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Comparative Analysis of *Vibrio cholerae* Biofilms and Planktonic Cells Exposed to Antimicrobial Nanomaterials

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The emergence of bacteria resistant to multiple antibiotics has been increasing in the past decades and has become a global health problem. The development of new antibiotics is not enough to overcome resistant microorganisms, so it is essential to explore new alternatives to prevent and eradicate bacterial infections. In this way, nanomaterials with microbicidal activity represent a real alternative to combat antibiotic multi-resistant bacteria. In this work, the effect of Silver (Ag), Copper (Cu), and Zinc (Zn) nanomaterials was evaluated on different lifestyles of the pathogenic *Vibrio cholerae* (*V. cholerae)*, the etiologic agent of cholerae. The three lifestyles are the surface biofilm, the benthic biofilm, as well as planktonic cells.

At structural level, scanning electron microscopy analysis showed no apparent damage to the cells that made up the surface and benthic biofilm caused by treatments with the Ag, Cu and Zn nanomaterials at sub-lethal concentrations. However, planktonic cells showed modifications in the cellular architecture and presence of vesicles or cell debris; it is presumed that these structures are generated as a resistance mechanism to these toxic nanomaterials. This work offers a basis to deepen the study of the effect of nanomaterials at the structural level, and to understand the response mechanisms of *V. cholerae* to antimicrobial nanomaterials.

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