

# Fungal Chitin Microparticles Reinforce High-Water Hydrogels

## Background/Objective

- Hydrogels are attractive for biomedical, soft-robotic, and environmental applications, but high-water content weakens polymer networks, limiting strength and durability. We investigated if fungal-derived chitin microparticles provided reinforcement to strengthen hydrogels without added chemical crosslinkers.

## Approach

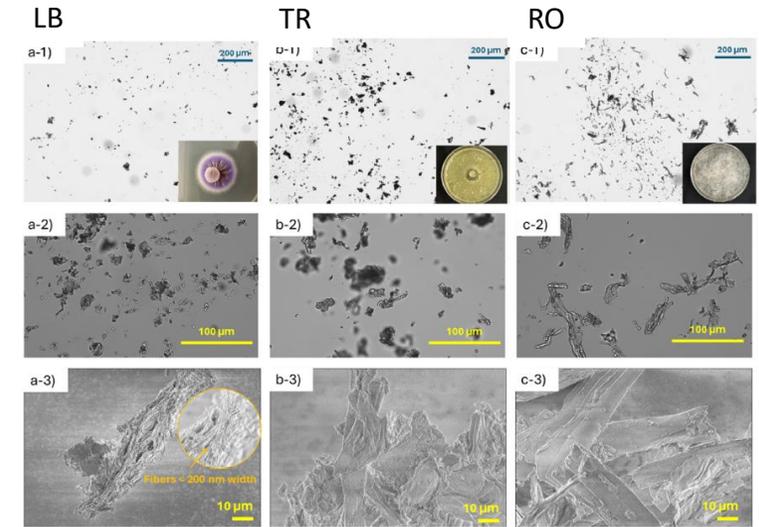
- Intact mycelium particles were generated from three taxonomically distinct fungi, *L. bicolor*, *T. reesei*, and *R. oryzae*, using mild alkaline pretreatment and ball milling.
- Species-specific chemical composition and morphology were characterized using FTIR and solid-state NMR.
- Fungal particles were incorporated into physically crosslinked polyvinyl alcohol (PVA) hydrogels to counteract water-induced weakening.
- Tensile properties, water content, and reswelling behavior were measured to assess reinforcement performance.

## Results

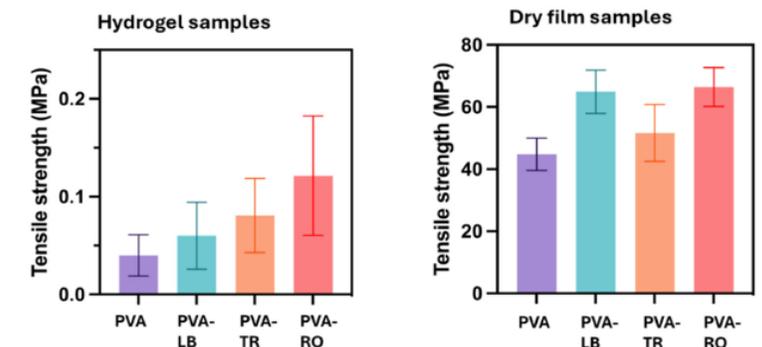
- Fungal microparticles increased hydrogel strength without added crosslinkers, with *Rhizopus oryzae*-derived particles roughly doubling tensile strength relative to neat PVA.
- Particles from *Laccaria bicolor* increased dry-film tensile strength by more than 45%, demonstrating morphology-driven reinforcement.
- Reinforcement occurred even as water content rose to ~86–91%, overcoming the typical trade-off between hydration and mechanical performance.

## Significance/Impacts

- Here, we demonstrate fungal biomass as a tunable reinforcement platform to improve hydrogel mechanics while avoiding toxic additives, allergens, and energy-intensive nanomaterials, creating a pathway for next-generation hydrogels across biomedical, environmental, and advanced materials applications.



Cell morphologies (top), optical microscopy (middle) and scanning electron micrographs (bottom) of extracted particles *L. bicolor* (LB), *T. reesei* (TR), and *R. oryzae* (RO).



Morphological and mechanical properties of pristine PVA hydrogel and chitin-reinforced composite hydrogels and films.