Research on Secondhand Marijuana Smoke

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https://doi.org/10.1016/j.aeaoa.2021.100106
1. Marijuana Joints and a Marlboro Cigarette

- Deli Marijuana Pre-rolled Joint
- Lola Marijuana Pre-rolled Joint
- Toastie Marijuana Pre-rolled Joint
- Marlboro Regular Cigarette
1a. Sidestream Smoke from Marijuana Joint
3. Glass Pipe with Marijuana Buds
4. Cannabis Vaping Pen
Research Approach

• Measure PM$_{2.5}$ Mass Concentrations
• Real-Time Particle Monitors
• Source-Specific Calibration Factors
• Measure Emission Rates in a Room
• Proximity Experiments in a House
• Whole-house Experiments
Source Strength Studies

• 60 Experiments in a 43 m³ Room
• Experienced Human Smoker
• Standardized Puffing Protocol
• Measure PM$_{2.5}$ Emission Rates
• 4 Marijuana Sources vs. Cigarette
"Doobie" Pre-rolled Marijuana Joint

Observed Concentration (Black Dots)

False Peak

True Peak $y_{peak} = 568 \, \mu g/m^3$

Exponential Decay Model (Red Line)

PM$_{2.5}$ SidePak SP-9, CF=0.38

COINCIDENT POINT

MODEL: $568\exp(-0.00722t)$

$y(t)$, PM$_{2.5}$ concentration ($\mu g/m^3$)

$t$, minutes

Smoking Starts
Comparison of PM$_{2.5}$ Emission Rates

BEDROOM

\[ n = 60 \]

<table>
<thead>
<tr>
<th>Source Type</th>
<th>PM$_{2.5}$ Emission Rate (mg/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint</td>
<td>7.8</td>
</tr>
<tr>
<td>Bong</td>
<td>5.2</td>
</tr>
<tr>
<td>Pipe</td>
<td>4.2</td>
</tr>
<tr>
<td>Vaping</td>
<td>3.4</td>
</tr>
<tr>
<td>Cigarette</td>
<td>2.2</td>
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</tbody>
</table>
Marijuana and Tobacco Smoke Contain the Same Toxic Chemicals

4350 chemicals in tobacco smoke; 2575 chemicals in marijuana smoke. 69 toxic chemicals in both tobacco and marijuana smoke pose serious health risks (Graves et al, 2020).

KNOWN HUMAN CARCINOGENS

- Benzene (marijuana joint 399 µg; tobacco cigarette 352 µg)
- Benzo(a)pyrene (joint 101 ng; cigarette 92 ng)
- Benzo(a)anthracene (joint 1.5 times greater than cigarette)
CONCLUSIONS

• Marijuana Smoking is a Major Source of PM$_{2.5}$
• Marijuana Emissions Exceed Tobacco Emissions
• Emission Rate of Joint 3.5 Times that of Cigarette
• Marijuana Smoke Contains the Same Toxic Chemicals and Carcinogens as Tobacco Smoke
• More Research Needed on Human Exposure and Health Effects of Secondhand Marijuana Smoke
RESEARCH TOPICS

• Source Strength Studies (4 papers)
• Proximity Studies (new paper)
• Whole-House Studies (underway)
  (4-bedroom, 2,200-square ft. house)