

<https://doi.org/10.7124/bc.000B9D>

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DEVELOPMENT OF A MIP-BASED SENSOR FOR EARLY MONITORING OF MYCOTOXICOSES CAUSED BY F2 GROUP MYCOTOXINS

Background/Aim. Early monitoring of F2 group mycotoxins is critical for clinical and veterinary diagnostics due to their severe estrogenic effects and immunotoxicity. This study aims to develop a fluorescent biomimetic sensor using nanostructured molecularly imprinted polymer (MIP) chips for the selective detection of zearalenone and its metabolites (α - and β -zearalenol) in biological fluids. **Methods.** Target-selective MIP chips were synthesized on glass slides via in situ polymerization. To ensure analytical accuracy, several non-toxic and non-fluorescent dummy templates (structural analogues of F2 mycotoxins) were used for the formation of the toxin-selective binding sites in the polymer structure. Computational modeling was employed to guide the rational selection and optimization of functional monomers and dummy templates. The analytical signal was registered under UV-irradiation, initiating the intrinsic fluorescence of the captured analytes. **Results.** Several functional monomers including ethylene glycol methacrylate phosphate, diethylaminoethyl methacrylate, 2-acrylamido-2-methylpropane sulfonic acid, 1-allylpiperazine, N,N'-methylenebisacrylamide, ethylene glycol dimethacrylate, and 4-vinylpyridine were used to establish complementary biomimetic recognition sites. MIP chips obtained with N,N'-methylenebisacrylamide at a template-to-monomer ratio of 1:2 demonstrated the highest differential sensor response, indicating superior binding efficiency and signal reproducibility. Effectiveness of cyclododecyl-2,4-dihydroxybenzoate, quercetin and two compounds affiliated to the class of aurones as dummy templates to be used for the formation of the toxin-selective binding sites was compared. The proposed sensor provided a limit of detection of 1 $\mu\text{g/mL}$ within a linear dynamic range of 1–25 $\mu\text{g/mL}$. The developed MIP-based sensor was successfully used for the detection of zearalenone and its metabolites in serum samples. **Conclusions.** The proposed MIP-based sensor represents a promising approach for molecular diagnostics, including non-invasive screening, point-of-care testing, and early monitoring of F2-group mycotoxin exposure. The nanostructured MIP chips offer a robust, cost-effective, highly selective and sensitive analysis of zearalenone and its metabolites in biological fluids. **Grants/Funding.** The authors gratefully acknowledge the financial support from the National Research Foundation of Ukraine (project № 2025.07/0225).

Keywords: MIP; biomimetic sensors; F2 mycotoxins; clinical diagnostics; fluorescence detection.

Received: 26.06.2026; Accepted: 08.09.2026; Published: 29.09.2026

Citation: Yarynka D.V., Dubey I.Y., Dubey L.V., Kuziv I.B., Ilchenko M.M., Negrutska V.V., Brovko O.O., Sergeyeva T.A. (2026) Development of a MIP-based sensor for early monitoring of mycotoxicoses caused by F2 group mycotoxins. *Biopolymers & Cell*, Special issue(42), 99. <https://doi.org/10.7124/bc.000B9D>

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