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Exploiting basidiomycetes and their enzymatic systems for the degradation of synthetic polymers

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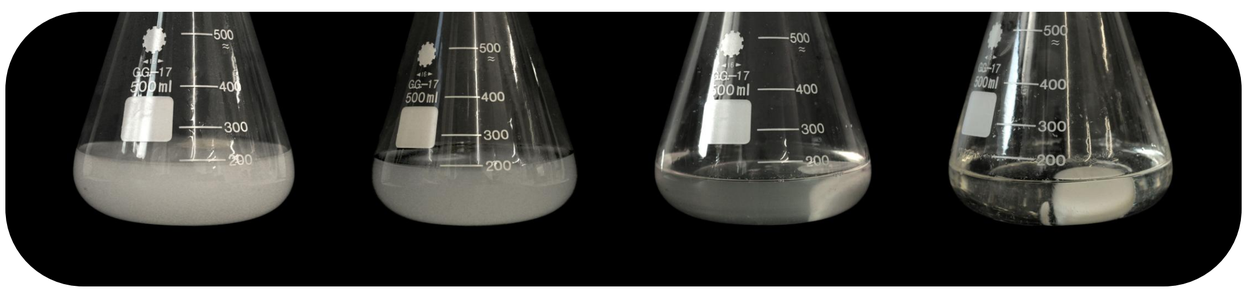
INTRODUCTION & AIM

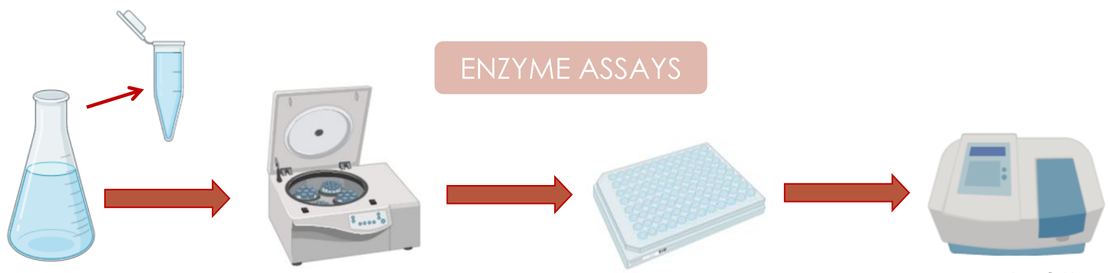
Plastic waste is a persistent global issue. Fungi, especially white-rot, offer promising solutions due to their ability to degrade complex polymers through powerful lignin-degrading enzymes.
This study investigates an Agaricales strain (Basidiomycota), isolated from a Greek habitat, to assess its potential to degrade polyurethane (PU) plastics and investigate its enzymatic degradation mechanisms.



Visual progression of Impranil® DLN-SD degradation from day 0 (opaque) to day 10 (fully transparent)

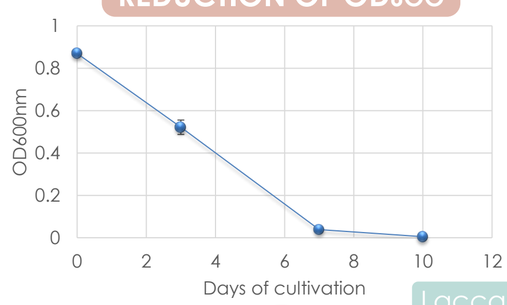
METHOD

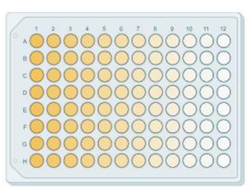
- The strain was cultured in liquid medium containing Impranil® DLN-SD, a commercial polyester-polyurethane (PU) dispersion, **as the sole carbon source**.
- **Polymer degradation** was assessed by measuring OD_{600nm} every 3 days.
- **Esterase, laccase, and peroxidase activities** were quantified spectrophotometrically from culture supernatants



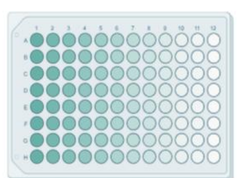
ENZYME ACTIVITY PROFILES

IMPRANIL® **DLN- SD REDUCTION OF OD600**

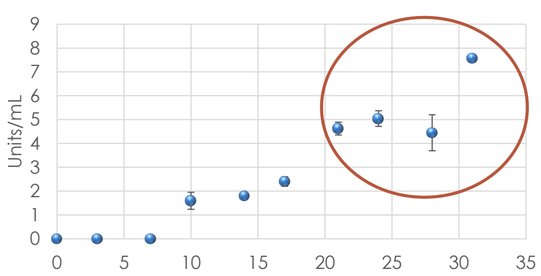


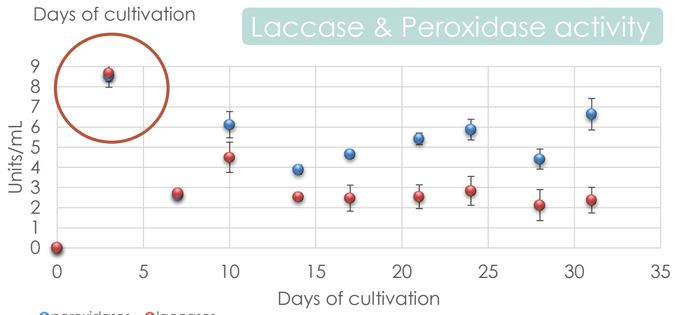


Esterase activity



Laccase & Peroxidase activity





RESULTS

- Complete Impranil® DLN-SD clearing achieved within 10 days
- **Laccase** activity peaked on day 3, then gradually decreased.
- **Peroxidase** activity was also high on day 3, maintained relatively elevated levels, and showed a second peak on day 31.
- **Esterase activity** was undetectable until day 7, gradually increasing and peaking on day 31

CONCLUSION

Impranil® DLN-SD degradation involves oxidative (laccases, peroxidases) and hydrolytic (esterases) enzymes, with laccases initiating oxidation, peroxidases sustaining activity, and esterases completing hydrolysis. This profile highlights the strain's potential for biotechnological synthetic polymer degradation.

FUTURE WORK

- GC-MS, LC-MS, and GPC for the identification of degradation products.
- Proteomics for the discovery of novel biocatalysts.
- Heterologous expression and characterization of key enzymes.
- Evaluation of the strain's activity on other synthetic polymers (e.g. PE, PS, PET).

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