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Zika Virus Biomarker Detection through Gold Nanoparticles and Dynamic Light Scattering

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Aedes aegypti mosquitos are vectors for several pathogens, such as Dengue, chikungunya, and Zika virus, being a constant threat to Brazil and other tropical regions.[1] These arboviruses cause similar symptoms, and without selective diagnostic tests, leads to inaccurate clinical diagnoses and less targeted treatments.[2,3] Therefore, there is a critical need for new detection methods that can distinguish between these diseases, improving diagnostic accuracy and guiding more effective treatments. In this study, we developed a gold nanoparticle (AuNP) based biosensor for the detection of the Zika virus (ZIKV) biomarker, the NS1 protein, using dynamic light scattering (DLS). The biosensors were produced functionalizing 123 nm AuNPs obtained by the seeded-growth method.[4] The AuNP functionalization was performed by attaching monoclonal anti-ZIKV NS1 protein antibodies to the particles surface using 3,3'-dithiobis(sulfosuccinimidylpropionate) (DTSSP) as a crosslinker agent.[5] The detection test relies on the aggregation and disaggregation of the biosensor in the presence of the protein, monitored by the hydrodynamic diameter (D_H), determined through DLS measurements. In high ionic strength medium, such as phosphate buffer (PBS), the biosensor agglomerates, leading to an increase in D_H (control). However, when the ZIKV NS1 protein is present, D_H remains unchanged and no agglomeration occurs. This indicates that the antibody-antigen interactions stabilize the biosensor, with the protein forming a passivation layer on the biosensor surface preventing agglomeration. The detection limit of the test was 5.13 µg mL^{-1}; at lower protein concentrations, there are insufficient proteins to form a monolayer around the biosensor. Selectivity tests were performed using NS1 protein of dengue virus (DENV2) and the spike protein from SARS-CoV-2. Only ZIKV NS1 protein stabilized the biosensor and prevented salt-induced aggregation. These results demonstrated that the proposed biosensor and method is a promising tool for accurate detection of the NS1 protein, facilitating the ZIKV diagnostic.

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