Supporting information

Characterization of pseudo-lignin from steam exploded birch

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It includes 12 pages with 5 figures and 1 table.
Figure S1. HSQC of SE-treated biomass of severity factor of 3.1 (170 °C – 10 min) in acetic acid-d$_4$. The shift values are slightly more upshift than with DMSO-d$_6$. The spectra are focused on aromatic region (above) and aliphatic region (below).
**Figure S2.** Topographic visualization of lignocellulosic biomass at untreated (above) and severity 4.7 (220 °C – 15 min) (below), focused on aromatic region.
Figure S3. FTIR of milledwood lignin (red), cellulose (blue), hemicellulose (xylan, green) and se-treated biomass (220 °C, 15 min, purple)
**Figure S4.** FT-IR of untreated biomass (above) and SE –treated with log $R_0$ 4.7 (below), focused in on 700 cm$^{-1}$ to 2000 cm$^{-1}$.
Figure S5. HSQC of 5-HMF standard in DMSO-d$_6$. 
### Table S1. Detected components from py-GC-MS at 350 and 600 °C.

| ID | Name               | M⁺ | Retention time (min) | Structure |
|----|--------------------|----|----------------------|-----------|
| 1  | Acetic acid        | 60 | 7.99                 | ![Acetic acid structure](image) |
| 2  | Furfural           | 96 | 19.58                | ![Furfural structure](image) |
| 3  | 2-Furanmethanol    | 98 | 21.22                | ![2-Furanmethanol structure](image) |
| 4  | Not identified     | 114| 23.98                | ![Not identified structure](image) |
| 5  | Not identified     | 114| 25.21                | ![Not identified structure](image) |
| 6  | Not identified     | 128| 27.35                | ![Not identified structure](image) |
| 7  | 2,5-Furandicarboxaldehyde | 124 | 28.35                | ![2,5-Furandicarboxaldehyde structure](image) |
| 8  | Not identified     | -  | 29.68                | ![Not identified structure](image) |
| 9  | Furan              | 68 | 30.93                | ![Furan structure](image) |
| 10 | Not identified     | 152| 33.87                | ![Not identified structure](image) |
| 11 | 2-Methoxy-4-vinylphenol | 150 | 35.05                | ![2-Methoxy-4-vinylphenol structure](image) |
| No. | Compound                              | MW  | Retention Time |
|-----|---------------------------------------|------|----------------|
| 12  | 5-Hydroxymethyl furfural              | 126  | 35.94          |
| 13  | 2,6-Dimethoxyphenol                   | 154  | 37.14          |
| 14  | Carbohydrate                          | 180  | 39.72          |
| 15  | 4-Hydroxy-3-methoxybenzaldehyde       | 152  | 41.27          |
| 16  | Not identified                        | --   | 43.4           |
| 17  | 1-(3,4-dimethoxyphenyl)ethanone       | 180  | 47.35          |
| 18  | Carbohydrate                          | 180  | 51.48          |
| 19  | Not identified                        | 166  | 51.79          |
| 20  | 4-Allyl-2,6-dimethoxyphenol           | 194  | 53.75          |
| 21  | 4-Hydroxy-3,5-dimethoxybenzaldehyde  | 182  | 54.79          |
| 22  | Not identified                        | 196  | 56.9           |
23 4-[(E)-3-hydroxyprop-1-enyl]-2,6-dimethoxyphenol 210 60.07

24 3-(4-hydroxy-3,5-dimethoxyphenyl)butan-2-one 224 62.02

25 3,5-Dimethoxy-4-hydroxycinnamaldehyde 208 70

26 1-hydroxy-2-propanone 74 9.31

27 1,2-Ethanediol, monoacetate 104 16.53

28 Pentanal, 2,4-dimethyl- 114 18.48

29 Propanoic acid, 2-oxo-, methyl ester 102 18.74
|   | Compound                                      | Retention Time | 0.6 h | 0.8 h |
|---|----------------------------------------------|----------------|------|------|
| 30| 2-Hydroxy-2-cyclopenten-1-one                |                | 98   | 23.24|
| 31| 2-Methylene cyclopentanol                    |                | 98   | 23.66|
| 32| 2-Furanone                                   |                | 84   | 24.48|
| 33| Not identified                               |                | 112  | 25.77|
| 34| 2-Hydroxy-3-methyl-2-cyclopenten-1-one       |                | 112  | 25.89|
| 35| Phenol                                      |                | 94   | 26.31|
| 36| Phenol-2-methoxy-                            |                | 124  | 27.14|
| 37| Phenol-2-methyl-                             |                | 108  | 27.66|
| 38| 5-Hydroxymethyldihydrofuran-2-one            |                | 116  | 28.9 |
| 39| Not identified                               |                | --   | 29.95|
| 40| 2-Methoxy-4-methylphenol                     |                | 138  | 30.14|
| No. | Compound                                | RRT | Retention Time |
|-----|----------------------------------------|-----|----------------|
| 41  | Coeluting                              | 114/152 | 32.38          |
| 42  | Not identified                         | --  | 32.64          |
| 43  | 4-Ethyl-2-methoxyphenol               | 152 | 32.95          |
| 44  | Not identified                         | 164 | 36.06          |
| 45  | Coeluting                              | 164/180 | 38.39          |
| 46  | Not identified                         | 144 | 38.95          |
| 47  | Carbohydrate                           | 244 | 39.71          |
| 48  | 2-methoxy-4-(1-propenyl)phenol        | 164 | 40.66          |
| 49  | 2,6-Dimethoxy-4-methylphenol          | 168 | 41.18          |
| 50  | 2-Methoxy-4-propylphenol              | 166 | 43.97          |
| 51  | 5-tert-butylbenzene-1,2,3-triol       | 182 | 44.69          |
| 52  | 1-(4-Hydroxy-3-methoxyphenyl)ethanone | 166 | 45.13          |
| 53  | Not identified                         | 194 | 48.33          |
|   | Description                                       | Retention Time | MW  |
|---|--------------------------------------------------|----------------|-----|
| 54| Not identified                                   | 194            | 50.87 |
| 55| Carbohydrate                                     | 180            | 51.55 |
| 56| 1-(4-Hydroxy-3,5-dimethoxyphenyl)ethanone        | 196            | 58.12 |
| 57| 1-(4-Hydroxy-3,5-dimethoxyphenyl)propan-1-one    | 210            | 61.77 |