Utilizing Fluorescent Nanodiamonds as Photostable Markers for Investigation of Comestible Liquids

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The work proposes the use of fluorescent nanodiamonds with nitrogen-vacancy centers as photostable markers for the investigation of comestible liquids. Interactions of NDs with products suitable for consumption are a research topic that is being turned to increasingly commonly. Nanodiamond and edible suspensions and cocktails with varying pH levels were prepared and studied using fluorescence, wettability, and zeta potential. The created cocktails had a significant impact on the properties of the nanodiamonds and their surface chemistry, affected by both pH and specific quenching compounds. Moreover, to evaluate sensing possibilities of NDs via fluorescence spectroscopy, a ratio of photon count rate at ZPL of NV^- centers to the photon count rate at ZPL of NV^0 centers was calculated where possible, and compared to data obtained for a reference series of suspensions of NDs in deionized water, with pH tuned either with HCl, or NaOH. This has been to verify whether pH is a crucial property of the media to potentially influence the fluorescence of NV centers, or whether the centers are more affected by the composition of their surrounding comestible environment. To assess the stability of the systems, zeta potential of the suspensions of NDs in the comestible liquids has been examined. The stability and biocompatibility of the nanodiamonds make them suitable for monitoring the condition of foodstuffs and detecting toxins and pathogens.
Additionally, this paper reports on the interaction of the hazardous contaminant ochratoxin A (OTA) with calf thymus DNA (ct DNA) on the nanodiamond surface. The immobilization of OTA has been performed in a few, widely available drinks, beverages, and liquids to assess the influence of the environment on OTA toxicity. What is more, complex of the OTA and NDs enables the investigations of the DNA-OTA interactions using both fluorescence and UV–Vis spectroscopy. Multispectroscopic techniques were used to elucidate the binding mechanism of OTA with ct DNA, and the results show that OTA binds to ds ct DNA to form complexes. The binding constant of OTA and ct DNA was obtained using fluorescence quenching and UV-Vis spectroscopy and was found to be 3.27 × 105 M−1 (UV-Vis) and 8.12 × 105 M−1 (fluorescence) for nanodiamond in green tea beverage OTA. The analysis indicates that OTA can interact with calf thymus DNA in a groove-binding mode, as evidenced by the hyperchromic effect of the absorption spectra. This study provides insights into the toxicological effect of mycotoxins.
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