PÔSTER - RESUMO - SENSORES E BIOSSENSORES

MONITORING PLANT HEALTH VIA METABOLITE BIOMARKERS USING NANOPARTICLE-FUNCTIONALIZED FIELD-EFFECT TRANSISTOR SENSORS

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Early and accurate detection of plant diseases is essential to minimize crop losses and promote sustainable agricultural practices1. When crops are subjected to these stressors, their cellular defense mechanisms activate immune responses influenced by metabolic changes2. This response can alter the basal concentrations of various compounds, including hormones, proteins, enzymes, and amino acids3. However, conventional analytical methods for

monitoring these metabolites are usually labor-intensive, laboratory-based, and unsuitable for rapid or in-field diagnosis. In this context, ascorbic acid (AA) and oxalic acid (AO) are two relevant metabolites to be monitored, as they are associated with some fungal infections in plants. In this study, an ion-sensitive field-effect transistor (CMISFET) sensor functionalized with silver nanoparticles (AgNPs), gold nanoparticles (AuNPs), and manganese dioxide nanoparticles (MnO2NPs) was developed for the electrochemical detection of AA and AO using electrical impedance spectroscopy. Among the modified devices, the CMISFET-AgNP sensor exhibited the highest sensitivity and the lowest charge transfer resistance, achieving limits of detection of 0.16 μM and 0.10 μM for AA and AO, respectively. Interference assays confirmed the high selectivity for both metabolites. Micro-Tom tomato plants, which are traditionally used as a model system for fungal infection due to their ability to mimic metabolic changes of plant, were employed to validate sensor performance in real sensors. Measurements performed in Micro-Tom tomato sap showed recovery rates above 85% for both analytes, demonstrating the applicability of the CMISFET-AgNP platform for detecting plant metabolites in complex biological matrices. Electrochemical and spectroscopic analyses led to a proposed detection mechanism that relies on interactions between nanoparticles and analytes, as well as surface charge modulation. The proposed CMISFET-AgNP sensor represents a robust platform for the early detection of plant metabolic biomarkers associated with disease and offers promising perspectives for the development of portable sensing strategies in precision agriculture.

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Palavras-chave: impedance sensor; cmisfet; ascorbic acid; oxalic acid; agriculture; fungal disease.