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Abstract

A smartphone-addressable aptamer-based lateral flow biosensor for ochratoxin A †

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Abstract: Ochratoxin A (OTA) is a mycotoxin produced as a secondary metabolite by several fungal species such as Aspergillus and Penicillium. Various studies have shown that OTA can cause several adverse health effects to animals and humans through its consumption in contaminated plant foods such as corn, wheat, oats, vegetables, coffee, beer and wine [1]. OTA has been shown to be nephrotoxic, teratogenic, immunotoxic, and carcinogenic. In particular, the International Agency for Research on Cancer (IARC) has classified OTA as a group 2B carcinogen [2]. Due to the toxicity of OTA, the European Union has set maximum limits (MLs) for OTA in foods in the range of 0.5–10 μg /kg [2]. Considering the severe toxic effects of OTA, it is of great importance to develop rapid and sensitive sensing platforms for OTA monitoring to ensure food safety issues and avoid or minimize the risk of OTA consumption. The detection of OTA in food is mostly based on conventional chromatographic techniques such as thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC) or gas chromatography (GC) which, although powerful, require expensive equipment, trained personnel and complex sample preparation [1,2]. On the contrary, enzyme-linked immunosorbent assays (ELISA) and immunochromatographic assays are more convenient and simpler to use, providing satisfactory sensitivity with the potential for high-throughput screening, but they often suffer from cross reactivity and require the use of expensive antibodies with limited stability [3]. Aptamer-based biosensors employ relatively inexpensive and stable single stranded oligonucleotides as biorecognition elements, which makes them ideal for rapid on-site detection of OTA [2], especially when combined with smartphone-based detection [4]. In this work, we describe a simple, portable and cost-efficient lateral flow assay for OTA determination. The biosensor strip utilizes an OTA-specific aptamer for biorecognition and is based on a competitive lateral flow assay using conjugates of OTA-specific aptamer with gold nanoparticles (AuNPs) as biorecognition element. In the presence of OTA, the OTA aptamer-AuNPs conjugates are bound by the target analyte and are not allowed to bind with the specific probe of the test line in the strip. Qualitative detection of OTA is performed by visual inspection while quantification is performed by reflectance colorimetry using a smartphone and image analysis. The key parameters of the assay were investigated in detail and the analytical features were established. The visual limit of detection of the strip for qualitative detection is 0.05 ng mL^{-1}, while the LOD for semi-quantitative detection is 0.04 ng mL^{-1}. The assay lasts 30 min, indicating that the aptamer-based strip could be a potential useful tool for rapid on-site detection of low levels of OTA.

Keywords: OTA; aptamer; lateral flow assay; smartphone;

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