Int.J.Curr.Res.Aca.Rev.2017; 5(11): 48-52

International Journal of Current Research and Academic Review

ISSN: 2347-3215 (Online) Volume 5 Number 11 (November-2017)

Journal homepage: http://www.ijcrar.com

doi: https://doi.org/10.20546/ijcrar.2017.511.009

Biodegradation of Domestic Waste Water using Fresh Water Thermophilic Fungi Isolated from Mayanur Dam, Tamil Nadu, India

R. Anbalagan and R. Sivakami*

Department of Zoology, Arignar Anna Govt. Arts College, Musiri-621211, Tamil Nadu, India

Corresponding author

Abstract

Fungi have been reported to play an important role in bioremediation processes. Hence the study was attempted using fungi to analyse the bioremediation effect. Results show that pH levels were found to decrease between 7.3 to 7.8 while nitrate levels decreased between 69.9 to 84% and phosphates between 79.2 to 83.4%. The BOD and COD levels showed reduction between 78.6 to 89.4% (BOD) and 82.6-85.6% (COD). Nevertheless, the maximum reduction was noticed in the setup which contained the consortium of organisms probably showing a synergistic effect.

Article Info

Accepted: 28 October 2017
Available Online: 20 November 2017

Keywords

Bioremediation,
Thermophilic Fungi,
Domestic Waste Water

Introduction

It is a well-known fact that aquatic fungi play an important role in degradation by secreting enzymes that degrade polysaccharides and polymers (Suberkropp and Klug, 1980; Singh, 1982; Chandrashekar and Kaveriappa, 1988; Sangar Rao, 2013).

Fungi are also efficient in degradation of recalcitrant compounds by their extracellular lignolytic enzyme system (Boulanger *et al.*, 2010).

In addition, literature also reveals that fungi can play a role in biosorption of toxic compounds during waste water treatment (Cooke, 1976; Kshirsagar *et. al*., 2012; Sivakami*et al.*, 2014; Smily, 2016).

Hence the present study was aimed at using commonly occurring fungal species to assess their degrading ability.

Materials and Methods

Collection of waste water

The domestic waste water samples used in this study were collected from Musiri area, Tiruchirappalli District, Tamil Nadu, India.

Analytical Methods

The waste water samples were analysed for pH using a pH meter. The biochemical oxygen demand (BOD), chemical oxygen demand (COD), phosphate and nitrate were determined as per standard methods (APHA, 1998).

Microorganism Selection

The fungi used in this study were isolated from water from the River Cauvery at Mayanur Dam, Karur District, Tamil Nadu. The experiments described in this study were carried out using four different species of fungi (*Aspergillus fumigatus*, *Rhizopus funiculosum*, *R. stolonifer* and *Fusarium oxysporum*) for the treatment of waste water.

Fungal Medium Culture

For isolation of fungi from the polluted water, PDA and malt extract broth medium were used. The pure fungal cultures were inoculated and grown in the test tube containing PDA medium maintained at 4 °C. 100 ml of malt extract broth (MEB).MEB was prepared and dispensed into 250ml conical flasks. On cooling, a loopful of individual fungal stains was inoculated in MEB under sterile condition and kept at 25-27°C for 7 days on a rotary shaker at 100rpm.

For experimental purposes, cultures were pre pared using mycelia from shaker flasks. The mycelium culture was pre-treated by homogenization at maximum speed (3000 rpm) for 3 min. After that, the whole mass was mixed in a blender to make a homogenous mixture. In order to obtain sufficient biomass for the subsequent growth and waste water treatment experiments, all the fungi were cultured in MEB and grown for a week before using for the experiment.

Experimental Set-up

The selected species of fungi were used for waste water treatment. The waste water samples collected from Musiri area, Tiruchirappalli District were used for the fungal assays. The waste water was filtered using Whatman No.1 filter paper to remove suspended solid particles.

To study the role of fungi in waste water treatment, the waste water was treated with selected species of fungi. Waste water without fungi was used as a control. Experiments were conducted intriplicates. Flasks with 200ml of waste water were used for the treatments. Two ml of uniform suspension of *Aspergillus fumigatus*, *Rhizopus funiculosum*, *Rhizopus stolonifer* and *Fusarium oxysporum* were used as initial inoculums (7 day sold culture) in each of the four flasks.

The experiment was conducted for a total duration of 16 days within a temperature range of 30±2°C. Samples were periodically (every 4 days) analyzed for physico-chemical parameters such as pH, phosphate, nitrate, BOD and COD using standard methods (APHA, 1998).

Results and Discussion

The results of the various parameters that were assessed are present in Tables 1-5.Table-1 records the influence of fungi on pH levels for a period of 15 days. As evident from the table, all the four fungi used in the study showed a decrease in the pH level. Among the fungi, *Penicillium funiculosum* recorded maximum reduction in pH (7.6). Nevertheless, it was the consortium of all the four fungi that recorded the maximum reduction in pH (7.39). Further, all the fungi including the consortium of fungi showed a decreasing level of pH on all the experimental days.

The effect of fungi on the NO_3 levels are presented in Table-2. As evident from the table, among the four fungi, *Aspergillus fumigatus* recorded maximum reduction in NO_3 level (84.0%) followed by *Fusarium oxysporum*. However, here also, it was the consortium of fungi that recorded the maximum reduction in nitrate level (86.4%). Here also all the fungi including the consortium continuously showed decreasing NO_3 level on all the days of the experiment.

The effect of fungi on phosphate removal are presented in Table-3. The table clearly shows that *Fusarium oxysporum* recorded maximum reduction in phosphate level (84.6%). The consortium also showed the same amount of phosphate reduction as *Fusarium* (84.6%). However, here also all the groups showed reduction till the last day of study.

The effect of fungi on BOD and COD are presented in Tables-4 and 5. It is clear that all the experimental groups showed a continuous decrease in both BOD and COD level on all the days of assessment. However, while *A. fumigatus* recorded a maximum decrease in BOD level (89.4%), it was *F. oxysporum* that recorded maximum decrease in COD level (85.6%). However, it was the consortium of fungi that recorded maximum decrease in both BOD (89.9%) and COD levels (87.6%).

A perusal of literature reveals that Sivakami *et al.*, (2014) also recorded a decrease in pH levels ranging from 8.16-8.89% using various fungi. However, they recorded maximum reduction levels in the set up containing *A. niger*, in the present study, the maximum reduction in pH was recorded by *P. funiculosum* followed by *A. fumigatus.* Further, while they noted a decrease in pH level only till the 12th day, the present study recorded a continuous decrease till the 15th day of study.

Table.1 Variation of pH content among the various experimental setups

Days	Control	*Aspergillus fumigatus*	*Penicillium funiculosum*	*Rhizopus stolonifer*	*Fusarium oxysporum*	Consortium Fungi
0	8.25	8.25	8.25	8.25	8.25	8.25
3	8.00	7.92	7.91	8.20	8.10	7.90
7	7.90	7.86	7.88	7.92	7.80	7.62
11	8.00	7.76	7.72	7.70	7.72	7.76
15	8.10	7.71	7.60	7.84	7.76	7.39

Table.2 Variation in NO_3 content among the various experimental setups

Days	Control	*Aspergillus fumigatus*	*Penicillium funiculosum*	*Rhizopus stolonifer*	*Fusarium oxysporum*	Consortium Fungi
0	100.0	100.0	100.0	100.0	100.0	100.0
3	6.3	17.6	20.4	21.0	21.4	23.4
7	7.8	46.6	31.0	32.6	34.6	40.0
11	8.7	67.0	63.0	58.0	67.8	70.0
15	11.2	84.0	79.6	69.9	79.9	86.4

Table.3 Variation in PO_4 content among the various experimental setups

Days	Control	*Aspergillus fumigatus*	*Penicillium funiculosum*	*Rhizopus stolonifer*	*Fusarium oxysporum*	Consortium Fungi
0	100.0	100.0	100.0	100.0	100.0	100.0
3	8.6	21.6	19.0	17.6	18.4	16.4
7	11.6	38.4	42.0	43.0	46.0	38.4
11	12.6	68.0	68.2	72.0	78.0	72.1
15	13.6	80.2	82.6	84.6	86.4	85.4

Table.4 Variation in BOD content among the various experimental setups

Days	Control	*Aspergillus fumigatus*	*Penicillium funiculosum*	*Rhizopus stolonifer*	*Fusarium oxysporum*	Consortium Fungi
0	100.0	100.0	100.0	100.0	100.0	100.0
3	2.3	19.4	18.4	16.4	20.2	30.2
7	3.5	48.0	36.4	34.6	40.6	48.6
11	4.8	76.4	72.6	68.0	70.6	72.2
15	5.8	89.4	84.0	78.6	88.4	89.4

Table.5 Variation in COD content among the various experimental setups

Days	Control	*Aspergillus fumigatus*	*Penicillium funiculosum*	*Rhizopus stolonifer*	*Fusarium oxysporum*	Consortium Fungi
0	100.0	100.0	100.0	100.0	100.0	100.0
3	3.2	20.4	21.0	20.6	20.1	21.4
7	5.7	46.4	47.0	48.0	49.6	50.6
11	8.0	70.2	71.0	72.0	73.2	74.9
15	8.4	82.6	84.6	85.6	86.0	87.6

In the present study, the removal of nitrates ranged between 69.9 to 84.0% with *Rhizopus stolonifer* recording the minimal and *A. fumigatus* recording the maximal removal rates. Earlier, Hwanga *et al.*, (2007) also recorded *Aspergillus* sp. to record the highest nitrate removal rates when compared to other species. Similar reports were also recorded by Kshirsagar (2012) and Sivakami *et al.*, (2014) using *A. niger*. Further, Sivakami *et al.*, (2014) also recorded minimal nitrate removal with *R. arrhizus*. This finding is similar to the present observation as minimal removal rates of nitrates was recorded with *R. stolonifer*.

With regard to phosphate levels, the removal rates were found to range from 80.2 (*P. funiculosum*) to 84.6% (*F. oxysporum*). Sivakami *et al.*, (2014) recorded phosphate reduction levels ranging from 79.2 to 83.4% with the maximum reduction taking place in the experimental set up containing *P. citrinum* which is different from the observation noticed in the present study.

In the present study, the BOD levels were found to reduce from 78.6 (*R. stolonifer*) to 89.4% (*A. fumigatus*). Azab (2008) recorded BOD reduction levels to range from 67.7 to 85% using fungi, while Andleeb *et al.*, (2010) noticed BOD levels to decrease by 66.5% in textile effluents and Kshirsagar *et al.*, (2012), noted a decrease in levels ranging from 66.9 to 82.4%. Recently, Sivakami *et al.*, (2014) recorded a decrease in BOD levels ranging from 71.6 to 88.4%; she recorded minimal decrease in BOD levels using *F. oxysporum* and maximum levels using *A. niger*. In the present study also, maximum decrease in BOD level was recorded with *A. fumigatus*.

COD levels were found to decrease in levels ranging from 82.6 (*A. fumigatus funiculosum*) to 85.6% (*F. oxysporum*). Hamdi *et al.*, (1991), Hamdi and Radhouane (1992), Cereti *et al.*, (2004) and Azab (2008) also recorded decrease in COD levels ranging from 35.0 - 64.0% using *A. niger*. However, Kshirsagar (2012) recorded decreased COD levels ranging from 71.0 - 85.5% using fungi. Thus, the results obtained in the present study are in line with those of others. Nevertheless, in the present study, it was the consortium of fungi that produced the best results. It is probable that they showed a synergistic relationship between themselves. However, this needs further study.

References

Andleeb, S., Atiq, N., Ali, M.I., Razi-UL-Hussain, R., Shafique, M., Ahmed, B, Ghumro, P.B., Hussain, M., Hameed, A. and Ahmed, S. (2010). Biological treatment of textile effluent in stirred tank bioreactor. *Int. J. Agric. Biol*., 12:256-260.

APHA (1998). *Standard methods for the examination of water and wastewater*. 18th ed. American Public Health Association, Washington, DC.

Azab, M. S. (2008). Waste water treatment technology and environmental management using sawdust bio-mixture, *J. Taibah Uni. Sci*., 1:12-23.

BenilaSmily, J. M. (2017). Studies on fresh water fungal diversity in subtropical lakes and efficacy of indigenous fungi in waste management. Ph.D. Thesis, Bharathidasan University, Tiruchirappalli. 2017.

Boulanger, M., Malle, N. and Van Haluwyn, C. (2010). *Complement au compterendu de la ses-sionlichénologique sur le littoral duPas-de Calais enmai 2008. Bulletin d'informations de 1'Association francaise de licheno1ogie*, 35: 97-99.

Cereti, C.F., Rossini, F., Fcderici, F., Quarantin, D., Vassile, N. and Fenice, M. (2004). Reuse of microbially treated olive mill wastewater as fertilizer for Wheat (*Triticum durum*Desf.). *Bioreso. Technol*., 91:135-140.

Chandrashekar, K.R. and Kaveriappa, K.M. (1988). Production of extracellular enzymes by aquatic hyphomycetes. Folia Microbiologica, 33:55-58.

Cooke, W.B. (1976). Fungi in Sewage:In: Present Advances in Aquatic Microbiology. (Ed. E.B.G. Jones).Elek Science, London, pp.389-434.

Hamdi, M. and Radhouane, E. (1992). Bubble column fermentation of olive mill wastewaters by *Aspergillus niger*. *J. Chem. Techno. Bio technol*., 54:331-335.

Hamdi, M., Khadir, A. and Garcia, J. (1991). The use of *Aspergillus niger* for the bioconversion of olive mill waste-waters. *Appl. Microbi. Biotechnol*, 34:828-831.

Hwanga, S. C., Lin, C. S., Chen, I. M. and Wu, I. M. (2007). Removal of nitrogenous substances by *Aspergillus niger*in a continuous stirred tank reactor (CSTR) system. *Aquacult. Engineer*., 36: 177-183.

Kshirsagar, A. D. and Gunale, V.R. (2011). Pollution status of river Mula (Pune city) Maharashtra, India. *J. Ecophysio. and Occupati. Hlth*., 11:81-90.

Kshirsagar, A.D., Ahire, M.L. and Gunale, V.R. (2012). Phytoplankton diversity related to pollution from Mula River at Pune City. *Terrestrial and Aquatic environment. Toxico*., 6: 136-142.

Singh, N. (1982). Cellulose decomposition by some tropical aquatic hyphomycetes. Transactions of the British Mycological Society, 79: 560-561.

Sivakami, R., Sirajunisha, V., Abdul Kader, K. and Prem Kishore, G. (2014). Experimental studies on biodegradation of domestic waste using thermophilic fungi. *International Journal of Current Research*, 6: 4475-4478.

Suberkropp, K. and Klug, M.J. (1980). The maceration of deciduous leaf litter by aquatic hyphomycetes. *Canadian Journal ofBotany*, 50: 1025-1031.

How to cite this article:

Anbalagan R. and Sivakami R. 2017. Biodegradation of Domestic Waste Water using Fresh Water Thermophilic Fungi Isolated from Mayanur Dam, Tamil Nadu, India. *Int.J.Curr.Res.Aca.Rev*. 5(11), 48-52.
doi: https://doi.org/10.20546/ijcrar.2017.511.009