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COD reduction by filamentous fungi of Waldhuni River Ulhasnagar (Thane): A case study

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ABSTRACT

Industry is a major source of air, water and soil pollution. The rapid increase of population and demand of industrial development have created problems of pollution. The physico-chemical parameters of the water body are affected by its pollution. The changes in these parameters indicate the quality of water. In this study biological treatment was applied to Waldhuni river water that is highly polluted to reduce chemical oxygen demand (COD). The biological treatment was carried out by using five fungal isolates (*Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Penicillium griseofulvum, Trichoderma koningii*). Out of the five selected fungi, *Aspergillus niger* gave maximum percentage of reduction of COD (74% to 80%). This was followed by *Aspergillus flavus* which gave its highest percent reduction of COD (66% to 75%) for the water sample collected at AMP gate and petrol pump. The fungus *Trichoderma koningii* gave its highest percent COD (60% to 77%) reduction for the water sample collected at CHM gate. *Penicillium graseofulvum* gave it highest reduction of COD (67% to 70%) for the water sample collected at Kakola lake next to *Aspergillus niger*. *Aspergillus terreus* proved to be the weakest in COD reducer in the selected fungi (62% to 73%).

Keywords: COD reduction, fungi, Waldhuni River.

INTRODUCTION

The Waldhuni River is a small River originating at Kakola hills, Kakola Lake near Ambernath and unites with Ulhas River near Kalyan. Its total length is 31.8km. The river is so much polluted that it is now referred to as Waldhuni Nallah. It flows through thickly populated area of Ambernath, Ulhasnagar and Vithalwadi and is severely polluted due to domestic and industrial sewage. Patil *et al* (2012) have observed that due to rapid urbanization and industrialization, and due to dumping of domestic and industrial effluents, there has been increasing stress on rivers giving rise to water pollution and resulting in environmental deterioration. Water was primarily used for domestic needs such as drinking, cooking, washing, bathing etc. But due to industrial and urban development, requirement of water is increased. Good quality of water with high dissolved oxygen, low

BOD and COD, minimum salts dissolved in it is required for living beings. The quality of water is dependent on physical, chemical and biological parameters (Jena *et al,* 2013).

Rapid release of municipal and industrial sewage severely decreases aquatic environment. Major sources of water pollution are from municipal water, industrial water, agricultural water, sewage water, etc. Polluted water may contain suspended solids, dissolved inorganic compounds, nitrogen and phosphorous compounds, animal wastes, toxic chemicals, insecticides, pesticides, medical waste, heavy metals and biological pollutants such as pathogenic bacteria, fungi, protozoa, viruses, parasitic worms, etc. (Aggarwal and Arora, 2012).

The increasing industrialization and urbanization all over the world has resulted in pollution of water due to dumping of its waste in water bodies and in deterioration of its quality. Traditional customs and habits of releasing domestic waste water, agricultural run-offs and industrial effluents in the water bodies have all resulted in deterioration of water quality and loss of its potability.

Fresh water is essential for agriculture, industry, human beings and animals. The sources of fresh water on the earth are limited. Without adequate quantity and quality of fresh water sustainable development will not be possible (Kumar, 1997, Mahananda, 2005). Since fresh water resources are getting deteriorated day-by-day at a very faster rate, water quality is a global problem (Mahananda, 2010). The healthy aquatic ecosystem is dependent on the biological diversity and is reflected by its physico-chemical characteristics (Venkatesharaju *et al*, 2010). Microorganisms are widely distributed in nature and diversity of microorganisms may be used as an indicator for organic pollution. (Andrew, 2012).

There are diverse types of microorganisms found in water. This diversity may be altered by the altered polluted conditions of water. It is very difficult to study all the diverse type of microorganisms. Hence diversity of filamentous fungi related to polluted water and the soil below the water levels has been studied. (Pardeshi and Vaidya, 2015). Various filamentous fungi isolated from these polluted waters were employed to reduce COD. The same is discussed in the present paper.

MATERIALS AND METHODS

The water samples were collected from the four locations of Waldhuni River. These locations are origin of Waldhuni River at Kakola lake at Kakola gaon, AMP Gate at Ambernath, CHM College Gate at Ulhasnagar and petrol pump of Vitthalwadi. The areas were selected on the basis of levels and types of pollution. At the point of origin, people use water for house hold purposes. The water here is almost free of pollution. At the second location, there is maximum domestic pollution. At the third location, there are many dye industries, the sewage from the industries from Ambernath containing inorganic wastes, those from dye industries containing dyes, acids, bases etc. are mixed with the water that already contains domestic sewage. The last location is the site just before the meeting point of Waldhuni and Ulhas Rivers. At this point, water contains all sorts of pollutants and is the site of extreme pollution.

In five sterile 250 ml Erlenmeyer's flasks, 100 ml PD broth was added in aseptic conditions. 10 ml of each water sample was added aseptically to each of the flasks and a control was maintained. The flasks were inoculated with a loop full of the selected culture, the flasks were then placed on rotary shaker at 120 rpm for four days each culture was then filtered through Whatmann's filter paper No.42 and the COD values of the filtrates were checked by COD analyzer (**Unit No AL125)**. For the analysis, *Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Penicillium griseofulvum, Trichoderma koningii* were selected. Each experiment was replicated thrice.

RESULT AND DISCUSSION

Out of the five selected fungi, *Aspergillus niger* gave maximum percentage of reduction of COD. This was followed by *Aspergillus flavus* which gave its highest percent reduction of COD for the water sample collected at AMP gate and petrol pump. The fungus *Trichoderma koningii* gave its highest percent COD reduction for the water sample collected at CHM gate next to that of *Aspergillus niger*. *Penicillium graseofulvum* gave it highest reduction next to *Aspergillus niger* for the water sample collected at Kakola lake. *Aspergillus terreus* proved to be the weakest in COD reduction in the selected fungi.

Table 1: COD reduction of water sample at Kakola Lake.

Fungal species	Before treatment of COD (ppm)	After treatment of COD (ppm)	% of COD reduction
Aspergillus niger	5	1	80
Aspergillus terreus	5	1.9	62
Aspergillus flavus	5	1.7	66
Penicillium griseofulvum	5	1.5	70
Trichoderma koningii	5	2	60

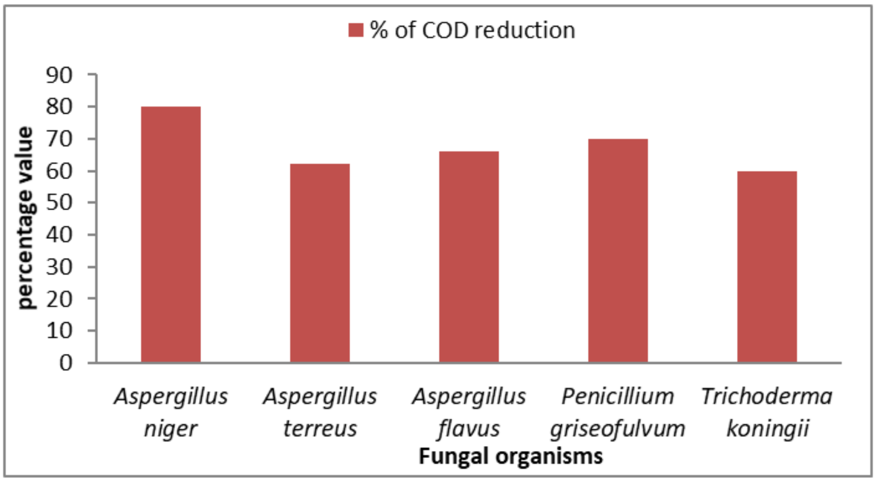

Figure 1: Showing percentage reduction of chemical oxygen demand

Table 2 : COD reduction of water sample at AMP gate

Fungal species	Before treatment of COD (ppm)	After treatment of COD (ppm)	% of cod reduction
Aspergillus niger	127	31	76
Aspergillus terreus	127	35	73
Aspergillus flavus	127	33	75
Penicillium griseofulvum	127	39	70
Trichoderma koningii	127	42	67

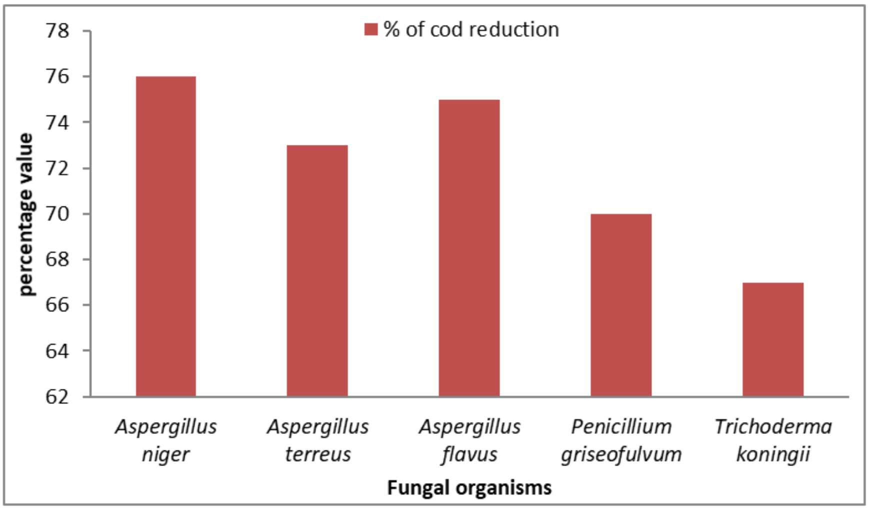

Figure 2: Showing percentage reduction of chemical oxygen demand

Table-3 COD reduction of water sample at CHM gate

Fungal species	Before treatment of COD (ppm)	After treatment of COD (ppm)	% of cod reduction
Aspergillus niger	544	125	78
Aspergillus terreus	544	167	70
Aspergillus flavus	544	141	75
Penicillium griseofulvum	544	177	68
Trichoderma koningii	544	130	77

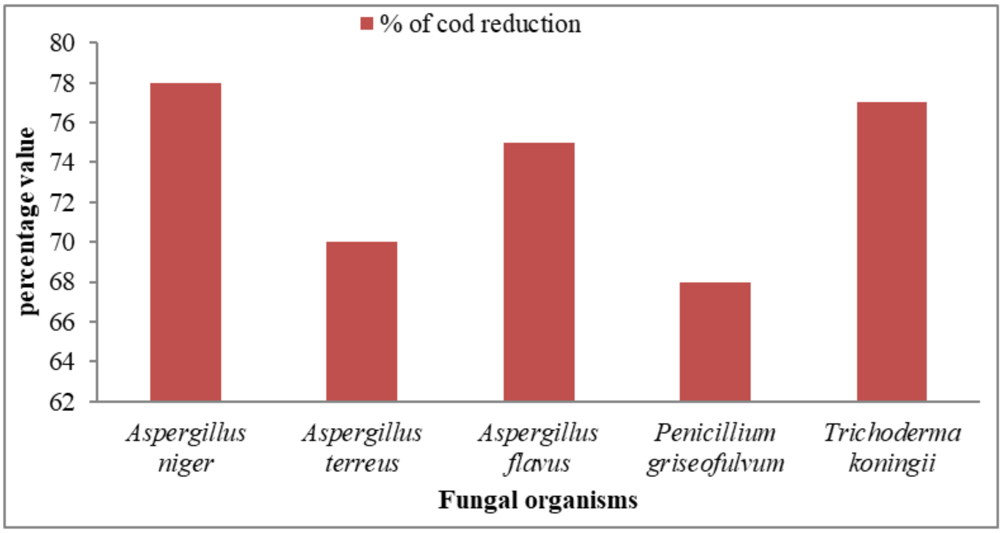

Figure 3: Showing percentage reduction of chemical oxygen demand

Table-4 COD reduction of water sample at petrol pump

Fungal species	Before treatment of COD (ppm)	After treatment of COD (ppm)	% of cod reduction
Aspergillus niger	722	189	74
Aspergillus terreus	722	215	71
Aspergillus flavus	722	197	73
Penicillium griseofulvum	722	245	67
Trichoderma koningii	722	228	69

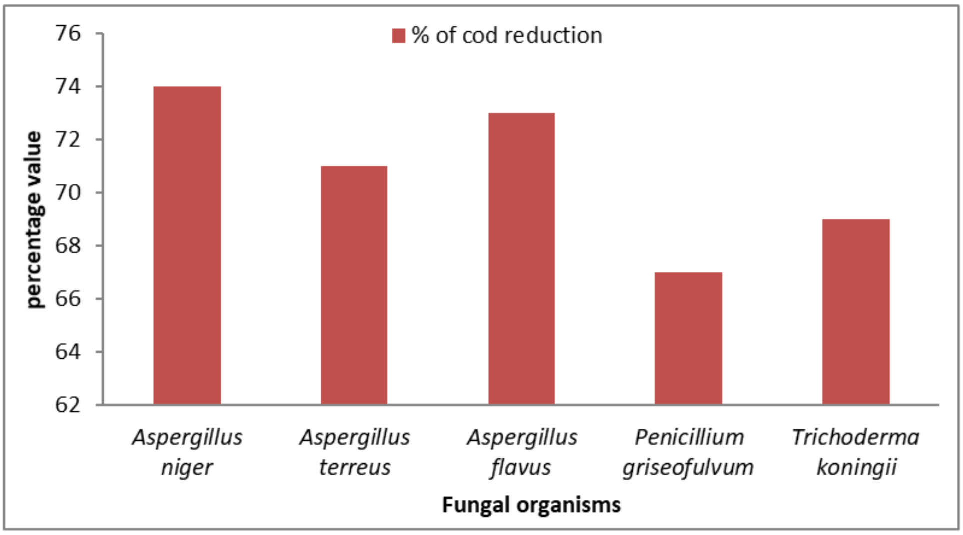

Figure 4: Showing percentage reduction of chemical oxygen demand

Sharma and Malviya (2013) have used *Aspergillus niger* strains for the bioremediation of tannery waste water. Tung *et al,* (2004) used *Aspergillus oryzae* for the treatment of Cassava starch processing waste water and studied its growth pattern.

Kshirsagar, (2014) used algae and fungi mixed cultures for the remediation of domestic waste water. They could get the best result by using *Aspergillus niger–Aspergillus terreus* combination and *Chlorella valgaris-Scenedesmus quadricauda* combination.
Yesilada, *et al* (1999), treated olive oil mill waste water with fungi such as *Coriolus versicolor, Funalina troggii, Phanerochaetae chrysosporium, Pleurotus ostreatus, Pleurotus sajar-kaju, Lentinus tigrinus* and *laetiporus sulphureus.* They could get nearly 65 percent reduction in COD.

Marimuthu *et al*, (2013) studied fungal decolorization of dye water using ten fungi. They could get maximum reduction of COD (72 %) with *Aspergillus niger.*

Bist and Harsh, (2014) used *Aspergillus niger* for bioremediation of tannery effluent They could get maximum reduction of COD (72 %) with *Aspergillus niger.*

Christopher *et al,* (2008) have reviewed the bioremediation processes and the organisms used for olive mill wastewater. They found that aerobic organisms provide the most viable option for reducing COD, color and phenolics.

In majority of studies *Aspergillus niger* and *Aspergillus flavus* were found to be the best suited fungi for COD reduction as is found in the present investigation even though there is 72 to 80 percent reduction, the water doesn't fit into WHO standard (10 ppm). But this can be achieved if the processes are supplemented with the *in situ* treatment to the pollution sources.

CONCLUSIONS

During this work it is clearly observed that selected five fungal species viz *Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Penicillium griseofulvum, Trichoderma koningii* were found to be more efficient in reduction of COD. Out of the five selected fungi, *Aspergillus niger* gave maximum percentage of reduction of COD (74% to 80%). This was followed by *Aspergillus flavus* which gave its highest percent reduction of COD (66% to 75%) for the water sample collected at AMP gate and petrol pump. The fungus with efficiency of reducing COD next to *Aspergillus* species was *Trichoderma koeningii.* It gave its highest percent COD (60% to 77%) reduction for the water sample collected at CHM gate. *Penicillium graseofulvum* gave it highest reduction of COD (67% to 70%) for the water sample collected at Kakola lake with the efficiency of reducing COD next to *Aspergillus* species. *Aspergillus terreus* proved to be the weakest in COD reduction in the selected fungi (62% to 73%).

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