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Supporting Information

**Title: Robust Myco-Composites: A Biocomposite Platform for Versatile Hybrid-Living Materials**

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| Material | Density ($g/cm^3$) | UTS (MPa) | UCS (MPa) | Young's Modulus (MPa) | Reference |
|---|---|---|---|---|---|
| Douglas fir (softwood) panel | 0.44 | 130 | 50 | 11000 | [1,2] |
| Walnut (hardwood) panel | 0.55 | 89 | 52 | 11583 | [1,3] |
| (PLA) Poly(lactic acid) | 1.24 | 70 | 94 | 3120 | [4] |
| Plywood panel | 0.5 | 31 | 36 | 12400 | [5,6] |
| Medium density fiberboard | 0.78 | 18 | 10 | 3447 | [7] |
| ABS (Acrylonitrile butadiene styrene) | 1.06 | * | 49 | 2270 | [4,8] |
| Particle Board | 0.74 | * | * | 1999 | [9] |
| Chitosan film | 1.22 | 52 | * | 2200 | [10] |
| Corn starch film | 1.55 | 7 | * | 50 | [11] |
| Chitosan + cellulose | 0.37 | 6.12 | * | 263 | [12] |
| Cornstarch + corn husk | 1.3 | 13 | * | 325 | [11] |
| Chitosan + waste wood flour | 0.41 | 2.14 | 1.11 | 127 | [12] |
| Chitosan + wood flour | 0.31 | 1.63 | 1.05 | 97 | [12] |
| Cornstarch + corn husk/sugar palm | 1.3 | 17 | * | 1050 | [11] |
| Kenaf core fiber | 0.2 | * | * | 300 | [13] |
| Chitosan + silk fibroin | 1.46 | 119 | * | * | [14] |
| Ecovative + cotton fiber | 0.14 | 0.2 | * | 3.65 | [15] |
| Ecovative + hemp pith | 0.12 | 0.13 | 0.23 | 6.14 | [15] |
| Ecovative + hemp fiber | 0.1 | 0.1 | * | 7.13 | [15] |
| Pleurotus ostreatus + rapeseed straw | 0.13 | 0.01 | * | 2 | [16] |
| Pleurotus ostreatus + wheat | 0.18 | 0.05 | 0.04 | * | [17] |
| Trametes versicolor + rapeseed straw | 0.1 | 0.04 | * | 4 | [16] |
| Trametes versicolor + beech sawdust | 0.17 | 0.05 | * | 13 | [16] |
| Trametes versicolor + hemp | 0.13 | * | 0.36 | * | [18] |
| Trametes versicolor + loose hemp | 0.09 | * | * | 0.51 | [19] |
| Trametes versicolor + chopped hemp | 0.08 | * | * | 0.77 | [19] |
| Trametes versicolor + pre-compressed flax | 0.07 | * | * | 1.35 | [19] |
| Trametes versicolor + flax waste | 0.1 | * | * | 0.31 | [19] |

| | | | | | |
|---|---|---|---|---|---|
| Trametes versicolor + loose flax | 0.06 | * | * | 0.28 | 19 |
| Trametes versicolor + chopped flax | 0.07 | * | * | 1.18 | 19 |
| Trametes versicolor + wood | 0.09 | * | * | 0.14 | 19 |
| Trametes versicolor + wood chips | 0.17 | * | 0.52 | * | 18 |
| Irpex lacteus + mixed fiber media | 0.28 | * | 0.5 | 28 | 20 |
| Ganoderma lucidum + beech sawdust | 0.249 | 0.17 | * | 9.67 | 21 |
| Ganoderma lucidum + “mycrocrete” media | 0.306 | 0.52 | * | 153 | 21 |
| This work: Ecovative + chitosan/cellulose/coffee biocomposite | 0.466 | 0.72 | * | 160.27 | * |

**Table S1.**

Reported mechanical properties for conventional materials, biocomposites, and mycelium composites reported in literature. Mycelium composites typically demonstrate relatively low density, tensile strength, compressive strength, and Young’s modulus.

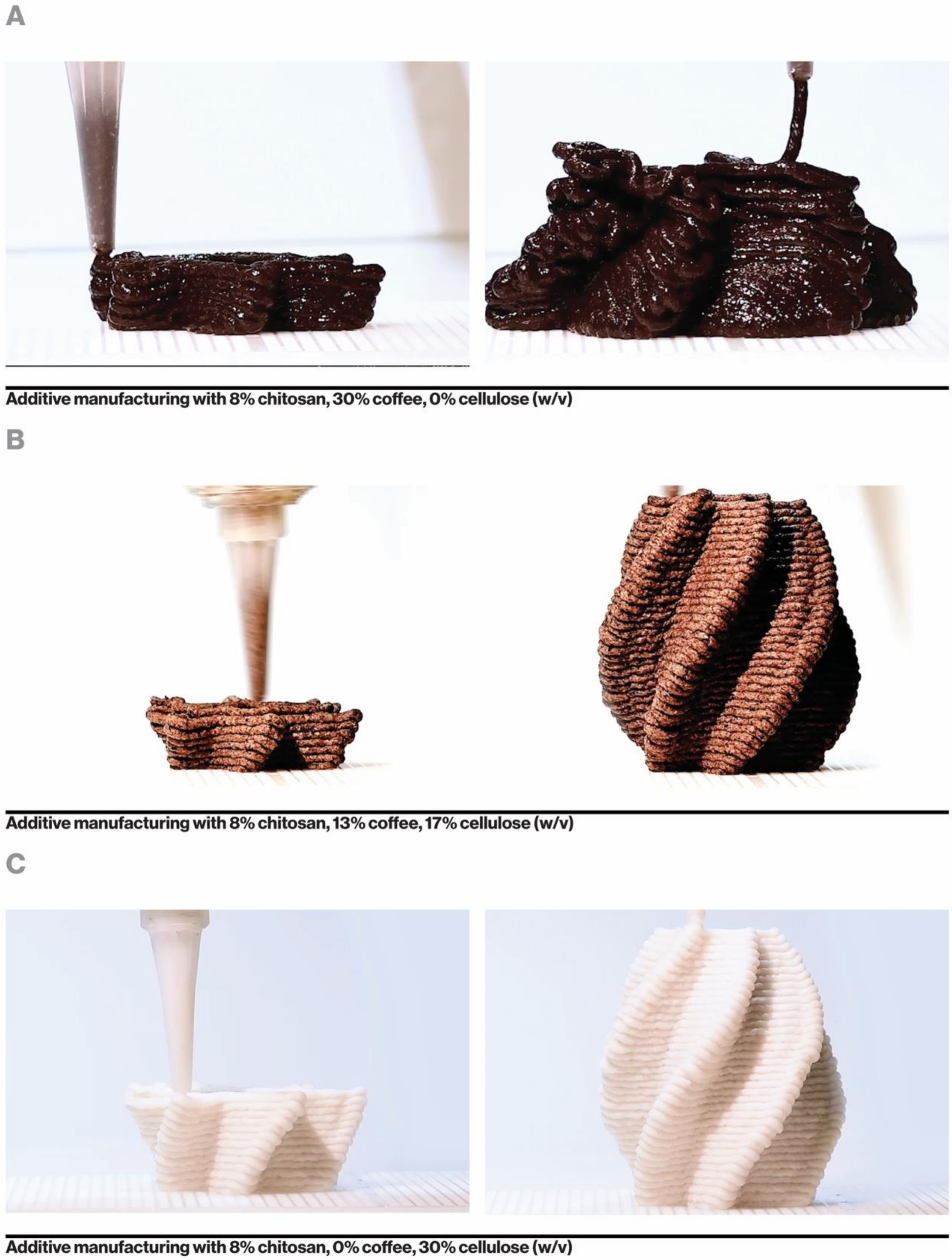


**Fig. S1.**

The biocomposite composition was optimized for printability and biocompatibility with mycelium. (**A**) Chitosan-bound compositions containing high quantities of coffee but no cellulose did not maintain integrity while printing vertical layers. (**B**) An addition of 13%

coffee grounds (w/v) provided a material with high integrity during vertical layering and fungal biocompatibility. (**C**) Composites with no coffee maintained high integrity during the printing process but did not encourage fungal growth.

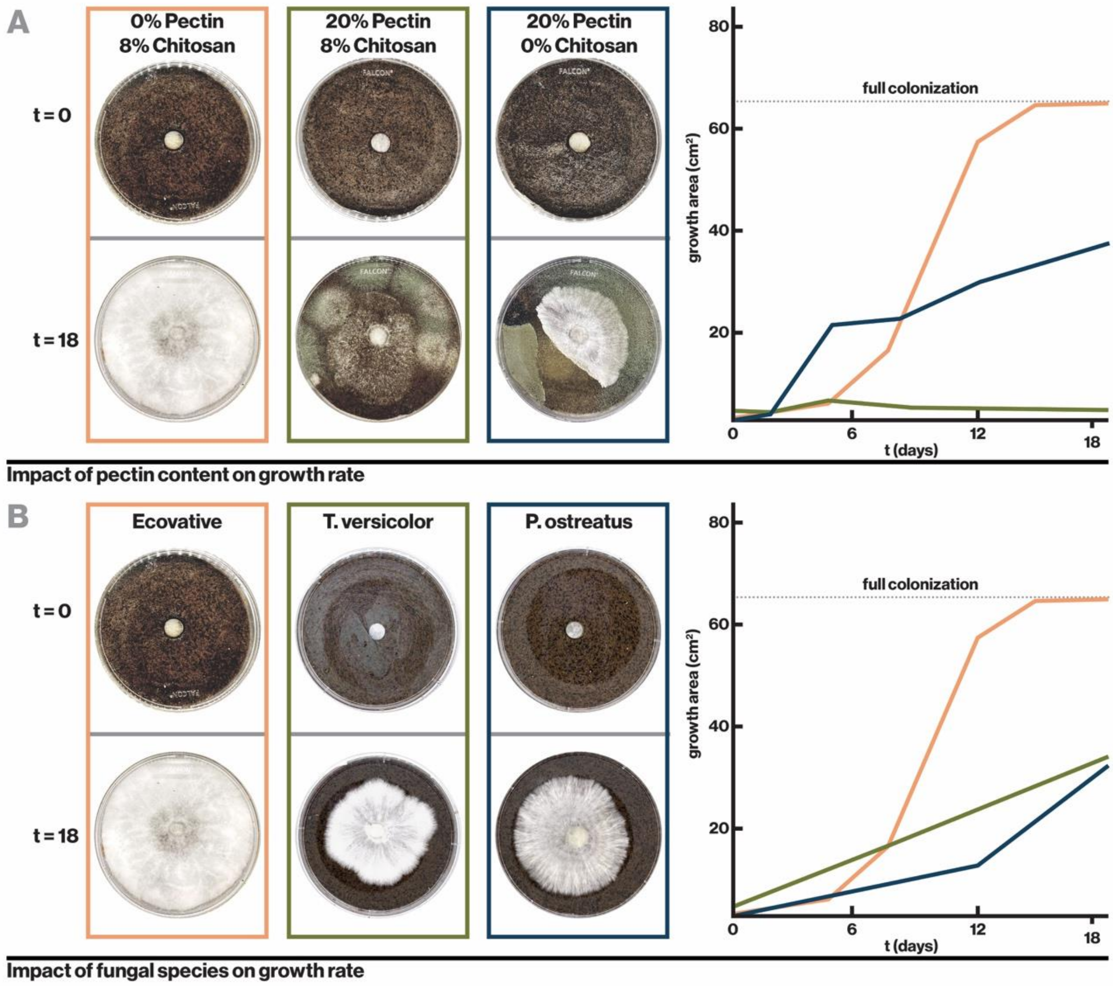


**Fig. S2.**

Impact of substrate pectin content and fungal species on growth rate. (**A**) Nutritious binding media containing pectin was explored as an alternative to coffee addition. Pectin-bound composites, which are rich in nutrition and calories, resulted in rapid initial growth followed by frequent contamination. This indicates that the nutrition source should be catered to the target organism. (**B**) Three species of fungi were explored using the optimized composite formulation. Ecovative mycelium was found to grow substantially faster than both T. versicolor and P. ostreatus strains on identical substrates, likely because it has been engineered for robust growth rather than gourmet fruit production.

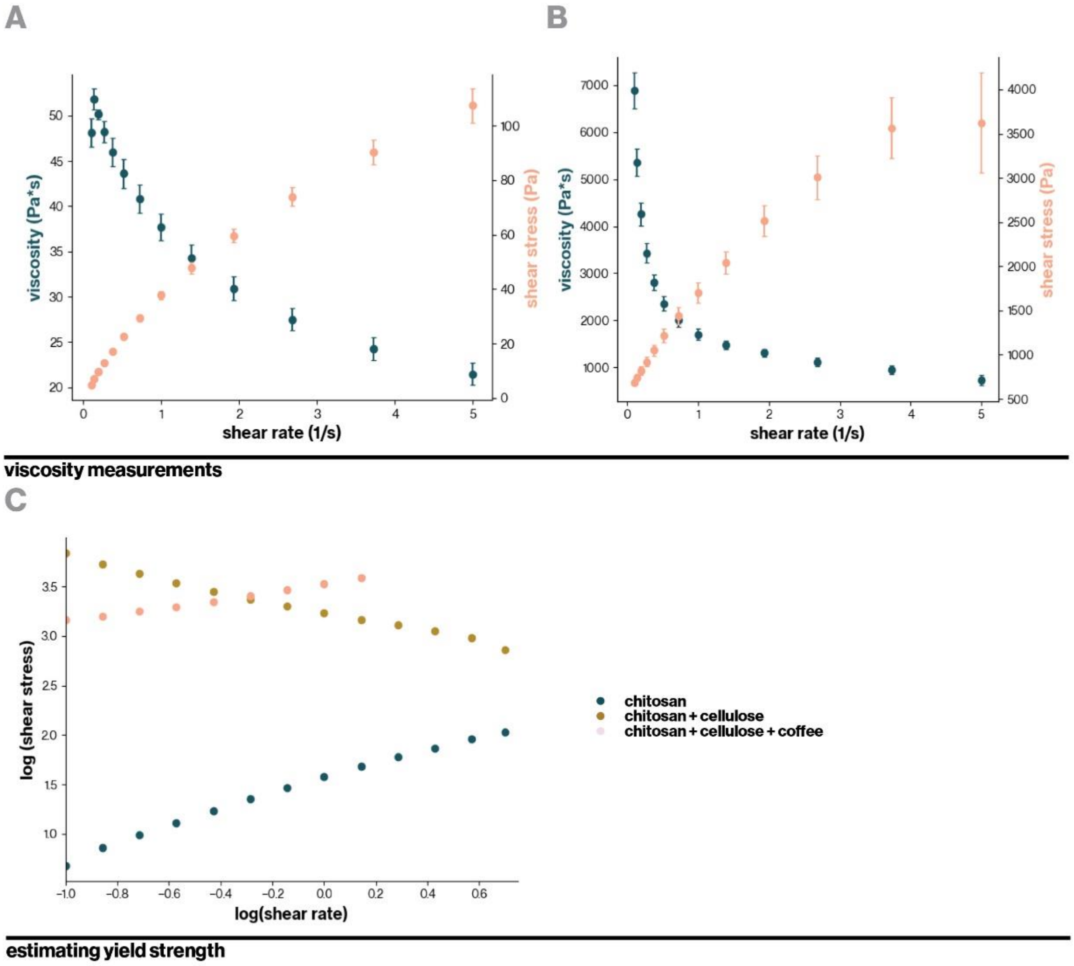


**Fig. S3.**

Dynamic shear viscosity of biocomposites. Viscosity and shear stress over multiple shear rates for (A) 8% chitosan solution and (B) 8% chitosan solution with 20% w/v cellulose, both exhibiting shear thinning behavior. Rheological properties of the optimized biocomposite are shown in **Fig. 2b** of the main manuscript. (C) Plotting the logarithm of shear rate against the logarithm of shear stress enables easy extrapolation of the data to where shear rate is zero, which roughly approximates the yield stress of each material.

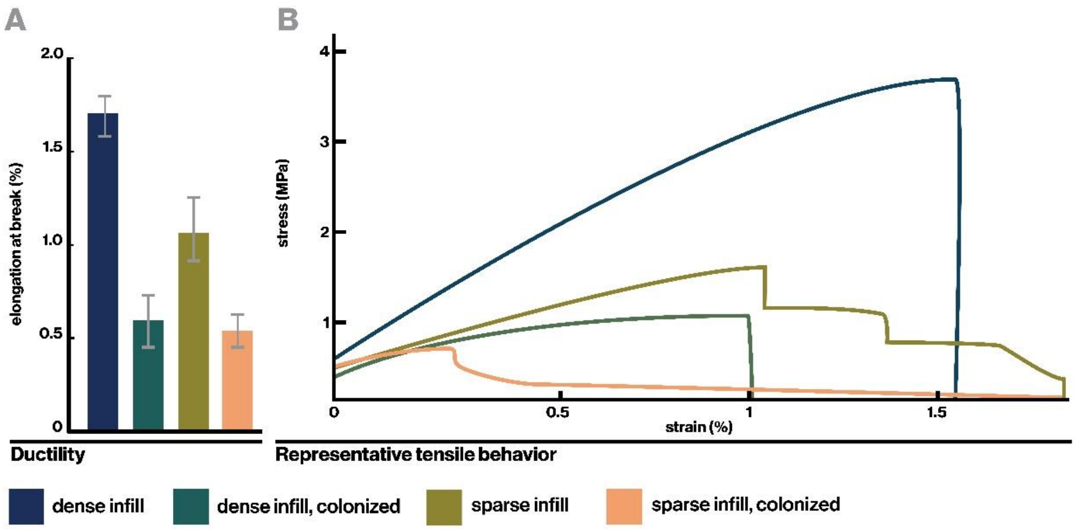


**Fig. S4.**

Colonization alters the tensile and compressive behavior of 3D printed samples with dense and sparse infills. (**A**) Elongation at break for dense and sparse samples, with and without colonization. Elongation is comparable for both dense and sparse samples when colonized with mycelium, indicating that mycelium behavior may be largely attributable for this response. (**B**) Representative curves for various samples. Tensile behavior is altered by colonization, with sparse-infill colonized samples exhibiting graceful failure rather than brittle fracture.

**Movie S1.**

Additive manufacturing of a chitosan-coffee composite, which shows limited structural integrity due to the lack of reinforcing structural components such as fibrous cellulose.

**Movie S2.**

Additive manufacturing of a chitosan-cellulose-coffee composite, which demonstrates good structural integrity.

**Movie S3.**

Additive manufacturing of a chitosan-cellulose composite, which demonstrates good structural integrity and smooth printability.

**Movie S4.**

A sealed container of living mycelium-biocomposite is cut open. The container is constructed from four flat panels of printed biocomposite spaced with 2 mm gaps between each panel. The mycelium grew to bridge the gaps, forming flexible hinges, at which point the box was folded into a 3D geometry. After a period of 7 days during which humidity was kept above 80%, mycelial growth proceeded to the point where the box was fully sealed and could be reopened using a knife. The void-space inside the container was maintained during growth.

**Movie S5.**

A flexible, living mycelium "textile" was constructed by printing islands of material with 1 mm spacing. Mycelium bridged the gaps to form flexible regions, allowing the thin sheet to be stretched or flexed in multiple directions without breaking.

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