FungAI: Optimizing Mycelium Bio-Composites Production Through AI Monitoring

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Introduction

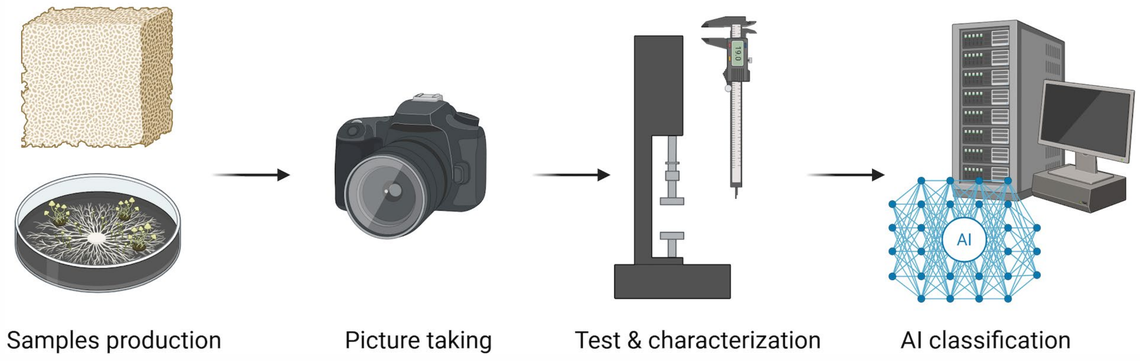
The use of fungi in biotechnology is growing, but two major challenges persist:

(1) Mycelium bio-composites are promising sustainable alternative materials but suffer from inconsistent growth and poor-quality control.

(2) Fungal strain identification and characterization still relies on costly and time-consuming molecular tools.

FungAI tackles both challenges by developing advanced AI models that analyze fungal growth visually. One track enables rapid, low-cost diagnostics from Petri dish images, identifying species traits and growth dynamics. The other monitors mycelium composites during incubation, predicting properties like strength, moisture resistance, and insulation. This project phase validates the technical and economic feasibility of using AI to optimize fungal research and material production.

Materials & Methods



Mycelium bio-composites were grown with a fixed recipe under controlled conditions. After incubation, samples were dried to deactivate the mycelium.

In parallel, a wide range of fungal strains were grown on Petri dishes to assess morphology, pigmentation, and colonization speed.

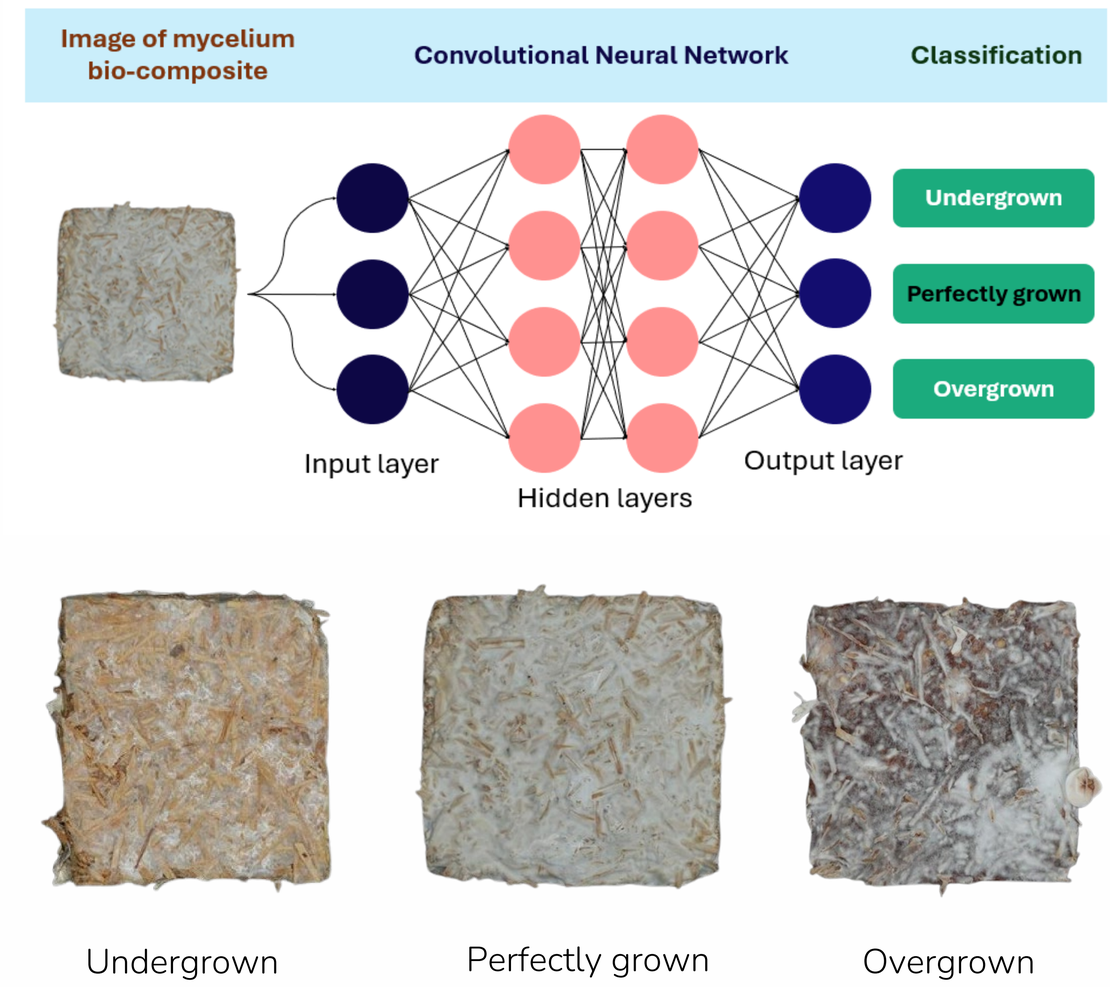
Thermal conductivity and compressive strength were tested across different growth conditions. Images from both Petri dishes and bio-composite growth stages were collected to train AI models for automated monitoring and property prediction.

Results

Fungal strains cultivated on Petri dishes displayed distinct morphological traits, pigment production, and colonization speeds.

Results

Mycelium bio-composites varied in thermal conductivity and compressive strength based on growth conditions. High-resolution images were collected throughout growth and stored in an annotated database, together with test outcomes. This structured dataset formed the foundation for training a Convolutional Neural Network (CNN). Evaluation metrics such as accuracy, precision, and recall are used to assess model performance. The tested samples are stored along with their correct annotations to support future fine-tuning and improvement of the model.



Undergrown | Perfectly grown | Overgrown

Discussion & Conclusion

Initial AI models show promising potential for automating fungal growth monitoring and material assessment. However, further development and a larger, more diverse dataset is needed to improve accuracy and reliability. Broader testing across fungal species, substrates, and growth conditions will be essential to optimize AI predictions and support scalable, consistent production of mycelium-based insulation materials.

Reference

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2.Slam, M. R., et al. “Mechanical Behavior of Mycelium-Based Particulate Composites.” *Journal of Materials Science*, vol. 53, 2018, pp. 16371–16382. Springer