Dissertation Title	Exploring Mycelium-based Biomaterials: Development from Selected Mushrooms and Locally Lignocellulosic Substrates in Thailand
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ABSTRACT

Mushroom mycelium-based biomaterials (MMBs) are sustainable alternatives to plastic- and foam-based materials and align with the principles of the circular economy. MMBs are developed using the mycelium of suitable fungal species and lignocellulosic substrates, derived from agricultural and forest by-products. This study has provided the first worldwide checklist of all fungal species within Basidiomycota, utilised in MMBs production and investigation, based on all the relevant published and available articles till 2024. The mushroom genera used in its development have also been presented according to hyphal system type. This study has summarised the wide range of MMB applications, mainly packaging, building, insulation, architectural designs, and leather. Additionally, it highlights key challenges in the MMB sector and explores potential solutions.

In this study, 15 fungal strains, *Coriolopsis brunneoleuca* (MFLUCC 24-0265), *Earliella scabrosa* (MFLUCC 24-0263), *Earliella scabrosa* (MFLUCC 24-0268), *Ganoderma australe* (MFLUCC 24-0262), *Ganoderma tropicum* (MFLUCC 24-0267), *Hexagonia tenuis* (MFLUCC 24-0266), *Hexagonia tenuis* (MFLUCC 24-0270), *Lentinus squarrosulus* (MFLUCC 24-0271), *Microporus xanthopus* (MFLUCC 24-0261), *Panus ciliatus* (MFLUCC 25-0173), *P. subfasciatus* (MFLUCC 25-0172), *Phlebiopsis friesii* (MFLUCC 24-0323), *Pleurotus ostreatus* (MFLUCC 24-0260), *Trametes polyzona* (MFLUCC 24-0269), and *Trametes sanguinea* (MFLUCC 24-0264), were used to develop MMB test samples. The fungal strains were identified through a combination of morphological characteristics and

phylogenetic analyses. MMB samples developed using mycelia of these species and locally-sourced rubber sawdust were comprehensively characterised for their physical, mechanical, hydrodynamic, and chemical properties. Additional analyses included FTIR spectroscopy, SEM analysis, thermogravimetric analysis, flammability testing, and soil burial degradability. Notably, Ashby's chart of mechanical properties showed the MMB could substitute synthetic foam. Soil burial of MMB for 90 days shows cumulative weight loss exceeding 60%, proving biodegradable. A new approach for mycelial viability maintenance is described and verified, addressing the challenge of maintaining vigorous mycelium. Notably, this study presents the first comprehensive report on the application of *Coriolopsis brunneoleuca*, *Ganoderma tropicum*, *Hexagonia tenuis*, *Microporus xanthopus*, *Panus ciliatus*, *P. subfasciatus*, *Phlebiopsis friesii*, *Trametes polyzona*, and *T. sanguinea* in MMB development, characterisation, and prototype development. Based on the material properties and successfully developed prototypes, the MMBs are potentially suitable for packaging, indoor use, construction, and insulation purposes, as an alternative to conventional synthetic materials. This study also reports three new fungal species, *Echinochaete thailandica*, *Phanerochaete brunneohyha*, and *Thelephora chiangmaiensis*, and four new geographical records, *Favolaschia variistipitata*, *Panus ciliatus*, *Podoscypha gillessi*, and *Trullella yunnanensis*, based on morphological characteristics and phylogenetic analyses (ITS and LSU).

This study provides an illustrated Fungalpedia, a compendium of fungi, fungus-like taxa that provide outlines and notes of genera and higher taxa, their applications, terminology, and definitions of terms used in mycology. It is published as a series. This study includes two sections: notes on 111 Basidiomycota genera and notes on 55 terminologies related to mushroom mycelium-based biomaterials. The remaining genera will be documented in further publications. Fungal genera and higher taxa entries comprise information on habit and habitat, classification, distinguishing morphological characteristics, genetic markers used, critical analysis of taxonomic placement, beneficial roles to humans and nature, and clarify discrepancies in the main fungal classification and nomenclature databases. Additionally, brief notes on fungal families related to the genera are provided. Line drawings of morphological

characters of all genera, except for a few that are unavailable, are provided with each entry to aid understanding. Notably, this study includes the first compilation of notes on terms commonly used in the mushroom mycelium-based biomaterials sector, featuring their definition, implications, and necessary diagrams. This effort contributes to the integration of mycology and mycelium-based biomaterials as innovative and sustainable materials.

Keywords: *Agaricomycetes*, Circular Economy, Fungal Application, Fungal Genera, Global Checklist, Hyphal System, Mushroom Species, Mycelium-Based Biomaterials, New Geographical Record, Phylogeny, New Species, Saprophytic Fungi, Sustainable Development, Taxonomy, White-rot