Nanomaterials with antimicrobial activity to preserve cultural heritage built with calcareous stone

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The archaeological and historical monuments in the Peninsula of Yucatan that are part of our cultural heritage are built mainly with calcareous rock. The process of biodeterioration by microorganisms is favored by the predominant tropical climate, therefore its establishment and colonization on the rocks. Among the main biodeterioration agents are fungi that produce oxalic acid, due to the progressive dissolution of the stone matrix and to the precipitation of secondary minerals such as oxalates, which cause structural damage and consequently contribute to the decay of cultural heritage. The application of nanotechnology in the cultural heritage conservation is marked by the possibility to design consolidate products highly compatible with the original stone substrate, in order to avoid microbial growth. In this work, the mode of action and the minimum inhibitory concentration (MIC) of nanoparticles of $Ca(Zn(OH)_3)_2 \cdot 2H_2O$ were determined, which were obtained by different methods of synthesis: sol-gel, hydrothermal, microwave, mechanochemical, and were tested against selected microorganisms that cause aesthetic damage and produce organic acids on the rock.