The Aptamer advantage: Biosensing Solutions for Neurohealth and Environment

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Abstract: Aptamers are short single-stranded DNA or RNA molecules which can form unique folds and three-dimensional structures. The sequence dependent folding gives rise to specificity of aptamers paving their way to be classified as recognition elements in biosensors. Nonetheless, their use is not limited to biosensors and it has spread across sectors including diagnostics, imaging, and therapeutics. Aptamers have gained widespread attention and success stories include two in-market therapies, *viz.,* Macugen and Zimura, while several others being in clinical trials. Fuelling the interest is growth in aptamer market where it is predicted to be $ 10.9 billion by the end of 2030.

Aptamer discovery pipeline involves multiples steps, including SELEX, NGS analysis to find putative aptamers, biophysical characterization and truncations to shorten the aptamer size. The selection strategies need to be adapted for target (stability, isoelectric point, size, etc.,), stringency, and type of input library (DNA/RNA).

The EU funded project 2D-BioPAD aims to develop the Alzheimer's' disease (AD) support tool for the easier diagnosis of neurodegenerative diseases by combining AD-biomarker specific aptamers with 2D material-based field effect and electrochemical sensors. To this end, at Novaptech we characterized novel DNA aptamers for Glial fibrillary acidic protein (GFAP) and Neurofilament light protein (Nfl) with low nanomolar affinities. The full-length aptamers were optimized to eliminate cross-reactivity. It led to truncated and highly specific GFAP and Nfl aptamers (K_D – 2.2 nM) with improved selectivity and increased cost efficiency. These aptamers have also shown promising results when incorporated with GFET sensors.

Novaptech specializes in generating structure-switching aptamers (Novaswitches) for targeting small molecules such as antibiotics, pesticides or toxins. Small molecule detection is particularly challenging and custom strategies have allowed us to select aptamers against multiple antibiotics, pesticides and toxins. For reference, a turn-on fluorescence sensor was developed for thiabendazole with a detection limit of 0.7 ppm. Several other aptamers targeting small molecules make repertoire of available aptamers covering large classes of aminoglycoside and cyclin antibiotics, pesticides, avian flu viruses, etc under NOVAptamer 'One Health' initiative.

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