Effect of Bio-Based Post-Treatments on Water Contact Angle of Mycelium Sheets

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Introduction

The apparel industry represents a significant environmental burden worldwide. Conventional leather production is resource-intensive and may involve hazardous chemicals, while synthetic alternatives such as PU and PVC are fossil-based and non-biodegradable [2] .
Mycelium-based materials are emerging as **sustainable alternatives** due to rapid growth, low resource demand, and tunable properties [3] .

However, **several challenges** still limit their practical implementation, including variability and limited mechanical performance, lack of process standardization, and scalability constraints [4]. In addition, many fungal biomaterials exhibit intrinsically **hydrophilic surfaces**, resulting in moisture sensitivity, dimensional instability, and reduced durability under humid conditions [1].
Targeted post-processing strategies are therefore necessary to modulate surface properties and enhance resistance to water exposure.

Experimental workflow

Fungal Strain & Mycelium sheets production
Trametes versicolor (SV1)
Liquid-state surface fermentation (LSSF)
Static incubation at 25°C

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Harvesting
Manual removal → rinsing → draining

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Post-processing
Soaking treatment → drying → surface treatment → hot pressing

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Mechanical characterization
on hot-pressed non-coated sample by DMA

Hydrophobicity assesment
on coated and hot-pressed samples by WCA

Mechanical results

Non-pressed samples	Hot-pressed samples
Ultimate stress: 0.31 ± 0.06 MPa	Ultimate stress: 0.45 ± 0.06 MPa

Based on this enhancement, all subsequent samples were hot-pressed prior to WCA analysis.

WCA Results

Surface treatment	FORMULATION	WCA (°)
BIOBINDER	Pure biobender	Sticky; excluded from analysis
NANOCELLULOSE	89% Cellulose Cellox (0.25%) + 1% glycerol + 1% citric acid	85.2 ± 8.4
SHELLAC	Shellac 30% (in ethanol) + 1,5 % glycerol	73.1 ± 7.8
WAX-OIL BALM	Wax-oil balm (candelilla wax + coconut oil 2:1)	95.3 ± 9.9
SOY PROTEINS	soy proteins (10%) + 1% glycerol + 1% citric acid	74.5 ± 7.3
CASEIN	Casein 12% + 1.5% glycerol + 1% citric acid	80.9 ± 10.3
CORN ZEIN	Corn zein (10% in 90% ethanol) + 1% glycerol	65.1 ± 9.6
CONTROL	-	99.8 ± 15.0

Conclusions

Hot pressing improved mechanical cohesion.
Under the tested conditions, **no formulation** surpassed the uncoated hot-pressed control.

References
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