Antifungal properties of ZnO and TiO_2 NPs in cultural heritage

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BIOLOGICAL COLONIZATION

Figure 1. Damaged quarry stone

BIODETERIORATION

Undesirable changes in the properties of a material, caused by the vital activities of organisms.

It causes aesthetic and structural problems that put the preservation of cultural heritage at risk.

CASE STUDY: SAN JUAN BAUTISTA

Figure 2. Damage over brick and mortar

Figure 3. Damage over quarry stone

Figure 4. Damage over brick (mustard lichen)

CASE STUDY (CONT.)

Figure 5. Damage over brick (green lichen)

Figure 6. Damage over brick (gray lichen)

Figure 7. Damage over mortar (black lichen)

CAUSAL AGENTS

Cladosporium cf. *cladosporioides*

Figure 8. Cladosporium sp. (from left to right and top to bottom: in SDA, on rock, under 400x lens)

Growth

Humid building surface (usually on marble).

One of the most common airborne fungi.

Health risks

Lung, eyes, and skin infections.

Asthmatic and allergic reactions.

Health risks for plants

Infects grapes and berries.

Mosyagin, Knauf, & Zelenskaya, 2009

CAUSAL AGENTS (CONT.)

Figure 9. Damage over brick and mortar (lichen community)

NANOTOXICOLOGY OF

Zinc Oxide

Synthesized by precipitation method.

Semiconductor activity could cause disruptions in the electron transport chain and gene expression (Gao *et al.*, 2013; Xia *et al.*, 2008).

Titanium Dioxide

<25 nm, 99.7% purity

Antimicrobial properties were attributed to ROS, upon the nanoparticles interaction with water or hydrogen in the organism (Arciniegas-Grijalba *et al.*, 2017).

EXPERIMENTAL DESIGN

ZnO

High: 600 ppm
Low: 300 ppm

TiO2

High: 600 ppm
Low: 300 ppm

pH

High: 8
Low: 6

Figure 10. Acarospora cf. *socialis* (SDA); control (five day growth)

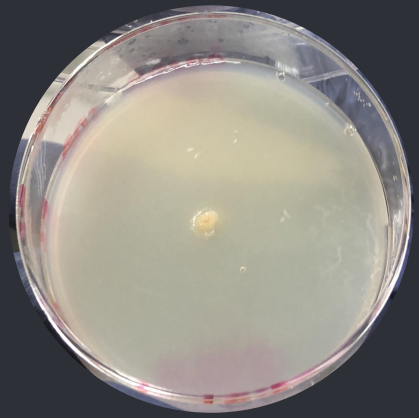

Figure 11. Acarospora cf. *socialis* (SDA); high ZnO concentration (five day growth)

RESULTS

	ZnO	TiO_2	pH
Acarospora cf. *socialis*	High	Nonsignificant	Nonsignificant
Acarospora cervina	High	Nonsignificant	Low
Acarospora impressula	High	Nonsignificant	Low
Cladosporium cf. *cladosporioides*	MIC: (50-100 ppm)	Nonsignificant	Nonsignificant
Squamulea subsoluta	MIC: (100-200 ppm)	MIC: (200-300 ppm)	Nonsignificant

FUTURE INVESTIGATION

- **Confirmation** of problem species via sequencing.
- **Characterization** of ZnO nanoparticle size.
- **Experimentation** to test their efficiency *in situ.*

Thanks!

ANY QUESTIONS?

You can contact us at

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