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# LIQUID-STATE SURFACE FERMENTATION OF MYCELIUM MATS TO PRODUCE SUSTAINABLE LEATHER-LIKE MATERIALS

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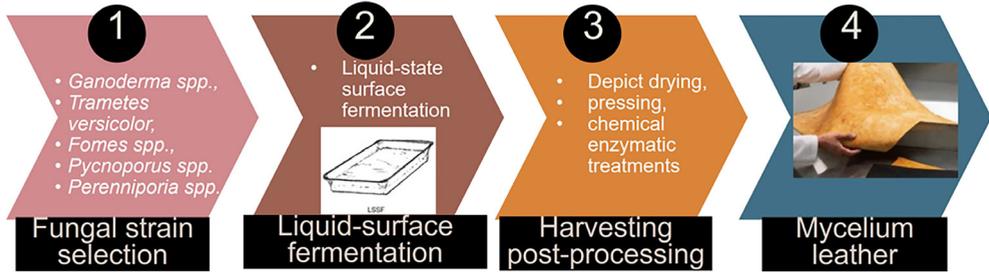
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**Abstract** –The increasing demand for sustainable alternatives to fossil-based materials has driven research towards biofabrication approaches. Textile and fashion industry is one of the most polluting industrial sectors in the world, responsible for high greenhouse gas emissions and global wastewater. For that reason, the fashion industry is facing growing pressure to reduce its environmental impact. Among the major environmental issues associated with this sector are the unsustainable cultivation of fibres, the extensive use of non-renewable and non-biodegradable materials and highly polluting production processes. One of these non-eco-friendly processes is leather tanning, which consumes large amounts of water and energy while potentially releasing heavy metals and toxic compounds into the environment. Conversely, plastic-based leathers, have a lower carbon footprint than animal leather during their production, but they are dependent on fossil resources and have negative environmental effects (microplastic accumulation). In this contribution a review on possible sustainable alternatives to synthetic leather is presented, focusing on innovative mycelium-based materials. Particular attention is given to production methods involving liquid-state surface fermentation, highlighting the potential for reducing environmental impact while maintaining desirable material properties. Filamentous fungi and their potential to create leather-like biomaterials through controlled fermentation processes are critically discussed. Important parameters like fungi species selection, nutrient composition, growth conditions and treatment techniques are analysed. A schematic overview of the process is provided in the figure. Moreover, different types of treatments that could enhance mechanical performance, durability and water resistance are explored. Comparisons with real and synthetic leather are analysed, highlighting the advantages that the mycelium-leather has in respect to biodegradability and energy efficiency. Current challenges such as scalability, production cost and the need for standardization are critically considered, as they still limit widespread industrial adoption. Ultimately, current advancements in mycelium biotechnology, bioengineering strategies and material optimization are explored, highlighting the potential of mycelium-based materials as a sustainable alternative to conventional leather.

**Keywords** – *Biofabrication; biomaterials; fungal-leather; fungal biotechnology; liquid-state surface fermentation; mimco-leather; non-leather materials; sustainability; sustainable fashion*



Scheme of the process to create leather-like biomaterials starting from *Filamentous fungi*