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Supplementary data

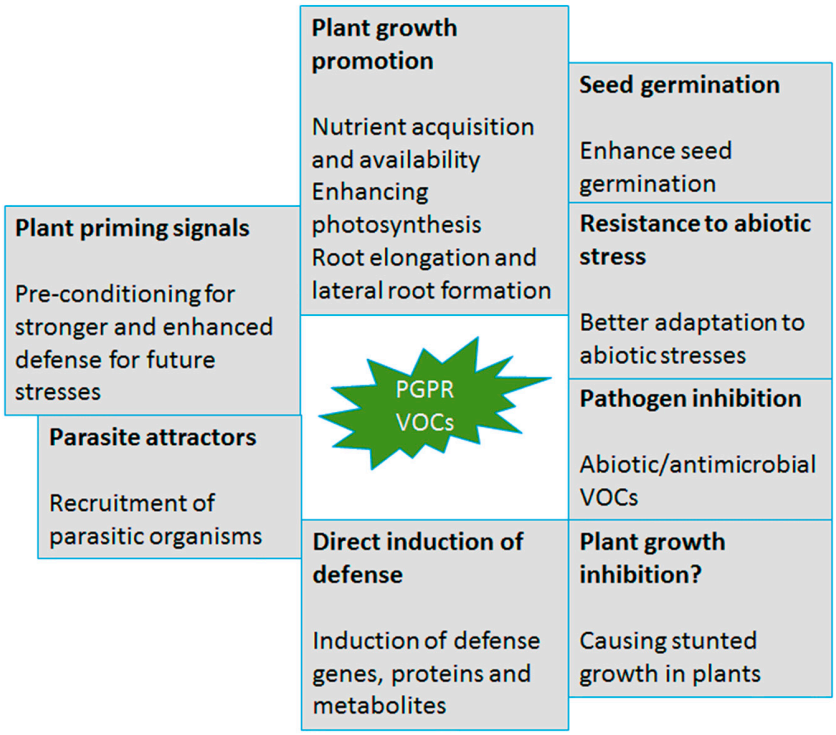

Figure S1. Action mechanisms of PGPR-derived VOCs. PGPR-emitted VOCs can influence different plant physiological processes in various ways. Some VOCs are able to inhibit germination and growth of plant pathogens in vitro or repel herbivores and attract herbivore parasitoids on infested plants. VOCs can impact on plant defensive systems by inducing the synthesis of defense genes, proteins and metabolites (e.g., phytoalexins) that impair microbial colonization. VOCs can also act as priming stimuli by inducing systemic changes and accumulation of transcription factors that may facilitate faster expression of plant defenses, thereby enhancing tolerance or resistance to a future stress.

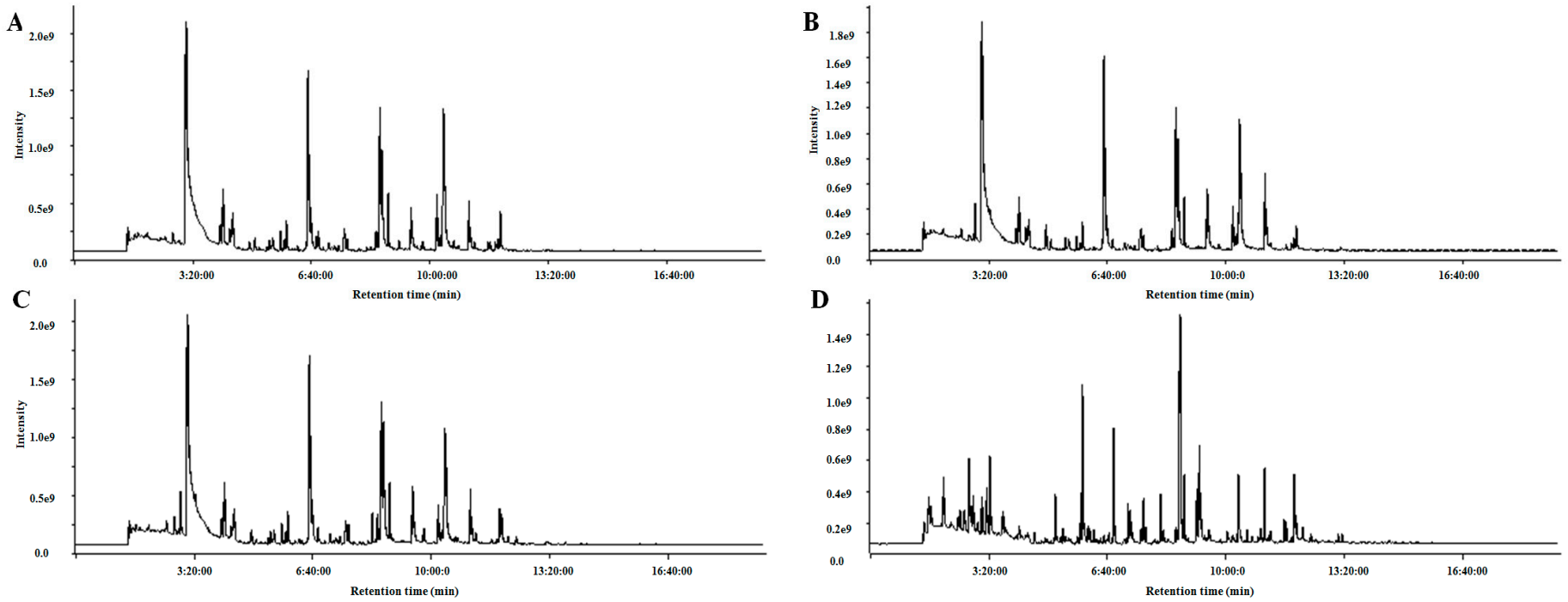

Figure S2. Representative GC-TOF-MS chromatograms of PGPR volatiles sampled by head-space SPME. GC-TOF-MS chromatograms displaying comparative chromatographic differences, and visual inspection thereof evidently shows differential peak populations. (**A)**: *Pseudomonas fluorescens* N04, (**B**): *Pseudomonas koreensis* N19, (**C**): *Lysinibacillus sphaericus* T19 and (**D**): *Paenibacillus alvei* T22.

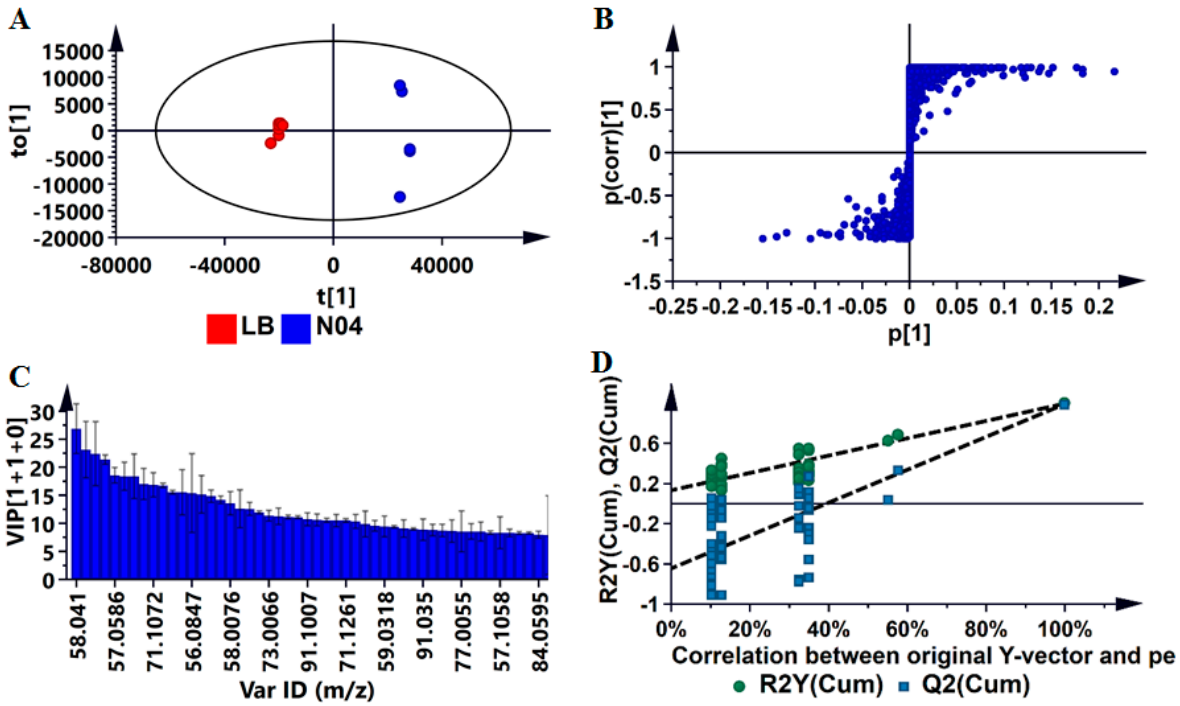

Figure S3. OPLS-DA modeling and variable/feature selection of *Pseudomonas fluorescens* N04 data acquired on GC-TOF-MS. (A): A typical **OPLS-DA score** separating un-inoculated media (LB) *vs.* inoculated media (N04) (1 + 1 + 0 components, $R^2X = 0.895$, $Q^2 = 0.999$, CV-ANOVA *p*-value = 1.3×10^{-19}). **(B)**: An OPLS-DA **loadings S-plot** for the same model in **(A)**; only variables with the correlation *[p(corr)]* of ≥ |0.5| and covariance of *(p1)* ≥ |0.5| were chosen as discriminating variables and identified using the *m/z* to generate elemental composition. **(C)**: A **variable importance for the projection (VIP)** plot for the same model, pointing mathematically to the importance of each variable in contributing to group separation in the OPLS-DA model. **(D)**: **The response permutation test plot** (n = 50) for the same OPLS-DA model: R^2 (0.0, 0.145) and Q^2 (0.0 − 0.672) values of the permuted models are represented on the left-hand side of the plot, corresponding to y-axis intercepts.

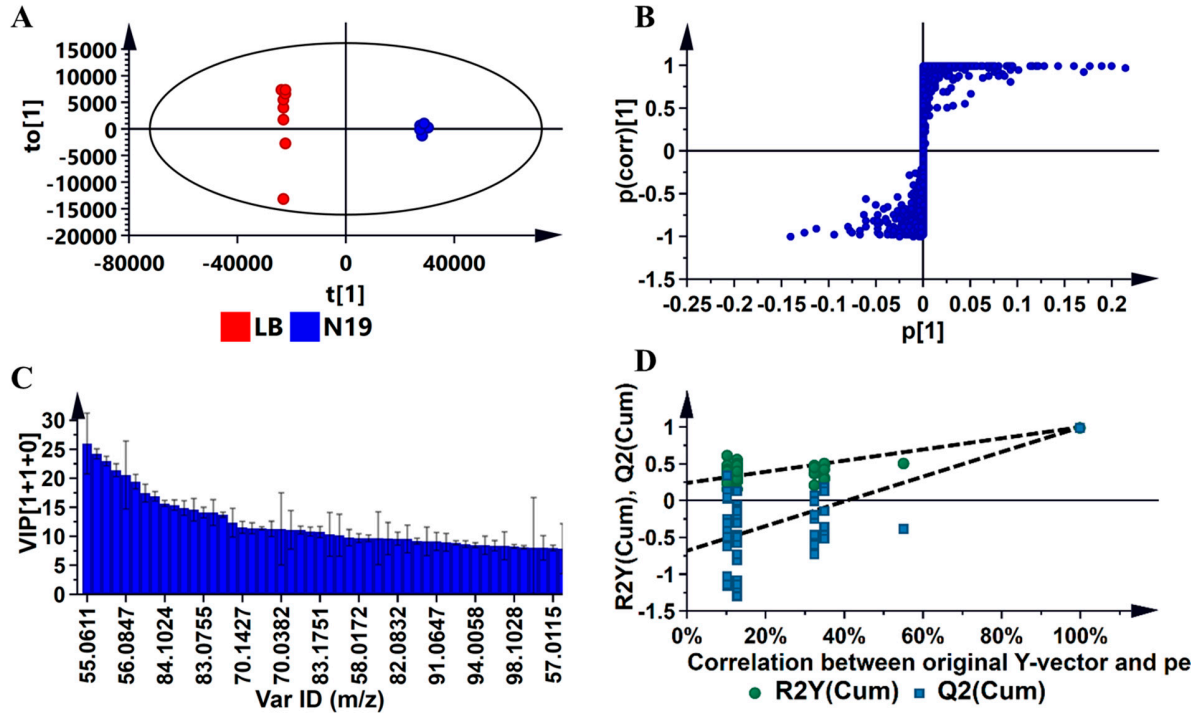

Figure S4. OPLS-DA modeling and variable/feature selection of *Pseudomonas koreensis* N19 data acquired on GC-TOF-MS. (A): A typical **OPLS-DA** score separating un-inoculated media (LB) *vs.* inoculated media (N19) (1 + 2 + 0 components, $R^2X = 0.920$, $Q^2 = 0.998$, CV-ANOVA p-value = 1.1×10^{-12}). **(B)**: An OPLS-DA **loadings S-plot** for the same model in **(A)**; only variables with the correlation *[p(corr)]* of ≥ |0.5| and covariance of *(p1)* ≥ |0.5| were chosen as discriminating variables and identified using the *m/z* to generate elemental composition. **(C)**: A **variable importance for the projection (VIP)** plot for the same model, pointing mathematically to the importance of each variable in contributing to group separation in the OPLS-DA model. **(D)**: The **response permutation test plot** (n = 50) for the same OPLS-DA model: R^2 (0.0, 0.273) and Q^2 (0.0 − 0.606) values of the permuted models are represented on the left-hand side of the plot, corresponding to y-axis intercepts.

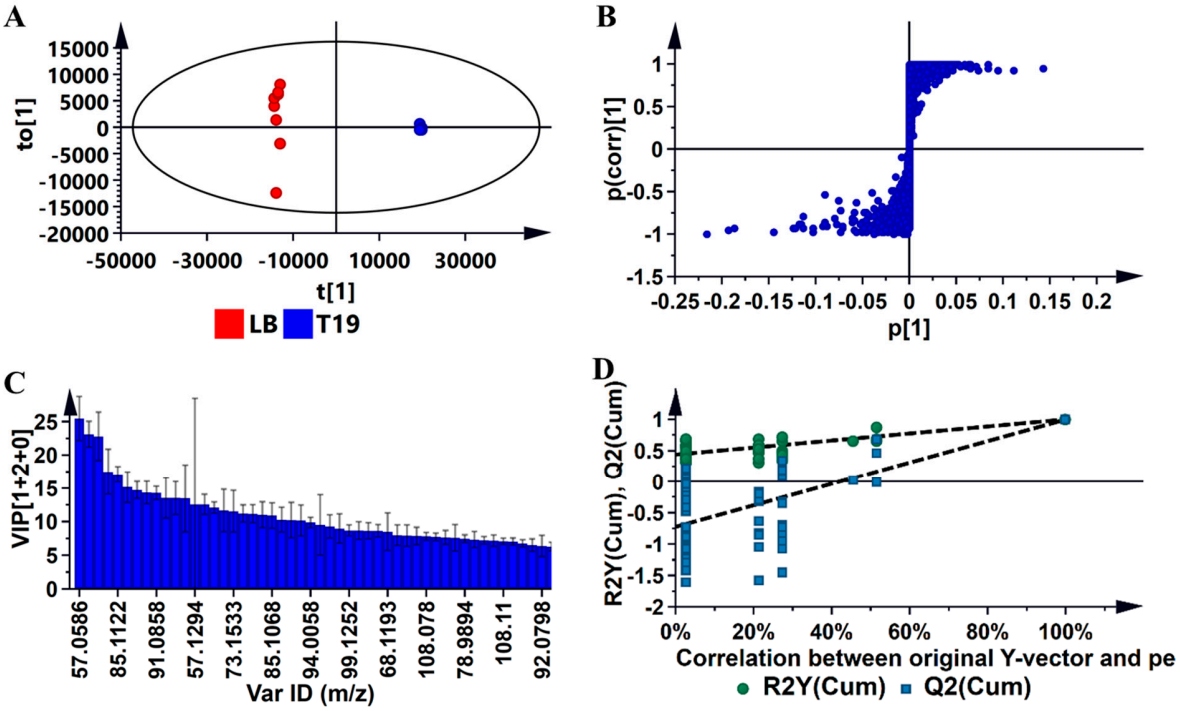

Figure S5. OPLS-DA modeling and variable/feature selection of *Paenibacillus alvei* T19 data acquired on GC-TOF-MS. (A): A typical **OPLS-DA score** separating un-inoculated media (LB) *vs.* inoculated media (T19) (1 + 1 + 0 components, $R^2X = 0.885$, $Q^2 = 0.999$, CV-ANOVA p-value = 1.6×10^{-19}). **(B)**: An OPLS-DA **loadings S-plot** for the same model in **(A)**; only variables with the correlation *[p(corr)]* of ≥ |0.5| and covariance of *(p1)* ≥ |0.5| were chosen as discriminating variables and identified using the *m/z* to generate elemental composition. **(C)**: A **variable importance for the projection (VIP)** plot for the same model, pointing mathematically to the importance of each variable in contributing to group separation in the OPLS-DA model. **(D)**: The response permutation test plot (n = 50) for the same OPLS-DA model: R^2 (0.0, 0.412) and Q^2 (0.0 − 0.757) values of the permuted models are represented on the left-hand side of the plot, corresponding to y-axis intercepts.

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Table S1. VOC profiles of PGPR strains: *Pseudomonas fluorescens* (N04), *Pseudomonas koreensis* (N19), *Paenibacillus alvei* (T19) and *Lysinibacillus sphaericus* (T22). Green indicates VOCs primarily present in N04 (but also in N19, T19 and T22); yellow indicates VOCs primarily present in N19 (also in T19 and T22); purple indicates VOCs primarily present in T19 (also in T22); and red indicates VOCs present only in T22.

Rt (min)	Base mass (*m*/*z*)	Compound name (tentative annotation)	*P.f.*_N04	*P.k.*_N19	*P.a.*_T19	*L.s.*_T22
Alcohols						
02:48.3	55.04	1-Pentanol				
03:00.7	45.02	1-Hexanol, 6-amino-				
03:52.7	59.04	1-Hexanol				
04:07.0	56.06	2-Decanol				
05:15.6	85.06	Pentanol, 5-amino-				
08:22.6	57.06	1-Penten-3-ol				
09:18.3	45.02	2-Undecanol				
09:48.2	43.01	2-Undecanol, acetate				
10:56.6	45.02	2-Tridecanol				
11:00.4	45.02	2-Tetradecanol				
11:02.3	55.04	11-Hexadecen-1-ol, (Z)-				
13:15.9	43.03	1-Hexadecanol				
16:53.4	71.06	2-Undecen-4-ol				
Ketones						
01:42.1	43.00	2-Propanone, 1-methoxy-				
02:38.8	43.03	2-Butanone, 3-methyl-				
02:59.2	43.01	3-Pentanone				
04:10.5	43.04	4-Heptanone				
06:31.4	43.02	3-Nonanone				
07:49.3	43.03	6,7-Dodecanedione				
08:46.7	120.07	Acetophenone, 4'-amino-				
08:54.8	69.04	2-Octen-4-one				
09:30.7	58.03	2-Dodecanone				
10:54.3	43.02	2-Nonadecanone				
11:05.9	43.02	11-Dodecen-2-one				
11:47.0	57.06	8-Pentadecanone				
12:26.9	58.04	2-Tetradecanone				
Alkanes						
01:59.3	59.04	Propane, 1-ethoxy-				
01:59.7	57.06	n-Hexane				
02:31.3	59.04	Butane, 1-ethoxy-				
02:53.6	45.01	2-Ethoxypentane				
03:01.4	43.01	Pentane, 1-ethoxy-				
03:32.4	59.04	Propane, 1,1-diethoxy-				
04:04.8	43.03	Heptane, 2,3-dimethyl-				
04:28.2	43.03	Nonane				
04:50.9	57.06	Octane, 2,2,6-trimethyl-				
05:09.6	57.06	Octane, 3,6-dimethyl-				
06:04.7	117.10	Indane				
07:40.5	43.03	Undecane				
10:09.0	57.06	Tetradecane, 3-methyl-				
11:11.9	43.03	Hexadecane				
11:30.6	91.06	Undecane, 6-phenyl-				
12:45.9	57.06	Heptadecane				
13:22.9	57.06	Octadecane				
15:17.3	57.06	Heneicosane				
15:33.8	57.06	Nonadecane				

15:35.3	43.03	Dodecane, 2-methyl-6-propyl-				
18:07.9	71.09	Triacontane				
18:08.0	57.06	Hexacosane				
Sulfides						
02:56.7	94.00	Disulfide, dimethyl				
05:21.0	126.01	Dimethyl trisulfide				
06:34.5	57.07	Sulfone, butyl isopropyl				
07:27.5	91.07	Benzyl methyl sulfide				
Alkenes						
04:27.2	91.07	Benzene, 1,3-dimethyl-				
04:44.8	57.06	Benzene, (2-methyloctyl)-				
06:28.8	67.05	1,9-Decadiene				
06:31.7	54.03	1,4-Undecadiene, (E)-				
06:34.3	70.07	1-Undecene				
07:34.5	41.02	Z-1,8-Dodecadiene				
08:29.0	45.02	1-Nonene				
08:58.2	43.03	1-Undecene, 7-methyl-				
09:53.0	71.04	3-Methoxyhex-1-ene				
10:19.8	55.04	7-Hexadecene, (Z)-				
10:33.0	43.03	1,9-Dodecadiene				
11:02.4	55.04	1,13-Tetradecadiene				
Salicylic acid derivatives						
07:44.0	120.05	Methyl salicylate				
10:48.3	120.05	Isoamyl salicylate				
11:55.0	120.04	n-Hexyl salicylate				
Terpenoids						
05:21.3	93.08	ß-Phellandrene				
05:25.1	93.08	ß-Pinene				
05:46.3	43.98	ß-Ocimene				
05:57.9	68.06	D-Limonene				
06:07.1	91.06	α-Pinene				
06:16.9	93.08	τ-Terpinene				
07:58.0	41.02	Citronellol				
Aldehydes						
02:16.5	44.02	Butanal, 3-methyl-				
05:12.3	77.04	Benzaldehyde				
05:37.0	41.02	Octanal				
06:07.0	91.06	Benzeneacetaldehyde				
06:13.7	41.02	2-Octenal, (E)-				
06:42.7	57.05	Nonanal				
07:44.9	43.03	Decanal				
08:08.0	41.02	2,6-Octadienal, 3,7-dimethyl-, (Z)-				
08:35.6	58.11	Hexanal, 2-methyl-				
08:43.8	57.05	Undecanal				
09:38.4	57.05	Dodecanal				
11:19.3	43.03	Tetradecanal				
12:50.2	57.05	Octadecanal				
Carboxylic acids						
02:37.8	57.02	Propanoic acid, ethyl ester				
02:43.0	43.04	Butanoic acid, methyl ester				
04:22.0	43.02	Butanethioic acid, S-methyl ester				
08:39.8	127.13	Octanethioic acid, S-hexyl ester				
09:29.5	88.06	Decanoic acid, ethyl ester				
12:36.8	105.05	Benzoic acid, 3-methylphenyl ester				
12:50.2	43.03	Pentadecanoic acid				
13:46.3	43.03	n-Hexadecanoic acid				
14:24.9	88.06	Octadecanoic acid, ethyl ester				

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Furans						
02:07.1	41.02	2(3H)-Furanone, dihydro-3-methyl-				
05:04.7	128.05	2-Methyl-3-(methylthio) furan				
05:30.5	81.04	Furan, 2-pentyl-				
05:37.7	118.06	Benzofuran				
08:05.2	115.05	Furan, 3-phenyl-				
Amines						
01:34.9	42.98	2-Methanesulfonylethanamine				
02:01.4	43.97	2-Pentanamine				
02:23.0	43.96	1-Hexanamine				
02:24.7	43.98	2-Octanamine				
02:38.8	61.02	Monoethanolamine				
02:50.2	56.05	2-Propen-1-amine				
03:57.0	41.01	Propylamine				
04:09.6	57.06	1,3-Propanediamine				
04:51.2	41.01	1-Heptanamine				
05:05.0	42.97	1-Butanamine, 3-methyl-				
05:34.8	91.07	Benzeneethanamine				
06:03.2	59.04	Propylamine				
08:34.9	41.70	Ethylenediamine				
10:10.1	73.05	1-Butanamine				
Pyrazine						
04:36.8	42.01	Pyrazine, 2,5-dimethyl-				
05:38.5	42.01	Pyrazine, trimethyl-				
06:11.9	121.10	Pyrazine, 2-methyl-5-(1-methylethyl)-				
07:03.8	108.09	2-Isobutyl-3-methylpyrazine				
07:18.0	149.14	Pyrazine, 3,5-diethyl-2-methyl-				
08:16.4	122.11	Pyrazine, 3-butyl-2,5-dimethyl-				