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Research Article

Exploring Schizophyllum commune for Sustainable Mycoremediation of Heavy Metals

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Abstract: This study evaluated the potential of live mycelia of *Schizophyllum commune* for the removal of heavy metals from aqueous solutions. Key experimental parameters, including pH, temperature, and contact time, were analyzed for their impact on the biosorption process. Under optimized conditions, the maximum biosorption capacities for Pb(II), Sr(II), Zn(II), and Cd(II) were determined to be 81.5, 90.71, 70.18, and 66.18 mg/g, respectively. Equilibrium in the biosorption process was achieved within 180 to 240 minutes for the studied metal ions. The adsorption efficiency of *S. commune* under optimal conditions followed the trend Sr(II) > Pb(II) > Zn(II) > Cd(II). These findings highlight the potential use of *Schizophyllum commune* as an effective biosorbent for the remediation of heavy metals in contaminated water or industrial effluents.

Keywords: *Schizophyllum commune*, Heavy metals, Biosorbent, Adsorption capacity

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1. Introduction

The rapid growth of industries and agricultural practices due to population expansion has significantly increased waste production, leading to water, air, and soil pollution. Water contamination, particularly by heavy metals, has become a critical issue, affecting around 71% of surface water (Pericherla and Vara, 2024). Industrial activities such as mining, energy production, electroplating, and pesticide manufacturing contribute to the release of heavy metals like Pb, Hg, Cd, Zn, Cr, and Ni, which pose severe environmental and health risks (Kumar et al. 2021). Biosorption, utilizing biological materials like fungi, algae, plants, and bacteria, offers a cost-effective and efficient approach to removing heavy metals. This method is advantageous due to its low cost, high selectivity, reusability, and ability to target multiple metals simultaneously. White rot fungi have demonstrated significant potential in heavy metal removal through bioaccumulation and cell wall binding (Sharma, Giri, and Sharma, 2020). This study explores the biosorption potential of live *Schizophyllum commune* biomass for Pb(II), Sr(II), Zn(II), and Cd(II) in synthetic aqueous solutions, focusing on the effects of pH, temperature, and contact time.

2. Materials and Methods

2.1 Fungal culture conditions and biomass preparation

The *Schizophyllum commune* was collected and inoculated on PDA. The inoculated PDA plates were incubated at 28±1°C for 5-6 days for the growth of mycelia. For the production of biomass, mycelia of *S. commune* transferred to PDB medium. The flasks were kept on an orbital shaker at 120 rpm at 25°C for 5-6 days. The biomass was filtered and washed for further applications.

2.2 Batch biosorption study

For biosorption studies, the live biomass was kept in aseptic condition. The effect of pH on the biosorption process was tested at pH 2, 3, 4, 5, 6, 7, 8, 9,10. The contact time was studied at 5, 10, 20, 40, 60, 120, 180, 240 minutes while the temperature were tested at 20, 30, 40, 50, 60, 70, 80°C. The supernatant was used to measure the concentration of heavy metals after the treatment using ICP-AES.

Equations of biosorption capacity and removal efficiency (Bazrafshan, Zarei, and Mostafapour 2016):

$$\boldsymbol{Qe} = \frac{(Ci - Ce) * V}{W}$$

(1)

$$\boldsymbol{Removal\ capacity}\ (\%) = \frac{(Ci - Ce)}{Ci} * 100$$

(2)

Where, q_e is the amount of metal ions adsorbed onto

the unit mass of the adsorbent (mg/g); C_i is the initial concentration of metal ions (mg/L); C_e is concentration of metal ions at equilibrium (mg/L); V is the volume of aqueous solution (L); and W is the amount of adsorbent (g).

3. Results

3.1 Effect of pH on biosorption process

The adsorption capacity of the live biomass was highly influenced by acidic pH levels, showing a significant increase as the pH rose from 2 to 5 (Fig. 1). Maximum removal efficiencies were observed at pH 4 for Pb(II) (81.5 mg/g) and Zn(II) (70.18 mg/g), and at pH 5 for Sr(II) (90.71 mg/g) and Cd(II) (66.18 mg/g) (Table 1). The solution pH plays a critical role in metal uptake, as it affects the protonation and ionization of functional groups present on or within the cell surface.

3.2 Effect of temperature on biosorption process

Heavy metals	pH	Temperatures (˚C)	Contact time (min)	Absorption capacity (mg/g)
Pb(H)	4	70	180	81.5 ± 0.31
Sr(H)	5	70	180	90.71 ± 0.36
Zn(H)	4	60	180	70.18 ± 0.28
Cd(H)	5	70	240	66.18 ± 0.02

The highest adsorption capacities were recorded at 70°C for Pb(II) (81.5 mg/g), Sr(II) (90.71 mg/g), and Cd(II) (66.16 mg/g), while Zn(II) showed a maximum capacity of 70.18 mg/g at 60°C (Table 1). In contrast, the lowest adsorption capacities were observed at 20°C, with values of 38.16 mg/g for Pb(II), 33.47 mg/g for Sr(II), 33.76 mg/g for Zn(II), and 28.2 mg/g for Cd(II). These findings indicate that an increase in temperature enhances the biosorption capacity of the fungal biomass.

3.3 Effect of contact time on biosorption process

The adsorption capacity of biomass was gradually increases with increase in contact time till equilibrium is reached. The adsorption phase reaches equilibrium at 240 min for Cd(II) with maximum adsorption capacity of 60.18 mg/g, while for Pb(II), Sr(II), and Zn(II), the maximum adsorption capacity was 81.5, 90.71, and 70.18 mg/g respectively at 180 min. With progress in biosorption process, the binding sites for adsorption process become occupied and lesser sites are available for binding resulting in slow rate of adsorption process and eventually reaches the equilibrium phase.

Table 1. Optimum conditions for removal of metals using live fungal biomass of *S.commune*.

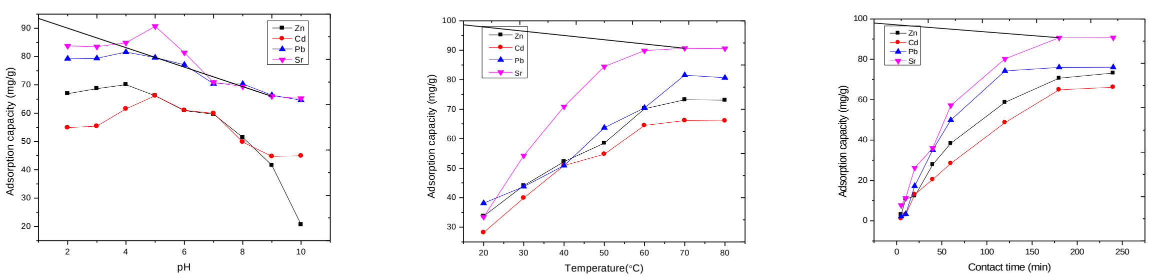

Fig. Effect of pH, temperature, and contact time on the biosorption process

5. Conclusions

This study utilized live biomass of *Schizophyllum commune* to remove Pb(II), Sr(II), Zn(II), and Cd(II) ions from aqueous solutions through a batch biosorption method. The optimal conditions for maximum adsorption capacity were determined as pH 4, 5, 4, and 5; temperatures of 70°C, 70°C, 60°C, and 70°C; and contact times of 180, 180, 180, and 240 minutes for Pb(II), Sr(II), Zn(II), and Cd(II), respectively. Under these optimized conditions, *S. commune* biomass demonstrated effective removal of the studied metal ions. The findings suggest its potential application as an efficient bioremediation tool for treating wastewater and other heavy metal-contaminated environments.

References

1. Pericherla, S. and S. Vara. 2024. Study on Agricultural Runoff Causing Heavy Metal Contamination in Surface Waters. *NATURALISTA CAMPANO*, *28*(1), pp.1268-1280.
2. Kumar, M., A. Seth, A. K. Singh, M. S. Rajput, and M. Sikandar. 2021. Remediation strategies for heavy metals contaminated ecosystem: A review. *Environmental and Sustainability Indicators*, *12*, p.100155. doi: 10.1016/j.indic.2021.100155
3. Sharma, K.R., R. Giri, and R. K. Sharma. 2020. Lead, cadmium and nickel removal efficiency of white-rot fungus *Phlebia brevispora*. *Letters in Applied Microbiology*, *71*(6), pp.637-644. doi:10.1111/lam.13372
4. Bazrafshan, E., A. A. Zarei, and F. K. Mostafapour. 2016. Biosorption of cadmium from aqueous solutions by Trichoderma fungus: kinetic, thermodynamic, and equilibrium study. *Desalination and Water Treatment*, *57*(31), pp.14598-14608. doi: 10.1080/19443994.2015.1065764