inhibition was measured by using the equation.

$I = C-T/C \times 100$

I= Percent inhibition

C= Colony diameter of control

T= Colony diameter of tested plates

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3. Results and discussion

Table.1. shows inhibition of different fungi causing deterioration of many cereal and vegetable seeds under storage. At 100 ppm of $(NPCl_2)_3$ *Penicillium humicola* gave 60% inhibition, whereas 70% inhibition was recorded in the case of *Chaetomium indicum*. At 200-ppm inhibition of different fungi increased upto as high at 80-85% in *A. flavus*, *A. niger*, *Monila geophila*, *Mucor sp.* and *Chaetomium indicum*. Growth of majority of microorganisms were seen to be completely inhibited at 500 ppm of $(NPCl_2)_3$ whereas only *P. humicola* and *P. oxalicum* could survive with 95-98% inhibition which show their higher tolerance limit. At 1000 ppm of $(PNCl_2)_3$ all the fungi were completely inhibited. Gram-positive bacteria, *Staphylococcus albus, S. aureus* and gram-negative bacilli *E. coli* and *Pseudomonas sp.* were tested against $(PNCl_2)_3$.

Table. 2. Shows that *S. aureus* and *Pseodomonas sp.*, both were inhibited upto 90% at 500 ppm. The compound was found to be ineffective to *E. coli*. $(PNCl_2)_3$ is therefore toxic compound against bacteria also. The toxic properties of the compounds are due to its cyclic structure [11-12].

Table-1. Effect of $(PNCl_2)_3$ on inhibition of fungi causing seed deterioration

Conc. of $(PNCl_2)_3$ (ppm)	% Inhibition of Fungi						
	Aspergillus		*Penicillium*		*Monila Geophila*	*Mucor Sp.*	*Chaetomium Indicum*
	A. Flavus	*A. Niger*	*P. Humicola*	*P. Oxalicum*			
100	70	76	60	64	76	68	70
200	80	85	70	75	85	80	85
500	100	100	95	98	100	100	100
1000	100	100	100	100	100	100	100

Table 2. Effect of $(PNCL_2)_3$ on inhibition of bacteria

Conc. of $(PNCl_2)_3$ (ppm)	% Inhibition of Bacteria			
	Staphylococcus-albus	*Staphylococcus-aureus*	*Escherichia-coli*	*Pseudomonas species*
100	68	55	-	60
200	80	70	-	78
500	100	90	-	90
1000	100	100	-	100

4. Conclusion

It is concluded that bacteria posses higher tolerance in comparison to fungi at all concentration of $(PNCl_2)_3$. The title compound may used as better fungitoxic agent.

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