

Surface-Enhanced Raman Spectroscopy on Gold Nanoparticles in the Kidney Disease

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Abstract : At the Life Science Research Center at Simon Bolivar University, a primary focus is the diagnosis of various diseases, and the use of gold nanoparticles (Au-NPs) in diverse biomedical applications is continually expanding. In the present study, Au-NPs were employed as substrates for Surface-Enhanced Raman Spectroscopy (SERS) aimed at diagnosing kidney diseases arising from Lupus Nephritis (LN), preeclampsia (PC), and Hypertension (H). Discrimination models were developed for distinguishing patients with and without kidney diseases based on the SERS signals from urine samples by partial least squares-discriminant analysis (PLS-DA). A comparative study of the Raman signals across the three conditions was conducted, leading to the identification of potential metabolite signals. Model performance was assessed through cross-validation and external validation, determining parameters like sensitivity and specificity. Additionally, a secondary analysis was performed using machine learning (ML) models, wherein different ML algorithms were evaluated for their efficiency. Models' validation was carried out using cross-validation and external validation, and other parameters were determined, such as sensitivity and specificity; the models showed average values of 0.9 for both parameters. Additionally, it is not possible to highlight this collaborative effort involved two university research centers and two healthcare institutions, ensuring ethical treatment and informed consent of patient samples.

Keywords : SERS, Raman, PLS-DA, kidney diseases

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