Supplementary information for

"Chemical composition, structures, and light absorption of N-containing aromatic compounds emitted from burning wood and charcoal in household cookstoves"

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S1. Cookstoves

To improve the cookstoves for the developing world, several rounds of cookstove tests under controlled conditions were sponsored by the Partnership for Clean Indoor Air (PCIA) and United States Environmental Protection Agency (US EPA; Jetter and Kariher, 2009; MacCarty et al., 2010; Jetter et al., 2012). The fuel-specific cookstoves for red oak and charcoal burning in this work are listed in Table S1. The measurement data of modified combustion efficiency (MCE, defined as $CO_2/(CO_2 + CO)$ on a molar basis), overall thermal efficiency, and emission factors (EFs) of organic (OC) and elemental carbon (EC) for each fuel-cookstove test were provided in Xie et al. (2018). A brief description of individual cookstoves was given below, and their global deployment could be found from the Clean Cooking Catalog website (http://catalog.cleancookstoves.org).

3-Stone: the 3-stone fire is the most commonly used traditional method of cooking (Jetter and Kariher, 2009; Jetter et al., 2012). A fire is made in the center of three stones to heat the cooking pot placed above.

EcoChula XXL (Alpha Renewable Energy Pvt. Ltd, India): A forced-draft fan-type cookstove designed for batch-fed operation using a variety of biomass types (Shen et al., 2017). This stove is mainly deployed in India.

Envirofit G-3300 (Envirofit International, CO, USA): A mass-produced stove initially developed by Colorado State University. The stove is constructed of high-temperature alloy steel with ceramic insulation and a cast-iron top. Removable gate and pot skirt made of cast-iron are also included. This type of cookstove is mainly deployed in Asia, North America, Southern Africa, and Australia.

Home Stove (BioLite LLC, NYC, USA): A low-cost, clean, and electricity generating biomass cookstove. This cookstove is designed to reduce smoke emissions and fuel consumptions, and is mainly used in Ghana, India, and Uganda. It also generates electricity from the flame, enabling users to charge small electronics.

Jiko Poa (BURN Manufacturing, Kenya): A rocket stove designed for continuous-fed operation using wood. It is constructed of metal with ceramic insulation. The Jiko Poa stove is initially designed in 2010 by Burn Design Labs and manufactured in Kenya.

CH4400 (Envirofit International, CO, USA): A dual-chamber stove designed for batch-fed operation using charcoal. An air vent is located at the based of the stove. The CH4400 stove is made of steel with cast-iron top, and is widely used in North America, Asia, Southern Africa, and Australia.

Éclair (GIZ, Bonn, Germany): A portable metal stove designed for batch-fed operation with charcoal. It was initially developed by Deutsch Gesellschaft für Internationale Zusammenarbeit (GiZ) to reduce charcoal consumption, cooking time, and CO emissions. The Éclair cookstove is suitable for various pot sizes and deployed in Benin.

Jiko Koa (BURN Manufacturing, Kenya): A typical small metal-clad ceramic charcoal stove designed for batch-fed operation. A ceramic grate for holding the charcoal fuel is considered an advantage over the common charcoal stove. This stove is manufactured in Kenya and used in many African countries (Jetter et al., 2012).

Prakti Leo (Prakti Design, India): A non-traditional metal charcoal stove. This stove was developed for clean and efficient burning by Prakti Desgin. The Prakti Leo stove is manufactured in India and used in Haiti and several African countries (e.g., Kenya, Sudan, and Senegal).

Zoom Jet (Ecozoom, OR, USA): A small metal charcoal stove with a durable, anti-rust coated cast-iron top. The Zoom Jet stove also has ceramic and high temperature thermal insulation. It was widely used and distributed in East Africa.

S2. Bulk chemical and optical analysis

A thermal-optical instrument (Sunset Laboratory, Portland, OR) running a revised NIOSH 5040 protocol (NIOSH, 1999) was used to measure the OC and EC concentrations. Bulk brown carbon (BrC) absorption of filtered (30 mm diameter. ×0.2 μm pore size, PTFE filter) methanol extracts was measured using UV/Vis spectrometry. Xie et al. (2018) characterized the UV-Vis absorption properties of BrC in the methanol extracts, providing the light absorption coefficient (Abs_λ, Mm^{-1}), mass absorption coefficient (MAC_λ, $m^2\ g^{-1}$), and solution absorption Ångström exponent ($Å_{abs}$). Currently, the concentrations of OC and EC, Abs_{365}, MAC_{365}, and $Å_{abs}$ of Q_f and Q_b samples collected for red oak and charcoal burning mainly at high power water boiling test (WBT) phases are summarized in Tables S1 and S2 of the supplementary information. The light absorption of OC extracts at 365 nm has been widely used to represent BrC absorption (Chen and Bond, 2010; Hecobian et al., 2010; Liu et al., 2013).

Table S1. Summaries of modified combustion efficiency (MCE), OC and EC concentrations and light-absorbing properties of OC in Q_f samples for each test fuel-cookstove combination.

Cookstove	Test phase	MCE[a] %	OC mg m^{-3}	EC mg m^{-3}	EC/OC[a]	Extraction[a] (%)	Abs_{365}[b] $Mm^{-1}/1000$	MAC_{365}[a] $m^2\ gC^{-1}$	$Å_{abs}$[a]
				Red oak					
3-Stone fire	CS	95.6 ± 0.44	1.11 ± 0.12	0.98 ± 0.067	0.90 ± 0.16	94.2 ± 0.60	3.64 ± 0.40	3.48 ± 0.10	5.88 ± 0.25
	SIM	93.7 ± 0.50	1.09 ± 0.33	0.33 ± 0.089	0.36 ± 0.17	96.9 ± 0.56	2.47 ± 1.26	2.57 ± 0.78	5.19 ± 0.94
EcoChula XXL	CS	99.5 ± 1.64	0.11 ± 0.017	0.47 ± 0.13	4.39 ± 1.33	93.5 ± 3.02	1.18 ± 0.58	11.3 ± 4.42	3.25 ± 0.35
	HS	99.4 ± 0.08	0.15 ± 0.056	0.62 ± 0.030	4.69 ± 2.17	71.9 ± 27.2	0.83 ± 0.67	7.64 ± 3.46	4.26 ± 0.96
Envirofit G3300	CS	97.2 ± 0.68	0.94 ± 0.25	1.43 ± 0.022	1.60 ± 0.43	87.8 ± 4.62	2.72 ± 0.92	3.33 ± 0.72	6.56 ± 0.25
	HS	95.2 ± 1.35	2.40 ± 1.04	2.73 ± 0.31	1.26 ± 0.45	76.3 ± 3.57	7.10 ± 2.85	3.93 ± 0.33	6.74 ± 0.22
Home Stove	CS	99.3 ± 0.13	0.15 ± 0.026	0.29 ± 0.056	1.96 ± 0.55	87.5 ± 2.14	0.69 ± 0.18	5.54 ± 2.22	3.59 ± 0.40
	HS	99.5 ± 0.06	0.21 ± 0.081	0.63 ± 0.14	3.11 ± 0.50	92.8 ± 7.05	0.57 ± 0.14	3.00 ± 0.55	3.43 ± 0.018
Jiko Poa	CS	97.7 ± 0.35	0.57 ± 0.028	0.70 ± 0.16	1.23 ± 0.32	96.7 ± 0.65	2.30 ± 0.32	4.15 ± 0.60	4.61 ± 0.20
	HS	97.7 ± 0.40	0.78 ± 0.066	1.25 ± 0.25	1.63 ± 0.43	92.3 ± 1.70	2.51 ± 0.41	3.67 ± 0.72	5.01 ± 0.49
Jiko Poa (HM[c])	CS	97.4 ± 0.25	0.86 ± 0.16	0.32 ± 0.11	0.37 ± 0.084	95.4 ± 1.32	2.24 ± 0.56	2.72 ± 0.29	5.06 ± 0.56
	HS	97.5 ± 0.19	0.82 ± 0.16	0.55 ± 0.20	0.71 ± 0.34	95.9 ± 0.85	3.28 ± 0.45	4.18 ± 0.35	3.99 ± 0.12
				Charcoal					
CH4400	CS	97.3 ± 0.06	0.048 ± 0.020	0.39 ± 0.082	8.73 ± 2.66	97.8 ± 3.02	0.12 ± 0.046	2.96 ± 1.73	3.79 ± 0.64
	HS	95.2 ± 0.78	0.072 ± 0.042	0.0030 ± 0.0010[d]	0.020 ± 0.019	96.3 ± 5.44	0.14 ± 0.099	1.96 ± 0.39	7.91 ± 1.55
Éclair	CS	90.3 ± 0.54	0.19 ± 0.068	0.68 ± 0.25	3.67 ± 0.11	95.3 ± 6.18	0.18 ± 0.12	0.93 ± 0.33	6.64 ± 2.20
	HS	88.9 ± 0.93	0.47 ± 0.022	0.020 ± 0.0044	0.042 ± 0.0094	96.6 ± 1.58	0.72 ± 0.072	1.57 ± 0.18	6.93 ± 0.15
Jiko Koa	CS	92.0 ± 1.44	0.14 ± 0.095	0.50 ± 0.29	4.69 ± 3.16	95.3 ± 2.24	0.35 ± 0.36	2.31 ± 1.20	4.16 ± 0.79
	HS	82.0 ± 2.14	0.63 ± 0.31	0.017 ± 0.0074	0.028 ± 0.0039	97.0 ± 0.79	1.03 ± 0.42	1.82 ± 0.44	7.21 ± 0.45
Prakti Leo	CS	92.0 ± 1.08	0.13 ± 0.063	0.72 ± 0.42	5.64 ± 0.60	97.9 ± 2.44	0.29 ± 0.16	2.30 ± 0.78	4.53 ± 0.99
	HS	87.9 ± 1.02	0.50 ± 0.092	0.010 ± 0.0020	0.021 ± 0.0038	98.3 ± 0.58	0.80 ± 0.24	1.60 ± 0.31	8.90 ± 0.63
Zoom Jet	CS	93.3 ± 1.00	0.073 ± 0.013	0.60 ± 0.33	7.89 ± 2.91	91.7 ± 7.07	0.19 ± 0.11	2.65 ± 0.87	3.88 ± 1.12
	HS	93.4 ± 1.05	0.56 ± 0.35	0.021 ± 0.014	0.036 ± 0.0061	95.5 ± 0.61	0.87 ± 0.47	1.77 ± 0.39	7.64 ± 0.62

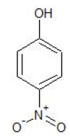
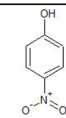
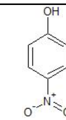
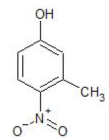
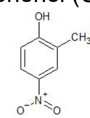
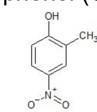
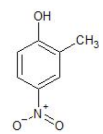
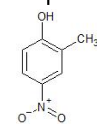
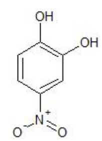
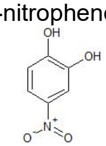
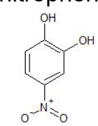
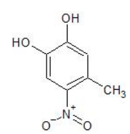
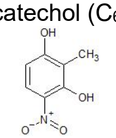
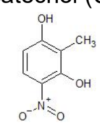
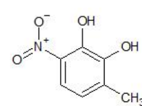
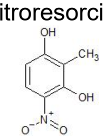
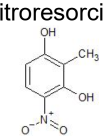
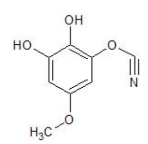
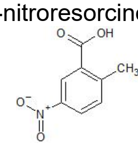
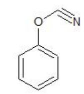
[a] Data were obtained from Xie et al. (2018); [b] values presented here have been divided by 1000; [c] high moisture; [d] measurements of only two filter samples were available, the values reported here are average ± difference between the two measurements/2

Table S2. Summaries of OC concentrations and light-absorbing properties of OC in Q_b samples for each test fuel-cookstove combination.

Cookstove	Test phase	OC mg m^{-3}	Q_b OC/Q_f OC[a] %	Abs365[b] Mm^{-1}/1000	MAC_{365}[a] m^2 gC^{-1}	Åabs[a]	Temp.[c] °C
				Red oak			
3-Stone fire	CS	0.13 ± 0.0091	11.9 ± 0.59	0.24 ± 0.0052	1.83 ± 0.12	6.86 ± 0.41	24.6 ± 0.57
	SIM	0.16 ± 0.066	16.2 ± 4.54	0.23 ± 0.055	1.50 ± 0.26	8.34 ± 1.26	24.2 ± 0.57
EcoChula XXL	CS	0.022 ± 0.0024	20.2 ± 0.96	0.064 ± 0.026	2.86 ± 0.94	3.78 ± 0.14	44.1 ± 1.81
	HS	0.027 ± 0.0070	20.1 ± 8.49	0.081 ± 0.0063	3.11 ± 0.81	3.53 ± 1.30	48.3 ± 1.52
Envirofit G3300	CS	0.095 ± 0.023	10.3 ± 1.93	0.17 ± 0.031	1.84 ± 0.33	8.58 ± 2.39	22.4 ± 0.61
	HS	0.15 ± 0.34	6.79 ± 1.56	0.31 ± 0.049	2.08 ± 0.46	6.40 ± 1.62	23.2 ± 0.49
Home Stove	CS	0.028 ± 0.0033	19.1 ± 1.55	0.046 ± 0.015	1.69 ± 0.62	5.59 ± 0.80	22.9 ± 0.62
	HS	0.039 ± 0.0009	20.5 ± 7.59	0.042 ± 0.014	1.05 ± 0.33	6.27 ± 2.39	24.1 ± 0.84
Jiko Poa	CS	0.081 ± 0.0065	14.0 ± 0.61	0.18 ± 0.013	2.23 ± 0.063	6.20 ± 0.36	23.7 ± 0.08
	HS	0.11 ± 0.016	14.2 ± 1.72	0.19 ± 0.061	1.83 ± 0.021	6.94 ± 0.19	24.8 ± 0.35
Jiko Poa (HM)	CS	0.11 ± 0.012	13.2 ± 1.06	0.15 ± 0.012	1.31 ± 0.084	8.23 ± 0.77	23.1 ± 0.16
	HS	0.11 ± 0.018	14.0 ± 0.55	0.16 ± 0.015	1.38 ± 0.21	7.74 ± 0.37	24.1 ± 0.05
				Charcoal			
CH4400	CS	0.020 ± 0.015	30.0 ± 21.7	0.017 ± 0.0085[d]	1.36 ± 0.60	6.32 ± 0.18	23.3 ± 0.22
	HS	0.041 ± 0.015	66.0 ± 26.4	0.029 ± 0.026	0.66 ± 0.55	10.5 ± 5.99	23.6 ± 0.27
Éclair	CS	0.059 ± 0.017	32.7 ± 4.66	0.031 ± 0.028	0.47 ± 0.31	8.44 ± 3.13	23.6 ± 0.51
	HS	0.13 ± 0.0077	27.7 ± 1.72	0.11 ± 0.012	0.83 ± 0.10	8.19 ± 2.63	23.8 ± 0.51
Jiko Koa	CS	0.058 ± 0.031	42.5 ± 7.12	0.057 ± 0.044	0.72 ± 0.26	11.8 ± 8.53	22.0 ± 0.53
	HS	0.21 ± 0.070	38.0 ± 12.8	0.17 ± 0.027	0.88 ± 0.47	10.5 ± 2.82	22.2 ± 0.84
Prakti Leo	CS	0.043 ± 0.010	37.5 ± 9.20	0.028 ± 0.012	0.65 ± 0.21	9.51 ± 3.13	22.6 ± 1.13
	HS	0.15 ± 0.027	30.7 ± 9.98	0.12 ± 0.016	0.81 ± 0.043	8.48 ± 1.03	23.2 ± 0.89
Zoom Jet	CS	0.023 ± 0.0076	32.5 ± 14.2	0.016 ± 0.014	0.96 ± 1.08	7.72 ± 2.23	22.7 ± 0.52
	HS	0.16 ± 0.077	31.6 ± 8.82	0.10 ± 0.077	0.57 ± 0.27	12.3 ± 3.04	23.0 ± 0.56

[a] Data were obtained from Xie et al. (2018); [b] values presented here have been divided by 1000; [c] sampling temperature; [d] measurements of only two filter samples were available, the values reported here are average ± difference between the two measurements/2

Table S3. Identified N-containing aromatic compounds by HPLC/ESI-Q-ToFMS from solid fuel combustions in cookstoves.

Suggested Formula	Theoretical m/z $[M-H]^-$	Measured m/z $[M-H]^-$	Proposed structure	Quantified as[b]	Absorbing as[c]
$C_6H_5NO_3$	138.0196	138.0194		 4-Nitrophenol ($C_6H_5NO_3$)	 4-Nitrophenol ($C_6H_5NO_3$)
$C_7H_7NO_3$ (Iso1[a])	152.0353	152.0356		 2-Methyl-4-nitrophenol ($C_7H_7NO_3$)	 2-Methyl-4-nitrophenol ($C_7H_7NO_3$)
$C_7H_7NO_3$ (Iso2)	152.0353	152.0361		 2-Methyl-4-nitrophenol ($C_7H_7NO_3$)	 2-Methyl-4-nitrophenol ($C_7H_7NO_3$)
$C_6H_5NO_4$	154.0145	154.0146		 4-Nitrocatechol ($C_6H_5NO_4$)	 4-Nitrocatechol ($C_6H_5NO_4$)
$C_7H_7NO_4$ (Iso1[a])	168.0302	168.0304		 2-Methyl-4-nitroresorcinol ($C_7H_7NO_4$)	 2-Methyl-4-nitroresorcinol ($C_7H_7NO_4$)
$C_7H_7NO_4$ (Iso2)	168.0302	168.0302		 2-Methyl-4-nitroresorcinol ($C_7H_7NO_4$)	 2-Methyl-4-nitroresorcinol ($C_7H_7NO_4$)
$C_8H_7NO_4$ (Iso1)	180.0302	180.0304		 2-Methyl-5-nitrobenzoic acid ($C_8H_7NO_4$)	 phenyl cyanate (C_7H_5NO)

[a] Isomer 1; [b] standard compounds used for the quantification of identified N-containing aromatic compounds; [c] standard compounds used to estimate the light absorption of N-containing aromatic compounds.

Table S3. Continue.

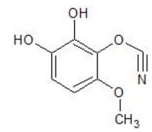
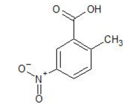
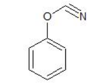
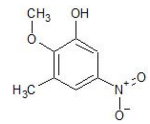
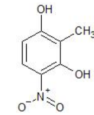
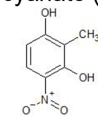
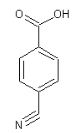
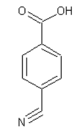
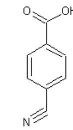
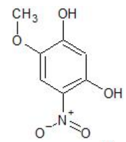
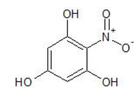
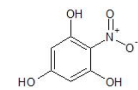
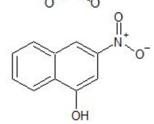
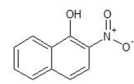
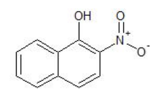
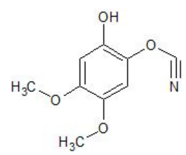
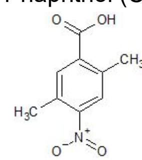
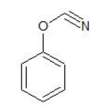
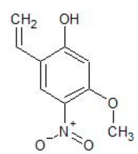
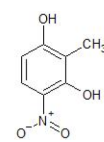
Suggested Formula	Theoretical m/z [M-H]⁻	Measured m/z [M-H]⁻	Proposed structure	Quantified as	Absorbing as
$C_8H_7NO_4$ (Iso2)	180.0302	180.0303		 2-Methyl-5-nitrobenzoic acid ($C_8H_7NO_4$)	 phenyl cyanate (C_7H_5NO)
$C_8H_9NO_4$	182.0459	182.0460		 2-Methyl-4-nitroresorcinol ($C_7H_7NO_4$)	 2-Methyl-4-nitroresorcinol ($C_7H_7NO_4$)
$C_8H_5NO_2$	146.0248	146.0248		 4-cyanobenzoic acid ($C_8H_5NO_2$)	 4-cyanobenzoic acid ($C_8H_5NO_2$)
$C_7H_7NO_5$	184.0253	184.0258		 2-Nitrophloroglucinol ($C_6H_5NO_5$)	 2-Nitrophloroglucinol ($C_6H_5NO_5$)
$C_{10}H_7NO_3$	188.0353	188.0357		 2-Nitro-1-naphthol ($C_{10}H_7NO_3$)	 2-Nitro-1-naphthol ($C_{10}H_7NO_3$)
$C_9H_9NO_4$ (Iso1)	194.0458	194.0464		 2,5-Dimethyl-4-nitrobenzoic acid ($C_9H_9NO_4$)	 phenyl cyanate (C_7H_5NO)
$C_9H_9NO_4$ (Iso2)	194.0458	194.0464		 2,5-Dimethyl-4-nitrobenzoic acid ($C_9H_9NO_4$)	 2-Methyl-4-nitroresorcinol ($C_7H_7NO_4$)

Table S3. Continue.

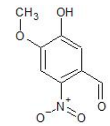
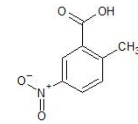
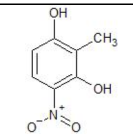
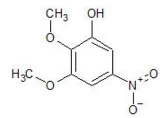
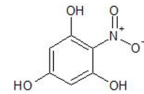
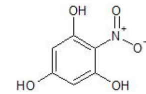
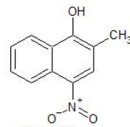
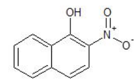
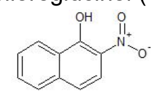
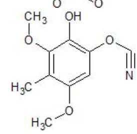
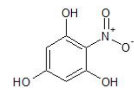
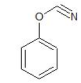
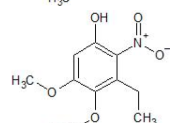
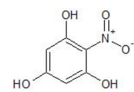
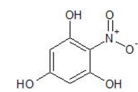
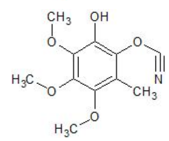
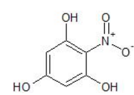
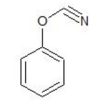
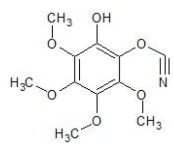
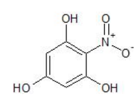
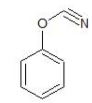
Suggested Formula	Theoretical m/z [M-H]⁻	Measured m/z [M-H]⁻	Proposed structure	Quantified as	Absorbing as
$C_8H_7NO_5$	196.0251	196.0252		 2-Methyl-5-nitrobenzoic acid ($C_8H_7NO_4$)	 2-Methyl-4-nitroresorcinol ($C_7H_7NO_4$)
$C_8H_9NO_5$	198.0407	198.0413		 2-Nitrophloroglucinol ($C_6H_5NO_5$)	 2-Nitrophloroglucinol ($C_6H_5NO_5$)
$C_{11}H_9NO_3$	202.0510	202.0492		 2-Nitro-1-naphthol ($C_{10}H_7NO_3$)	 2-Nitro-1-naphthol ($C_{10}H_7NO_3$)
$C_{10}H_{11}NO_4$	208.0615	208.0621		 2-Nitrophloroglucinol ($C_6H_5NO_5$)	 phenyl cyanate (C_7H_5NO)
$C_{10}H_{11}NO_5$	224.0564	224.0592		 2-Nitrophloroglucinol ($C_6H_5NO_5$)	 2-Nitrophloroglucinol ($C_6H_5NO_5$)
$C_{11}H_{13}NO_5$	238.0721	238.0722		 2-Nitrophloroglucinol ($C_6H_5NO_5$)	 phenyl cyanate (C_7H_5NO)
$C_{11}H_{13}NO_6$	254.0670	254.0670		 2-Nitrophloroglucinol ($C_6H_5NO_5$)	 phenyl cyanate (C_7H_5NO)

Table S4. $MAC_{365, iNAC}$ (m^2 g^{-1}) values for identified NAC formulas.

Formula	MW $(M\text{-}H)^-$	$MAC_{365,iNAC}$[a]
$C_6H_5NO_3$	138.0197	2.44
$C_7H_7NO_3$	152.0353	3.15
$C_6H_5NO_4$	154.0146	7.02
$C_7H_7NO_4$	168.0302	12.9
$C_8H_7NO_4$	180.0302	0
$C_8H_9NO_4$	182.0459	12.9
$C_8H_5NO_2$	146.0248	0[b]
$C_7H_7NO_5$	184.0251	14.0
$C_{10}H_7NO_3$	188.0353	3.75
$C_9H_9NO_4$	194.0459	12.9[c]
$C_8H_7NO_5$	196.0251	12.9
$C_8H_9NO_5$	198.0407	14.0
$C_{11}H_9NO_3$	202.051	3.75
$C_{10}H_{11}NO_4$	208.0615	0
$C_{10}H_{11}NO_5$	224.0564	14.0
$C_{11}H_{13}NO_5$	238.0721	0
$C_{11}H_{13}NO_6$	254.067	0

[a] Obtained from Xie et al. (2017, 2019); [c] obtained in this study, and no light absorption was observed for 4-cyanobenzoic acid at > 350 nm; [c] value for the second isomer, and the $MAC_{365,iNAC}$ of the first isomer is set at 0 based on its structure.

Table S5. Average emission factors of total NACs and OC

Fuel &Test phase	Red Oak		Charcoal	
	CS	HS[a]	CS	HS
		Front filter (Q_f)		
Sample number	18	17[b]	15	15
total NAC (mg kg^{-1} dry fuel)	1.18 ± 0.58	1.23 ± 0.69	0.79 ± 0.65	1.40 ± 0.65
OC (mg kg^{-1} dry fuel)	244 ± 170	340 ± 326	179 ± 114	619 ± 368
		Backup filter (Q_b)		
Sample number	18	17[b]	14[b]	15
total NAC (mg kg^{-1} dry fuel)	0.55 ± 0.24	0.61 ± 0.38	0.62 ± 0.53	1.83 ± 0.79
OC (mg kg^{-1} dry fuel)	30.5 ± 17.6	38.2 ± 24.8	66.5 ± 38.9	196 ± 96.2

[a] Including three SIM phase samples from the 3-stone fire; [b] one filter sample was missed for analysis.

Table S6. Average mass ratios (%) of individual NACs to OC (iNAC$_{OC}$%) in Q$_f$ samples for burning red oak in different household cookstoves.

Compound	3-Stone fire		EcoChula XXL		Envirofit G3300	
	CS	SIM	CS	HS	CS	HS
C6H5NO3	0.0054 ± 0.0009	0.0026 ± 0.0014	0.33 ± 0.069	0.33 ± 0.10	0.0015 ± 0.0012[b]	0.0018 ± 0.0015[b]
C7H7NO3	0.0008[a]	/	0.028 ± 0.0068	0.029 ± 0.010	0.0032[a]	/
C6H5NO4	0.040 ± 0.11	0.053 ± 0.057	0..082 ± 0.036	0.092 ± 0.050	0.024 ± 0.0062	0.021 ± 0.0052
C7H7NO4	0.018 ± 0.0075	0.020 ± 0.021	0.010 ± 0.0066	0.011 ± 0.010	0.0088 ± 0.0018	0.0097 ± 0.0069
C8H7NO4	0.034 ± 0.018	0.021 ± 0.0095[b]	0.021 ± 0.0030	0.021 ± 0.012	0.028 ± 0.0051	0.014 ± 0.0052
C8H9NO4	0.012 ± 0.0046	0.012 ± 0.0066	0.0030 ± 0.0013	0.0045 ± 0.0020	0.0038 ± 0.0017	0.0035 ± 0.0052
C8H5NO2	/	/	/	/	/	/
C7H7NO5	0.0014 ± 0.0006	0.0048 ± 0.0050	/	/	/	/
C10H7NO3	0.11 ± 0.026	0.037 ± 0.031	2.16 ± 0.35	2.04 ± 0.55	0.15 ± 0.068	0.087 ± 0.041
C9H9NO4	0.031 ± 0.012	0.020 ± 0.010	0.071 ± 0.035	0.051 ± 0.021	0.046 ± 0.013	0.015 ± 0.0052
C8H7NO5	0.0051[a]	/	0.026 ± 0.0047	0.029 ± 0.018	0.058 ± 0.026	0.016 ± 0.010
C8H9NO5	0.0094 ± 0.0053	0.012 ± 0.0095	0.071 ± 0.016	0.080 ± 0.050	0.011 ± 0.0040	0.0046 ± 0.0017
C11H9NO3	0.10 ± 0.057	0.034[a]	0.42 ± 0.10	0.38 ± 0.082	0.056 ± 0.019	0.044 ± 0.018
C10H11NO4	0.0069 ± 0.0047	0.0046 ± 0.0013	0.0042 ± 0.0013[b]	0.020[a]	0.013 ± 0.0068	0.0030 ± 0.0020
C10H11NO5	0.030 ± 0.0090	0.028 ± 0.014	/	0.015[a]	/	/
C11H13NO5	0.036 ± 0.016	0.062 ± 0.042	0.0028[a]	0.015[a]	0.0006[a]	/
C11H13NO6	0.0064 ± 0.0050	0.0008 ± 0.0008	0.0096 ± 0.0013	0.0040 ± 0.0014[b]	/	/
Subtotal	0.44 ± 0.17	0.28 ± 0.18	3.23 ± 0.50	3.09 ± 0.81	0.40 ± 0.14	0.22 ± 0.088
OC (µg m^{-3})	1113 ± 122	1090 ± 732	110 ± 16.5	149 ± 55.6	936 ± 248	2395 ± 1042

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S6. Continue

Compound	Home Stove		Jiko Poa		Jiko Poa (HM)	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.0028 ± 0.0007[b]	0.0040 ± 0.0021[b]	0.0023 ± 0.0017	0.0027[a]	0.0011 ± 0.0004[b]	0.0024 ± 0.0007[b]
C7H7NO3	0.0024[a]	0.0012 ± 0.0007[b]	0.0005 ± 0.0001	0.0004 ± 0.0001[b]	0.0002 ± 0.0000[b]	/
C6H5NO4	0.041 ± 0.0009	0.044 ± 0.027	0.029 ± 0.0059	0.034 ± 0.0067[b]	0.029 ± 0.011	0.044 ± 0.021
C7H7NO4	0.026 ± 0.0094	0.010 ± 0.0074	0.011 ± 0.0022	0.013 ± 0.0025[b]	0.0096 ± 0.0022	0.016 ± 0.0056
C8H7NO4	0.039 ± 0.012	0.011 ± 0.0022[b]	0.049 ± 0.014	0.061 ± 0.028[b]	0.031 ± 0.0039[b]	0.021 ± 0.011
C8H9NO4	0.020 ± 0.013	0.0023 ± 0.0018	0.0093 ± 0.0012	0.0085 ± 0.0036[b]	0.0071 ± 0.0022	0.010 ± 0.0023
C8H5NO2	/	/	0.24 ± 0.16	0.42 ± 0.14[b]	0.0065 ± 0.0012	0.028 ± 0.013
C7H7NO5	0.0077 ± 0.0025[b]	0.0021[a]	0.0069 ± 0.0022	0.0029 ± 0.0008[b]	0.0061 ± 0.0019	0.0075 ± 0.0036
C10H7NO3	0.13 ± 0.10	0.12 ± 0.071	0.093 ± 0.023	0.12 ± 0.017[b]	0.051 ± 0.0092	0.090 ± 0.034
C9H9NO4	0.12 ± 0.034	0.085 ± 0.029	0.060 ± 0.015	0.060 ± 0.023[b]	0.057 ± 0.027	0.050 ± 0.026
C8H7NO5	0.10 ± 0.075	0.11 ± 0.0061	0.027 ± 0.019	0.037 ± 0.0072[b]	0.0028[a]	0.0059 ± 0.0045
C8H9NO5	0.10 ± 0.046	0.098 ± 0.087	0.018 ± 0.0061	0.026 ± 0.0096[b]	0.0097 ± 0.0020	0.021 ± 0.0093
C11H9NO3	0.086 ± 0.054	0.057 ± 0.024[b]	0.057 ± 0.0064	0.072 ± 0.028[b]	0.026 ± 0.0036	0056 ± 0.019
C10H11NO4	0.024 ± 0.0024	0.047 ± 0.030	0.016 ± 0.0089	0.016 ± 0.0045[b]	0.0093 ± 0.0043	0.013 ± 0.0067
C10H11NO5	0.085 ± 0.047	0.040 ± 0.020	0.046 ± 0.022	0.045 ± 0.016[b]	0.075 ± 0.038	0.10 ± 0.066
C11H13NO5	0.072 ± 0.017	0.099 ± 0.081	0.031 ± 0.0025	0.029 ± 0.0064[b]	0.085 ± 0.060	0.13 ± 0.098
C11H13NO6	0.026 ± 0.0066	0.035 ± 0.032	0.0066 ± 0.0035	0.013 ± 0.0010[b]	0.0045 ± 0.0030	0.016 ± 0.014
Subtotal	0.89 ± 0.21	0.74 ± 0.40	0.70 ± 0.090	0.96± 0.029[b]	0.40 ± 0.18	0.61 ± 0.32
OC (μg m^{-3})	149 ± 25.6	212 ± 80.7	574 ± 27.7	776 ± 66.0	861 ± 161	824 ± 164

Table S7. Average mass ratios (%) of individual NACs to OC ($iNAC_{OC}$%) in Q_b samples for burning red oak in different household cookstoves.

Compound	3-stone fire		EcoChula XXL		Envirofit G3300	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.0052[a]	0.0038 ± 0.0040	0.77 ± 0.16	0.75 ± 0.12	0.0049 ± 0.0035b	0.011[a]
C7H7NO3	/	/	0.077 ± 0.027	0.077 ± 0.0094	0.032[a]	
C6H5NO4	0.17 ± 0.018	0.21 ± 0.19	0.37 ± 0.20	0.90 ± 0.94	0.091 ± 0.016	0.14 ± 0.036
C7H7NO4	0.10 ± 0.039	0.11 ± 0.085	0.033 ± 0.023	0.046 ± 0.042	0.095 ± 0.024	0.16 ± 0.050
C8H7NO4	0.090 ± 0.046	0.015 ± 0.011	0.026[a]	0.023[a]	0.12 ± 0.0077	0.14 ± 0.055
C8H9NO4	0.057 ± 0.0011	0.074 ± 0.022	0.013 ± 0.0034	0.015 ± 0.012	0.047 ± 0.022	0.099 ± 0.078
C8H5NO2	/	/	/	/	/	/
C7H7NO5	0.021 ± 0.0047	0.033 ± 0.033	/	/	/	/
C10H7NO3	0.25 ± 0.11	0.076 ± 0.10	7.27 ± 2.60	4.21 ± 1.73	0.22 ± 0.12	0.18 ± 0.22
C9H9NO4	0.17 ± 0.081	0.14 ± 0.13	0.21 ± 0.11	0.20 ± 0.19	0.27 ± 0.050	0.14 ± 0.041
C8H7NO5	0.023 ± 0.0058	0.019 ± 0.0050	0.15 ± 0.053	0.13 ± 0.026	0.33 ± 0.12	0.082 ± 0.061
C8H9NO5	0.071 ± 0.034	0.073 ± 0.040	0.33 ± 0.12	0.32 ± 0.22	0.055 ± 0.028	0.031 ± 0.012
C11H9NO3	0.50 ± 0.24	0.10 ± 0.096	1.11 ± 0.78	1.37 ± 0.31	0.26 ± 0.089	0.25 ± 0.17
C10H11NO4	0.047 ± 0.031	0.041 ± 0.025	0.021 ± 0.015	0.039 ± 0.063	0.052 ± 0.017	0.013 ± 0.0043
C10H11NO5	0.25 ± 0.11	0.45 ± 0.40	/	/	/	/
C11H13NO5	0.11 ± 0.070	0.33 ± 0.33	0.017[a]	/	0.0008[a]	/
C11H13NO6	0.0009 ± 0.0004	0.0060 ± 0.0053[b]	/	/	/	/
Subtotal	1.86 ± 0.76	1.67 ± 0.88	10.4 ± 2.94	8.70 ± 1.78	1.56 ± 0.35	1.23 ± 0.45
OC (μg m^{-3})	132 ± 9.14	157 ± 66.3	22.1 ± 2.44	27.2 ± 6.99	95.3 ± 22.9	152 ± 34.0

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S7. Continue

Compound	Home Stove		Jiko Poa		Jiko Poa (HM)	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.013 ± 0.012[b]	0.0031 ± 0.0009[b]	0.0068 ± 0.0028	0.0059[a]	0.00050[a]	0.0023 ± 0.0017[b]
C7H7NO3	/	/	0.0013 ± 0.0002	0.0010 ± 0.0009[b]	/	/
C6H5NO4	0.13 ± 0.016	0.12 ± 0.035	0.10 ± 0.027	0.11 ± 0.088[b]	0.13 ± 0.044	0.21 ± 0.093
C7H7NO4	0.069 ± 0.055	0.024 ± 0.0070	0.072 ± 0.012	0.063 ± 0.055[b]	0.067 ± 0.014	0.090 ± 0.0052
C8H7NO4	0.063 ± 0.018[b]	/	0.20 ± 0.074	0.20 ± 0.16[b]	0.11 ± 0.015[b]	0.054 ± 0.039
C8H9NO4	0.052 ± 0.051	0.0042 ± 0.0025	0.068 ± 0.0068	0.053 ± 0.038[b]	0.052 ± 0.026	0.053 ± 0.018
C8H5NO2	/	/	0.023 ± 0.0019[b]	0.12 ± 0.056[b]	0.0046[a]	/
C7H7NO5	0.018 ± 0.0079[b]	0.0045[a]	0.010 ± 0.0008	0.0073 ± 0.0035[b]	0.024 ± 0.0034	0.037 ± 0.014
C10H7NO3	0.43 ± 0.46	0.20 ± 0.15	0.10 ± 0.0030	0.10 ± 0.060[b]	0.051 ± 0.0018	0.12 ± 0.031
C9H9NO4	0.49 ± 0.20	0.35 ± 0.082	0.23 ± 0.075	0.24 ± 0.099[b]	0.20 ± 0.091	0.23 ± 0.14
C8H7NO5	0.46 ± 0.22	0.35 ± 0.18	0.077 ± 0.026	0.10 ± 0.011[b]	0.023 ± 0.019	0.034 ± 0.016
C8H9NO5	0.45 ± 0.13	0.29 ± 0.030	0.053 ± 0.0046	0.074 ± 0.050[b]	0.070 ± 0.034	0.088 ± 0.012
C11H9NO3	0.31 ± 0.18	0.11 ± 0.050[b]	0.27 ± 0.023	0.27 ± 0.17[b]	0.12 ± 0.0063	0.20 ± 0.016
C10H11NO4	0.094 ± 0.0035	0.11 ± 0.067	0.031 ± 0.018	0.041 ± 0.015[b]	0.038 ± 0.024	0.052 ± 0.039
C10H11NO5	0.28 ± 0.13	0.13 ± 0.041	0.24 ± 0.059	0.23 ± 0.15[b]	0.47 ± 0.17	0.43 ± 0.21
C11H13NO5	0.12 ± 0.069	0.064 ± 0.043	0.048 ± 0.012	0.048 ± 0.014[b]	0.29 ± 0.23	0.28 ± 0.22
C11H13NO6	/	0.0050[a]	0.0007 ± 0.0003	0.0012[a]	0.0033 ± 0.0028	0.0030 ± 0.0013
Subtotal	2.96 ± 0.82	1.74 ± 0.21	1.53 ± 0.29	1.65 ± 0.36[b]	1.61 ± 0.54	1.87 ± 0.75
OC (μg m^{-3})	28.1 ± 3.25	39.5 ± 0.92	80.6 ± 6.49	110 ± 15.7	113 ± 12.3	115 ± 17.9

Table S8. Average mass ratios (%) of individual NACs to OC (iNAC$_{OC}$%) in Q_f samples for burning charcoal in different household cookstoves.

Compound	CH4400		Éclair		Jiko Koa	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.047 ± 0.042	0.055 ± 0.035b	0.010 ± 0.0037	0.0035 ± 0.0025	0.0062 ± 0.0067	0.0027 ± 0.0008
C7H7NO3	0.0090 ± 0.0053	0.0073 ± 0.0032	0.0027 ± 0.0014	0.0011[a]	0.0038 ± 0.0002[b]	0.0011[a]
C6H5NO4	/	0.030[a]	0.019 ± 0.0025[b]	0.041 ± 0.0038	0.073[a]	0.033 ± 0.022
C7H7NO4	0.0045[a]	0.0024[a]	0.0030 ± 0.0005	0.024 ± 0.0035	0.040 ± 0.038[b]	0.025 ± 0.028
C8H7NO4	/	/	/	0.0066[a]	/	/
C8H9NO4	0.0015 ± 0.0008[b]	0.0023 ± 0.0016[b]	0.0041 ± 0.0004[b]	0.029 ± 0.0094	0.034 ± 0.032[b]	0.025 ± 0.030
C8H5NO2	/	/	0.16 ± 0.13	0.039 ± 0.030	/	/
C7H7NO5	/	/	0.00075[a]	0.0056 ± 0.0031	0.011[a]	0.0046 ± 0.0035[b]
C10H7NO3	0.17 ± 0.13	0.17 ± 0.041	0.077 ± 0.047	0.016 ± 0.011	0.055 ± 0.018	0.018 ± 0.016
C9H9NO4	0.010[a]	0.025[a]	0.0032 ± 0.0001[b]	0.028 ± 0.017	/	/
C8H7NO5	0.11[a]	0.041 ± 0.022[b]	0.015 ± 0.0047	0.0033[a]	0.0083 ± 0.0043	/
C8H9NO5	0.094 ± 0.15	0.20 ± 0.14	0.12 ± 0.025	0.030 ± 0.022	0.030 ± 0.011	0.016 ± 0.017
C11H9NO3	0.065 ± 0.065	0.13 ± 0.075	0.061 ± 0.045	0.044 ± 0.044	0.064 ± 0.055	0.041 ± 0.031
C10H11NO4	0.0076[a]	0.040[a]	0.0015 ± 0.0006	0.0039 ± 0.0038	/	0.00088[a]
C10H11NO5	/	/	/	0.016 ± 0.0064[b]	/	0.0013[a]
C11H13NO5	/	/	0.0011 ± 0.0002[b]	0.0087 ± 0.0091	0.0022[a]	0.0008 ± 0.0001[b]
C11H13NO6	/	/	/		/	/
Subtotal	0.43 ± 0.45	0.61 ± 0.27	0.47 ± 0.097	0.28 ± 0.066	0.25 ± 0.17	0.16 ± 0.077
OC (μg m^{-3})	48.2 ± 20.4	72.4 ± 41.9	186 ± 67.7	474 ± 21.8	143 ± 94.8	626 ± 313

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S8. Continue

Compound	Prakti Leo		Zoom Jet	
	CS	HS	CS	HS
C6H5NO3	0.015 ± 0.0033	0.0041 ± 0.0016	0.0095 ± 0.0020	0.0020 ± 0.0014
C7H7NO3	0.0039 ± 0.0030	0.0008[a]	0.0039 ± 0.0015	/
C6H5NO4	0.016 ± 0.0062[b]	0.040 ± 0.017	0.034[a]	0.038 ± 0.029
C7H7NO4	0.0014 ± 0.0005[b]	0.038 ± 0.021	0.0037 ± 0.0021[b]	0.037 ± 0.030
C8H7NO4	/	/	/	0.0028[a]
C8H9NO4	0.0038 ± 0.0002[b]	0.058 ± 0.034	0.015[a]	0.040 ± 0.016
C8H5NO2	/	/	/	/
C7H7NO5	0.0031[a]	0.0078 ± 0.0063	0.0062[a]	0.0089 ± 0.0094
C10H7NO3	0.12 ± 0.093	0.019 ± 0.0066	0.072 ± 0.032	0.030 ± 0.021
C9H9NO4	0.012[a]	0.0060[a]	/	0.019[a]
C8H7NO5	0.042 ± 0.0029[b]	0.0008[a]	0.044[a]	/
C8H9NO5	0.26 ± 0.15	0.017 ± 0.0045	0.18 ± 0.26	0.060 ± 0.087
C11H9NO3	0.089 ± 0.083	0.030 ± 0.0038	0.040 ± 0.018	0.064 ± 0.058
C10H11NO4	0.0026 ± 0.0004[b]	0.0014 ± 0.0010	/	0.0019 ± 0.0008
C10H11NO5	/	0.0019 ± 0.0007[b]	/	0.0017 ± 0.0001[b]
C11H13NO5	0.0011	0.0018 ± 0.0010[b]	/	0.0042 ± 0.0020
C11H13NO6	/	/	/	/
Subtotal	0.54 ± 0.083	0.22 ± 0.058	0.34 ± 0.32	0.29 ± 0.24
OC (μg m^{-3})	125 ± 63.4	504 ± 92.2	73.5 ± 13.4	558 ± 347

Table S9. Average mass ratios (%) of individual NACs to OC (iNAC$_{OC}$%) in Q$_b$ samples for burning charcoal in different household cookstoves.

Compound	CH4400		Éclair		Jiko Koa	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.12 ± 0.010[b]	0.056 ± 0.074	0.0083 ± 0.0049	0.0039[a]	0.071[a]	0.0006 ± 0.00002[b]
C7H7NO3	0.020 ± 0.0058[b]	0.0096 ± 0.0063	0.0035 ± 0.0011[b]	0.0014[a]	0.0046 ± 0.0026[b]	/
C6H5NO4	/	0.32[a]	0.054 ± 0.012[b]	0.14 ± 0.015	0.086 ± 0.074[b]	0.11 ± 0.066
C7H7NO4	0.029[a]	0.064[a]	0.0087 ± 0.0031	0.12 ± 0.051	0.11 ± 0.11[b]	0.13 ± 0.12
C8H7NO4	/	/	/	0.051[a]	/	/
C8H9NO4	0.0031 ± 0.0024[b]	0.016[a]	0.0091 ± 0.0032[b]	0.18 ± 0.13	0.092 ± 0.091[b]	0.11 ± 0.11
C8H5NO2	/	/	/	/	/	/
C7H7NO5	/	/	/	0.021 ± 0.011	0.030[a]	0.0092[a]
C10H7NO3	0.76 ± 0.023[b]	0.43 ± 0.19	0.10 ± 0.084	0.036 ± 0.035	0.10 ± 0.021	0.0033 ± 0.040
C9H9NO4	0.041[a]	0.037[a]	0.0077 ± 0.0022[b]	0.070 ± 0.061	/	0.053[a]
C8H7NO5	0.17[a]	0.087[a]	0.023 ± 0.012[b]	0.013 ± 0.0019	0.011[a]	0.037[a]
C8H9NO5	0.23 ± 0.11[b]	0.39 ± 0.14	0.33 ± 0.11	0.20 ± 0.11	0.13 ± 0.074	0.046 ± 0.025
C11H9NO3	0.99 ± 0.36[b]	0.37 ± 0.25	0.13 ± 0.086	0.18 ± 0.18	0.23 ± 0.17	0.11 ± 0.060
C10H11NO4	0.0067[a]	0.0063[a]	0.0030 ± 0.0010[b]	0.019 ± 0.015	/	0.0099[a]
C10H11NO5	/	/	0.0007[a]	0.075 ± 0.071	/	0.0011[a]
C11H13NO5	/	/	0.0033[a]	0.041 ± 0.042	0.0063[a]	0.0038[a]
C11H13NO6	/	/	/	/	/	/
Subtotal	2.25 ± 0.17[b]	1.44 ± 0.20	0.65 ± 0.23	1.12 ± 0.12	0.70 ± 0.51	0.58 ± 0.20
OC (μg m^{-3})	19.2 ± 14.7[b]	40.5 ± 15.3	59.0 ± 17.0	131 ± 7.68	57.8 ± 30.8	212 ± 69.7

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S9. Continue

	Prakti Leo		Zoom Jet	
	CS	HS	CS	HS
C6H5NO3	0.017 ± 0.017	0.0034[a]	0.0065 ± 0.0046[b]	/
C7H7NO3	0.0046 ± 0.0025	/	0.0096 ± 0.010	/
C6H5NO4	0.049 ± 0.032[b]	0.17 ± 0.14	0.20[a]	0.17 ± 0.11
C7H7NO4	0.0063 ± 0.0046[b]	0.28 ± 0.29	0.011 ± 0.017	0.19 ± 0.12
C8H7NO4	/	/	/	/
C8H9NO4	0.011 ± 0.0062[b]	0.31 ± 0.26	0.065[a]	0.18 ± 0.070
C8H5NO2	/	/	/	/
C7H7NO5	0.0041[a]	0.052 ± 0.062	/	0.036 ± 0.027
C10H7NO3	0.13 ± 0.095	0.026 ± 0.012	0.10 ± 0.12	0.041 ± 0.041
C9H9NO4	0.078[a]	0.048 ± 0.0056[b]	/	0.031 ± 0.013
C8H7NO5	0.072 ± 0.018[b]	0.018[a]	/	0.019 ± 0.0081[b]
C8H9NO5	0.57 ± 0.37	0.13 ± 0.016	0.97 ± 1.51	0.21 ± 0.24
C11H9NO3	0.12 ± 0.072	0.12 ± 0.012	0.24 ± 0.14	0.18 ± 0.16
C10H11NO4	0.0051 ± 0.0007[b]	0.0081 ± 0.037	0.0051[a]	0.0078 ± 0.0023
C10H11NO5	/	0.021 ± 0.0014[b]	/	0.023 ± 0.017
C11H13NO5	/	0.013 ± 0.013[b]	/	0.025 ± 0.019
C11H13NO6	/	/	/	/
subtotal	0.96 ± 0.33	1.17 ± 0.75	1.34 ± 1.64	1.12 ± 0.76
OC ($\mu g\ m^{-3}$)	43.1 ± 10.4	149 ± 26.5	22.6 ± 7.59	157 ± 77.4

Table S10. Vapor pressure of five NAC standards at 25 °C ($p^{o,*}_L$).

Standard compounds	Formula	*m/z*, [M-H]$^-$	$p^{o,*}_L$ (atm)
4-Nitrophenol	$C_6H_5NO_3$	138.0196	1.58×10^{-5}
2-Methyl-4-nitrophenol	$C_7H_7NO_3$	152.0353	4.57×10^{-6}
4-Nitrocatechol	$C_6H_5NO_4$	154.0145	3.37×10^{-7}
2-Methyl-5-nitrobenzoic acid	$C_8H_7NO_4$	180.0302	1.07×10^{-8}
2-Nitro-1-naphthol	$C_{10}H_7NO_3$	188.0353	4.62×10^{-8}

Table S11. Average contributions (%) of individual NACs to Abs_{365} of Q_f extracts for burning red oak in different household cookstoves.

Compound	3-stone fire		EcoChula XXL		Envirofit G3300	
	CS	SIM	CS	HS	CS	HS
C6H5NO3	0.0040 ± 0.0007	0.024 ± 0.0005	0.090 ± 0.060	0.20 ± 0.12	0.0011 ± 0.0009[b]	0.0015 ± 0.0012[b]
C7H7NO3	0.0007[a]	/	0.010 ± 0.0071	0.23 ± 0.014	0.0032[a]	/
C6H5NO4	0.085 ± 0.023	0.13 ± 0.10	0.054 ± 0.0054	0.16 ± 0.12	0.059 ± 0.012	0.048 ± 0.011
C7H7NO4	0.071 ± 0.029	0.090 ± 0.070	0.011 ± 0.0052	0.032 ± 0.039	0.039 ± 0.0025	0.041 ± 0.028
C8H7NO4	/	/	/	/	/	/
C8H9NO4	0.046 ± 0.017	0.059 ± 0.018	0.0037 ± 0.0010	0.014 ± 0.0098	0.017 ± 0.0075	0.015 ± 0.022
C8H5NO2	/	/	/	/	/	/
C7H7NO5	0.0059 ± 0.0026	0.023 ± 0.019	/	/	/	/
C10H7NO3	0.12 ± 0.030	0.051 ± 0.027	0.90 ± 0.54	1.92 ± 1.16	0.19 ± 0.076	0.11 ± 0.049
C9H9NO4	0.060 ± 0.022	0.043 ± 0.016	0.016 ± 0.0023[b]	0.021 ± 0.014[b]	0.070 ± 0.018	0.026 ± 0.013
C8H7NO5	0.020[a]		0.037 ± 0.022	0.090 ± 0.075	0.25 ± 0.093	0.069 ± 0.044
C8H9NO5	0.040 ± 0.023	0.061 ± 0.029	0.10 ± 0.045	0.31 ± 0.29	0.056 ± 0.032	0.021 ± 0.072
C11H9NO3	0.12 ± 0.064	0.037	0.18 ± 0.12	0.36 ± 0.22	0.073 ± 0.023	0.055 ± 0.021
C10H11NO4	/	/	/	/	/	/
C10H11NO5	0.13 ± 0.038	0.16 ± 0.090	/	0.068[a]	/	/
C11H13NO5	/	/	/	/	/	/
C11H13NO6	/	/	/	/	/	/
Subtotal	0.69 ± 0.25	0.63 ± 0.28	1.39 ± 0.78	3.14 ± 1.91	0.76 ± 0.21	0.39 ± 0.15

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S11. Continue

Compound	Home Stove		Jiko Poa		Jiko Poa (HM)	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.0017 ± 0.0000[b]	0.0036 ± 0.0015[b]	0.0015 ± 0.0011	0.0024[a]	0.0011 ± 0.0004[b]	0.0014 ± 0.0004[b]
C7H7NO3	0.0011[a]	0.0012 ± 0.0007[b]	0.0004 ± 0.0001	0.0004 ± 0.0001[b]	0.0003 ± 0.0000[b]	/
C6H5NO4	0.068 ± 0.021	0.11 ± 0.056	0.051 ± 0.0030	0.070 ± 0.0014[b]	0.079 ± 0.025	0.076 ± 0.035
C7H7NO4	0.084 ± 0.056	0.045 ± 0.028	0.034 ± 0.0027	0.048 ± 0.0010[b]	0.048 ± 0.014	0.050 ± 0.015
C8H7NO4	/	/	/	/	/	/
C8H9NO4	0.062 ± 0.043	0.0099 ± 0.0073	0.030 ± 0.0006	0.031 ± 0.0083[b]	0.036 ± 0.015	0.032 ± 0.0050
C8H5NO2	/	/	/	/	/	/
C7H7NO5	0.027 ± 0.0018[b]	0.0093[a]	0.024 ± 0.0057	0.012 ± 0.0013[b]	0.033 ± 0.010	0.026 ± 0.012
C10H7NO3	0.10 ± 0.047	0.15 ± 0.079	0.087 ± 0.012	0.13 ± 0.0040[b]	0.073 ± 0.0057	0.083 ± 0.029
C9H9NO4	0.16 ± 0.0000[b]	/	0.11 ± 0.016	0.12 ± 0.031[b]	0.12 ± 0.057	0.066 ± 0.031
C8H7NO5	0.27 ± 0.13	0.51 ± 0.13	0.083 ± 0.052	0.14 ± 0.0025[b]	0.016[a]	0.018 ± 0.013
C8H9NO5	0.31 ± 0.13	0.46 ± 0.41	0.061 ± 0.014	0.11 ± 0.021[b]	0.052 ± 0.0063	0.073 ± 0.027
C11H9NO3	0.071 ± 0.043	0.069 ± 0.027	0.054 ± 0.0040	0.076 ± 0.018[b]	0.038 ± 0.0041	0.052 ± 0.014
C10H11NO4	/	/	/	/	/	/
C10H11NO5	0.29 ± 0.19	0.20 ± 0.083	0.16 ± 0.016	0.21 ± 0.10[b]	0.40 ± 0.19	0.34 ± 0.22
C11H13NO5	/	/	/	/	/	/
C11H13NO6	/	/	/	/	/	/
subtotal	1.38 ± 0.48	1.54 ± 0.56	0.69 ± 0.093	0.94 ± 0.025[b]	0.88 ± 0.27	0.82 ± 0.37

Table S12. Average contributions (%) of individual NACs to Abs_{365} of Q_b extracts for burning red oak in different household cookstoves.

Compound	3-stone fire		EcoChula XXL		Envirofit G3300	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.0076[a]	0.0060 ± 0.0060	0.69 ± 0.20	0.63 ± 0.25	0.0079 ± 0.0062b	0.011[a]
C7H7NO3	/	/	0.089 ± 0.030	0.081 ± 0.018	0.051[a]	/
C6H5NO4	0.64 ± 0.029	0.97 ± 0.83	0.85 ± 0.32	2.05 ± 1.83	0.35 ± 0.074	0.46 ± 0.024
C7H7NO4	0.72 ± 0.24	0.89 ± 0.67	0.14 ± 0.060	0.24 ± 0.28	0.67 ± 0.11	1.05 ± 0.48
C8H7NO4	/	/	/	/	/	/
C8H9NO4	0.41 ± 0.036	0.63 ± 0.14	0.062 ± 0.025	0.078 ± 0.084	0.33 ± 0.13	0.64 ± 0.47
C8H5NO2	/	/	/	/	/	/
C7H7NO5	0.16 ± 0.026	0.31 ± 0.29	/	/	/	/
C10H7NO3	0.50 ± 0.21	0.18 ± 0.23	9.55 ± 1.73	5.65 ± 3.70	0.45 ± 0.22	0.29 ± 0.31
C9H9NO4	0.40 ± 0.18	0.30 ± 0.11	/	0.032[a]	0.86 ± 0.12	0.57 ± 0.17
C8H7NO5	0.16 ± 0.036	0.16 ± 0.020	0.66 ± 0.070	0.58 ± 0.29	2.28 ± 0.57	0.47 ± 0.28
C8H9NO5	0.53 ± 0.24	0.67 ± 0.33	1.63 ± 0.20	1.73 ± 1.67	0.45 ± 0.31	0.21 ± 0.036
C11H9NO3	1.01 ± 0.44	0.24 ± 0.22	1.57 ± 1.13	1.74 ± 0.60	0.54 ± 0.18	0.42 ± 0.21
C10H11NO4	/	/	/	/	/	/
C10H11NO5	1.91 ± 0.78	3.90 ± 3.01	/	/	/	/
C11H13NO5	/	/	/	/	/	/
C11H13NO6	/	/	/	/	/	/
subtotal	6.44 ± 1.96	8.27 ± 2.86	15.2 ± 0.75	12.8 ± 6.46	5.95 ± 0.62	4.10 ± 0.33

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S12. Continue

Compound	Home Stove		Jiko Poa		Jiko Poa (HM)	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.016 ± 0.014[b]	0.0061 ± 0.0019[b]	0.0075 ± 0.0033	0.0079[a]	0.0009[a]	0.0037 ± 0.0017[b]
C7H7NO3	/	/	0.0019 ± 0.0003	0.0018 ± 0.0011[b]	/	/
C6H5NO4	0.61 ± 0.32	0.95 ± 0.59	0.33 ± 0.078	0.41 ± 0.24[b]	0.69 ± 0.21	1.03 ± 0.38
C7H7NO4	0.57 ± 0.39	0.33 ± 0.17	0.42 ± 0.061	0.45 ± 0.28[b]	0.66 ± 0.18	0.86 ± 0.16
C8H7NO4	/	/	/	/	/	/
C8H9NO4	0.43 ± 0.34	0.050 ± 0.019	0.40 ± 0.032	0.37 ± 0.19[b]	0.52 ± 0.29	0.52 ± 0.24
C8H5NO2	/	/	/	/	/	/
C7H7NO5	0.16 ± 0.017[b]	0.048[a]	0.065 ± 0.0050	0.056 ± 0.020[b]	0.25 ± 0.034	0.37 ± 0.13
C10H7NO3	0.96 ± 0.81	0.92 ± 1.00	0.17 ± 0.0043	0.21 ± 0.090[b]	0.15 ± 0.0042	0.32 ± 0.035
C9H9NO4	1.21 ± 0.015[b]	/	0.79 ± 0.24	0.89 ± 0.40[b]	0.81 ± 0.33	0.37 ± 0.19
C8H7NO5	3.81 ± 1.65	4.53 ± 2.00	0.45 ± 0.15	0.73 ± 0.062[b]	0.24 ± 0.20	0.33 ± 0.18
C8H9NO5	4.22 ± 2.20	4.24 ± 1.52	0.33 ± 0.020	0.57 ± 0.28[b]	0.76 ± 0.41	0.90 ± 0.20
C11H9NO3	0.81 ± 0.57	0.53 ± 0.36[b]	0.46 ± 0.027	0.55 ± 0.26[b]	0.34 ± 0.0043	0.54 ± 0.053
C10H11NO4	/	/	/	/	/	/
C10H11NO5	2.72 ± 1.78	1.94 ± 0.88	1.49 ± 0.35	1.72 ± 0.79[b]	4.97 ± 1.53	4.35 ± 2.08
C11H13NO5	/	/	/	/	/	/
C11H13NO6	/	/	/	/	/	/
subtotal	15.0 ± 6.21	13.3 ± 5.28	4.91 ± 0.85	5.96 ± 1.04	9.38 ± 1.10	9.59 ± 2.35

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S13. Average contributions (%) of individual NACs to Abs_{365} of Q_f extracts for burning charcoal in different household cookstoves.

Compound	CH4400		Éclair		Jiko Koa	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.081 ± 0.11	0.087 ± 0.067[b]	0.032 ± 0.020	0.0054 ± 0.0034	0.0088 ± 0.0075	0.0037 ± 0.0002[b]
C7H7NO3	0.017 ± 0.022	0.014 ± 0.0088	0.011 ± 0.0082	0.0022[a]	0.0093 ± 0.0051[b]	0.0015[a]
C6H5NO4	/	0.092[a]	0.13 ± 0.014[b]	0.19 ± 0.0013	0.17[a]	0.13 ± 0.082
C7H7NO4	0.019a	0.013[a]	0.039 ± 0.0036[b]	0.21 ± 0.050	0.18 ± 0.15[b]	0.19 ± 0.19
C8H7NO4	/	/	/	/	/	/
C8H9NO4	0.0091 ± 0.0009b	0.020 ± 0.016[b]	0.053 ± 0.0070[b]	0.25 ± 0.096	0.16 ± 0.13[b]	0.19 ± 0.20
C8H5NO2	/	/	/	/	/	/
C7H7NO5	/	/	0.0083[a]	0.054 ± 0.033	0.051[a]	0.037 ± 0.025[b]
C10H7NO3	0.43 ± 0.57	0.37 ± 0.16	0.31 ± 0.073	0.038 ± 0.023	0.15 ± 0.15	0.035 ± 0.024
C9H9NO4	/	/	/	/	/	/
C8H7NO5	1.25[a]	0.35 ± 0.22[b]	0.25 ± 0.13	0.026[a]	0.070 ± 0.064	/
C8H9NO5	1.14 ± 1.90	1.73 ± 1.63	2.05 ± 0.73	0.27 ± 0.17	0.30 ± 0.16	0.11 ± 0.10
C11H9NO3	0.18 ± 0.26	0.25 ± 0.13	0.24 ± 0.082	0.10 ± 0.095	0.12 ± 0.079	0.079 ± 0.046
C10H11NO4	/	/	/	/	/	/
C10H11NO5	/	/	/	0.16 ± 0.055	/	0.010[a]
C11H13NO5	/	/	/	/	/	/
C11H13NO6	/	/	/	/	/	/
subtotal	2.27 ± 3.59	2.71 ± 2.20	3.03 ± 0.72	1.24 ± 0.065	0.95 ± 0.51	0.7675

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S13. Continue

Compound	Prakti Leo		Zoom Jet	
	CS	HS	CS	HS
C6H5NO3	0.015 ± 0.0098	0.0074 ± 0.0041	0.010 ± 0.0044	0.0028 ± 0.0015
C7H7NO3	0.0039 ± 0.0010[b]	0.0027 ± 0.0011[b]	0.0059 ± 0.0035	/
C6H5NO4	0.21 ± 0.14[b]	0.12 ± 0.11	0.069[a]	0.15 ± 0.094
C7H7NO4	0.46 ± 0.45[b]	0.17 ± 0.20	0.016 ± 0.0053[b]	0.27 ± 0.18
C8H7NO4	/	/	/	/
C8H9NO4	0.88 ± 0.85[b]	0.22 ± 0.25	0.055[a]	0.30 ± 0.068
C8H5NO2	/	/	/	/
C7H7NO5	0.082 ± 0.062[b]	0.065 ± 0.045[b]	0.025[a]	0.067 ± 0.065
C10H7NO3	0.12 ± 0.034	0.078 ± 0.053	0.12 ± 0.071	0.063 ± 0.034
C9H9NO4	/	/	/	/
C8H7NO5	0.21 ± 0.18	/	0.16[a]	/
C8H9NO5	1.86 ± 1.27	0.17 ± 0.056	0.76 ± 1.01	0.45 ± 0.62
C11H9NO3	0.11 ± 0.058	0.082 ± 0.029	0.065 ± 0.039	0.13 ± 0.10
C10H11NO4	/	/	/	/
C10H11NO5	0.059[a]	0.0090[a]	/	0.016 ± 0.0020[b]
C11H13NO5	/	/	/	/
C11H13NO6	/	/	/	/
subtotal	3.43 ± 0.42	0.89 ± 0.49	1.08 ± 1.14	1.44 ± 1.13

Table S14. Average contributions (%) of individual NACs to Abs_{365} of Q_b extracts for burning charcoal in different household cookstoves.

Compound	CH4400		Éclair		Jiko Koa	
	CS	HS	CS	HS	CS	HS
C6H5NO3	0.37 ± 0.35[b]	0.31 ± 0.35	0.076 ± 0.091	0.012[a]	/	0.0018 ± 0.0007[b]
C7H7NO3	0.066 ± 0.043[b]	0.081 ± 0.063	0.043 ± 0.034[b]	0.0057[a]	0.014[a]	/
C6H5NO4	/	1.76[a]	0.65 ± 0.071[b]	1.21 ± 0.25	0.66 ± 0.48[b]	1.17 ± 0.90
C7H7NO4	0.19[a]	0.64[a]	0.18 ± 0.0070[b]	1.89 ± 0.74	1.50 ± 1.47[b]	2.81 ± 2.86
C8H7NO4	/	/	/	/	/	/
C8H9NO4	0.024 ± 0.012[b]	0.16[a]	0.19 ± 0.0046[b]	2.86 ± 2.26	1.21 ± 1.19[b]	2.51 ± 2.70
C8H5NO2	/	/	/	/	/	/
C7H7NO5	/	/	/	0.36 ± 0.17	0.42[a]	0.19[a]
C10H7NO3	2.57 ± 1.07[b]	4.92 ± 5.69	0.79 ± 0.12	0.16 ± 0.17	0.66 ± 0.34[b]	0.11 ± 0.084
C9H9NO4	/	/	/	/	/	/
C8H7NO5	2.94[a]	2.29[a]	0.64 ± 0.47[b]	0.20 ± 0.050	0.15[a]	0.72[a]
C8H9NO5	3.61 ± 2.71[b]	13.9 ± 10.3	13.4 ± 7.65	3.28 ± 1.93	2.01 ± 0.67[b]	0.74 ± 0.031
C11H9NO3	2.69 ± 0.077[b]	2.69 ± 1.74	1.15 ± 0.31	0.84 ± 0.87	1.73 ± 0.22[b]	0.48 ± 0.16
C10H11NO4	/	/	/	/	/	/
C10H11NO5	/	/	/	1.29 ± 1.31	/	0.023[a]
C11H13NO5	/	/	/	/	/	/
C11H13NO6	/	/	/	/	/	/
Subtotal	10.9 ± 5.46	23.6 ± 15.7	16.5 ± 7.50	12.1 ± 1.95	8.07 ± 3.53	8.12 ± 6.41

[a] The compound was detected in only one of the three filter samples; [b] the compound was detected in two of the three filter samples or only two out of the three filters were available for measurement, the values reported here are average ± difference between the two measurements/2.

Table S14. Continue

Compound	Prakti Leo		Zoom Jet	
	CS	HS	CS	HS
C6H5NO3	0.070 ± 0.046[b]	0.0088 ± 0.0016[b]	0.012 ± 0.0007[b]	/
C7H7NO3	0.015 ± 0.0077[b]	0.0090[a]	0.063 ± 0.065	/
C6H5NO4	3.20 ± 2.48[b]	1.20 ± 1.61	0.65[a]	3.32 ± 3.89
C7H7NO4	8.12 ± 7.94[b]	3.65 ± 5.60	0.19	6.72 ± 7.80
C8H7NO4	/	/	/	/
C8H9NO4	11.7 ± 11.4[b]	3.68 ± 5.41	0.39[a]	5.07 ± 3.52
C8H5NO2	/	/	/	/
C7H7NO5	1.16 ± 1.08[b]	1.18 ± 1.05[b]	/	1.41 ± 1.77
C10H7NO3	0.50 ± 0.27	0.20 ± 0.16	0.93 ± 0.75	0.47 ± 0.65
C9H9NO4	/	/	/	/
C8H7NO5	1.32 ± 0.37	/	/	0.74 ± 0.53[b]
C8H9NO5	13.2 ± 2.83	1.86 ± 0.72	7.73 ± 8.55	9.29 ± 13.6
C11H9NO3	1.33 ± 1.68	0.47 ± 0.13	1.18 ± 1.00[b]	1.99 ± 2.63
C10H11NO4	/	/	/	/
C10H11NO5	2.07[a]	0.36[a]	/	0.89 ± 1.06
C11H13NO5	/	/	/	/
C11H13NO6	/	/	/	/
Subtotal	33.2 ± 29.1	12.0 ± 14.2	10.1 ± 8.02	29.7 ± 35.4

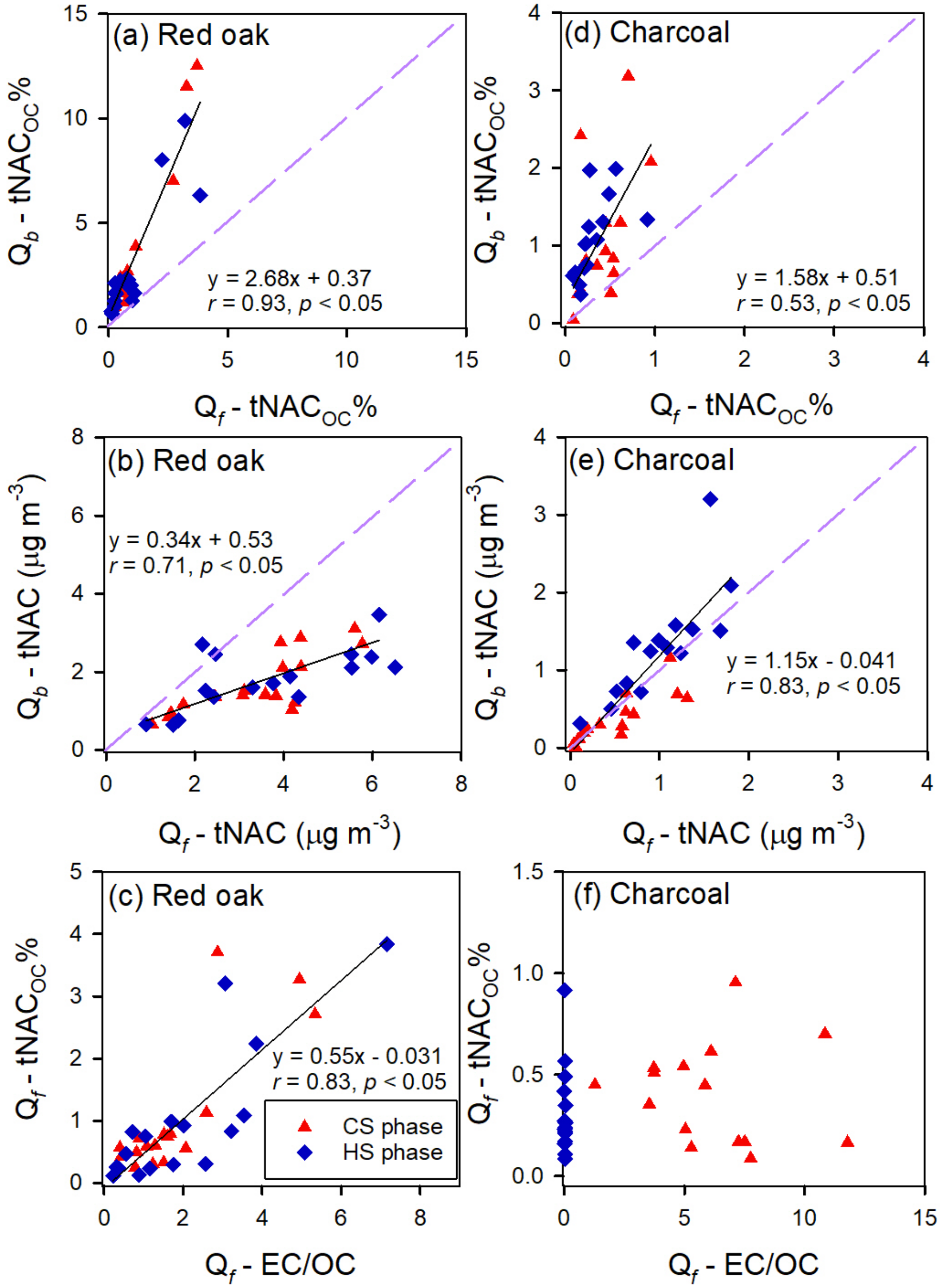


Figure S1. Linear regressions of (a, d) $tNAC_{OC}$% in Q_f vs. Q_b samples, (b, e) total NAC concentrations in Q_f vs. Q_b samples, (c, f) $tNAC_{OC}$% vs. EC/OC for Q_f samples for red oak and charcoal burning, respectively.

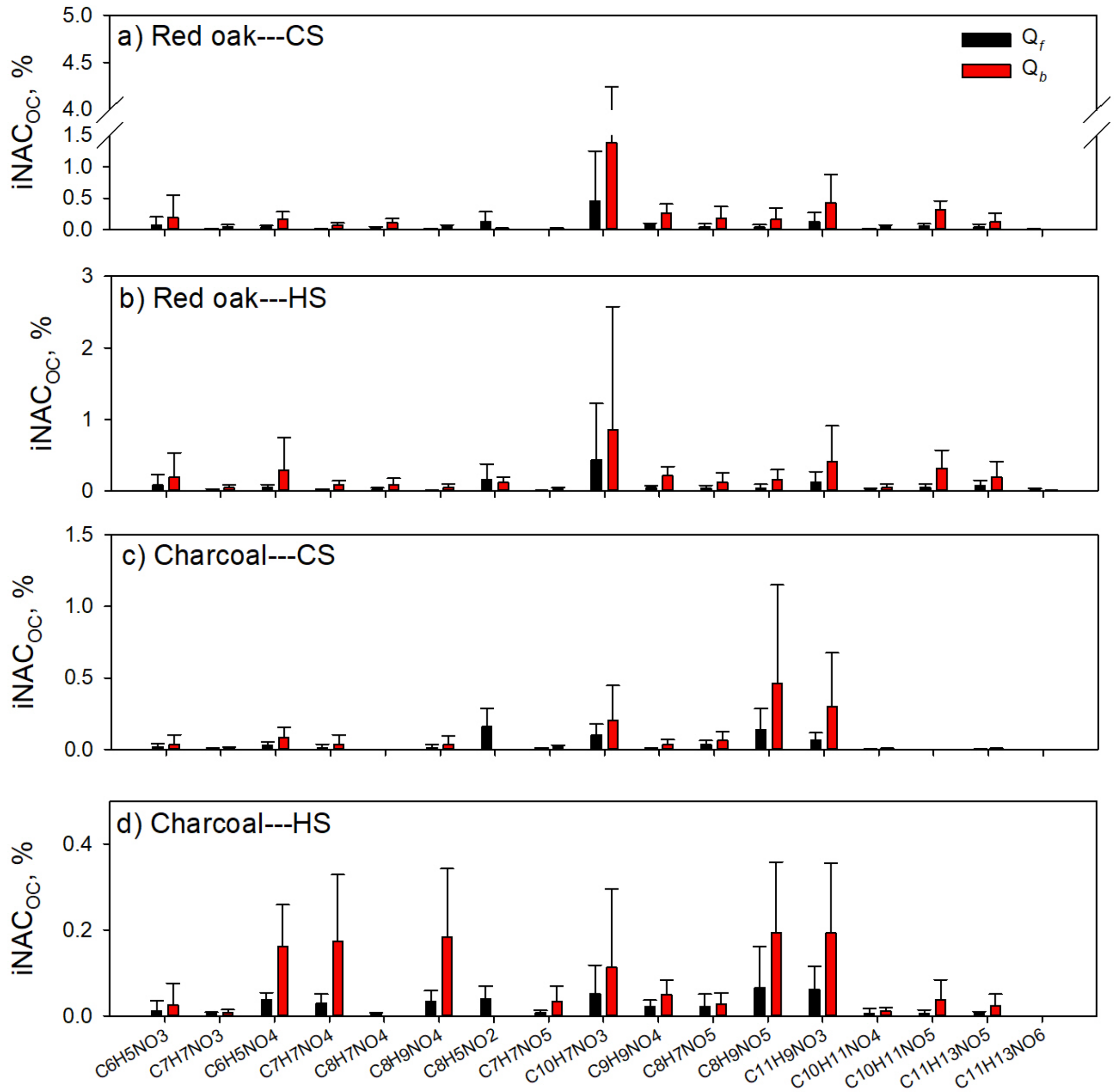


Figure S2. Average mass ratios of individual NACs to OC × 100% ($iNAC_{OC}$%) for (a) red oak burning under the CS phase, (b) red oak burning under the HS phase, (c) charcoal burning under the CS phase, and (d) charcoal burning under the HS phase.

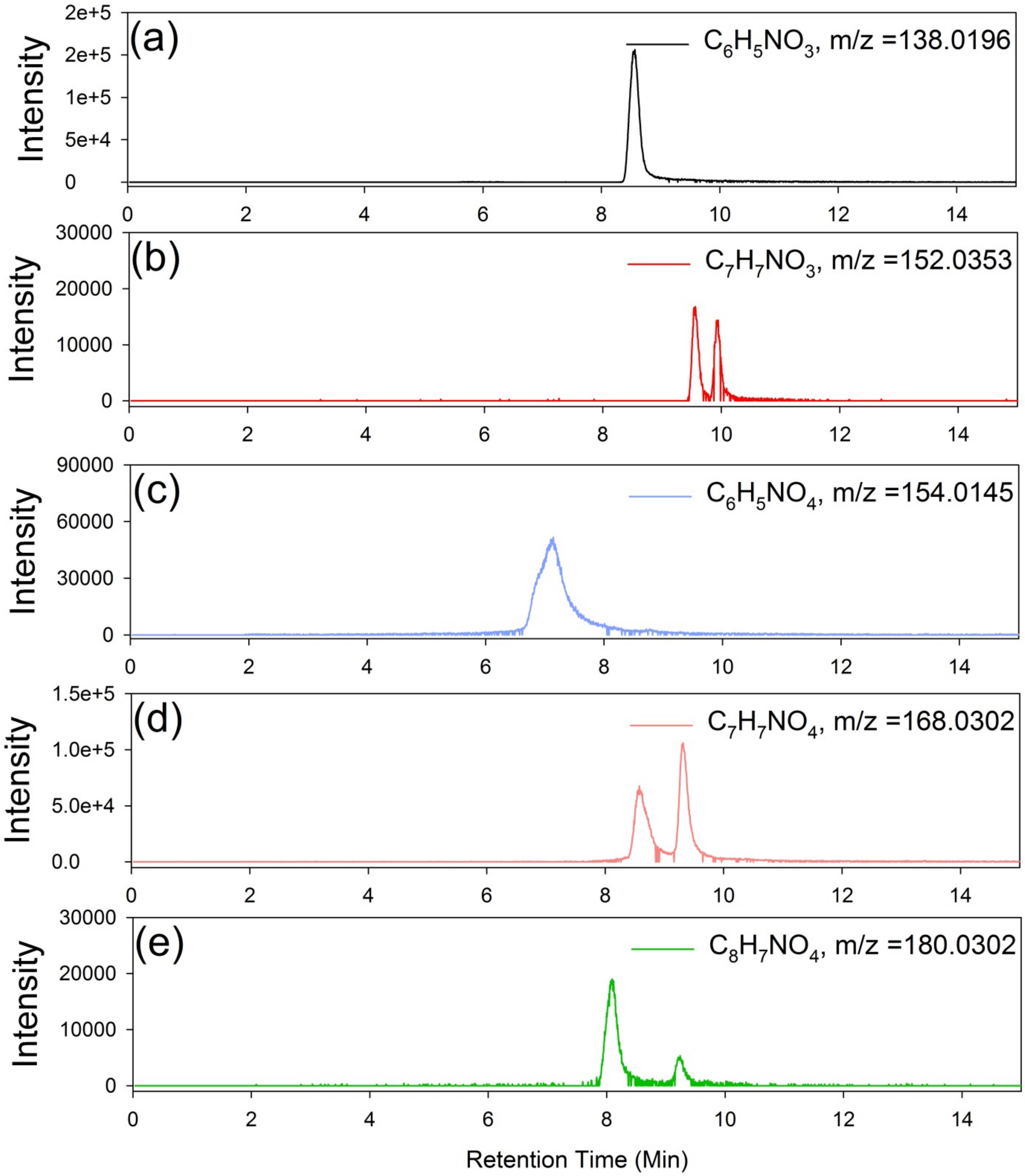


Figure S3. Extracted ion chromatograms (EIC) of (a) $C_6H_5NO_3$, (b) $C_7H_7NO_3$, (c) $C_6H_5NO_4$, (d) $C_7H_7NO_4$, (e) $C_8H_7NO_4$, (f) $C_8H_9NO_4$, (g) $C_8H_5NO_2$, (h) $C_7H_7NO_5$, (i) $C_{10}H_7NO_3$, (j) $C_9H_9NO_4$, (k) $C_8H_7NO_5$, (l) $C_8H_9NO_5$, (m) $C_{11}H_9NO_3$, (n) $C_{10}H_{11}NO_4$, (o) $C_{10}H_{11}NO_5$, (p) $C_{11}H_{13}NO_5$ and (q) $C_{11}H_{13}NO_6$ identified in emissions from solid fuel-cookstove combustions (Table S3).

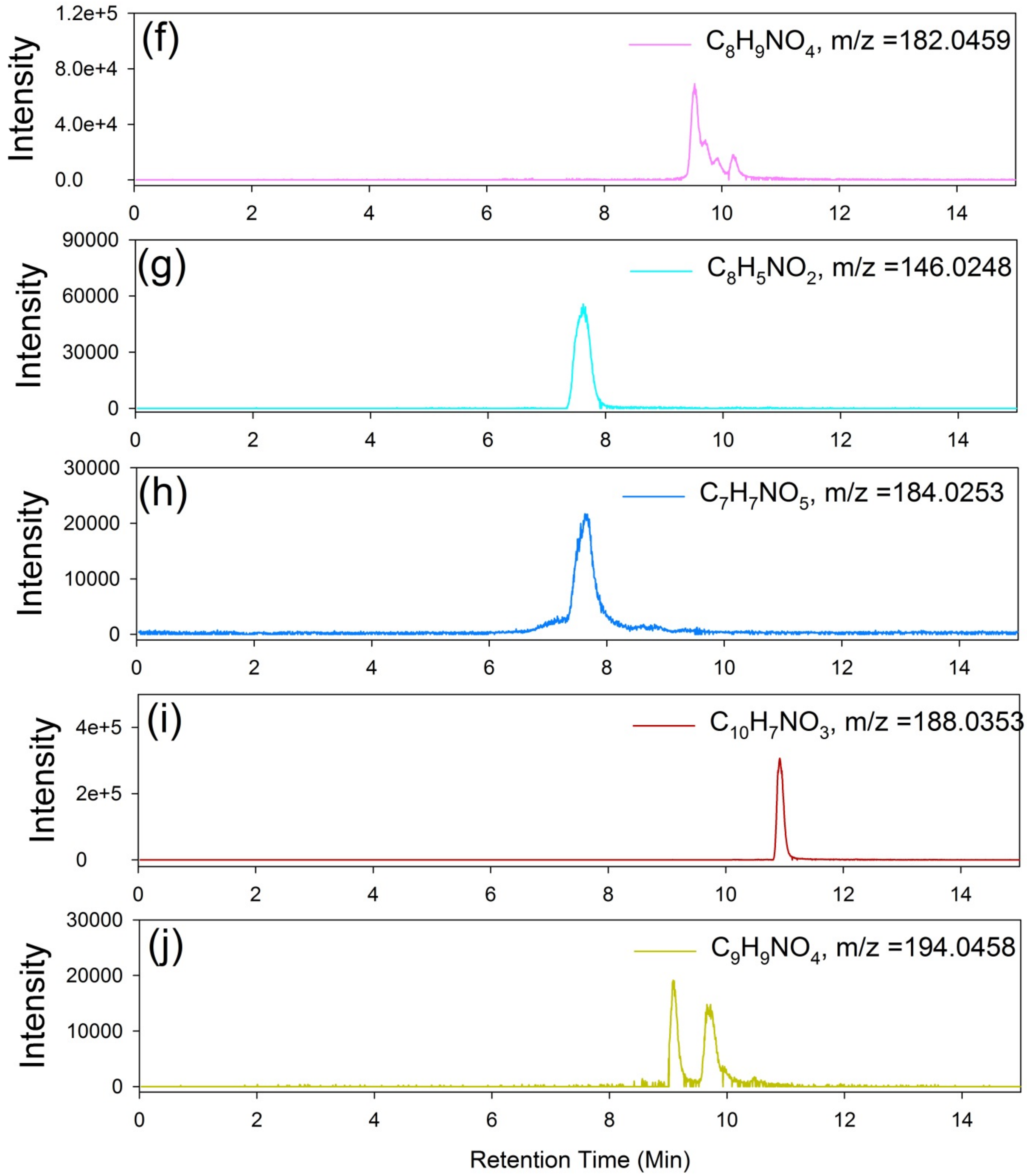


Figure S3. Continued.

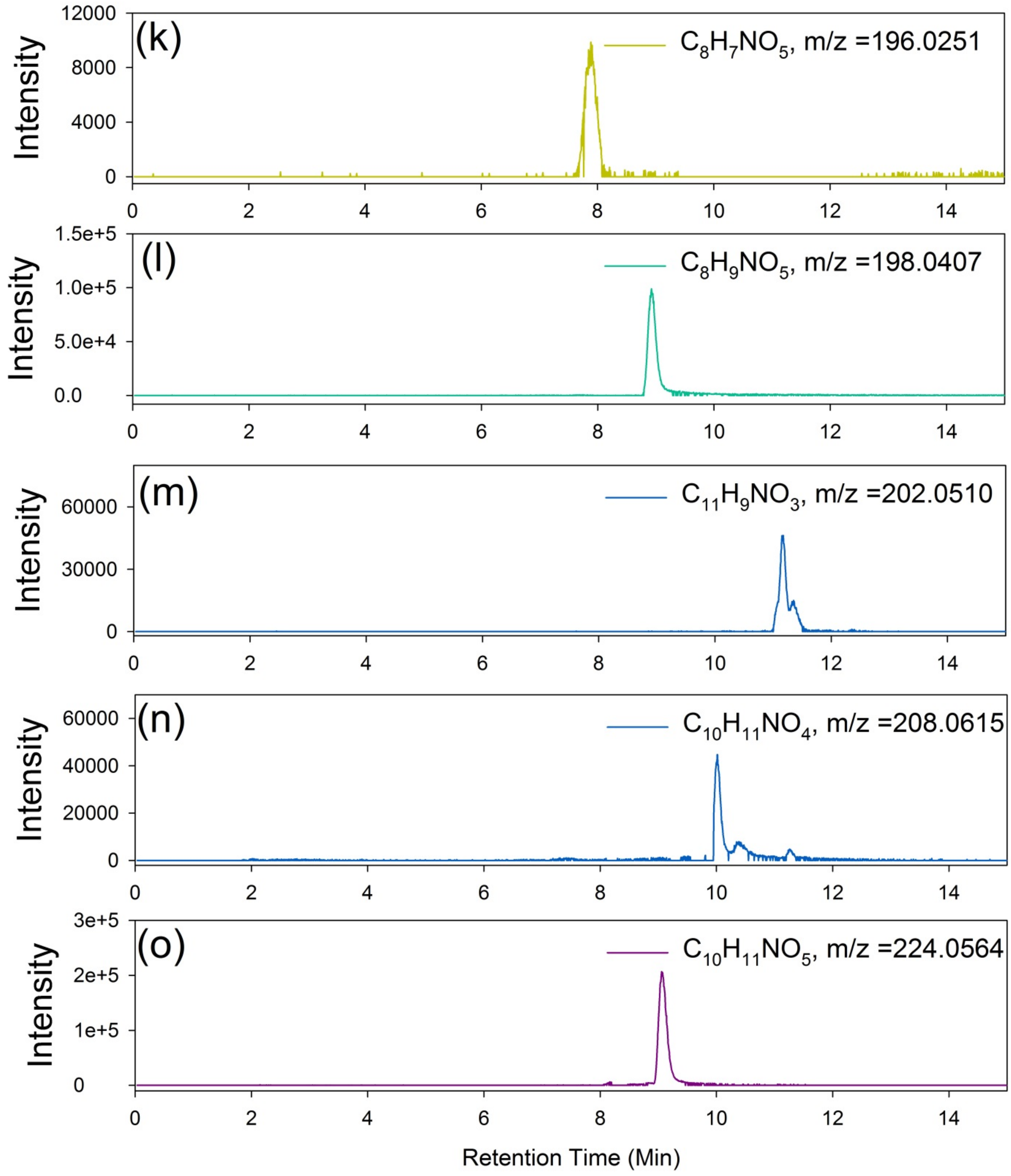


Figure S3. Continued.

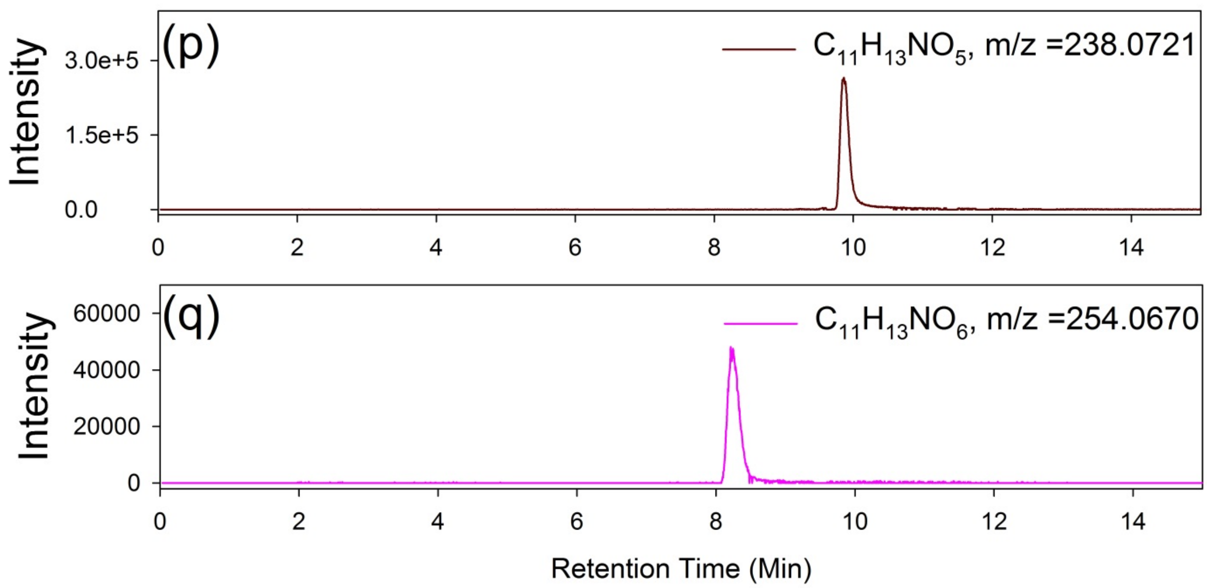


Figure S3. Continued.

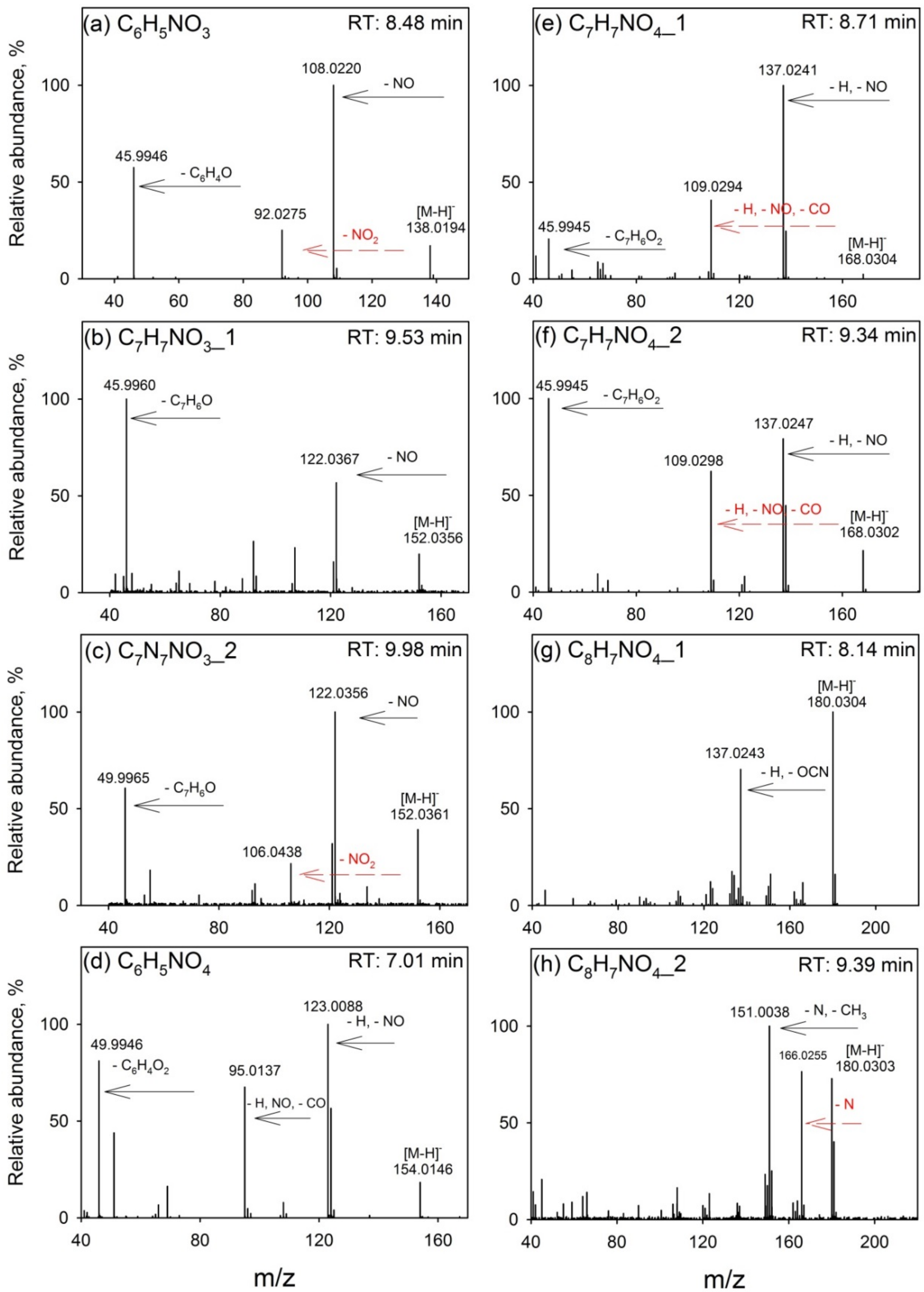


Figure S4. MS/MS spectra of (a) $C_6H_5NO_3$, (b, c) $C_7H_7NO_3$ isomers, (d) $C_6H_5NO_4$, (e, f) $C_7H_7NO_4$ isomers, (g, h) $C_8H_7NO_4$ isomers, (i) $C_8H_9NO_4$, (j) $C_8H_5NO_2$, (k) $C_7H_7NO_5$, (l) $C_{10}H_7NO_3$, (m, n) $C_9H_9NO_4$ isomers, (o) $C_8H_7NO_5$, (p) $C_8H_9NO_5$, (q) $C_{11}H_9NO_3$, (r) $C_{10}H_{11}NO_4$, (s) $C_{10}H_{11}NO_5$, (t) $C_{11}H_{13}NO_5$ and (u) $C_{11}H_{13}NO_6$ identified in emissions from solid fuel-cookstove combustions (Table S3).

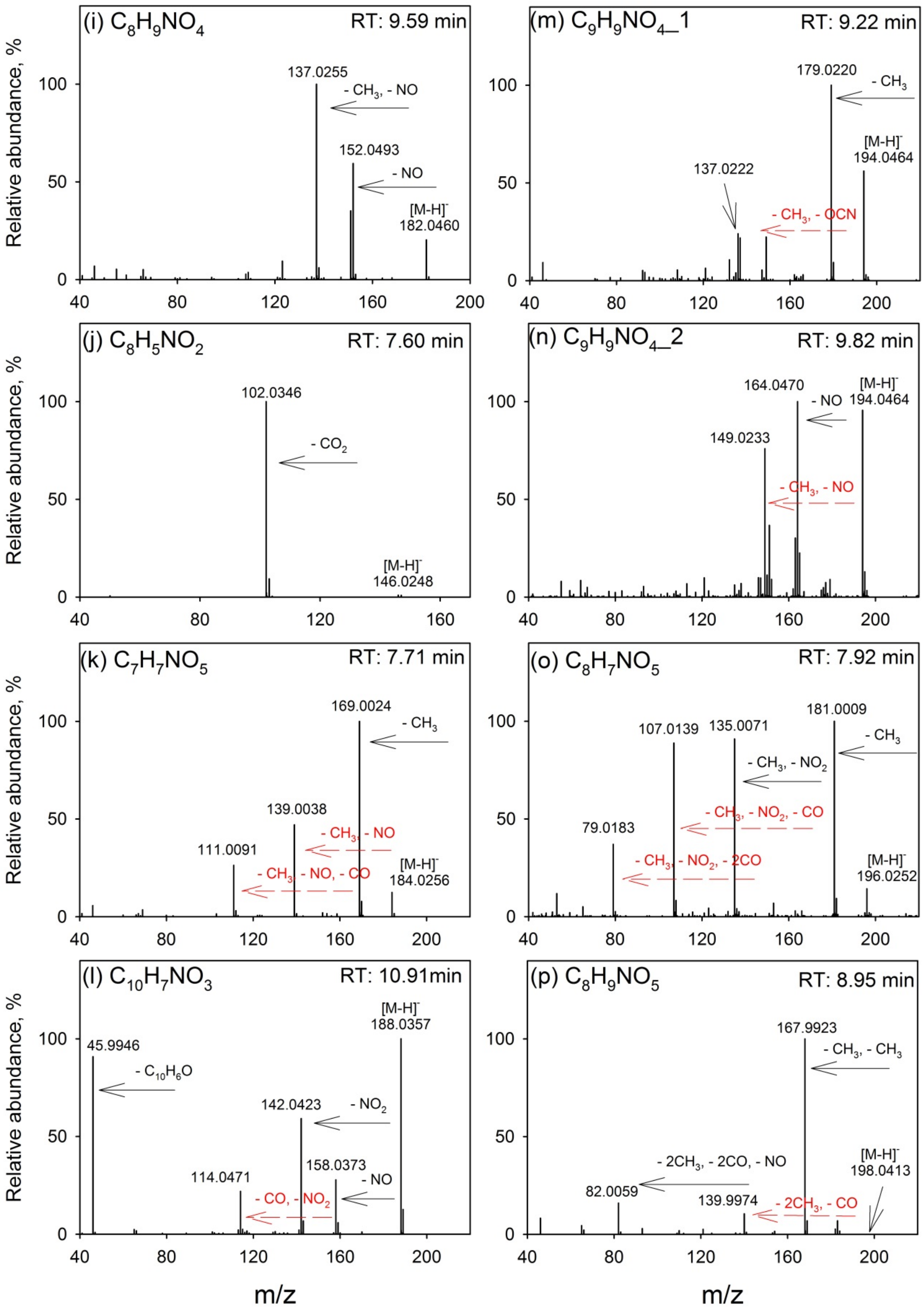


Figure S4. Continued

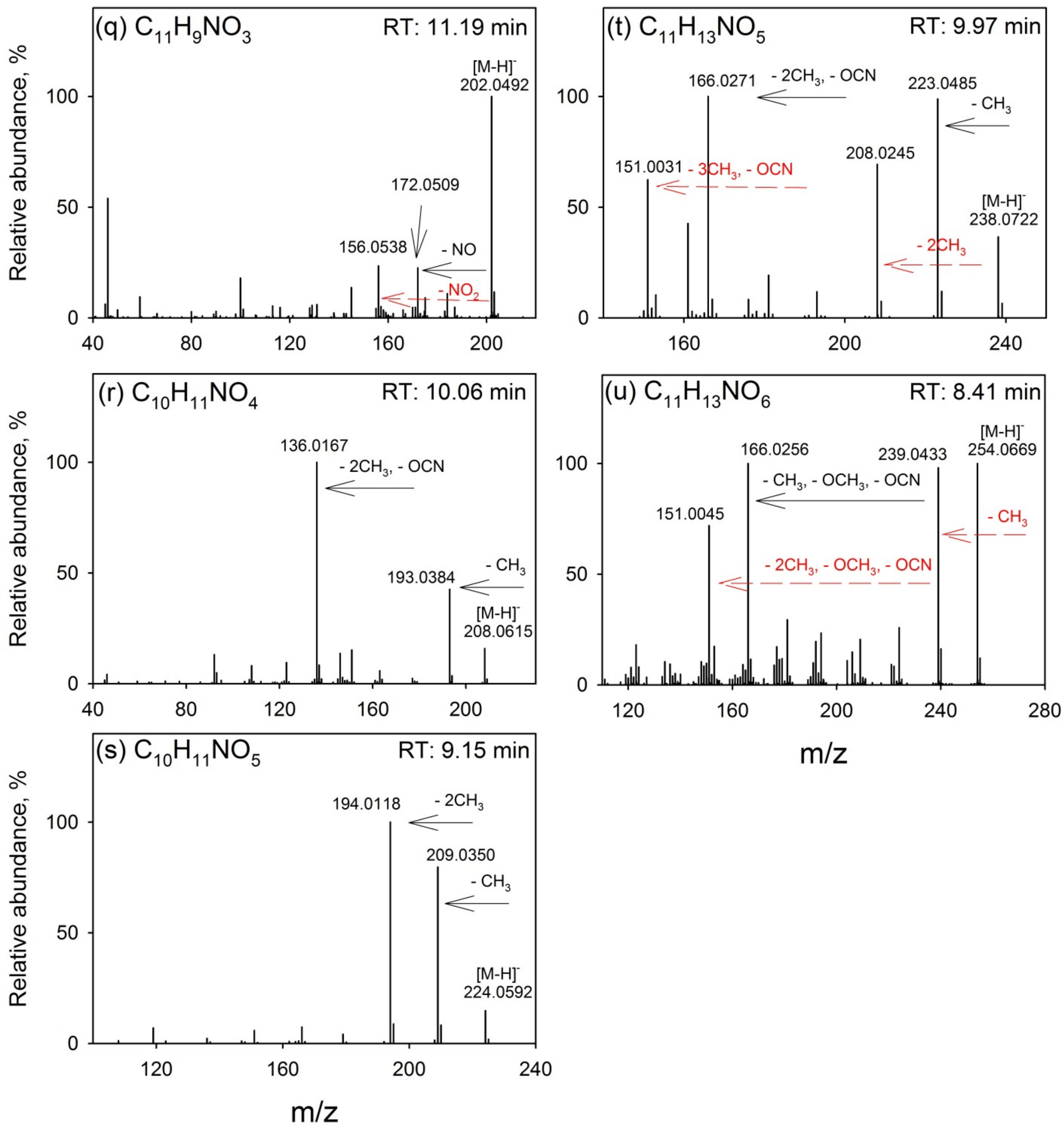


Figure S4. Continued

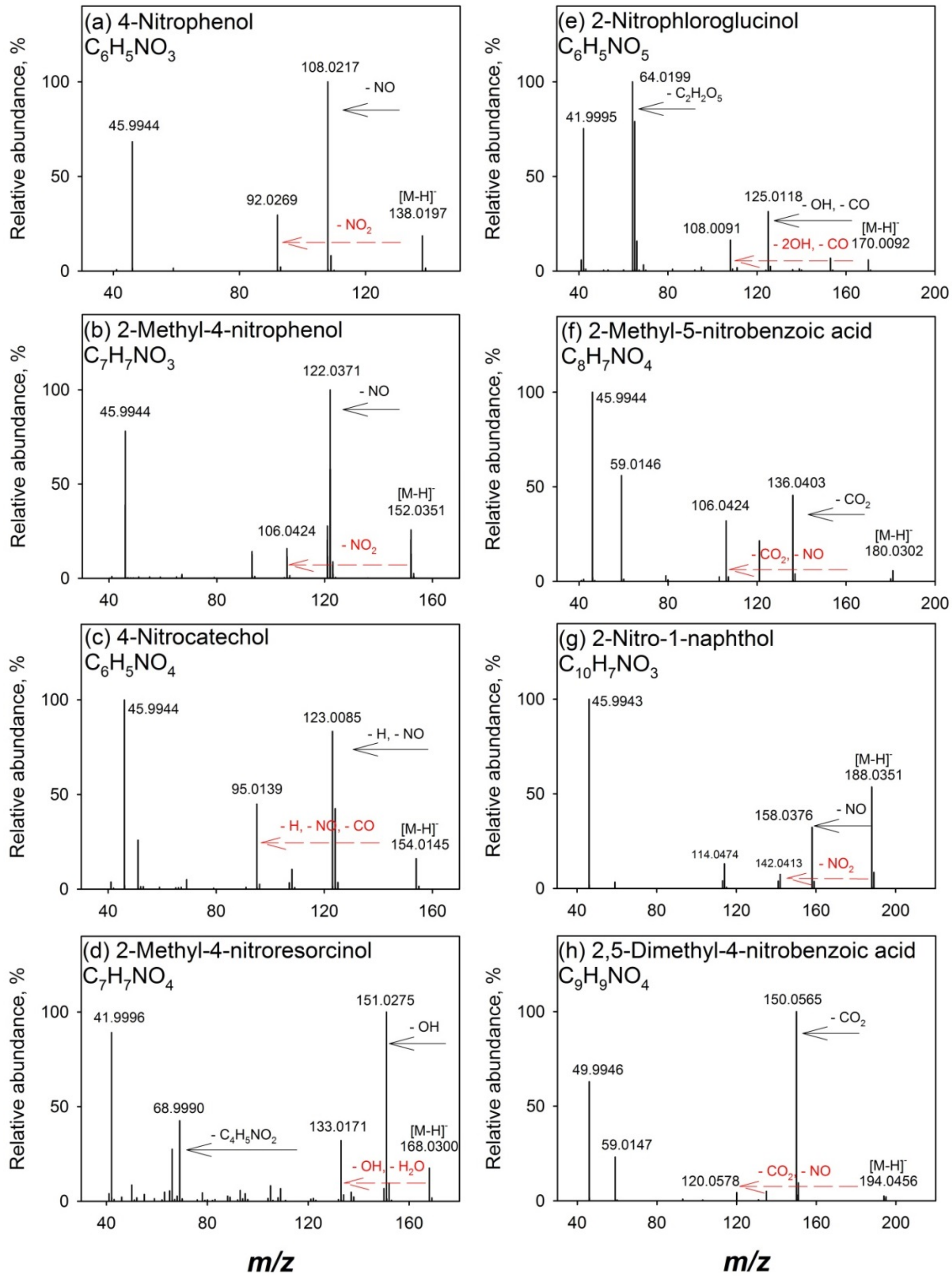


Figure S5. MS/MS spectra (ESI-) (a) 4-nitrophenol, (b) 2-methyl-4-nitrophenol, (c) 4-nitrocatechol, (d)2-methyl-4-nitroresorcinol, (e) 2-nitrophloroglucinol, (f) 2-methyl-5-nitrobenzoic acid, (g) 2-nitro-1-naphthol and (h) 2,5-dimethyl-4-nitrobenzoic acid (Xie et al., 2017); mass spectra of (i) phenyl cyanate, (j) benzoxazole, (k) 4-methoxyphenyl isocyanate, and (l) 2,4-dimethoxyphenyl isocyanate with EI mode (Xie et al., 2019); MS/MS spectra (ESI+) of (e) 4-methoxyphenyl isocyanate and (f) 2,4-dimethoxyphenyl isocyanate with ESI positive ion mode (Xie et al., 2019); MS/MS spectra (ESI-) of (o) 4-cyanobenzoic acid.

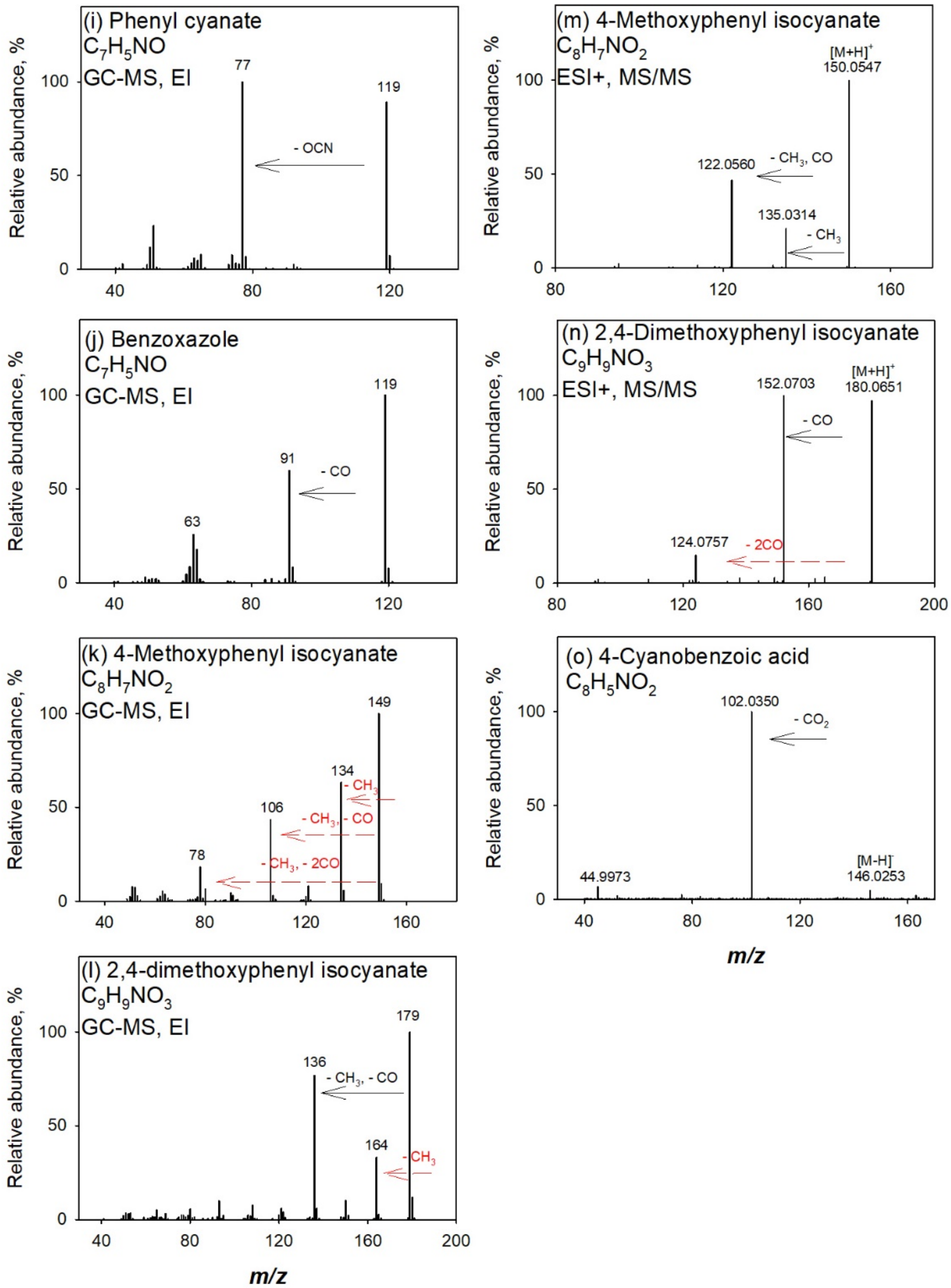


Figure S5. Continued

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