Single Particle ICP-MS for the Characterization of Metals in Electronic Cigarette Aerosols

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Objectives

1. Electronic Cigarettes
2. Single-Particle-ICP-MS (SP-ICP-MS)
3. My Research
Electronic Cigarette Use

More than **2.5 million** high and middle school students currently use e-cigarettes.

Among current youth e-cigarette users:

- More than **1 in 4** use e-cigarettes daily
- The most commonly used device type is **disposables**
- Almost **85%** use flavored e-cigarettes

**NYTS 2022**

Electronic Cigarettes

E-cig devices

Metal e-cig coils
Composition of E-cig Aerosols

Flavor chemicals

Pb

Fe

Pb^{2+}

Fe^{2+}

Unidentified compounds

Radical species

Particulate matter

Aldehydes
Carbonyls

Metals
Cellular Metal Uptake

Hypothesis:

Metal nanoparticles are present in E-Cig aerosols that are inhaled by users.
What is SP-ICP-MS?

- Particles are aerosolized using a nebulizer, passed through a spray chamber, then introduced into the ICP plasma
- Introduce one particle into the instrument at a time using low flow rate
- Short (1 ms) dwell times to capture individual particle events
SP-ICP-MS

Area under peak = mass (g) of metal per particle
Project Goals

Characterize metals found in e-cig aerosols to inform risk assessment.
Study Design

ELFBAR BC5000 GUMI
ELFBAR BC5000 BLUE RAZZ ICE
ORION NO. 130 COOL MINT
ORION NO. 130 BLUEBERRY RASPBERRY
VUSE ORIGINALS x2 Alto Golden Tobacco
VUSE ORIGINALS x2 Alto Menthol
Study Design

Condensate collection

Single particle analysis
Bulk Metal

- Elfbar Blue Razz Ice
- Elfbar Gumi
- Orion Blueberry Raspberry
- Orion Cool Mint
- Vuse Menthol
- Vuse Golden Tobacco

Metal concentrations (ng metal/puff):

- $^{27}$Al
- $^{52}$Cr
- $^{56}$Fe
- $^{59}$Co
- $^{60}$Ni
- $^{63}$Cu
- $^{208}$Pb
SP-ICP-MS Result

$^{60}\text{Ni}$

$^{208}\text{Pb}$

$^{63}\text{Cu}$
### SP-ICP-MS Result: $^{60}\text{Ni}$

<table>
<thead>
<tr>
<th>Device</th>
<th>N</th>
<th>Number of particles detected</th>
<th>Size Geometric Mean (nm)</th>
<th>Size Coefficient of Variation (%)</th>
<th>Mass Geometric Mean (fg)</th>
<th>Mass Coefficient of Variation (%)</th>
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<tbody>
<tr>
<td>Elf Bar Blue Razz Ice</td>
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<td>59</td>
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### SP-ICP-MS Result: $^{208}\text{Pb}$

<table>
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<th>Device</th>
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<th>Number of particles detected</th>
<th>Size Geometric Mean (nm)</th>
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## SP-ICP-MS Results: $^{63}$Cu

<table>
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<th>Device</th>
<th>N</th>
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<th>Size Geometric Mean (nm)</th>
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<th>Mass Geometric Mean (fg)</th>
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Summary

- Metals are present in e-cig aerosols
- Metal particles are present in e-cig aerosols
  - Some metals detected were not particles
- Metal particles are present in all vapes analyzed
  - Most were nanoparticles (<100nm)
- Metal particles are present in a size distribution
Acknowledgments

Advisors:
- Dr. Bressler
- Dr. Rule

Thesis advisory committee:
- Dr. Culotta
- Dr. Sidhaye
- Dr. Quarles

Collaborators at ESI
- Dr. Quarles
- Patrick Sullivan

Collaborators at University of Oviedo:
- Dr. Rosario Pereiro
- Dr. Beatriz Fernández
- Paula Moreno

Funding:
- NIEHS Award T32ES007141
- BREATHE Center Pilot Project Award grant number 139504
Thank You!

Questions

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