ANV-Probe: Deteriorative Airborne Neurotropic Virus and Immune Modulation Using a Novel DNA Aptamer-Eggshell Vitelline Membrane Metal-Organic Framework in Caenorhabditis elegans

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Airborne Neurotropic Viruses (ANVs) are emergent invasive neuropathogens, affecting 300-500 million people and being responsible for >700,000 deaths annually. Early neurotropic transcriptomic sequestration is crucial for treating proteotoxicity and DAF-16/FOXO3 longevity pathway dysfunction, yet < 2% of over 1,400 human viral pathogens are medicinally treatable. Thus, my project presents ANV-Probe: the first study to synthesize an avian-inspired, programmable, waste-derived DNA Aptamer–Eggshell Vitelline Membrane Metal-Organic Framework (MOF) (ANV-Probe) for DAF-16/FOXO3 signaling in Caenorhabditis elegans (83% human orthology) as a viable therapeutic target for treating virus-induced neurodegeneration and multi-organ diseases. This study assesses several ANV symptoms, including neuro-muscular impairment, cytotoxicity, germline stress, and viral titre. Methods include in-silico chimeraX docking, sol-gel nucleation, polydopamine coating for eggshell vitelline membrane biofunctionalization, and DNA aptamer conjugation. Pathogenesis molecular assays (Viral MFI) and physiological assays (locomotion, longevity, fecundity) (n=20, N=320), were conducted to assess the efficacy of the ANV-Probe in modulating DAF-16/FOXO3 signaling markers for immune modulation. After extensive experimentation, results achieved impressive ($p<0.00001$) sub-nanomolar pathogenic absorption, enhanced homeostatic restoration, and upregulated transcriptomic regulation beyond existing non-functionalized therapeutics in resource-limited clinical settings. Bioinformatic simulations of multi-organ ANV-related diseases revealed superior deployable human efficacy. ANV-Probe offers clinicians the first intravenous, bio-programmable, and low-cost nanotechnology therapeutic for neurotropic viral treatment.

Awards Won: