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Comment on Gas/Particle Partitioning of Two Acid−Base Active Compounds in Mainstream Tobacco Smoke: Nicotine and Ammonia

In a recent paper published in this *Journal*, Drs. Chen and Pankow (*1*) concluded "that a thorough examination of unbound and bound ammonia in MTS will be required before the role of ammonia in affecting volatility of nicotine in MTS can be understood." [MTS was the abbreviation used for mainstream tobacco smoke (*1*).] Whether or not the authors' conclusion was correct, there were disturbing aspects of their paper that need to be publicized.

First, the experimental procedures (Materials and Methods, Brands and Smoking) for smoking the cigarettes were incorrect. The text reads, "All cigarettes were smoked to a 23 mm 'butt length'." For most, if not all, of the cigarette brand-styles listed, smoking to a 23 mm butt length would have resulted in charring the tipping paper, if not the cellulose acetate filter and its wrapping material, thus changing MTS composition. Cigarettes have tipping papers that are 4−5 mm longer than the length of the filter (typical range of 19−32 mm), and the correct butt length is tipping length plus 3 mm for both the Federal Trade Commission (FTC) method (*2*) and the Massachusetts Department of Public Health (MDPH) method (*3*). Thus, butt lengths for king size cigarettes are typically 25 mm or longer (*4*). **Table 1** shows the correct butt lengths reported by the Tobacco Industry Testing Laboratory (TITL), an independent laboratory that provided data to the FTC (*2*, *4*). Furthermore, the device Chen and Pankow used to smoke the cigarettes did not meet the part of the MDPH regulations (*3*) specifying through reference to ISO Standard 3308 [3rd ed., 1991-10-15 (*5*)] an upward air flow across the cigarettes of 200 ± 50 mm/s measured 40 mm ahead of the puff termination device (*5*). This air flow removes the sidestream smoke (SSS) generated between puffs. SSS is rich in ammonia (*6*), and failure to remove SSS from the air around the cigarette permits the ammonia-rich SSS to be drawn into the lit end of the cigarette, the pores of the cigarette paper, and the filter ventilation holes when a puff is taken. This added ammonia would likely interfere with MTS ammonia determinations.

Second, the authors reported MDPH tar and nicotine values that were too low in most cases, and some were lower than the most recent FTC values available for the same brand-style (*7*) even though MDPH tar and nicotine deliveries are always higher than the FTC's values(*8*). The authors' experimental values were also lower than the values obtained using equations to predict the MDPH values from the corresponding FTC values and are also in **Table 1** (*8*). The low values cannot be explained by use of dry cigarettes (*9*). The low MDPH tar and nicotine deliveries, the butt length errors, and the apparent failure of Chen and Pankow to use proper air flows indicated their data were so compromised as to render any conclusions drawn from them to be highly suspect. Furthermore, the authors claim to have used the Virginia Slims FF KS product, but the reported cigarette weight and the removal of that brand-style from the U.S. market after 2002 (*7*, *10*) indicated the smoke data likely came from another product.

Third, the authors cited over 40 tobacco company reports, but most were not scientific reports (one was handwritten meeting notes) and/or not relevant to the determination of ammonia or

Table 1. Relevant Parameters for Cigarettes Used in Reference *1*[a]

brand (*1*)	style/type (*1*)	TITL butt length (mm from mouth end) (*4*)	2005 FTC "tar" (mg/cig) (*7*)	2005 FTC nicotine (mg/cig) (*7*)	MDPH "tar" (mg/cig) (*1*)	MDPH nicotine (mg/cig) (*1*)	predicted[b] MDPH "tar" (mg/cig)	predicted[b] MDPH nicotine (mg/cig)
Craven A	FF, F, K, HP	NR	14	1.2	10	3.2	29	2.3
Basic	FF, F, K, HP	27−28	15	1.1	13	1.7	31	2.1
American Spirit Blue	FF, F, K, HP	NR	17	1.8	15	2.3	34	3.2
Camel	FF, F, K, HP	27−29	16	1.3	14	1.8	32	2.4
Doral	FF, F, K, HP	26−28	14	1.1	14	1.7	29	2.1
GPC	FF, F, K, HP	28−29	16	1	10	1	32	2.0
Marlboro	FF, F, K, HP	25−27	15	1.1	22	2.1	31	2.1
Newport	FF, F, K, HP	27.5−29.5	17	1.3	25	2.4	34	2.4
American Spirit Red	FF, F, K, HP	NR	16	1.9	10	1.5	32	3.3
Mild Seven	charcoal filter, K, HP	33[c]	10[d]	0.8[d]	15	1.8	NA	NA
True	ultralights, F, K, SP	32.5−33.5	5	0.5	7	0.9	15	1.2
Virginia Slims[e]	FF, F, K,[e] HP	34.5−35	NR	NR	20	2.5	NA	NA
Winston	FF, F, K, HP	27.5−29	14	1.2	16	2.1	29	2.3

[a] Abbreviations: F, filter cigarette (cellulose acetate filter unless specified otherwise); FF, full flavor (>15 mg/cig FTC "tar"); FTC, Federal Trade Commission; K, king size (more commonly abbreviated KS) cigarette (generally cigarette length between 79 and 88 mm); HP, hard pack, also known as crush-proof box; SP, soft pack (traditional paper packaging); MDPH, Massachusetts Department of Public Health; mg/cig, milligrams per cigarette; NA, not applicable; NR, not reported. [b] Values predicted from equations given in this document's ref *8*. [c] Value given in e-mail dated June 22, 2009, from Dr. Osamu Endo, Azabu University, Sagamihara, Kanagawa, Japan. [d] Values obtained with ISO smoking regimen and reported in Endo et al., Nicotine, tar, and mutagenicity of mainstream smoke generated by machine smoking with International Organization for Standardization and Health Canada Intense regimens of major Japanese cigarette brands, *J. Health Sci.* **2009**, *55*, 421−427. [e] The designation of this product as Virginia Slims FF KS HP does not match cigarette weight data and availability in the U.S. market on the dates reported for sample purchase. Thus, there were no data for the KS Virginia Slims product in the 2005 FTC report.

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nicotine in MTS. The only relevant and unique scientific reports apparently not published in scientific journals were their references 40, 47, and 54.

In conclusion, the authors should obtain new smoke data using the proper equipment, procedures, and cigarette brand-style identifications and issue corrected findings as soon as practical.

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