

An Improved Quantitative Method for the Analysis of Tobacco-Specific Nitrosamines in Cigarette Tobacco and Mainstream Cigarette Smoke by Use of Isotope Dilution Liquid Chromatography Tandem Mass Spectrometry

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Table S-1. LOD and LOQ for Determination of TSNA in Cigarette Tobacco

analyte	LC-MS/MS		LC-MS/MS		GC-TEA	
	LOD	LOQ	LOD	LOQ	LOD	LOQ
	(ng/mL)	(ng/mL)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
NNN	0.049	0.164	1.97	6.56	54.0	180
NAT	0.040	0.135	1.62	5.40	63.9	213
NAB	0.027	0.090	1.08	3.60	31.0	103
NNK	0.040	0.133	1.59	5.30	81.5	272

Table S-2. Comparison of Results from Determination of TSNA in Cigarette Tobacco

brand	year	NNN (ng/g)		NAT (ng/g)		NAB (ng/g)		NNK (ng/g)	
		TEA	LC/MS	TEA	LC/MS	TEA*	LC/MS	TEA	LC/MS
A	2003	437	487	697	570	48.0	27.5	729	714
A	2004	288	365	433	432	86.6	16.4	504	478
A	2005	87.4	105	215	131	49.3	6.25	148	110
B	2003	463	530	688	589	50.4	29.1	784	777
B	2004	336	375	494	490	64.8	19.8	639	601
B	2005	115	152	245	204	36.7	7.45	208	222
C	2003	408	441	633	548	45.2	24.3	647	648
C	2004	298	425	467	456	93.7	19.9	522	618
C	2005	108	143	172	169	39.6	8.42	164	185
D	2003	434	532	733	654	147	29.1	787	800
D	2004	280	386	433	473	62.1	19.7	495	615
D	2005	113	139	227	193	37.7	8.36	237	219

TEA* data are below the Limit of Quantification (LOQ) for the GC-TEA method.

Table S-3. LOD and LOQ for Determination of TSNA in Mainstream Cigarette Smoke

analyte	LC-MS/MS mainstream ISO		GC-TEA mainstream ISO	
	LOD	LOQ	LOD	LOQ
	(ng/cig)	(ng/cig)	(ng/cig)	(ng/cig)
NNN	0.197	0.656	1.49	4.80
NAT	0.162	0.540	1.87	6.20
NAB	0.108	0.360	0.634	2.00
NNK	0.159	0.530	3.72	12.4

Table S-4. Internal Standard Response Decrease Caused by Sample (KY2R4F) Matrices

analyte	calibration standard		cigarette tobacco sample		response decrease	
	peak area	RSD (%)	peak area	RSD (%)	decreased	(%)
NNN- <i>d4</i>	3.49E+06	13.7	8.02E+05	2.2	2.69E+06	77.0
NAT- <i>d4</i>	8.39E+06	10.9	5.53E+06	3.8	2.86E+06	34.0
NAB- <i>d4</i>	2.66E+06	9.0	1.37E+06	3.2	1.29E+06	48.5
NNK- <i>d4</i>	3.23E+06	10.6	9.15E+05	1.5	2.31E+06	71.7
analyte	calibration standard		MSS smoke sample		response decrease	
	peak area	RSD (%)	peak area	RSD (%)	decreased	(%)
NNN- <i>d4</i>	3.28E+06	3.3	7.34E+05	8.5	2.55E+06	77.6
NAT- <i>d4</i>	6.59E+06	3.4	3.52E+06	7.4	3.07E+06	46.5
NAB- <i>d4</i>	1.73E+06	2.9	7.03E+05	7.0	1.03E+06	59.3
NNK- <i>d4</i>	2.31E+06	4.6	4.83E+05	6.3	1.83E+06	79.1

Table S-5. Peak Area Ratio of the Second Ion Pair to the First Ion Pair for Cigarette Tobacco

sample ID	NNN2/NNN1	NAT2/NAT1	NAB2/NAB1	NNK2/NNK1
standard1	0.549	0.318	0.398	0.217
standard2	0.516	0.305	0.405	0.209
standard3	0.509	0.310	0.405	0.217
standard4	0.506	0.311	0.413	0.217
standard5	0.509	0.312	0.406	0.216
standard6	0.498	0.314	0.405	0.216
standard7	0.511	0.314	0.408	0.221
average	0.514	0.312	0.406	0.216
std. dev.	0.016	0.004	0.004	0.004
coeff. var.	3.2	1.3	1.1	1.7
KY2R4F	0.508	0.311	0.402	0.223
KY2R4F	0.506	0.315	0.405	0.225
KY2R4F	0.511	0.311	0.399	0.221
KY2R4F	0.508	0.310	0.402	0.221
KY2R4F	0.503	0.312	0.413	0.219
KY2R4F	0.497	0.310	0.404	0.218
KY2R4F	0.503	0.311	0.400	0.229
average	0.505	0.311	0.404	0.222
std. dev.	0.005	0.002	0.005	0.004
coeff. var.	0.9	0.6	1.2	1.7

Table S-6. Comparison of Results for TSNA in Cigarette Tobacco KY2R4F

	GC-TEA ^a	LC-MS/MS ^b	LC-MS/MS ^c	LC-MS/MS ^d
analyte	ng/g	ng/g	ng/g	ng/g
NNN	2923 (218)	3015 (24)	2999 (48)	2692 (103)
NAT	2045 (139)	1875 (92)	3996 (277)	1800 (165)
NAB	145 (18)	71.7 (3.8)	120 (10)	92.5 (8.3)
NNK	1398 (120)	1477 (34)	1438 (27)	1309 (61)

^a this study using Health Canada method

^b this study using four internal standards

^c this study using two internal standards

^d data reported by Chwojdak et al. (Ref. 4)

^e values in parentheses are standard deviations

Figure S-1. Correlation between the Results Obtained by GC-TEA and Those Obtained by LC-MS/MS for Mainstream Smoke Sample Analyses

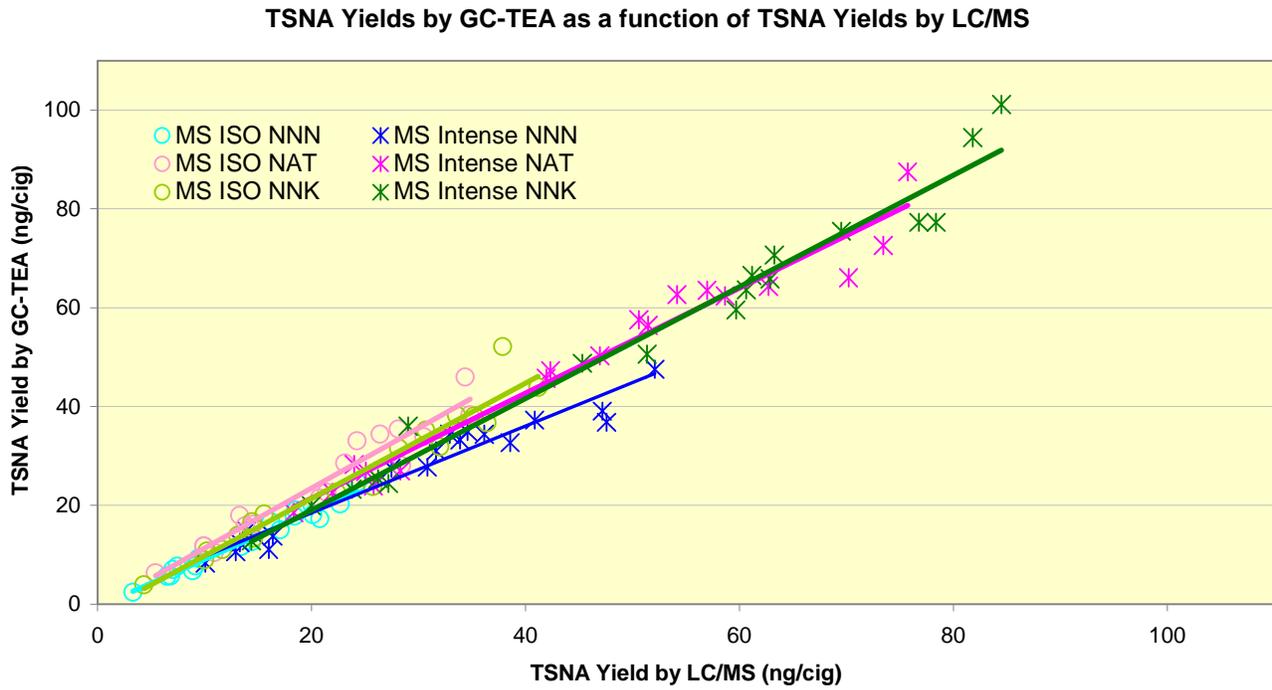


Figure S-2. Chromatograms of a Mainstream Smoke Sample Obtained in This Study

