

Analytical and toxicological evaluation of flavor chemicals in electronic cigarette refill fluids

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Inventory Number	Refill Fluid	Company
1	Domestic	RO
2	Island	RO
3	Marcado	RO
4	Swiss Dark	RO
5	Tennessee Cured	RO
6	Valencia	RO
7	Wisconsin Frost	RO
8	Arctic Menthol	JC
9	Black Cherry	JC
10	Chocolate Truffle	JC
11	Espresso	JC
12	French Vanilla	JC
13	JC Original	JC
14	Mint Chocolate	JC
15	Simply Strawberry	JC
16	Summer Peach	JC
17	Tennessee Cured	JC
18	Bubblegum	FS
19	Butterfinger	FS
21	Caramel	FS
22	Cinnamon Ceylon	FS
23	Menthol Arctic	FS
25	Vanilla Tahity	FS
26	Caramel	FS
27	Caramel	FS
28	Caramel	FS
29	Butterscotch	FS
30	Butterscotch	FS
31	Tennessee Cured	JC
34	JC Original	JC
40	Caramel	GS
41	Butterscotch	FS
71	Domestic (dup of #1)	RO
73	Marcado (dup of #3)	RO
74	Swiss Dark (dup of #4)	RO
81	Espresso (dup of #11)	JC
51	Tennessee Cured (dup of #31)	JC
42	Cinnamon	FS
53	Sinful Cinnamon	TP
54	Cinnamon FlavourArt	FS
58	Cinna-Bomb x2	vaporbomb.com
60	Cinnamon	e-cigexpress
61	Cinnabun	e-cigexpress
65	Cinnamon E-Liquid	DIY Flavor Shack
69	Sinful Cinnamon (dup of #53)	TP

Supplementary Table 1. Inventory number and commercial refill fluid information. RO = Red Oak. JC = Johnson Creek. FS = Freedom Smoke USA. GS = Global Smoke. TP = Tasty Puff. Dup = Duplicate bottle.

Inv. #	Refill fluid	hPF refill fluid IC ₅₀ (%) Bahl et al.	Total flavor chemical conc. (mg/ml)	Dominant flavor chemicals? (> 1 mg/ml)
34	JC Original	> 1	1.2	-
27	Caramel	> 1	0.2	-
17	TN cured	> 1	1.1	-
16	Summer Peach	> 1	1.3	-
15	Simply Strawberry	> 1	1.0	-
14	Mint Chocolate	> 1	1.2	-
13	JC Original	> 1	1.1	-
10	Chocolate Truffle	> 1	1.2	1.03 EM
8	Arctic Menthol	> 1	2.7	1.4 Menthone
6	Valencia	> 1	2.0	1.4 EM
9	Black Cherry	> 1	19.2	1.6 Benzaldehyde, 14 BPGA*
18	Bubblegum	> 1	0.5	-
11	Espresso	> 1	2.1	1.1 EM
31	TN cured	> 1	1.2	-
2	Island	> 1	10.6	1.1 Van, 2.3 EM, 4.9 Maltol
5	TN cured	> 1	4.2	3.4 EM
1	Domestic	> 1	1.8	1.3 EM
7	Wisconsin Frost	> 1	4.1	1.8 EM, 1.1 Menthol
19	Butterfinger	> 1	0.7	-
28	Caramel	> 1	0.1	-
30	Butterscotch	> 1	0.5	-
29	Butterscotch	> 1	0.2	-
26	Caramel	> 1	0.5	-
12	French Vanilla	0.97	1.4	-
3	Marcado	0.82	18.0	2.8 CAD, 12 Eug, 1.3 Maltol, 1.7 EM
23	Menthol Arctic	0.45	82.8	84 Menthol
40	Caramel	0.41	0.3	-
4	Swiss Dark	0.30	3.9	2.1 EM, 1.7 Van
41	Butterscotch	0.26	12.3	3.8 Maltol, 1.3 Tri, 6.6 Van
21	Caramel	0.22	11.2	1.1 EM, 9.9 Van
25	Vanilla Tahity	0.19	42.8	9.0 Anis, 2.8 Tri, 31 Van
22	Cinnamon Ceylon	0.07	26.8	26 CAD

Supplementary Table 2. Relationship between refill fluid IC₅₀ data from Bahl et al. 2012, total flavor chemical concentration identified in this study, and the presence of one or more dominant flavor chemicals. Inv. # = inventory number. Total chemical flavor conc. = the average total concentration of replicate samples. TN = Tennessee. EM = ethyl maltol. Van = vanillin. CAD = cinnamaldehyde. Eug = eugenol. Tri = Triacetin. Anis = p-anisaldehyde. BPGA* = Benzaldehyde propylene glycol acetal. * not tested for cytotoxicity.

Chemical Name	Which cell type is more sensitive at 3V?	Which cell type is more sensitive at 5V?	Evidence of RXP at 5V? If yes, which cell type?
Menthol	hPF	hPF	Yes, Both
Cinnamaldehyde	hPF	hPF	No
Ethyl Maltol	hPF	hPF	No
Eugenol	hPF	Similar	Yes, Both
Maltol	hPF	Similar	No
Vanillin	hPF	A549	Yes, A549
Ethyl Cinnamate	hPF	A549	Yes, A549
Propylene Glycol	Similar	hPF	Yes, hPF
Benzyl Alcohol	Similar	Similar	No
Benzaldehyde	Similar	Similar	Yes, Both
<i>p</i> -Anisaldehyde	Similar	A549	Yes, A549
Triacetin	Similar	A549	Yes, A549
Menthone	Similar	A549	No

Supplementary Table 3. Cell type sensitivities and evidence of reaction products from heating dominant flavor chemicals and propylene glycol. For cell type sensitivity, a response of 'Similar' indicates both hPF and A549 having a similar dose-response curves for a chemical. For reaction products (= RXP) evidence, a response of 'Both' indicates that hPF and A549 each had a dose-response curve shift to the left at 5V as compared to 3V for a chemical. Rows are ordered by cell type sensitivities with hPF being most sensitive, then "Similar" which includes both cell types, and lastly A549.

