Scavenging Of Waste Water Using Oyster Mushrooms

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ABSTRACT

Water contamination is a never-ending perpetual trouble and ruefully its a result of urbanization, industrialization along with population expansion, and other ancillary factors. Environmental deterioration had always impacted negatively on both biotic and abiotic components. The major impact of it had serious consequences on one of the pivotal natural resource- water. In addition to the agony of water scarcity the lack of treatment of wastewater in third world countries causes challenges and thus reuse and recycling becomes the only way out of the predicament. The challenge however lies to create cost effective, simpler, user-friendly technologies that prevent endangering the significant water-dependent livelihoods while also protecting our priceless natural resource. The best technique apart from conventional chemical techniques is to take resort to green bioremediation involving mushrooms and recycle the waste therein. Mushrooms growing on natural materials such as wheat straw, rice straw, and other agricultural wastes are been used for a long time as a nutritional ingredient being laden with rich protein content. Mushroom are also seen to be an effective bioremediation tool of their usage in the removal of an array of contaminants. These are easy to cultivate and has the propensity specifically to store a lot of heavy metals and other harmful compounds. Oyster mushrooms has been reported to act as "scavengers" of the environment by digesting dead wood, rejuvenating the soil and providing minerals in usable form to the ecosystem. This review highly rests on the importance of oyster mushrooms where extracellular oxidative enzymes produced by the mushrooms can be used to degrade a wide range of notorious chemicals and substances that pollute the environment.

Keywords: Heavy metals, Mycofiltration, Mycoremediation, Oyster mushrooms, Wastewater.

INTRODUCTION:

Though all time an exaggerated statement the environment being a hub of biotic and abiotic components should be protected. Fast industrialization in developing nations has aided economic escalation, it paved way to significant economic declination for the adverse effects due to unplanned anthropological encroachment in the ecosystem contributing by and large to air and water pollution. Poor waste and effluent management from homes, industries, and agricultural fields is wreaking havoc on the ecosystem,

which is already suffering Akhtar *et* al 2020). According to a report by the World Health Organization, 2.2 billion people lack access to safe drinking water, with 144 million people drinking contaminated water

(WHO, 2019). The provision of clean, healthy water for individuals and processed technological water for industrial firms is one of the world's most pressing environmental issues. Aside from its negative impact on public health and the economy, pollution can also jeopardize food security, drinking water supply, and biodiversity. As a result, developing measures to prevent soil and water pollution caused by a variety of chemicals and heavy metals has become critical (Akhtar *et* al 2020) Given the widespread contamination of the environment by persistent and harmful chemical pollutants originating from industrial waste water, it is critical to create cost-effective remediation technologies. For the removal and degradation of numerous resistant and dangerous compounds from soil and water, a variety of physical and chemical approaches are currently available. These procedures, are costly, produce hazardous byproducts, and are ineffectual for low concentrations of highly harmful substances (Khan *et*.al 2019). A technique that may overcome these restrictions and enable in-situ pollution treatment must be devised.

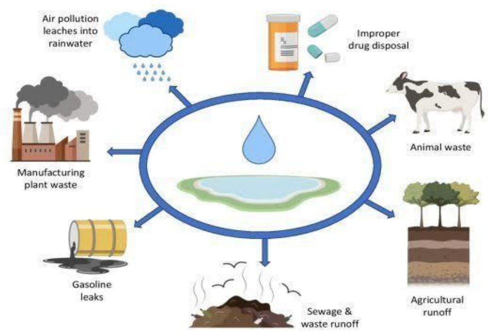
The current study classified wastewater into municipal, farm, and industrial sources based on source and occurrence, as discussed below.

- *Municipal wastewater:* The most essential technique at the moment is to treat home or municipal wastewater. Salts, BOD, various hydrocarbons, including medicines and personal care items, suspended solids, a variety of heavy metals, and coliforms are the most common pollutants in municipal wastewater. Due to the dynamic nature of a variety of pollutants, municipal wastewater treatment systems must be able to handle significantly fluctuating water budgets and quality, which are frequently insufficiently addressed by typical treatment systems (Kataki *et* al 2021).

- *Industrial wastewater*: Industrial wastewater is produced when substances are released either in dissolved form or they remain as solids suspended in water that happens during industrial production process or the cleaning operations that accompany that process. Industrial effluent composition varies significantly, with various degrees of biodegradability and (Skrzypiecbcef and Gajewskaad, 2017). Higher amounts of organic contaminants alongside high acidic or alkaline pH, salts, colloids, and other hazardous pollutants are the key features of industrial (Wu and *et* al. 2015).

- *Agricultural and farm wastewater*

The surplus water that runs off the field at the low end of furrows, boundary strips, basins, and flooded regions during surface irrigation is referred to as agricultural wastewater. Irrigation tailwater is another name for this wastewater. Agricultural wastewater from various farming processes generates effluent streams that must be treated before being released into the



environment.(Kataki, Sampriti ,2021.

Fig 1. Sources of water contamination (Images courtesy of Biorender)

Water footprint: a map to assess water pollution

The amount of water needed to generate each of the goods and services used is measured by water footprint. It might be quantified for a particular process, such as rice farming, a product, such as a pair of pants, or the gasoline we put in our cars, or for an entire multinational corporation. (Hoekstra, Arjen Y.,2012) water footprint can also tell us how much water is consumed in a certain river basin or from an aquifer by a particular country – or globally.

Water sourcing out from precipitation are trapped in the root region of the soil which consequently gets either evaporated, transpired, or absorbed by plants is referred to as green water footprint. Agriculture, horticulture, and forestry products are particularly affected.

Ground or surface water resources that is evaporated, mixed into a product, or taken from one body of water and returned to another at a later time is referred to as blue water footprint. Blue water footprints can be created by irrigated agriculture, industry, and home water use.(Mekonnen, Mesfin M.,2011)

The amount of fresh water necessary to assimilate contaminants to achieve specified water quality criteria is known as the grey water footprint (Hoekstra, Arjen Y.,2012) which takes into account point-source pollution that is released directly into freshwater bodies or indirectly or are leached from the soil, impermeable surfaces, or other diffuse sources. (Mekonnen, Mesfin M.,2011)

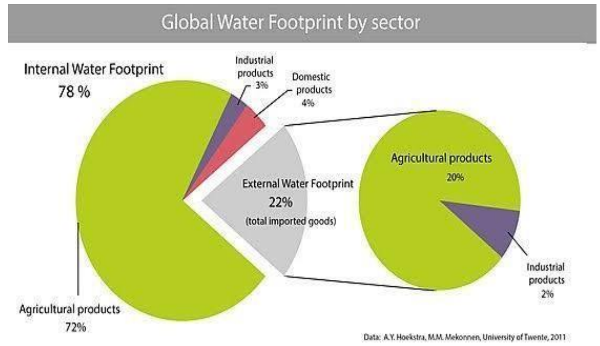


Fig 2. Sector wise Global average numbers and composition of all national water footprints (Sampa ,2018)

Water conservation: The need of the hour: conservational methods of water recycling

Conserving water ensures that there will be enough for everyone in our community to utilize as it makes a significant difference to utilise water wisely and economically.

Filtration, activated carbon, specialized coagulation, and chemical flocculation are examples of conventional wastewater treatment procedures that have been employed and prove

d to be effective, but they are also highly costly (Bhatnagar *et* al 2021). Flocculation and adsorption both require distinct treatments before disposal, and they both produce enormous amounts of sludge and debris, requiring more effort and expenditure (Camarero *et* al,2005), contamination of sludge that necessitates careful disposal (Aziz *et* al. 2015), In this situation, it is critical to choose an economically practical and effective treatment technology that is free of these constraints and can translate the demand for heavy metal removal into an environmentally benign strategy (Kapahi *et* al 2017).

Biological methods of wastewater treatment: The cost- effective resort for conservation

Bioremediation can be achieved through bioleaching. It is a biological process in which heavy metals are absorbed from the environment by microorganisms (Das *et* al. 2008, Chatterjee *et* al. 2019). Because of their great tolerance to heavy metals and higher surface-to-volume ratio, fungi are regarded the best prospects for bioremediation among all bioleaching microbes (Nath *et* al. 2018; Lima de Silva *et* al. 2012). The potential for bioremediation connected with microorganisms' ligninolytic enzymes and the creation of useful biomass makes their usage very intriguing. The key benefit of using an indigenous fungal strain is that it is adapted to the presence of pollutants as well as the site's environmental conditions. As a result, new technologies for heavy metal removal from polluted soil based on indigenous fungalstrains are needed (Khan *et* al 2019) .

Fig. 4 *Pleurotus ostreatus* Fruiting bodies (Source:Marcel Golian 2022 *et al)*

Mycoremediation, or the use of fungi or their derivatives for environmental pollution remediation, is a relatively cost-efficient, environmentally benign, and effective approach *Pleurotus*, sometimes known as oyster mushroom, belonging to the family of gilled mushrooms that grows solely on wood. *P. ostreatus, P. pulmonary, P. sajorcaju, P. cornucopiae, P. sapidus, P. platypus* and *P. ostreatoroseus* are example of those species included. Oyster mushrooms have been discovered to have a high biosorption capacity for a variety of environmental pollutants, including heavy metals. Accumulation of toxic heavy metals takes place in the fruit bodies of the mushrooms (Ogbo and Okhuoya 2011). Heavy metals have accumulated in clogged roadways, emission zones, and polluted cement and battery waste sites. Oyster mushrooms that grow near polluted areas have the ability to absorb substantial levels of heavy metals in their bodies.

Many essential materials are produced by studies on the role of discarded mushroom substrates after growing, including enzymes (Melanouri *et* al ,2020; Ranjithkumar, M.,2020) biomass (Anele, U.Y,2021), bioethanol (Fasiku, S., 2021), feed components, and functional meals (Medina, J.,2020). Studies on the biodegradation of agro-wastes or agro-industrial by-products by *P. ostreatus* using solid-state fermentation or submerged fermentation, such as using deinking sludge as a substrate to produce lignocellulolytic enzymes (Vodovnik *et* al 2018), producing exo-polygalacturonases using pomelo peel powder under submerged fermentation by
P. ostreatus (Majumder *et* al, 2020) and producing laccases by white-rot fungi (Chmelová, *et* al 2022).

Studies on the development and potential of ligninolytic enzymes (Tramontina *et* al 2020).Manganese peroxidase, laccase, and lignin peroxidase are the most important ligninolytic enzymes produced by *Pleurotus* through biodegradation, which differed from species to species. The pH, pollutant/waste content, and C:N ratio of the substrate are the key parameters that control the ability of *Pleurotus* species to create enzymes or digest wastes or pollutant (Kunjadia *et* al 2016).

Table. 1 : An account of the different species of mushrooms involved in waste removal

Mushroom spp.	**Waste/Pollutants**	**Function**	**References**
Pleurotus tuber-regium	crude oil	Bio-absorption of some heavy metals	Ogbo EM, Okhuoya JA (2011)
Pleurotus eryngii	Between 80 and saponin	Mycoremediation of manganese and Phenanthren	Wu M, Xu Y, Ding W, Li Y, Xu H (2016
Pleurotus ostreatus	Maize Straw	Pretreatment of Maize Straw for Bioethanol production.	Fasiku, S (2021)
Pleurotus Djamor		Biosynthesis of TiO2 Nanoparticle	Manimara(2021)

CONCLUSION

Mushrooms are fungi that are valuable source of human food due to their high nutritional content, bioactive chemicals, and several medical applications. These mushrooms have recently found new uses, particularly in the field of biotechnology. In the fields of mycoremediation, bio-fermentation, bioethanol, and enzyme production, these applications rely primarily on the mushrooms. In the bioremediation of polluted settings, the biodegradation of agro-wastes or agro-industrial wastes, and the biofermentation of ligninolytic wastes to produce enzymes, oyster mushrooms are regarded a sustainable solution.

FUTURE PROSPECTS

Oyster mushrooms (*Pleurotus ostreatus L*.) can be used to make biomass, feed components, and functional meals. The discarded substrate of the oyster mushroom has a number of uses, including recycling as a substrate for new mushroom growing cycles, producing biofuels, acting as a bio-control agent, a biofertilizer, and serving as a soil amendment.

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