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'Menthol-Plus': a Major Category of Cigarette Found Among 'Concept' Descriptor Cigarettes from Mexico

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'Menthol-Plus': a major category of cigarette found among 'concept' descriptor cigarettes from Mexico

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ABSTRACT

Background Tobacco companies are offering cigarettes with 'concept' descriptor names that suggest sensation and/or flavour properties (eg, Marlboro 'Velvet Fusion'). Little has been known about the identities and levels of flavour chemicals in such cigarettes.

Methods Thirty-three filter cigarette variants from 27 packs (including two sampler packs with four variations each) from Canada and Mexico were analysed (rod + filter) for 177 flavour chemicals plus triacetin, a filter plasticiser and possible flavourant. Five brands of US mentholated filter cigarettes were also analysed.

Results Twenty-seven of the 33 cigarettes (all were Mexican variants) were categorised as 'menthol-plus': significant menthol (3.0–11.9 mg/cigarette), plus varying amounts (0.32–3.4 mg/cigarette) of total other flavour chemicals (TOFCs) (excludes triacetin). For 10 of the 27, TOFCs >1.0 mg/cigarette. For 7 of the 27, the TOFCs profile was categorised as containing total fruit flavour compounds (TFFCs) >1.0 mg/cigarette. One Mexican variant was categorised as 'menthol-only' (TOFCs ≤0.15 mg/cigarette). All menthol-plus and menthol-only cigarettes contained one or two optional-crush capsules in their filters (crushed prior to analysis). All five Canadian brand variants were 'non-flavoured'. All five US brand variants were 'menthol-only'.

Conclusions All but one of the 'concept' descriptor cigarettes from Mexico were 'menthol-plus'. While the Canadian cigarettes complied with Canada's flavour chemical ban, concept descriptors on the packs may increase appeal. Given the scale of the problem posed by menthol alone, health officials seeking to decrease the appeal of smoked tobacco should examine the extent to which 'concept descriptor' cigarettes using 'menthol-plus' flavour profiling together with artful descriptors are furthering the problem of smoked tobacco.

INTRODUCTION

WHO Framework Convention on Tobacco Control (FCTC) lays out evidence-based interventions that tackle the causes of the globalised tobacco epidemic. As of October 2020, 182 countries—from all regions of the world—have signed and ratified the convention, committing to implement measures that reduce the supply and demand for tobacco. One aim of the FCTC is to reduce the appeal of tobacco products,[1] and Article 9 requires Parties to regulate the content and emissions of tobacco products. Article 9 states 'From the perspective of public health, there is no justification for permitting the use of ingredients, such as flavouring agents, which help make tobacco products attractive'[2] and disguise the harshness of tobacco.

A number of national and subnational (eg, state, province, municipality) jurisdictions have taken steps to constrain sales of flavoured tobacco products. As of April 2020, 11 countries and the European Union (EU) have implemented a national-level tobacco product flavour policy[3]; some countries (eg, the EU Member States) regulate characterising flavours as a sensory property of the product while others (eg, Canada) regulate flavour components added to the tobacco product. Canada prohibits 'additives that have flavouring properties or that enhance flavour,' including menthol.[4 5] Mexico does not currently have a ban on tobacco flavour chemicals. The US prohibits any 'constituent (including a smoke constituent) or additive, an artificial or natural flavour (other than tobacco or menthol) … that is a characterising flavour of the tobacco product or tobacco smoke.'[6]

As an apparent response to the increasing enactment of tobacco product flavour restriction policies, new 'concept' descriptor names are being seen on packs around the world that, while not overtly identifying a particular flavour, do imply that some type of flavour, sensation, taste or aroma awaits the consumer.[3] Example concept descriptor names are 'Ibiza Sunset', 'Velvet Fusion Blast' and 'Maui Crepuscule'. There is a need to understand the identities and levels of flavour chemicals that may be present in these products.

Detailed chemical analyses of flavoured tobacco products available for sale in the USA have been carried out by Brown *et al*[7] and Farley *et al*[8]; no study has yet been undertaken for the 'concept' descriptor cigarettes available in other nations. Here, we determine and compare the levels and identities of 177 flavour chemicals (plus triacetin) in 27 unique packs of 'concept' descriptor cigarettes purchased in Canada and Mexico with a range of suggestive names, but no explicit flavour indications on the packs.

METHODS

Canadian and Mexican samples

A convenience sample of 27 unique packs of cigarettes with concept descriptor names was purchased from stores selling cigarettes (summer 2017) in Toronto, Canada (n=5) and Mexico City, Mexico (n=22). Table 1 gives the country of origin (and, if present, the number of crushable flavour capsules in the filter). Packs were put into 'barrier foil' Ziplock pouches (Ted Pella, Redding, California, USA) and shipped by courier to Portland State University for analysis. The samples were stored at 4°C until analysed. Most of the cigarettes were extracted and

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Table 1 Brand variants (with number of crushable flavour capsules) and chemical levels (mg/cigarette) found in cigarettes from 27 packs purchased in Canada and Mexico*, and from five 'menthol' brands purchased in the USA within each of four pairs (◯, □, ◇, △,) the flavour profiles are essentially identical

Pack #	Sampler member (if applicable)	Brand name and variant (# of crushable flavour capsules)	Country	Name Abbreviation	Total other flavour compounds (TOFCs)† (mg/cig)	Menthol (#90) (mg/cig)	Flavour category‡	Total fruit flavour compounds (TFFCs)§ (mg/cig)	Total non-menthol non-fruit, flavour compounds (TNMNFFCs)¶ (mg/cig)	Triacetin (#124) (mg/cig)
1	–	Marlboro 'Fusion Shine' (1)	Mexico	M-FS	3.43	8.42	M+4	3.27	0.16	6.50
2	–	◯ Lucky Strike 'Convertibles' blue" (1)	Mexico	LS-CB	2.36	9.18	M+3	0.33	2.03	17.3
3	blue	◯ Lucky Strike 'Flow Filter' March/blue (1)	Mexico	LS-M/b	2.26	9.25	M+3	0.29	1.97	16.7
4	–	□Marlboro 'Velvet Fusion Blast' (2)	Mexico	M-VFB	1.87	11.0	M+2	1.48	0.39	11.2
5	–	□Marlboro 'Double Fusion Velvet' (2)	Mexico	M-DFV	1.63	11.3	M+2	1.29	0.34	10.1
6	light green	Lucky Strike 'Flow Filter' October/lt. green (1)	Mexico	LS-O/lg	1.41	4.62	M+2	0.74	0.67	16.5
7	–	Benson & Hedges 'Polar Pearls' (2)	Mexico	BH-PP	1.36	11.9	M+2	1.15	0.21	11.3
8	–	◇Marlboro 'Amber' (2)	Mexico	M-A	1.27	7.88	M+2	1.08	0.19	10.8
9	–	◇Marlboro 'Double Fusion Amber' (2)	Mexico	M-DFA	1.27	7.88	M+2	1.10	0.17	7.90
10	–	Pall Mall/XL 'Mystery' (2)	Mexico	PM-Mys	1.18	6.12	M+2	1.15	0.03	11.5
11	–	Marlboro 'Capsula Fresca' (1)	Mexico	M-CF	0.81	4.65	M+1	0.03	0.78	9.12
3	orange	Lucky Strike 'Flow Filter' March/orange (1)	Mexico	LS-M/o	0.71	7.80	M+1	0.51	0.20	18.4
12	–	Lucky Strike 'Convertibles' purple (1)	Mexico	LS-CP	0.70	4.64	M+1	0.67	0.03	17.3
13	–	Pall Mall/XL 'Tokyo Midnight' (2)	Mexico	PM-TM	0.68	8.66	M+1	0.39	0.29	12.5
6	purple	Lucky Strike 'Flow Filter' October/purple (1)	Mexico	LS-O/p	0.63	6.56	M+1	0.60	0.03	16.9
14	–	Marlboro 'uby Fusion Blast' (2)	Mexico	M-RFB	0.58	10.3	M+1	0.38	0.20	13.1
3	red	△Lucky Strike 'Flow Filter' March/red (1)	Mexico	LS-M/r	0.56	2.97	M+1	0.54	0.02	17.4
6	red	△Lucky Strike 'Flow Filter' October/red (1)	Mexico	LS-O/r	0.56	3.82	M+1	0.54	0.02	16.8
15	–	Pall Mall/XL 'Black Edition/Maui Crepuscule' (1)	Mexico	PM-Maui	0.56	5.40	M+1	0.53	0.03	11.8
16	–	Marlboro 'Double Fusion Ruby' (2)	Mexico	M-DFR	0.55	10.6	M+1	0.36	0.19	9.79
6	green	Lucky Strike 'Flow Filter' October/green (1)	Mexico	LS-O/g	0.53	8.27	M+1	0.24	0.29	19.4
17	–	Chesterfield 'Caps Purple' (1)	Mexico	C-CP	0.47	5.94	M+1	0.37	0.10	9.78
18	–	Benson & Hedges 'Crystal Violet' (1)	Mexico	BH-CV	0.42	5.05	M+1	0.35	0.07	4.39
19	–	Pall Mall/XL 'Black Edition/Ibiza Sunset' (1)	Mexico	PM-IS	0.41	3.18	M+1	0.40	0.01	10.6
20	–	Pall Mall 'Wave' (1)	Mexico	PM-W	0.39	3.37	M+1	0.38	0.01	7.90
3	green	Lucky Strike 'Flow Filter' March/green (1)	Mexico	LS-M/g	0.32	6.17	M+1	0.18	0.14	19.3
21	–	Pall Mall/XL 'Mykonos Nightfall' (1)	Mexico	PM-Myk	0.15 (0.65)**	5.89	M+1	0.03 (0.53)**	0.12	13.9
22	–	Benson & Hedges 'Crystal Blue' (1)	Mexico	BH-CB	0.12	6.77	M	0.01	0.11	8.97
23	–	Next 'Green' (0)	Canada	N-G	0.01	<0.01	NF	<0.01	~0	3.07
24	–	John Player 'Choice' (0)	Canada	JP-C	0.01	<0.01	NF	0.01	~0	9.63
25	–	Benson and Hedges 'Unison' (0)	Canada	BH-U	0.01	ND††	NF	0.01	~0	6.66
26	–	Camel 'North, Aqua Filter' (0)	Canada	C-NA	<0.01	ND	NF	<0.01	~0	8.58
27	–	Du Maurier 'Nano Blue' (0)	Canada	DM-NB	<0.01	<0.01	NF	<0.01	~0	14.5
		All Lucky Strike from Mexico—average ±SD:			1.00±0.74	6.33±2.26				17.61±1.06
		All Pall Mall from Mexico—average ±SD:			0.64±0.29	5.44±2.02				11.35±2.03
		All Marlboro from Mexico—average ±SD:			1.43±0.94	9.02±2.26				9.81±2.03

Continued

Table 1 Continued

Pack #	Sampler member (if applicable)	Brand name and variant (# of crushable flavour capsules)	Country	Name Abbreviation	Total other flavour compounds (TOFCs)† (mg/cig)	Menthol (#90) (mg/cig)	Flavour category‡	Total fruit flavour compounds (TFFCs)§ (mg/cig)	Total non-menthol non-fruit, flavour compounds (TNMNFFCs)¶ (mg/cig)	Triacetin (#124) (mg/cig)
		All Benson & Hedges from Mexico—average ±SD:			0.63±0.65	7.91±3.56				8.22±3.52
		US Brands (no of crushable flavour capsules)								
28	–	Camel 'Crush' (menthol) (1)		CC-M/U.S.	0.03	3.05	M	0.01	~0	9.50
29	–	Nat Sherman 'Menthol' (0)		NS-M/U.S.	0.01	2.92	M	0.01	~0	11.6
30	–	Natural American Spirit 'Menthol' (0)		NAS-M	0.03	2.63	M	0.01	~0	5.80
31	–	Marlboro 'menthol' (0)		M-M/U.S.	0.13	2.10	M	0.12	0.01	8.11
32	–	Newport (menthol) (0)		Np-M/U.S.	0.01	1.58	M	0.01	~0	5.90

*The Lucky Strike 'Flow Filter' March pack (Mexico) contained four flavour variants in the pack as colour coded on the filter: blue (b), orange (o), green (g) and red (r). The Lucky Strike 'Flow Filter' October pack (Mexico) also contained four flavour variants in the pack as colour coded on the filter: light green (lg), green (g), purple (p), red (r).

†TOFCs=total other flavour chemicals (excludes menthol, excludes triacetin).

‡M=menthol only; M-4+=menthol plus 4 mg/cig>TOFCS > 3 mg/cig; M-3+=menthol plus 3 mg/cig>TOFCS > 2 mg/cig; M-2+=menthol plus 2 mg/cig>TOFCS > 1 mg/cig; M-1+=menthol 1 mg/cig>TOFCS > 0.3 mg/cig; NF=not flavoured.

§TFFCs=total fruit flavour compounds (compounds considered to be in the 'fruit' and 'mint' groups are identified in online supplemental table 1.

¶TNMNFFCs=total non-menthol non-fruit flavour compounds.

**The non-target flavour compound 6Z-nonenal (CAS 2277-19-2) was tentatively identified as also being present (at ~0.5 mg/cigarette).

††ND=not detected.

analysed within 1 week of receipt. For the Lucky Strike 'Flow Filter' March sampler pack, a single analysis was carried out within 1 week of receipt for the blue version and for the orange version; duplicate analyses were carried out within 8 weeks for the red and green versions. For the Lucky Strike 'Flow Filter' October pack, duplicate analyses were carried out within 1 week of receipt for the green version; duplicate analyses were carried out within 8 weeks for the light green, purple and red versions. Example photographs of four of the 27 packs are given in figure 1. Photographs of all the packs, filter ends and opened filters (showing crushable capsules, if present) are provided in online supplemental figure S1A−S27A.

US sample

Five packs of US menthol cigarettes were purchased in a tobacconist shop in Portland, Oregon (table 1) in July 2019. Only the Camel 'Crush' variety used a crushable flavour capsule. Packs were stored at 4°C and analysed the next day.

Analytical methods used to determine flavour chemicals

The analytical methods used here are based on our prior work.[7 8] For each analysis of each cigarette variant, two actual cigarettes of that variant were separated into filter and tobacco rod sections. (Analysis in duplicate required four actual cigarettes.) The two rods were combined in a tared 40 mL glass vial. The vial was weighed then spiked with 200 µL of a surrogate standard (SS) solution of 1,3,5-trichlorobenzene (4000 ng/µL) in isopropyl alcohol (IPA). 20.0 mL of high purity IPA was then added for extraction. The filters were handled in the same manner except that each filter was cut open; if present, the flavour capsule(s) inside the filter were crushed after the IPA was added . After extraction for 1 hour (with shaking), the vials were refrigerated at 4°C. The next day, after warming on the lab bench to room temperature, each vial was shaken on a mixer for 1 hour, then left undisturbed for 2 hours to allow settling of the solids. A 1.0 mL of the supernatant extract was placed in a 2 mL autosampler vial, and spiked with 20 µL of an internal standard (IS) solution of 1,2,3-trichlorobenzene (2000 ng/µL) in IPA. For each filter extract, a 5×diluted (IPA) sample was also prepared for improved determination of the high concentration compounds (menthol and triacetin). Triacetin is a compound that has long been discussed foremost as being a plasticiser for the fibres used in cigarette filters, including in the filters of 'regular', non-flavoured cigarettes.[9] However, as an ester, and considering the levels at which it is commonly used, the possibility of some role in imparting flavour effects should be kept in mind. Indeed, triacetin has been characterised as having a 'mild clean tropical fruity' odour and a 'creamy with an oily mouthfeel' flavour (http://www.thegoodscentscompany.com/search2.html).

Each extract was analysed by gas chromatography/mass spectrometry (GC/MS) using an Agilent (Santa Clara, California, USA) 7693 autosampler, Agilent 7890A GC, and Agilent 5975 C MS. The GC column type was Restek (Bellefonte, PA) Rxi-624Sil MS: 30 m long, 0.25 mm i.d., and 1.4 µm film thickness. For each sample, 1.0 µL was injected at 235°C with a 10:1 'split'. The GC temperature programme for all analyses was: 40°C hold for 2 min; 10 °C/min to 100°C; then 12 °C/min to 280°C and hold at 280°C for 8 min, then 10 °C/min to 230°C. The MS source temperature was 225°C. The MS was operated in the electron impact ionisation mode with an ionisation potential of 70 eV, with scanning from 34 to 400 atomic mass units (amu). Only values > 1 µg/cig (0.001 mg/cig) are reported here. Most of the reported data values are averages for duplicate extractions.

Figure 1 Four example packs from the 27 examined in this study. (A) Lucky Strike 'Convertibles blue'; (B) Marlboro 'velvet fusion blast'; (C) Benson & Hedges 'polar pearls' and (D) Pall Mall 'XL mystery'. Photos Copyright Portland state University, 2020.

Each of these is a confirmed GC/MS result based on authentic standards (ie, matches between the sample and standard runs for the GC retention time and MS fragmentation pattern), with final IS-corrected quantitation value based on calibration standards. Values for nicotine are not given because the extraction method was not optimised for alkaloids.

For all of the samples, the calculated SS extraction recoveries ranged from 85.7% to 108.1%; the average recovery ±1 SD was 96.4%±5.0%. (When average SS recovery values are ~100%, some calculated recoveries at >100% are normal, due to statistical fluctuations in the analytical steps). Coefficient of variation (CV) values were calculated for each analyte as found in each cigarette type. As averaged over all samples, for analyte determinations of ≥1000 µg/g, the overall mean CV ±1 sd was 5.4%±3.3%. For analyte results at <1000 µg/g but ≥100 µg/g, 5.2%±3.0%; for results at <100 µg/g, 9.9%±7.1%.

The cigarette variants were allocated among six categories: (1) M=menthol only; (2) M+4=menthol plus 4 mg/cig>total other flavour chemicals (TOFCs) > 3 mg/cig; (3) M+3=menthol plus 3 mg/cig>TOFCs >2 mg/cig; (4) M+2=menthol plus 2 mg/cig>TOFCs > 1 mg/cig; (5) M+1=menthol 1 mg/cig>TOFCs > 0.3 mg/cig; and (6) NF=not flavoured. Examples in the total fruit flavour compounds (TFFCs) list are: #24-hexanol, #38-benzaldehyde, #46-limonene, #57-benzyl alcohol, #68-linalool, citral, #168-raspberry ketone and #174-δ-dodecalactone.

RESULTS

Table 1 provides a results summary for the 33 cigarette brand variants from Mexico and Canada, and for the five US brands. Of the 177 target compounds, 101 were detected at ≥0.001 mg/cigarette in one or more brand variant. As noted, analyses were performed separately for the filters and for the rods. The percentage of each compound found in the filter of each brand variant is provided in online supplementary material. For much of the presentation here, the filter and rod values were combined to obtain per cigarette values. For all brands, over 85% (85.9%–99.8%) of the total analyte list compounds (including menthol and triacetin) were found in the filters. Table 1 gives those per cigarette values for the total of the 176 other (non-menthol) flavour chemicals (TOFCs), menthol, the total for the 69 compounds included in the fruit-flavour compounds (TFFCs) group as enumerated in online supplementary table S1, the total non-menthol non-fruit-flavoured compounds (TNMNFFCs=TOFCs – TFFCs) and triacetin. Identifying compounds as being associated with fruity flavours was based on information found in the Good Scents Company Information System (http://www.thegoodscentscompany.com/search2.html). Within each of four pairs (marked with ◯, □, ◇, △), the flavour profiles are essentially identical.

In the menthol-plus group, 14 cigarette variants had TFFCs values of ≥0.5 mg/cigarette, and 7 brand variants had TFFCs values of ≥1.0 mg/cigarette. Non-menthol flavour compounds other than those typically associated with 'fruit' (the TNMNFFCs, for example, the mint-related compound #85-*p*-menthone) were also found at significant levels in some brand variants: in four, TNMNFFCs=TOFCs - TFFCs≥0.5 mg/cigarette, and in two, TNMNFFCs≥1.0 mg/cigarette. All cigarettes contained significant levels of triacetin.[9] The detailed analytical results are provided in a spreadsheet as online supplementary table S1.

The Marlboro, Lucky Strike and Pall Mall groups spanned generally similar ranges of menthol; the Lucky Strike group was found to contain a distinctly higher average level of triacetin than the Pall Mall and Marlboro groups (online supplementary figure S28). The Marlboro group gave the highest average TOFCs value (1.43 mg/cigarette).

Some example composition figures are provided in figures 2–5. The composition figures for all 33 cigarette variants from Canada and Mexico are provided in online supplementary figures S1B to S27.b. For TOFCs, the values trended higher with increasing menthol, but the correlation was not high (online supplementary figure S29).

DISCUSSION

This is the first study to our knowledge that has assessed the levels of flavour chemicals in concept descriptor cigarettes. From among our sample of 27 packs (22 from Mexico, 5 from Canada), we found that 21 packs contained cigarettes classified as some version of menthol plus (ie, M+4, M+3, M+2, or M+1)—all from Mexico, in stark contrast to the five brands of US menthol cigarettes which were found to be menthol only. All 22 menthol-plus or menthol only cigarettes from Mexico used flavour capsules in the filters, which is consistent with other findings indicating that capsules have become a preferred means to carry flavour chemicals, possibly because they may offer some sense of control or choice to the user.[10–12]

Our findings strongly suggest that vagueness and ambiguity in concept descriptors is in common use by multinational tobacco companies in Mexico as a means to market flavoured cigarettes without explicit flavour identification. This is consistent with the use of concept descriptors as seen on other tobacco products in

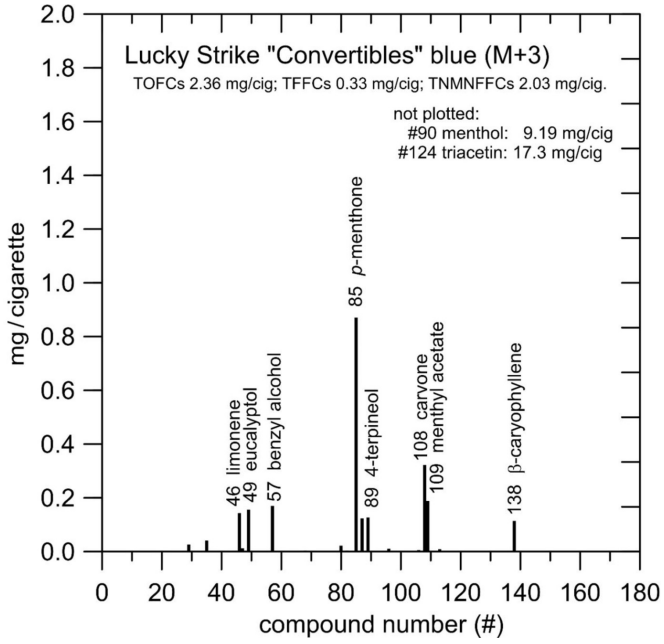

Figure 2 Flavour chemical profile for Lucky Strike 'convertibles' blue. Flavour category = M+3: menthol + 3 mg/cig ≥ TOFCs > 2 mg/cig. TFFCs, total fruit flavour compounds; TNMNFFCs, total non-menthol non-fruit flavour compounds; TOFCs, total other flavour chemicals.

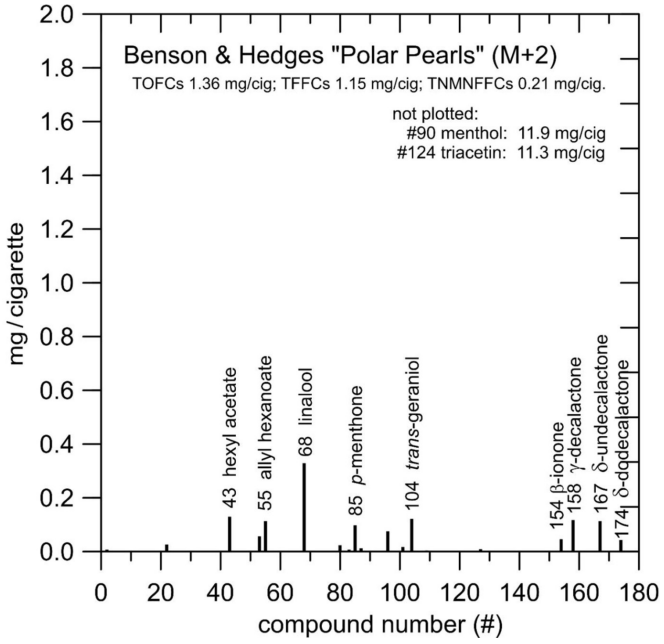

Figure 4 Flavour chemical profile for Benson and Hedges 'polar pearls'. Flavour category = M+2: menthol + 2 mg/cig ≥ TOFCs > 1 mg/cig. TFFCs, total fruit flavour compounds; TNMNFFCs, total non-menthol non-fruit flavour compounds;TOFCs, total other flavour chemicals).

the USA.[13 14] Indeed, Farley *et al* analysed the flavour chemicals in non-cigarette products sold in New York City in 2015 having packaging without explicit flavour descriptors, and found most of the products to include flavour compounds.[8]

Bans on flavoured tobacco products have been shown to reduce adolescent tobacco use,[15 16] and almost a half of US adults reported supporting a flavour ban for all tobacco products.[17] But the tobacco industry exploits loopholes in tobacco control policies. If bans are not comprehensive across all flavours, including concept flavours, and across all tobacco products, and if there is not strong implementation of the ban, tobacco companies will manage to market some form of flavoured tobacco product.[18–20] Implementation and enforcement of comprehensive tobacco flavour ban policies can be challenging, and even more so in low-income and middle-income countries where resources are particularly constrained. There is some literature

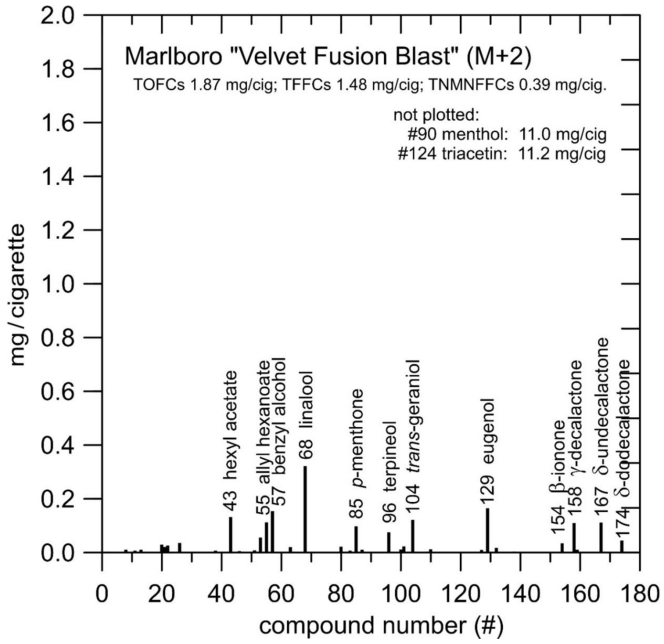

Figure 3 Flavour chemical profile for Marlboro 'velvet fusion blast'. Flavour category = M+2: menthol + 2 mg/cig ≥ TOFCs > 1 mg/cig. TFFCs, total fruit flavour compounds; TNMNFFCs, total non-menthol non-fruit flavour compounds;TOFCs, total other flavour chemicals.

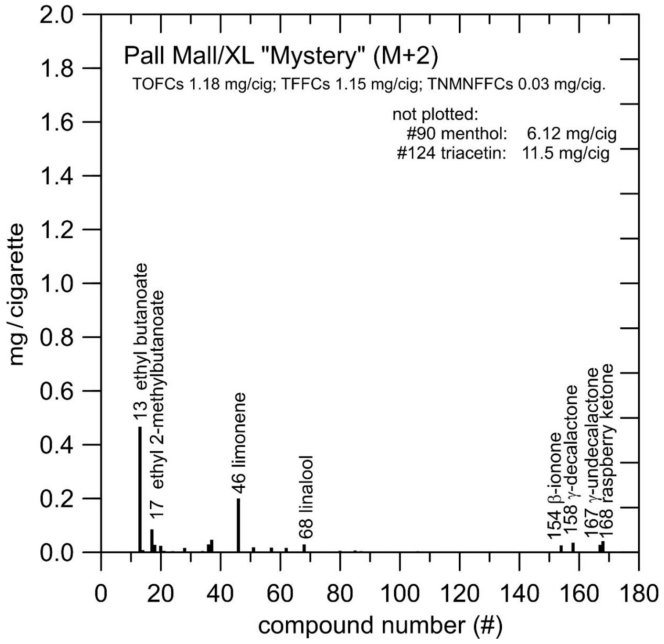

Figure 5 Flavour chemical profile for Pall Mall 'XL mystery'. Flavour category = M+2: menthol + 2 mg/cig ≥ TOFCs > 1 mg/cig. TFFCs, total fruit flavour compounds; TNMNFFCs, total non-menthol non-fruit flavour compounds; TOFCs, total other flavour chemicals.

What this paper adds

- Article 9 of the WHO Framework Convention on Tobacco Control states 'From the perspective of public health, there is no justification for permitting the use of ingredients, such as flavouring agents, which help make tobacco products attractive.' Some countries have restricted the use of flavours in some tobacco products. The tobacco industry has been introducing cigarette brand variants with 'concept' descriptors that are interpretable as implying a taste, aroma or sensation.
- We determined the levels of flavour chemicals in cigarettes with 'concept' descriptors on their packs. Twenty-seven of the 33 cigarettes (all but one of the Mexican variants) were categorised as 'menthol-plus': significant menthol, plus some amount of other flavour chemicals.
- Multinational tobacco companies are offering cigarettes in a new 'menthol-plus' category in 'concept' descriptor packaging. Regulation of both 'menthol-plus' flavour profiling and concept descriptor packaging should be considered.

suggesting that humans are able to detect the odours due to myriad flavour chemicals in tobacco products,[21 22] however, these assessments do not appear to have been done for cigarettes with capsules and/or concept descriptor names.

While all but one of the 22 packs purchased in Mexico contained cigarettes that fell into one of the menthol plus categories, an even larger sample size would be needed to allow a conclusion that menthol plus profiles do completely predominate cigarettes currently sold there in concept descriptor packaging. The five packs purchased in Canada were determined to be non-flavoured, in compliance with Canadian law; a much larger sample size is needed to provide a reliable estimate of tobacco companies' compliance with Canada's ban on additives that have flavouring properties or that enhance flavour, including menthol. The Canadian packs did have colour and other concept descriptors, and it is possible that these descriptors in and of themselves may increase appeal. Further research could assess the impacts of concept descriptors on packs of cigarettes that do not contain flavour chemicals on consumer perceptions of attractiveness of these products. The current study necessarily only used chemical analyses of cigarette products to discover the importance of menthol plus flavour profiles; some understanding of actual consumer liking of these products is needed, especially as compared with menthol only cigarettes.

Given that the harm from tobacco products depends in part on the number of people who use them and their patterns of use, and that product appeal is one determinant of patterns of use,[23] it is important for regulators to address appeal including flavours. In addition to the actual flavours in tobacco products, research has found that appeal is also influenced by the presence of flavour descriptors, imagery and colours on the product packaging[24 25]; thus, restrictions on the use of imagery, descriptors and colours that may connote flavours, including those with concept descriptors, could be a valuable complement to tobacco flavour bans.

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