УДК 577.29

Ultrasensitive-selective DNA nanomachine for Testicular Germ Cell Tumers detection

Alaji M. (ITMO University - ChemBio Cluster)
Supervisor-PhD, Eldeeb A. A. (ITMO University - ChemBio Cluster)

Introduction. Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths in 2020. Testicular germ cell tumors (TGCTs) represent the most common solid malignancy in young men. TGCTs start in the germ cells, which are cells in the testicles, and develop into sperm. MicroRNA-371a-3p (miR371) has been suggested as a sensitive biomarker in TGCT, since it increases in the plasma in the early stages [1]. There are five other miRNAs that have a high similarity to the miR371 sequence, which makes it difficult to detect using PCR. DNA nanomachines based on binary deoxyribozyme (Dz) are considered simple, cheap, sequence-specific, and sensitive tools for DNA/RNA analysis, specifically miRNA detection.

Main Part. By studying and analysing relevant studies, we found that the formation of a binary Dz catalytic core has an effective role in analyte recognition and DNA nanomachine efficiency [2]. A recent study showed that the hook-equipped DNA machine (HDNM) improves detection sensitivity and offers an 80-fold enhancement in DNA and RNA detection [3].
Traditionally, the design of DNA machines based on binary Dz relied on the full complementarity between the analyte and the analyte binding arms of binary Dz.
Throughout this approach, we designed HDNM based on binary Dz with selective miR371-binding arms that are complementary to the miR371 sequence but have mismatches with the five other healthy miRNAs affecting Dz catalytic core formation in order to achieve high selectivity towards miR371. Accordingly, we will first test our design with a series of dilutions of synthetic miRNAs, then examine it with samples from TGCT patients.

Conclusion. Our study aims to develop a highly selective and highly sensitive DNA nanomachine based on binary Dz for amplification-free detection of the cancer marker miR371. To gauge the performance of our proposed approach, we started compare the DNM efficiency with synthetic miR371 and five other miRNAs and measure the limit of detection of HDNM which successfully reached 28.9pM in miR371 detection. Then we will test HDNM on patient samples and compare it with the results using PCR. Ultimately, our research endeavors to make a significant contribution to the early diagnosis of TGCTs.

References.

1. Nestler, T., Schoch, J., Belge, G., & Dieckmann, K. (2022). MicroRNA-371a-3p—The Novel Serum Biomarker in Testicular Germ Cell Tumors. *Cancers*, *15*(15), 3944.
2. Kolpashchikov, Dmitry M. "A binary deoxyribozyme for nucleic acid analysis." *Chembiochem : a European journal of chemical Biology,* vol. 8,17 (2007): 2039-42.
3. Zain Hussein, Moustapha A. Y. Nour, Anastasia V. Kozlova, Dmitry M. Kolpashchikov, Andrey B. Komissarov, and Ahmed A. El-Deeb Analytical Chemistry 2023 *95* (51), 18667-18672

Alaji M. (auther) **Eldeeb A. (supervisor)**