Supplementary Information

Effect of Spruce-derived Phenolics Extracted Using Microwave Enhanced Pyrolysis on Oxidative Stability of Biodiesel

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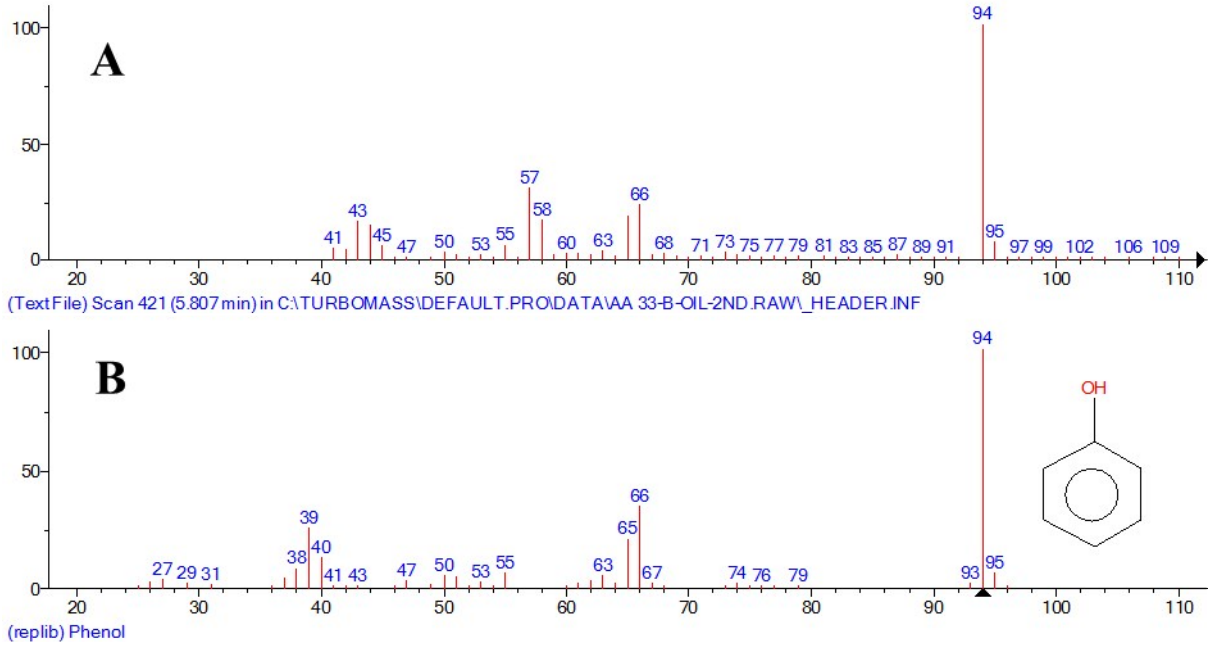
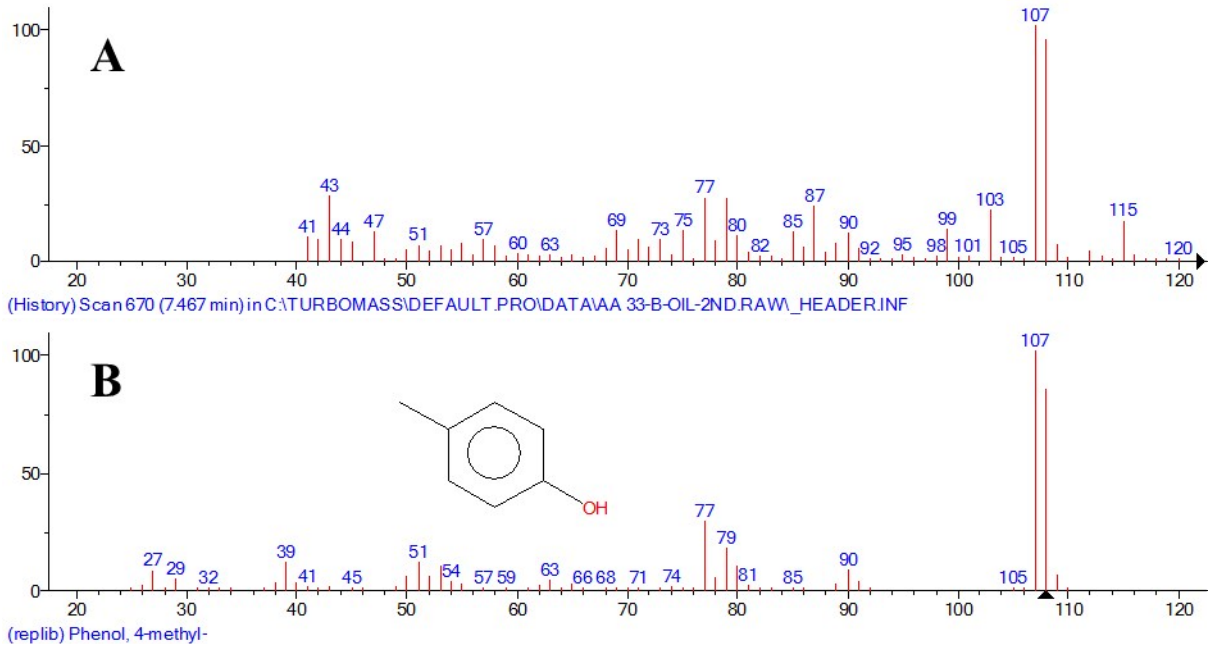
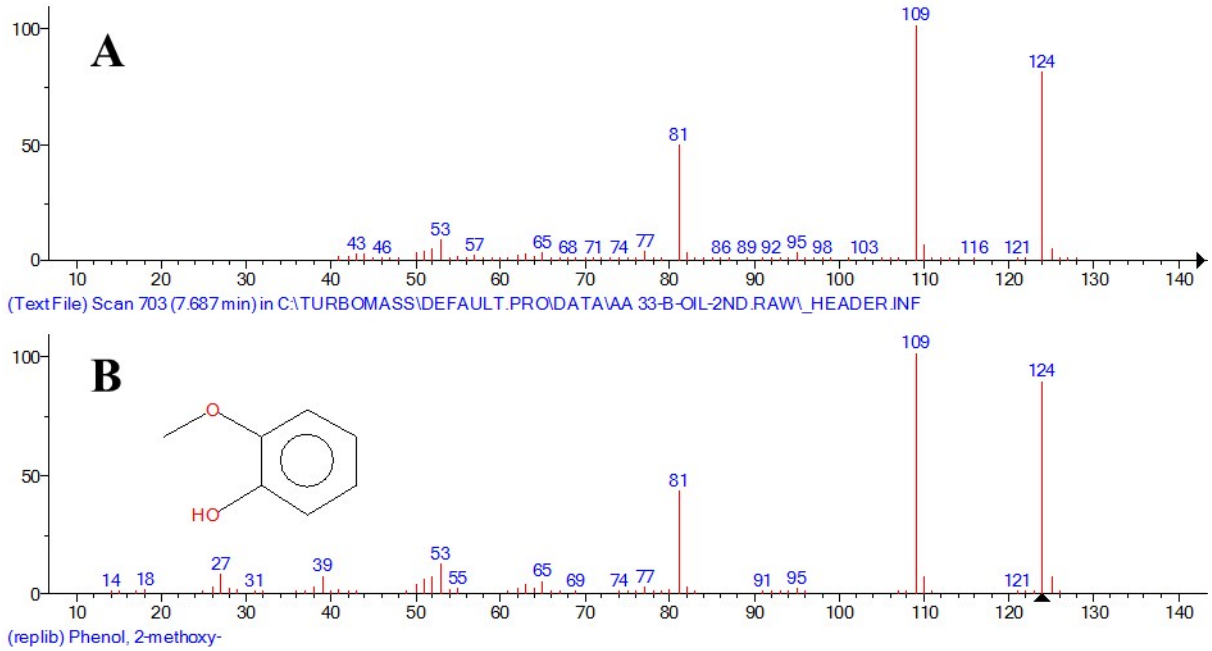
Identified crude bio-oil phenolics MS and their best MS match from NIST Spectral library.



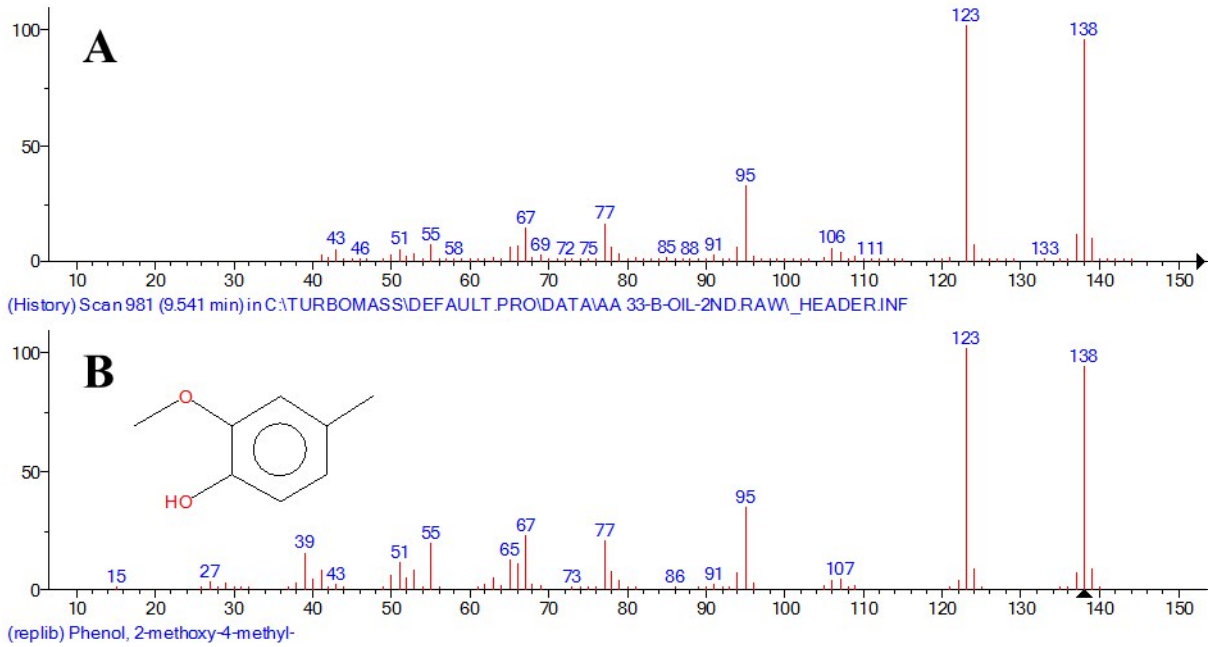
SI Figure 1: Matching MS spectrum of peak 5.81 MS in crude bio-oil GC-MS: A) MS of Peak 5.81 in crude bio-oil sample; B) MS of phenol according to NIST library.



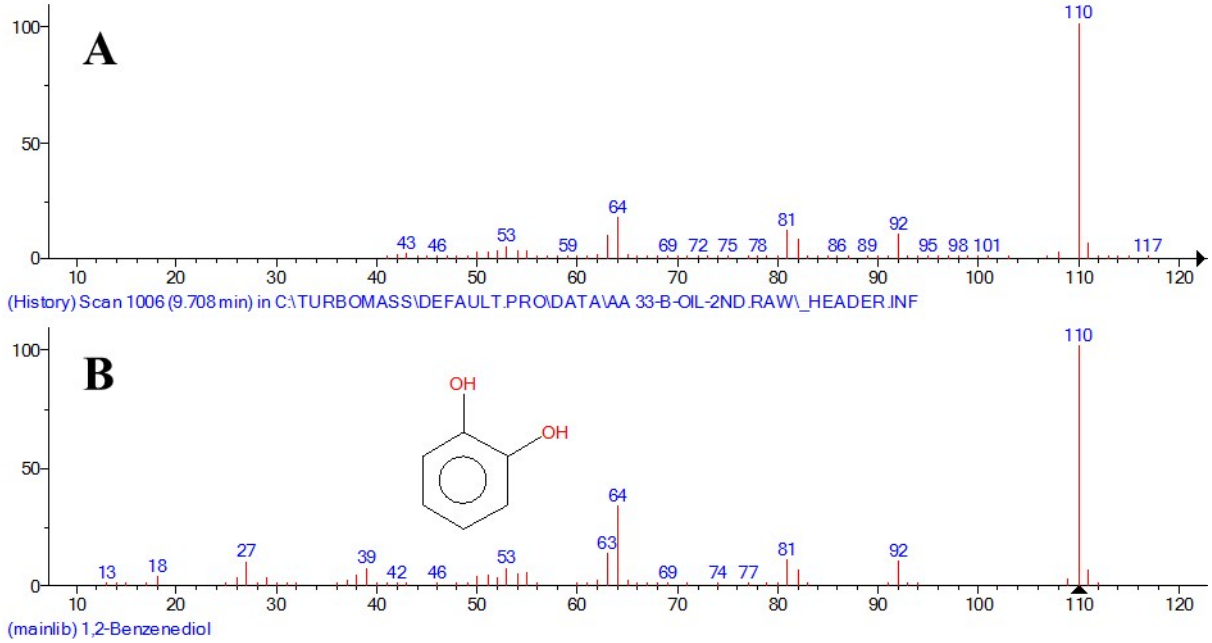
SI Figure 2: Matching MS spectrum of peak 7.47 MS in crude bio-oil GC-MS: A) MS of peak 7.47 MS in crude bio-oil sample; B) MS of Phenol, 4-methyl- according to NIST library.



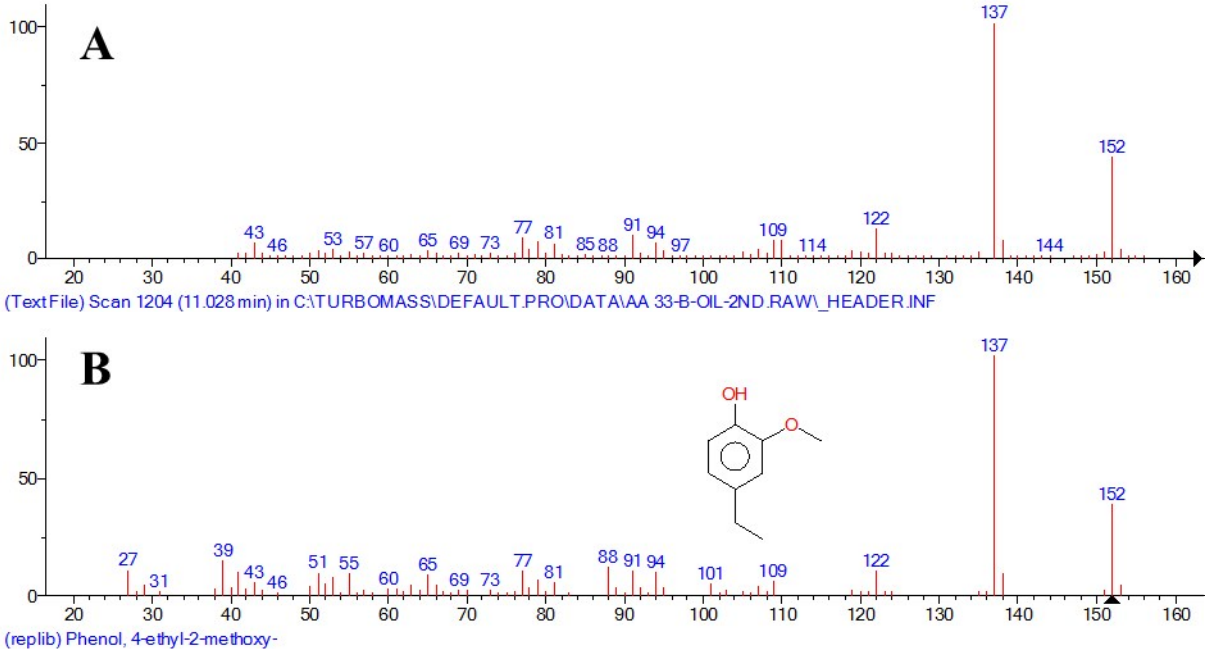
SI Figure 3: Matching MS spectrum of peak 7.69 MS in crude bio-oil GC-MS: A) MS of Peak 7.69 in crude bio-oil sample; B) MS of Phenol, 2-methoxy- according to NIST library.



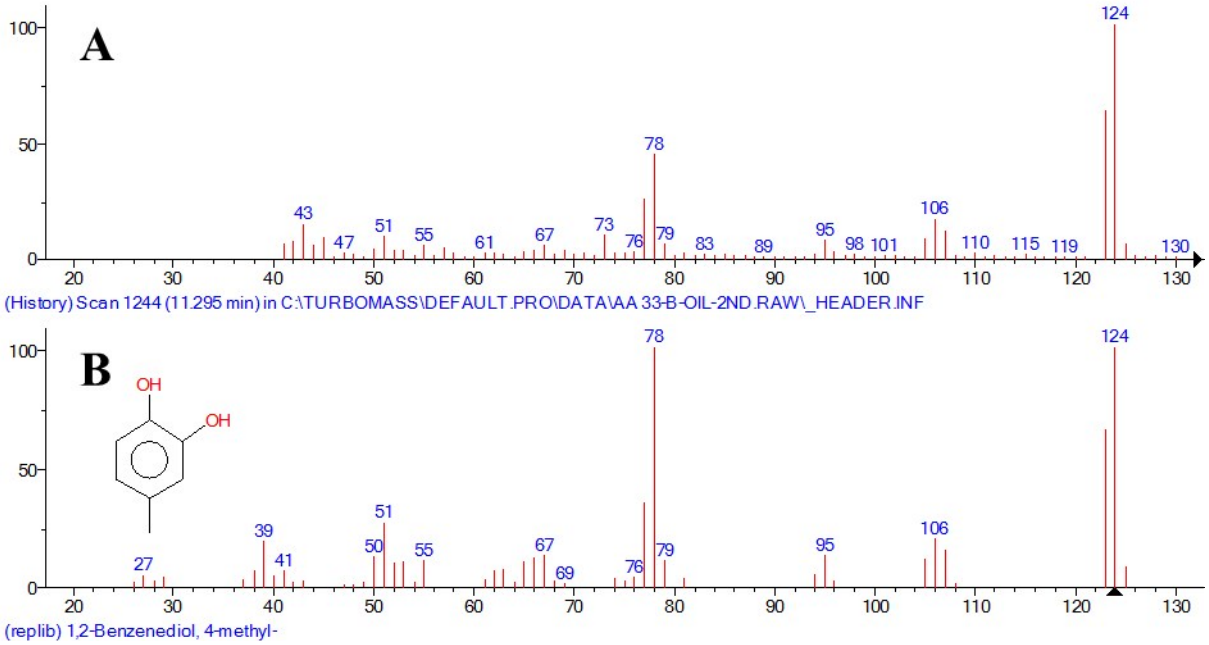
SI Figure 4: Matching MS spectrum of peak 9.53 MS in crude bio-oil GC-MS: A) MS of peak 9.53 MS in crude bio-oil sample; B) MS of Phenol, 2-methoxy-4-methyl- according to NIST library.



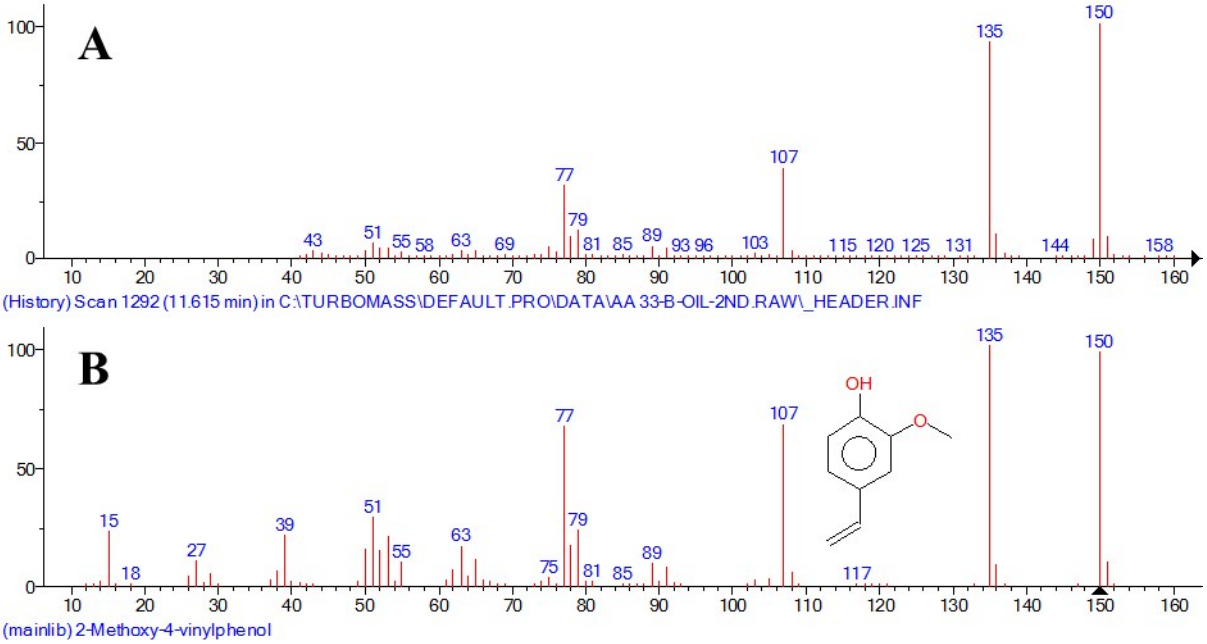
SI Figure 5: Matching MS spectrum of peak 9.72 MS in crude bio-oil GC-MS: A) MS of peak 9.72 in crude bio-oil sample; B) MS of 1,2-Benzenediol according to NIST library.



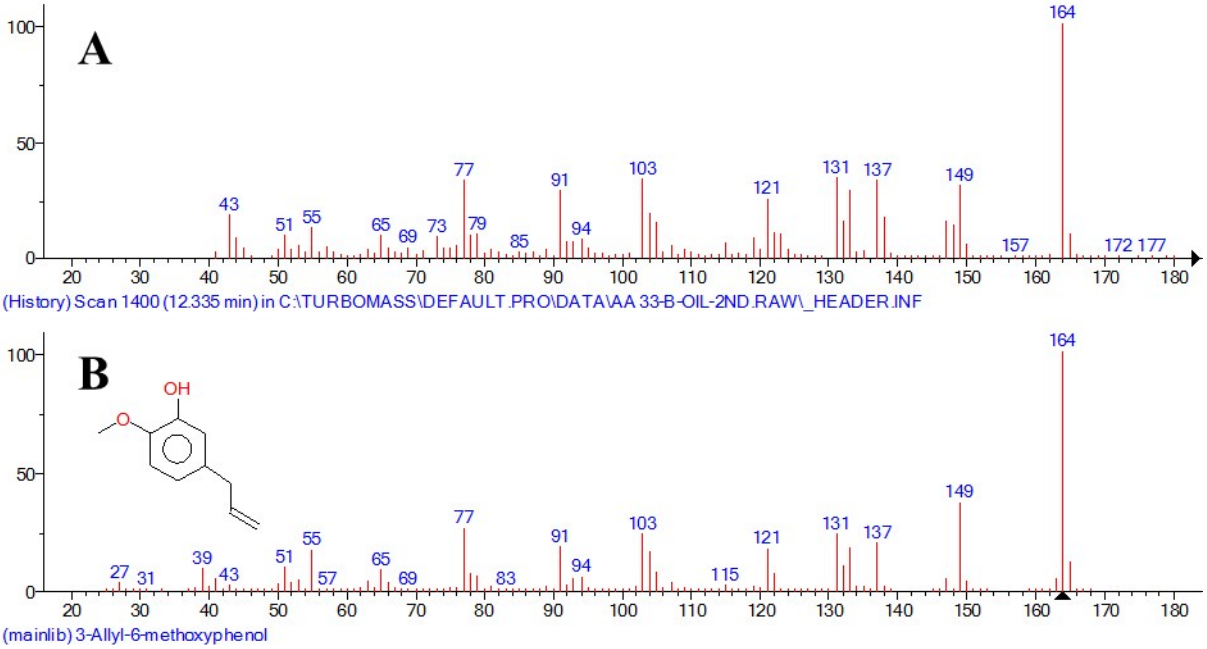
SI Figure 6: Matching MS spectrum of peak 11.03 MS in crude bio-oil GC-MS: A) MS of peak 11.03 in crude bio-oil sample; B) MS of Phenol, 4-ethyl-2-methoxy- according to NIST library.



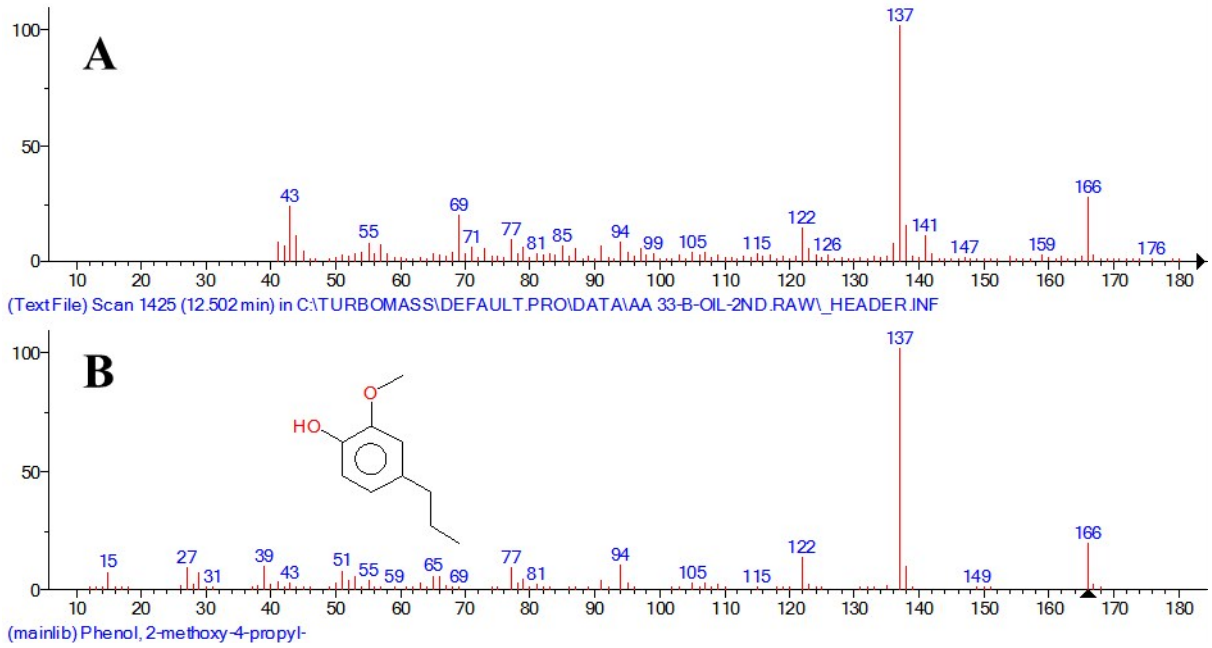
SI Figure 7: Matching MS spectrum of peak 11.30 MS in crude bio-oil GC-MS: A) MS of peak 11.30 in crude bio-oil sample; B) MS of 1,2-Benzenediol, 4-methyl- according to NIST library.



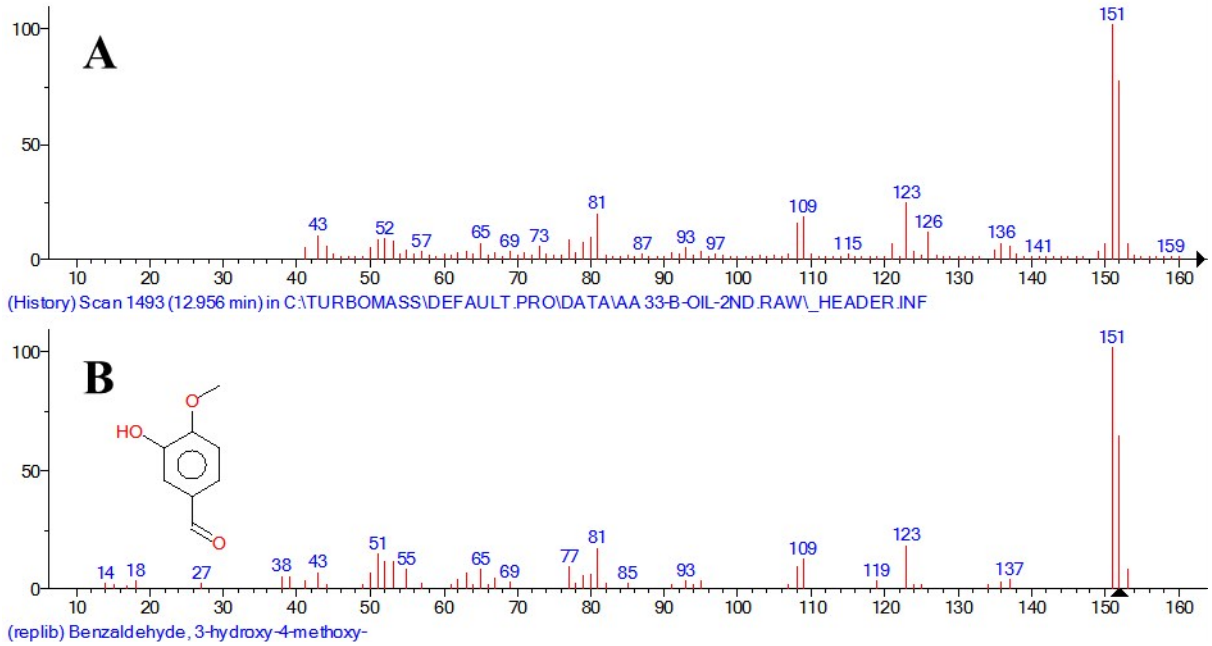
SI Figure 8: Matching MS spectrum of peak 11.62 MS in crude bio-oil GC-MS: A) MS of peak 11.62 in crude bio-oil sample; B) MS of 2-Methoxy-4-vinylphenol according to NIST library.



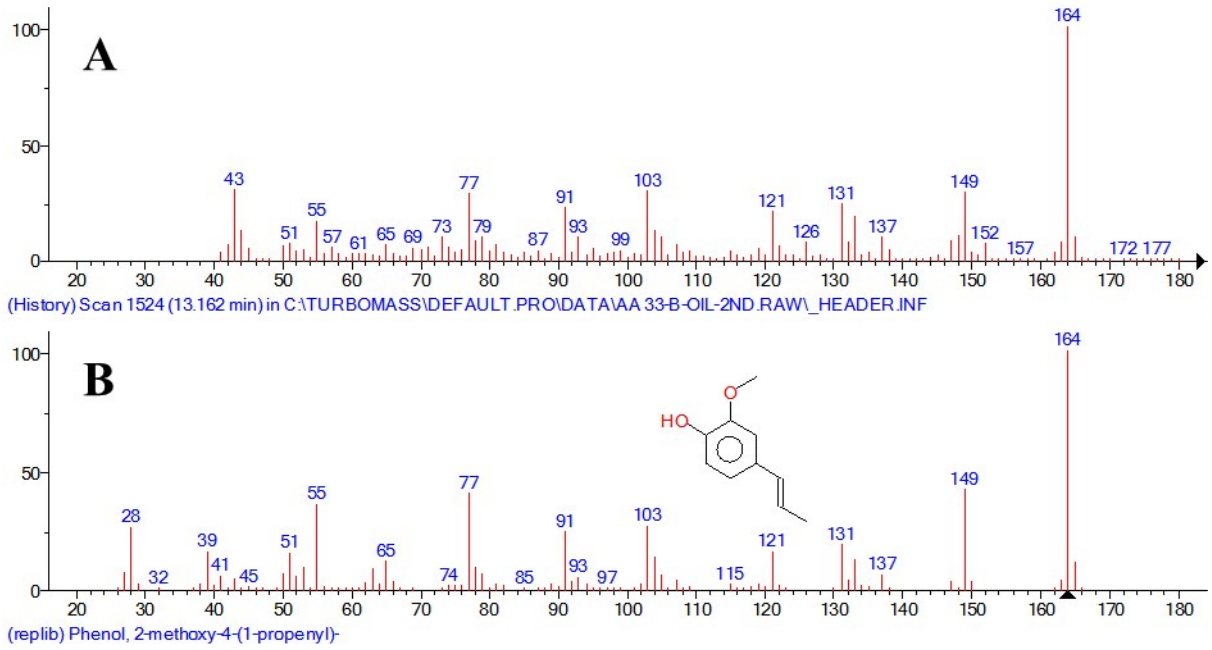
SI Figure 9: Matching MS spectrum of peak 12.33 MS in crude bio-oil GC-MS: A) MS of peak 12.33 in crude bio-oil sample; B) MS of 3-Allyl-6-methoxyphenol according to NIST library.



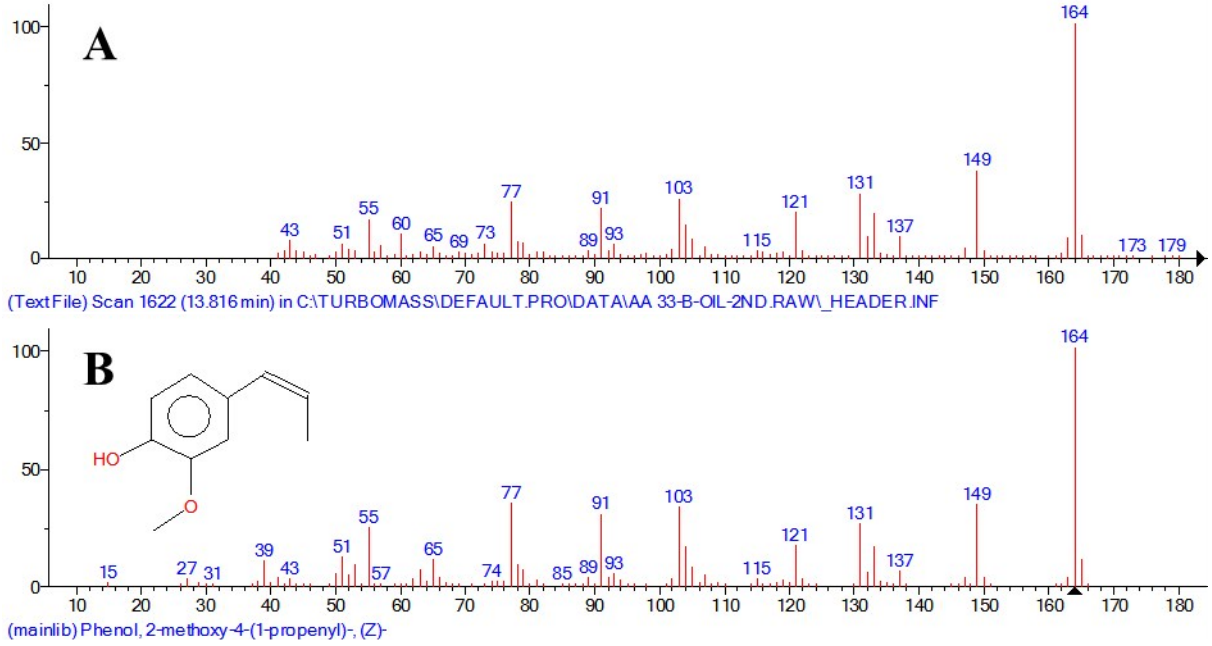
SI Figure 10: Matching MS spectrum of peak 12.50 MS in crude bio-oil GC-MS: A) MS of peak 12.50 in crude bio-oil sample; B) MS of Phenol, 2-methoxy-4-propyl- according to NIST library.



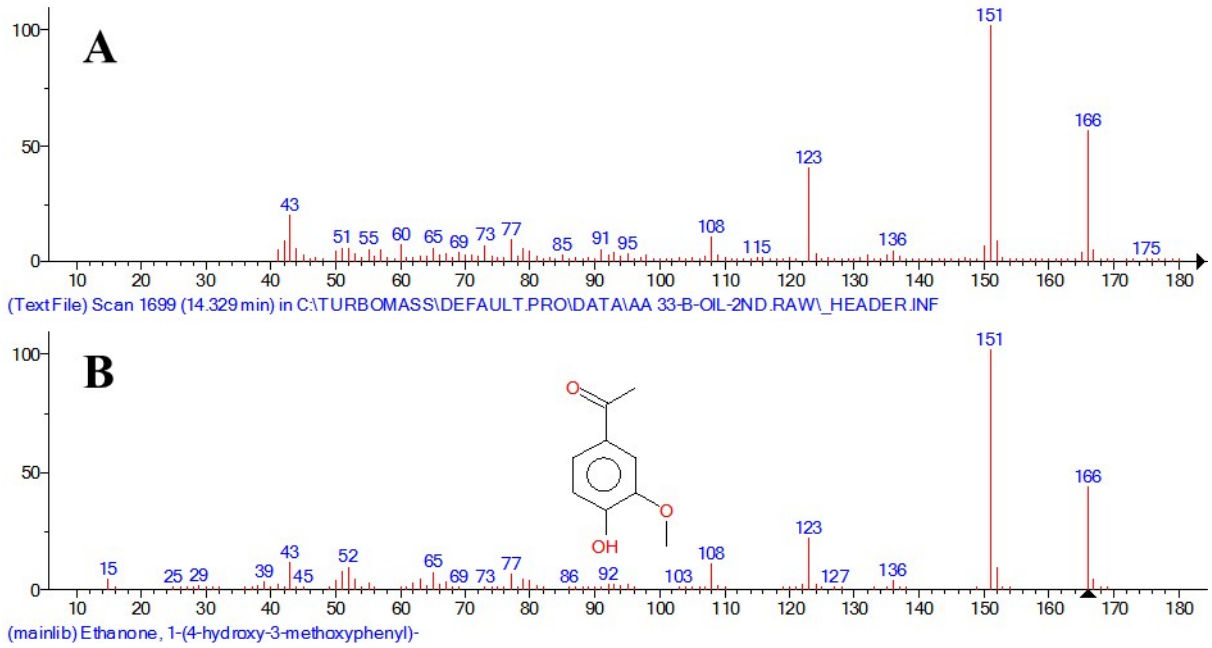
SI Figure 11: Matching MS spectrum of peak 12.96 MS in crude bio-oil GC-MS: A) MS of peak 12.96 in crude bio-oil sample; B) MS of Benzaldehyde, 3-hydroxy-4-methoxy- according to NIST library.



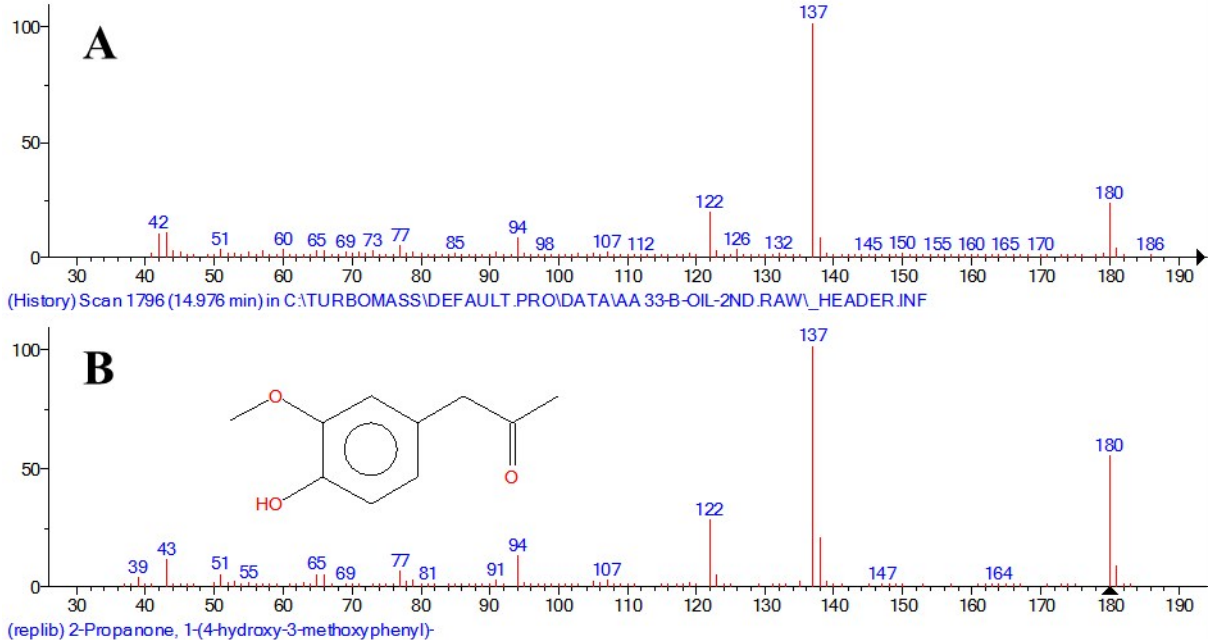
SI Figure 12: Matching MS spectrum of peak 13.16 MS in crude bio-oil GC-MS: A) MS of peak 13.16 in crude bio-oil sample; B) MS of Phenol, 2-methoxy-4-(1-propenyl)- according to NIST library.



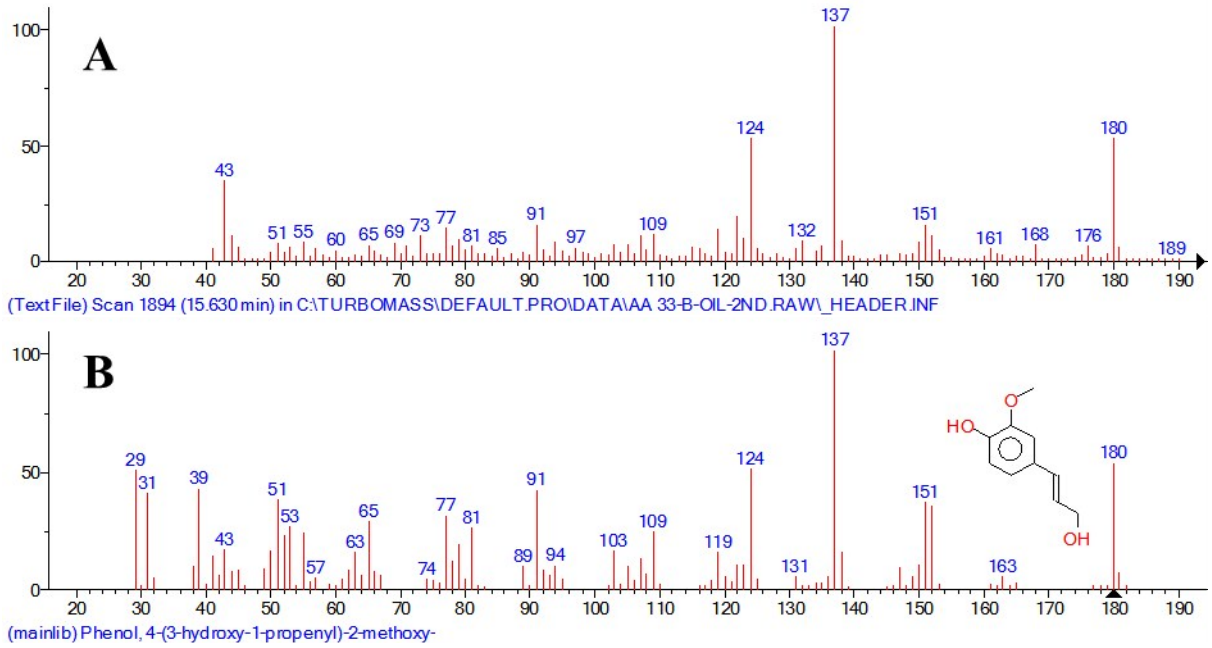
SI Figure 13: Matching MS spectrum of peak 13.82 MS in crude bio-oil GC-MS: A) MS of peak 13.82 in crude bio-oil sample; B) MS of Phenol, 2-methoxy-4-(1-propenyl)-, (Z)- according to NIST library.



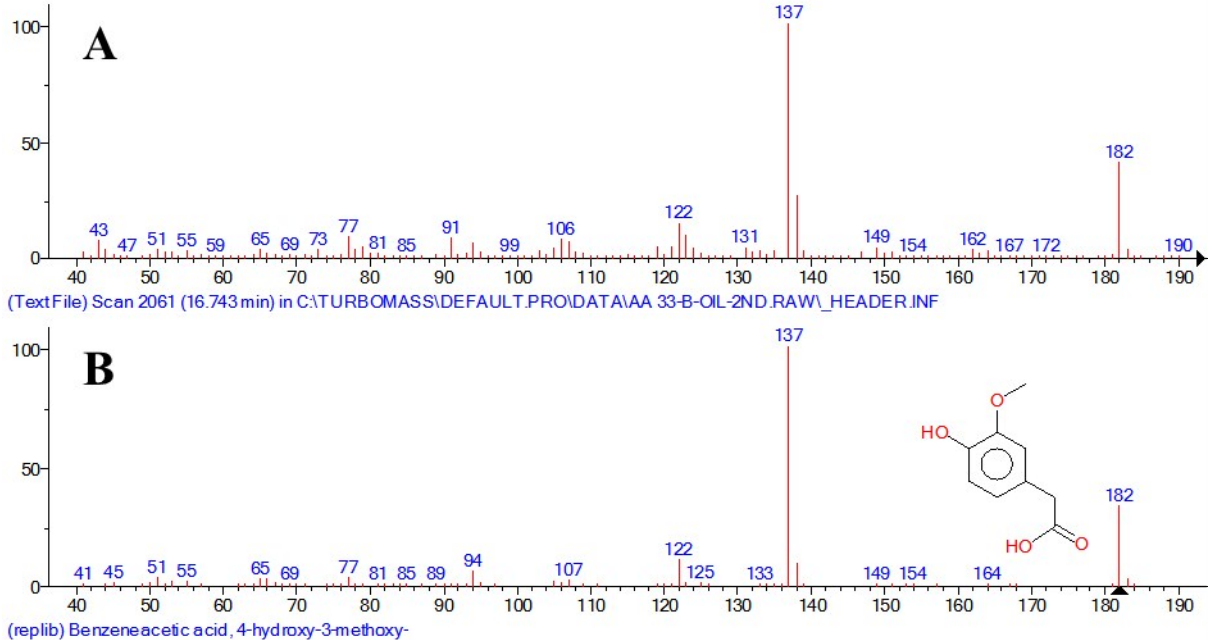
SI Figure 14: Matching MS spectrum of peak 14.34 MS in crude bio-oil GC-MS: A) MS of peak 14.34 in crude bio-oil sample; B) MS of Ethanone, 1-(4-hydroxy-3-methoxyphenyl)- according to NIST library.



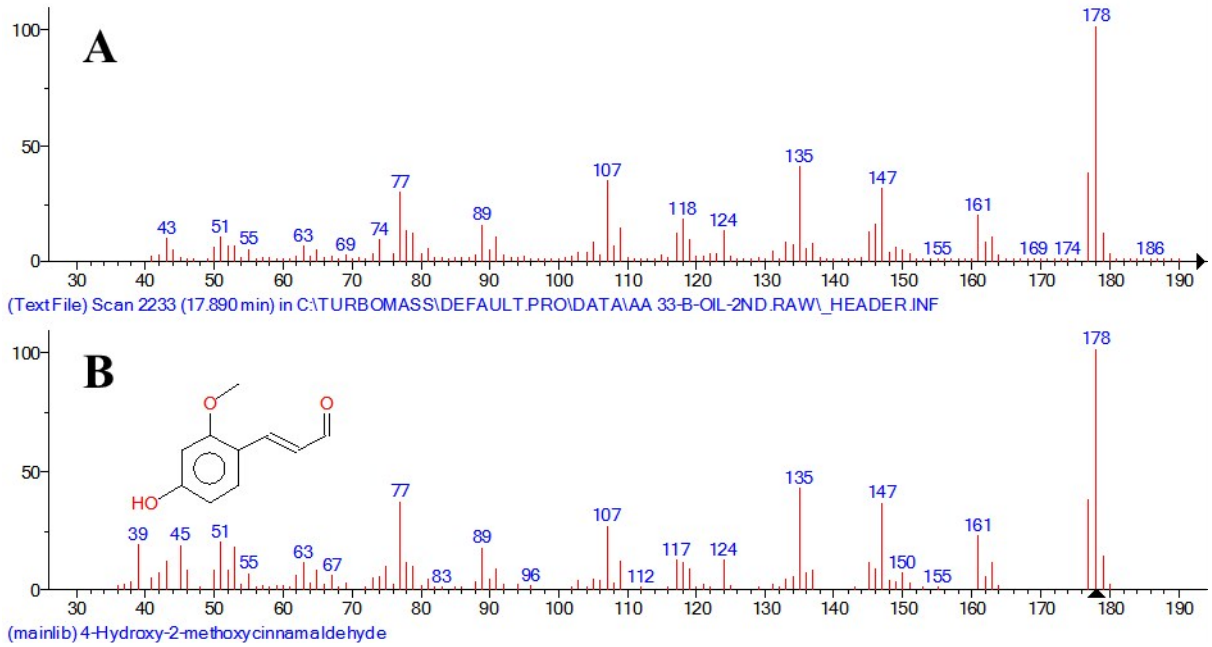
SI Figure 15: Matching MS spectrum of peak 14.98 MS in crude bio-oil GC-MS: A) MS of peak 14.98 in crude bio-oil sample; B) MS of 2-Propanone, 1-(4-hydroxy-3-methoxyphenyl)- according to NIST library.



SI Figure 16: Matching MS spectrum of peak 15.63 MS in crude bio-oil GC-MS: A) MS of peak 15.63 in crude bio-oil sample; B) MS of Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy- according to NIST library.

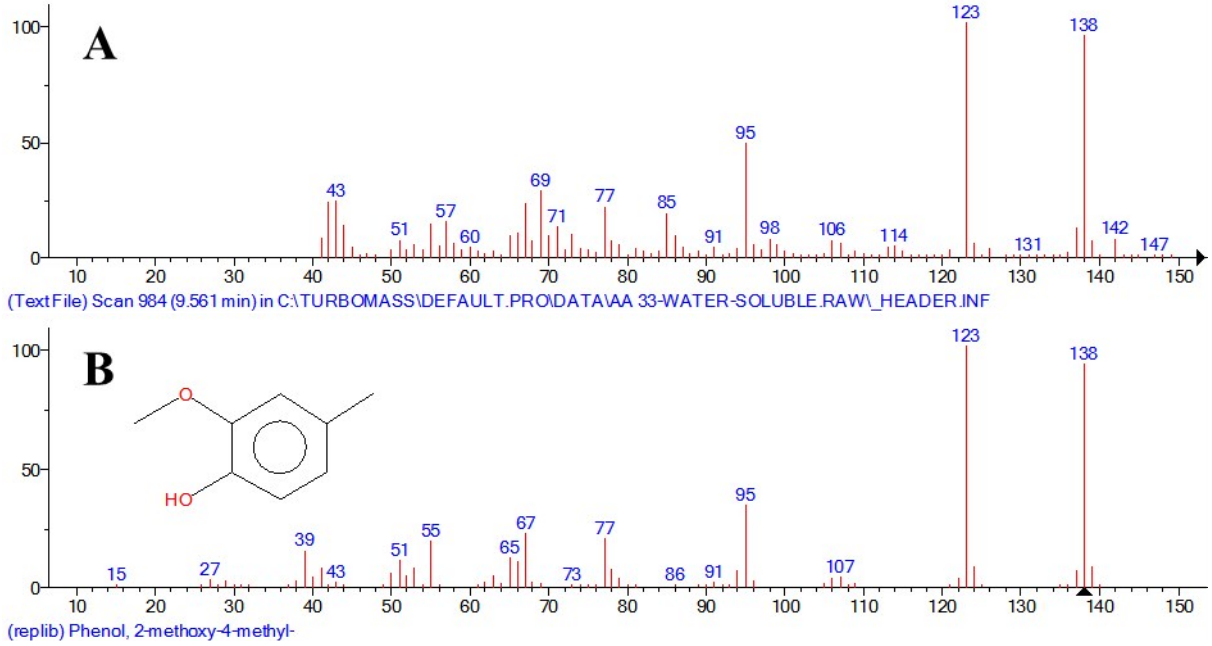


SI Figure 17: Matching MS spectrum of peak 16.74 MS in crude bio-oil GC-MS: A) MS of peak 16.74 in crude bio-oil sample; B) MS of Benzeneacetic acid, 4-hydroxy-3-methoxy- according to NIST library.

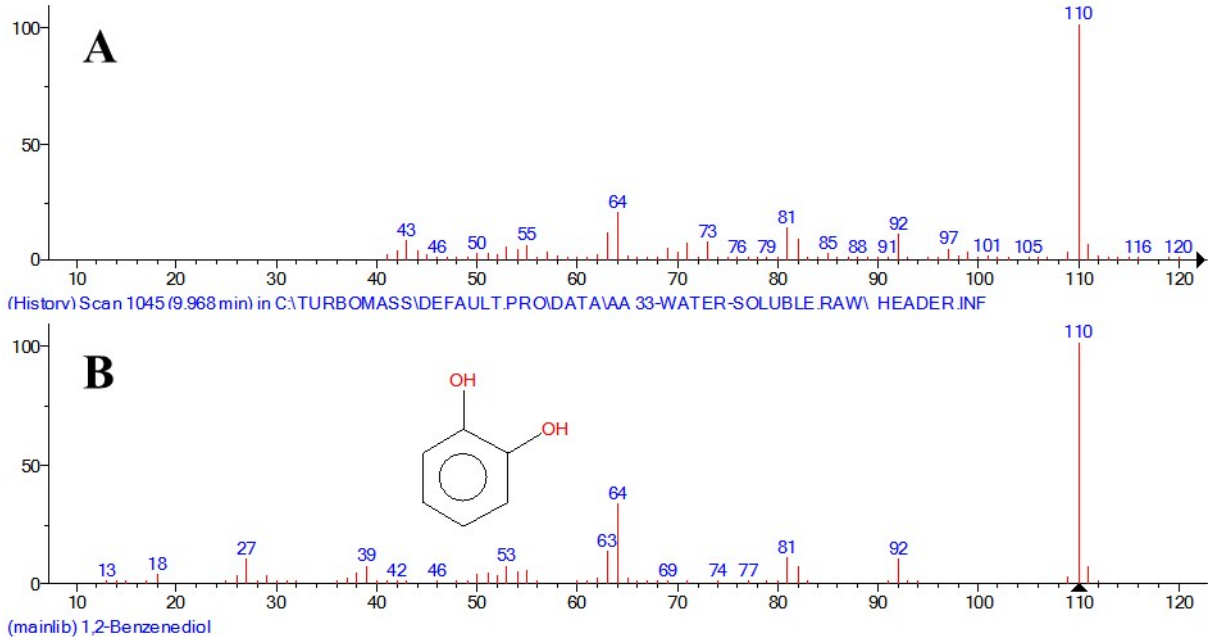


SI Figure 18: Matching MS spectrum of peak 17.89 MS in crude bio-oil GC-MS: A) MS of peak 17.89 in crude bio-oil sample; B) MS of 4-Hydroxy-2-methoxycinnamaldehyde according to NIST library.

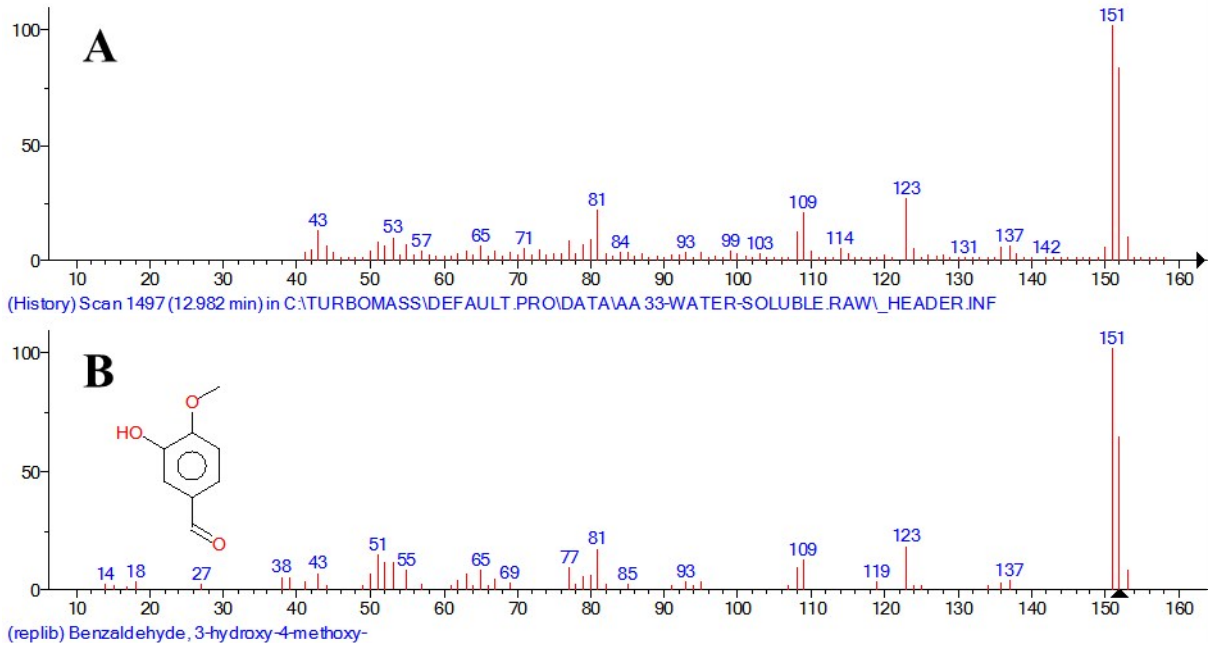
Water-soluble extract MS of Identified phenols and their best MS match from NIST Spectral library.



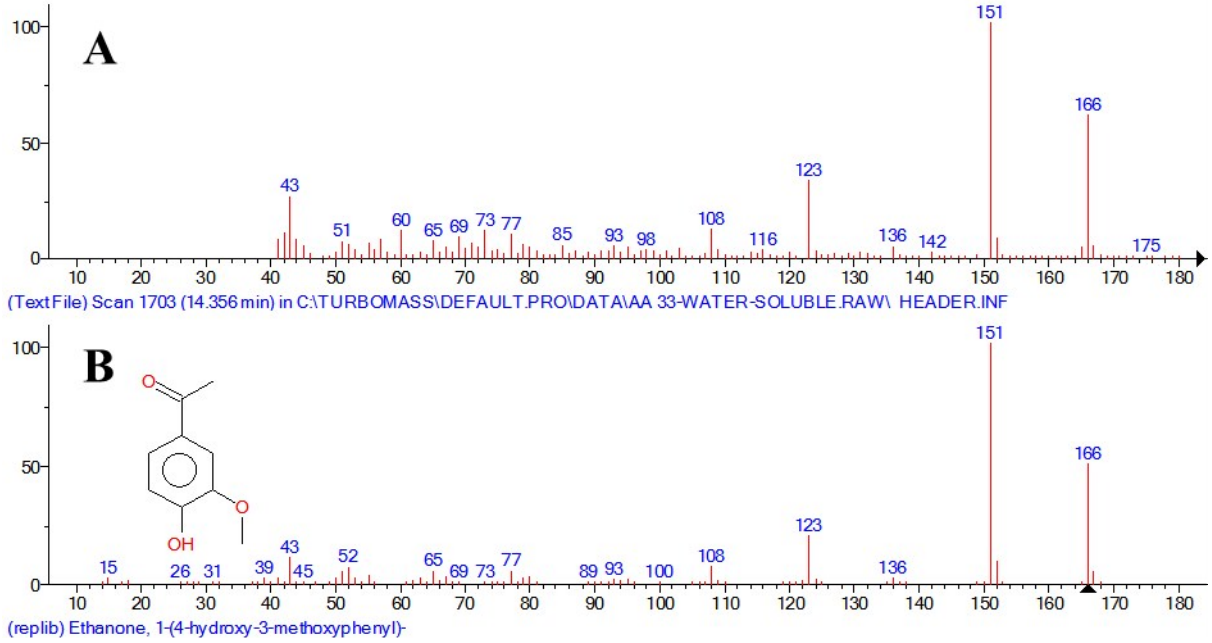
SI Figure 19: Matching MS spectrum of peak 9.55 MS in water-soluble extract GC-MS: A) MS of peak 9.55 in water-soluble extract sample; B) MS of Phenol, 2-methoxy-4-methyl- according to NIST library.



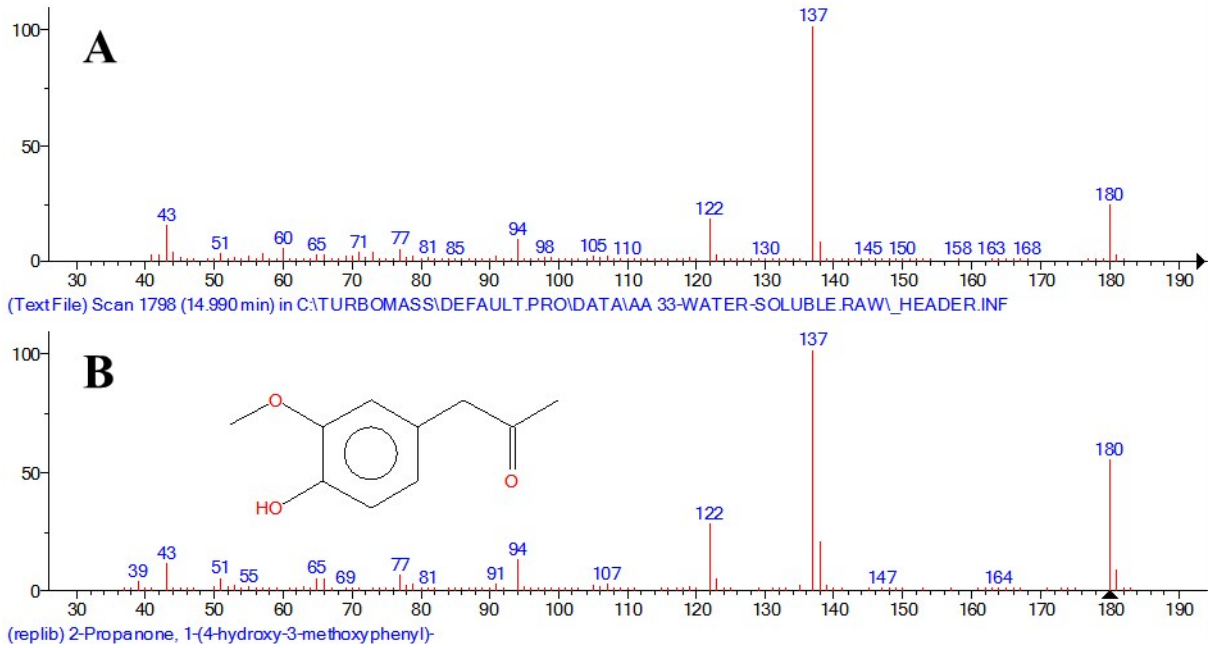
SI Figure 20: Matching MS spectrum of peak 9.96 MS in water-soluble extract GC-MS: A) MS of peak 9.96 in water-soluble extract sample; B) MS of 1,2-Benzenediol according to NIST library.



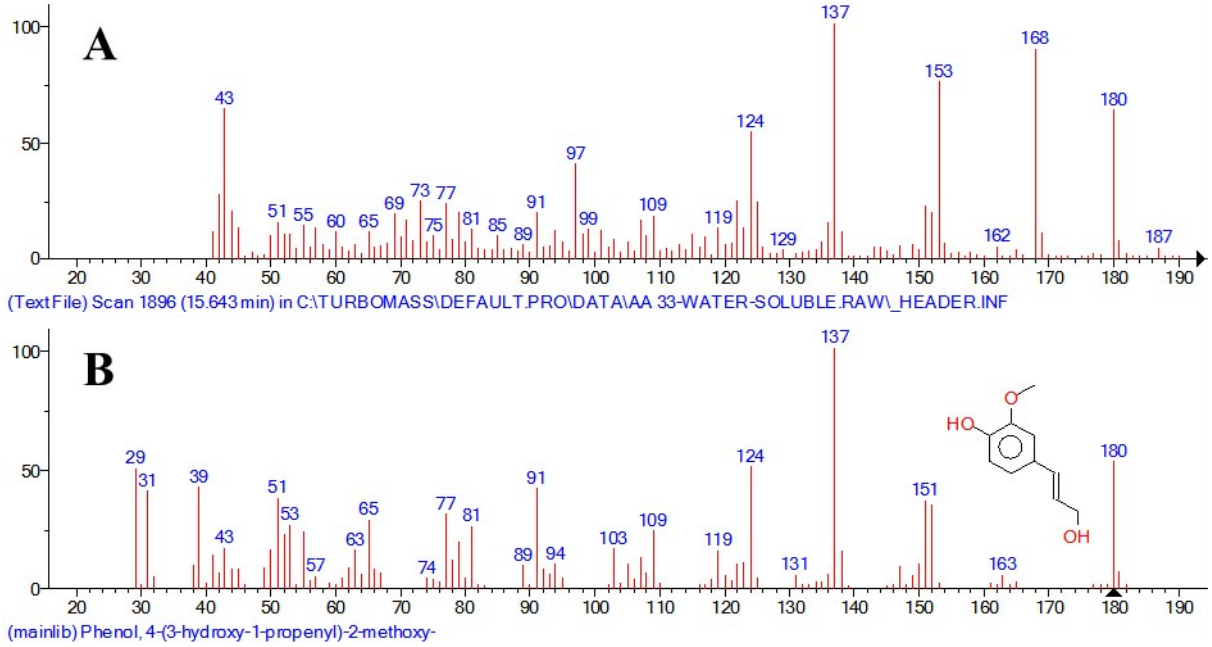
SI Figure 21: Matching MS spectrum of peak 12.98 MS in water-soluble extract GC-MS: A) MS of peak 12.98 in water-soluble extract sample; B) MS of Benzaldehyde, 3-hydroxy-4-methoxy- according to NIST library.



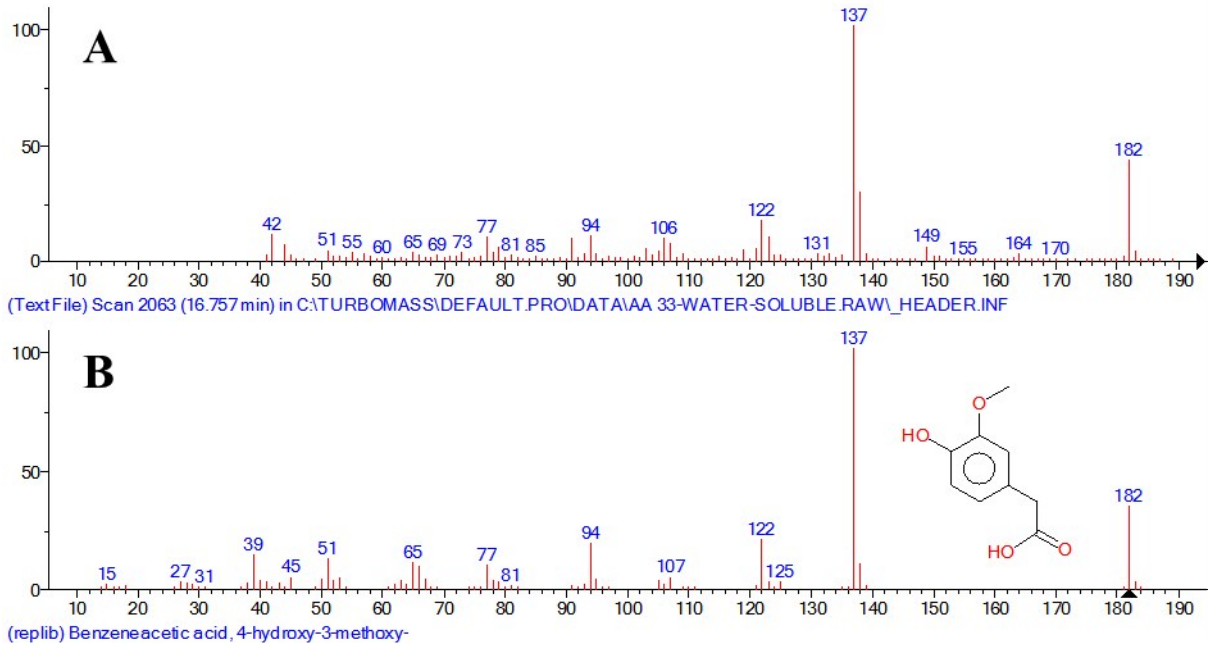
SI Figure 22: Matching MS spectrum of peak 14.35 MS in water-soluble extract GC-MS: A) MS of peak 14.35 in water-soluble extract sample; B) MS of Ethanone, 1-(4-hydroxy-3-methoxyphenyl)- according to NIST library.



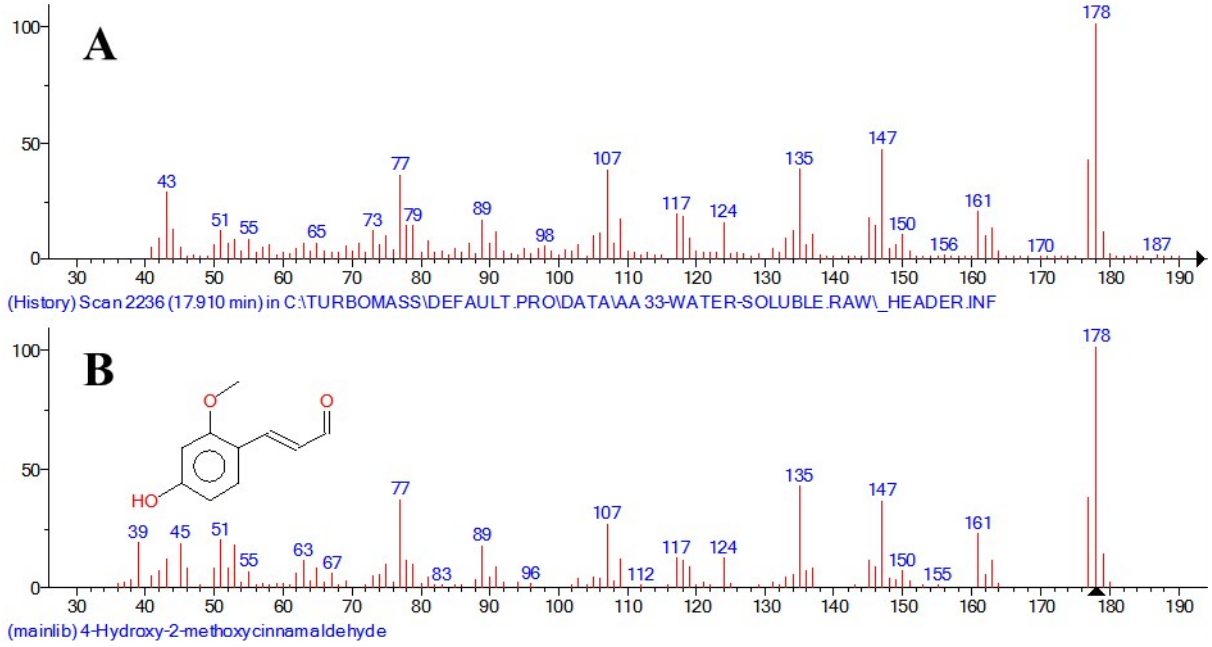
SI Figure 23: Matching MS spectrum of peak 14.99 MS in water-soluble extract GC-MS: A) MS of peak 14.99 in water-soluble extract sample; B) MS of 2-Propanone, 1-(4-hydroxy-3-methoxyphenyl)- according to NIST library.



SI Figure 24: Matching MS spectrum of peak 15.64 MS in water-soluble extract GC-MS: A) MS of peak 15.64 in water-soluble extract sample; B) MS of Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy- according to NIST library.

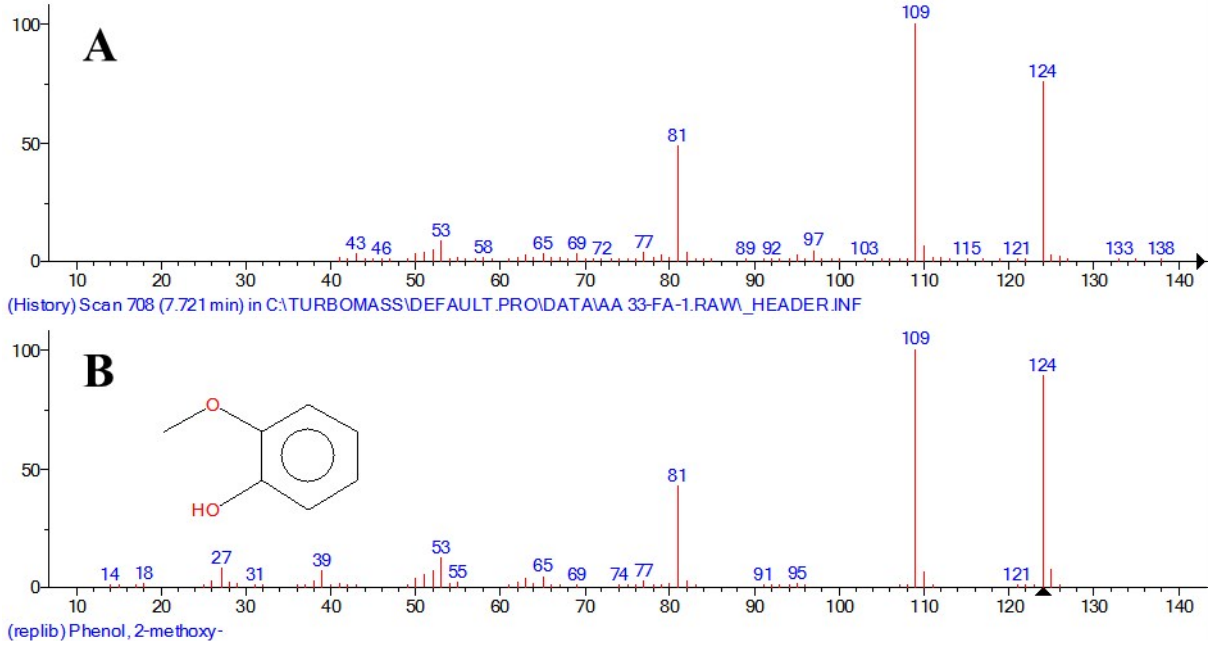


SI Figure 25: Matching MS spectrum of peak 16.76 MS in water-soluble extract GC-MS: A) MS of peak 16.76 in water-soluble extract sample; B) MS of Benzeneacetic acid, 4-hydroxy-3-methoxy- according to NIST library.

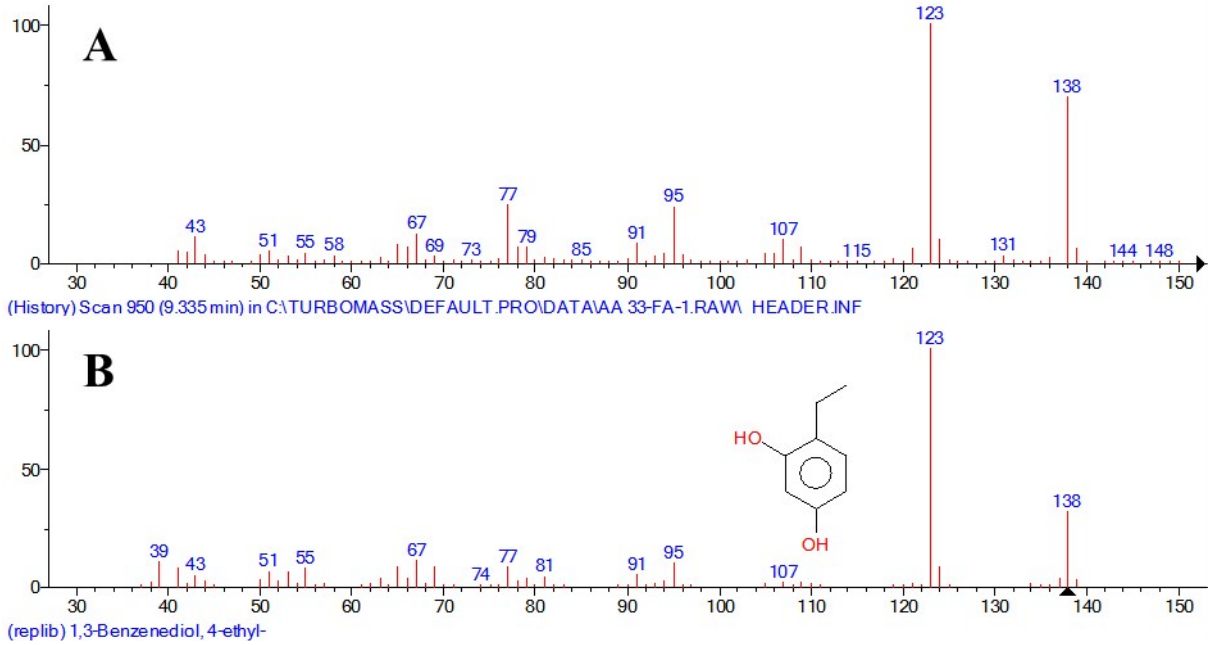


SI Figure 26: Matching MS spectrum of peak 17.91 MS in water-soluble extract GC-MS: A) MS of peak 17.91 in water-soluble extract sample; B) MS of 4-Hydroxy-2-methoxycinnamaldehyde according to NIST library.

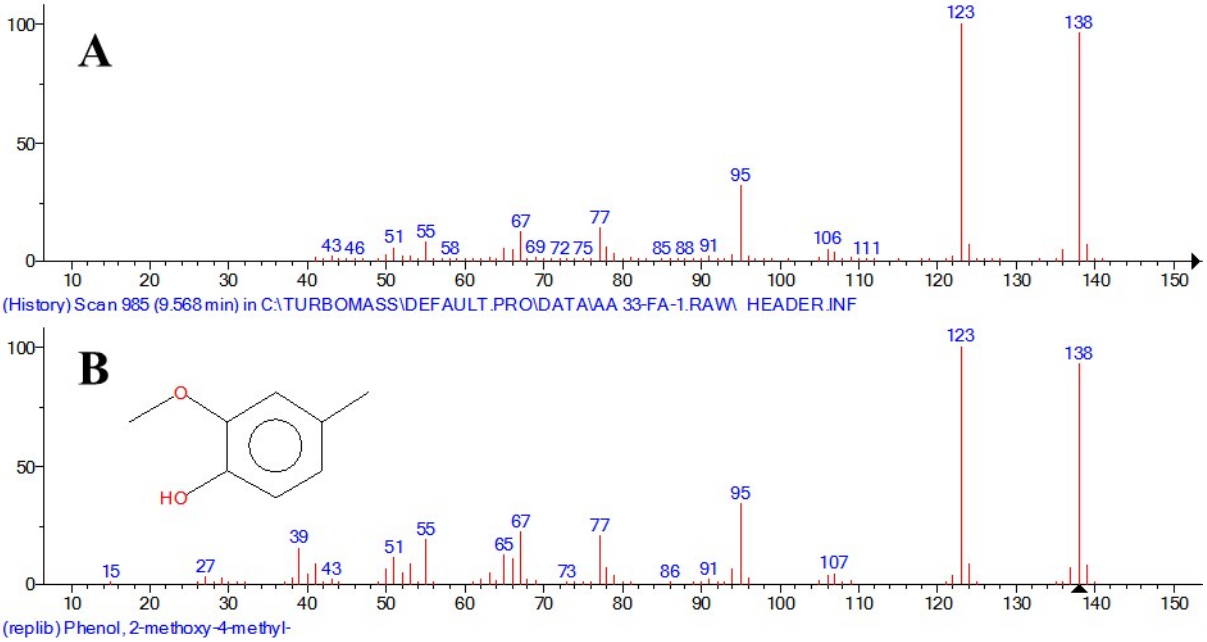
Neutral extract MS of Identified phenols and their best MS match from NIST Spectral library.



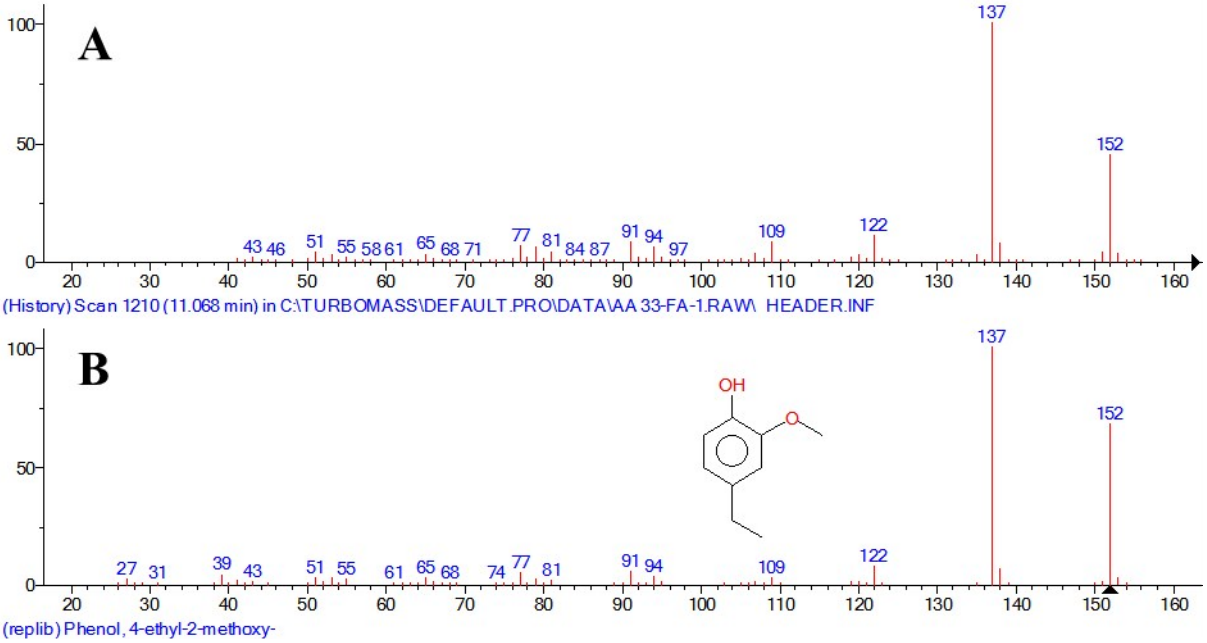
SI Figure 27: Matching MS spectrum of peak 7.72 MS in neutral extract GC-MS: A) MS of peak 7.72 in neutral extract sample; B) MS of Phenol, 2-methoxy- according to NIST library.



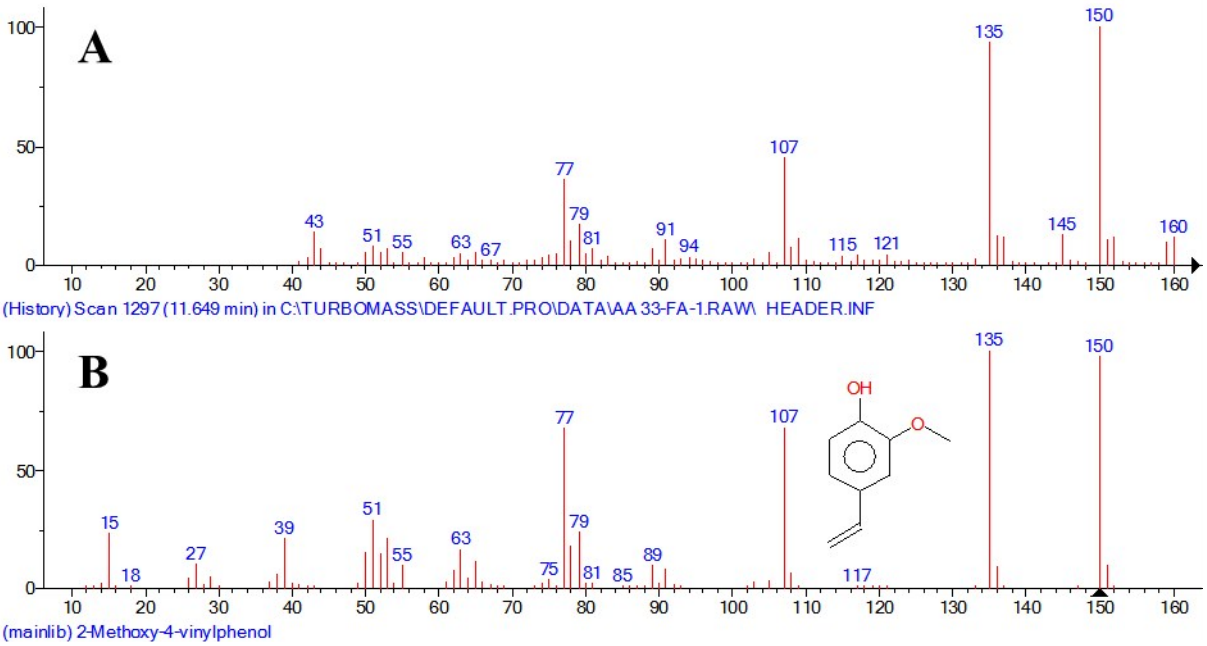
SI Figure 28: Matching MS spectrum of peak 9.33 MS in neutral extract GC-MS: A) MS of peak 9.33 in neutral extract sample; B) MS of 1,3-Benzenediol, 4-ethyl- according to NIST library.



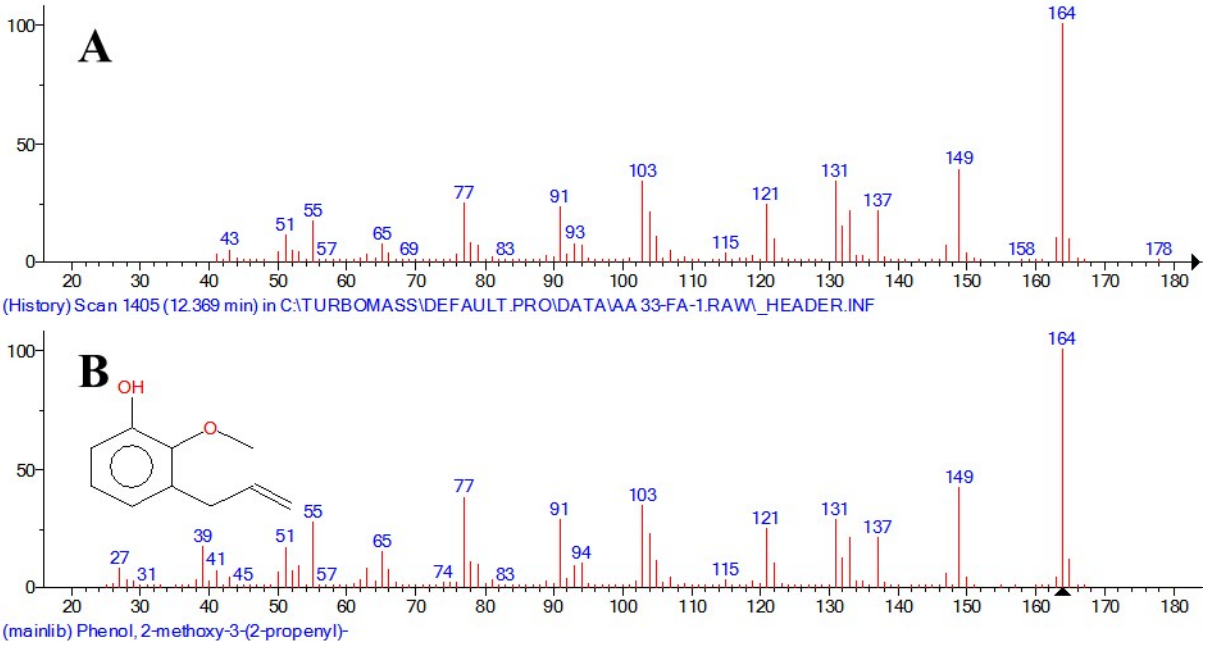
SI Figure 29: Matching MS spectrum of peak 9.57 MS in neutral extract GC-MS: A) MS of peak 9.57 in neutral extract sample; B) MS of Phenol, 2-methoxy-4-methyl- according to NIST library.



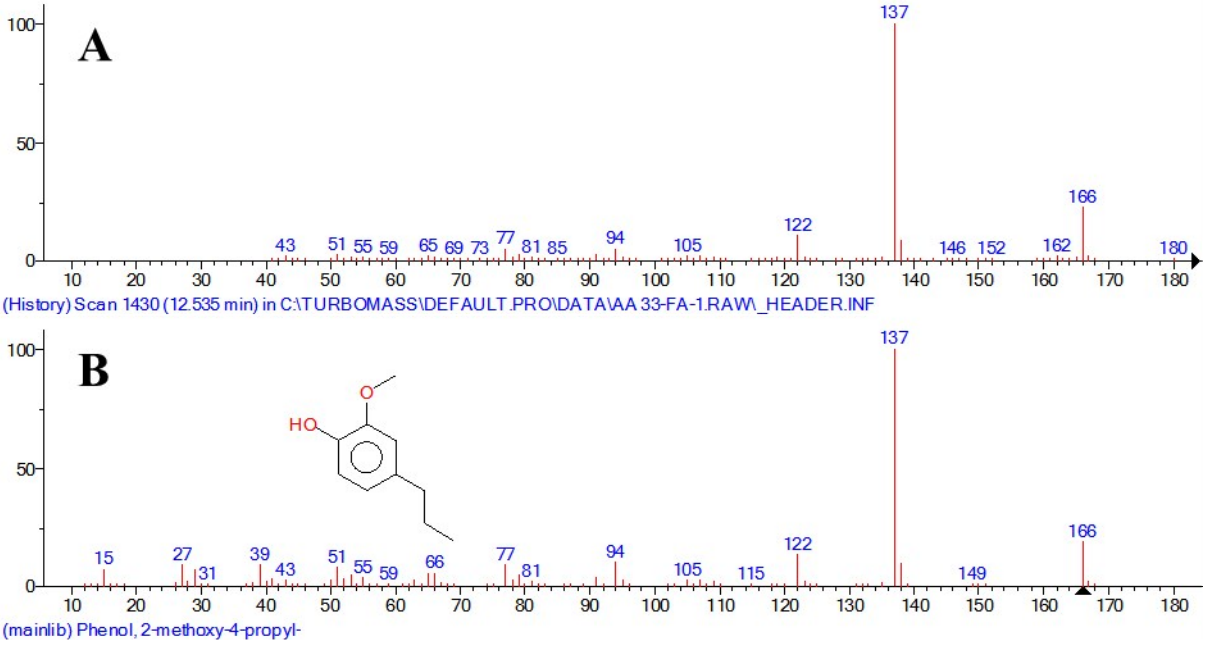
SI Figure 30: Matching MS spectrum of peak 11.07 MS in neutral extract GC-MS: A) MS of peak 11.07 in neutral extract sample; B) MS of Phenol, 4-ethyl-2-methoxy- according to NIST library.



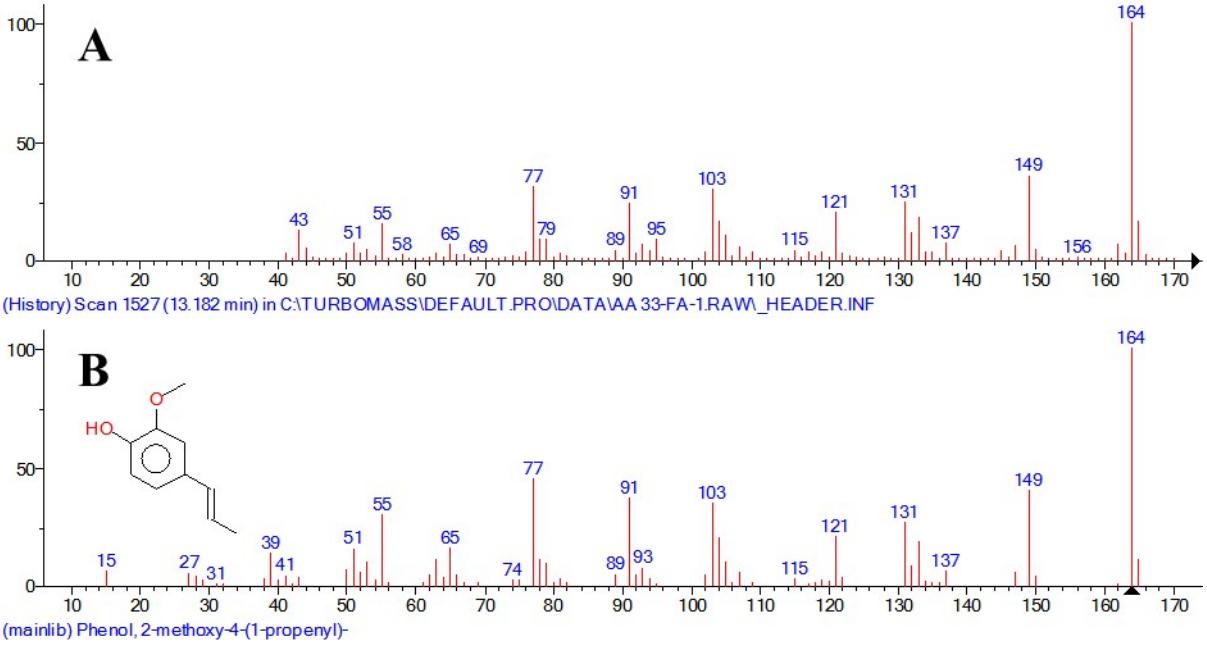
SI Figure 31: Matching MS spectrum of peak 11.65 MS in neutral extract GC-MS: A) MS of peak 11.65 in neutral extract sample; B) MS of 2-Methoxy-4-vinylphenol according to NIST library.



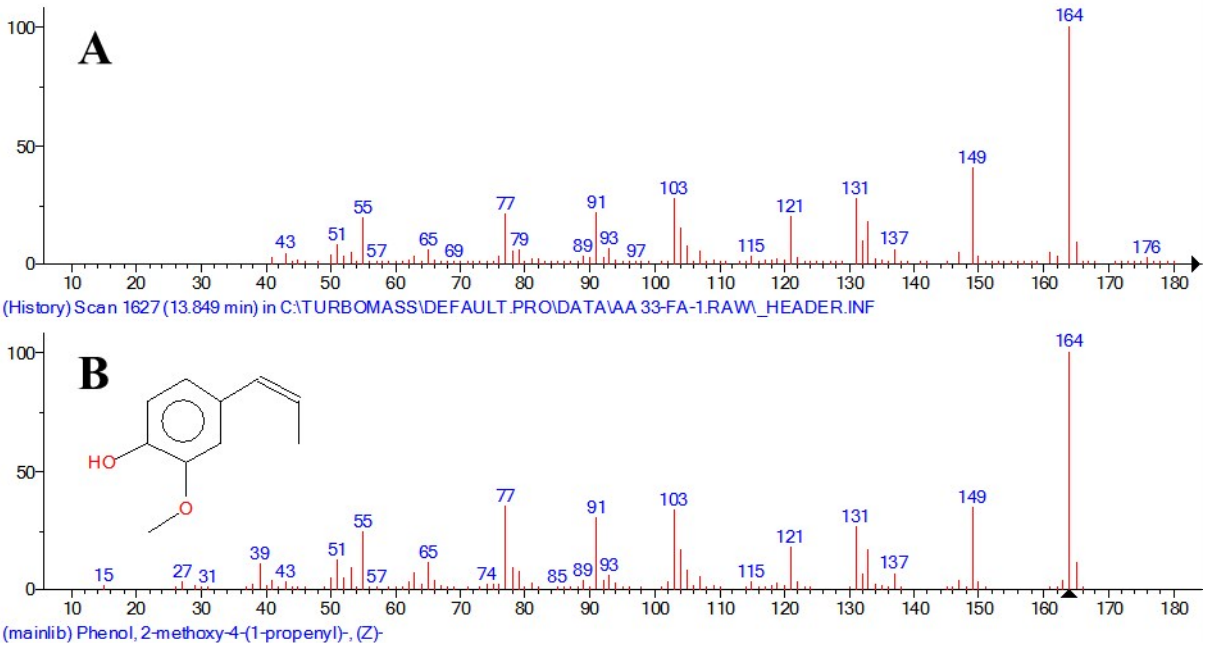
SI Figure 32: Matching MS spectrum of peak 12.37 MS in neutral extract GC-MS: A) MS of peak 12.37 in neutral extract sample; B) MS of 3-Allyl-6-methoxyphenol according to NIST library.



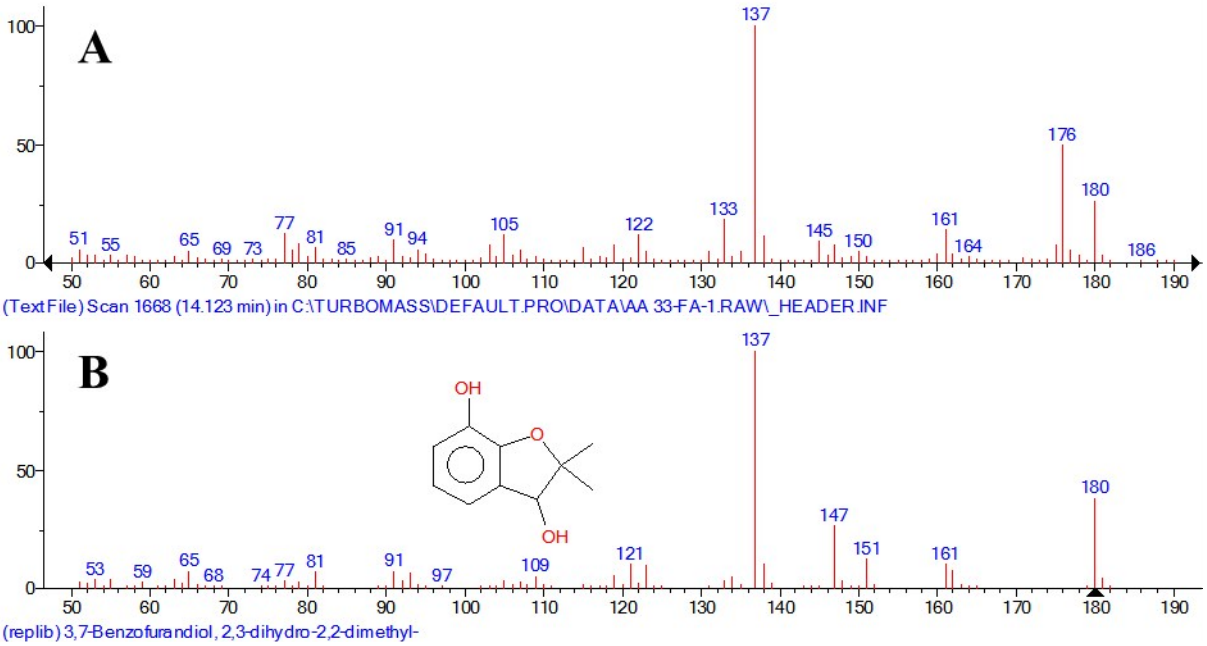
SI Figure 33: Matching MS spectrum of peak 12.54 MS in neutral extract GC-MS: A) MS of peak 12.54 in neutral extract sample; B) MS of Phenol, 2-methoxy-4-propyl- according to NIST library.



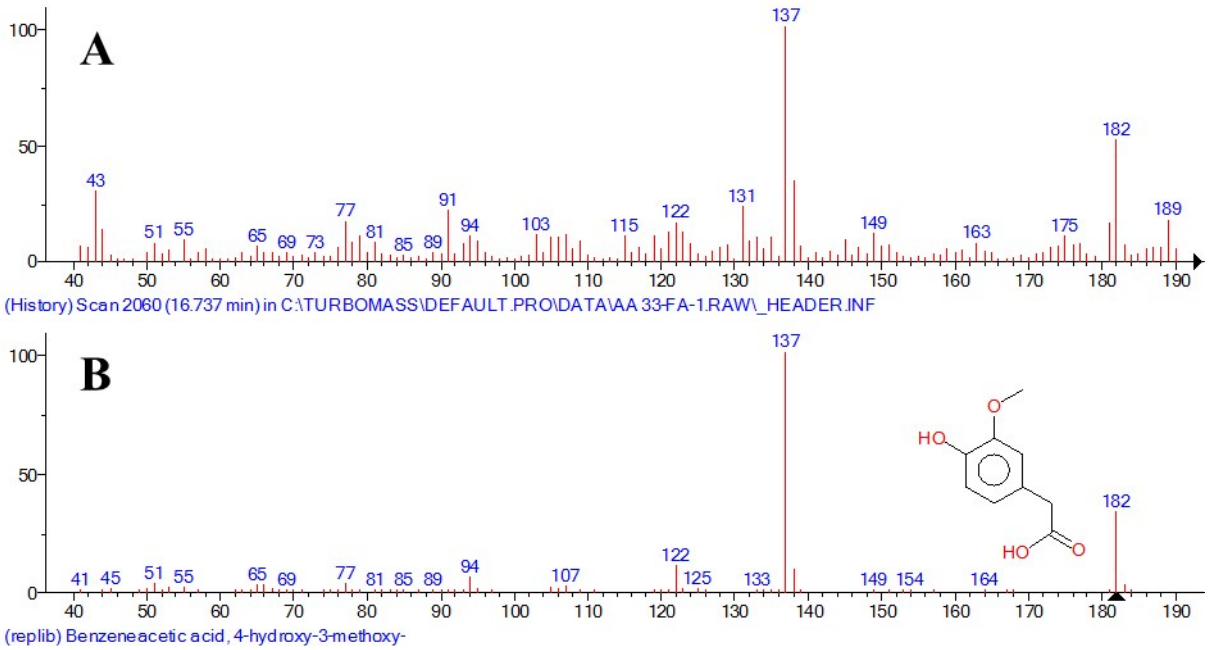
SI Figure 34: Matching MS spectrum of peak 13.18 MS in neutral extract GC-MS: A) MS of peak 13.18 in neutral extract sample; B) MS of Phenol, 2-methoxy-4-(1-propenyl)- according to NIST library.



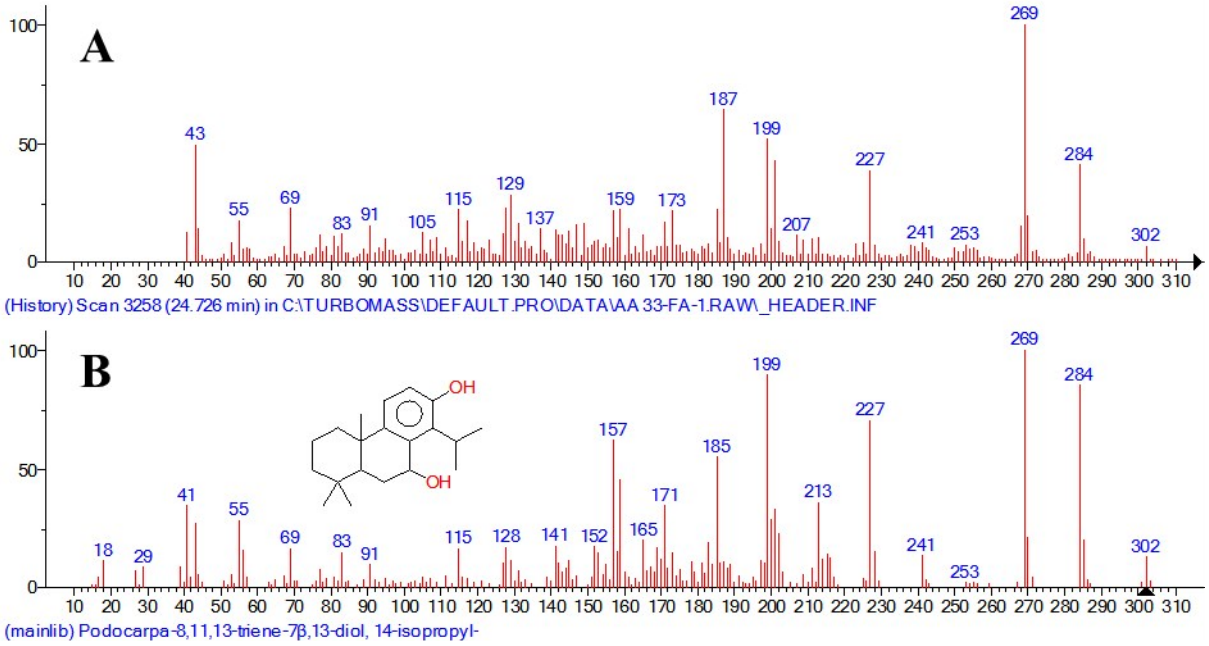
SI Figure 35: Matching MS spectrum of peak 13.85 MS in neutral extract GC-MS: A) MS of peak 13.85 in neutral extract sample; B) MS of Phenol, 2-methoxy-4-(1-propenyl)-, (Z)- according to NIST library.



SI Figure 36: Matching MS spectrum of peak 14.12 MS in neutral extract GC-MS: A) MS of peak 14.12 in neutral extract sample; B) MS of 3,7-Benzofurandiol, 2,3-dihydro-2,2-dimethyl- according to NIST library.

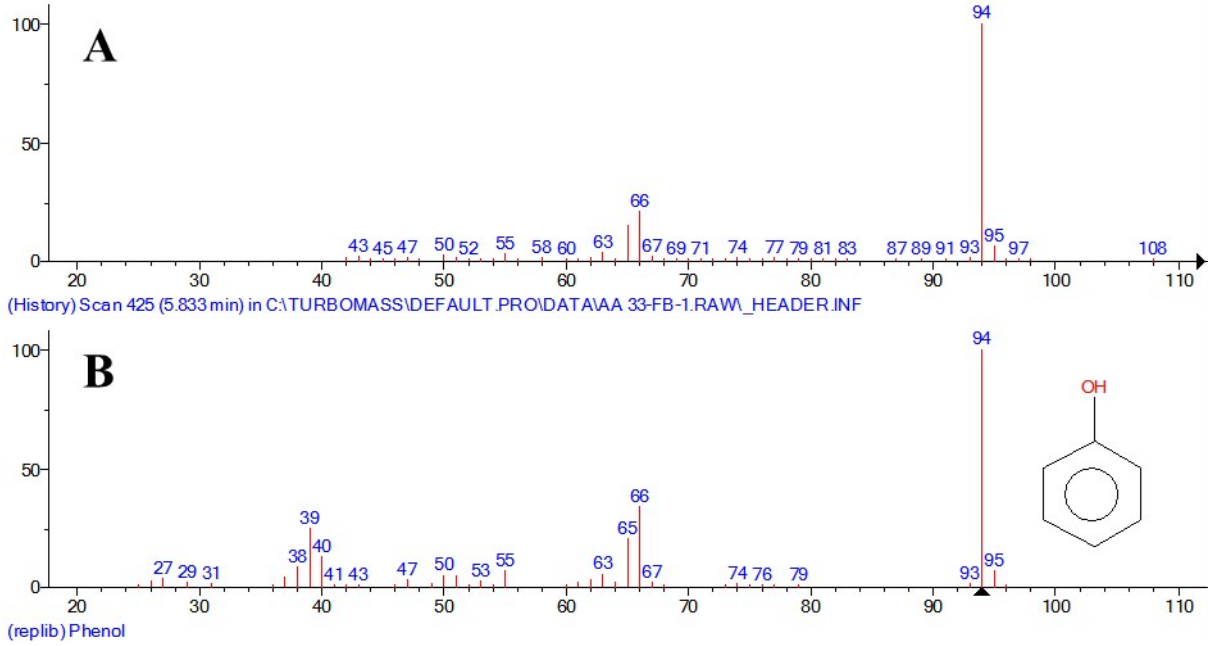


SI Figure 37: Matching MS spectrum of peak 16.74 MS in neutral extract GC-MS: A) MS of peak 16.74 in neutral extract sample; B) MS of Benzeneacetic acid, 4-hydroxy-3-methoxy- according to NIST library.

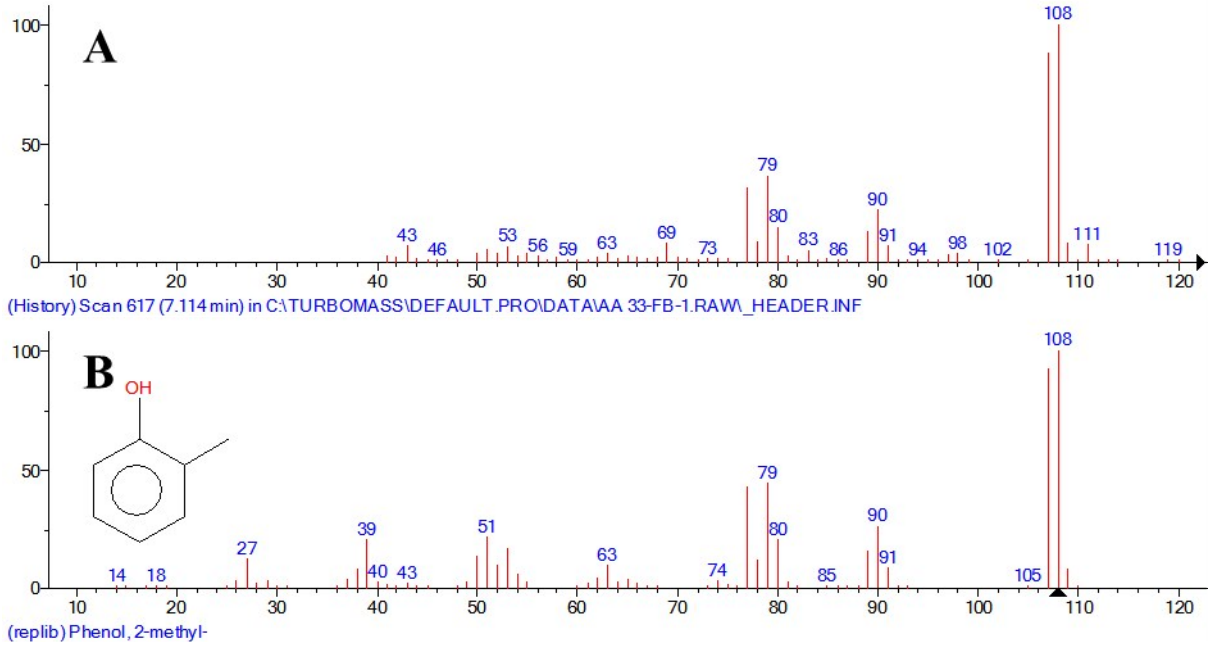


SI Figure 38: Matching MS spectrum of peak 24.73 MS in neutral extract GC-MS: A) MS of peak 24.73 in neutral extract sample; B) MS of Podocarpa-8,11,13-triene-7β,13-diol, 14-isopropyl- according to NIST library.

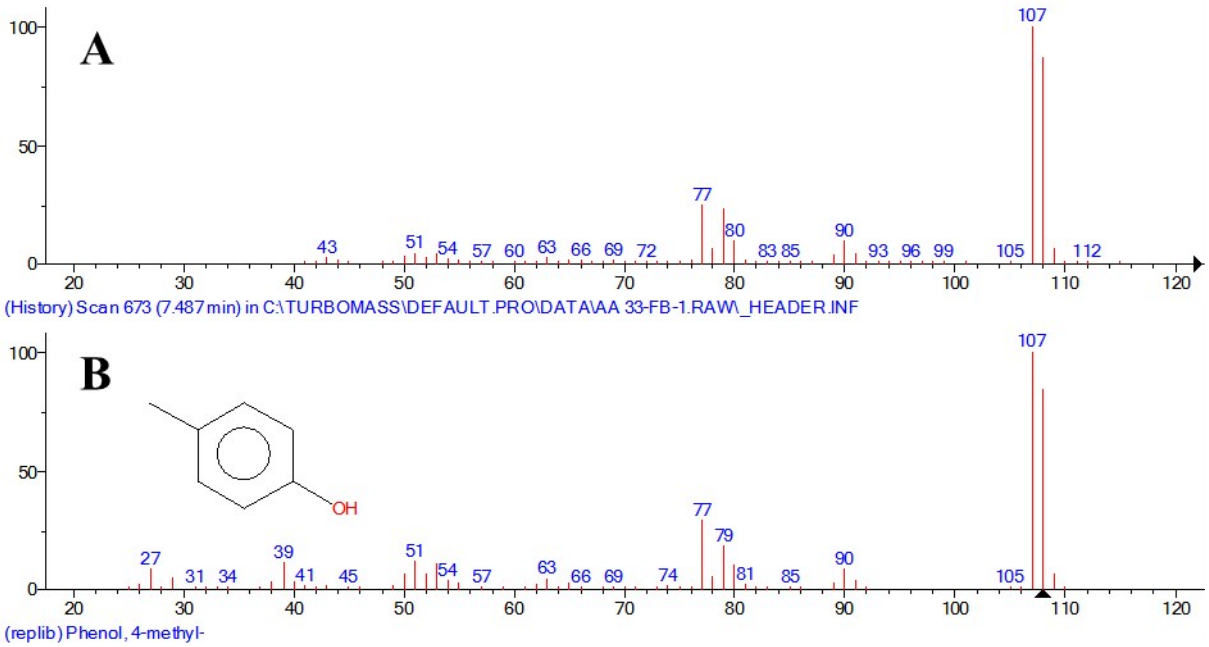
Phenolic extract MS of identified phenols and their best MS match from NIST Spectral library.



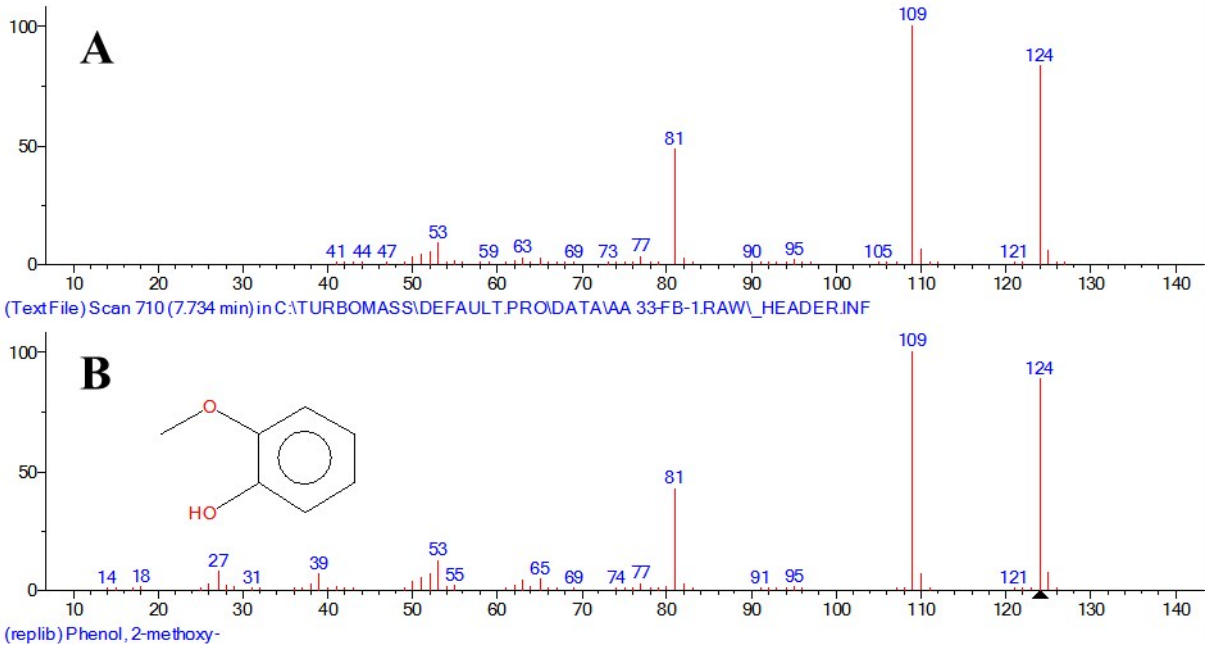
SI Figure 39: Matching MS spectrum of peak 5.83 MS in phenolic extract GC-MS: A) MS of peak 5.83 in phenolic extract sample; B) MS of Phenol according to NIST library.



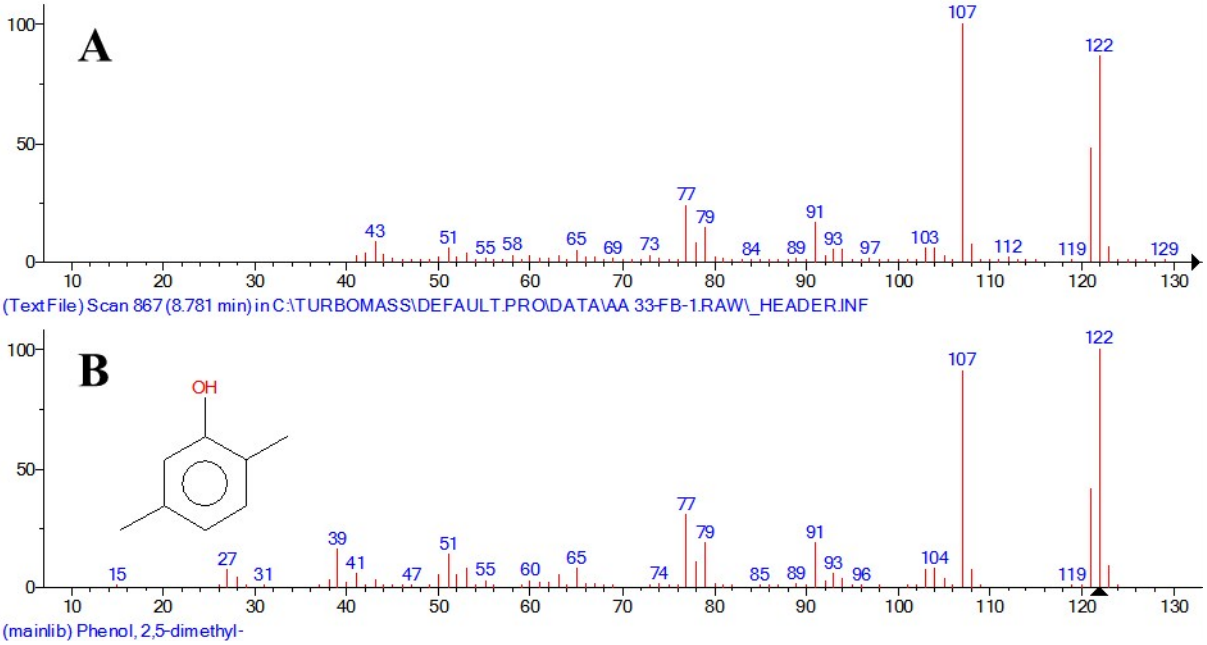
SI Figure 40: Matching MS spectrum of peak 7.12 MS in phenolic extract GC-MS: A) MS of peak 7.12 in phenolic extract sample; B) MS of Phenol, 2-methyl- according to NIST library.



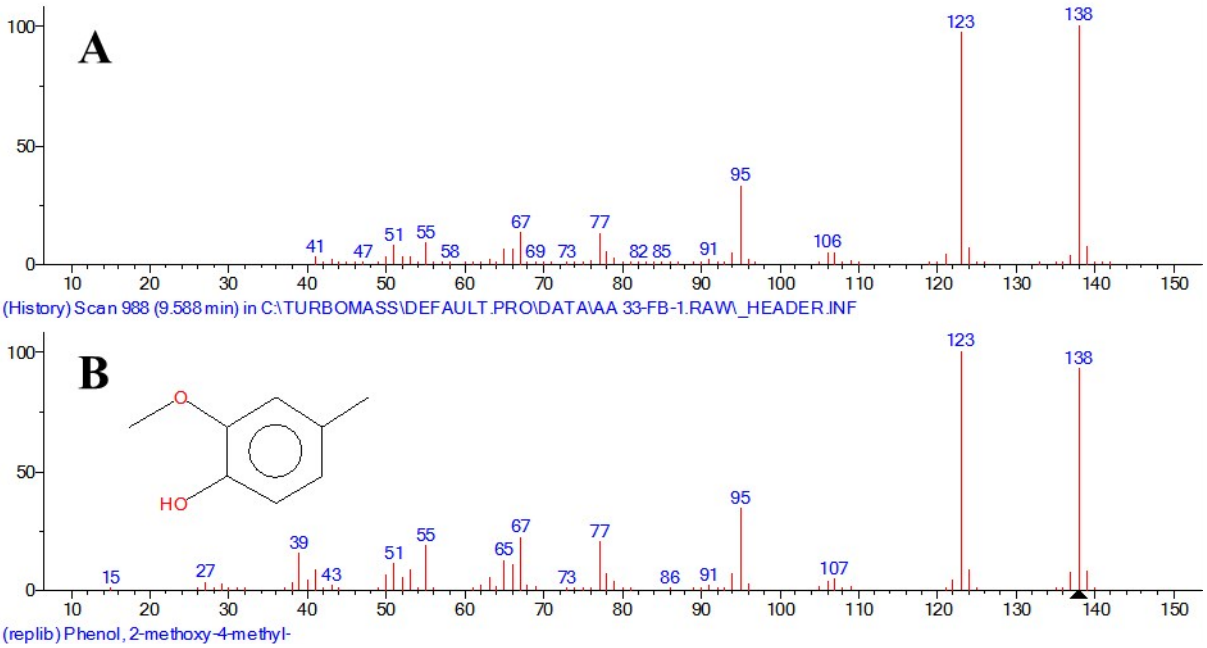
SI Figure 41: Matching MS spectrum of peak 7.49 MS in phenolic extract GC-MS: A) MS of peak 7.49 in phenolic extract sample; B) MS of Phenol, 4-methyl- according to NIST library.



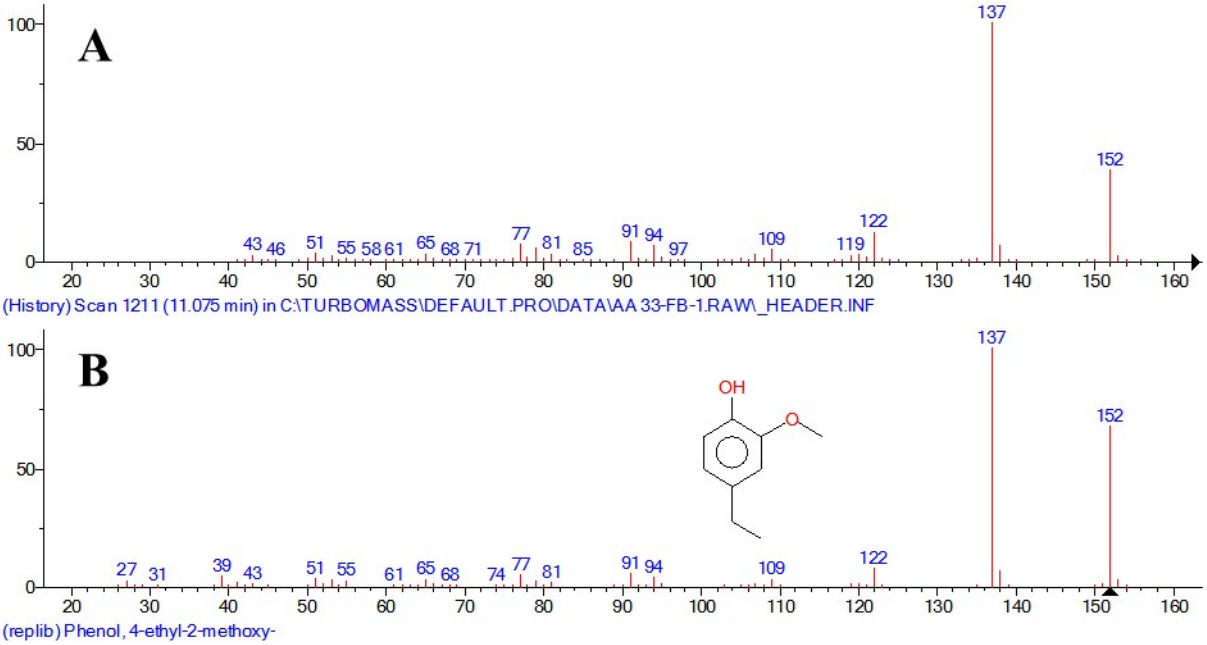
SI Figure 42: Matching MS spectrum of peak 7.73 MS in phenolic extract GC-MS: A) MS of peak 7.73 in phenolic extract sample; B) MS of Phenol, 2-methoxy- according to NIST library.



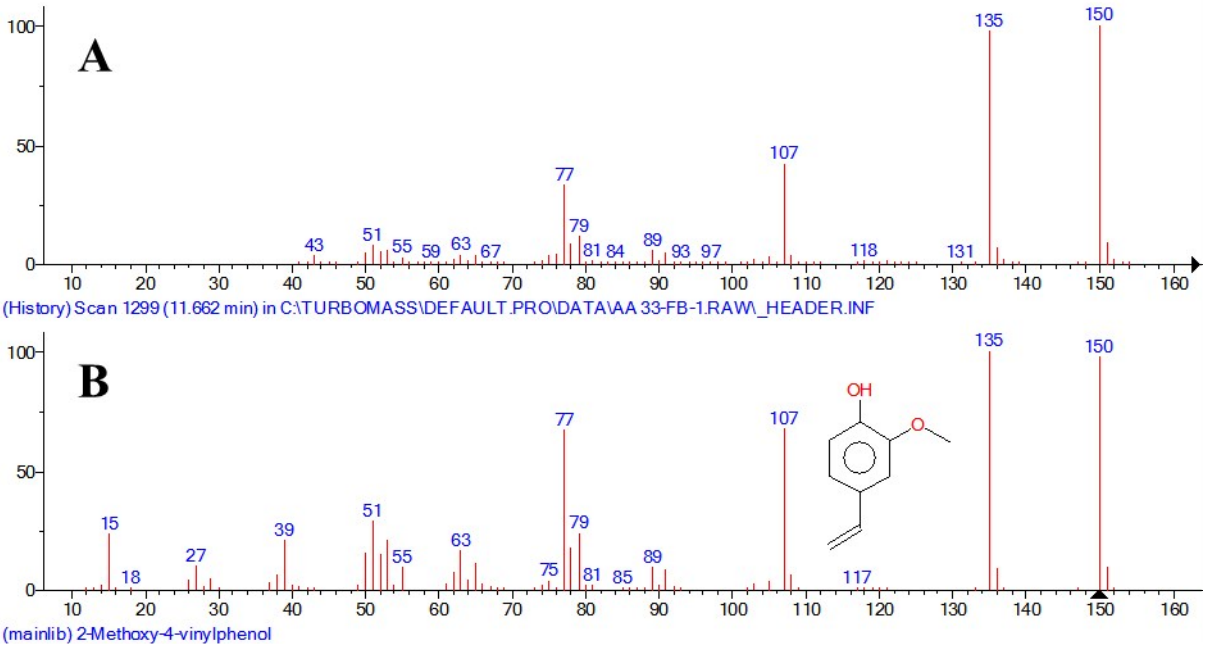
SI Figure 43: Matching MS spectrum of peak 8.79 MS in phenolic extract GC-MS: A) MS of peak 8.79 in phenolic extract sample; B) MS of Phenol, 2,5-dimethyl- according to NIST library.



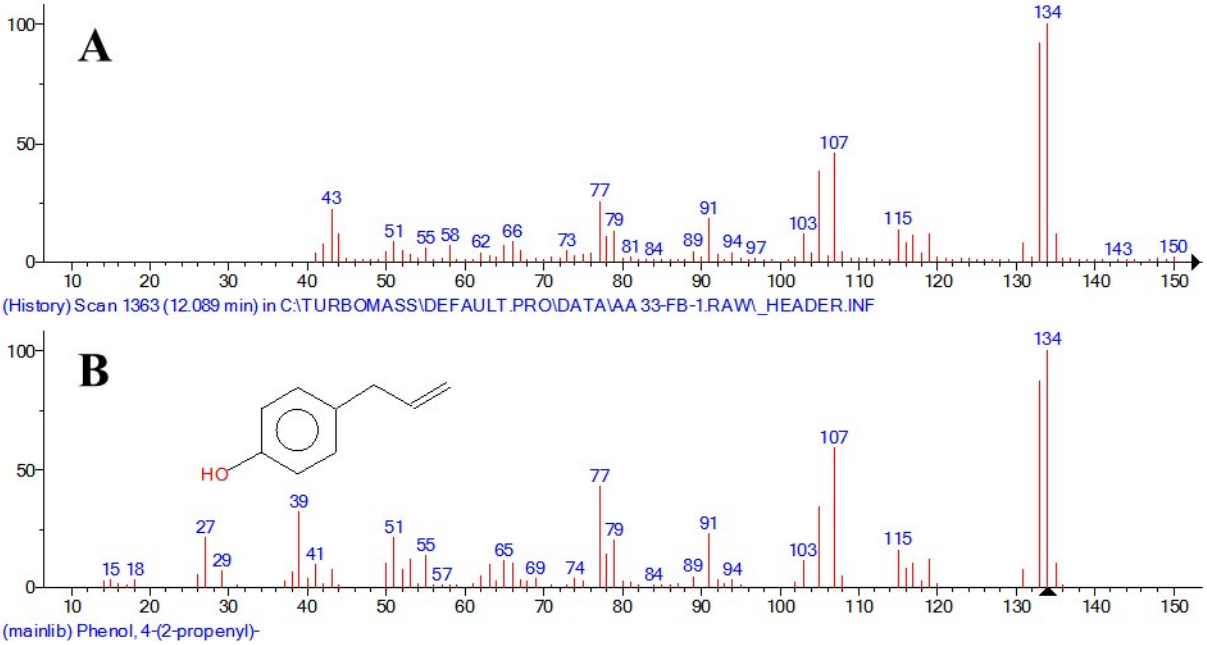
SI Figure 44: Matching MS spectrum of peak 9.59 MS in phenolic extract GC-MS: A) MS of peak 9.59 in phenolic extract sample; B) MS of Phenol, 2-methoxy-4-methyl- according to NIST library.



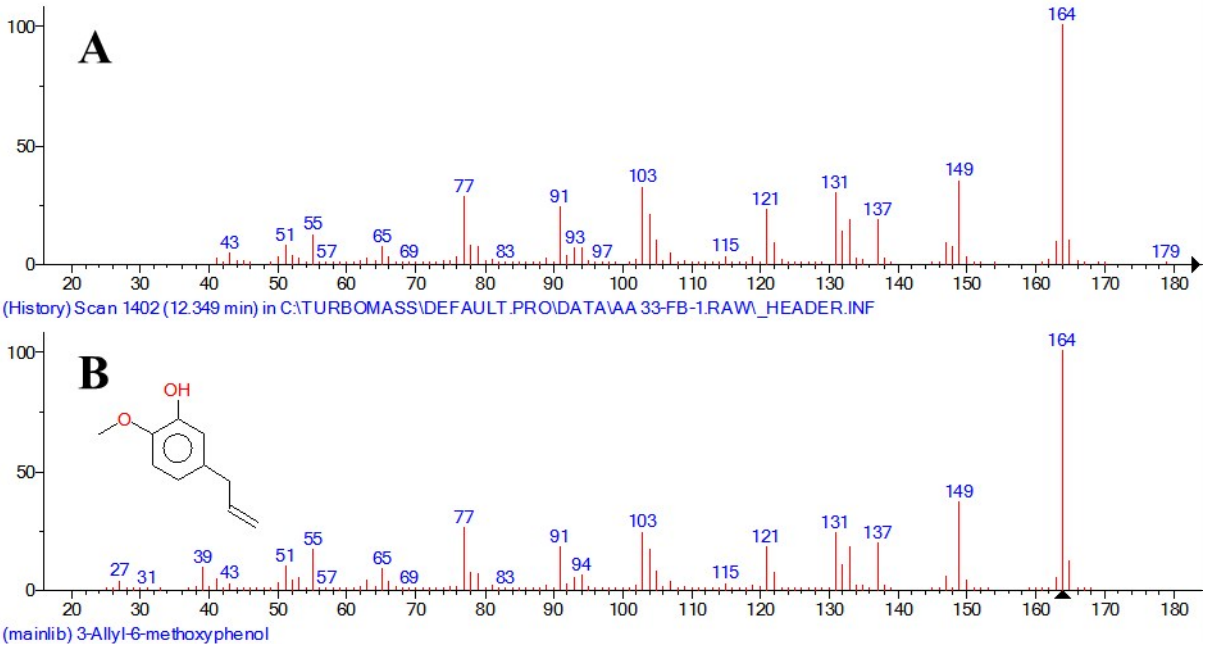
SI Figure 45: Matching MS spectrum of peak 11.06 MS in phenolic extract GC-MS: A) MS of peak 11.06 in phenolic extract sample; B) MS of Phenol, 4-ethyl-2-methoxy- according to NIST library.



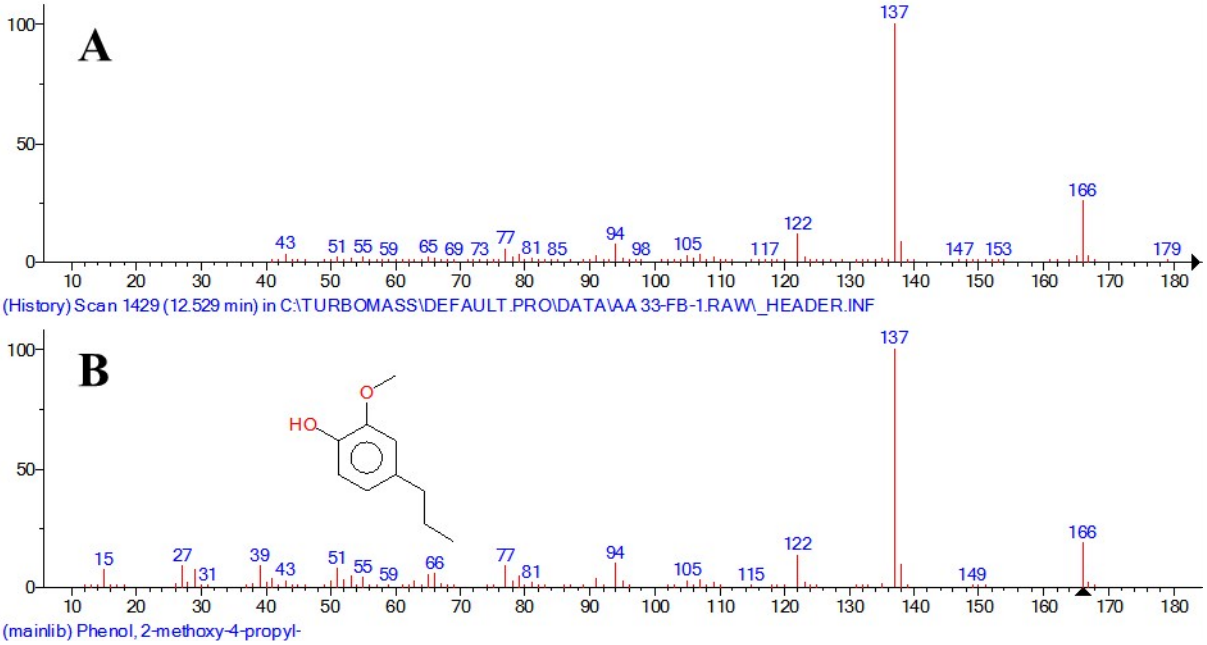
SI Figure 46: Matching MS spectrum of peak 11.66 MS in phenolic extract GC-MS: A) MS of peak 11.66 in phenolic extract sample; B) MS of 2-Methoxy-4-vinylphenol according to NIST library.



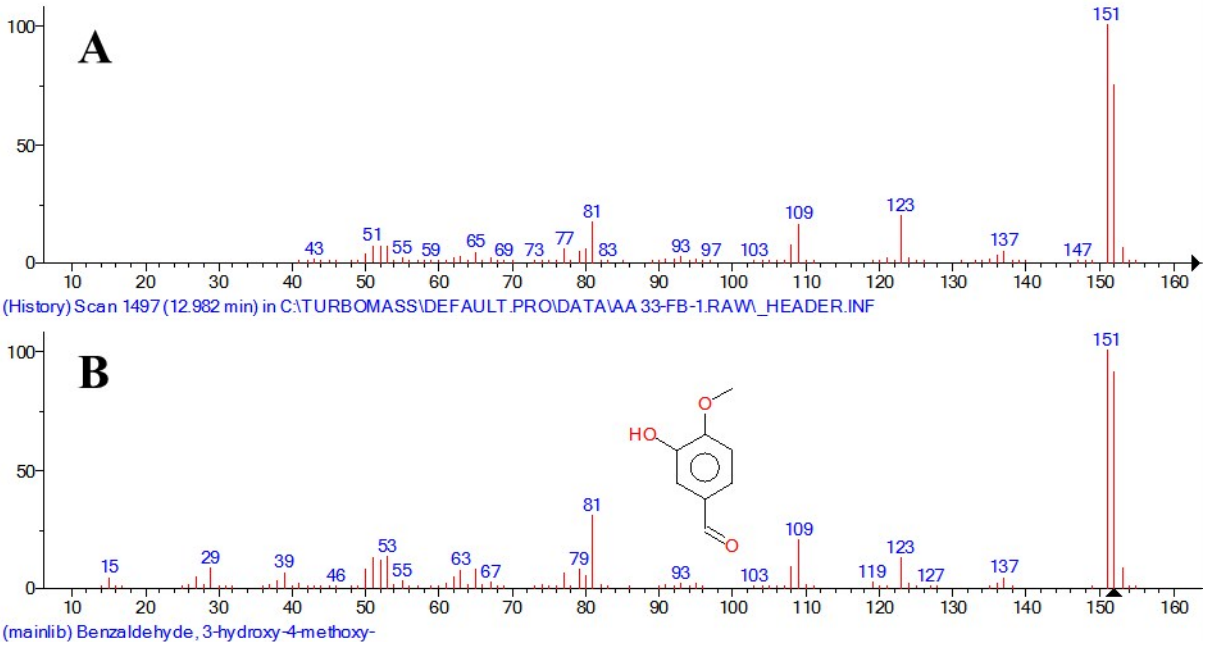
SI Figure 47: Matching MS spectrum of peak 12.10 MS in phenolic extract GC-MS: A) MS of peak 12.10 in phenolic extract sample; B) MS of Phenol, 4-(2-propenyl)- according to NIST library.



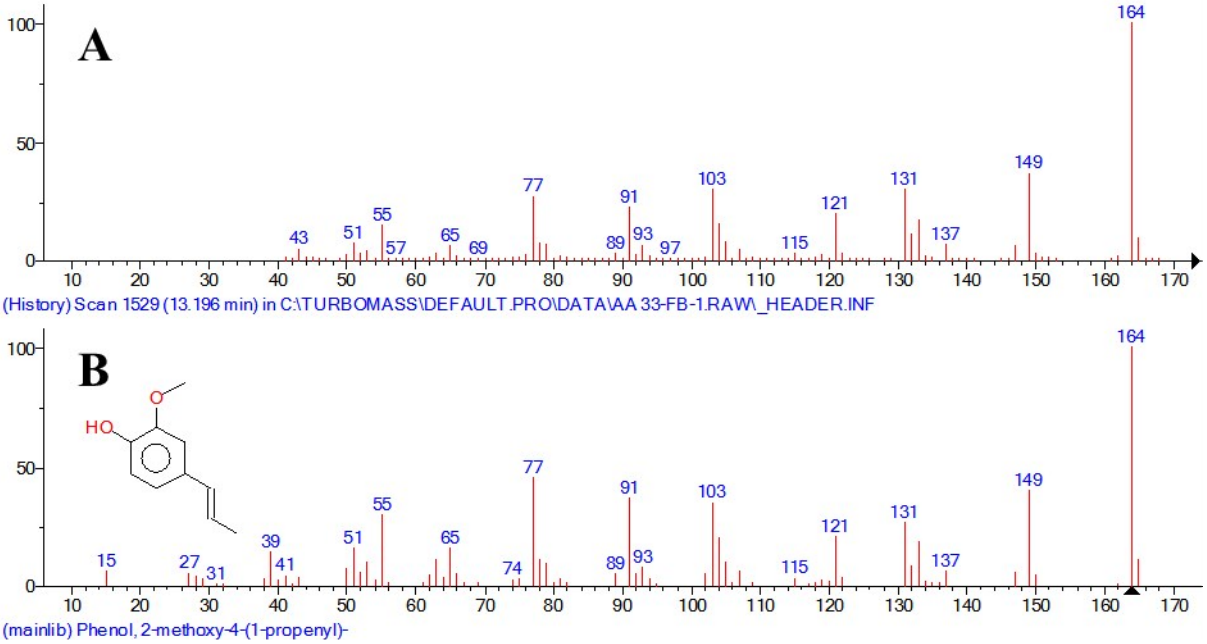
SI Figure 48: Matching MS spectrum of peak 12.36 MS in phenolic extract GC-MS: A) MS of peak 12.36 in phenolic extract sample; B) MS of 3-Allyl-6-methoxyphenol according to NIST library.



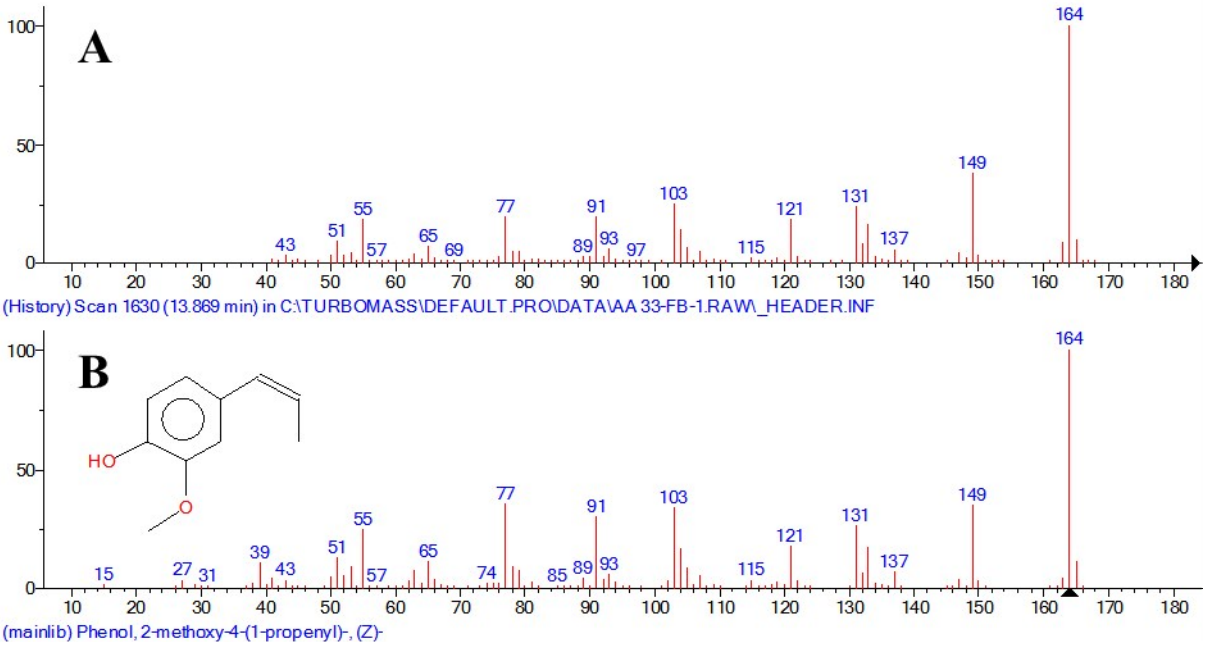
SI Figure 49: Matching MS spectrum of peak 12.53 MS in phenolic extract GC-MS: A) MS of peak 12.53 in phenolic extract sample; B) MS of Phenol, 2-methoxy-4-propyl- according to NIST library.



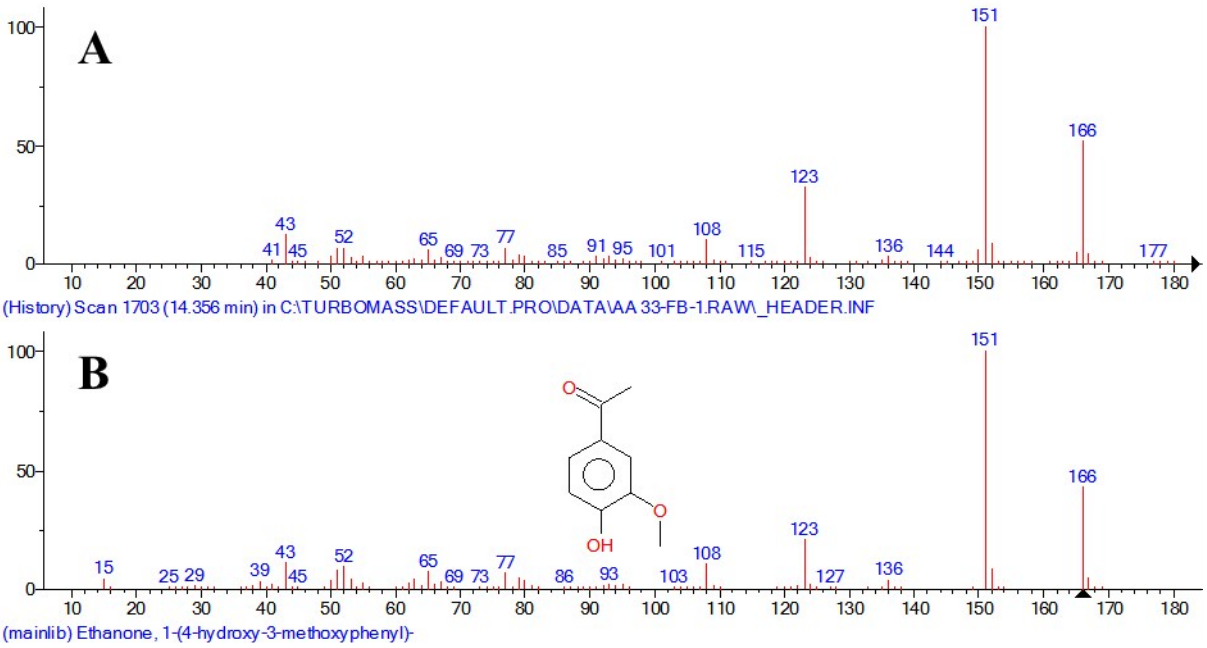
SI Figure 50: Matching MS spectrum of peak 13.00 MS in phenolic extract GC-MS: A) MS of peak 13.00 in phenolic extract sample; B) MS of Benzaldehyde, 3-hydroxy-4-methoxy- according to NIST library.



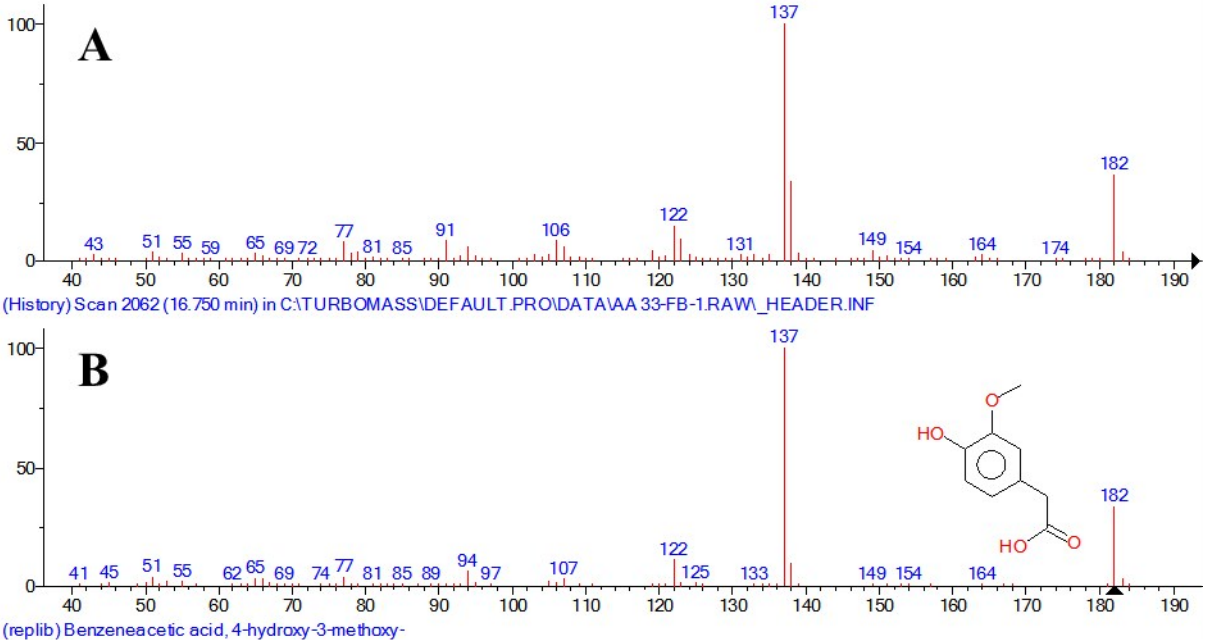
SI Figure 51: Matching MS spectrum of peak 13.19 MS in phenolic extract GC-MS: A) MS of peak 13.19 in phenolic extract sample; B) MS of Phenol, 2-methoxy-4-(1-propenyl)- according to NIST library.



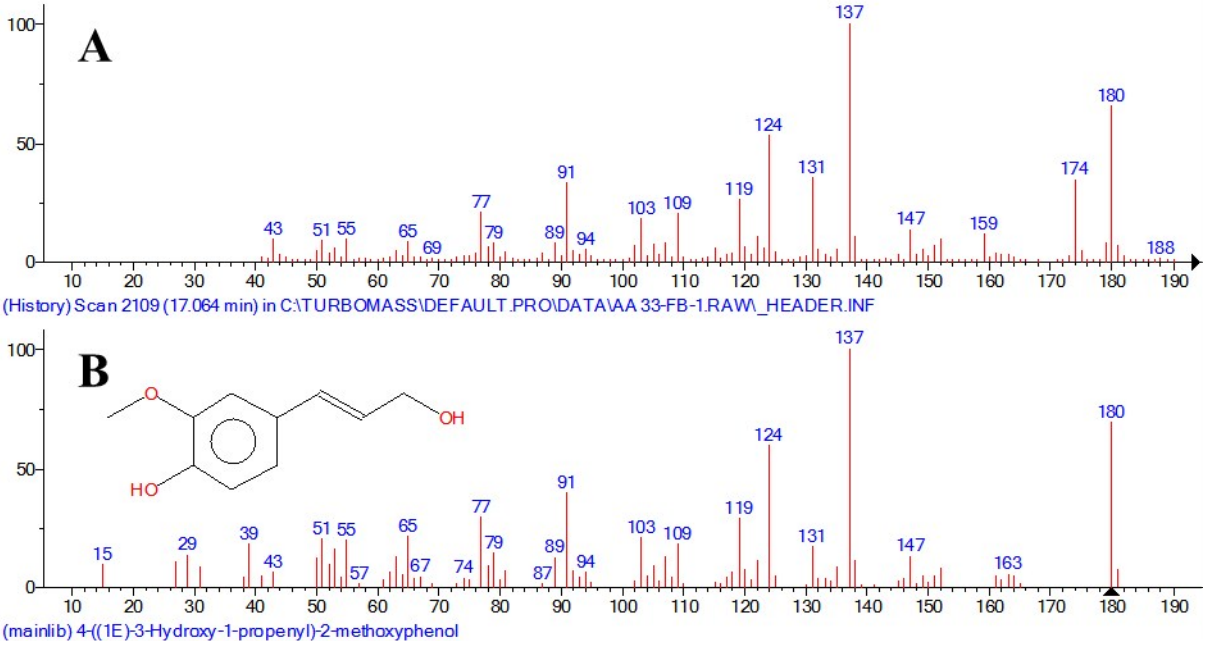
SI Figure 52: Matching MS spectrum of peak 13.87 MS in phenolic extract GC-MS: A) MS of peak 13.87 in phenolic extract sample; B) MS of Phenol, 2-methoxy-4-(1-propenyl)-, (Z)- according to NIST library.



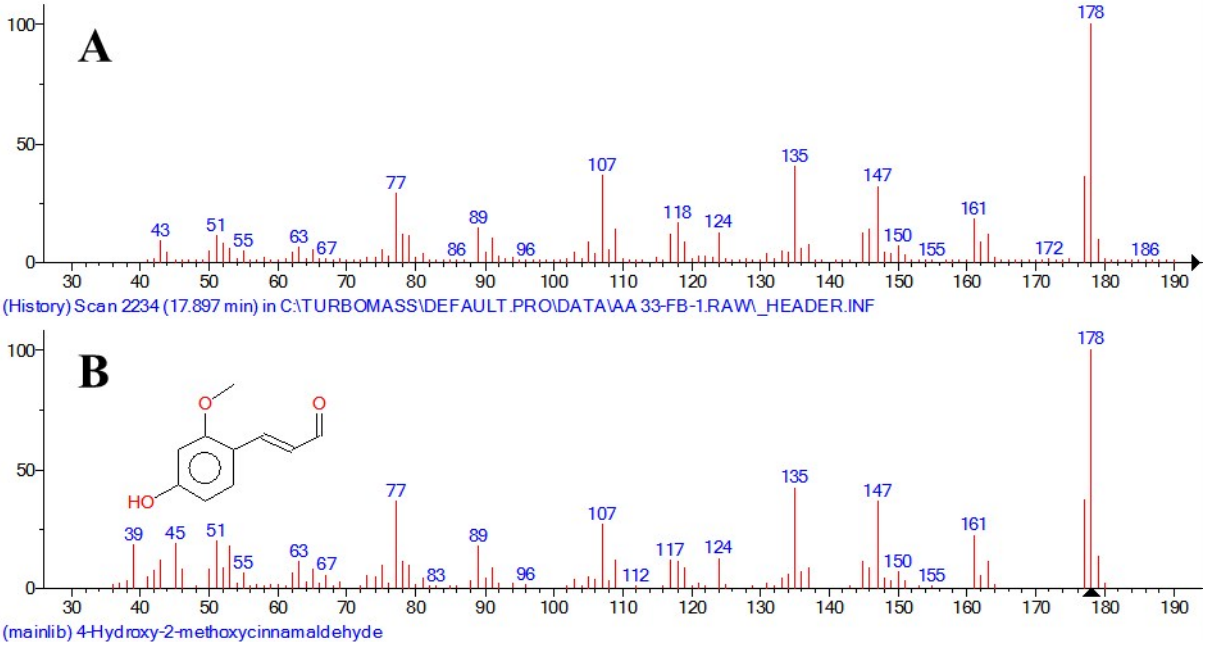
SI Figure 53: Matching MS spectrum of peak 14.36 MS in phenolic extract GC-MS: A) MS of peak 14.36 in phenolic extract sample; B) MS of Ethanone, 1-(4-hydroxy-3-methoxyphenyl)- according to NIST library.



SI Figure 54: Matching MS spectrum of peak 16.75 MS in phenolic extract GC-MS: A) MS of peak 16.75 in phenolic extract sample; B) MS of Benzeneacetic acid, 4-hydroxy-3-methoxy- according to NIST library.

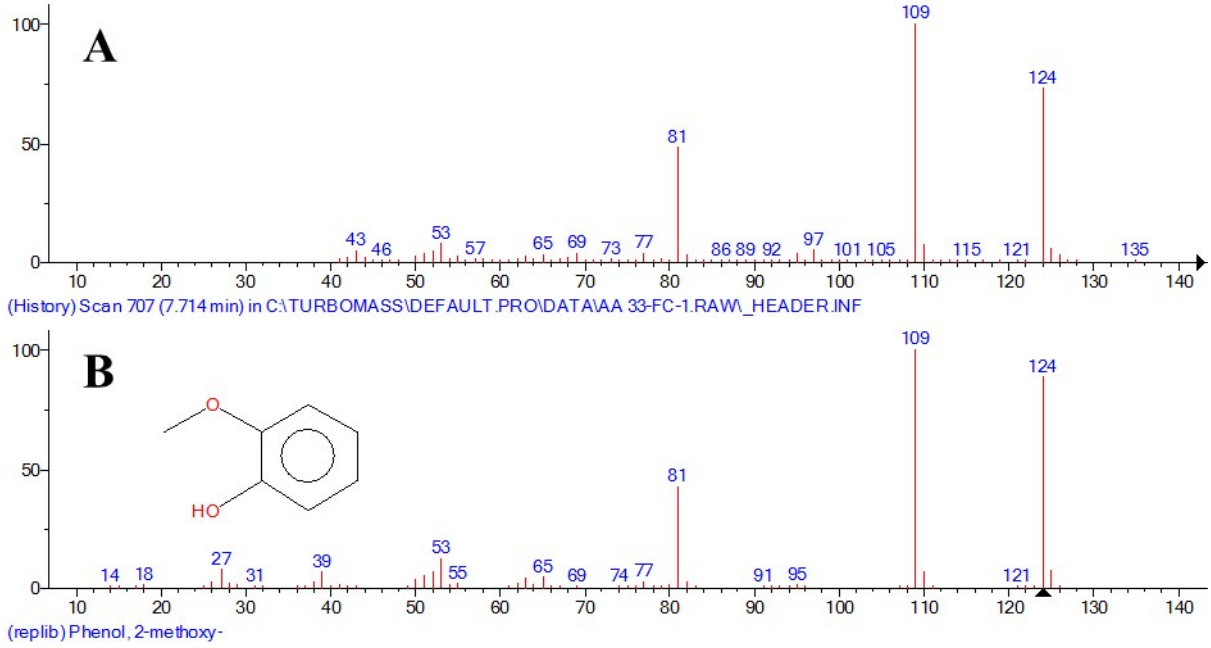


SI Figure 55: Matching MS spectrum of peak 17.06 MS in phenolic extract GC-MS: A) MS of peak 17.06 in phenolic extract sample; B) MS of 4-((1E)-3-Hydroxy-1-propenyl)-2-methoxyphenol according to NIST library.

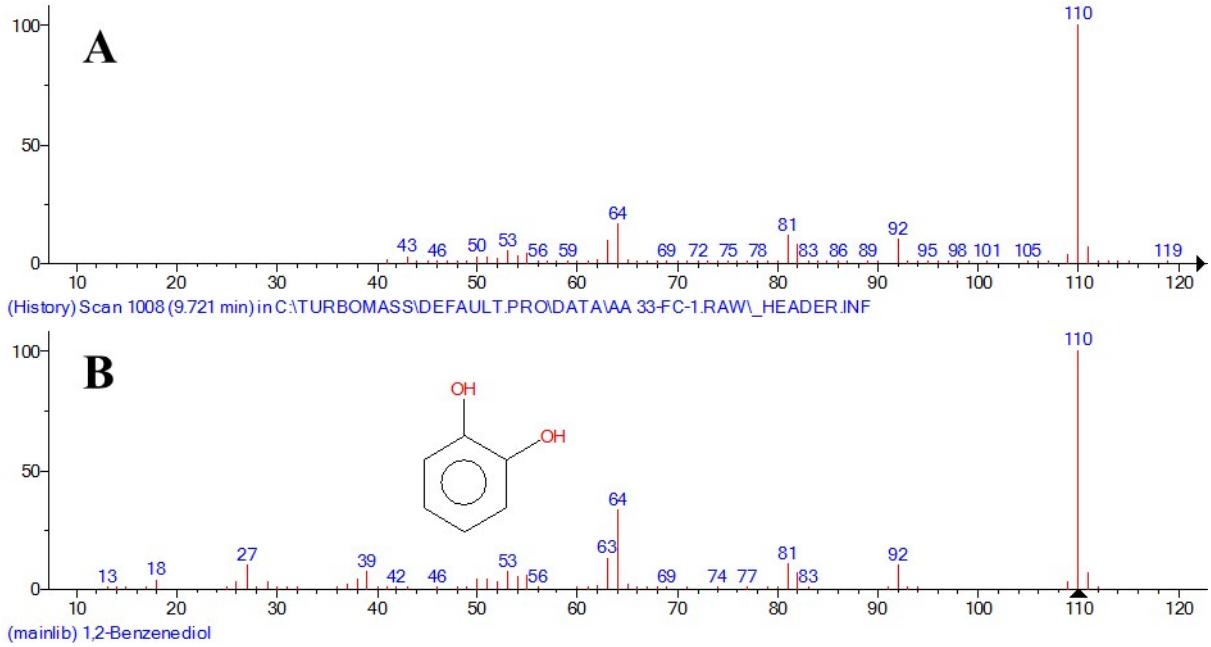


SI Figure 56: Matching MS spectrum of peak 17.90 MS in phenolic extract GC-MS: A) MS of peak 17.90 in phenolic extract sample; B) MS of 4-Hydroxy-2-methoxycinnamaldehyde according to NIST library.

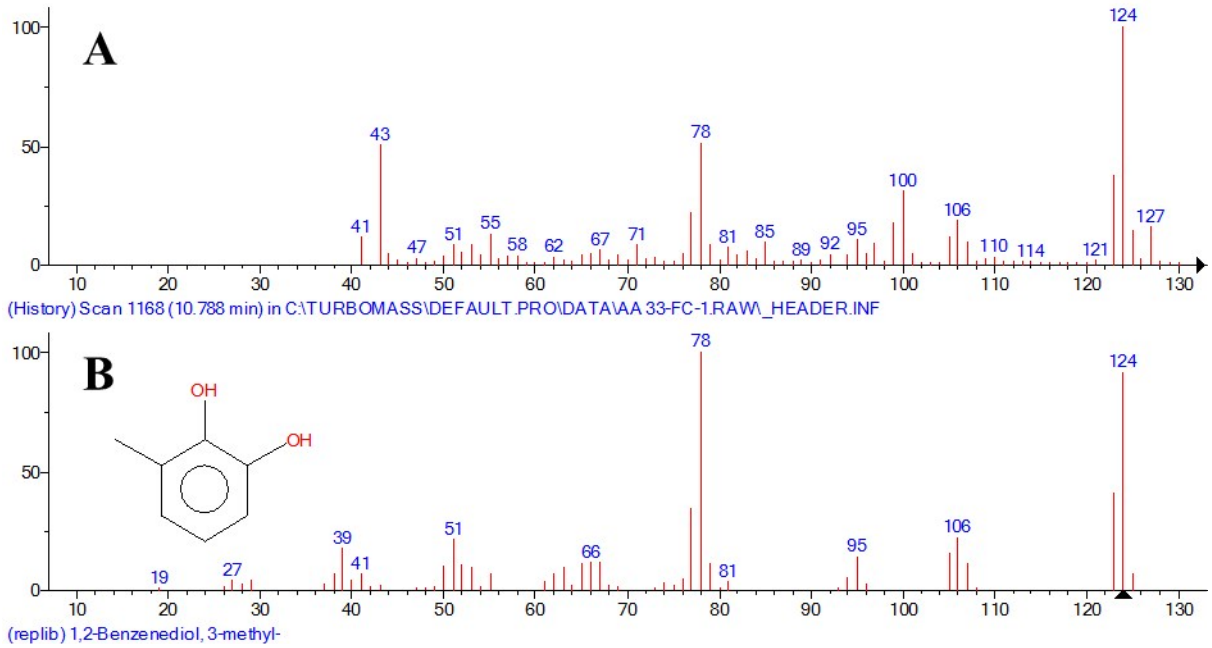
Organic acids extract MS of identified phenols and their best MS match from NIST Spectral library.



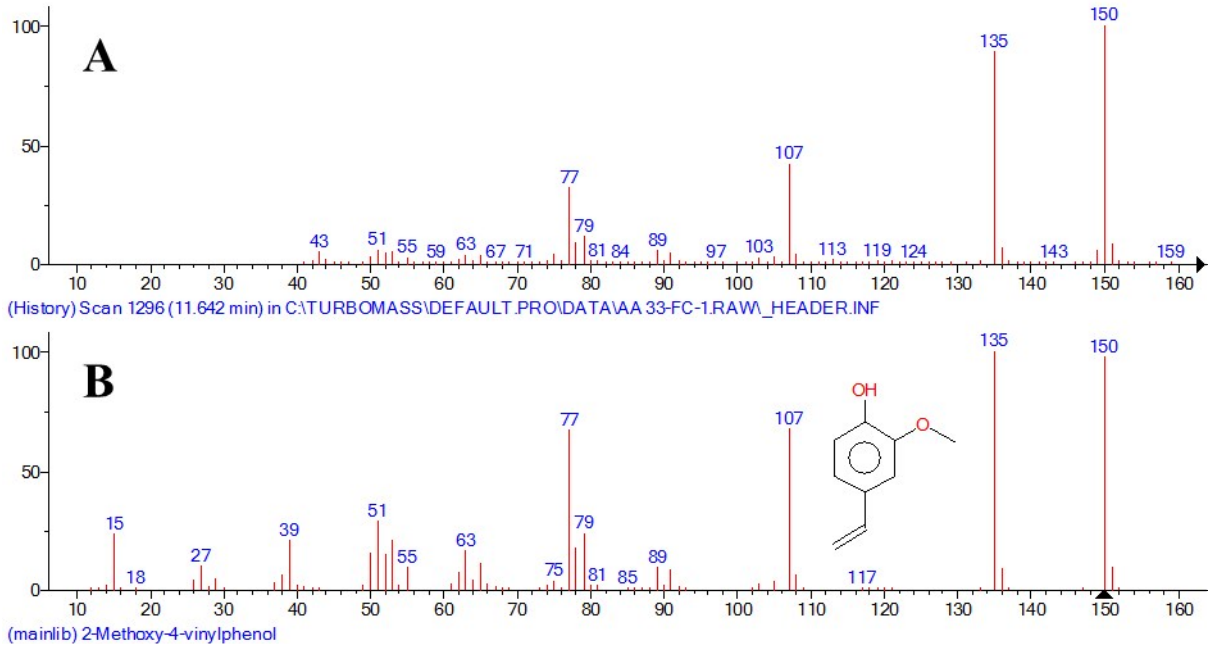
SI Figure 57: Matching MS spectrum of peak 7.72 MS in organic acids extract GC-MS: A) MS of peak 7.72 in organic acids extract sample; B) MS of Phenol, 2-methoxy- according to NIST library.



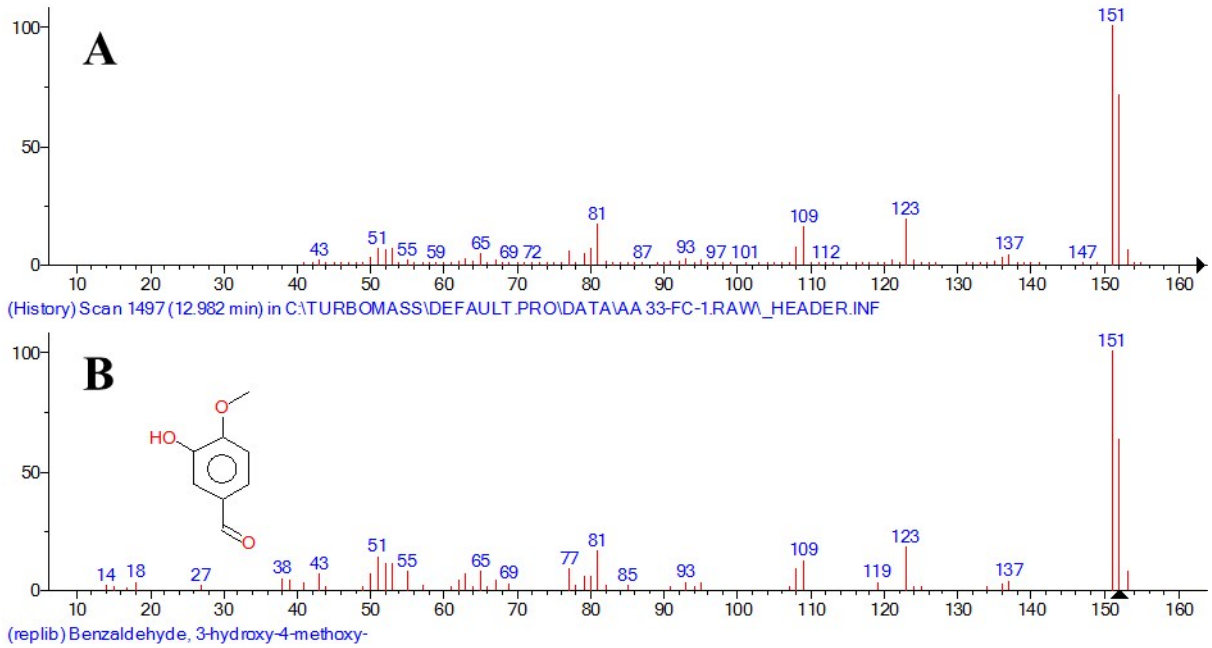
SI Figure 58: Matching MS spectrum of peak 9.72 MS in organic acids extract GC-MS: A) MS of peak 9.72 in organic acids extract sample; B) MS of 1,2-Benzenediol according to NIST library.



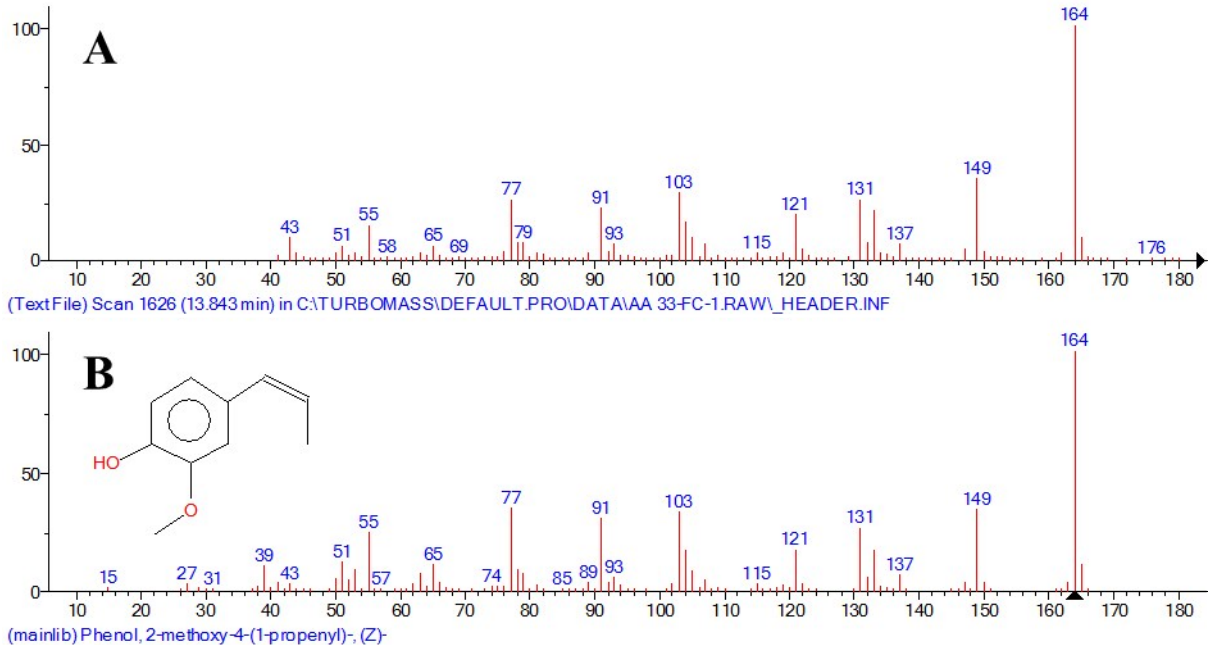
SI Figure 59: Matching MS spectrum of peak 10.79 MS in organic acids extract GC-MS: A) MS of peak 10.79 in organic acids extract sample; B) MS of 1,2-Benzenediol, 3-methyl- according to NIST library.



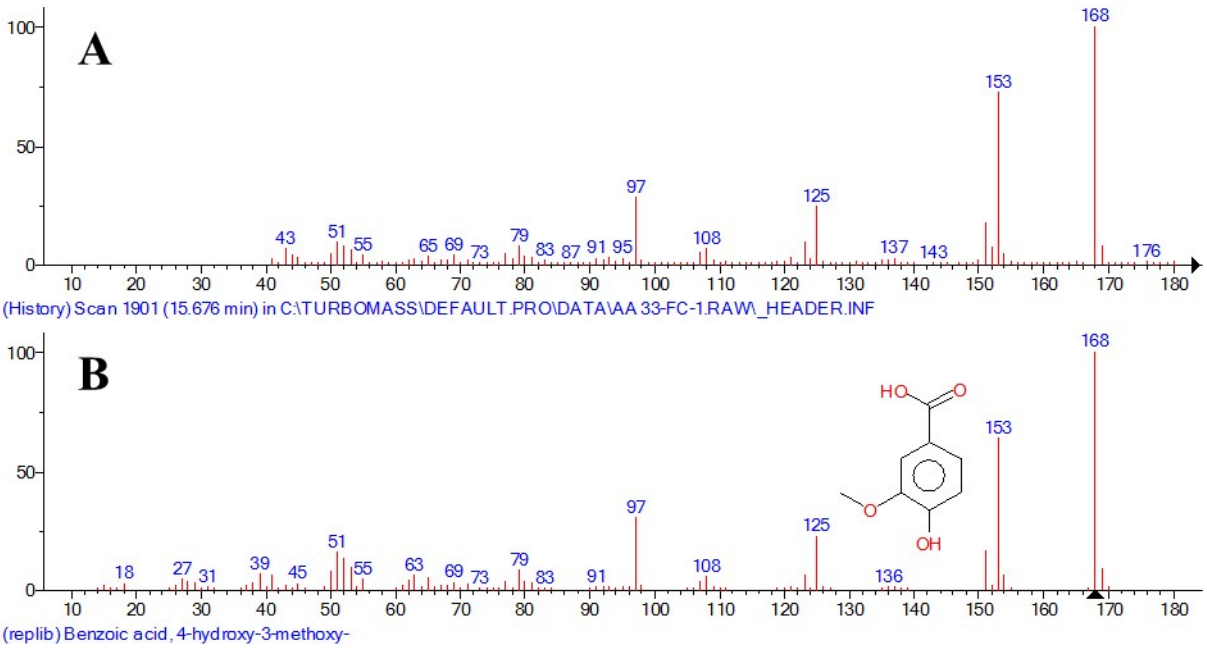
SI Figure 60: Matching MS spectrum of peak 11.64 MS in organic acids extract GC-MS: A) MS of peak 11.64 in organic acids extract sample; B) MS of 2-Methoxy-4-vinylphenol according to NIST library.



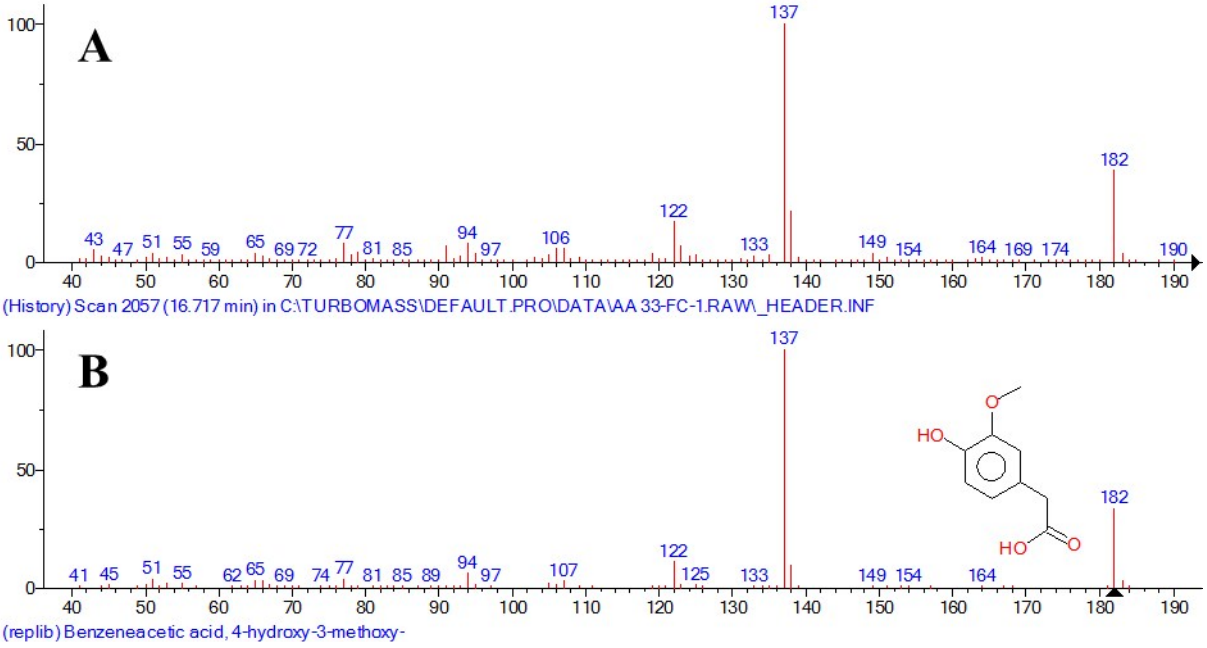
SI Figure 61: Matching MS spectrum of peak 12.98 MS in organic acids extract GC-MS: A) MS of peak 12.98 in organic acids extract sample; B) MS of Benzaldehyde, 3-hydroxy-4-methoxy- according to NIST library.



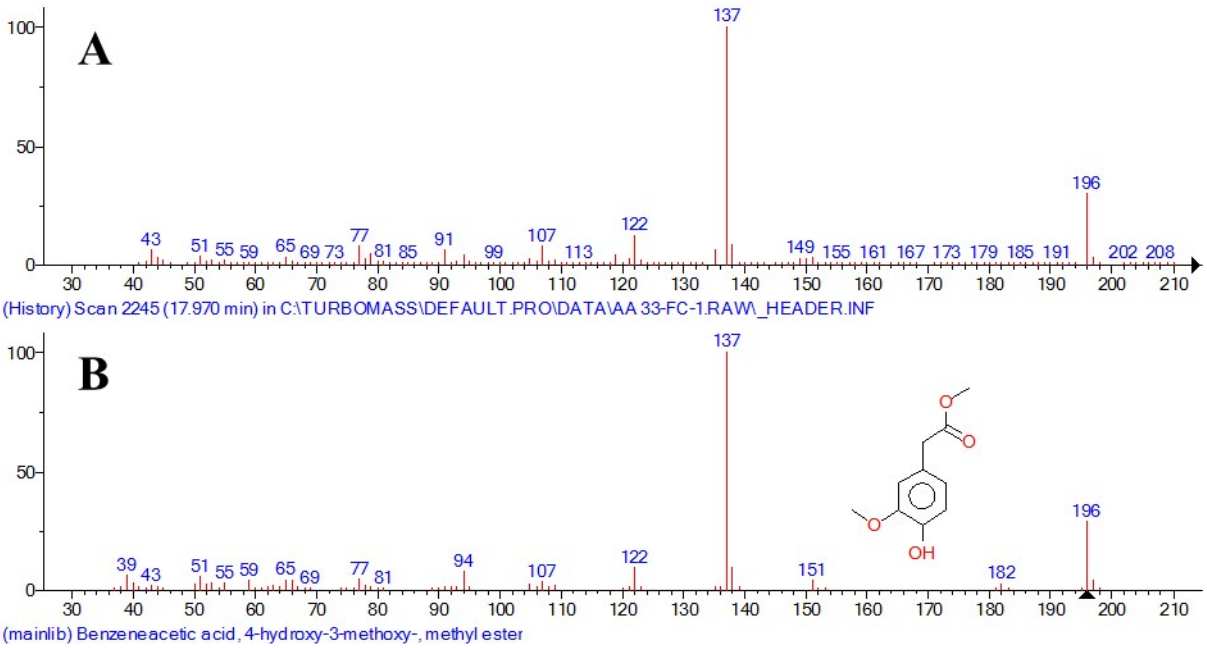
SI Figure 62: Matching MS spectrum of peak 13.84 MS in organic acids extract GC-MS: A) MS of peak 13.84 in organic acids extract sample; B) MS of Phenol, 2-methoxy-4-(1-propenyl)-, (Z)- according to NIST library.



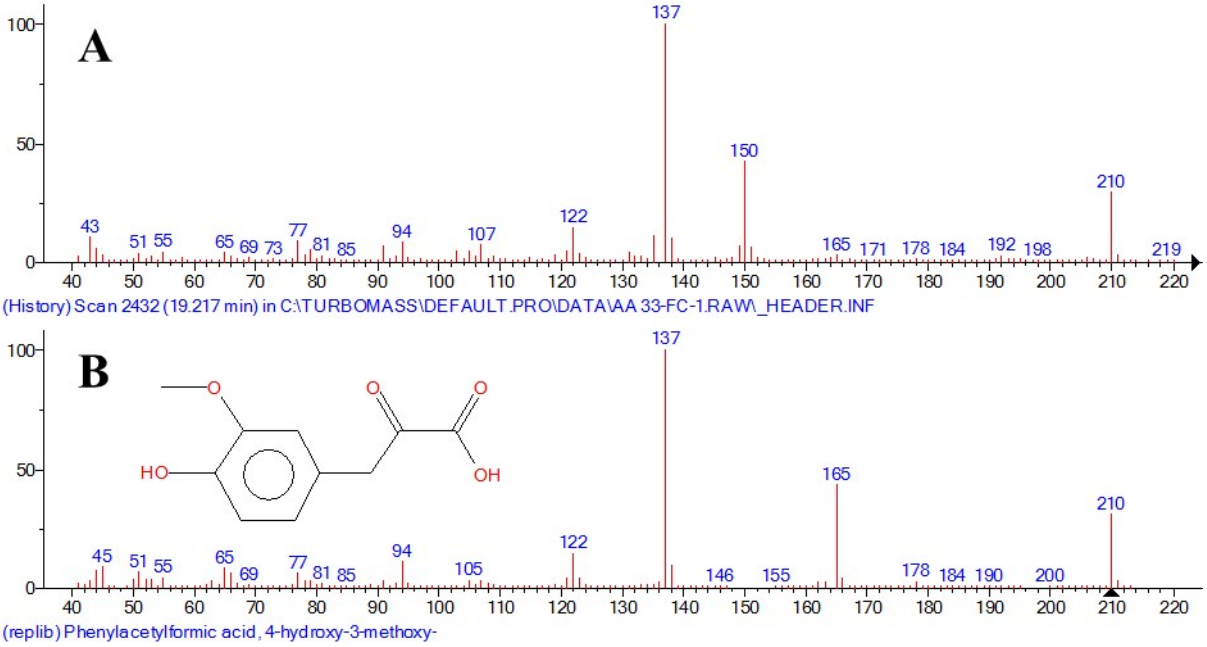
SI Figure 63: Matching MS spectrum of peak 15.68 MS in organic acids extract GC-MS: A) MS of peak 15.68 in organic acids extract sample; B) MS of Benzoic acid, 4-hydroxy-3-methoxy- according to NIST library.



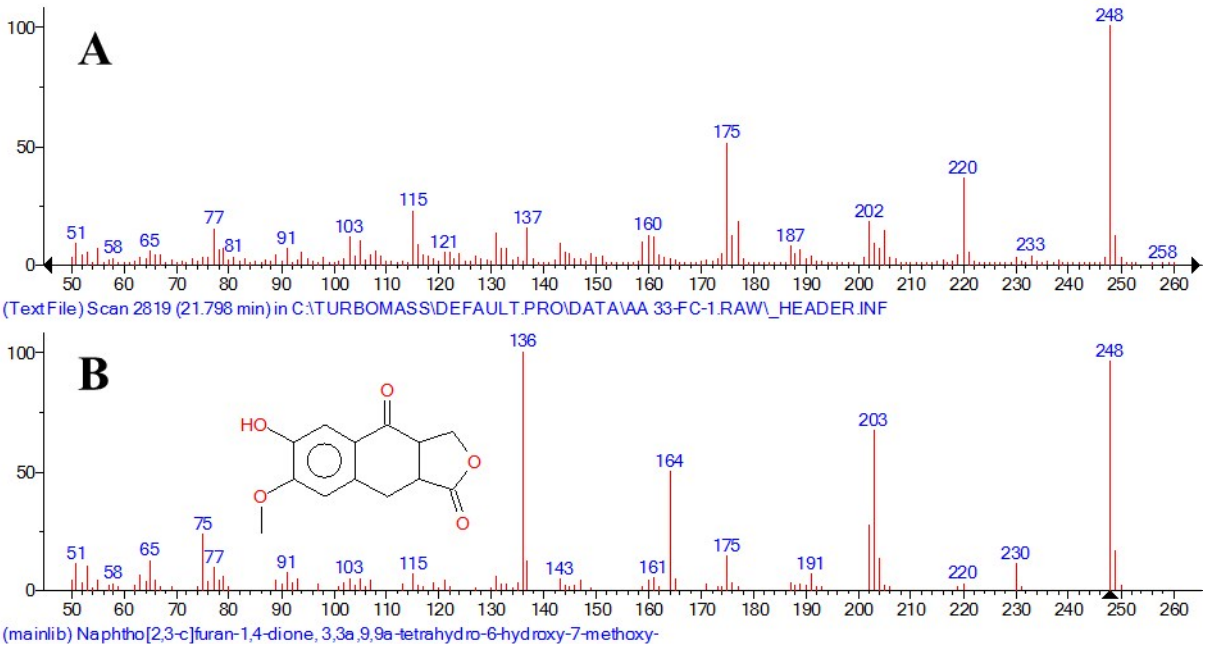
SI Figure 64: Matching MS spectrum of peak 16.74 MS in organic acids extract GC-MS: A) MS of peak 16.74 in organic acids extract sample; B) MS of Benzeneacetic acid, 4-hydroxy-3-methoxy- according to NIST library.



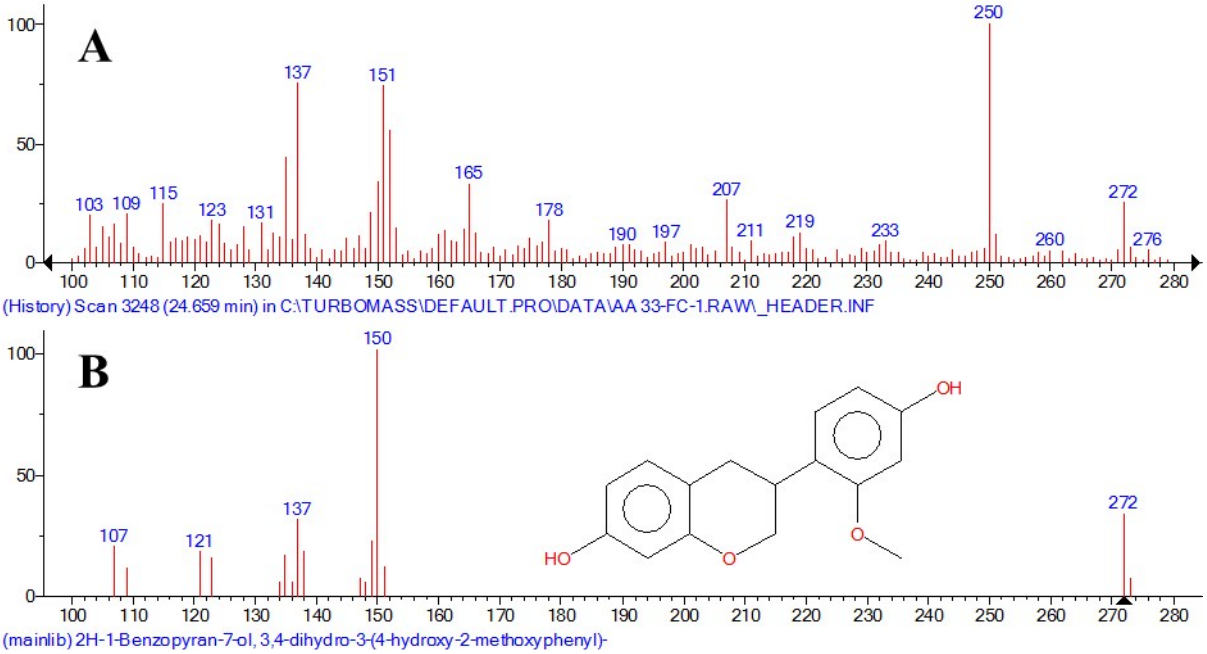
SI Figure 65: Matching MS spectrum of peak 17.97 MS in organic acids extract GC-MS: A) MS of peak 17.97 in organic acids extract sample; B) MS of Benzeneacetic acid, 4-hydroxy-3-methoxy-, methyl ester according to NIST library.



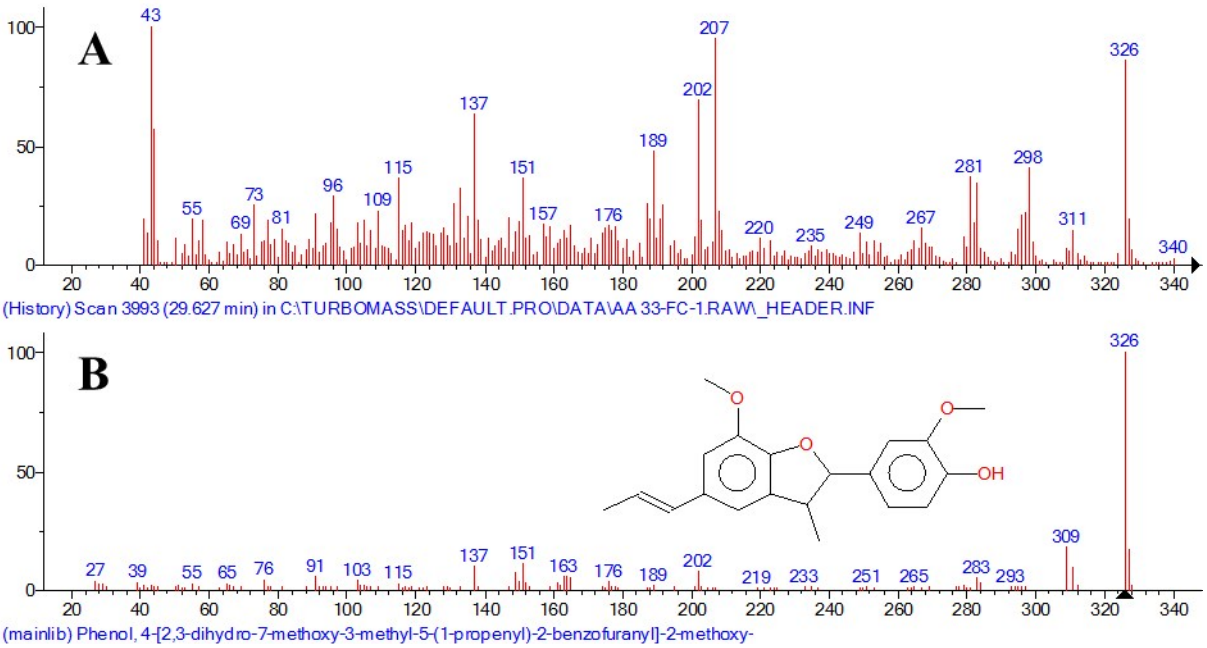
SI Figure 66: Matching MS spectrum of peak 19.22 MS in organic acids extract GC-MS: A) MS of peak 19.22 in organic acids extract sample; B) MS of Phenylacetylformic acid, 4-hydroxy-3-methoxy- according to NIST library.



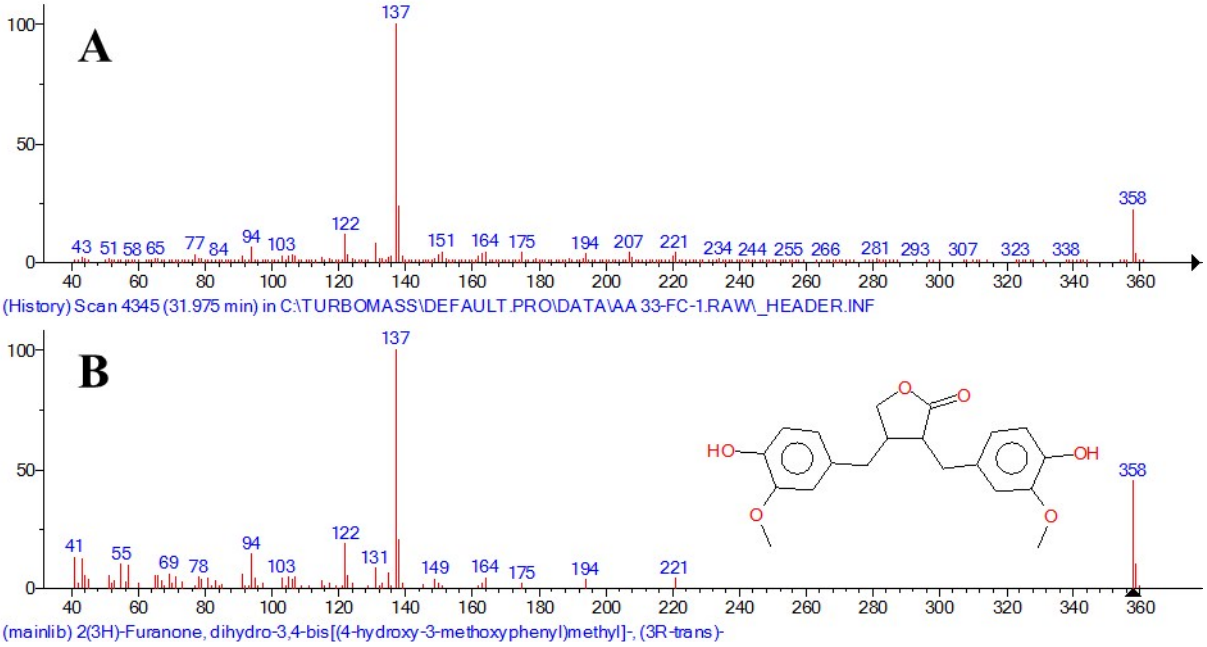
SI Figure 67: Matching MS spectrum of peak 21.80 MS in organic acids extract GC-MS: A) MS of peak 21.80 in organic acids extract sample; B) MS of Naphtho[2,3-c]furan-1,4-dione, 3,3a,9,9a-tetrahydro-6-hydroxy-7-methoxy- according to NIST library.



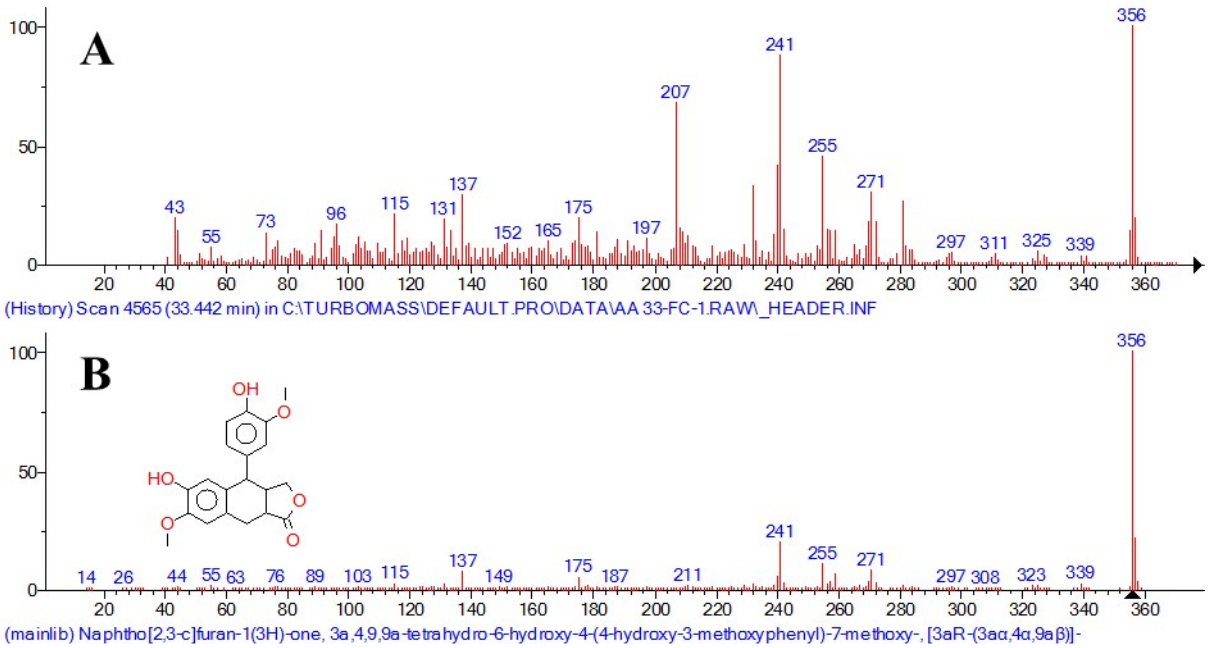
SI Figure 68: Matching MS spectrum of peak 24.66 MS in organic acids extract GC-MS: A) MS of peak 24.66 in organic acids extract sample; B) MS of 2H-1-Benzopyran-7-ol, 3,4-dihydro-3-(4-hydroxy-2-methoxyphenyl)- according to NIST library.



SI Figure 69: Matching MS spectrum of peak 29.63 MS in organic acids extract GC-MS: A) MS of peak 29.63 in organic acids extract sample; B) MS of Phenol, 4-[2,3-dihydro-7-methoxy-3-methyl-5-(1-propenyl)-2-benzofuranyl]-2-methoxy- according to NIST library.



SI Figure 70: Matching MS spectrum of peak 31.98 MS in organic acids extract GC-MS: A) MS of peak 31.98 in organic acids extract sample; B) MS of 2(3H)-Furanone, dihydro-3,4-bis[(4-hydroxy-3-methoxyphenyl)methyl]-, (3R-trans)- according to NIST library.



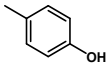
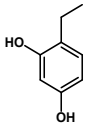
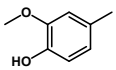
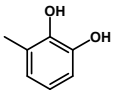
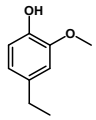
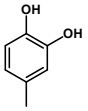
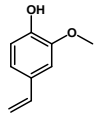
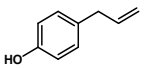
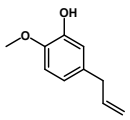
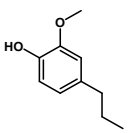
SI Figure 71: Matching MS spectrum of peak 33.44 MS in organic acids extract GC-MS: A) MS of peak 33.44 in organic acids extract sample; B) MS of Naphtho[2,3-c]furan-1(3H)-one, 3a,4,9,9a-tetrahydro-6-hydroxy-4-(4-hydroxy-3-methoxyphenyl)-7-methoxy-, [3aR-(3aα,4α,9aβ)]- according to NIST library.

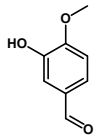
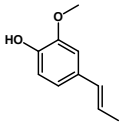
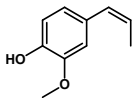
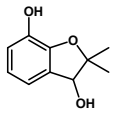
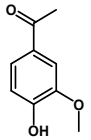
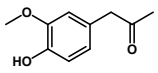
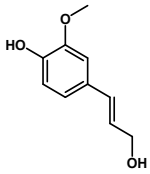
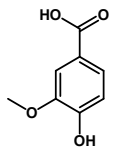
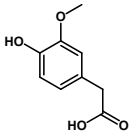
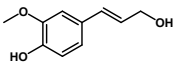
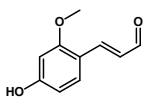
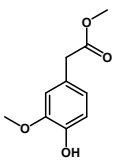
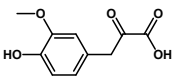
SI Table 1: ECN reduction values by functional group used for analysis in this experiment.

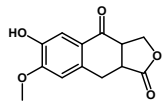
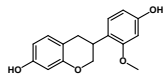
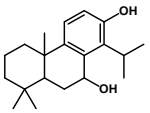
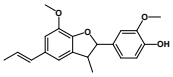
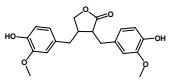
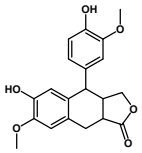
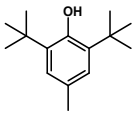
Functional Group	ECN Reduction	Source
Phenol	- 0.83	(27)[a]
Ether	- 1.00	(25)[b]
Olefinic C	- 0.05	(25)
Carbonyl	- 1.00	(25)
Carboxyl	- 1.00	(25)
Primary Alcohol	- 0.60	(25)
Secondary Alcohol	- 0.75	(25)
Ester	- 1.25	(25)

[a] According to reference number 27 in the original paper.
[b] According to reference number 25 in the original paper.

SI Table 2: ECN reduction by functional group for each identified phenolic compound including the standard compound.

Structure	Name	Group(s)	No. of carbons	Reduction	ECN (theoretical)
	Phenol	phenol	6	0.83	5.17
	Phenol, 2-methyl-	phenol	7	0.83	6.17
	Phenol, 4-methyl-	phenol	7	0.83	6.17
	Phenol, 2-methoxy-	phenol + ether	7	0.83 + 1.00	5.17
	Phenol, 2,5-dimethyl-	phenol	8	0.83	7.17
	1,3-Benzenediol, 4-ethyl-	two phenol	8	2 x 0.83	6.34
	Phenol, 2-methoxy-4-methyl-	phenol + ether	8	0.83 + 1.00	6.17
	1,2-Benzenediol	two phenol	6	2 x 0.83	4.34
	1,2-Benzenediol, 3-methyl-	two phenol	7	2 x 0.83	5.34
	Phenol, 4-ethyl-2-methoxy-	phenol + ether	9	0.83 + 1.00	7.17
	1,2-Benzenediol, 4-methyl-	two phenol	7	2 x 0.83	5.34
	2-Methoxy-4-vinylphenol	phenol + ether + two olefinic C	9	0.83 + 1.00 + (2 x 0.05)	7.07
	Phenol, 4-(2-propenyl)-	phenol + two olefinic C	9	0.83 + (2 x 0.05)	8.07
	3-Allyl-6-methoxyphenol	phenol + ether + two olefinic C	10	0.83 + 1.00 + (2 x 0.05)	8.07
	Phenol, 2-methoxy-4-propyl-	phenol + ether	10	0.83 + 1.00	8.17

	Benzaldehyde, 3-hydroxy-4-methoxy-	phenol + ether + carbonyl	8	0.83 + 1.00 + 1.00	5.17
	Phenol, 2-methoxy-4-(1-propenyl)-	phenol + ether + two olefinic C	10	0.83 + 1.00 + (2 x 0.05)	8.07
	Phenol, 2-methoxy-4-(1-propenyl)-, (Z)-	phenol + ether + two olefinic C	10	0.83 + 1.00 + (2 x 0.05)	8.07
	3,7-Benzofurandiol, 2,3-dihydro-2,2-dimethyl-	phenol + ether + secondary alcohol	10	0.83 + 1.00 + 0.75	7.42
	Ethanone, 1-(4-hydroxy-3-methoxyphenyl)-	phenol + ether + carbonyl	9	0.83 + 1.00 + 1.00	6.17
	2-Propanone, 1-(4-hydroxy-3-methoxyphenyl)-	Phenol + ether + carbonyl	10	0.83 + 1.00 + 1.00	7.17
	Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy-	phenol + ether + two olefinic C + primary alcohol	10	0.83 + 1.00 + (2 x 0.05) + 0.60	7.47
	Benzoic acid, 4-hydroxy-3-methoxy-	phenol + ether + carboxyl	8	0.83 + 1.00 + 1.00	5.17
	Benzeneacetic acid, 4-hydroxy-3-methoxy-	phenol + ether + carboxyl	9	0.83 + 1.00 + 1.00	6.17
	4-((1E)-3-Hydroxy-1-propenyl)-2-methoxyphenol	phenol + ether + two olefinic C + primary alcohol	10	0.83 + 1.00 + (2 x 0.05) + 0.60	7.47
	4-Hydroxy-2-methoxycinnamaldehyde	phenol + ether + two olefinic C + carbonyl	10	0.83 + 1.00 + (2 x 0.05) + 1.00	7.07
	Benzeneacetic acid, 4-hydroxy-3-methoxy-, methyl ester	phenol + ether + ester	10	0.83 + 1.00 + 1.25	6.92
	Phenylacetylformic acid, 4-hydroxy-3-methoxy-	phenol + ether + carbonyl + carboxyl	10	0.83 + 1.00 + 1.00 + 1.00	6.17

	Naphtho[2,3-c]furan-1,4-dione, 3,3a,9,9a-tetrahydro-6-hydroxy-7-methoxy-	Phenol + ether + carbonyl + ester	13	0.83 + 1.00 + 1.00 + 1.25	8.92
	2H-1-Benzopyran-7-ol, 3,4-dihydro-3-(4-hydroxy-2-methoxyphenyl)-	two phenol + two ether	16	(2 x 0.83) + (2 x 1.00)	12.34
	Podocarpa-8,11,13-triene-7β,13-diol, 14-isopropyl-	phenol + secondary alcohol	20	0.83 + 0.75	18.42
	Phenol, 4-[2,3-dihydro-7-methoxy-3-methyl-5-(1-propenyl)-2-benzofuranyl]-2-methoxy-	phenol + three ether + two olefinic C	20	0.83 + (3 x 1.00) + (2 x 0.05)	16.07
	2(3H)-Furanone, dihydro-3,4-bis[(4-hydroxy-3-methoxyphenyl)methyl]-, (3R-trans)-	two phenol + two ether + ester	20	(2 x 0.83) + (2 x 1.00) + 1.25	15.09
	Naphtho[2,3-c]furan-1(3H)-one, 3a,4,9,9a-tetrahydro-6-hydroxy-4-(4-hydroxy-3-methoxyphenyl)-7-methoxy-, [3aR-(3aα,4α,9aβ)]-	two phenol + two ether + ester	20	(2 x 0.83) + (2 x 1.00) + 1.25	15.09
	Butylated Hydroxytoluene	phenol	15	0.83	14.17

SI Table 3: The exact amounts of standard antioxidants blended with 2 ml methyl linoleate and their measured induction time at 120 °C and 1 bar of oxygen.

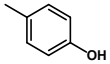
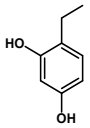
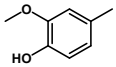
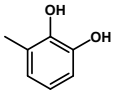
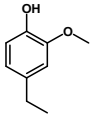
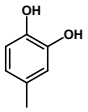
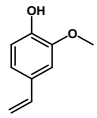
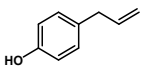
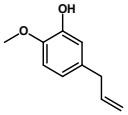
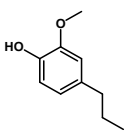
Antioxidant	Sample weight (mg)	Phenolic Concentration (mg/ml)	Phenolic Concentration (mol/dm^3) x 10^{-3}	Phenolic Concentration (% w/w)	Induction time (min)
BHT	0	0	0	0	0
	2.7	1.35	6	0.15	54
	8.9	4.45	20	0.5	108
	17.8	8.9	40	1	148
	35.6	17.8	80	2	192
Eugenol	0	0	0	0	0
	8.9	4.45	27	0.5	23
	17.8	8.9	54	1	32
	35.6	17.8	108	2	34
	53.4	26.7	162	3	36
Catechol	0	0	0	0	0
	2.7	1.35	12.3	0.15	38
	8.9	4.45	40.5	0.5	134
	17.8	8.9	81	1	80
	35.6	17.8	162	2	28

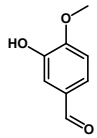
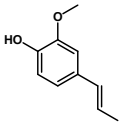
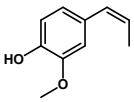
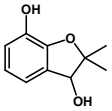
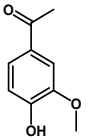
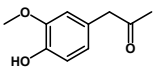
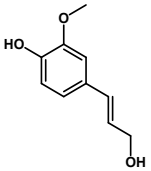
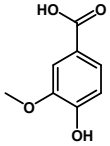
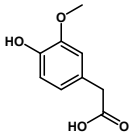
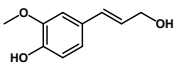
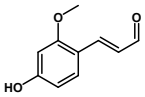
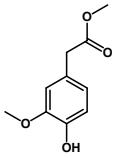
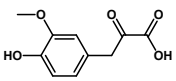
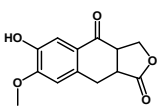
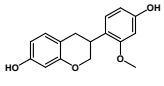
SI Table 4: The exact amounts of crude extracts blended with 2 ml methyl linoleate and their measured induction time at 120 °C and 1 bar of oxygen.

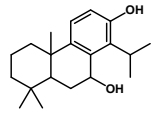
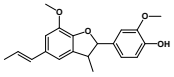
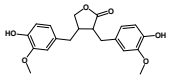
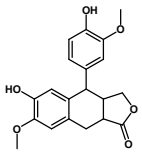
Extract ID	Sample weight[a] (mg)	Phenolic Concentration[b] (mg EE/ml)	Phenolic Concentration[c] (mol EE/dm^3) x 10^{-3}	Phenolic Concentration[d] (% w EE/w)	Induction time (min)
Crude bio-oil	0	0	0	0	0
	25	2.88	17.38	0.32	52
	50	5.75	34.75	0.65	98
	100	11.5	69.5	1.30	163
Water-soluble extract	0	0	0	0	0
	25	1.75	10.38	0.2	22
	50	3.5	20.75	0.4	48
	100	7	41.5	0.79	87
Neutral extract	0	0	0	0	0
	25	1.38	8.63	0.16	8
	50	2.75	17.25	0.31	14
	100	5.5	34.5	0.62	18
Phenolic extract	0	0	0	0	0
	25	6.25	37.75	0.70	50
	50	12.5	75.5	1.41	108
	100	25	151	2.81	128
Organic acids extract	0	0	0	0	0
	25	4.75	29.13	0.53	45
	50	9.5	58.25	1.07	88
	100	19	116.5	2.14	100

[a] Actual extract weight blended with 2 ml ML.
[b] In eugenol equivalent (EE) as estimated according to FC reagent assay.
[c] In eugenol equivalent (EE) as estimated according to FC reagent assay.
[d] In eugenol equivalent (EE) as estimated according to FC reagent assay.

SI Table 5: The calculated concentrations of each detected phenolic compound via GC-FID in 100 mg crude bio-oil or its extracts that blended with 2 ml methyl linoleate [a].

Structure	Name	Concentration (mol/dm^3) x 10^{-3}				
		Crude bio-oil	Water-soluble extract	Neutral extract	Phenolic extract	Organic acids extract
	Phenol	0	/	/	0.48	/
	Phenol, 2-methyl-	/	/	/	0.26	/
	Phenol, 4-methyl-	0	/	/	0.77	/
	Phenol, 2-methoxy-	3.02	/	0.40	8.59	1.37
	Phenol, 2,5-dimethyl-	/	/	/	0.06	/
	1,3-Benzenediol, 4-ethyl-	/	/	0.18	/	/
	Phenol, 2-methoxy-4-methyl-	2.27	0.25	5.07	12.75	/
	1,2-Benzenediol	4.25	3.28	/	/	2.11
	1,2-Benzenediol, 3-methyl-	/	/	/	/	0.38
	Phenol, 4-ethyl-2-methoxy-	0.59	/	4.45	2.76	/
	1,2-Benzenediol, 4-methyl-	0.95	/	/	/	/
	2-Methoxy-4-vinylphenol	1.53	/	0.12	2.91	0.54
	Phenol, 4-(2-propenyl)-	/	/	/	0.19	/
	3-Allyl-6-methoxyphenol	0.4	/	4.57	2.61	/
	Phenol, 2-methoxy-4-propyl-	0.06	/	1.85	0.35	/

	Benzaldehyde, 3-hydroxy-4-methoxy-	0.93	0.72	/	4.5	2.57
	Phenol, 2-methoxy-4-(1-propenyl)-	0.12	/	0.25	1.68	/
	Phenol, 2-methoxy-4-(1-propenyl)-, (Z)-	2.66	/	4.79	11.55	0.69
	3,7-Benzofurandiol, 2,3-dihydro-2,2-dimethyl-	/	/	0.39	/	/
	Ethanone, 1-(4-hydroxy-3-methoxyphenyl)-	0.61	0.18	/	2.44	/
	2-Propanone, 1-(4-hydroxy-3-methoxyphenyl)-	1.79	0.40	/	/	/
	Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy-	0.22	0.06	/	/	/
	Benzoic acid, 4-hydroxy-3-methoxy-	/	/	/	/	2.87
	Benzeneacetic acid, 4-hydroxy-3-methoxy-	1.13	0.44	0	4.79	2.73
	4-((1E)-3-Hydroxy-1-propenyl)-2-methoxyphenol	/	/	/	0.77	/
	4-Hydroxy-2-methoxycinnamaldehyde	0.71	0.17	/	0.36	/
	Benzeneacetic acid, 4-hydroxy-3-methoxy-, methyl ester	/	/	/	/	0.66
	Phenylacetylformic acid, 4-hydroxy-3-methoxy-	/	/	/	/	0.32
	Naphtho[2,3-c]furan-1,4-dione, 3,3a,9,9a-tetrahydro-6-hydroxy-7-methoxy-	/	/	/	/	0.31
	2H-1-Benzopyran-7-ol, 3,4-dihydro-3-(4-hydroxy-2-methoxyphenyl)-	/	/	/	/	0

	Podocarpa-8,11,13-triene-7β,13-diol, 14-isopropyl-	/	/	0.08	/	/
	Phenol, 4-[2,3-dihydro-7-methoxy-3-methyl-5-(1-propenyl)-2-benzofuranyl]-2-methoxy-	/	/	/	/	0
	2(3H)-Furanone, dihydro-3,4-bis[(4-hydroxy-3-methoxyphenyl)methyl]-, (3R-trans)-	/	/	/	/	0.63
	Naphtho[2,3-c]furan-1(3H)-one, 3a,4,9,9a-tetrahydro-6-hydroxy-4-(4-hydroxy-3-methoxyphenyl)-7-methoxy-, [3aR-(3aα,4α,9aβ)]-	/	/	/	/	0.19
Total		~ 21.24	~ 5.52	~ 22.14	~ 57.81	~ 15.36

[a] Assuming that all detected phenolics were fully dissolved in ML.