Molecularly Imprinted Polymers (MIPs) as Synthetic Antibodies for Inhibiting SARS-CoV-2 Omicron Variant

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Emerging zoonoses, which are infectious diseases transmitted from animals to humans, present significant public health challenges due to their potential for widespread outbreaks, requiring prompt and effective therapeutic responses, as seen with COVID-19. In this context, the present study focuses on advancing the technology used to prepare Molecularly Imprinted Polymers (MIPs), which act as synthetic antibodies targeting specific molecules involved in zoonotic diseases [1].
Following docking simulations, MIPs designed to specifically target the Receptor-Binding Domain (RBD) of SARS-CoV-2, with a focus on the Omicron variant, were prepared (Fig. 1). The synthesis was performed via inverse microemulsion polymerization, and the resulting MIPs were characterized by DLS, ξ-potential, TEM (Fig. 1A) and NTA analyses. Building on previous research [2], the process conditions were modified to improve particle stability and achieve better control over size and distribution, addressing limitations observed in earlier studies.
The selective recognition properties of MIPs and their ability to block the interaction between ACE2 and the RBD of SARS-CoV-2 were investigated *in vitro*, using Non-Imprinted Polymers (NIPs) as control materials, and binding studies were carried out using a Quartz Crystal Microbalance with Dissipation monitoring (QCM-D).
The prepared imprinted nanoparticles were monodisperse with an average diameter of 40.24 ± 6.383 nm and a ξ-potential of -33.3 ± 8.14 mV. The nanoparticles showed significant recognition properties and a concentration-dependent ability to reduce RBD binding to its receptor ACE2 (Fig. 1B-1E), suggesting they can effectively inhibit this interaction and, thus, the infection process. In addition, the synthesized MIPs exhibited no cytotoxicity or sensitizing effects, as evaluated by MTT and h-CLAT assays.
MIPs-based antibodies offer a promising alternative to natural antibodies for SARS-CoV-2 treatment, providing a versatile platform for addressing emerging zoonotic diseases.

References

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[2] Parisi OI, Dattilo M, Patitucci F, Malivindi R, Delbue S, Ferrante P, Parapini S, Galeazzi R, Cavarelli M, Cilurzo F, Franzè S, Perrotta I, Pezzi V, Selmin F, Ruffo M, Puoci F, Nanoscale, 13 (2021) 16885

Figures

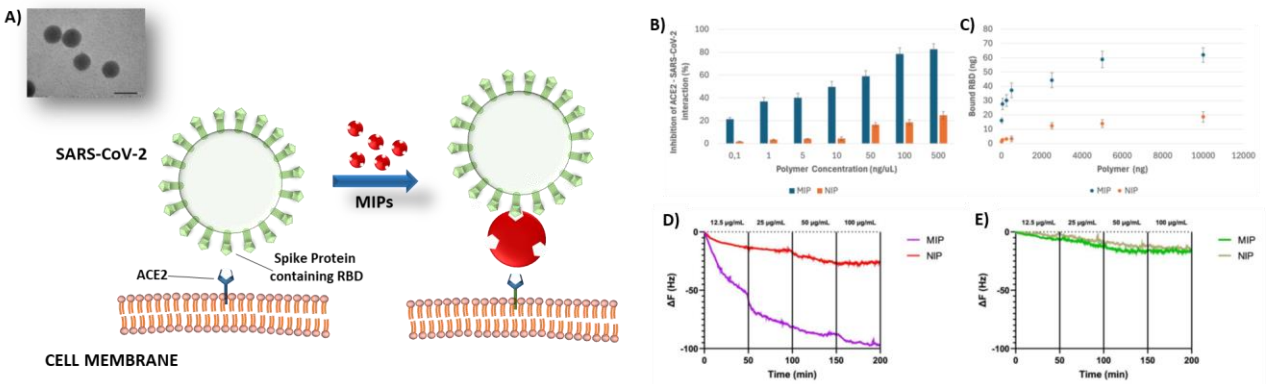

Figure 1: MIPs-based antibodies: **A)** TEM; **B)** inhibition of ACE2-RBD interactions; **C)** binding isotherms; real-time changes in resonant frequency (ΔF) on functionalized QCM-D sensor chips with **D)** RBD and **E)** HSA.