Biosorption and Bioaccumulation Potential of *Trametes versicolor* in Heavy Metal Remediation: A Toxicological Perspective

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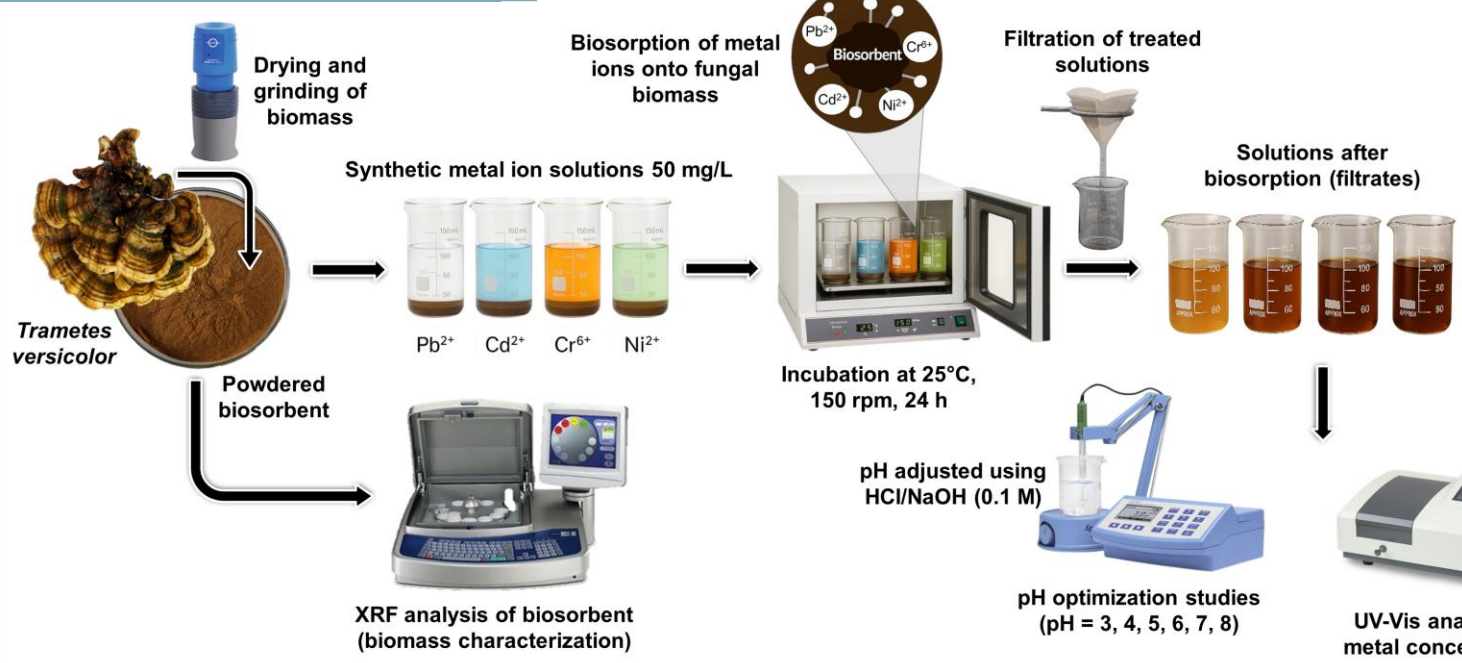
BACKGROUND

Trametes versicolor, commonly known as turkey tail, is a medicinal mushroom rich in bioactive compounds such as polysaccharides and phenolics. Beyond its therapeutic use, it has emerged as a promising candidate for mycoremediation, particularly in the removal of toxic heavy metals like cadmium (Cd), lead (Pb), nickel (Ni), and hexavalent chromium (Cr^{6+}). The fungus removes metals via biosorption, through functional groups in the cell wall (e.g., chitin, β-glucans), and via bioaccumulation, involving intracellular uptake and enzymatic detoxification. Literature reports removal efficiencies up to 90% for Pb and Cr, depending on biomass state and environmental conditions [1,2]. These features make *T. versicolor* a sustainable and cost-effective solution for wastewater treatment in industries such as electroplating and tanning.

AIM & OBJECTIVES

- ✓ This study aimed to evaluate the biosorption and bioaccumulation capacity of *Trametes versicolor* for removing heavy metals from synthetic aqueous solutions under controlled laboratory conditions.
- ✓ ***Specific objectives:***
  - ➢ To determine the removal efficiency of *T. versicolor* for heavy metals (Pb^{2+}, Cd^{2+}, Cr^{6+}, Ni^{2+}); To investigate the influence of pH on the biosorption process; To estimate the maximum biosorption capacity (q_{max}) for each analyzed metal; To confirm metal uptake in fungal biomass through XRF analysis.

MATERIALS & METHODS



- Fungal biomass: Dried *Trametes versicolor* (obtained from Retezat Mountains), ground and homogenized.
- Synthetic solutions of heavy metals: Pb^{2+}, Cd^{2+}, Cr^{6+}, and Ni^{2+} prepared at 50 mg/L in distilled water.
- Reagents: 0.1 M HCl and 0.1 M NaOH for pH adjustment.
- Equipment: orbital shaker, pH meter, analytical balance, drying oven, UV-Vis spectrophotometer, and XRF analyzer.

$$\text{Removal efficiency (\%)} = \frac{C_i - C_f}{C_i} \cdot 100$$

$$q_{max} = \frac{(C_i - C_f) \cdot V}{m}$$

C_i = initial concentration (mg/L)
C_f = final concentration (mg/L)
V = solution volume (L)
m = mass of fungal biomass (g)

RESULTS & DISCUSSIONS

- ❑ ***Heavy Metal Biosorption Efficiency (Fig. 1)***:
  - ✓ *After 24 hours of biosorption, Trametes versicolor biomass exhibited high removal efficiency.*

  Results varied based on the metal type: Pb^{2+} = 91.2%, Cr^{6+} = 87.8%, Cd^{2+} = 83.4%, Ni^{2+} =78.5%.
  These values confirm the high affinity of the fungal biomass for metal ions, especially lead and chromium.
- ❑ ***Influence of pH on Biosorption (Fig. 2)***:
  - ✓ Biosorption efficiency was highly dependent on pH:
    - Maximum removal occurred at pH = 5–6 for all metals.
    - At pH = 5, Pb^{2+} and Cr^{6+} removal reached 90–91% and 88%, respectively.
    - Lower pH (3–4) significantly reduced biosorption due to H^+ competition with metal ions.
- ❑ ***Maximum Biosorption Capacity (q_{max}) (Fig. 3)***:
  - ✓ The maximum biosorption capacity (qmax) was calculated for each metal, indicating effective uptake by the fungal biomass:
  - ✓ Pb^{2+} = 82.3, Cr^{6+} = 74.1, Cd^{2+} = 67.8, Ni^{2+} = 61.5 mg/g.
  - ✓ These results indicate a strong metal-binding capacity of the fungal matrix, particularly for Pb^{2+}.
- ❑ ***XRF Analysis of Treated Biomass (Fig. 4)***:
  - ✓ XRF spectroscopy confirmed the presence of metal ions (Pb, Cd, Cr, Ni) in the fungal biomass after treatment.
  - ✓ The characteristic peaks were absent in control (untreated) samples.
  - ✓ This confirms true metal uptake beyond surface adsorption, suggesting partial intracellular accumulation.

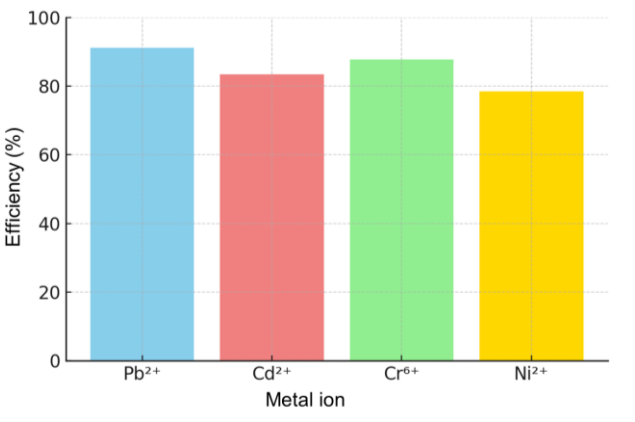


Fig. 1. Effect of pH on biosorption efficiency

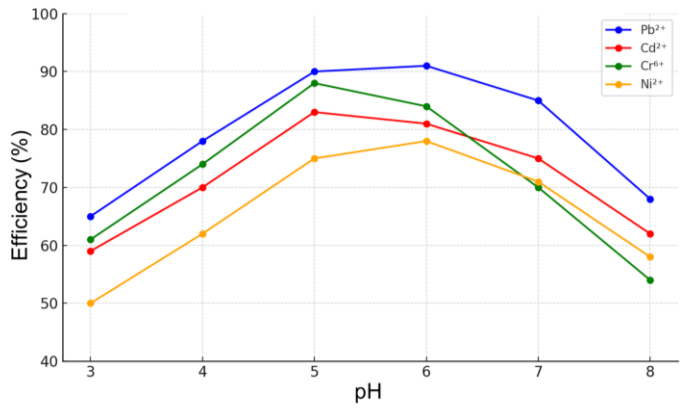


Fig. 2. Effect of pH on biosorption efficiency

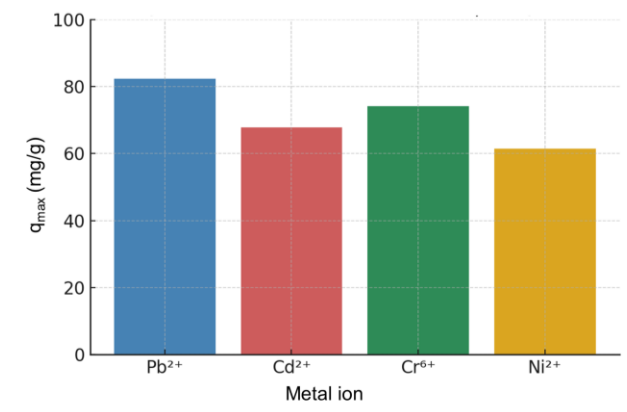


Fig. 3. Maximum biosorption capacity (qmax)

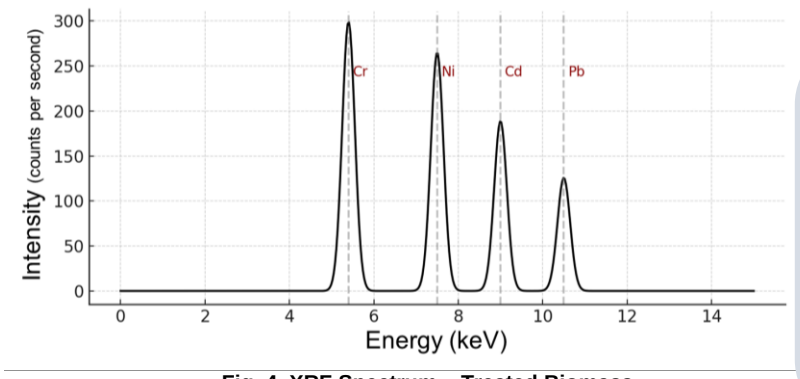


Fig. 4. XRF Spectrum – Treated Biomass

CONCLUSIONS

- ✓ *Trametes versicolor* showed high biosorption potential for all tested metals, with removal efficiencies up to 91.2% for Pb^{2+} and 87.8% for Cr^{6+}.
- ✓ Optimal biosorption occurred at pH = 5–6, confirming the importance of acidic conditions.
- ✓ Maximum biosorption capacities ranged between 61.5 and 82.3 mg/g, depending on the metal ion.
- ✓ XRF analysis validated metal uptake into fungal biomass, supporting possible intracellular accumulation.
- ✓ These results highlight the feasibility of using *T. versicolor* as an eco-friendly biosorbent for heavy metal remediation in wastewater applications.

REFERENCES

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