TITLE: ANTIFUNGAL EVALUATION OF MESOPOROUS SILICA NANOPARTICLES INCORPORATED WITH ZINC OXIDE AGAINST TOXIGENIC FUNGI STRAINS

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ABSTRACT:
The development of environmentally friendly strategies to control fungal pathogens have been often proposed, including mesoporous silica nanoparticles (MSNs) as proper carriers for antimicrobial substance delivery. They act as carriers of the inorganic compounds such as zinc oxide (ZnO) that can add antimicrobial properties to these nanomaterials for food safety purposes. In this study we evaluated the use of MSNs incorporated with ZnO as potential antifungal agent against *Fusarium graminearum* and *Aspergillus flavus* strains, as well as its antimycotoxin properties. The ZnO release by MSNs during antifungal activity were evaluated as well as its action on fungi structure. The MSNs were properly synthesized and characterized mainly by the X-ray diffraction, Fourier transform infrared spectroscopy and transmission electron microscopy. The concentrations of zinc were analyzed by inductively coupled plasma optical emission spectrometers. The antifungal activity of the MSNs-ZnO were evaluated by an adaptation of the agar dilution method and the mycotoxins levels from toxigenic strains carried out by high-performance liquid chromatography system. The morphological alterations of toxigenic strains were examined using a scanning electron microscope. The MSNs were able of higher ZnO release in the first 24 h while that after this, the ZnO release is more slowly, providing greater durability of the antifungal effect. Significative (P<0.001) growth reduction of *F. graminearum* (81%) and *A. flavus* (65%) compared to Control were obtained at higher concentration of the MSNs-ZnO (1.0 mg/mL). Moreover, the MSNs-ZnO treatment caused morphology alteration in both fungi showing ruptures and deformations in the fungal hyphae affecting its growth and toxin production. A significative reduction (P<0.001) in the deoxynivalenol (89%) and aflatoxin B_1 (58%) production by *F. graminearum* and *A. flavus* was also observed. Ours results showed that these materials affect the colony growth causing alterations on fungal structure, which can impair fungi metabolism, affecting the secondary metabolites production as the mycotoxins. The antifungal effects of zinc compounds release by MSNs can be reached in low concentration due to longer time of contact with the fungi structure. These results suggest that the use of MSNs as carriers of zinc compounds as ZnO can be investigated as a safe alternative for the efficient control of the toxigenic fungi in the agriculture field.

Keywords: *Aspergillus flavus*, *Fusarium graminearum*, mesoporous materials, metals, mycotoxins

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