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Biological Activities of Fe(III)-Propan-1,3-Diol Di Xanthate

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Abstract

Fe(III)-complex of Potassium Propan-1,3-Diol Di Xanthate (PPDDX) was studied to examine its antimicrobial activities by using disc diffusion method. This complex is highly toxic against common pathogenic fungi such as *Aspergillus niger, Aspergillus flavus* and *Candida albicans*. The radial growth *Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae* and *Staphylococcus aureus* was not inhibited by this complex. In this case, the disc diffusion method is used to examine the complex aforementioned behaviour.

Key words : *Potassium Propan-1,3-Diol Di Xanthate, Antibacterial activity, Pathogenic fungi, Chelates*

Introduction

Several metal chelates and complexes have been shown to have antimicrobial properties. The most common donor atoms in these chelates or complexes are nitrogen and sulphur. While such inspections are conducted in an ad-hoc manner. (1) looked into the biochemical activity of Cu(II) complexes with a 'S' as a donor atom. Heavy metal removal from aqueous solution by fungus was investigated by (2). (3) investigated the antibacterial properties of Uranium complexes. (4) looked at how various 3d-metal complexes reacted with fungus and yeast. Some metal chelates, according to (5), have extraordinary antibacterial properties against some live microbes. (6) investigated the anti-Rhizopus migricone behaviour of Cr(IV) chelate.

(7) investigated the antibacterial activities of various 4d-metal chelates against a variety of complex live microbes. (8) investigated fungal biosorption as a treatment method for waste water containing heavy metals. Using single and multi-metal solutions, (9) examined the biosorption of Ni, Cr and Cd by metal toltant of *Aspergillus niger* and *Penicillium* species. Antifungal activity of Ni(II)-Complexes against Staphylococcus aureus and *Aspergillus niger* was also examined by (10). They discovered antimicrobial activity in some 3d-metal complexes against *E. coli, Klebsiella pneumoniae, Aspergillus flavus*, and other bacteria. (11) investigated the broad range antifungal properties of Co(II)-chelates. The antibacterial properties of various Fe(III)-chelates were investigated using the disc diffusion method by (12).

(13) studied the sublimable xanthate- mediated solid-state synthesis of highly interspersed g-C_3N_4/Ag_2S nanocomposites exhibiting efficient bactericidal effects both under dark and light conditions. (14) synthesized the Single precursor-based transition metal sulfide nanoparticles and evaluation of their antimicrobial, antioxidant and cytotoxic potentials.

Keeping in view, the above facts regarding the survey of literature, antifungal and antibacterial activities of metal chelates formed by potassium propan-1,3-diol dixanthate with Fe(III) are studied in detailed.

Materials and Methods

Culture Media : The following media were used in the study: nutrient agar (Himedia, M001), soyabean casein digest agar (Himedia, M290), nutrient broth (Himedia, M002), yeast malt agar (Himedia, M424), yeast malt broth (Himedia, M425), Sabouraud Chloramphenicol agar (Himedia, M1067) and Sabouraud dextrose broth (Himedia, M033). The media's composition is listed below.

Nutrient Agar (Himedia, M001)

Peptic digest of animal tissue	5.0 gm.
Yeast extract	1.5 gm.
Beef extract	1.5 gm.
Sodium chloride	5.0 gm.
Agar	15 gm.
D/w	1 ltr.
Final pH (at 25°C)	7.4 ± 0.2

A total of 2.8 gram of nutrient agar (M001) was suspended in 1000ml distilled water and autoclaved for 15 minutes at 15 lbs pressure (121°C).

Soyabean Chloramphenicol Agar (Himedia M1067)

Peptic digest of animal tissue	5.0 gm.
Casein enzymatic hydrolysate	5.0 gm.
Dextrose	40.0 gm.

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Chloramphenicol	0.05 gm.
Agar	15 gm.
D/w	1 ltr.
Final pH (at 25°C)	5.6 ± 0.2

A total of 65.0 grams of medium (M1067) was suspended in 1000ml distilled water and autoclaved for 15 minutes at 15 lbs pressure (121°C).

Sabouraud Dextrose Broth (Himedia M033)

Dextrose	20.0 gm.
Special peptone	10.0 gm.
D/w	1 ltr.
Final pH (at 25°C)	5.6 ± 0.2

A total of 30.0 grams of medium (M033) was suspended in 1000ml distilled water and autoclaved for 15 minutes at 15 lbs pressure (121°C).

Soyabean Chloramphenicol Agar (Himedia M1067)

Peptic digest of animal tissue	5.0 gm.
Casein enzymatic hydrolysate	5.0 gm.
Dextrose	40.0 gm.
Chloramphenicol	0.05 gm.
Agar	15 gm.
D/w	1 ltr.
Final pH (at 25°C)	5.6 ± 0.2

A total of 65.0 grams of medium (M1067) was suspended in 1000 ml distilled water and autoclaved for 15 minutes at 15 lbs pressure (121°C).

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Final pH (at 25°C)	5.6 ± 0.2

A total of 30.0 grams of medium (M033) was suspended in 1000 ml distilled water and autoclaved for 15 minutes at 15 lbs pressure (121°C).

Microorganism : From IMTech Chandigarh and kept for a long time, according to IMTech Chandigarh's instructions.

Pseudomonas aeruginosa	(MTCC No. 1680)
Klebsiella pneumoniae	(MTCC No. 109)
Aspergillus niger	(MTCC No. 1344)
Staphylococcus aureus	(MTCC No. 737)
Aspergillus flavus	(MTCC No. 871)
Escherichia coli	(MTCC No. 1687)
Candida albicans	(MTCC No. 227)

Fe(III)-Complex of Potassium Propan-1,3-Diol Di Xanthate (PPDDX)

Disc-Diffusion Method : Vincet and Vincent used this approach in 1944. The organism (inoculum) was generated after culturing the organism by transferring a loop full of the relevant organism from the stock culture into the sterile broth (at the same temperature and incubation period). The organisms were transferred using a 5 ml sterile broth loop. The microbial cultures were incubated according to the instructions below.

Fungus	26°C for 72 hours
Bacterial	37°C for 24 hours
Yeast like	26°C for 24 hours
C. albicans	

20 ml sterilized base agar was transferred directly to sterile Petri dishes and allowed to set equally. After that, each petri dish received 0.2 ml of old broth (fresh 5 ml). The chemical samples (various concentrations) were thoroughly moistened on sterile filter paper discs (whatman 44, dia 6 mm) and placed on seeded agar plates.

After an appropriate incubation period for each microorganism, the compounds inhibitory action was observed against the tested organisms. With the help of the disorder, the diameter of the zone of inhibition (mm) was measured accurately to the closest mm.

Tube dilution method for minimum inhibitory concentration (MIC) estimation : To determine the MIC of the drugs against microorganisms, tube dilution method was used.

In vitro antibacterial testing : On nutritional agar slant, the test bacteria *E. coli, S. aureus, Kb. pneumoniae*, and *P. aeruginosa* were kept. (Himedia M001).

After inoculation with a loop full of culture from the slants, nutrient broth (M002, Himedia) was used to investigate antibacterial activity of compounds. The broths were cultured at 37°C ± 1°C for 24 hours. 0.25 ml of 24 hour broth culture was seeded into a new 20 ml media. After dissolving the compounds in dimethyl sulphoxide (DMSO) to produce a 200 mg/ml stock solution, the first dilution was made by mixing 0.2 ml of the test material solution with 1.8 ml of seeded broth.

To make the second dilution, 1 ml of this has been diluted with 1 ml of seeded broth. As a control, a set of tubes containing mainly seeded broths was retained and a suitable solvent (DMSO) was used.

Results and Discussion

Fe(III)-PPDDX complex antimicrobial and antifungal activity : The Fe(III)-PPDDX complex did not significantly

Table-1 : Effect of Fe(III)-PPDDX complex on radial growth of various bacteria done by disc diffusion method. Figure-1

Fe(III)-PPDDX complex	Zone of inhibition (mm)			
Concentration (ppm)	*E. coli*	*P. aeruginosa*	*S. aureus*	*Kb. pneumoniae*
600	9.0	8.0	9.0	8.5
700	9.2	8.5	9.5	9.0
800	9.6	8.7	9.5	9.0
900	10.0	9.0	10.0	10.0
1000	10.0	9.5	10.5	10.0

Disc diameter = 6 mm

Table-2 : Effect of Fe(III)-PPDDX complex on radial growth of various fungi done by disc diffusion method. Figure-2

Fe(III)-PPDDX complex	Zone of inhibition (mm)		
Concentration (ppm)	*Aspergillus flavus*	*Aspergillus niger*	*Candida albicans*
500	13.0	16.0	16.0
800	16.0	19.0	18.0
1000	21.0	21.0	23.0

Disc diameter = 6 mm

Table-3 : Minimum inhibitory concentration of complex of Fe(III) on growth of some fungi and bacteria by tube dilution method.

Organisms	*Escherichia coli*	*Staphylococcus aureus*	*Pseudomanas aeruginosa*	*Klebsiella pneumoniae*	*Aspergillus flavus*	*Aspergillus niger*	*Candida albicans*
MIC (mg/ml)	21.0	21.0	21.0	11.0	2.25	2.25	2.25

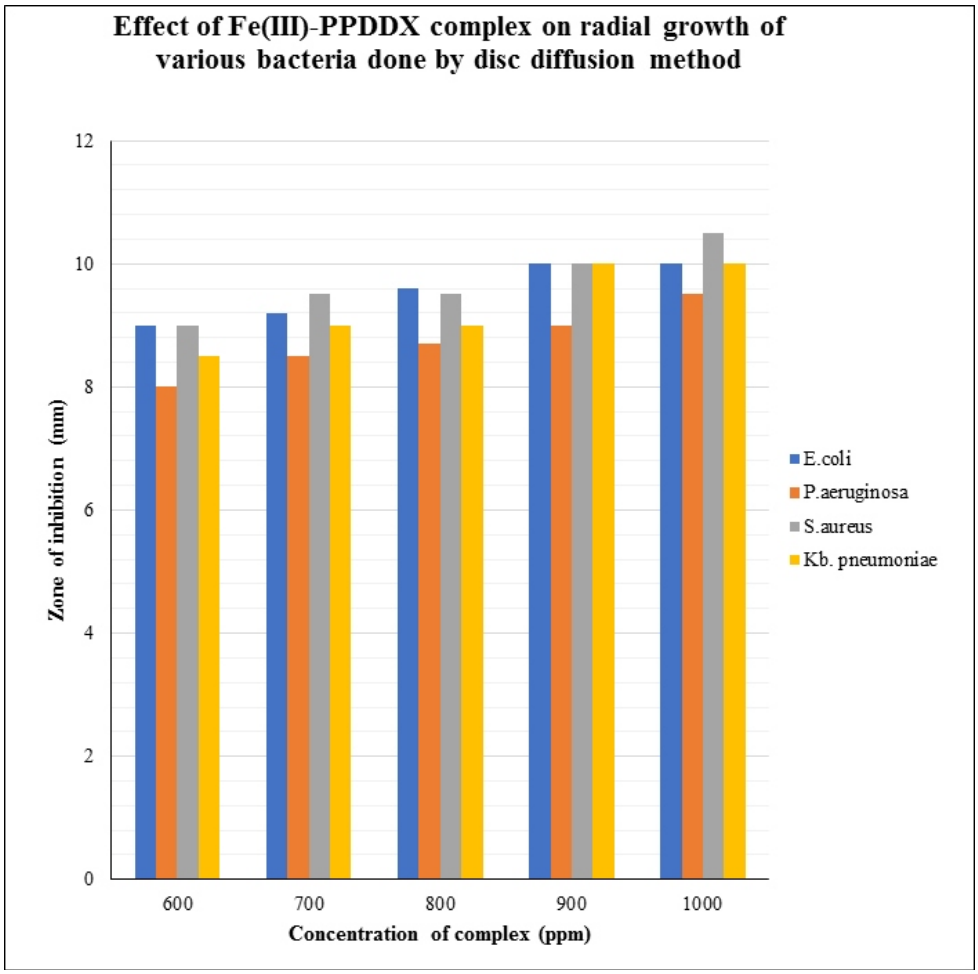

Figure-1

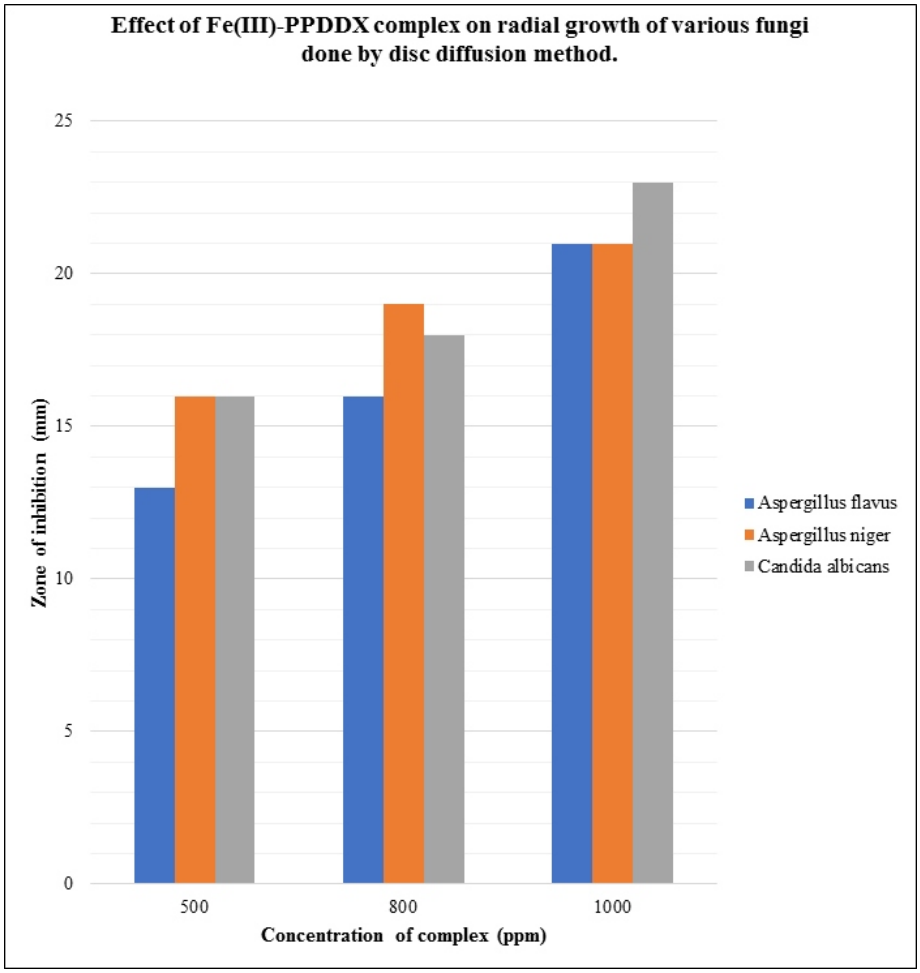

Figure-2

inhibit the radial growth *of Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae* and *Staphylococcus aureus* at various concentrations. *E. coli* (9.0mm) *P.aeruginosa* (8.0 mm) *S. aureus* (9.0 mm) and *Kb. pneumoniae* (8.5 mm) were not inhibited effectively by the 600 ppm of Fe(III)-PPDDX complex. At greater concentrations of 1000 ppm, Fe(III)-PPDDX complex had no effect on pathogenic bacteria such as *E.coli, Kb. pneumoniae, S. aureus. and P.aeruginosa*. (Table-1)

The Fe(III)-PPDDX complex has been shown to be lethal to pathogenic fungus like *Aspergillus niger. Aspergillus flavus* and *Candida albicans*. At 500 ppm, the Fe(III)-PPDDX complex had an effect on fungus i.e. *Aspergillus flavus* (13.0 mm), *Aspergillus niger* (16.0 mm) and *Candida albicans* (16.0 mm). All fungus showed higher inhibition at high concentrations (1000 ppm) (Table-2). Distinct amounts of Fe(III)-PPDDX complex inhibited pathogenic organism growth in different ways.

Conclusion

In this study, the antibacterial and antifungal properties of the complex Fe(III)-Potassium Propan-1,3-Diol Di Xanthate (PPDDX) is examined. The complex is screened against four types of bacteria and three types of fungi. The Fe(III)-PPDDX complex is found to be more effective in their antifungal activities than the antibacterial activities.

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