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NANOMIPS BY SOLID PHASE POLYMERIZATION SYNTHESIS: AN INNOVATIVE APPROACH TOWARDS ARTIFICIAL ANTIBODIES FOR ANALYTICAL APPLICATIONS

C. Baggiani, L. Anfossi, S. Cavalera, F. Di Nardo

Dipartimento di Chimica, Università degli Studi di Torino, Torino, Italy

Molecularly imprinted polymers (MIPs) are synthetic materials obtained by polymerization in presence of a template target molecule and able to rebind selectively to this target. MIPs in the form of nanoparticles (nanoMIPs) offer good control of the quality of binding sites and morphology of the polymer. Thus, nanoMIPs have the potential to be low-cost and robust alternatives to antibodies in applications as immunoassay, sensoristics and complex sample purification by affinity chromatography. Anyhow, when prepared by traditional synthetic methods, nanoMIPs usefulness has been limited by the presence of residual template and large-scale manufacturing costly, labor intensive and difficult to standardize.

To overcome such limitations a solid-phase polymerization synthesis (SPPS) approach has been proposed recently [1]. It relies on the covalent immobilization of the template onto the surface of a solid support, the fast polymerization of nanoMIPs around the template and the release of the imprinted nanoparticles by changing the medium conditions. The obtained nanoMIPs are virtually free of template and demonstrate high affinity for the target molecule. Moreover, because of an affinity separation step performed on the solid phase after polymerization, poor binders and unproductive polymer are removed, so the final product has more uniform binding characteristics.

Here we present the results obtained by using ciprofloxacin as immobilized template in a proof-of-the-concept study. The effects on the binding properties of the resulting nanoMIPs were studied by batch rebinding experiments, considering different experimental conditions in the SPPS protocol (different template scaffolding, pre-polymerization mixtures, and polymerization conditions) and different rebinding conditions (buffer composition, presence of organic solvents).

From the experimental results we found that the SPPS approach is highly flexible, and that resulting nanoMIPs show very good rebinding properties and excellent target selectivity in aqueous buffers, with equilibrium dissociation constants in the micromolar range. The extension of this approach to different analytical targets (mycotoxins, peptides, proteins) and the application of these nanoMIPs to the development of MIP-based immunoassays will be briefly discussed.

References

[1] Canfarotta F., Poma A., Guerreiro A., and Piletsky S., Nature Prot., 2016, 11, 443