Development of an *in vitro* Model for the Identification of Volatile Biomarkers of Pneumonia

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Research Question

The objective of this research is to identify biomarkers of Pneumonia by developing a co-culture system using custom technology and examining its volatile organic compound expression across time.

Introduction

Pneumonia remains one of the leading causes of global mortality affecting 2.49 million people annually due to poor diagnostic measures [1]. In recent years, volatile organic compounds (VOCs) have emerged as easily accessible biomarkers for use in point-of-care diagnostics. Despite recent advancements, exhaled breath analysis studies have demonstrated poor predictive accuracy with VOCs falsely discovered due to noise or contamination [2]. Through this work, we aim to utilize custom technology to collect VOCs released exclusively by pneumonia-causing bacterial strains in the presence of small cell lung cancer cells with dramatically reduced noise levels.

Experimental Design

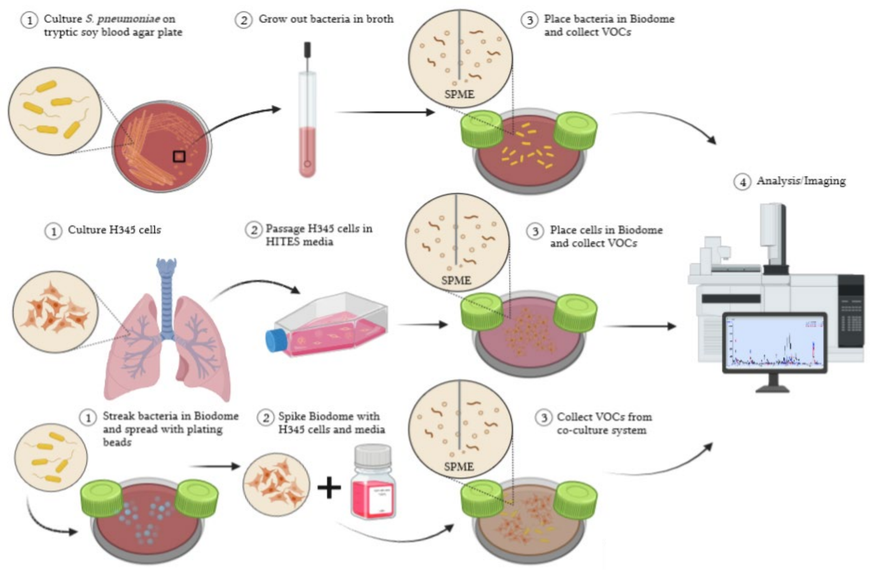

Figure 1. Schematic of experimental process of pneumonia, H345 cell, and co-culture conditions.

Results

Experimental Set-Up and Image Analysis

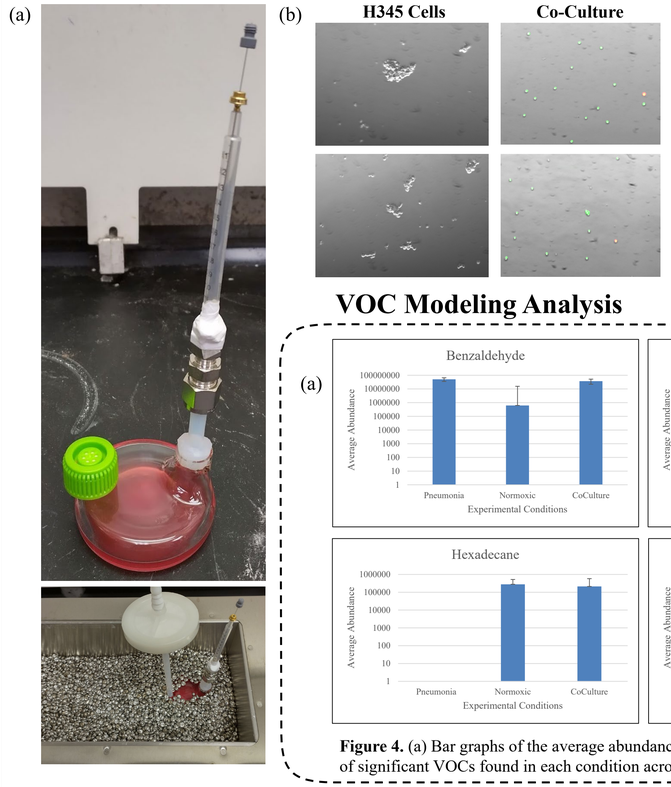

Figure 2. (a) Experimental set-up of Biodome with SPME fiber and carbon bead bath for data collection. (b) Bright field images of H345 cells after 48 hours (left) and LIVE/DEAD assay images of H345 cells in the co-culture system after 48 hours (right).

Mass Spectrometry Chromatograms

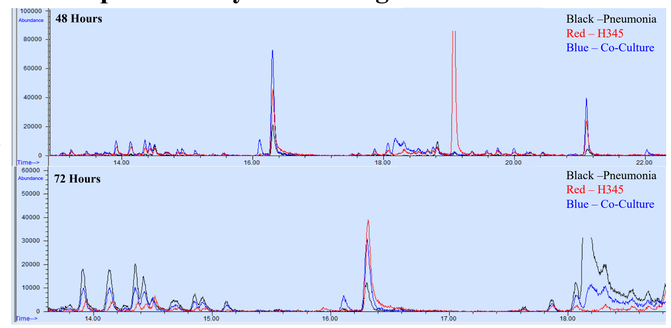

Figure 3. Chromatogram overlays of pneumonia only, H345 only, and co-culture conditions after 48 hours (top) and 72 hours (bottom).

VOC Modeling Analysis

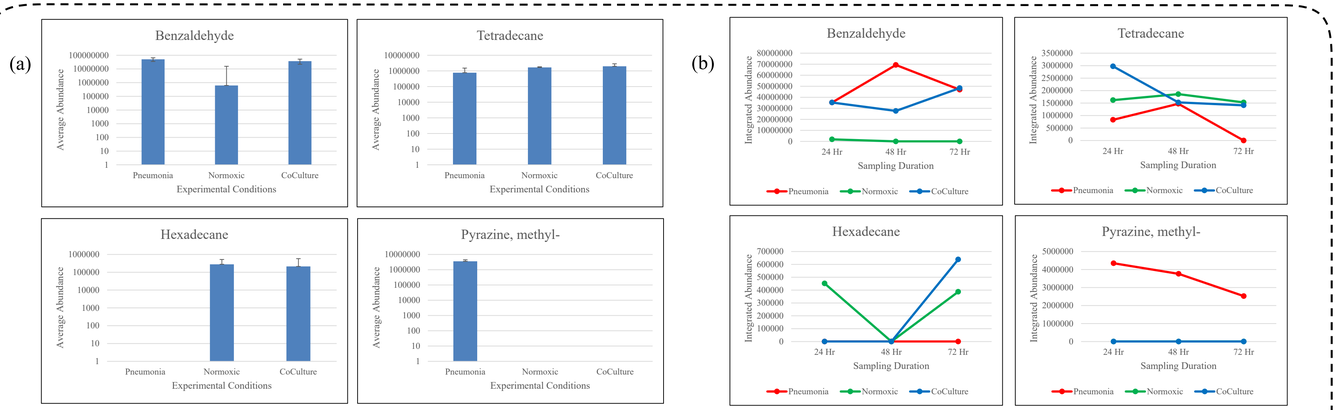

Figure 4. (a) Bar graphs of the average abundance in significant VOCs found in pneumonia only, H345 only, and co-culture conditions. (b) Line plots of the integrated abundances of significant VOCs found in each condition across 72 hours.

Conclusion

In this study, we successfully developed a physiologically relevant model to collect VOCs from pneumonia-causing bacteria in the presence of small cell lung cancer cells. Benzaldehyde was a VOC that was found in the pneumonia and co-culture samples, but not in the normoxic H345 sample. This may indicate a potential VOC associated with pneumonia that is worth investigating further.

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References

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2. van Oort, P. M. P., de Bruin, S., Weda, H., Knobel, H.H., Schultz, M. J., & Bos, L. D. (2017, February 19). Exhaled breath metabolomics for the diagnosis of pneumonia in intubated and mechanically-ventilated intensive care unit (ICU) Patients. International journal of molecular sciences. Retrieved October 9, 2021, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5343983/

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