Characterization of Occupational Exposure to Airborne Contaminants in an Indoor Cannabis Production Facility

Brynee Silvey, Christopher Simpson, Edmund Seto
University of Washington, School of Public Health, Department of Environmental and Occupational Health Sciences, Seattle, WA

Introduction & Objectives

The past several decades in U.S. history have resulted in several changes in the policies and restrictions in place regarding cannabis and cannabis-related products. Currently, 29 states have decriminalized the use of medical marijuana and 8 states plus the District of Columbia have legalized recreational marijuana use (Husain, 2018).

The recent increase in cannabis/marijuana use has helped the industry emerge as a billion-dollar a year industry with approximately 160,000 full time employees in the United States alone. The industry is expected to employ 340,000 employees by the year 2022 (Bas, 2018; McKinsey, 2016). Potential occupational exposures in this industry include ergonomic and musculoskeletal risks, and inhalation exposures to bacterial and fungal spores, particulate matter (PM), volatile organic compounds (VOCs), TRC, carbon monoxide and carbon dioxide (WA L&I, 2014; Simpson, 2017; Vicky et al, 2018). Few studies in current literature have conducted sampling of occupational exposures to PM and VOCs in cannabis production and processing facilities, and those available focus on one aspect of the production process or report qualitative exposure estimates.

Study Aims

1. Determine the differences in particle number concentrations (PNC), particle mass concentrations (PMC), and size distributions among four specific tasks in the facility (Trim, Pre-Roll, Grow, Office).
2. Quantify and compare VOC total terpene mass concentrations associated with the four specific tasks.
3. Compare correlations between PNC and total terpene mass concentrations for each of the four task zones.

Methods

Data collection and field work was completed at a single cannabis production facility located in Seattle, WA during 3 separate sampling campaigns between October 2018 and January 2019. Samples were collected for the duration of a full work shift (8:00 am – 4:00 pm) and were placed as close to the worker’s task zone as possible at breathing zone height.

Sample Analysis

• Converted Dylos data output from PNC (count/m3) to PMC (μg/m3).
• Analyzed 21 specific terpenes following the NFOS NNNAM 1552. Terpenes methodology using gas chromatograph mass spectrometry (GC/MS) to find total terpene mass concentration (μg/m3).
• Adjusted VOC output from PID sensor using laboratory produced calibration curve

Data Analysis

• Computed descriptive statistics for all particle and VOC data and visualized data via boxplots, time-series plots and particle size distributions.
• Determined task zone mean PNC, PMC or VOC total terpene mass concentrations were different from the referent task area using the Mann-Whitney U Test.
• Measured task zone correlation between PMC and VOC mass concentrations via the Spearman rank-order correlation.

Results

Table 1. Summary of p-value results from using the Mann-Whitney U test, to test for statistical significant differences between average PMC, PMC and total terpene mass concentrations between the task areas and the office referent group. *statistically significant p-value <0.05

<table>
<thead>
<tr>
<th>Location</th>
<th>Correlation Coefficient (rho)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trim</td>
<td></td>
<td>0.067</td>
</tr>
<tr>
<td>Pre-Roll</td>
<td></td>
<td>0.280</td>
</tr>
<tr>
<td>Grow</td>
<td></td>
<td>0.320</td>
</tr>
<tr>
<td>Office</td>
<td></td>
<td>0.150</td>
</tr>
</tbody>
</table>

Table 2. Summary of correlation coefficients resulting from the Spearman Rank Correlation test of correlation between PMC and total terpene mass concentrations among the four specific task zones.

Discussion

Key Findings

• Overall, particle number concentrations were high in the indoor cannabis production facility. As expected, PMCs were greatest in task areas where manure from the cannabis plant occurred frequently (i.e. Trim and Pre-Roll task zones) and were lower in task areas where plants were handled periodically or not at all (i.e. Grow and Office areas).
• Similar to PNC results, particle mass concentrations were highest in the Trim task area, followed by the Pre-Roll, Grow and Office areas. The Trim and Pre-Roll PMCs averaged were statistically significantly different from the office referent area values.
• There were weak correlations between PMC and total terpene mass concentrations among each of the four task zones.
• Large inter-sample and inter-location variation in PMC resulted in task areas that required workers to perform a variety of jobs in their task location.

Limitations

• Reliance on area air monitoring measures for particulate matter and VOCs. Future steps following this pilot project would be to collect personal samples on workers.
• Limited sample sizes due to time and budget constraints.
• Samples were only collected at one cannabis production facility. Future steps would be to visit multiple facilities that may be different production scales to see differences among particle exposures
• Converted Dylos PNCs to PMC's using an equation that required assumptions to be made about aerosol size and density.

Conclusions

This study characterized the potential occupational exposure to particulate matter and VOCs unique to the cannabis production industry. Workers who complete the Trim and Pre-Roll tasks of production appear to be exposed to higher levels of PMC, PMC and VOC concentrations due to constant manipulation and handling of cannabis plant products and joint power. In their measurement, using personal sampling and sampling at multiple facility sites, is needed to best characterize the levels of exposures encountered in this up and coming industry. Continued evaluation of occupational hazards in this industry is essential in order to develop recommendations to reduce worker injury and illness in the cannabis industry.

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References


Note: Figures and tables are not included in the natural text representation.