

# Chemical Composition Of An E-cigarette Aerosol – A Quantitative Comparison With Cigarette Smoke

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## INTRODUCTION

Despite growing use of e-cigarettes, to date there have been few publications examining the broad chemical composition of e-cigarette aerosols, with most studies focusing on specific compound groups. Here we report the most complete chemical comparison to date (142 compounds) of emissions from an e-cigarette and a tobacco cigarette, including FDA HPHC compounds, and species previously found with e-cigarettes.

## TEST PIECES AND METHODOLOGY

Test-pieces were Vype e-Pen Blended Tobacco flavour, and the Kentucky Reference Cigarette 3R4F. Vype e-Pen was puffed in two separate 100-puff blocks using a 55/3/30 puffing regime (volume(cm<sup>3</sup>)/ duration(s)/ interval(s)), and 3R4F smoke was collected, in separate rooms, using the Health Canada 55/2/30 regime (ventilation blocked). With anticipated low levels of some e-cigarettes constituents, air/method blank analysis was made at the same time, location and method as the e-cigarette measurements. Independent contract labs used ISO17025 accredited methods to quantify the following emissions: carbon/nitrogen oxides, carbonyls/dicarbonyls, alcohols/di-alcohols, phenols, o-heterocycles, chlorinated dioxins/furans; volatile, substituted and, polynuclear aromatic hydrocarbons; amides, azines, aromatic and aliphatic amines, nicotine & related compounds, nitrosamines, metals and radionuclides (shown below).



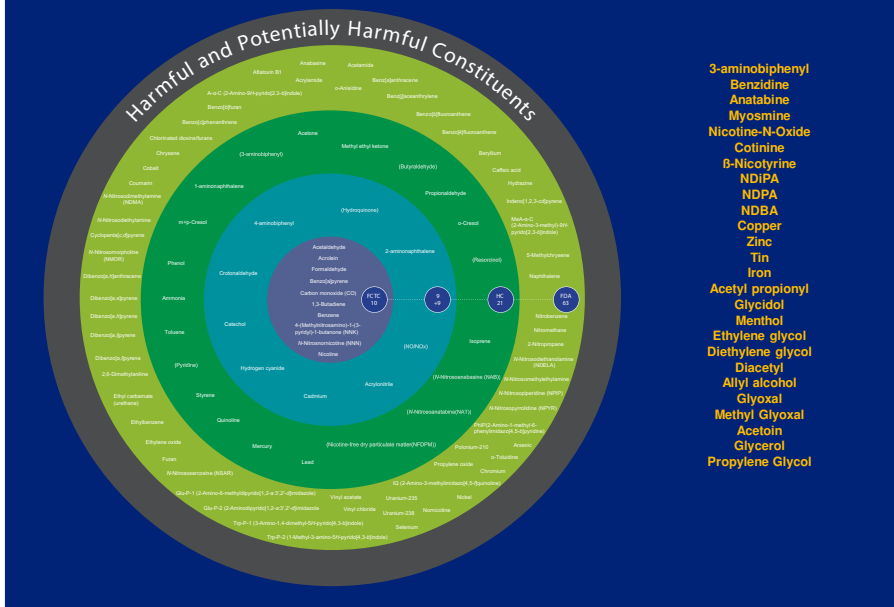
## DETECTABILITY OF COMPOUNDS IN E-CIGARETTE EMISSIONS

Parameter	Number from 142 compounds		
	ePen	Air Measurement	3R4F Cigarette
Number of compounds measured below detection limit	98	106	36
Number of compounds measured below quantification limit	17	19	9
Number of compounds measured in quantifiable levels	27	17	97

## COMPARABILITY OF MEASURED COMPOUND LEVELS IN E-CIGARETTE EMISSIONS AND AIR/METHOD BLANKS

Compounds arising from air/method blank contamination/artefacts			Compounds partially arising from air/method blank contamination/artefacts		
Compound	ePen Average Level (200 puffs)	Air/Method Average Level (200 puffs)	Compound	ePen Average Level (200 puffs)	Air/Method Average Level (200 puffs)
Acetone (µg)	14.5	21.08	Formaldehyde (µg)	24.4	13.38
MEK (µg)	13.8	31.45	o-toluidine (ng)	1.13	0.88
Zinc (ng)	2467.6	2619.1	NNN (ng)	10.77	3.11
CO (mg)	11.49	11.43	NDELA (ng)	22.45	19.69
Toluene (µg)	4.98	4.96	Chrysene (ng)	2.10	0.62
NDBA (ng)	20.74	23.66	Iron (ng)	850.6	607.58
NPYR (ng)	15.86	17.95	Copper (ng)	378.11	187.36
Naphthalene (ng)	10.88	10.59	Chromium (ng)	69.59	58.66
Styrene (µg)	0.77	1.30			

## Compounds Analysed in this Study



## EMISSION CHEMISTRY COMPARISONS BETWEEN VYPE E-PEN AND THE TOBACCO CIGARETTE

Comparison of toxicant emissions between Vype e-Pen and 3R4F were conducted on a per-puff basis. Air/method contamination levels were not removed for this comparison. Values were averaged across a toxicant group, and summarised in the figure. Substantial reductions were found in the e-Pen emissions for all four toxicant groups, in excess of 99% for WHO TobReg and FDA truncated lists, and over 92% for the full FDA HPHC list. Four aerosol constituents were measured at higher per-puff levels than from 3R4F – PG, VG, menthol and chromium.



## CONCLUSIONS

In conclusion, this study shows substantial chemical differences between emissions from e-cigarettes and tobacco cigarettes. Most cigarette toxicants examined could not be detected in the e-cigarette aerosol. Measuring air/method blanks is an essential step for identifying experimental artefacts amongst trace-level e-cigarette aerosol constituents.

