BREATHE: Bioactive Respiratory Extracellular Vesicles for Vaping Addiction Therapy and Healing of Epithelium

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Vaping is a common habit and a widespread health issue that affects over 100 million people and has transformed into a youth epidemic, with teens being around nine times more likely than adults to vape. Vaping involves detrimental health complications, including nicotine addiction and lung epithelial cell injury, which is largely driven by oxidative stress caused by heavy metals. Current treatments do not address vaping-induced cellular damage, and inhaled products ("wellness vapes") rely on heat, which can cause thermal degradation and harmful byproducts. BREATHE (Bioactive Respiratory Extracellular Vesicles for Vaping Addiction Therapy and Healing of Epithelium) introduces the delivery of inhalable plant-derived extracellular vesicles (EVs) to promote lung epithelial recovery and behavioral withdrawal, employing a sleek, portable ultrasonic nebulizer as a heat-free platform. The goal was to develop BREATHE and assess its ability to generate an inhalable mist and reduce oxidative stress. The results indicated that the ultrasonic nebulizer generated aerosol droplets that can be deposited into the alveolar region. Furthermore, nebulization of tomato and coffee-derived EVs did not compromise vesicular morphology. EVs were successfully internalized by human lung epithelial cells, as demonstrated by fluorescence microscopy. Hydrogen peroxide was used to induce oxidative stress in the cells, with tomato EV treatment significantly reducing apoptosis and morphological damage. Intriguingly, EV treatment also restored cell viability in a dose-dependent manner, increased antioxidant enzyme activity, and upregulated reparative and proliferative genes. Overall, BREATHE essentially reframes harmful inhalation behavior as a therapeutic one and may help vapers attain cessation.

Awards Won:

First Award of $6,000

Lehigh University: Four Scholarships ($20,000 per year for four years)