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Menthol levels in cigarettes from eight manufacturers

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Menthol-labelled cigarettes accounted for almost one-third of the US cigarette market in 2012.¹ Menthol may be present in cigarettes not labelled to contain menthol, either by intentional addition in small quantities,² as a contaminant in the manufacturing facilities which were used for menthol cigarettes production,³ or as a naturally occurring constituent in tobacco.⁴ We previously examined menthol amounts in 46 commercial cigarettes. The amount of menthol measured in the whole cigarettes ranged from 2.9 to 19.6 mg/cigarette for menthol-flavoured cigarettes and from 0.002 to 0.07 mg/cigarette for cigarettes without a detectable menthol flavour.⁵ In an effort to understand how menthol may be used by various cigarette manufacturers, here we present the repeated and additional measurements of menthol quantities in the cigarette rods, cigarette filters and whole cigarettes of these 46 cigarettes from the following manufacturers: Commonwealth Brands, Liggett Group, Lorillard Tobacco, Philip Morris USA, RJ Reynolds Tobacco, British American Tobacco and Santa Fe Natural Tobacco (SFNTC) and compare them with University of Kentucky reference cigarettes. SFNTC Company is a subsidiary of RJ Reynolds Tobacco Company and the University of Kentucky only makes reference cigarettes which are not for commercial consumption. Instead of examining the menthol levels of different cigarette brands,⁵ we consider the levels of menthol application among cigarette manufacturers and explore whether there are patterns with different manufacturers for menthol-flavoured cigarettes. We also consider possible sources of menthol in non-menthol-flavoured cigarettes (intentionally added or contamination in the manufacturing facility). Menthol content measured in the whole cigarette for the 46 products of these manufacturers is shown in figure 1. There are three products with measured menthol content >10 mg/cigarette: two are Camel Crush cigarettes and the other is SFNTC Natural American Spirit (NAS) Light Green Menthol. Another tested SFNTC NAS menthol cigarette also has a relatively high level of menthol (7.9 mg/cigarette). All of these products are from RJ Reynolds Tobacco Company and its subsidiary, SFNTC. Except for these four products, the menthol contents in the other 19 menthol cigarette products span a relatively narrow range as can be seen in figure 1. This menthol range (3.3–6.4 mg/cigarette) covers cigarettes across six tobacco manufacturers. RJ

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Reynolds' Capri Green has the least menthol content (3.27 mg/cigarette) among the tested menthol cigarettes. However, this lowest tested menthol level is more than three times higher than the menthol perceptible threshold of 1 mg/g of tobacco.⁶ Other manufacturers such as Philip Morris, Lorillard Tobacco and Liggett Group also have menthol products at this level (<4 mg/cigarette). Considering cigarette design features, for example, tobacco weight, paper permeability and filter ventilation, the menthol content added to different brands of cigarettes should exhibit differences in menthol delivery to the smoker.³ The observed narrow ranges of menthol content suggest that menthol application is relatively consistent for menthol-flavoured cigarettes across US cigarette manufacturers.

For products not labelled to contain menthol, two products from Commonwealth Brands, USA Gold Red and Fortuna Red, have the lowest menthol contents (0.00138 and 0.00183 mg/cigarette, respectively). This is more than 2000-fold less than the lowest content of labelled menthol cigarettes. However, this quantity is still much higher than the reported quantity of naturally occurring menthol in tobacco, 0.00023 mg/cigarette.⁴ Research cigarettes, 3R4F and 1R5F, from the University of Kentucky have a menthol content at 0.00351 and 0.00216 mg/cigarette, respectively. No menthol was intentionally added to these two products.⁷ Several other commercial non-menthol-flavoured cigarettes from Commonwealth Brands (Rave Red), SFNTC (NAS Yellow Mellow) and RJ Reynolds (Winston Red) also have the menthol contents in the same range as research cigarettes (<0.005 mg/cigarette), suggesting that menthol in these products could originate from contamination by menthol residue in the manufacturing facility. Several manufacturers have non-menthol-flavoured products tested in this study with menthol levels greater than that of 3R4F. The tested menthol ranges are 0.00911–0.0202 mg/cigarette for Philip Morris products, 0.0079–0.0256 mg/cigarette for RJ Reynolds products and 0.0130–0.0148 mg/cigarette for Lorillard products. These manufacturers appear to add small quantities of menthol to their products. Liggett Group's two non-menthol-flavoured products, Pyramid Red and Pyramid Blue, have relatively high menthol contents (0.077 and 0.109 mg/cigarette, respectively). The menthol is likely added to these products intentionally or as part of added complex ingredients.

As shown in figure 1, menthol levels vary significantly among all tested non-menthol-flavoured cigarettes. In contrast to menthol cigarettes, in which menthol levels occur within a narrow range for the majority of products across six of the manufacturers, the non-menthol-flavoured cigarettes have measured menthol across a relatively larger range. However, this large variation is among the manufacturers, whereas the intramanufacturer variation in menthol amounts is much smaller for non-menthol-flavoured cigarettes (red dots in figure 1). The larger variation in menthol amounts in non-menthol-flavoured cigarettes may be due to the individual manufacturing practices of each manufacturer. Menthol added to cigarettes as part of complex ingredients has large variations among different brands and/or manufacturers. Variability is also observed for the residual menthol amounts in manufacturing facilities across different manufacturers. Each manufacturer may produce both menthol cigarettes and non-menthol cigarettes in the same manufacturing facility, which may cause menthol contamination across different production runs. These factors may contribute to the wide range of menthol observed for the non-menthol-flavoured cigarettes versus the narrow range seen with menthol-flavoured cigarettes from the same manufacturer.

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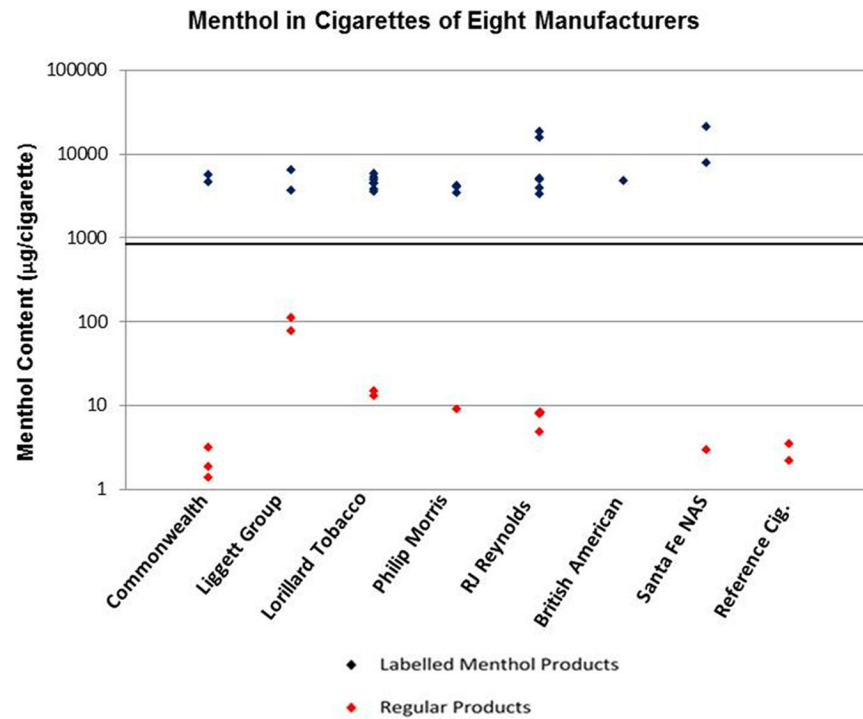


Figure 1. Measured menthol contents in cigarette products from eight manufacturers. Each point represents the mean of seven replicate measurements (n=7). The perceptible level of menthol is about 1 mg/g, which is approximated (based on an average cigarette weight of 0.75 g) in the figure as a black line.