Supporting Information

Bio-oil Production from *Prosopis juliflora* via Microwave Pyrolysis

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Figure S1. Snapshots of P. juliflora biomass of different particle sizes.

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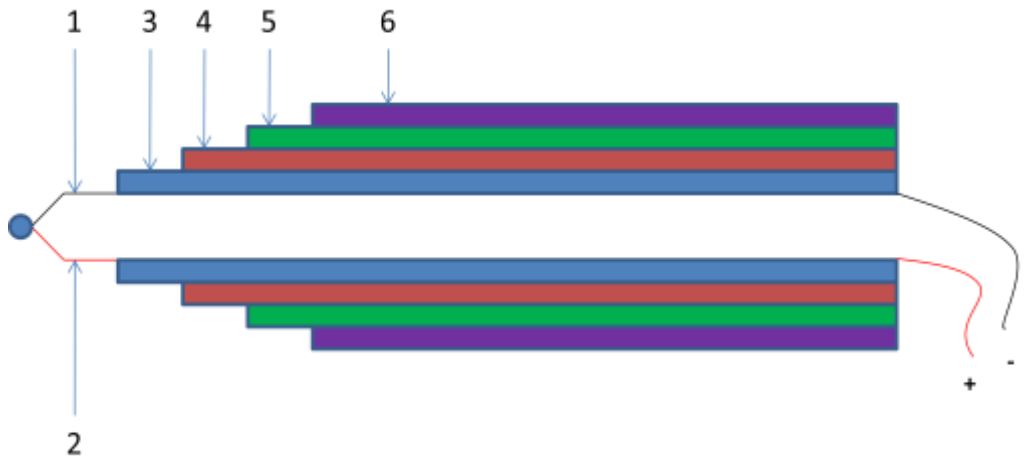

1. Chromel wire.
2. Alumel wire.
3. Alumina bead casing.
4. Aluminium foil.
5. Borosilicate glass tube.
6. Aluminium foil.

Figure S2. Schematic diagram of modified temperature sensor.

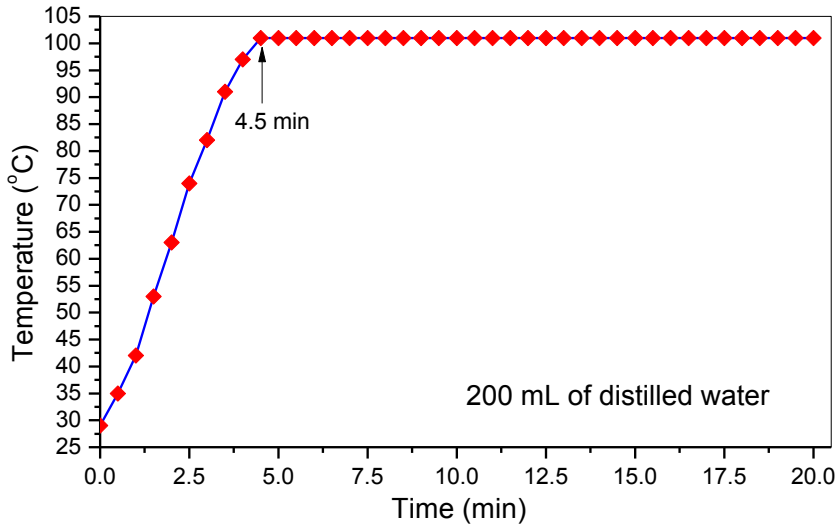

Figure S3. Temperature profile measured using the modified temperature sensor during microwave heating of 200 mL of distilled water. This shows the standardization of the thermocouple for accurate temperature measurements.

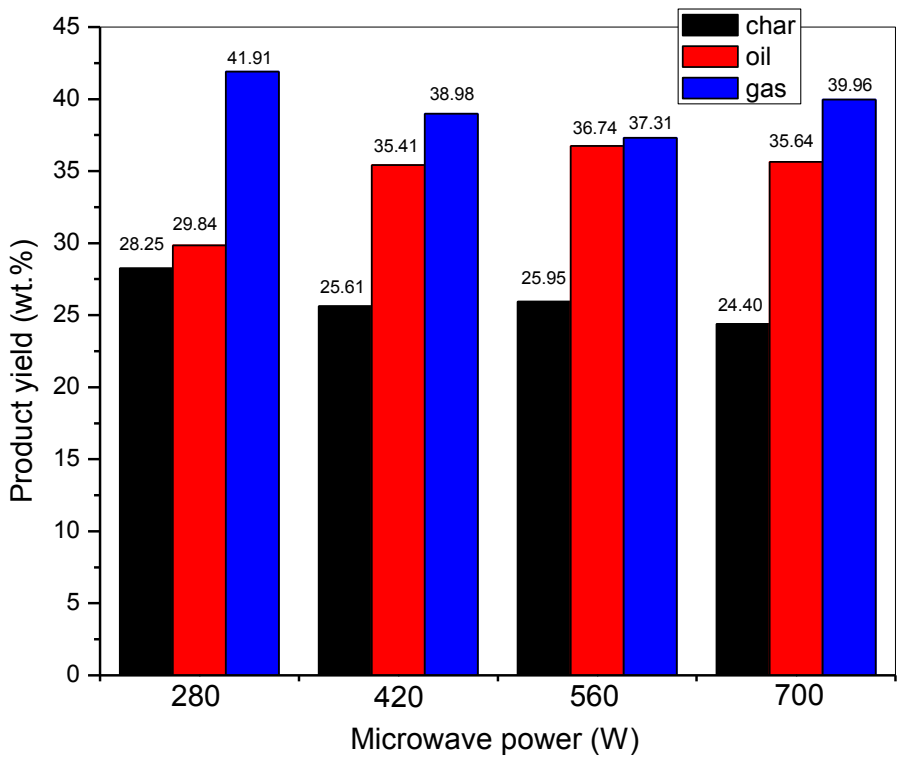

Figure S4. Yields of char, bio-oil and non-condensable gases for different microwave powers (PJF mass = 20 g, PJF to fly ash ratio (wt./wt.) = 100:1, PJF particle size = 2-4 mm).

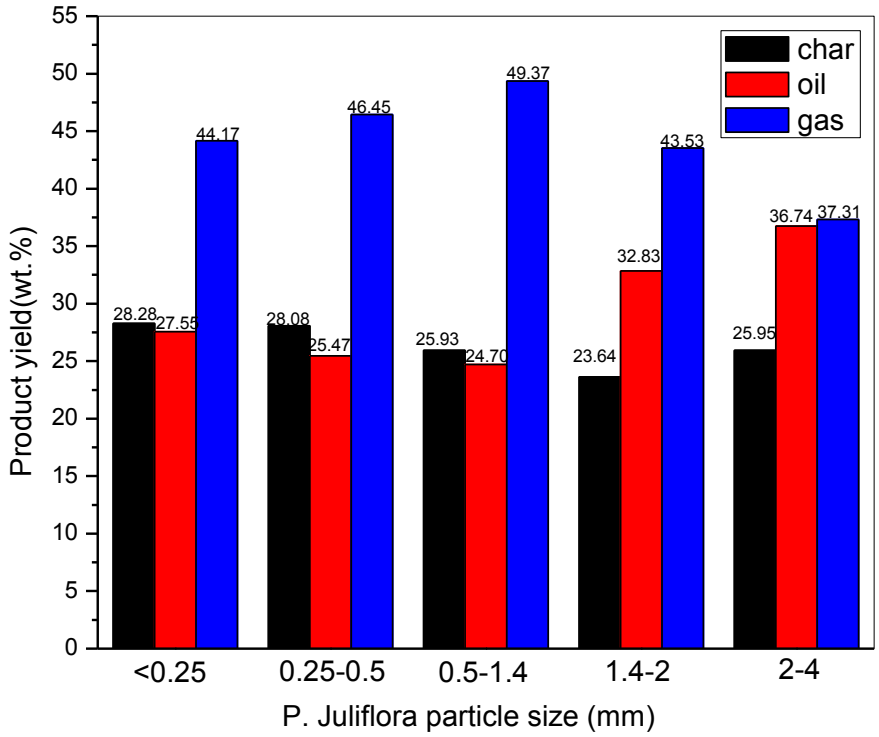

Figure S5. Yields of char, bio-oil and non-condensable gases for different PJF particle sizes (PJF mass = 20 g, PJF to fly ash ratio (wt./wt.) = 100:1, microwave power = 560 W).

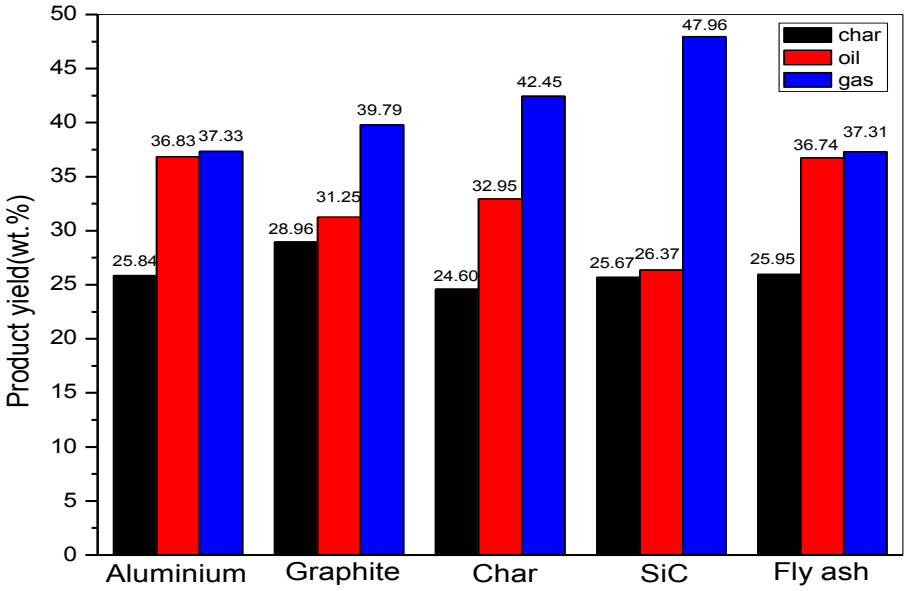

Figure S6. Yields of char, bio-oil and non-condensable gases with different susceptors (PJF mass = 20 g, PJF to susceptor ratio (wt./wt.) = 100:1, PJF particle size = 2-4 mm, microwave power = 560 W).

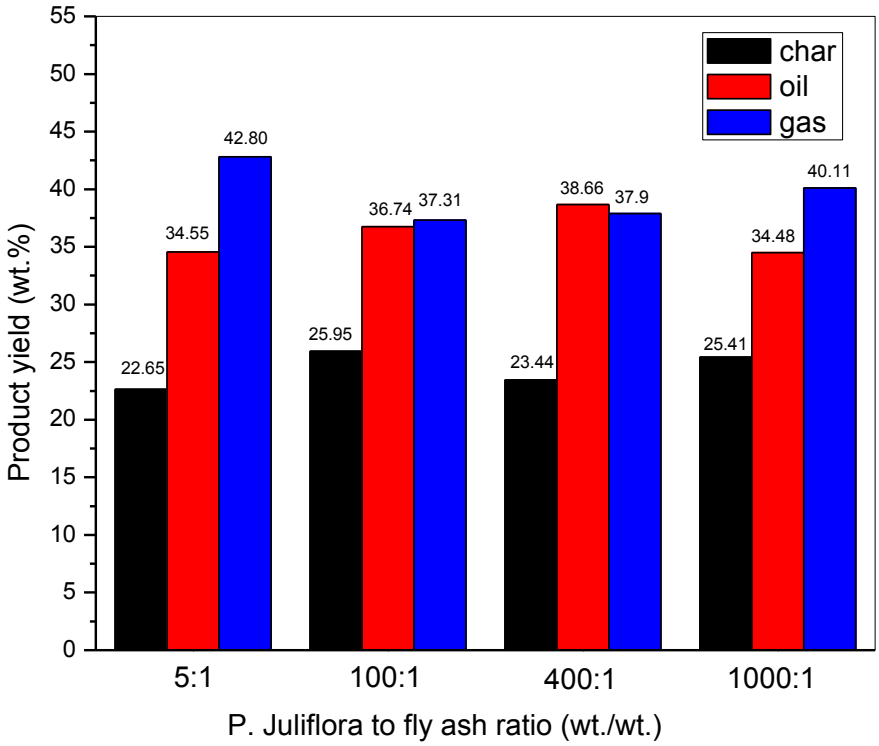

Figure S7. Yields of char, bio-oil and non-condensable gases for different PJF to fly ash ratios (wt./wt.) (PJF mass = 20 g, PJF particle size = 2-4 mm, microwave power = 560 W).

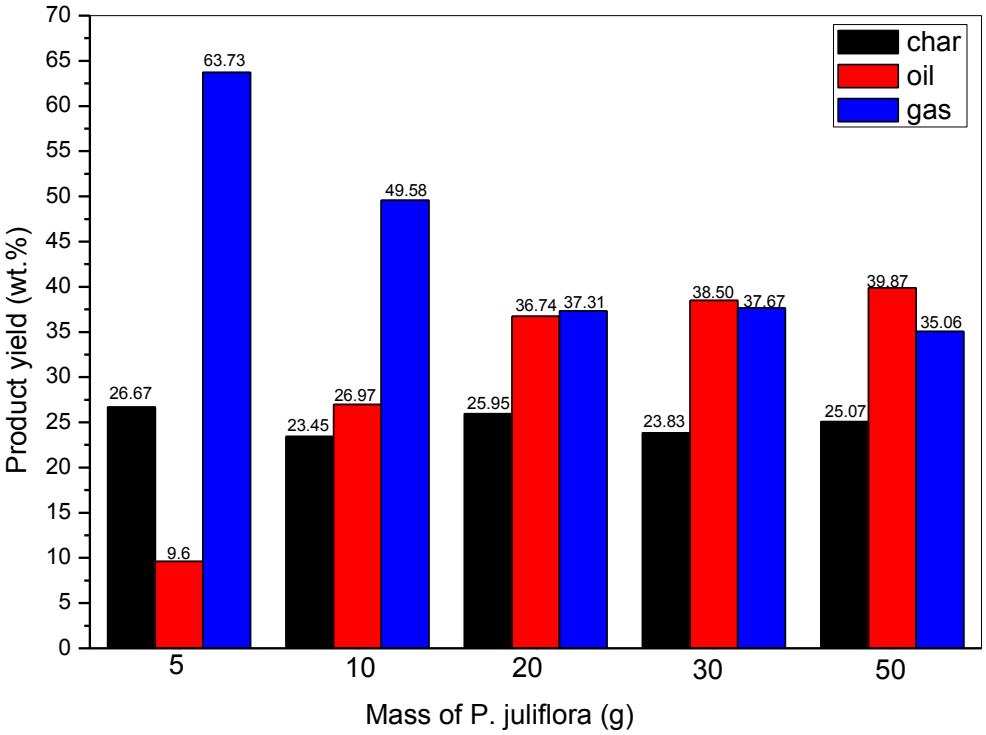

Figure S8. Yields of char, bio-oil and non-condensable gases for different initial masses of PJF feed (PJF to fly ash ratio (wt./wt.) = 100:1, microwave power level = 560 W, PJF particle size = 2-4 mm).

Table S1. Composition of bio-oil (in wt.% yield) obtained from microwave pyrolysis of P. juliflora under different experimental conditions on moisture free basis.

Expt. code	Guaiacols	Syringols	Simple phenols	Linear ketones/acids /alcohols	Aromatic hydrocarbons	Furan derivatives	Cyclopentanones	Others	Total bio-oil yield (wt.%)
E1	5.31	1.86	2.28	10.88	0.28	4.87	3.65	0.71	**29.84**
E2	8.82	2.41	3.35	11.86	0.46	4.91	3.22	0.38	**35.41**
E3	7.68	2.99	5.75	8.64	1.24	5.81	3.08	1.55	**36.74**
E4	8.72	2.1	5.44	7.55	3.43	4.38	3.04	0.98	**35.64**
E5	8.8	2.9	4.74	5.62	4.84	3.53	3.39	0.73	**34.55**
E6	9.72	4.76	6.54	7.54	3.76	2.97	2.5	0.87	**38.66**
E7	8.37	3.07	6.25	6.99	3.34	3.48	2.46	0.52	**34.48**
E8	7.83	2.34	6.62	7.15	4.88	4.15	2.38	1.48	**36.83**
E9	8.44	2.65	5.3	4.9	2.72	3.79	2.5	0.95	**31.25**
E10	8.47	2.26	4.58	6.18	3.84	3.81	2.26	1.55	**32.95**
E11	7.86	3.31	3.45	1.94	3.69	2.29	1.79	2.04	**26.37**
E12	3.08	1.47	1.55	1.34	1.05	0.55	0.15	0.41	**9.6**
E13	7.16	2.03	3.41	6.15	3.25	2.34	2.51	0.12	**26.97**
E14	12.24	3.16	6.19	6.97	2.98	3.83	2.71	0.42	**38.5**
E15	11.58	5.25	8.61	3.96	3.08	3.87	2.94	0.58	**39.87**
E16	4.1	1.47	6.51	1.99	7.52	2.03	1.52	2.41	**27.55**
E17	7.03	1.2	3.97	3.4	5.59	1.78	1.31	1.19	**25.47**
E18	6.7	2.07	3.88	3.47	3.57	2.07	1.46	1.48	**24.7**
E19	8.55	3.68	4.6	4.2	3.82	3.28	2.48	2.22	**32.83**

Table S2. Selectivities of bio-oil components under different experimental conditions.

Expt. Code	Guaiacols	Syringols	Simple phenols	Linear ketones/acids /alcohols	Aromatic hydrocarbons	Furan derivatives	Cyclopentanones
E1	17.79	6.23	7.64	36.46	0.94	16.32	12.23
E2	24.91	6.81	9.46	33.49	1.30	13.87	9.09
E3	20.90	8.14	15.65	23.52	3.38	15.81	8.38
E4	24.47	5.89	15.26	21.18	9.62	12.29	8.53
E5	25.47	8.39	13.72	16.27	14.01	10.22	9.81
E6	25.14	12.31	16.92	19.50	9.73	7.68	6.47
E7	24.27	8.90	18.13	20.27	9.69	10.09	7.13
E8	21.26	6.35	17.97	19.41	13.25	11.27	6.46
E9	27.01	8.48	16.96	15.68	8.70	12.13	8.00
E10	25.71	6.86	13.90	18.76	11.65	11.56	6.86
E11	29.81	12.55	13.08	7.36	13.99	8.68	6.79
E12	32.08	15.31	16.15	13.96	10.94	5.73	1.56
E13	26.55	7.53	12.64	22.80	12.05	8.68	9.31
E14	31.79	8.21	16.08	18.10	7.74	9.95	7.04
E15	29.04	13.17	21.60	9.93	7.73	9.71	7.37
E16	14.88	5.34	23.63	7.22	27.3	7.37	5.52
E17	27.60	4.71	15.59	13.35	21.95	6.99	5.14
E18	27.13	8.38	15.71	14.05	14.45	8.38	5.91
E19	26.04	11.21	14.01	12.79	11.64	9.99	7.55

Table S3. Yield of various compounds present in bio-oil obtained from experiment E1 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**5.31**
2-Methoxyphenol	0.41
4-Methyl-2-methoxyphenol	1.62
3-Methoxy-1,2-benzenediol	0.26
4-Ethyl-2-methoxyphenol	0.49
2-Methoxy-4-vinylphenol	0.14
Vanillin	0.27
4-Hydroxy-3-methoxybenzoic acid	0.71
2-Methoxy-4-(1-Propenyl)phenol	0.36
Homovanillyl alcohol	0.55
Apocynin	0.28
3-(4-Hydroxy-3-methoxyphenyl)-2-Propenal	0.22
Syringols	**1.86**
2,6-Dimethoxyphenol	1.07
2,6-Dimethoxy-4-(2-Propenyl)phenol	0.4
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.12
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.19
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.08
Simple phenols	**2.28**
Phenol	0.5
Cresols	0.39
2,6-Dimethylphenol	0.07
2,3-Dimethylphenol	0.08
3-Ethylphenol	0.11
Catechol	0.22
4-Methyl-1,2-benzenediol	0.21
5-(T-Butyl)Pyrogallol	0.22
Desaspidinol	0.48
Linear ketones/acids/alcohols	**10.88**
Acetic acid	5.41
Propanoic acid	0.74
Propanones	2.29
Butanoic acid	0.09
Butanones	1.75
Pentanones	0.6
Aromatic hydrocarbons	**0.28**
2,7-Bis(1,1-Dimethylethyl)naphthalene	0.21
1,3-Dimethyl-1H-indene	0.07
Furan derivatives	**4.87**
Furfural	2.65
2-Furanmethanol	0.58
1-(2-Furanyl)Ethanone	0.23

2-Furanone	0.28
Butyrolactone	0.27
5-Methyl-2-furanone	0.08
5-Methyl-2-furancarboxaldehyde	0.35
3-Methyl-2-furanone	0.08
1-(2-Furanyl)-1-Propanone	0.08
4-Methyl-5H-furan-2-one	0.11
4,7-Dimethylbenzofuran	0.09
5-Hydroxymethylfurfural	0.07
Cyclopentanones	**3.65**
Cyclopentanone	0.16
2-Cyclopenten-1-one	0.79
2-Methylcyclopentanone	0.07
2-Methyl-2-cyclopenten-1-one	0.32
1,2-Cyclopentanedione	0.37
3-Methyl-2-cyclopenten-1-one	0.37
3,4-Dimethyl-2-cyclopenten-1-one	0.21
2,3-Dimethyl-2-cyclopenten-1-one	0.35
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.71
2-Hydroxy-3,4-dimethyl-2-cyclopenten-1-one	0.1
3-Ethyl-2-hydroxy-2-cyclopenten-1-one	0.2
Others	**0.71**
Pyridine	0.15
N-methyl-1,3-propanediamine	0.12
Maltol	0.13
3,4-Anhydro-d-galactosan	0.15
3',5'-Dimethoxyacetophenone	0.16
Total	**29.84**

Table S4. Yield of various compounds present in bio-oil obtained from experiment E2 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**8.82**
2-Methoxyphenol	2.23
4-Methyl-2-methoxyphenol	1.96
3-Methoxy-1,2-benzenediol	0.34
4-Ethyl-2-methoxyphenol	0.47
2-Methoxy-4-vinylphenol	0.41
Vanillin	0.34
4-Hydroxy-3-methoxybenzoic acid	0.85
2-Methoxy-4-(1-Propenyl)phenol	0.6
2-Methoxy-4-propylphenol	0.18
Apocynin	0.41
Homovanillyl alcohol	0.72
3-(4-Hydroxy-3-methoxyphenyl)-2-Propenal	0.31
Syringols	**2.41**
2,6-Dimethoxyphenol	1.24
2,6-Dimethoxy-4-(2-Propenyl)phenol	0.65
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.17
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.23
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.12
Simple phenols	**3.35**
Phenol	0.52
Resorcinol	0.2
Cresols	0.6
2,6-Dimethylphenol	0.07
2,3-Dimethylphenol	0.13
3-Ethylphenol	0.13
Catechol	0.38
3-Methyl-1,2-benzenediol	0.13
4-Methyl-1,2-benzenediol	0.27
3,4-Dimethoxyphenol	0.16
5-(T-Butyl)Pyrogallol	0.24
Desaspidinol	0.52
Linear ketones/acids/alcohols	**11.86**
Ethanol	0.12
Acetic acid	5.32
Propanoic acid	1.38
Propanones	2.48
Butanoic acid	0.28
Butanones	2.17
Pentanones	0.11
Aromatic hydrocarbons	**0.46**
O-Xylene	0.09

1,3-Dimethyl-1H-indene	0.15
2,6-Bis(1,1-Dimethylethyl)naphthalene	0.22
Furan derivatives	**4.91**
Furfural	2.88
2-Furanmethanol	0.54
1-(2-Furanyl)Ethanone	0.19
2-Furanone	0.38
5-Methyl-2-furanone	0.1
5-Methyl-2-furancarboxaldehyde	0.31
4-Methyl-5H-furan-2-one	0.19
4,7-Dimethylbenzofuran	0.11
5-Hydroxymethylfurfural	0.21
Cyclopentanones	**3.22**
Cyclopentanone	0.18
2-Cyclopenten-1-one	0.59
2-Methyl-2-cyclopenten-1-one	0.35
1,2-Cyclopentanedione	0.4
3-Methyl-2-cyclopenten-1-one	0.25
3,4-Dimethyl-2-cyclopenten-1-one	0.11
2,3-Dimethyl-2-cyclopenten-1-one	0.32
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.88
3-Ethyl-2-hydroxy-2-cyclopenten-1-one	0.14
Others	**0.38**
Maltol	0.18
2,3-Anhydro-d-mannosan	0.2
Total	**35.41**

Table S5. Yields of various compounds present in bio-oil obtained from experiment E3 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**7.68**
2-Methoxyphenol	1.59
4-Methyl-2-methoxyphenol	1.61
4-Ethyl-2-methoxyphenol	0.66
3-Methoxy-1,2-benzenediol	0.15
2-Methoxy-4-vinylphenol	0.89
2-Methoxy-4-propylphenol	0.1
Vanillin	0.18
4-Hydroxy-3-methoxybenzoic acid	0.65
2-Methoxy-4-(1-Propenyl)phenol	0.75
Apocynin	0.37
Homovanillyl alcohol	0.54
3-(4-Hydroxy-3-methoxyphenyl)-2-Propenal	0.19
Syringols	**2.99**
2,6-Dimethoxyphenol	1.6
2,6-Dimethoxy-4-(2-Propenyl)phenol	0.97
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.16
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.17
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.09
Simple phenols	**5.75**
Phenol	0.52
Resorcinol	0.15
Cresols	1.87
2-Ethylphenol	0.11
2,3-Dimethylphenol	0.57
4-Ethylphenol	0.34
3,4-Dimethylphenol	0.11
Catechol	0.37
2-Ethyl-5-methylphenol	0.11
3-Methyl-1,2-benzenediol	0.14
4-Methyl-1,2-benzenediol	0.23
4-(T-Butyl)Catechol dimethyl ether	0.08
3,4-Dimethoxyphenol	0.15
5-(T-Butyl)Pyrogallol	0.59
Desaspidinol	0.41
Linear ketones/acids/alcohols	**8.64**
Acetic acid	3.18
Propanol	0.08
Propanoic acid	1.09
Propanones	1.28
Butanones	2.56

Pentanones	0.45
Aromatic hydrocarbons	**1.24**
Indene	0.11
Naphthalene	0.13
2,7-Bis(1,1-Dimethylethyl)naphthalene	0.22
1,3-Dimethyl-1H-indene	0.12
1,2-Dihydro-6-methylnaphthalene	0.11
Cis-Stilbene	0.12
2-Ethylnaphthalene	0.23
Biphenylene	0.20
Furan derivatives	**5.81**
Furfural	2.76
2-Furanmethanol	0.68
1-(2-Furanyl)Ethanone	0.13
2-Furanone	0.37
Butyrolactone	0.21
5-Methyl-2-furanone	0.10
5-Methyl-2-furancarboxaldehyde	0.86
3-Methyl-2-furanone	0.14
2,5-Dihydro-3,5-dimethyl-2-furanone	0.27
2-Methylbenzofuran	0.14
5-Hydroxymethylfurfural	0.15
Cyclopentanones	**3.08**
Cyclopentanone	0.24
2-Cyclopenten-1-one	0.33
2-Methyl-2-cyclopenten-1-one	0.43
2-Hydroxy-2-cyclopenten-1-one	0.39
3,4-Dimethyl-2-cyclopenten-1-one	0.09
3-Methyl-2-cyclopenten-1-one	0.53
2,3-Dimethyl-2-cyclopenten-1-one	0.35
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.63
2-Hydroxy-3,4-dimethyl-2-cyclopenten-1-one	0.09
Others	**1.55**
Pyridine	0.1
Trans-2-Methyl-4-hexen-3-ol	0.19
N-methyl-1,3-propanediamine	0.21
Maltol	0.12
3,4-Dimethoxytoluene	0.12
1,4-Dimethoxy-2,3,5,6-tetramethylbenzene	0.09
4-Ethyl-1,2-dimethoxybenzene	0.13
1,2,3-Trimethoxy-5-methylbenzene	0.12
3',5'-Dimethoxyacetophenone	0.47
Total	**36.74**

Table S6. Yield of various compounds present in bio-oil obtained from experiment E4 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**8.72**
2-Methoxyphenol	1.18
4-Methyl-2-methoxyphenol	1.57
3-Methoxy-1,2-benzenediol	0.21
4-Ethyl-2-methoxyphenol	0.52
2-Methoxy-4-vinylphenol	1
Eugenol	0.99
Vanillin	0.15
4-Hydroxy-3-methoxybenzoic acid	0.72
2-Methoxy-4-(1-Propenyl)phenol	1.17
2-Methoxy-4-propylphenol	0.1
Apocynin	0.36
Homovanillyl alcohol	0.42
3-(4-Hydroxy-3-methoxyphenyl)-2-Propenal	0.33
Syringols	**2.1**
2,6-Dimethoxyphenol	0.39
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.28
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.13
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.17
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.13
Simple phenols	**5.44**
Phenol	0.6
2-Hydroxybenzaldehyde	0.09
Cresols	1.78
2,6-Dimethylphenol	0.14
2-Ethylphenol	0.12
2,3-Dimethylphenol	0.53
3-Ethylphenol	0.41
3,5-Dimethylphenol	0.11
3,4-Dimethylphenol	0.14
3-Methyl-1,2-benzenediol	0.23
2-Allylphenol	0.09
4-Methyl-1,2-benzenediol	0.65
5-(T-Butyl) Pyrogallol	0.55
Linear ketones/acids/alcohols	**7.55**
Acetic acid	3.33
Propanoic acid	0.8

Propanones	1.5
Butanones	1.92
Aromatic hydrocarbons	**3.43**
P-Xylene	0.09
Styrene	0.16
Indene	0.22
1,2,4,5-Tetramethylbenzene	0.15
1-Methylene-1H-indene	0.2
1,3-Dimethyl-1H-indene	0.37
1-Methylnaphthalene	0.36
1,6-Dimethylnaphthalene	0.25
2,6-Dimethylnaphthalene	0.19
Biphenylene	0.27
Stilbene	0.59
Fluorene	0.31
2-Methyl-9-fluorene	0.27
Furan derivatives	**4.38**
Furfural	2.09
2-Furanmethanol	0.52
1-(2-Furanyl)Ethanone	0.15
2-Furanone	0.27
Butyrolactone	0.16
5-Methyl-2-furancarboxaldehyde	0.5
3-Methyl-2-furanone	0.11
2-Methylbenzofuran	0.25
2,3-Dihydrobenzofuran	0.09
5-Hydroxymethylfurfural	0.24
Cyclopentanones	**3.04**
Cyclopentanone	0.15
2-Cyclopenten-1-one	0.37
2-Methyl-2-cyclopenten-1-one	0.42
1,2-Cyclopentanedione	0.35
3-Methyl-2-cyclopenten-1-one	0.57
2,3-Dimethyl-2-cyclopenten-1-one	0.5
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.57
1-(2-Methyl-1-cyclopenten-1-yl)-Ethanone	0.11
Others	**0.98**
1-Methoxy-4-methylbenzene	0.11
3-Methylbenzaldehyde	0.12
3,4-Dimethoxytoluene	0.22
1-Ethyl-4-methoxybenzene	0.19

N-(4-Methoxyphenyl)-2-hydroxyiminoacetamide	0.19
9H-Fluoren-9-ol	0.15
Total	**35.64**

Table S7. Yield of various compounds present in bio-oil obtained from experiment E5 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**8.8**
2-Methoxyphenol	1.61
4-Methyl-2-methoxyphenol	1.1
4-Ethyl-2-methoxyphenol	1.35
2-Methoxy-4-vinylphenol	1.38
2-Methoxy-4-propylphenol	0.28
Vanillin	0.32
4-Hydroxy-3-methoxybenzoic acid	0.46
2-Methoxy-4-(1-Propenyl)phenol	1.27
Apocynin	0.29
4-Hydroxy-3-methoxybenxoic acid methyl ester	0.09
Homovanillyl alcohol	0.37
3-(4-Hydroxy-3-methoxyphenyl)-2-Propenal	0.28
Syringols	**2.9**
2,6-Dimethoxyphenol	1.19
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.37
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.13
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.11
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.1
Simple phenols	**4.74**
Phenol	0.97
Cresols	1.38
2,3-Dimethylphenol	0.52
4-Ethylphenol	0.25
3,4-Dimethylphenol	0.09
Catechol	0.24
3-Methyl-1,2-benzenediol	0.09
4-Methyl-1,2-benzenediol	0.24
3,4-Dimethoxyphenol	0.18
5-(T-Butyl)Pyrogallol	0.45
Desaspidinol	0.33
Linear ketones/acids/alcohols	**5.62**

Acetic acid	2.07
Propanoic acid	0.75
Propanones	1.14
Butanones	1.53
Pentanones	0.13
Aromatic hydrocarbons	**4.84**
Benzene	0.11
M-Xylene	0.08
Styrene	0.15
Indene	0.31
Naphthalene	1.71
1,3-Dimethyl-1H-indene	0.31
1-Methylnaphthalene	0.31
2,7-Dimethylnaphthalene	0.25
2,6-Dimethylnaphthalene	0.12
Biphenylene	0.28
Stilbene	0.5
Fluorene	0.38
1-Methyl-9H-fluorene	0.09
Anthracene	0.13
Phenanthrene	0.11
Furan derivatives	**3.53**
Furfural	1.86
2-Furanmethanol	0.33
1-(2-Furanyl)Ethanone	0.1
5-Methyl-2-furancarboxaldehyde	0.21
Butyrolactone	0.1
2(5H)-Furanone	0.22
2-Methylbenzofuran	0.34
Dibenzofuran	0.15
4-Methyldibenzofuran	0.22
Cyclopentanones	**3.39**
Cyclopentanone	0.24
2-Cyclopenten-1-one	0.17
2-Methyl-2-cyclopenten-1-one	0.35
1,2-Cyclopentanedione	0.16
3,4-Dimethyl-2-cyclopenten-1-one	0.55
3-Methyl-2-cyclopenten-1-one	0.7
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.64
2,3-Dimethyl-2-cyclopenten-1-one	0.5
3-Ethyl-2-hydroxy-2-cyclopenten-1-one	0.08

Others	**0.73**
2-Methylbenzaldehyde	0.09
Maltol	0.09
3,4-Dimethoxytoluene	0.22
1-Ethyl-4-methoxybenzene	0.11
2,3-Dihydro-1H-inden-1-one	0.1
1,2,3-Trimethoxy-5-methylbenzene	0.12
Total	**34.55**

Table S8. Yield of various compounds present in bio-oil obtained from experiment E6 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**9.72**
2-Methoxyphenol	1.97
4-Methyl-2-methoxyphenol	1.47
4-Ethyl-2-methoxyphenol	1.45
2-Methoxy-4-vinylphenol	1.55
Vanillin	0.42
4-Hydroxy-3-methoxybenzoic acid	0.55
2-Methoxy-4-(1-Propenyl)phenol	1.07
2-Methoxy-4-propylphenol	0.15
Apocynin	0.33
Homovanillyl alcohol	0.47
4-Hydroxy-3-methoxycinnamaldehyde	0.29
Syringols	**4.76**
2,6-Dimethoxyphenol	1.46
2,6-Dimethoxy-4-(2-Propenyl)phenol	2.63
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.43
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.14
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.1
Simple phenols	**6.54**
Phenol	1.05
Cresols	1.82
2,4-Dimethylphenol	0.66
4-Ethylphenol	0.35
3,4-Dimethylphenol	0.09
Catechol	0.73
3-Methyl-1,2-benzenediol	0.2
4-Methyl-1,2-benzenediol	0.45

3,4-Dimethoxyphenol	0.24
5-(T-Butyl)Pyrogallol	0.54
Desaspidinol	0.41
Linear ketones/acids/alcohols	**7.54**
Ethanol	0.1
Acetic acid	2.55
Propanoic acid	0.78
Propanones	1.3
Butanones	2.47
Pentanones	0.34
Aromatic hydrocarbons	**3.76**
Benzene	0.19
Toluene	0.11
O-Xylene	0.16
Styrene	0.16
1,2,3-Trimethylbenzene	0.28
Indene	0.18
1-Methyl-1H-indene	0.1
Naphthalene	0.19
1,3-Dimethyl-1H-indene	0.32
1-Methylnaphthalene	0.35
1-Ethylnaphthalene	0.15
2,7-Dimethylnaphthalene	0.27
Biphenylene	0.3
Fluorene	0.41
2-Methyl-9H-fluorene	0.27
Anthracene	0.17
Phenanthrene	0.15
Furan derivatives	**2.97**
Furfural	1.5
2-Furanmethanol	0.55
Butyrolactone	0.15
2(5H)-Furanone	0.19
2-Methylbenzofuran	0.28
4-Methylbenzofuran	0.3
Cyclopentanones	**2.5**
Cyclopentanone	0.23
2-Cyclopenten-1-one	0.2
2-Methyl-2-cyclopenten-1-one	0.38
1,2-Cyclopentanedione	0.31
3-Methyl-2-cyclopenten-1-one	0.3

2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.79
2,3-Dimethyl-2-cyclopenten-1-one	0.18
3,4-Dimethyl-2-cyclopenten-1-one	0.11
Others	**0.87**
3-Methylbenzaldehyde	0.11
Maltol	0.12
3,4-Dimethoxytoluene	0.2
1-Ethyl-4-methoxybenzene	0.17
2,3-Dihydro-1H-inden-1-one	0.12
1,2,3-Trimethoxy-5-methylbenzene	0.15
Total	**38.66**

Table S9. Yield of various compounds present in bio-oil obtained from experiment E7 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**8.37**
2-Methoxyphenol	1.45
4-Methyl-2-methoxyphenol	1.57
3-Methoxy-1,2-benzenediol	0.13
4-Ethyl-2-methoxyphenol	0.82
2-Methoxy-4-vinylphenol	1.19
2-Methoxy-4-propylphenol	0.26
Vanillin	0.31
4-Hydroxy-3-methoxybenzoic acid	0.56
2-Methoxy-4-(1-Propenyl)phenol	1.02
Apocynin	0.31
4-Hydroxy-3-methoxybenxoic acid methyl ester	0.08
Homovanillyl alcohol	0.44
4-Hydroxy-3-methoxycinnamaldehyde	0.23
Syringols	**3.07**
2,6-Dimethoxyphenol	1.54
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.19
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.12
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.13
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.09
Simple phenols	**6.25**
Phenol	1.13
Cresols	1.92

2,6-Dimethylphenol	0.08
3-Ethylphenol	0.12
2,4-Dimethylphenol	0.66
4-Ethylphenol	0.37
3,4-Dimethylphenol	0.11
Catechol	0.41
3-Methyl-1,2-benzenediol	0.14
4-Methyl-1,2-benzenediol	0.2
3,4-Dimethoxyphenol	0.21
5-(T-Butyl)Pyrogallol	0.55
Desaspidinol	0.35
Linear ketones/acids/alcohols	**6.99**
Ethanol	0.1
Acetic acid	3.25
Propanoic acid	0.79
Propanones	0.95
Butanones	1.82
Pentanones	0.08
Aromatic hydrocarbons	**3.34**
Benzene	0.17
1,3-Dimethylbenzene	0.12
Styrene	0.22
Indene	0.34
Naphthalene	0.42
1,3-Dimethyl-1H-indene	0.33
1-Methylnaphthalene	0.37
1-Ethylnaphthalene	0.33
2,7-Dimethylnaphthalene	0.24
Biphenylene	0.31
Fluorene	0.37
2-Methyl-9H-fluorene	0.12
Furan derivatives	**3.48**
Furfural	1.71
2-Furanmethanol	0.5
1-(2-Furanyl)Ethanone	0.12
Butyrolactone	0.16
2(5H)-Furanone	0.26
2-Methylbenzofuran	0.22
2-Ethylbenzofuran	0.09
5-Hydroxymethylfurfural	0.08
Dibenzofuran	0.16

4-Methyldibenzofuran	0.18
Cyclopentanones	**2.46**
Cyclopentanone	0.18
2-Cyclopenten-1-one	0.25
2-Methyl-2-cyclopenten-1-one	0.43
1,2-Cyclopentanedione	0.44
3,4-Dimethyl-2-cyclopenten-1-one	0.09
3-Methyl-2-cyclopenten-1-one	0.3
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.63
2,3-Dimethyl-2-cyclopenten-1-one	0.14
Others	**0.52**
4-Methylbenzaldehyde	0.09
3,4-Dimethoxytoluene	0.16
1-Ethyl-4-methoxybenzene	0.14
1,2,3-Trimethoxy-5-methylbenzene	0.13
Total	**34.48**

Table S10. Yield of various compounds present in bio-oil obtained from experiment E8 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**7.83**
2-Methoxyphenol	0.97
4-Methyl-2-methoxyphenol	1.55
3-Methoxy-1,2-benzenediol	0.21
4-Ethyl-2-methoxyphenol	0.44
2-Methoxy-4-vinylphenol	0.75
Eugenol	0.88
Vanillin	0.18
4-Hydroxy-3-methoxybenzoic acid	0.74
2-Methoxy-4-(1-Propenyl)phenol	1.21
Apocynin	0.31
Homovanillyl alcohol	0.33
3-(4-Hydroxy-3-methoxyphenyl)-2-Propenal	0.26
Syringols	**2.34**
2,6-Dimethoxyphenol	0.66
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.53
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.15
Simple phenols	**6.62**
Phenol	0.88

Cresols	1.96
2,6-Dimethylphenol	0.15
2-Ethylphenol	0.12
2,3-Dimethylphenol	0.62
4-Ethylphenol	0.44
3,4-Dimethylphenol	0.21
2,4,6-Trimethylphenol	0.2
2-Ethyl-5-methylphenol	0.22
3-Methyl-1,2-benzenediol	0.18
4-Methyl-1,2-benzenediol	0.74
3,4-Dimethoxyphenol	0.2
5-(T-Butyl)Pyrogallol	0.44
Desaspidinol	0.26
Linear ketones/acids/alcohols	**7.15**
Acetic acid	3.33
Propanoic acid	0.57
Propanones	1.15
Butanones	1.87
Pentanones	0.23
Aromatic hydrocarbons	**4.88**
M-Xylene	0.23
Styrene	0.17
Mesitylene	0.24
Indene	0.22
1-Methyl-1H-indene	0.15
Naphthalene	0.19
1,3-Dimethyl-1H-indene	0.37
Stilbene	0.61
2-Methylnaphthalene	0.38
2-Ethylnaphthalene	0.45
2,6-Dimethylnaphthalene	0.28
2,3-Dimethylnaphthalene	0.21
Biphenylene	0.3
2-Ethenylnaphthalene	0.17
1,6,7-Trimethylnaphthalene	0.16
Fluorene	0.38
2-Methyl-9H-fluorene	0.37
Furan derivatives	**4.15**
Furfural	2.11
2-Furanmethanol	0.48
1-(2-Furanyl)Ethanone	0.13

2(5H)-Furanone	0.25
Butyrolactone	0.15
5-Methyl-2-furancarboxaldehyde	0.4
2-Methylbenzofuran	0.23
2-Ethylbenzofuran	0.14
4-Methyldibenzofuran	0.26
Cyclopentanones	**2.38**
2-Cyclopenten-1-one	0.47
2-Methyl-2-cyclopenten-1-one	0.32
1,2-Cyclopentanedione	0.34
3-Methyl-2-cyclopenten-1-one	0.42
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.52
2,3-Dimethyl-2-cyclopenten-1-one	0.31
Others	**1.48**
Trans-2-Methyl-4-hexen-3-ol	0.31
1-Methoxy-4-methylbenzene	0.1
4-Methylbenzaldehyde	0.1
N-methyl-1,3-propanediamine	0.11
1,4-Dimethoxy-2,3,5,6-tetramethylbenzene	0.17
4-Ethyl-1,2-dimethoxybenzene	0.14
4-(T-Butyl)Catechol dimethyl ether	0.37
3,4-Dimethoxytoluene	0.18
Total	**36.83**

Table S11. Yield of various compounds present in bio-oil obtained from experiment E9 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**8.44**
2-Methoxyphenol	1.19
4-Methyl-2-methoxyphenol	1.56
3-Methoxy-1,2-benzenediol	0.25
4-Ethyl-2-methoxyphenol	1.19
2-Methoxy-4-vinylphenol	0.83
2-Methoxy-4-propylphenol	0.22
2-Methoxy-4-(1-Propenyl)phenol	1.09
Vanillin	0.22
3-Hydroxy-4-methoxybenzoic acid	1.2
Apocynin	0.25
Homovanillyl alcohol	0.19
Homovanillic acid	0.12
3-(4-Hydroxy-3-methoxyphenyl)-2-Propenal	0.13
Syringols	**2.65**
2,6-Dimethoxyphenol	1.02
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.53
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.1
Simple phenols	**5.3**
Phenol	0.85
Cresols	1.91
2,6-Dimethylphenol	0.1
2,3-Dimethylphenol	0.59
4-Ethylphenol	0.13
3,4-Dimethylphenol	0.42
Catechol	0.16
3-Methyl-1,2-benzenediol	0.31
4-Methyl-1,2-benzenediol	0.45
4-Ethylcatechol	0.38
Linear ketones/acids/alcohols	**4.9**
Acetic acid	2.44
Propanoic acid	0.44
Propanones	1.16
Butanones	0.67
Pentanones	0.19
Aromatic hydrocarbons	**2.72**
Toluene	0.09

Styrene	0.13
Mesitylene	0.19
Indene	0.09
1-Methyl-1H-indene	0.1
Naphthalene	0.36
2,3-Dimethyl-1H-indene	0.17
1-Methylnaphthalene	0.1
2,7-Dimethylnaphthalene	0.23
2,6-Dimethylnaphthalene	0.15
Stilbene	0.33
Fluorene	0.55
1-Methyl-9H-fluorene	0.1
Anthracene	0.13
Furan derivatives	**3.79**
Furfural	1.41
2-Furanmethanol	0.51
1-(2-Furanyl)Ethanone	0.16
Butyrolactone	0.09
2(5H)-Furanone	0.11
5-Methyl-2-furancarboxaldehyde	0.76
2-Methylbenzofuran	0.4
2-Ethylbenzofuran	0.11
4,7-Dimethylbenzofuran	0.09
4-Methyldibenzofuran	0.15
Cyclopentanones	**2.5**
Cyclopentanone	0.16
2-Cyclopenten-1-one	0.34
2-Methyl-2-cyclopenten-1-one	0.34
1,2-Cyclopentanedione	0.3
2,3-Dimethyl-2-cyclopenten-1-one	0.28
3-Methyl-2-cyclopenten-1-one	0.31
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.77
Others	**0.95**
1-Methoxy-4-methylbenzene	0.09
2-Methylbenzaldehyde	0.09
Maltol	0.09
1,2-Dimethoxytoluene	0.1
3,4-Dimethoxytoluene	0.19
4-(t-Butyl)Catechol dimethyl ether	0.13
4-Methoxy-7-methylindan-1-one	0.26
Total	**31.25**

Table S12. Yield of various compounds present in bio-oil obtained from experiment E10 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**8.47**
2-Methoxyphenol	0.92
4-Methyl-2-methoxyphenol	1.76
3-Methoxy-1,2-benzenediol	0.16
4-Ethyl-2-methoxyphenol	0.44
2-Methoxy-4-vinylphenol	0.86
Eugenol	1.4
Vanillin	0.12
3-Hydroxy-4-methoxybenzoic acid	0.73
2-Methoxy-4-(1-Propenyl)phenol	1.13
Apocynin	0.3
Methyleugenol	0.13
Homovanillyl alcohol	0.35
4-Hydroxy-3-methoxycinnamaldehyde	0.17
Syringols	**2.26**
2,6-Dimethoxyphenol	0.39
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.55
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.1
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.13
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.09
Simple phenols	**4.58**
Phenol	0.61
Resorcinol	0.1
Cresols	1.5
2,6-Dimethylphenol	0.13
2-Ethylphenol	0.09
2,3-Dimethylphenol	0.48
4-Ethylphenol	0.35
3,4-Dimethylphenol	0.16
2,4,6-Trimethylphenol	0.08
2-Ethyl-5-methylphenol	0.12
3-Methyl-1,2-benzenediol	0.08
4-Methyl-1,2-benzenediol	0.22
3,4-Dimethoxyphenol	0.12
5-(T-Butyl)Pyrogallol	0.54
Linear ketones/acids/alcohols	**6.18**
Acetic acid	2.93

Propanoic acid	0.72
Propanones	1.19
Butanones	1.22
Pentanones	0.12
Aromatic hydrocarbons	**3.84**
Benzene	0.09
Toluene	0.09
M-Xylene	0.11
Styrene	0.2
Mesitylene	0.2
Indene	0.34
1-Methyl-1H-indene	0.1
Naphthalene	0.29
2,6-Bis(1,1-Dimethylethyl)naphthalene	0.19
1,3-Dimethyl-1H-indene	0.29
1,1-Diphenylethylene	0.12
2-Methylnaphthalene	0.33
2-Ethylnaphthalene	0.24
2,7-Dimethylnaphthalene	0.26
2,6-Dimethylnaphthalene	0.15
Biphenylene	0.3
2-Ethenylnaphthalene	0.13
Fluorene	0.32
1,2,4,5-Tetramethylbenzene	0.09
Furan derivatives	**3.81**
Furfural	1.67
2-Furanmethanol	0.31
1-(2-Furanyl)Ethanone	0.13
2(5H)-Furanone	0.12
Butyrolactone	0.1
5-Methyl-2-furancarboxaldehyde	0.29
3-Methyl-2-(5H)furanone	0.1
1-(2-Furanyl)-1-propanone	0.11
4-Methyl-5H-furan-2-one	0.08
2-Methylbenzofuran	0.22
2-Ethylbenzofuran	0.09
4,7-Dimethylbenzofuran	0.09
2,3-Dihydrabenzofuran	0.08
5-Hydroxymethylfurfural	0.21
4-Methylbenzofuran	0.21
Cyclopentanones	**2.26**

Cyclopentanone	0.11
2-Cyclopenten-1-one	0.42
2-Methyl-2-cyclopenten-1-one	0.34
1,2-Cyclopentanedione	0.18
3-Methyl-2-cyclopenten-1-one	0.38
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.59
2,3-Dimethyl-2-cyclopenten-1-one	0.24
Others	**1.55**
1-Methoxy-4-methylbenzene	0.23
N-methyl-1,3-propanediamine	0.1
3,4-Dimethoxytoluene	0.16
1,4-Dimethoxy-2,3,5,6-tetramethylbenzene	0.12
4-Ethyl-1,2-dimethoxybenzene	0.14
4-(T-Butyl)Catechol dimethyl ether	0.16
1,2,3-Trimethoxy-5-methylbenzene	0.12
3',5'-Dimethoxyacetophenone	0.52
Total	**32.95**

Table S13. Yield of various compounds present in bio-oil obtained from experiment E11 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**7.86**
2-Methoxyphenol	1.28
4-Methyl-2-methoxyphenol	1.07
4-Ethyl-2-methoxyphenol	1.08
2-Methoxy-4-vinylphenol	1.26
Vanillin	0.27
4-Hydroxy-3-methoxybenzoic acid	1.51
2-Methoxy-4-(1-Propenyl)phenol	0.48
Homovanillyl alcohol	0.42
Apocynin	0.18
4-Hydroxy-3-methoxycinnamaldehyde	0.31
Syringols	**3.31**
2,6-Dimethoxyphenol	1.23
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.9
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.12
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.06
Simple phenols	**3.45**
Phenol	0.52
P-Cresol	1.1

2,3-Dimethylphenol	0.52
4-Ethylphenol	0.25
3,4-Dimethylphenol	0.1
2,4,6-Trimethylbenzene	0.08
4-Methyl-1,2-benzenediol	0.12
5-(T-Butyl)Pyrogallol	0.48
Desaspidinol	0.28
Linear ketones/acids/alcohols	**1.94**
Acetic acid	0.23
Propanoic acid	0.25
Propanones	0.41
Butanones	0.93
Pentanones	0.12
Aromatic hydrocarbons	**3.69**
Benzene	0.11
Toluene	0.11
P-Xylene	0.13
Styrene	0.17
Mesitylene	0.26
Indene	0.19
1-Methyl-1H-indene	0.21
Naphthalene	0.7
1,3-Dimethyl-1H-indene	0.3
1-Methylnaphthalene	0.26
2-Ethylnaphthalene	0.1
2,7-Dimethylnaphthalene	0.23
2,6-Dimethylnaphthalene	0.13
Fluorene	0.41
1-Methylfluorene	0.1
Anthracene	0.15
Phenanthrene	0.13
Furan derivatives	**2.29**
Furfural	0.87
2-Furanmethanol	0.15
1-(2-Furanyl)Ethanone	0.08
2-Furanone	0.07
2-Methylbenzofuran	0.34
2-Ethylbenzofuran	0.11
4,7-Dimethylbenzofuran	0.24
Dibenzofuran	0.17
4-Methylbenzofuran	0.26
Cyclopentanones	**1.79**
Cyclopentanone	0.09
2-Cyclopenten-1-one	0.12
2-Methyl-2-cyclopenten-1-one	0.23
1,2-Cyclopentanedione	0.07

2,3-Dimethyl-2-cyclopenten-1-one	0.38
3-Methyl-2-cyclopenten-1-one	0.55
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.35
Others	**2.04**
1-Methoxy-4-methylbenzene	0.15
2-Methylbenzaldehyde	0.09
Maltol	0.07
1,2-Dimethoxybenzene	0.08
3,4-Dimethoxytoluene	0.19
1-Ethyl-4-methoxybenzene	0.14
2,3-Dihydro-1H-inden-1-one	0.11
1,4-Dimethoxy-2,3,5,6-tetramethylbenzene	0.1
4-(T-Butyl)Catechol dimethyl ether	0.19
1,2,3-Trimethoxy-5-methylbenzene	0.18
4-Methoxy-7-methylindan-1-one	0.25
3',5'-Dimethoxyacetophenone	0.49
Total	**26.37**

Table S14. Yield of various compounds present in bio-oil obtained from experiment E12 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**3.08**
2-Methoxyphenol	0.32
4-Methyl-2-methoxyphenol	0.85
Vanillin	0.13
4-Hydroxy-3-methoxybenzoic acid	0.61
2-Methoxy-4-(1-Propenyl)phenol	0.89
Apocynin	0.16
4-Hydroxy-3-methoxycinnamaldehyde	0.12
Syringols	**1.47**
2,6-Dimethoxyphenol	0.67
2,6-Dimethoxy-4-(2-Propenyl)phenol	0.8
Simple phenols	**1.55**
Phenol	0.49
Cresols	0.73
2,5-Dimethylphenol	0.12
4-Ethylphenol	0.21
Linear ketones/acids/alcohols	**1.34**
Acetic acid	0.94
Propanones	0.4
Aromatic hydrocarbons	**1.05**

2,6-Bis(1,1-Dimethylethyl)naphthalene	0.45
1,3-Dimethyl-1H-indene	0.35
1-Ethylnaphthalene	0.25
Furans	**0.55**
Furfural	0.14
2-Furanmethanol	0.14
4-Methylbenzofuran	0.27
Cyclopentanones	**0.15**
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.08
1,2-Cyclopentanedione	0.07
Others	**0.41**
1-Ethyl-4-methoxybenzene	0.41
Total	**9.6**

Table S15. Yield of various compounds present in bio-oil obtained from experiment E13 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**7.16**
2-Methoxyphenol	1.76
4-Methyl-2-methoxyphenol	2.1
3-Methoxy-1,2-benzenediol	0.13
2-Methoxy-4-vinylphenol	0.41
Eugenol	0.26
Vanillin	0.2
4-Hydroxy-3-methoxybenzoic acid	0.7
2-Methoxy-4-(1-Propenyl)phenol	1.22
Apocynin	0.18
3-(4-Hydroxy-3-methoxyphenyl)-2-Propenal	0.2
Syringols	**2.03**
2,6-Dimethoxyphenol	0.77
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.16
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.1
Simple phenols	**3.41**
Phenol	1.34
Cresols	1.02
2,5-Dimethylphenol	0.17
2,3-Dimethylphenol	0.23
3,4-Dimethylphenol	0.32
2,4-Dimethylphenol	0.11

4-Methyl-1,2-benzenediol	0.12
5-(T-Butyl)Pyrogallol	0.1
Linear ketones/acids/alcohols	**6.15**
Acetic acid	3.22
Propanoic acid	0.86
Propanones	1.69
Butanones	0.38
Aromatic hydrocarbons	**3.25**
Indene	0.14
1-Methyl-1H-indene	0.11
Naphthalene	0.19
2,6-Bis(1,1-Dimethylethyl)naphthalene	0.32
1,3-Dimethyl-1H-indene	0.35
2-Methylnaphthalene	0.71
Biphenyl	0.15
2,6-Dimethylnaphthalene	0.24
1,6-Dimethylnaphthalene	0.18
Biphenylene	0.31
Fluorene	0.11
2-Methyl-9H-fluorene	0.12
1-Ethylnaphthalene	0.32
Furans	**2.34**
Furfural	1.16
2-Furanmethanol	0.44
1-(2-Furanyl)Ethanone	0.17
2-Furanone	0.24
5-Methyl-2-furancarboxaldehyde	0.16
2-Methylbenzofuran	0.17
Cyclopentanones	**2.51**
2-Cyclopenten-1-one	0.81
2-Methyl-2-cyclopenten-1-one	0.13
1,2-Cyclopentanedione	0.3
3-Methyl-2-cyclopenten-1-one	0.36
2,3-Dimethyl-2-cyclopenten-1-one	0.4
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.28
3-Ethyl-2-cyclopenten-1-one	0.1
3-Ethyl-2-hydroxy-2-cyclopenten-1-one	0.13
Others	**0.12**
1-Ethyl-4-methoxybenzene	0.12
Total	**26.97**

Table S16. Yield of various compounds present in bio-oil obtained from experiment E14 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**12.24**
2-Methoxyphenol	2.21
4-Methyl-2-methoxyphenol	1.89
3-Methoxy-1,2-benzenediol	0.12
4-Ethyl-2-methoxyphenol	1.06
2-Methoxy-4-vinylphenol	1.44
Eugenol	1.2
2-Methoxy-4-propylphenol	0.15
Vanillin	0.33
4-Hydroxy-3-methoxybenzoic acid	0.7
2-Methoxy-4-(1-Propenyl)phenol	1.94
Apocynin	0.39
Homovanillyl alcohol	0.46
4-Hydroxy-3-methoxycinnamaldehyde	0.35
Syringols	**3.16**
2,6-Dimethoxyphenol	0.44
2,6-Dimethoxy-4-(2-Propenyl)phenol	2.26
3,5-Dimethoxy-4-hydroxycinnamaldehyde	0.13
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.14
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.19
Simple phenols	**6.19**
Phenol	1.4
Cresols	2.11
2,3-Dimethylphenol	0.61
4-Ethylphenol	0.41
3,4-Dimethylphenol	0.12
Catechol	0.37
3-Methyl-1,2-benzenediol	0.2
4-Methyl-1,2-benzenediol	0.41
5-(T-Butyl)Pyrogallol	0.56
Linear ketones/acids/alcohols	**6.97**
Acetic acid	3.16
Propanoic acid	0.69
Propanones	1.51
Butanones	1.61
Aromatic hydrocarbons	**2.98**
Styrene	0.18
Indene	0.28
Naphthalene	0.38

1,3-Dimethyl-1H-indene	0.34
2-Methylnaphthalene	0.38
2,6-Dimethylnaphthalene	0.4
Biphenylene	0.33
Fluorene	0.37
2-Methyl-9H-fluorene	0.17
Anthracene	0.15
Furans	**3.83**
Furfural	1.73
2-Furanmethanol	0.55
1-(2-Furanyl)Ethanone	0.13
2-Furanone	0.18
5-Methyl-2-furancarboxaldehyde	0.47
2-Methylbenzofuran	0.26
2-Ethylbenzofuran	0.13
4-Methyldibenzofuran	0.25
Butyrolactone	0.13
Cyclopentanones	**2.71**
Cyclopentanone	0.21
2-Cyclopenten-1-one	0.27
2-Methyl-2-cyclopenten-1-one	0.34
1,2-Cyclopentanedione	0.23
3-Methyl-2-cyclopenten-1-one	0.73
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.36
2,3-Dimethyl-2-cyclopenten-1-one	0.18
3-Methyl-1,2-cyclopentanedione	0.39
Others	**0.42**
3,4-Dimethoxytoluene	0.27
1-Ethyl-4-methoxybenzene	0.15
Total	**38.5**

Table S17. Yield of various compounds present in bio-oil obtained from experiment E15 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**11.58**
2-Methoxyphenol	2.2
4-Methyl-2-methoxyphenol	1.94
4-Ethyl-2-methoxyphenol	1.41
2-Methoxy-4-vinylphenol	1.34
2-Methoxy-4-propylphenol	0.37
2-Methoxy-4-(1-Propenyl)phenol	2.81
Vanillin	0.21
4-Hydroxy-3-methoxybenzoic acid	0.17
Apocynin	0.35
Homovanillyl alcohol	0.52
4-Hydroxy-3-methoxycinnamaldehyde	0.26
Syringols	**5.25**
2,6-Dimethoxyphenol	2.28
2,6-Dimethoxy-4-(2-Propenyl)phenol	2.82
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.15
Simple phenols	**8.61**
Phenol	1.07
Cresols	2.1
2,5-Dimethylphenol	0.73
2,4-Dimethylphenol	0.26
4-Ethylphenol	0.45
4-Methoxy-3-methylphenol	0.32
3,4-Dimethylphenol	0.16
Catechol	0.84
3-Ethyl-5-methylphenol	0.17
4-Hydroxy-3-methylacetophenone	0.3
2,4,6-Trimethylphenol,	0.37
4-Methyl-1,2-benzenediol	0.85
5-(T-Butyl)Pyrogallol	0.99
Linear ketones/acids/alcohols	**3.96**
Acetic acid	2.1
Propanoic acid	0.57
Propanones	0.8
Butanones	0.49
Aromatic hydrocarbons	**3.08**
Benzene	0.23

Toluene	0.2
1-Methyl-1-indene	0.77
Naphthalene	0.51
1-Methylnaphthalene	0.28
2,6-Dimethylnaphthalene	0.55
2-Methyl-9H-fluorene	0.16
Anthracene	0.2
Phenanthrene	0.18
Furans	**3.87**
Furfural	1.81
2-Furanmethanol	0.47
1-(2-Furanyl)Ethanone	0.22
2-Furanone	0.34
Benzofuran	0.26
2-Methylbenzofuran	0.29
Dibenzofuran	0.27
4-Methyldibenzofuran	0.21
Cyclopentanones	**2.94**
Cyclopentanone	0.14
2-Cyclopenten-1-one	0.2
2-Methyl-2-cyclopenten-1-one	0.28
1,2-Cyclopentanedione	0.2
3-Methyl-2-cyclopenten-1-one	0.96
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.46
2,3-Dimethyl-2-cyclopenten-1-one	0.16
3-Methyl-1,2-cyclopentanedione	0.39
3-Ethyl-2-hydroxy-2-cyclopenten-1-one	0.15
Others	**0.58**
1-Ethyl-4-methoxybenzene	0.58
Total	**39.87**

Table S18. Yield of various compounds present in bio-oil obtained from experiment E16 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**4.1**
4-Methyl-2-methoxyphenol	0.49
4-Ethyl-2-methoxyphenol	0.86
2-Methoxyphenol	0.92
2-Methoxy-4-vinylphenol	0.7
4-Hydroxy-3-methoxybenzoic acid	0.13
2-Methoxy-4-(1-Propenyl)phenol	0.65
Apocynin	0.18
Homovanillyl alcohol	0.17
Syringols	**1.47**
2,6-Dimethoxyphenol	0.63
2,6-Dimethoxy-4-(2-Propenyl)phenol	0.84
Simple phenols	**6.51**
Phenol	1.49
Cresols	2.25
2,3-Dimethylphenol	0.57
4-Ethylphenol	0.41
3,5-Dimethylphenol	0.2
Catechol	0.23
2-Ethyl-5-methylphenol	0.12
3-Methyl-1,2-benzenediol	0.08
3,4-Dimethoxyphenol	0.18
5-(T-Butyl)Pyrogallol	0.23
3-Phenoxyphenol	0.38
Desaspidinol	0.14
4-(2-Phenylethenyl)Phenol	0.23
Linear ketones/acids/alcohols	**1.99**
Acetic acid	0.86
Propanoic acid	0.11
Propanones	0.54
Butanones	0.29
Pentanones	0.19
Aromatic hydrocarbons	**7.52**
Benzene	0.1
Toluene	0.17
M-Xylene	0.31

Styrene	0.28
1,2,3-Trimethylbenzene	0.39
Indene	0.52
(2-Methyl-1-propenyl)Benzene	0.29
1-Methyl-1-indene	0.75
Naphthalene	0.53
1,3-Dimethyl-1H-indene	0.41
2-Methylnaphthalene	0.3
2-Ethylnaphthalene	0.33
2,6-Dimethylnaphthalene	0.48
Biphenylene	0.3
4-Methyl-1,1'-biphenyl	0.25
1,4,6-Trimethylnaphthalene	0.37
1,6,7-Trimethylnaphthalene	0.17
Fluorene	0.44
1-Methyl-9-fluorene	0.2
2-Methyl-9-fluorene	0.25
Anthracene	0.46
1-Methylphenanthrene	0.22
Furan derivatives	**2.03**
Furfural	0.6
2-Furanmethanol	0.23
2-Methylbenzofuran	0.39
5-Hydroxymethylfurfural	0.15
2-Methyl-3-(2-ethyl-1,3,3-trimethylcyclohexyl)tetrahydrofuran	0.34
4-Methyldibenzofuran	0.32
Cyclopentanones	**1.52**
2-Cyclopenten-1-one	0.3
2-Methyl-2-cyclopenten-1-one	0.27
3-Methyl-2-cyclopenten-1-one	0.55
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.24
2,3-Dimethyl-2-cyclopenten-1-one	0.16
Others	**2.41**
Pyridine	0.28
Fampridine	0.18
4-Methylpyridine	0.19
Trans-2-Methyl-4-hexen-3-ol	0.15
1-Methoxy-4-methylbenzene	0.2
1-(2-Pyridinyl)Ethanone	0.14

3,4-Dimethoxytoluene	0.19
Nonadecane	0.17
3',5'-Dimethoxyacetophenone	0.2
Carbazole	0.19
3-Ethylcarbazole	0.26
Hexadecane	0.12
Oxalic acid isobutyl tetradecyl ester	0.14
Total	**27.55**

Table S19. Yield of various compounds present in bio-oil obtained from experiment E17 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**7.03**
2-Methoxyphenol	1.57
4-Methyl-2-methoxyphenol	1.12
3-Methoxy-1,2-benzenediol	0.14
4-Ethyl-2-methoxyphenol	0.49
2-Methoxy-4-vinylphenol	0.99
Eugenol	0.79
4-Hydroxy-3-methoxybenzoic acid	0.47
2-Methoxy-4-(1-Propenyl)phenol	0.97
Apocynin	0.25
Homovanillyl alcohol	0.24
Syringols	**1.2**
2,6-Dimethoxyphenol	0.37
2,6-Dimethoxy-4-(2-Propenyl)phenol	0.83
Simple phenols	**3.97**
Phenol	0.62
Cresols	2.09
2,3-Dimethylphenol	0.47
4-Ethylphenol	0.47
5-(T-Butyl)Pyrogallol	0.32
Linear ketones/acids/alcohols	**3.4**
Acetic acid	1.58
Propanoic acid	0.34
Propanones	0.95
Butanones	0.37
Pentanones	0.16

Aromatic hydrocarbons	**5.59**
Benzene	0.16
M-Xylene	0.2
Styrene	0.28
1,2,3-Trimethylbenzene	0.32
Indene	0.46
1-Methyl-1-indene	0.54
Naphthalene	0.58
2,7-Bis(1,1-Dimethylethyl)naphthalene	0.22
1,3-Dimethyl-1H-indene	0.36
2-Methylnaphthalene	0.38
2-Ethylnaphthalene	0.28
2,6-Dimethylnaphthalene	0.27
Biphenylene	0.32
1,4,6-Trimethylnaphthalene	0.21
3-(2-Methylpropenyl)-1H-indene	0.15
1-Methyl-9-fluorene	0.13
2-Methyl-9-fluorene	0.24
Phenanthrene	0.49
Furan derivatives	**1.78**
Furfural	0.92
2-Furanmethanol	0.36
2-Methylbenzofuran	0.29
4-Methyldibenzofuran	0.21
Cyclopentanones	**1.31**
2-Cyclopenten-1-one	0.49
2-Methyl-2-cyclopenten-1-one	0.32
3-Methyl-2-cyclopenten-1-one	0.2
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.3
Others	**1.19**
Pyridine	0.19
Fampridine	0.22
1-Methoxy-4-methylbenzene	0.15
3,4-Dimethoxytoluene	0.14
N-(4-Methoxyphenyl)-2-hydroxyimino-acetamide	0.16
3',5'-Dimethoxyacetophenone	0.33
Total	**25.47**

Table S20. Yield of various compounds present in bio-oil obtained from experiment E18 on moisture free basis.

Compound	Yield (wt.%)
Guaiacols	**6.7**
2-Methoxyphenol	1.01
4-Methyl-2-methoxyphenol	1.05
4-Ethyl-2-methoxyphenol	0.3
2-Methoxy-4-vinylphenol	1.09
Eugenol	0.82
2-Methoxy-4-propylphenol	0.08
Vanillin	0.1
4-Hydroxy-3-methoxybenzoic acid	0.44
2-Methoxy-4-(1-Propenyl)phenol	0.89
3-Methoxy-1,2-benzenediol	0.14
Apocynin	0.28
Methyleugenol	0.1
Homovanillyl alcohol	0.27
4-Hydroxy-3-methoxycinnamaldehyde	0.13
Syringols	**2.07**
2,6-Dimethoxyphenol	0.36
2,6-Dimethoxy-4-(2-Propenyl)phenol	1.49
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.09
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.13
Simple phenols	**3.88**
Phenol	0.68
Resorcinol	0.14
Cresols	1.32
2,3-Dimethylphenol	0.38
4-Ethylphenol	0.26
3,4-Dimethylphenol	0.09
Catechol	0.06
2-Ethyl-5-methylphenol	0.07
3-Methyl-1,2-benzenediol	0.09
4-Methyl-1,2-benzenediol	0.19
3,4-Dimethoxyphenol	0.1
5-(T-Butyl)Pyrogallol	0.31
Desaspidinol	0.19
Linear ketones/acids/alcohols	**3.47**
Acetic acid	1.8

Propanoic acid	0.48
Propanones	0.66
Butanones	0.4
Pentanones	0.13
Aromatic hydrocarbons	**3.57**
Benzene	0.08
M-Xylene	0.12
Styrene	0.14
Indene	0.36
Naphthalene	0.41
1,3-Dimethyl-1H-indene	0.13
1-Methyl-1-indene	0.26
1,2-Dihydro-6-methylnaphthalene	0.1
2-Methylnaphthalene	0.11
1-Methylnaphthalene	0.28
2-Ethylnaphthalene	0.23
2,6-Dimethylnaphthalene	0.22
Biphenylene	0.23
2-Ethenylnaphthalene	0.11
Fluorene	0.25
1-Methyl-9-fluorene	0.06
2-Methyl-9-fluorene	0.14
Anthracene	0.34
Furan derivatives	**2.07**
Furfural	0.8
2-Furanmethanol	0.21
1-(2-Furanyl)Ethanone	0.09
2-Furanone	0.17
Butyrolactone	0.08
5-Methyl-2-furancarboxaldehyde	0.15
4-Methyl-5H-furan-2-one	0.06
2-Methybenzofuran	0.17
4,7-Dimethylbenzofuran	0.06
2,3-Dihydrobenzofuran	0.07
5-Hydroxymethylfurfural	0.06
4-Methyldibenzofuran	0.15
Cyclopentanones	**1.46**
2-Cyclopenten-1-one	0.38
2-Methyl-2-cyclopenten-1-one	0.23

1,2-Cyclopentanedione	0.07
3-Methyl-2-cyclopenten-1-one	0.27
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.35
2,3-Dimethyl-2-cyclopenten-1-one	0.16
Others	**1.48**
Pyridine	0.09
1-Methoxy-4-methylbenzene	0.06
4-Methylbenzaldehyde	0.05
N-methyl-1,3-propanediamine	0.07
3,4-Dimethoxytoluene	0.12
4-Ethyl-1,2-dimethoxybenzene	0.14
N-(4-Methoxyphenyl)-2-hydroxyimino-acetamide	0.1
1,2,3-Trimethoxy-5-methylbenzene	0.1
3',5'-Dimethoxyacetophenone	0.51
3,4-Dimethoxycinnamic acid	0.13
Carbazole	0.11
Total	**24.7**

Table S21. Yield of various compounds present in bio-oil obtained from experiment E19 on moisture free basis.

Product	Yield (wt.%)
Guaiacols	**8.55**
2-Methoxyphenol	1.73
4-Methyl-2-methoxyphenol	1.27
3-Methoxy-1,2-benzenediol	0.08
4-Ethyl-2-methoxyphenol	1.11
2-Methoxy-4-vinylphenol	1.03
2-Methoxy-4-propylphenol	0.15
Vanillin	0.19
4-Hydroxy-3-methoxybenzoic acid	0.62
2-Methoxy-4-(1-Propenyl)phenol	1.48
Apocynin	0.37
Homovanillyl alcohol	0.38
4-Hydroxy-3-methoxycinnamaldehyde	0.14
Syringols	**3.68**
2,6-Dimethoxyphenol	1.34

2,6-Dimethoxy-4-(2-Propenyl)phenol	2.08
4-Hydroxy-3,5-dimethoxybenzaldehyde	0.08
1-(4-Hydroxy-3,5-dimethoxyphenyl)Ethanone	0.18
Simple phenols	**4.6**
Phenol	0.71
Cresols	1.38
2,3-Dimethylphenol	0.34
4-Ethylphenol	0.3
Catechol	0.31
2-Ethyl-5-methylphenol	0.1
3-Methyl-1,2-benzenediol	0.14
4-Methyl-1,2-benzenediol	0.29
3,4-Dimethoxyphenol	0.18
1-(2,4,6-Trihydroxyphenyl)Ethanone	0.08
5-(T-Butyl)Pyrogallol	0.44
Desaspidinol	0.33
Linear ketones/acids/alcohols	**4.2**
Acetic acid	1.78
Propanoic acid	0.36
Propanones	0.73
Butanones	1.03
Pentanones	0.3
Aromatic hydrocarbons	**3.82**
Benzene	0.08
Toluene	0.15
M-Xylene	0.08
Styrene	0.12
1,2,3-Trimethylbenzene	0.21
Indene	0.21
1-Methyl-1-indene	0.36
Naphthalene	0.75
2,7-bis(1,1-dimethylethyl)naphthalene	0.12
1,3-Dimethyl-1-indene	0.16
1,2-Dihydro-6-methylnaphthalene	0.13
1,1-Diphenylethylene	0.12
1-Methylnaphthalene	0.12
2-Methylnaphthalene	0.31
2-Ethenylnaphthalene	0.31
Biphenylene	0.23

Fluorene	0.36
Furan derivatives	**3.28**
Furfural	1.64
2-Furanmethanol	0.31
1-(2-Furanyl)-Ethanone	0.09
2-Furanone	0.1
5-Methyl-2-furancarboxaldehyde	0.32
2-Methybenzofuran	0.31
Hexahydro-3-methylenebenzofuranone	0.08
2-Ethybenzofuran	0.1
4,7-Dimethylbenzofuran	0.08
5-Hydroxymethylfurfural	0.08
4-Methyldibenzofuran	0.17
Cyclopentanones	**2.48**
Cyclopentanone	0.16
2-Cyclopenten-1-one	0.28
2-Methyl-2-cyclopenten-1-one	0.36
2-Hydroxy-2-cyclopenten-1-one	0.11
3,4-Dimethyl-2-cyclopenten-1-one	0.16
3-Methyl-2-cyclopenten-1-one	0.59
2-Hydroxy-3-methyl-2-cyclopenten-1-one	0.47
2,3-Dimethyl-2-cyclopenten-1-one	0.35
Others	**2.22**
Pyridine	0.16
Trans-2-methyl-4-hexen-3-ol	0.11
4-Methylbenzaldehyde	0.4
N-methyl-1,3-propanediamine	0.08
Maltol	0.19
3,4-Dimethoxytoluene	0.18
4-Ethyl-1,2-dimethoxybenzene	0.15
1,2,3-Trimethoxy-5-methylbenzene	0.13
3',5'-Dimethoxyacetophenone	0.43
3,4-Dimethoxycinnamic acid	0.2
Carbazole	0.19
Total	**32.83**

Table S22. Estimated elemental composition of bio-oil calculated from data presented in Tables S3-S21.

Expt. Code	Elemental Composition (wt.%)			Atomic O/C ratio	Atomic H/C ratio
	C	H	O		
E1	64.40	6.93	28.67	0.33	1.29
E2	65.14	6.92	27.93	0.32	1.28
E3	67.43	6.98	25.60	0.28	1.24
E4	69.42	7.08	23.50	0.25	1.22
E5	70.92	7.13	21.95	0.23	1.21
E6	69.49	7.12	23.39	0.25	1.23
E7	69.58	7.09	23.33	0.25	1.22
E8	70.68	7.15	22.17	0.24	1.21
E9	70.12	7.10	22.77	0.24	1.22
E10	69.83	7.05	23.11	0.25	1.21
E11	71.61	7.16	21.23	0.22	1.20
E12	70.19	7.12	22.69	0.24	1.22
E13	69.65	7.12	23.23	0.25	1.23
E14	69.27	7.04	23.70	0.26	1.22
E15	70.29	7.05	22.66	0.24	1.20
E16	75.72	7.43	16.85	0.17	1.18
E17	73.38	7.27	19.35	0.20	1.19
E18	71.36	7.19	21.45	0.23	1.21
E19	70.63	7.14	22.24	0.24	1.21