INDOOR AIR CHEMISTRY- An Exploratory Study On E-Cigarettes Shows No Negative Impact On Indoor Air Quality *

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Introduction

Studies in environmentally controlled rooms have been used over the years to assess the impact of Environmental Tobacco Smoke (ETS) on Indoor Air Quality (IAQ). As new tobacco products are developed, it is necessary to determine their impact on air quality when used indoors. Electronic vapor products do not produce sidestream aerosol and the only source of aerosol constituents in the indoor environment is exhaled aerosol. The goal of this study was the assessment of the impact on IAQ of a selection of e-cigarettes in an environmentally controlled room. The Indoor Air Chemistries (IAC) of e-cigarettes were compared to the IAC of background air. E-cigarettes analysed were: Solaris KS, Nicolites and Vivid.

Environmentally controlled room (IAQ room)

Dimensions: 24.1 m² / 72.3 m³
The room is equipped with standard office furniture adequate for the study, an airtight ceiling and air filtration. The **temperature** and **pressure** can be **controlled** and the **humidity** is continuously **monitored**.

The **ventilation rate** can be changed between 87 and 879 m³/h corresponding to 1.2 and 12.2 air changes per hour. The air can be collected by 26 pumps connected to a mass flow controller.

Before accessing the environmentally controlled room there is an air lock area that prevents cross-contamination from outdoor air.

01. Sample

Products: Rechargeable and refillable tobacco-flavored e-cigarettes (Solaris KS, Nicolites, Vivid) and **Background**

Panelists: Non-smokers for background, adult e-cig and dual users for vaping sessions

8 Markers: ETS markers (RSP, nicotine 3-ethenylpyridine), IAQ markers (carbonyls and TVOC), specific analytes (glycerin, propylene glycol)

* 3 repetitions of each session performed on 3 separate weeks

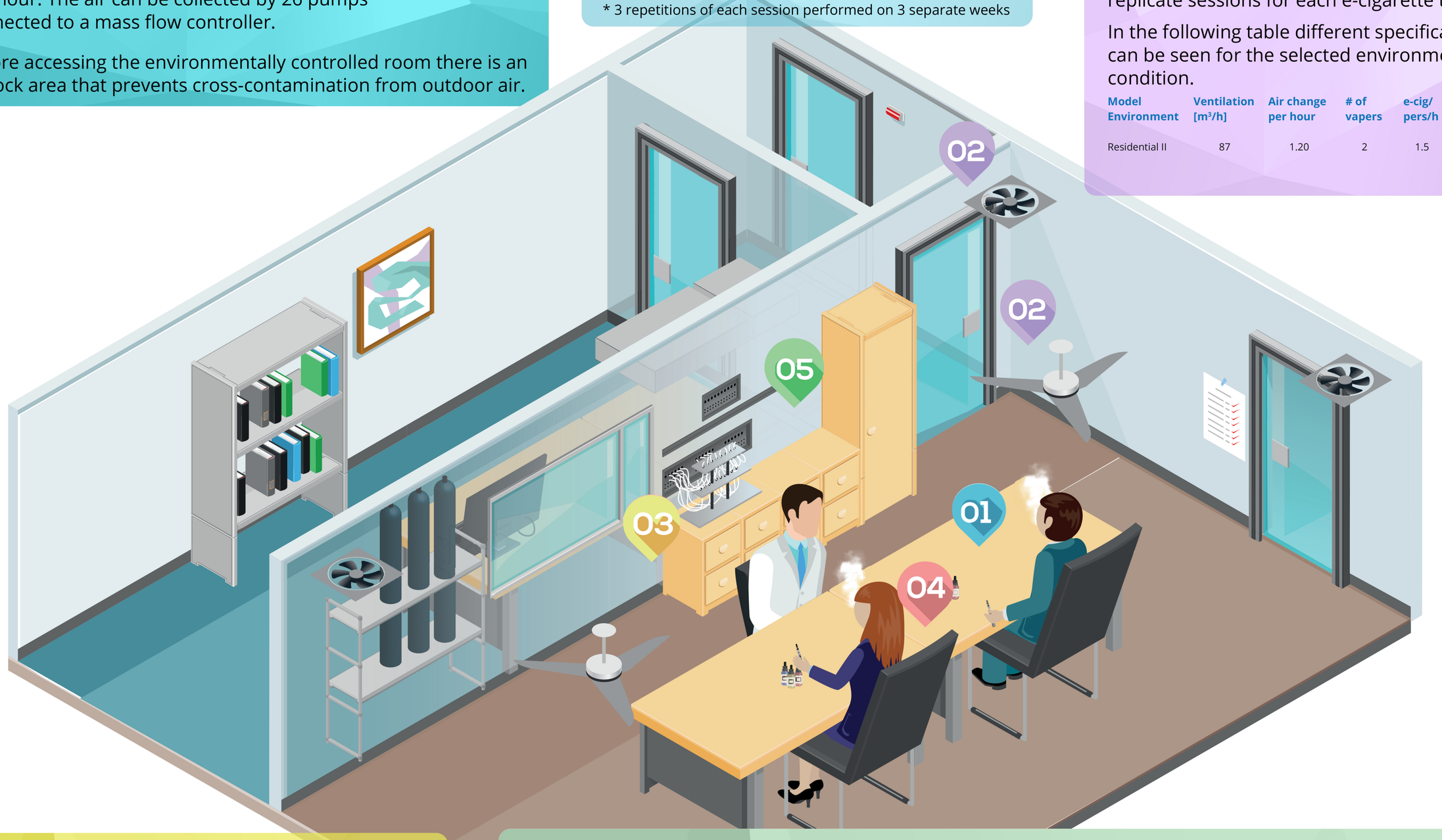
02. Simulated environmental conditions

We can simulate **different environmental conditions** with the ventilation system and by varying the number of occupants to match the airflows defined by the EN 15251:2007.

Vaping: every 40 min for 10 min (without restraint during vaping) per panelist (3 replicate sessions for each e-cigarette type)

In the following table different specifications can be seen for the selected environmental condition.

Model Environment	Ventilation [m³/h]	Air change per hour	# of vapers	e-cig/ pers/h	e-cig/h
Residential II	87	1.20	2	1.5	3



03. Collection and analysis of the indoor air

4 hours collection, 5 trapping systems

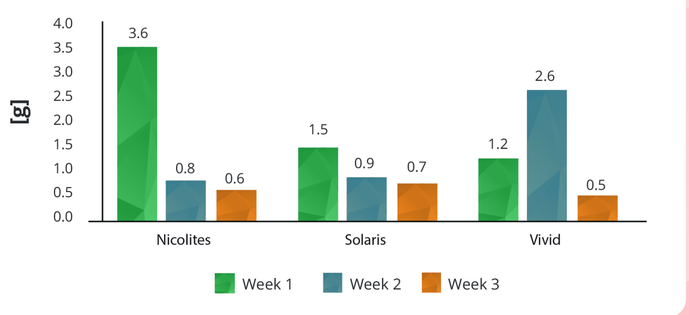
The air from the test room is drawn through different types of collectors, known as **"traps"**. Each type of trap captures **specific groups of chemical** compounds that need **to be measured**.

The trapped chemicals are then extracted in the laboratory and the levels measured using sensitive analytical techniques such as HPLC, or GC, coupled to mass spectrometers (MS).

04. Consumption of e-liquid

Large differences in the amount of e-liquids consumed during the sessions were measured and were explained by the different vaping behavior of panelists.

Normalized values showed a factor up to 6 for e-liquid consumption that influenced the indoor air concentrations for major e-liquid constituents.



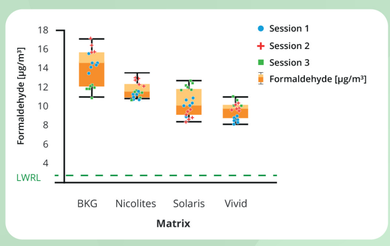
05. Results

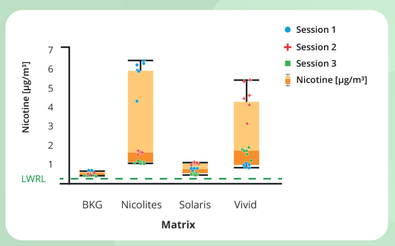
Statistical evaluation of results showed concentration in background and environmental aerosol of tested e-cigarettes could be considered as equivalent for 5 of 8 analytes (RSP-gravimetric, 3-ethenylpyridine, acetaldehyde, formaldehyde and TVOC expressed as toluene equivalent)

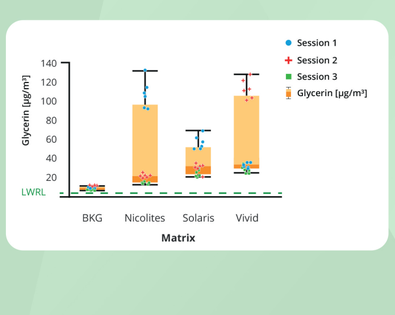
Compounds	Statistical Increase Above Background
Formaldehyde	✗
Nicotine	✓
Glycerin	✓

Median levels of nicotine are at least two orders of magnitude lower than EU indicative occupational exposure limit of 500 µg/ m³ (Commission Directive 2006/ 15/ EC)

Median levels of glycerin are at least two orders of magnitude lower than guideline levels of 10 000 µg/ m³ (ACGIH, 2001)







Analytes median levels obtained for e-cigarettes environmental aerosols after background subtraction.

"-" the value is equivalent to background value for e-cigarettes.

Analyte	Solaris KS adjusted * (-)**	Nicolites adjusted * (-)**	Vivid adjusted * (-)**
RSP gravimetric [µg/m³]	-	-	-
3-Ethenylpyridine [µg/m³]	-	-	-
Nicotine [µg/m³]	0.221 (0.0761-0.411)	0.791 (0.305-5.57)	1.28 (0.444-3.67)
Glycerin [µg/m³]	26.5 (21.2-52.1)	15.6 (9.78-90.3)	25.7 (22.0-99.8)
Propylene glycol [µg/m³]	20.7 (13.0-24.0)	204 (90.1-1381)	0.143 (34.7-503)
Acetaldehyde [µg/m³]	-	-	-
Formaldehyde [µg/m³]	-	-	-
TVOC (toluene equivalent) [µg/m³]	-	-	-

CONCLUSIONS

- 5 out of 8 analytes were equivalent to background. Nicotine, glycerin and propylene glycol levels were higher compared to background in the environmental aerosol of all studied brands.
- Under the simulated residential category II environmental condition, the measured median levels of nicotine, glycerin and propylene glycol in e-cigarettes environmental aerosols were considerably lower than the few guidelines values that exist for these compounds (nicotine: Commission Directive 2006/15/ EC, glycerin: ACGIH, 2001, propylene glycol: AIHA, 2011)
- No negative impact on the overall indoor air quality was observed when using e-cigarettes in an indoor environment (under the residential category environmental condition and on measured indoor air quality parameters).

Competing Financial Interests The research described in this poster was sponsored by Philip Morris International.

*For detailed information please refer to original poster "Indoor Air Chemistry, an exploratory study on e-cigarette shows no negative impact on indoor air quality"

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