JAZ INDIA

Journal of Advanced Zoology

ISSN: 0253-7214
Volume ***44*** *Issue* ***S5 Year 2023*** *Page* ***2498-2501***

Potential Approach Of Mushrooms In Bioremediation –A Short Review

Arpita Chakraborty[1], Sapna Mandal[2], Keya Mandal[3], Dipti Das[4], Supriya Kumar Bose[5], Aritri Laha[6], Sabyasachi Ghosh[7*]

[1,2,3,4,5,7]Department of Biotechnology, School of life science, Swami Vivekananda University, Barrackpore, West Bengal-700121, India.*
[3]Department of Environmental Science, Kalna College, Purba Bardhaman, West Bengal-713409, India.
[4]Department of Botany, Kalna College, Purba Bardhaman, West Bengal-713409, India.
[6]Department of Microbiology, School of life science, Swami Vivekananda University, Barrackpore, West Bengal-700121, India.

****Corresponding author:** Sabyasachi Ghosh*
**Department of Biotechnology, School of life science, Swami Vivekananda University, Barrackpore, West Bengal-700121, India. Email: sabyasachig@svu.ac.in*

Article History

Received: 30/09/2023
Revised: 15/10/2023
Accepted: 30/10/2023

Abstract

One of the biggest environmental problems facing the world today is the soil contamination caused by industrialization and the widespread use of chemicals. "Bioremediation" is an affordable and ecologically beneficial cleanup method that employs microorganisms to swiftly and efficiently break down dangerous pollutants. Substances that are toxic are changed into less harmful forms. The ability of fungi to change a variety of hazardous compounds has led to the possibility of using them in bioremediation. Mushroom-foring fungi, mostly basidiomycetes, are some of the natural most powerful decomposers due to their quick development and huge biomass output. They also emit strong extracellular enzymes. Among these enzymes are lignin peroxidases, laccase, and manganese peroxidase. Several mushrooms have been used to remove contaminants from contaminated environments, including *Agaricus bisporus*, *Pleurotus ostreatus*, and *Phanerochaete chrysosporium Trametes versicolor*. Bioremediation has made use of *Lentinus squarrosulus*, *Pleurotus tuber-regium*, *P. ostreatus*, and *P. pulmonarius*. This paper highlights the use of mushrooms for bioremediation as well as applying fungal mycelia in bioremediation, in general referred to as myco-remediation. A brief summary of the future of using mushrooms for bioremediation is also provided.

Keywords: Bioremediation, Mycoremediation Bio-degradation, Heavy metals, Edible Mushroom

INTRODUCTION:

Systems for managing biological waste are becoming increasingly important on a global scale. A wide range of activities, including as industrialization, agro-industries, urban trash, and agriculture in its raw form, produce wastes every year. According to Wijnhoven et al., (2007) huge volumes of waste and organic pollutants are produced annually and discharged into the surroundings (soil and water). There are many different ways to remove heavy metals, but none of them are as active as biological approaches (using plants, algae, fungus, and bacteria). This is because biological methods are more expensive, don't always succeed in removing heavy metals completely, and still require a lot of resources. Given the seriousness of the problem and the lack of a practical remedy, an expedient, economical, and environmentally benign process of clearing up is badly desired (Hamman, 2004). Numerous species, including plants, algae, fungi, and bacteria have been employed to break down pollutants and purify our environment (Leung, 2004). But fungi, the most exceptional biological decomposer, are essential in turning these wastes into useful products. Because of their physiological adaptability, they can be found in a variety of habitats with acidic pH level, temperature, oxygen concentrations, salinity, and concentrations of heavy metal (Woldemariam, 2019). It has been shown that mushrooms' extracellular enzymes can break down a wide range of wastes, including both organic and inorganic contaminants, transforming them into food with excellent quality, flavor, and nutritional value. Therefore, mushrooms are among the fungi that show promise for environmental bioremediation. Mushrooms are especially environmentally benign since they may be used to produce food, feed, and fertilizer from lignocellulosic waste. It can be produced in plastic containers, plates, reservoirs, and containers and similar containers by producing artificially controlled conditions (Woldemariam, 2019). After spawning, these creatures grow rather quickly and can be harvested three to four weeks later. Consequently, mushroom farming is a crucial biological decomposer with a short payoff that is necessary for converting waste into goods that are valuable. The following are some efficient mycoremediation procedures for pollutant removal: mycoacumulation, mycodegradation, mycovolatilization, mycostabilization, and mycostimulation (Figure 1). The use of fungus mycelia and mushrooms in bioremediation are highlighted in this review literature. Additionally, a concise overview of the future scope of mushrooms in bioremediation is also discussed.

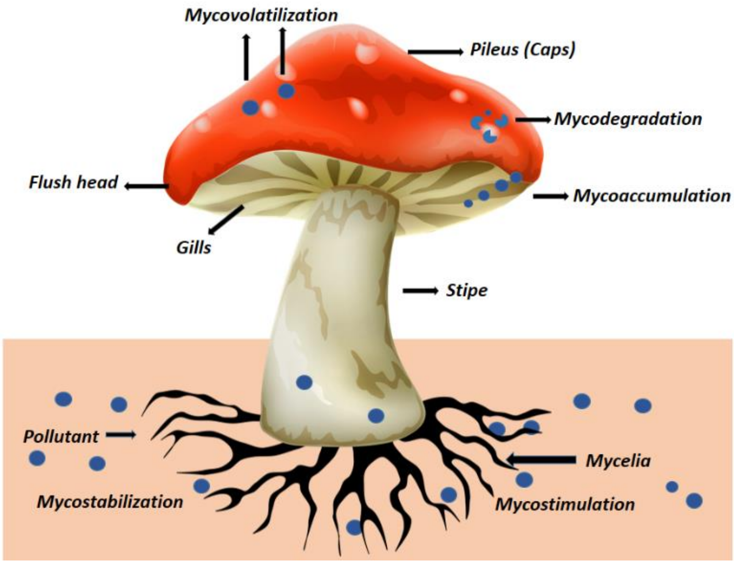

Figure 1: Different mycoremediation techniques using mushrooms.

APPLICATION OF MUSHROOM IN BIOREMEDIATION

A. Bioremediation using sporocarp of mushroom.

A highly promising approach to mitigating the deleterious impact of heavy metal-induced environmental contamination on human well-being and the Bioremediation in ecosystem. But because they are expensive and don't remove enough metal, none of the traditional treatments work as well as biological treatment. The ultimate goal of bioremediation is to fully mineralize contaminants, may change them to other forms, as water (H_2O), carbon dioxide (CO_2), nitrogen dioxide (N_2), hydrogen chloride (HCL), etc. If their solubility is changed or diminished, heavy metals and radioactive ions & radioactive elements can be less damaging to the environment even though they cannot be broken down (Singh et al., 2014). Phytoremediation and myco-remediation, which include gathering the fungus, are further methods of getting rid of them. The biotechnology and waste bioremediation fields hold a lot of promise for using mushrooms. The bio-remediation of soil wastes using mushrooms. According to some studies (Çayır et al., 2010; Demirbas 2002; Zhang, D. et al., 2008) mushrooms have the ability to convert accumulated heavy metals like nickel, chromium, copper, lead, and cadmium, and agricultural wastes into beneficial chemicals. *Agaricus bisporus* is a species that absorbs copper relatively much more than other species; Pleurotus ostreatus absorbs most cadmium, very little mercury, and zinc, but not lead; and Lepiotarhacodes accumulates lead at very high levels (Das, 2005). Only a few examples of persistent xenobiotic compounds that mushrooms can degrade are, *Trametes versicolor, Pleurotus ostreatus, Bjerkandera adusta, Pleurotus pulmonarius Lentinula edodes, Agaricus bisporus, Irpex lacteus, and Pleurotus tuberregium,.*

B. Bioconversion of Agricultural Contaminants

Agricultural transforming businesses, such as those that change fruits and vegetables, breweries, and grain mills, produce agro-industrial pollutants, which are good sources of specific bioactive molecules and nutrients. According to Kulshreshtha et al., (2014), consideration might be given to the bioconversion of these contaminants into some important alternative beneficial elements.

One well-known example of bioconversion, the process by which the fruiting bodies of mushrooms can be consumed as valuable objects is the growth of mycelia on agro-industrial pollutants. Only in situations where the substrates are notably present can the choice of agro-industrial substrates be made (Kulshreshtha et al., 2014). Since mushrooms are excellent sources of nutrients, their involvement in mycoremediation of agro-industrial pollution promotes the production of fruiting bodies rich in protein.

C. White-rot Fungi Deterioration System

The fungus industry's stimulant-induced lignin degradation mechanism is one of the prevalent biodeterioration techniques. Very few substrates are precise enough for Extracellular stimuli that alter lignin to consolidate the abundant proportion of highly refractory contaminants that share structural similarities with lignin (Mansur et al., 2003; Pointing, 2001)

Manganese peroxidase, laccase, lignin-peroxidase, and peroxidase-generating stimulants are the main players in the degradation of lignin, however not all ligninolytic fungi display all three forms of enzymatic action. In order to ascertain the action of the lignocellulolytic substates, on maize stalks, an experimental solid-state fermenting experiment using the *Lentinus squarrosulus* variant MBFBL 201 has been carried out. White-rot fungi have been projected for the biodeterioration of contaminated spots that contain challenging mixes like crude oil and creosote (Isikhuemhen et al., 2012).

After 30 days, the results demonstrated that *L. squarrosulus* was effective in breaking down maize stalks. On the sixth day of the culture procedure, lignocellulolytic stimulants started to function much more quickly. Which is a helpful producer of exopolysaccharides. Since it shows an active supply of acceptors, *L. squarrosulus* is a great choice for industrial pretreatment and the process of lignocellulosic biomass being biodelignified.

FUTURE SCOPE:

In a maximum mycoremediation experiment, mushroom was grown in lab soil, but sometimes it is difficult to replicate the results in real soil since many pollutants are located there in insoluble forms that make it difficult to remove them. While research is being done to optimize mushroom ability and properly understand the impact of metal heavy or pollutants accumulation inside the mushroom and their effect on their physiology, crop production, growth, and tolerance capacity, genetically modified and transgenic mushroom are currently giving better commercial responses. Therefore, there is still much to learn about ability of mushroom employed for heavy metal & pollutant removal in the future. However, it is hoped that various agronomic management techniques and technologies would be applied to address the issue of acclimatization of mushroom in various environments.

CONCLUSION:

As everyone is aware, microbial bioremediation and biodegradation are among the most concentrated areas of study for enduring developments because of their strong enzymatic activity and remarkable adaptability under harsh environmental conditions. Based on the circumstances given above, it can be concluded that mushroom cultivation attracted a lot of attention in the study area for biological degradation and bioremediation. Employing mushrooms that harbor a beneficial bacterial strain may accelerate the breakdown of pollutants. If the genes causing the biodegradation of pollutants are found and added to the native strain, future prospects may be enhanced. The availability of high strains in real-world environments. Future research must build links between specialists in interdisciplinary fields like microbiology, biotechnology, genetic engineering and chemistry, in order to create a workable bioremediation method.

REFERENCES:

1. Belewu, M. A., & Belewu, K. Y. 2005. Cultivation of mushroom (Volvariella volvacea) on banana leaves. African journal of Biotechnology, 4(12).
2. Bilal, M., & Asgher, M. 2016. Biodegradation of agrowastes by lignocellulolytic activity of an oyster mushroom, Pleurotus sapidus.
3. Çayır, A., Coşkun, M., & Coşkun, M. 2010. The heavy metal content of wild edible mushroom samples collected in Canakkale Province, Turkey. Biological Trace Element Research, 134, 212-219.
4. Das, S., Bisoyi, S. K., Anmoldeep, P. D., & Srivastava, S. (2021). Role of Cultivated Mushrooms in Bioremediation: A Review. Biol. For, 13(1), 160-168.
5. Demirbaş, A. 2001. Heavy metal bioaccumulation by mushrooms from artificially fortified soils. Food chemistry, 74(3), 293-301.icially fortified soils. Food chemistry, 74(3), 293-301.
6. Demirbaş, A. 2002. Metal ion uptake by mushrooms from natural and artificially enriched soils. Food Chemistry, 78(1), 89-93.
7. da Luz, J. M. R., Paes, S. A., Ribeiro, K. V. G., Mendes, I. R., & Kasuya, M. C. M. 2015. Degradation of green polyethylene by Pleurotus ostreatus. PLoS One, 10(6), e0126047.
8. Hamman, S. 2004. Bioremediation capabilities of white rot fungi. Biodegradation, 52(16), 11.
9. Isikhuemhen, O. S., Mikiashvili, N. A., Adenipekun, C. O., Ohimain, E. I., & Shahbazi, G. 2012. The tropical white rot fungus, Lentinus squarrosulus Mont.: lignocellulolytic enzymes activities and sugar release from cornstalks under solid state fermentation. World Journal of Microbiology and Biotechnology, 28, 1961-1966.
10. Kuforiji, O. O., & Fasidi, I. O. 2008. Enzyme activities of Pleurotus tuber-regium (Fries) Singer, cultivated on selected agricultural wastes. Bioresource Technology, 99(10), 4275-4278.
11. Kulshreshtha, S., Mathur, N., & Bhatnagar, P. 2014. Mushroom as a product and their role in mycoremediation. AMB express, 4, 1-7.
12. Lechner, B. E., & Papinutti, V. L. 2006. Production of lignocellulosic enzymes during growth and fruiting of the edible fungus Lentinus tigrinus on wheat straw. Process Biochemistry, 41(3), 594-598.
13. Leung, M. 2004. Bioremediation: techniques for cleaning up a mess. Biotech Journal, 2, 18-22.
14. Mansur, M., Arias, M. E., Copa-Patiño, J. L., Flärdh, M., & González, A. E. 2003. The white-rot fungus Pleurotus ostreatus secretes laccase isozymes with different substrate specificities. Mycologia, 95(6), 1013-1020.
15. Pointing, S. 2001. Feasibility of bioremediation by white-rot fungi. Applied microbiology and biotechnology, 57, 20-33.
16. Rani, P., Kalyani, N., & Prathiba, K. 2008. Evaluation of lignocellulosic wastes for production of edible mushrooms. Applied biochemistry and biotechnology, 151, 151-159.
17. Singh, G., Şengör, S. S., Bhalla, A., Kumar, S., De, J., Stewart, B., & Sani, R. K. 2014. Reoxidation of biogenic reduced uranium: a challenge toward bioremediation. Critical Reviews in Environmental Science and Technology, 44(4), 391-415.
18. Tüzen, M. 2003. Determination of heavy metals in soil, mushroom and plant samples by atomic absorption spectrometry. Microchemical Journal, 74(3), 289-297.
19. Wijnhoven, S., Leuven, R. S. E. W., van der Velde, G., Jungheim, G., Koelemij, E. I., De Vries, F. T., ... & Smits, A. J. M. 2007. Heavy-metal concentrations in small mammals from a diffusely polluted floodplain: importance of species-and location-specific characteristics. Archives of Environmental Contamination and Toxicology, 52, 603-613.
20. Woldemariam, W. G. 2019. Mushrooms in the Bio-Remediation of Wastes from Soil. Adv. Life Sci. Tech, 76, 41-46.
21. Zhang, D., Gao, T., Ma, P., Luo, Y., & Su, P. 2008. Bioaccumulation of heavy metal in wild growing mushrooms from Liangshan Yi nationality autonomous prefecture, China. Wuhan University. Journal of Natural Sciences, 13(3), 267-272.