Rapid mycotoxins monitoring systems in cereals using smartphone-based biomimetic sensor

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Aim. This study describes smartphone-based fluorescent sensor systems capable of rapid and accurate contamination monitoring of most prevalent mycotoxins — aflatoxin B1 (AFB1) and zearalenone (ZON) in cereals using biomimetic polymers as highly sensitive, cost-effective elements for mycotoxin recognition. **Methods.** Biomimetic polymers in the form of free-standing molecularly imprinted polymer (MIP) membranes were synthesized using the technique of molecular imprinting and method of *in situ* polymerization. Ethyl-2-oxocyclopentanecarboxylate and cyclododecyl-2,4dihydroxybenzoate — non-toxic and non-fluorescent close structural analogues of AFB1 and ZON, respectively, were used as dummy templates. Functional monomers were chosen using the results of computational modeling. The 60 μm-thick MIP polymeric membranes were obtained using UV-irradiation conducted during 30 min (Sergeyeva *et al.* 2017). The fluorescent sensor response associated with the AFB1 and ZON binding to the MIP membrane surface were registered by the smartphone camera (Meizu 16, 20 MP, F/1,8) after 1 min excitation with UV-irradiation. Smartphone application Spotxel® dependencies of fluorescence intensity on the toxin concentration in the sample within real time. **Results.** MIP membranes that mimic the receptors towards AFB1 and ZON were synthesized and used as sensing elements in smartphone-based biomimetic sensor. The critical parameters of analyzed sample, including pH, buffer concentration, salt addition, that can affect the recognition properties of the MIP membranes, were investigated and optimized. The working parameters of the sensors systems for AFB1 and ZON detection were further analyzed. The MIP membranes with the optimized composition can successfully discriminate between an analyte of interest (AFB1 or ZON) and its close structural analogues (AFB2, AFG2, OTA, zearalenol, 17-β-estradiol, bisphenol A, resorcinol). The limits of detection (LOD) as well as linear detection ranges were determined. The aflatoxin B1 detection limit was established to be 15 ng/ml and the working range 15–500 ng/ml. The ZON-specific MIP membrane-based sensor system showed LOD of ZON detection 1 μg/mL, the linear detection range was 1–10 μg/mL. The proposed sensing elements remain stable at room temperature for 18 months. Using the smartphone-based biomimetic polymers sensor systems, AFB1 and ZON were quantitatively detected in the spiked wheat, rye and maize flour samples along with the naturally contaminated wheat and maize. **Conclusions.** The MIP membrane-based sensor systems were designed and used for monitoring the most common mycotoxins — AFB1 and ZON in cereals using smartphone as detector and quantifier. The proposed smartphone-based sensor systems provide a promising technique for highly sensitive, on-site monitoring of mycotoxin contamination and personalized food safety. **Acknowledgement.** Financial support from National Academy of Sciences of Ukraine.