e-cigarette aerosol: Physical and Chemical Characterisation

CHEMICAL COMPOSITION

Lists of cigarette smoke priority toxicants have been developed to focus regulatory initiatives. We examined 150 chemical emissions from e-cigarettes (Vype ePen, Nicoventures, UK):
- Blended Tobacco flavour cartridge, 18 mg/mL nicotine concentration
- 650 mAh battery, 3.6 V, 2.85Ω
- 2 x 100 puff blocks: 55 mL puff/1s pre-puff, 3 s puff every 30 s; n = 5
- a reference tobacco cigarette (University of Kentucky 3RAF)
- Health Canada Intense 55/2/30 regime; vents blocked; n = 5
- laboratory air/method blanks

All measurements were conducted by a contract research laboratory using ISO 17025 accredited methods (Margham et al., 2016).

Of the 150 measurands examined in the e-cigarette aerosol:
- 104 were not detected; 21 were present due to laboratory background
- Of the 25 detected aerosol constituents,
  - 9 were present at levels too low to be quantified
  - 16 were generated in whole or in part by the e-cigarette (acetone and butyraldehyde were < air blank in main study but detected subsequently)

By contrast, approximately 100 measurands were detected in mainstream cigarette smoke.

The e-cigarette emissions comprised:
- major e-liquid constituents (nicotine, propylene glycol, and glycerol), recognized impurities in Pharmacopoeia-quality nicotine, and
- eight thermal decomposition products of propylene glycol or glycerol

PHYSICAL BEHAVIOUR

Dose based on physical aerosol properties, is discussed more deeply in an accompanying poster (P213, ISAM, 2017).

In short, e-cigarette condensation aerosols are liquid droplets:
- comprising glycerol, propylene glycol, nicotine, water and flavours
- typically 400–600 nm mass median diameter
- droplet concentrations up to 10^9 cm^-3

The principal factors controlling growth and deposition are:
- coagulation in the mouth
- hygroscopic growth in the lung (Pichelstorfer et al., 2016).

Predicted aerosol deposition fraction is high (> 0.9) consistent with experimental data (St Hel- en et al., 2015) and published cigarette smoke data (Baker & Dixon, 2006).

Conclusion: These data demonstrate that e-cigarettes with appropriate design and stewardship criteria can be developed that offer the potential for substantially reduced exposure and dose relative to cigarette smoke toxicants. Further studies are required to establish whether the potential lower consumer exposure to these toxicants will result in tangible public health benefits.