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OPTIMIZATION OF AFFINITY AND STABILITY OF SELECTED APTAMER FOR BSA

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Введение. Aptamers have emerged as promising tools for in vivo monitoring and targeted drug delivery due to their unique properties and advantages over traditional antibodies. These molecules can specifically bind to a wide range of targets: proteins, cells, and small molecules. Aptamers offer several key advantages over monoclonal antibodies. Their ability to be easily modified and synthesized in the laboratory makes them versatile tools for diagnostic applications and targeted therapy. In this context, aptamers hold great potential for revolutionizing in vivo monitoring and drug delivery, offering a more efficient and precise approach compared to traditional antibodies. However, the current aptamers have a high K-off. This results in the aptamers dissociating from their target even if they have a high attraction for them.

Основная часть. Through this project, we are establishing the experimental validation phase for the NIRMA-backed initiative focused on digitally designing aptamers for the sensitive detection of small chemical molecules using artificial intelligence techniques [1]. Aptamers are small nucleic acids (single-stranded DNA or RNA) that exhibit high specificity and affinity for their targets. They contain a random central region flanked by constant regions and fold into various three-dimensional structures to bind their targets. Aptamers are selected through the SELEX technique, involving multiple rounds of incubation, amplification, and selection. These aptamers have binding affinities typically in the low nanomolar to picomolar range, with some reaching femtomolar levels. They can bind to a wide range of targets using different interactions, making them comparable to monoclonal antibodies but with advantages such as being non-immunogenic and cost-effective [2,3]. One challenge with aptamer-protein binding in aqueous environments is the non-equilibrium conditions, which can result in a high dissociation rate constant (k-off) and unstable complexes. To address this issue, we are exploring chemical modifications to aptamer nucleotides and designing structural locks to enhance stability and reduce k-off. Once tight binding is achieved, the plan is to attach the aptamers to DNA nano constructs (in our experimental designs we have linked these aptamers to different scaffolds which should protect them in aqueous environments and choose which scaffold gives us the best outputs) for effective binding to BSA. Aptamers can avoid the immune system which leads us to see them as a future replacement for the antibody. Наши планы на это исследование**:** Selection of DNA aptamers that have a strong affinity for the bovine serum albumin and improving the K-off rate by incorporating hydrophobic modifications into the chosen DNA aptamers and using a protective scaffold to shield the complex from water-based environments.

Выводы. By modifying oligonucleotides for hydrophobicity and utilizing a protective scaffold to reduce dissociation in aqueous environments, aptamers have the potential to become effective gene therapy agents with enhanced binding capabilities to target proteins [4].

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