Smart plasmonic surfaces for SERS-based detection of tetracyclines

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Nowadays, several antibiotics are used worldwide for multiple applications ranging from healthcare, to animal breeding and agriculture. Among them, tetracyclines are broadly used. In addition to the obvious advantages linked to the use of these pharmaceutical compounds, some drawbacks have to be highlighted, such as the increasing drug-resistance of pathogens and the health risks, due to an excessive exposure to such xenobiotics contaminating water and food. For these reasons, it is mandatory to find strategies to detect these molecules with high sensitivity and good specificity. In such a framework, Surface-enhanced Raman Scattering (SERS) is an optical technique that relies on the amplification of the analytes Raman signal taking advantage from a nanostructured plasmonic substrate based on noble metal nanoparticles, allowing to obtain spectra that contain the vibrational fingerprint of a specific molecule in physical contact with the substrate surface. In this work, SERS spectroscopy was exploited to perform the detection of tetracyclines in food matrices. To this aim, different thiol-modified aptamers were grafted on Ag-decorated porous silicon (pSi) membranes coupled to polydimethylsiloxane (PDMS) dices. Among the tested sequences, the A8 aptamer, which showed the highest affinity for the analyte, was selected. As a result of the specific interaction with its target, this short sequence acquires a peculiar folded structure that traps the analyte close to the nanostructured surface. After a careful optimization of all the bioassay steps, it was possible to identify Tetracycline at a concentration lower than 100 ppb. Furthermore, the specificity and selectivity of the assay was assessed by evaluating other antibiotic solutions (e.g. sulphonamides) or by using no-tetracycline-specific aptamers to capture tetracycline antibiotics. In both cases no relevant signals were detected. The analysis was also performed in a microfluidic chip, by using an automated procedure and a portable Raman spectrometer. Promising results have been reached, paving the way for the SERS analysis of antibiotics in food stuff and raw materials.