

## Preventing fungal growth on heritage paper with antifungal and cellulase inhibiting magnesium oxide nanoparticles

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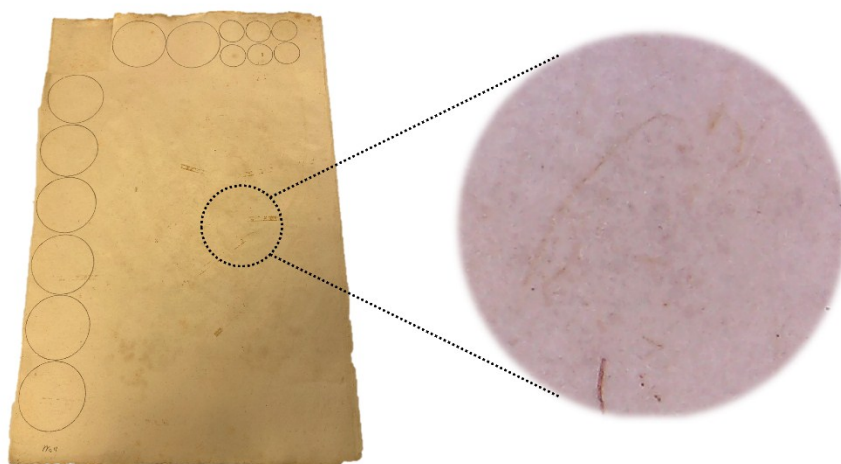
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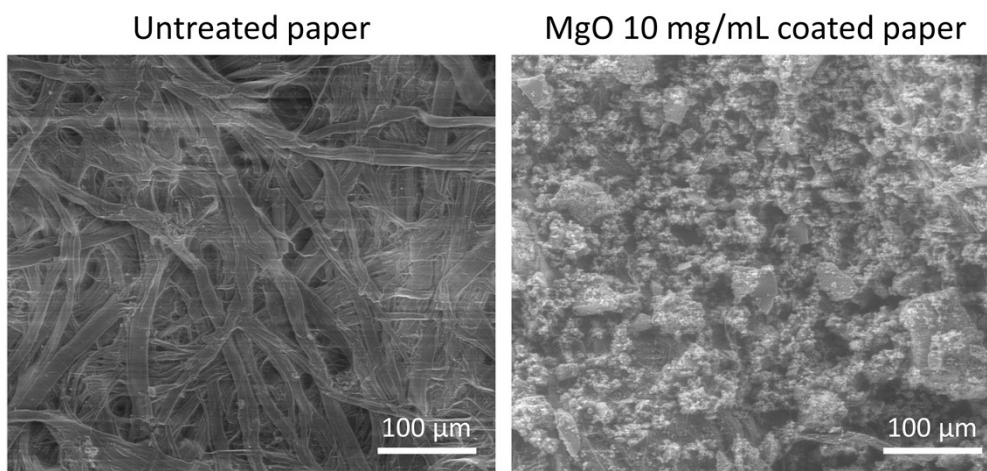
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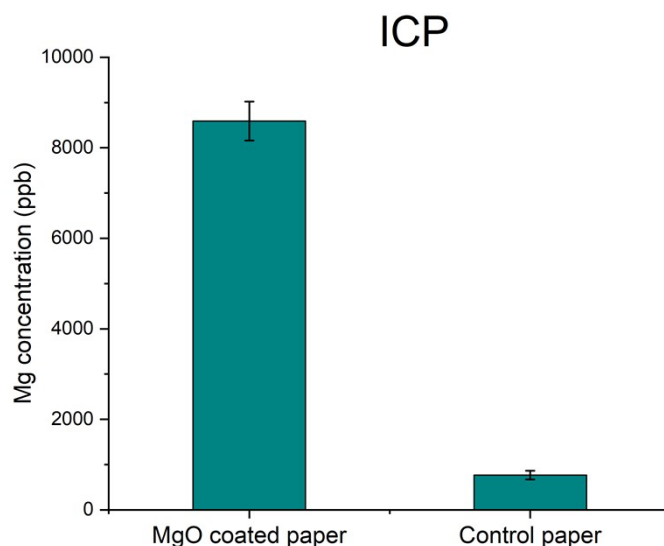


**Figure S1.** 18<sup>th</sup> century paper sample from the Real Jardín Botánico (CSIC), Madrid. On the left, a paper sample with pencil marks to cut for the antifungal assays. The right image corresponds to a magnified section of the paper.

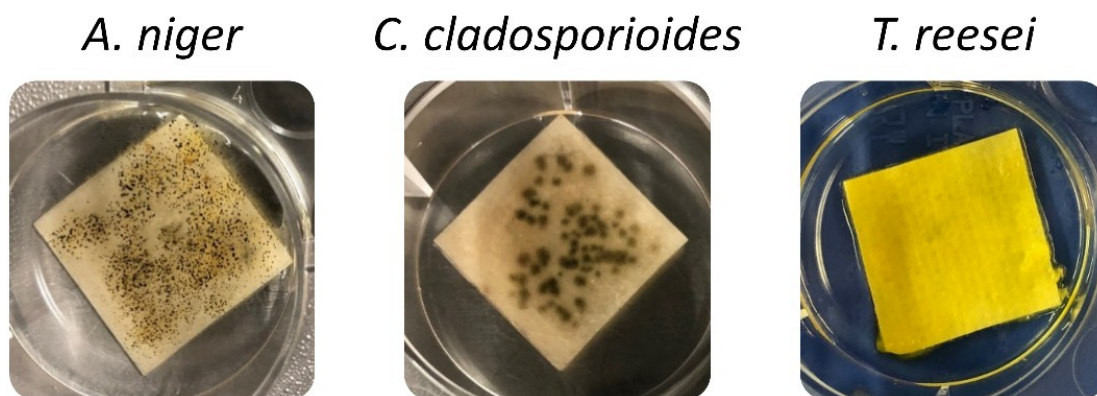


**Figure S2.** ESEM images of 18<sup>th</sup> century papers. On the left, an untreated sample where only the cellulose fibres are observed. On the right, an image of a coated paper with a 10 mg/mL MgO NP solution, showing the homogeneity of the nanoparticles over the paper surface.

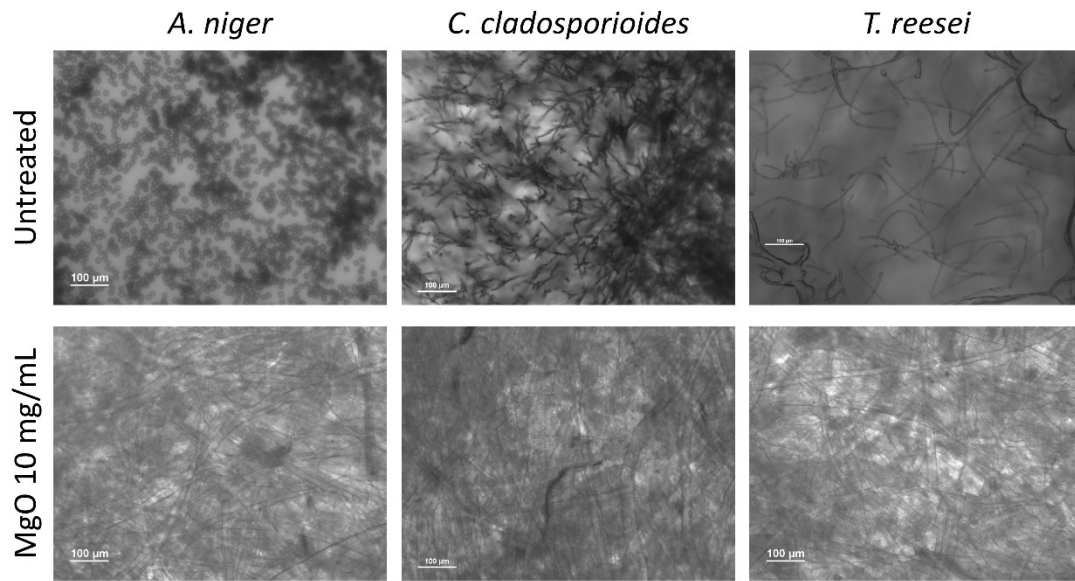
## Supporting Information



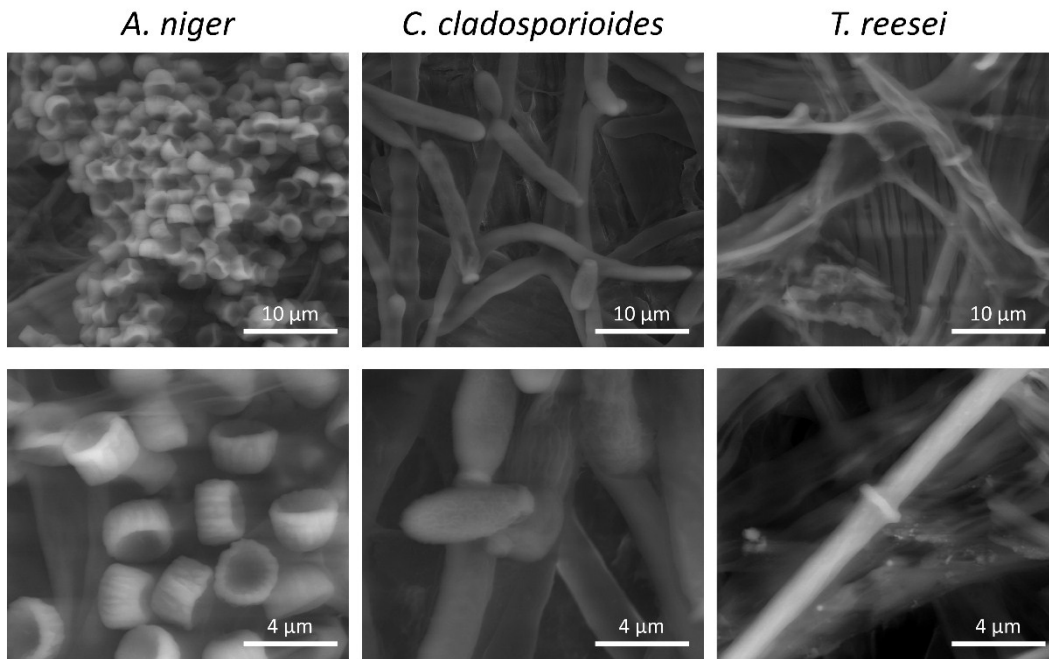
**Figure S3.** The magnesium (Mg) content of 18<sup>th</sup> century papers coated with 10 mg/mL MgO NPs (and uncoated as control paper samples) was analysed by Inductively Coupled Plasma Mass Spectrometry (ICP–MS). The MgO NP coated paper samples contained ten times more Mg content than the uncoated control paper samples.



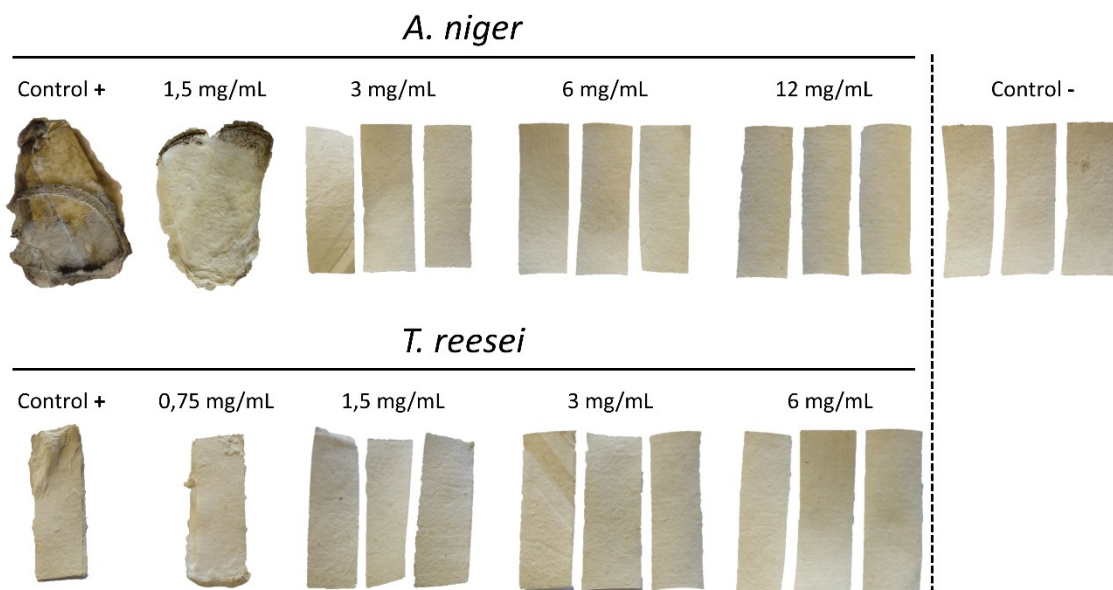
**Figure S4.** Untreated 18<sup>th</sup> century paper samples incubated with *A. niger*, *C. cladosporioides* and *T. reesei*. In absence of MgO NPs the three molds grow over the papers. The *A. niger* sample presents a blackish colour due to the sporulation of the fungus. The *C. cladosporioides* sample present green colonies formed mostly by the mycelium. The *T. reesei* paper is full covered by the fungus mycelium, which gives it the yellow colour, and it has lost some of its integrity due to the high production of cellulases by *T. reesei*.



**Figure S5.** Optical microscopy images of 18<sup>th</sup> century papers (untreated and coated with 10 mg/mL of MgO NPs) inoculated with *A. niger*, *C. cladosporioides* and *T. reesei*. The untreated samples present a high growth of the fungi over the paper, which can be seen covered in spores (in the *A. niger* sample) and by the fungal mycelium (in the *C. cladosporioides* and *T. reesei* samples). Only cellulose fibres are observed in papers coated with MgO NPs.



**Figure S6.** ESEM images of the 18<sup>th</sup> century papers colonized by *A. niger*, *C. cladosporioides* and *T. reesei*. The *A. niger* sample is riddled with fungal spores and the mycelium is hidden beneath them. In the *C. cladosporioides* sample both mycelium and spores can be observed. *T. reesei* is the least sporulating of the moulds and only the fungal mycelium is observed.



**Figure S7.** Papers obtained from the 'paper adhesion inhibition' test. The control samples from both *A. niger* and *T. reesei* are completely covered by the fungi, and the three papers of each sample adhere to each other due to the fungal growth over the paper. At the lowest concentration of MgO NPs (1.5 mg/mL for *A. niger* and 0.75 mg/mL for *T. reesei*) the fungi are still able to get attach to the paper surface and proliferate, but at the next concentration (3 mg/mL for *A. niger* and 1.5 mg/mL for *T. reesei*) the papers are completely free of fungal growth.