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Short Communication

REMOVAL OF CU AND ZN BY FUNGI IN MUNICIPAL SEWAGE WATER

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ABSTRACT
Peri-urban cultivated areas of many cities in India are being irrigated from municipal and/or industrial sewage water since long. Water sample are collected from two zone of Jabalpur (Civil Line and Adhartal) and investigate the status of heavy metals, microbe's diversity and fungal tolerance to heavy metals. There was marked differentiation among the water for various heavy metals (Zn, Cu, Cd, and Ni etc) and fungal diversity. Seven fungal species were found in this water. The most common fungal strains viz., *Aspergillus* sp, *Fusarium* sp, *Sarcinnella* sp. and *Cladosporium* sp. were tested for tolerance against the heavy metals Zn and Cu. The degree of tolerance was measured by concentration of heavy metals absorb by fungal strains. Among the isolated fungal strains of both zones *Fusarium* sp and *Cladosporium* sp. was most tolerant against the tested heavy metals. It absorb high amount of heavy metals followed by *Aspergillus* sp, and *Sarcinnella* sp. Thus the heavy metals absorb fungus *Sarcinnella* sp. has shown a high absorbance concentration, which makes it attractive potential candidate for further investigation regarding its ability to remove metals from contaminated water.

KEYWORDS: municipal sewage water, heavy metals, fungal tolerance, pollution, bio sorption.

INTRODUCTION

India has the world's largest canal irrigation system, and its economy is based mainly on agriculture. However, canal water is not enough to cope with the crop water requirements and there is need of other resources of irrigation water for crop production. As the main sources of irrigation are canal and tube well water but the quality of groundwater is so poor for the sustainability of agriculture system. For meeting the present demand, use of municipal sewage water containing mainly the domestic liquid waste and industrial effluents, is becoming a common practice. Environmental pollution with heavy metals is a global concern being everywhere, though to different degrees and is specific to certain parts of the biogeosphere. Living organisms are not able to prepare and adapt rapidly to a sudden and huge load of different toxic substances. Accumulation of certain elements, especially of heavy metals with toxic effect, can cause undesirable changes in the biosphere bearing unforeseeable consequences (Djukic & Mandic, 2000). Biological approach has the great potential that contributes for the achievement of this goal. Biosorption is proven to be quite effective for the removal of metal ions from contaminated solution in a low cost and environment friendly manner (Volesky, 1990). Biosorption process, using microbial biomass as a biosorbent has been demonstrated. Both active and heat killed biomass of active filamentous fungi utilized in biosorption process (Gadd, 1990).

MATERIAL & METHODS

Study area and samples collection

Water samples were collected from two municipal sewage areas of Jabalpur (Civil Line and Adhartal). These sites are irrigated by industrial and sewage polluted water.

Isolation, Identification of Fungi

Potato dextrose agar (PDA) media (1 litre) was used for the isolation of fungi. The water samples were processed with isolation procedure using the water dilution method. After incubation distinct colonies were counted and identified. The cultures were identified on the basis of macroscopic (colonial morphology, colour, texture, shape, diameter and appearance of colony) and microscopic characteristics (septation in mycelium, presence of specific reproductive structures, shape and structure of conidia and presence of sterile mycelium). Pure cultures of fungi isolates were identified with the help of literature (Domsch *et al.,* 1980; Barnett & Hunter, 1999).

Metal Tolerance and Absorption test for fungi

Isolated fungus strains (7 sps.) were tested for their tolerance against different heavy metals ($ZnSO_4$, $CuSO_4$). And test the amount of heavy metals adsorbed by fungi. Potato dextrose broth media was used for this experiment. The concentration (1.8 gm $ZnSO_4$ in 1000ml of distilled water and 2.65gm $CuSO_4$ in 1li) stock solutions prepare. Then prepare two concentrations 25% (0.6625gm/li) and 50% (1.325 gm/li). Inoculated the fungal strain and add 1ml of metal solution of the different concentration (3 sets). Incubation was conducted at 24ºC for 5, 10, &15 days. The growth of fungus and adsorption of heavy metals was measured for given time duration.

RESULTS

In sample A, 3 fungi and 10 bacteria and in sample B, 4 fungi and 4 bacteria are isolated. Concentrations of heavy metals are higher in sample A as compared to sample B. After 15 days incubation isolated fungi were degraded the both (Zn, Cu) metal ions. But degradation amount and rate of Cu was higher than Zn. At the 25% (0.45mg/l Zn

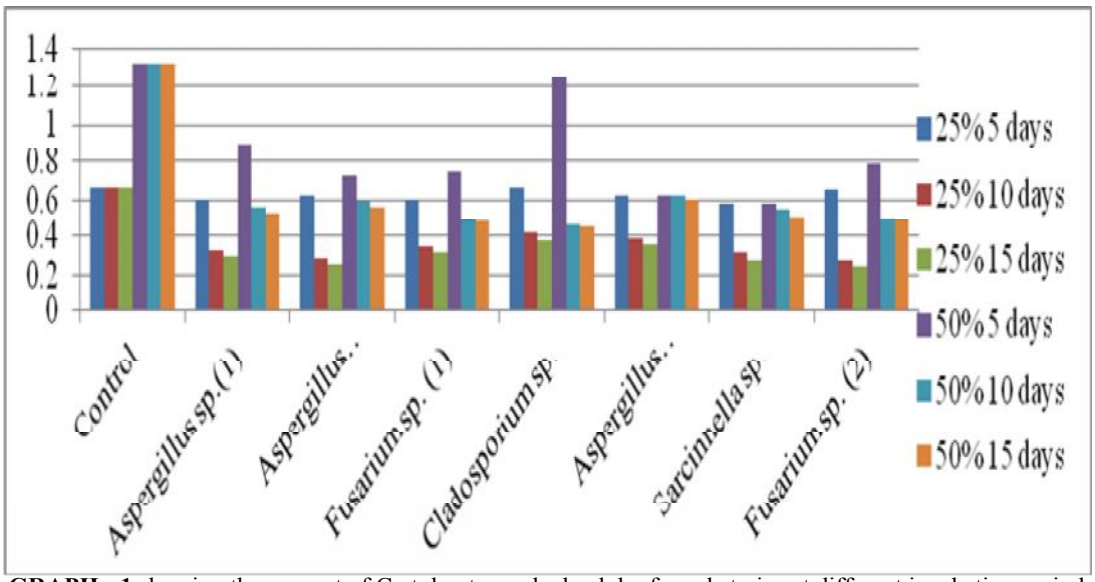
and 0.6625mg/l Cu) concentration degradation rate was lower than 50% (0.90mg/l Zn and 1.325mg/l Cu) concentration. At 25% concentration after 15 days *Sarcinnella* sp. was absorbed the high amount (0.32mg/l) of Zn ion. And Cu ion was highly absorbed by *Aspergillus flavus* (2) (0.25mg/l) and *Fusarium* sp. (2) (0.24mg/l). At the 50% concentration *Fusarium* sp. (1) (0.06mg/l) and *Aspergillus ustus (3)* (0.06mg/l) was absorbed the high amount of Zn ion. And Cu ion was highly absorbed by *Cladosporium* sp. (0.44mg/l). These results shows that isolated fungus in Sample B (Adhartal**)** was more tolerant compared to Sample A (Civil Line). Analysis of heavy metal shows that amount of heavy metals was higher in Sample A (Civil Line) compared to Sample B (Adhartal**)**. The study shows that isolated fungus in Sample B (Adhartal**)** was more tolerant compared to Sample A (Civil Line) due to this reason occurrence of heavy metals was lower in Sample B (Adhartal) as compared to Sample A (Civil Line).

TABLE - 1 showing the amount of Cu tolerates and adsorb by fungal strains at different incubation period

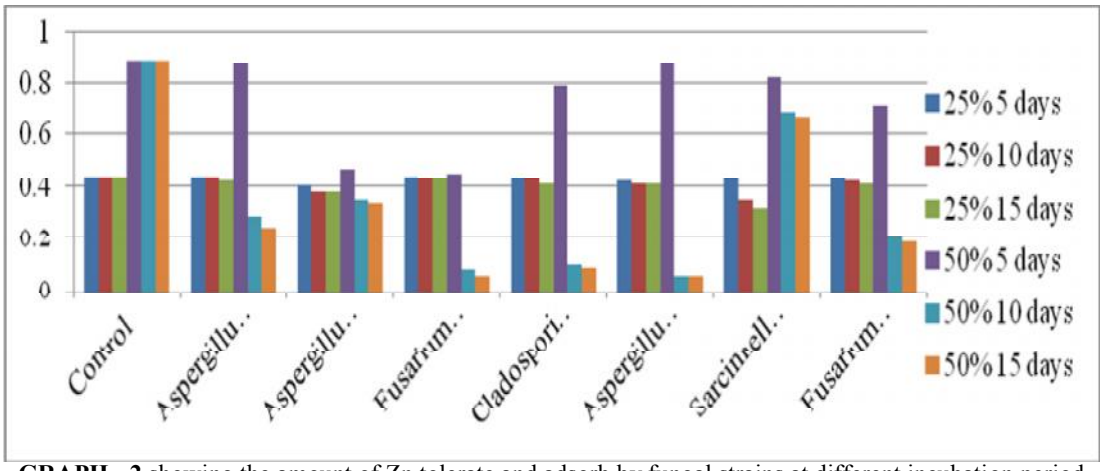
S.No.	Fungal Strains	25%			50%		
		5 days	10 days	15 days	5 days	10 days	15 days
1.	Control	0.6625	0.6625	0.6625	1.325	1.325	1.325
2.	*Aspergillus* sp.(1)	0.60	0.32	0.29	0.90	0.56	0.53
3.	*Aspergillus flavus* (2)	0.62	0.28	0.25	0.72	0.59	0.56
4.	*Fusarium* sp. (1)	0.60	0.34	0.31	0.74	0.48	0.47
5.	*Cladosporium* sp.	0.66	0.41	0.37	1.26	0.45	0.44
6.	*Aspergillus ustus* (3)	0.62	0.38	0.35	0.62	0.62	0.60
7.	*Sarcinnella* sp.	0.58	0.31	0.27	0.58	0.55	0.51
8.	*Fusarium* sp. (2)	0.65	0.27	0.24	0.78	0.50	0.48

TABLE - 2 showing the amount of Zn tolerate and adsorb by fungal strains at different incubation period

S.No.	Fungal Strains	25%			50%		
		5 days	10 days	15 days	5 days	10 days	15 days
1.	Control	0.45	0.45	0.45	0.90	0.90	0.90
2.	*Aspergillus* sp.(1)	0.45	0.45	0.42	0.89	0.29	0.25
3.	*Aspergillus flavus* (2)	0.40	0.38	0.38	0.48	0.35	0.34
4.	*Fusarium* sp. (1)	0.45	0.44	0.44	0.46	0.08	0.06
5.	*Cladosporium* sp.	0.44	0.43	0.41	0.79	0.10	0.09
6.	*Aspergillus ustus* (3)	0.42	0.41	0.41	0.89	0.06	0.06
7.	*Sarcinnella* sp.	0.43	0.35	0.32	0.82	0.70	0.68
8.	*Fusarium* sp. (2)	0.44	0.42	0.41	0.72	0.20	0.18



GRAPH - 1 showing the amount of Cu tolerates and adsorb by fungal strains at different incubation period



GRAPH - 2 showing the amount of Zn tolerate and adsorb by fungal strains at different incubation period

DISCUSSION

It is well known that a long-time exposure of water and sediment to heavy metals can produce considerable modification of their microbial populations, reducing their activity and their number. In the present study, water samples collected from municipal sewage of Jabalpur (M.P.) in two regions Sample A (Civil Line) and Sample B (Adhartal) where heavy metals and other pollutants have been emitted in industrial effluents for several years. Different 7 species of fungi were isolated and identified from the collected water samples. *Aspergillus flavus, Aspergillus ustus, Fusarium* sp., *Cladosporium* sp., and *Sarcinnela* sp., were present and dominant in both the water samples. Metal resistant fungi (*Aspergillus* sp., *Fusarium* sp., *Sarcinnella* sp., *Trichoderma* sp. and *Cladosporium* sp.) can be isolated from the municipal sewage water polluted with industrial and municipal water (Mehra *et al*., 2002). Abundance and activities of microflora in water strata are controlled by the availability of water, nutrients, pH, concentration of metal ions, and hydrodynamic communication with the ground surface and so on (Edward *et al*., 2009). Environmental stresses brought about by the contamination could be a reason for the reduction in microbial species but increasing the population of few surviving species (Griffioen, 1994). In Jabalpur, Sample A (Civil Line) the frequency of fungi was 3 while in Sample B (Adhartal) the frequency was 4. The water samples collected from polluted sites were more affected by wastewater irrigation which affected the population densities of fungi. The differences between the sampled sites regarding their richness on microbial isolates appear to be closely linked to the degree of heavy metal pollution. Generally, pollution of soil and water by heavy metals may lead to a decrease in microbial diversity. The sources of pollutant as well as long periods of exposure are also the important factors regulating the stress and fungal adaptation (Pal *et al*., 2004; Edward *et al*., 2006).

CONCLUSION

The present study shows that the water samples of Jabalpur, Sample A (Civil Line) showed higher concentration of heavy metals as compared to that from Sample B (Adhartal). The isolated fungi of Sample B (Adhartal) were more tolerant to heavy metals. Our conclusion indicates that fungal population isolated from heavy metal contaminated sites has the ability to resist higher concentration of metals. A comparative level of metal resistance was also shown by filamentous fungi originated from unpolluted sites. The tolerance and resistance of the isolates depended much more on the fungus tested than on the site of its isolation. This variation may be explained by the development of tolerance and adaptation of the fungi to heavy metals. *Aspergillus* sp. and *Fusarium* sp. was the most resistance to all the metals tested, which make them promising candidates for further investigations regarding their ability to remove metals from contaminated environment. The present study indicates that isolated fungi of contaminated water can be used as bioremediation agents.

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