DOI: 10.25205/978-5-4437-1691-6-212

OPTIMIZING SELECTED APTAMERS FOR BINDING TO BOVINE SERUM ALBUMIN: ENHANCING AFFINITY AND STABILITY*

A. Nbeaa[1], M. A. Y. Nour[1], A. A. Eldeeb[1], D. M. Kolpashchikov[2–4]

[1] *SCAMT Institute, ITMO University, Saint Petersburg*
[2] *Chemistry Department, University of Central Florida, Orlando, USA*
[3] *Burnett School of Biomedical Sciences, University of Central Florida, Orlando, USA*
[4] *National Center for Forensic Science, University of Central Florida, Orlando, USA*

✉ nbeaa@scamt-itmo.ru

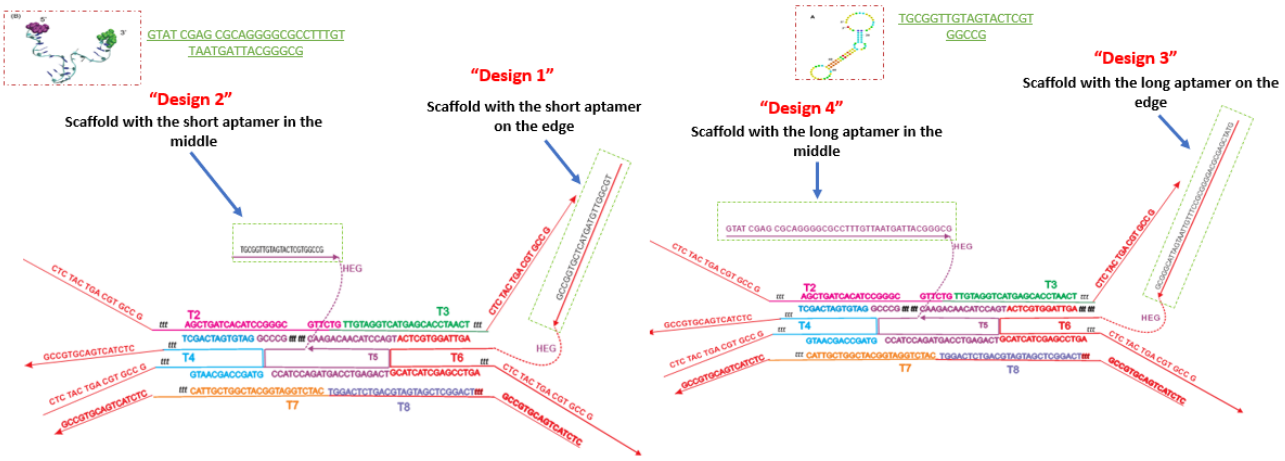
Abstract

Aptamers have been recently paying significant attention to advanced platforms for in vivo detection and targeting for drug delivery due to their unique characteristics. The advantages in aptamers make these molecules bind with high specificity and efficiency to several targets: proteins, cells, and small molecules. The ability of ease synthesis and modification at low cost in laboratories makes them versatile tools for diagnostic applications and targeted therapy.

Aptamers are short synthetic nucleic acids, single-stranded DNA or RNA, that fold into three-dimensional structure for target binding. They are selected through the Systematic Evolution of Ligands by Exponential enrichment (SELEX) which involve multiple rounds of incubation, partitioning and amplification [1].

The obtained aptamer following the SELEX procedure have mainly a dissociation constant (Kd) ranging from micromolar to nanomolar and from literature some of them can goes as low as picomolar. Their importance comes from their ability to be used directly in vivo application, unlike antibodies that are recognized by the immune system [2, 3].

A major issue with aptamers is their high k-off, meaning that the complexes they form with their targets are often unstable and quickly fall apart. This instability makes the aptamers which currently used in research ineffective for in vivo applications.



Design of aptamers attached to protective Scaffolds for BSA protein binding

In our work, we aim to enable aptamers to function effectively on cells line models. But before that, we have started working with BSA (bovine serum albumin) as a first step to see if the affinity of our aptamers (already selected ones for BSA binding) will be improved or not after covering these aptamers with a protective scaffold, which will provide the appropriate conditions to have specific three-dimensional structure, reducing their disassociation constant. This makes our approach promising for drug delivery and gene therapy, particularly as a superior alternative to traditional delivery systems like liposomes [4–7].

* The study is supported by the Priority 2030 Federal Academic Leadership Program.

References

1. Kuntip N., Japrung D., Pongprayoon P. How human serum albumin-selective DNA aptamer binds to bovine and canine serum albumins // Biopolymers. 2021. Vol. 112 (3).

2. Wang C., Du X., Xie T., Li H. Label- and modification-free-based in situ selection of bovine serum albumin specific aptamer // Journal of Separation Science. 2019. Vol. 42 (23). P. 3571–3578.

3. Krämer M., Kissmann A. K., Raber H. F. et al. BSA Hydrogel Beads Functionalized with a Specific Aptamer Library for Capturing Pseudomonas aeruginosa in Serum and Blood // Intern. J. Mol. Sci. 2021. Vol. 22 (20). P. 11118–11118.

4. Cortez C. M., Silva D., Silva C. M. C., Missailidis S. Interactions of aptamers with sera albumins // Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy. 2012. Vol. 95. P. 270–275.

5. Ropii B., Bethasari M., Anshori I. et al. The assessment of molecular dynamics results of three-dimensional RNA aptamer structure prediction // PloS One. 2023. Vol. 18 (7). P. e0288684.

6. Oliveira R., Pinho E., Sousa A. L. et al. Modelling aptamers with nucleic acid mimics (NAM): From sequence to three-dimensional docking // PloS One. 2022. Vol. 17 (3). P. e0264701.

7. Sercombe L., Veerati T., Moheimani F. et al. Advances and challenges of liposome Assisted Drug Delivery // Frontiers in Pharmacology. 2015. Vol. 6.