

Benzo[a]pyrene in the Mainstream Smoke of Little Cigars

CENTER FOR TOBACCO PRODUCTS



Office of Science | Center for Tobacco Products | Presented by Sandra I. Salido, Matthew D. Hassink, Kenneth M. Taylor; Center for Tobacco Products, Food and Drug Administration, Silver Spring, MD, USA, 20850
Cliff Watson, Peter Kuklenyik, Ruth Wang, Patrick Chen, Liza Valentin-Blasini, and Brett Kimbrell; Centers for Disease Control and Prevention, National Center for Environmental Health, Atlanta, GA, 30341

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BACKGROUND

- Little cigars (small sheet-wrapped cigars, weight $\leq 1.36g$) are a subcategory of cigars, an FDA regulated tobacco product that can have appealing flavors.¹⁻⁶
- Little cigars have similar dimensions, filters, and appearance to cigarettes, and appeal to consumers, including youth, due to characterizing flavors, lower costs, and the perception of reduced risk.¹⁻⁵
- Youth and young adults commonly initiated smoking with a flavored little cigar.^{1,4-6} In addition, appealing flavored products increase the chances of continued tobacco product use.^{5,6}
- Flavored cigars comprised more than half of the U.S. cigar market in 2015.⁷
- Cigar mainstream smoke (MSS) delivery of harmful and potentially harmful constituents (HPHCs), such as benzo[a]pyrene (B[a]P), has not been as extensively investigated as cigarette B[a]P yields.
- B[a]P is the most potent carcinogen among the Polycyclic Aromatic Hydrocarbons (PAHs).⁸ It is listed as a Group 1 carcinogen by the IARC⁹ and is an upper respiratory tract and lung carcinogen.¹⁰
- Little cigar physical characteristics and B[a]P smoke yields were compared to those of 50 commercial American Blend cigarettes,¹¹ as shown in Table 1 and Figure 2.

OBJECTIVE

The potential harm of little cigars was investigated by comparing their relative toxicity to cigarettes in terms of the MSS yields of B[a]P, a human carcinogen, and related physical properties.

Table 1. Physical attributes of 60 little cigars and 50 commercial cigarettes

Product Attributes	Little Cigar Median (Range)	Cigarettes Median (Range)
Tobacco Rod Length (mm)	99 (73.9 – 100)	84 (79.6 – 99.2)
Filter Length (mm) ^a	27 (8.11 – 31.8)	27 (15 – 31.9)
Rod Diameter	7.9 (6.84 – 8.36)	NA
Filter Ventilation (%)	0.9 (0.13 – 53.9)	26.1 (0.13 – 66.6)
Paper/Wrapper Porosity (CU)	83 (24.16 – 131)	48.1 (17.3 – 72.1)
Tobacco Weight (mg)	1089 (767 – 1367)	661 (401 – 880.7)
Draw Resistance (open)(mmWG)	173 (85.6 – 254)	111 (7.7 – 136.2)
Draw Resistance (closed)(mmWG)	195 (100 – 297)	138 (10.1 – 194)
Tobacco pH	6.2 (5.4 – 6.6)	5.4 (5.29 – 5.61)

^a Three little cigar products do not contain a filter (Panter Coffee, Cafe Creme Original, Cafe Creme Blue)

- Little cigars have higher tobacco weights, wrapper porosity, and draw resistance; but lower median filter ventilation, although having a similar range, compared to cigarettes.
- Little cigars have higher filler pH, which can affect nicotine chemistry.
- Rod lengths and filter lengths of little cigars and cigarettes are within range and are similar.
- Little cigars generally contain more tobacco than cigarettes: 767 - 1,367 mg versus 401 – 880.7 mg.
- Based on internal FDA data,¹² little cigars contain air-cured and flue-cured, rolled stems, and reconstituted tobacco. Typical American blended cigarettes contain a mixture of flue-cured (e.g., bright, Virginia), air-cured (e.g., burley), sun-cured (e.g., oriental, Turkish), and reconstituted tobaccos.
- Overall, little cigars and cigarettes have similar physical appearance but the differences in physical design parameters and differences in tobacco weight and blends affect B[a]P yields.

METHODS

Sixty little cigars were purchased in the Atlanta area from retail and wholesale sources based on 2012-2013 Nielsen data.

- Smoking Regimens:** The little cigars were tested using the non-intense International Organization for Standardization (ISO) and Canadian Intense (CI) smoking regimens.
- Validated GC/MS Method:** Extraction of Cambridge filter pads spiked with 20 μ L of isotopically-labeled B[a]P-¹³C₄ with 10 mL hexane followed by GC/MS. 3R4F reference cigarette and CM8 monitor used for validation and quality control.

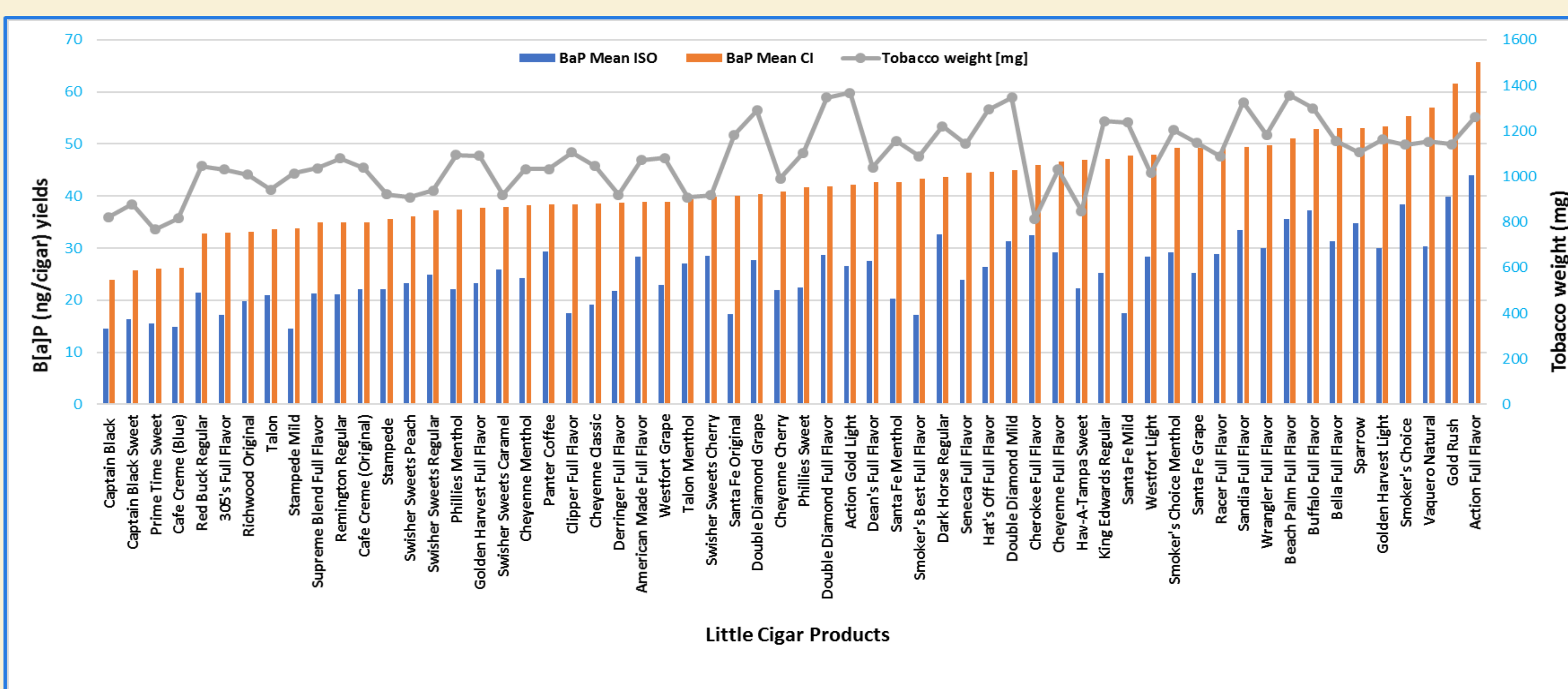
Table 2. Testing variability of little cigars, commercial cigarettes and 3R4F

Testing Variability	Mean % RSD	
	ISO	CI
Little Cigars	9.07%	9.65%
Commercial Cigarettes	11.86%	14.57%
3R4F Cigarettes	11.43%	13.13%

- Little cigar testing variability was lower compared to commercial and reference cigarettes.
- Both smoking regimens are optimized for cigarettes and are suitable, based on mean % Relative Standard Deviation (RSD), for little cigar analysis.

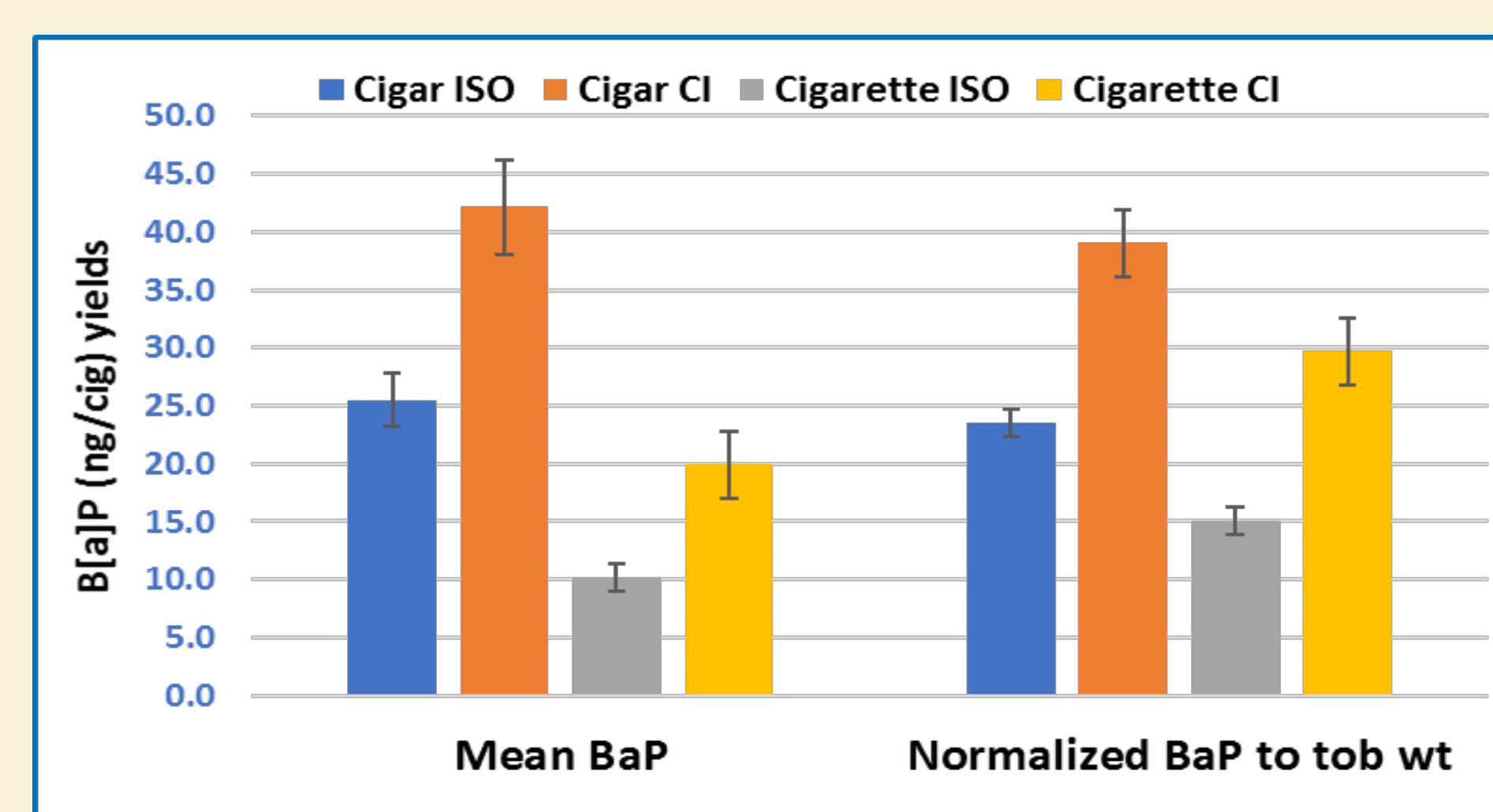
RESULTS: LITTLE CIGAR DATA

Figure 1. Mean smoke B[a]P yields of little cigars for ISO and CI regimens, listed in ascending order for CI smoking regimen



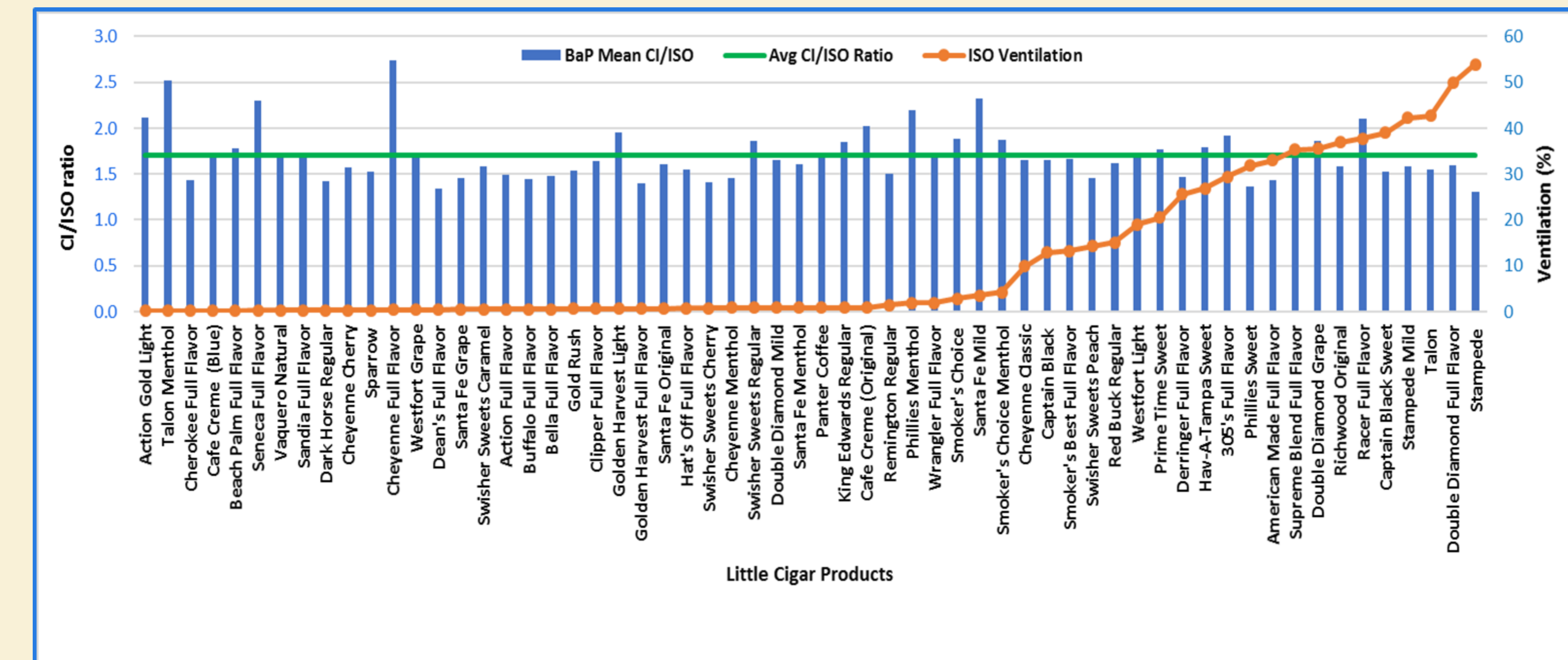
- The average cigar B[a]P ISO smoke yield and range are 25.5 (14.5 – 44.0) ng/cigar and CI yield and range are 42.2 (24.0 – 65.7) ng/cigar.
- Prime Time International Sweet has the lowest tobacco weight (767mg), 4th lowest ISO B[a]P yield, and 3rd lowest CI B[a]P yield and A&T Tobacco Imports Action Gold Light has the highest tobacco weight (1367mg) and the 35th highest ISO B[a]P yield and 28th highest CI B[a]P yield.
- Scandinavian Tobacco Group Lane LTD, Captain Black 100s, has the lowest B[a]P yield for both regimens: ISO: 14.5 ng/cig, CI: 24.0 ng/cig, and tobacco weight of 822mg.
- A&T Tobacco Imports Action Full Flavor has the highest B[a]P yield for both regimens: ISO: 44.0 ng/cig, CI: 65.7 ng/cig, and tobacco weight of 1261mg.

Figure 2. Comparison of little cigar and cigarette Mean B[a]P yields and Normalized to tobacco weight



- Little cigar mean ISO B[a]P yield is 25.5 ng/cigar and mean CI B[a]P yield is 42.2 ng/cigar, which are 2.5- and 2-fold greater than cigarette ISO and CI yields, respectively.
- Due to the weight differences between little cigars and cigarettes, B[a]P yields of cigars were normalized to tobacco weight and are 1.5- and 1.3- fold greater for ISO non-intense and CI, respectively, than normalized cigarette yields.
- Little cigar B[a]P yields (ISO, $R^2 = 0.24$; CI, $R^2 = 0.35$) correlation to tobacco weight is similar to cigarette yield correlations (ISO, $R^2 = 0.21$; CI, $R^2 = 0.31$).
- B[a]P yield correlation with tobacco weight is the strongest correlation of all the physical design parameters for little cigars.

Figure 3. Ratio CI/ISO smoking regimen mainstream smoke yields of B[a]P with increasing ventilation



- B[a]P yields had a low correlation (ISO, $R^2=0.17$) with filter ventilation, so the ratio of CI to non-intense ISO MSS yields with filter ventilation, an alternative analysis approach previously used in a cigarette study, was employed.¹¹
- The ratio of CI to ISO mean B[a]P smoke yields, when compared to the average value of this ratio, does not significantly differ as little cigar filter ventilation increases, indicating no clear trend and negligible correlation ($R^2=0.03$) to B[a]P yields.
- Ventilation does not appear to have a significant effect on little cigar B[a]P yields, so two other physical design parameters were further investigated.
- Although little cigars have higher packing density than cigarettes (0.305 mg/mm³ vs 0.221 mg/mm³), correlations to B[a]P yields are lower (ISO, $R^2=0.20$; CI, $R^2=0.20$) than tobacco weight correlations. Filter length was also investigated and exhibits low to nonexistent correlations with little cigar B[a]P yields (ISO, $R^2 = 0.06$; CI, $R^2 = 0.002$).

CONCLUSIONS

This study demonstrates that although little cigars have similar physical parameters to cigarettes, little cigars:

- Generate higher B[a]P yields for both ISO and CI smoking regimens.
 - Have a low correlation between B[a]P yield and tobacco weight, and other design parameters such as filter length, ventilation and packing density have similarly individual weak or nonexistent correlations and cannot account for B[a]P yield differences.
- Also,
- Reported tobacco blend differences between little cigars¹² and cigarettes are expected to contribute to the B[a]P yield differences. Therefore, the cumulative effects of differences in design parameters and tobacco blend are likely responsible for the higher observed B[a]P yields and thus potential different impacts on public health.

ACKNOWLEDGEMENTS

This work was funded by the Interagency Agreement, ID number 224-10-9022, between the Food and Drug Administration and the Centers for Disease Control and Prevention. The authors have no competing financial interests.

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