Mycelia inactivation processes –maintaining the flexibility and strength of mycelium-based biocomposites

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Introduction

Mycelium-based biocomposites (MBB), which consists of defragmented lignocellulosic particles linked by dense mycelium, are an ecological and innovative solution to replace petroleum-based products. MBB have shown advantageous properties, such as acoustic insulation, fire resistance, and the absence of harmful synthetic chemical components. These properties are the basis for the production and use of MBB for a wide range of applications, including paper, textiles, and foams for packaging material [1]. Briefly, MBB production is achieved through the sterilization the biomass, inoculation and incubation with selected fungi, homogenization, and interruption of fungal growth (or inactivation) [2]. Most MBB go through a heating treatment to inactivate the mycelia. However, that treatment results in rigid biocomposites with low flexibility.

This work investigated the performance of alternative inactivation methods aiming to achieve flexible but sturdy MBB.

Methods

Inactivation methods

Grape stalk biomass colonized by *Trametes versicolor* or *Ganoderma lucidum*

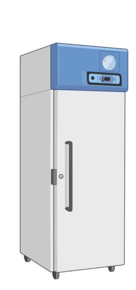
Chemical treatment

Spraying with $CuSO_4$ (20 g/L)

Physical treatment

Low temperature

-20 ºC (1 or 3 days)

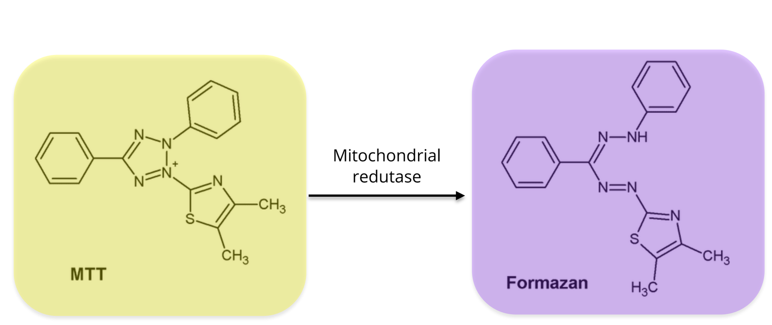


-80 ºC (1 or 3 days)

Cell viability

Assessment of the inactivation efficiency

MTT assay [3]



Results

Biocomposites' characterisitics after inactivation

Biocomposites showed desirable features after being subjected to inactivation methods:

- ✓ Flexibility
- ✓ Robust structure

Inactivation efficiency

Treatment	Cell viability [a] (mean ± SD [b])
$CuSO_4$	45 ± 60
-20 ºC, 1 day	49 ± 12
-20 ºC, 3 days	1 ± 0.3
-80 ºC, 1 day	88 ± 14
-80 ºC, 3 days	2 ± 1

[a] Cell viability assay performed 2 days after treatment
[b] SD: standard deviation

Inactivation with $CuSO_4$ not effective

Low temperature treatments seemed to have inactivated the mycelia

15 days after treatment:

Treatment	Viability (average ± SD[a])
-20 ºC, 3 day	38 ± 32
-80 ºC, 3 days	94 ± 23

- Mycelia resumed growth
- Low temperature treatments not effective

Conclusions

- None of the tested methods compromised the biocomposites' flexibility features.
- Spraying MBB with a CuSO4 solution did not efficiently inactivate the fungi.
- Low temperatures seemed to have inactivated the mycelia 2 days after treatment, but 15 days later the mycelia resumed growth again. This treatment did not efficiently inactivate the fungi but left them in a latent dormancy state.
- Further studies are needed to identify inactivation methods to produce MBB with a more diverse range of physical characteristics to expand their application potential.

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