Nanostructured electrochemical aptasensors for ochratoxin A (OTA) determination

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Ochratoxin A is a naturally occuring mycotoxin produced primarily by Aspergillus ochraceus and Penicillium verrucosum usually present in a variety of foods. It is mainly found as a contaminant of cereals, cereal products and coffee beans. Previously, we have developed a device based on Quartz Crystal Microbalance sensor for OTA determination.

In the literature has been reported the combination of electrochemical immunosensor using gold nanoparticles (AuNPs), carbon nanotubes (CNTs) or magnetic beads (MBs). Nanostructured materials have proven as one of the most powerful tool in new technologies and research, due to their absolutely peculiar properties at nanometer size scale.

The interesting approach of this work is related to the using of a selective aptamer to OTA. Aptamers are nucleic acids (DNA or RNA) that selectively bind to low molecular weight organic or inorganic substrates or to macromolecules such as proteins.

Anyway, this work is the first step in the realization of an assay for OTA based on the use of the specific aptamer exploiting the known advantages of these biomimetic receptors. In literature only two papers report the development of an assay for OTA detection using specific aptamer.

A disposable electrochemical assay involving MBs and carbon-based screen-printed electrodes (SPCEs) was developed for the detection of OTA. The Streptavidin Paramagnetic Particles consist of a magnetite core coated with streptavidin. Thus, these particles combine convenient magnetic separation technology with the versatility and high affinity of the biotin-streptavidin interaction. The assay was based on a direct competitive format in which a DNA aptamer biotinylated was used as biorecognition element, and horse-radish-peroxidase (HRP) was used as enzymatic label.

All steps of the assay were carried out onto MBs; only the electrochemical detection was performed transferring the functionalized MBs onto the working electrode of a SPCE. In this assay there is a competition step between OTA and OTA-HRP, finally hycroquinone (HQ) and H_2O_2 were added as co-substrate and substrate.The enzymatic product was determined by DPV.

The performance of the assay in terms of sensitivity, reproducibility and selectivity were studied. The calibration curve carried out shows a LOD and LOQ 0.2 and 6 μg/l respectively and the average coefficient of variation (ACV) resulted 8 %.

Finally, this approach will be applied to the analysis of some OTA samples to determine the concentration of OTA and predict the risk of a possible contamination with OTA.