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A novel SERS-based approach to detect hydrogen peroxide scavenging activity

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The importance of evaluating the antioxidant activity has been widely reported in the past two decades not only for the extensive application of antioxidants in food industry and food nutriology, but also because of the discoveries of the strong correlations between reactive oxygen species (ROS) and many pathogenesis of human diseases, e.g. nervous system injuries, atherosclerosis and cancer. Hydrogen peroxide (H_2O_2), a key part of ROS, is generated in vivo under physiological conditions by peroxisomes (a kind of oxidative enzyme including glucose oxidase and D-amino acid oxidase) and superoxide dismutase which catalyze the dismutation of superoxide radicals. Along with superoxide anion radical, H_2O_2 can damage many cellular components and further convert into more ROS such as hydroxyl radical. Thus, the evaluation of H_2O_2 scavenging activity is an important part for assessing the ROS scavenging activity. Generally, the evaluation of H_2O_2 scavenging activity is peroxidase based or enzyme-free but biomarker dependent. Many methodologies based on different mechanisms have been developed for detecting H_2O_2 and/or H_2O_2 scavenging activity, e.g. chemiluminescence, fluorometry, colorimetry, cyclic voltammetry, electro spin resonance, etc. Surface-enhanced Raman Scattering (SERS) is a new powerful analytical technique with ultrahigh sensitivity. In addition to the "whole-finger-prints" information and the low water background, SERS has high signal enhancement and fluorescence quenching effects, which are extremely desirable for the biological sample analysis. Because of its unique attributes, SERS has been used in a wide range of fields, including homeland security, food safety, clinical diagnosis, trace detection, chemical and biochemical monitoring, etc., since it was discovered in the late 1970s. In this work, a novel SERS-based approach to detect H_2O_2 scavenging activity by using gold nanoshell precursor nanocomposites (SiO_2/GNPs) as nanoprobes is developed. Compared with conventional methods, the novel SERS-based method presented here with high sensitivity, rapid determination, relative ease of measurement may serve as an additional means for estimating the activities of multifunctional antioxidants.

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