

Supporting Information for

From Compost to Colloids – Valorization of Spent
Mushroom Substrate

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List of tables

Table S1. Compositional analysis of carbohydrate-enriched extracts obtained after thermochemical pretreatments of SMS/WS mixtures. 4

Table S2. Compositional analysis of filter cake obtained after thermochemical pretreatments of SMS/WS mixtures. 4

Table S3. Compositional analysis of lignin enriched extracts obtained after organosolv treatments of SMS alone or of a pretreated SMS-WS mixture. 5

Table S4. Interfacial tension measured by spinning drop tensiometry between CHCl_3 and water at a concentration of 10.0 mg mL^{-1} . 5

Table S5. Distribution coefficient between milliQ water (pH7) and octanol at a concentration of 2.5 mg mL^{-1} . 5

List of figures

Figure S1. ^1H NMR spectra (DMSO- d_6 , 25°C , 300 MHz) of SMS extracts, obtained either after thermochemical treatments (top) or after Organosolv extraction (bottom). 6

Figure S2. Overlay of FT-IR (KBr) spectra of lignin enriched SMS extracts obtained after Organosolv treatment (red) compared to a commercial lignin (black). 7

Figure S3. SEM images of polystyrene nanoparticles prepared by free-radical 7
miniemulsion polymerization of styrene, stabilized with the SMS-derived biobased
surfactant.

Figure S4. TEM image of nanocarriers obtained from SMS-derived lignin (from 8
Organosolv process).

Figure S5. SEC elugrams using UV-detection (270 nm, left) or RI-detection (right) from 8
extracts obtained from thermochemical pretreatments under 160°C, 175°C or 190°C
without catalyst.

Figure S6. SEC elugrams using UV-detection (270 nm, left) or RI-detection (right) from 9
extracts obtained from thermochemical pretreatments under 190°C using different
catalysts.

Figure S7. Composition of pristine SMS and a SMS-wheat straw mixture (ratio 4:6). All 9
fractions are given in weight % of dry mass. The carbohydrates include glucan, xylan,
arabinan, glucose, xylose and arabinose. Exemplarily, a) the amount of lignin isolated
using Organosolv extraction (EtOH-Water 50:50) or b) the amount of isolated
carbohydrates applying a thermochemical pretreatment (190°C, catalyst: H₂SO₄) is
shown.

Figure S8. SEC elugrams of “organosolv extract” obtained after extraction with an 10
EtOH-water mixture (50:50). (M = Monomer; D = Dimer; T = Trimer)

Table S1. Compositional analysis of carbohydrate-enriched extracts obtained after thermochemical pretreatments of SMS/WS mixtures.

| Temperature °C | 160 | | 175 | | 190 | | 190 | | 190 | | 192 | |
|--|---------------|-----|---------------|-----|---------------|-----|---------------|-----|---------------|-----|---------------|------|
| Residence time (min) | 10 | | 10 | | 10 | | 10 | | 10 | | 10 | |
| Catalyst | - | | - | | - | | NaOH 4% | | Na2CO3 4% | | H2SO4 4% | |
| Feedstock code | 030/17-031/17 | | 030/17-031/17 | | 030/17-031/17 | | 030/17-031/17 | | 030/17-031/17 | | 062/13+005/17 | |
| Sample code | EXP2_LF | | EXP3_LF | | EXP4_LF | | EXP8-LF | | EXP12_LF | | EXP5_LF | |
| g/L | Avg. | SD |
| Monomeric and oligomeric sugars | | | | | | | | | | | | |
| Glucose | 7,2 | 0,2 | 8,1 | 0,5 | 6,2 | 0,0 | 7,2 | 0,3 | 5,0 | 0,2 | 3,5 | 0,0 |
| Xylose | 16,4 | 0,3 | 29,9 | 1,5 | 33,8 | 0,1 | 29,3 | 1,6 | 23,5 | 1,1 | 13,9 | 0,1 |
| Arabinose | 3,3 | 0,0 | 4,3 | 0,2 | 1,6 | 0,0 | 2,8 | 0,1 | 3,4 | 0,2 | 0,5 | 0,0 |
| Organic acids | | | | | | | | | | | | |
| Succinic Acid | 0,1 | 0,0 | 0,1 | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,1 | 0,0 | 0,0 | 0,0 |
| Lactic acid | 0,2 | 0,0 | 0,5 | 0,0 | 0,8 | 0,0 | 1,2 | 0,0 | 0,4 | 0,0 | 0,1 | 0,0 |
| Acetic acid | 1,5 | 0,0 | 3,1 | 0,0 | 4,8 | 0,0 | 9,6 | 0,0 | 8,3 | 0,0 | 3,4 | 0,1 |
| Levulinic acid | 0,3 | 0,0 | 0,2 | 0,0 | 0,0 | 0,0 | 0,2 | 0,0 | 0,1 | 0,0 | 0,1 | 0,0 |
| mg/L | Avg. | SD |
| SHMF | 488,7 | 0,0 | 258,3 | 0,0 | 294,9 | 0,0 | 38,7 | 0,0 | 53,9 | 0,0 | 744,5 | 25,4 |
| 4-hydroxybenzoic | 17,1 | 0,0 | 13,9 | 0,0 | 11,1 | 0,0 | 1,7 | 0,0 | 6,6 | 0,0 | 17,5 | 20,9 |
| Vanillic/syringic | 71,1 | 0,0 | 83,3 | 0,0 | 63,7 | 0,0 | 54,2 | 0,0 | 69,9 | 0,0 | 99,7 | 4,4 |
| p-Coumaric | 24,5 | 0,0 | 14,8 | 0,0 | 6,0 | 0,0 | 12,9 | 0,0 | 7,7 | 0,0 | 7,9 | 0,7 |
| Furfural | 43,0 | 0,0 | 70,6 | 0,0 | 342,4 | 0,0 | 100,7 | 0,0 | 39,5 | 0,0 | 1411,7 | 15,0 |
| Ferulic acid | 6,5 | 0,0 | 10,7 | 0,0 | 16,4 | 0,0 | 4,4 | 0,0 | 12,5 | 0,0 | 11,7 | 1,2 |
| Vainillin/syringaldehyde | 40,1 | 0,0 | 42,9 | 0,0 | 56,0 | 0,0 | 20,2 | 0,0 | 24,4 | 0,0 | 90,1 | 3,8 |
| 5MethylFurfural | 2,5 | 0,0 | 4,9 | 0,0 | 14,1 | 0,0 | 8,7 | 0,0 | 6,8 | 0,0 | 39,6 | 0,7 |
| Phenol | 0,0 | 0,0 | 0,0 | 0,0 | 12,2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| Benzoic | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 29,9 | 0,0 | 51,8 | 0,0 | 0,0 | 0,0 |
| Syringol | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 23,3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| Guayacol | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 10,4 | 0,0 | 16,4 | 0,0 | 0,0 | 0,0 |
| Benzaldehyde | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |

Table S2. Compositional analysis of filter cake obtained after thermochemical pretreatments of SMS/WS mixtures.

| Temperature °C | 160 | | 175 | | 190 | | 190 | | 190 | | 192 | |
|----------------------|---------------|-----|---------------|-----|---------------|-----|----------------------|-----|---------------|-----|---------------|-----|
| Residence time (min) | 10 | | 10 | | 10 | | 10 | | 10 | | 10 | |
| Catalyst | - | | - | | - | | NaOH | | Na2CO3 | | H2SO4 4% | |
| Feedstock code | 030/17-031/17 | | 030/17-031/17 | | 030/17-031/17 | | 030/17-031/17 13/062 | | 030/17-031/17 | | 13/062+005/17 | |
| Sample code | EXP2_SF | | EXP3_SF | | EXP4_SF | | EXP8-SF | | EXP12_SF | | EXP5_SF | |
| %w/w | Avg. | SD | Avg. | SD | Avg. | SD | Avg. | SD | Avg. | SD | Avg. | SD |
| Moisture | 7,7 | 0,0 | 8,6 | 0,0 | 8,7 | 0,1 | 10,5 | 0,1 | 9,8 | 0,1 | 59,3 | 0,3 |
| Ashes | 67,7 | 0,4 | 62,9 | 1,2 | 65,7 | 0,3 | 63,1 | 0,3 | 60,6 | 0,8 | 12,3 | 0,5 |
| Insolubles | | | | | | | | | | | | |
| Glucan | 31,8 | 0,0 | 32,3 | 0,7 | 35,4 | 0,1 | 34,0 | 0,7 | 34,2 | 0,3 | 34,0 | 0,4 |
| Xylan | 18,7 | 0,0 | 14,8 | 0,1 | 6,2 | 0,0 | 8,8 | 0,0 | 13,3 | 0,0 | 2,8 | 0,1 |
| Arabinan | 1,3 | 0,0 | 0,7 | 0,0 | 0,2 | 0,0 | 0,3 | 0,0 | 0,6 | 0,0 | 0,0 | 0,0 |
| Al Lignin | 18,4 | 0,0 | 19,6 | 0,4 | 24,4 | 0,1 | 24,4 | 0,5 | 21,7 | 0,3 | 31,9 | 0,1 |
| AS Lignin | 0,8 | 0,0 | 0,7 | 0,0 | 0,9 | 0,0 | 1,2 | 0,0 | 0,8 | 0,0 | 1,2 | 0,0 |
| Al Ash | 1,8 | 0,0 | 2,0 | 0,1 | 2,4 | 0,0 | 2,6 | 0,0 | 2,1 | 0,1 | 3,0 | 0,1 |

Table S3. Compositional analysis of lignin enriched extracts obtained after organosolv treatments of SMS alone or of a pretreated SMS-WS mixture.

| Temperatura (°C) | SMS alone (before Organosolv) | | 250 | | 250 | | 250 | |
|------------------|-------------------------------|-----|------------------|-----|------------------|-----|------------------|-----|
| Etanol:H2O | | | 50:50 | | 60:40 | | 70:30 | |
| Tsolids (%w/w) | | | 10 | | 10 | | 10 | |
| Code | (015/18) SMS_EXT 28-SF | | SMS_Ext26_RAC-01 | | SMS_EXT28_RAC-02 | | SMS_EXT28_RAC-03 | |
| | Avg. | SD | Avg. | SD | Avg. | SD | Avg. | SD |
| Glucan | 8,2 | 0,8 | 5,3 | 0,2 | 4,4 | 0,1 | 5,6 | 0,5 |
| Xylose | 0,4 | 0,1 | 0,2 | 0,0 | 0,2 | 0,0 | 0,3 | 0,0 |
| Arabinan | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| Al Lignin | 27,0 | 0,0 | 17,1 | 0,5 | 18,3 | 0,2 | 18,3 | 0,0 |
| AS Lignin | 0,4 | 0,0 | 0,9 | 0,0 | 0,4 | 0,0 | 0,3 | 0,0 |
| Al Ash | 9,2 | 0,2 | 5,3 | 0,0 | 5,8 | 0,0 | 6,2 | 0,1 |

Table S4. Interfacial tension measured by spinning drop tensiometry between CHCl₃ and water at a concentration of 10.0 mg mL⁻¹.

| Sample code | Catalyst | Interfacial Tension / Nm m ⁻¹ |
|-------------------------|--------------------------------------|---|
| 030/17-031/17 Exp 4 LF | - | 7.3 ± 0.45 |
| 030/17-031/17 Exp 8 LF | NaOH (4%) | 10.00 ± 0.03 |
| 030/17-031/17 Exp 12 LF | Na ₂ CO ₃ (4%) | 11.11 ± 0.46 |
| 062/13-005/17 Exp 5 LF | H ₂ SO ₄ (4%) | 11.36 ± 0.01 |

Table S5. Distribution coefficient between milliQ water (pH7) and octanol at a concentration of 2.5 mg mL⁻¹.

| Sample code | Catalyst | LogD = log(c _{octanol})-log(c _{water}) |
|------------------------|-----------|--|
| 030/17-031/17 Exp 4 LF | - | -0.42 |
| 030/17-031/17 Exp 8 LF | NaOH (4%) | -0.92 |

030/17-031/17 Exp 12 LF

Na₂CO₃ (4%)

-0.98

062/13-005/17 Exp 5 LF

H₂SO₄ (4%)

-0.66

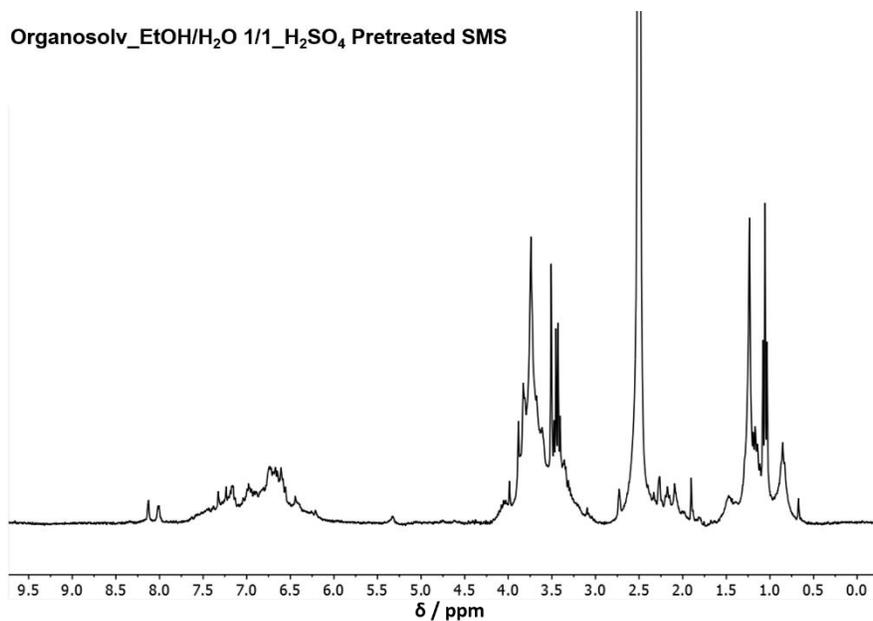
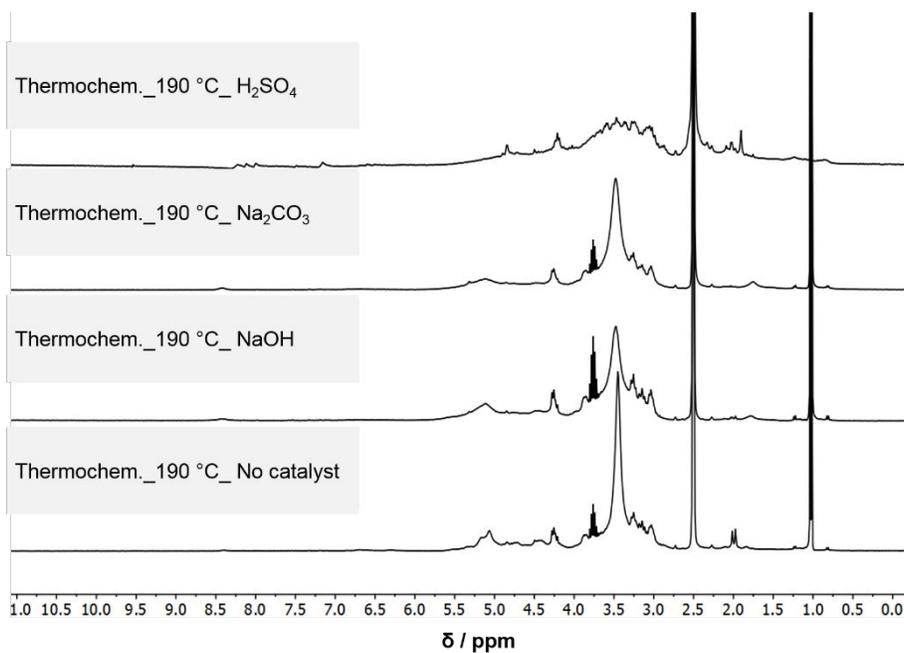


Figure S1. ^1H NMR spectra (DMSO- d_6 , 25°C, 300 MHz) of SMS extracts, obtained either after thermochemical treatments (top) or after Organosolv extraction (bottom).

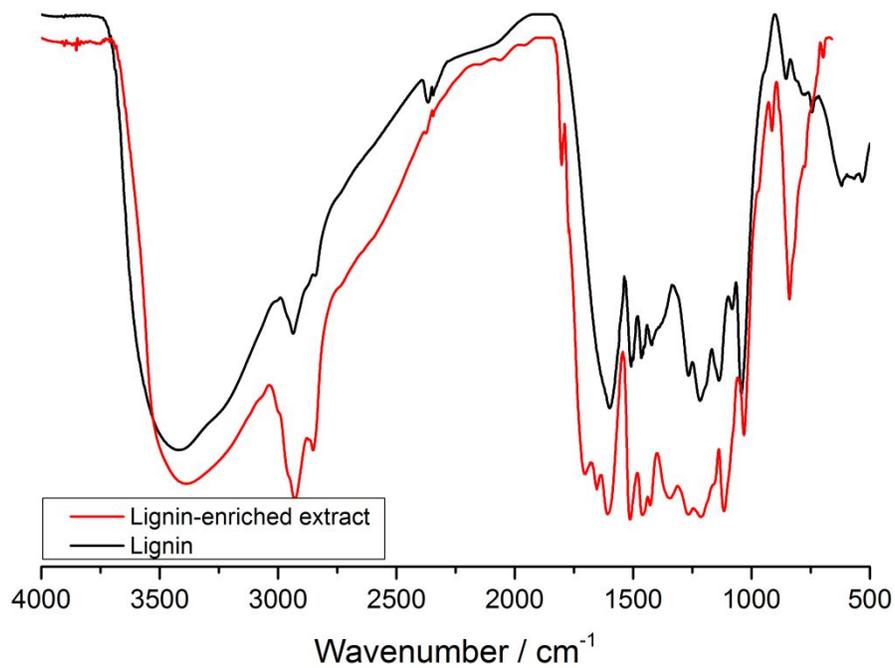


Figure S2. Overlay of FT-IR (KBr) spectra of lignin enriched SMS extracts obtained after Organosolv treatment (red) compared to a commercial lignin (black).

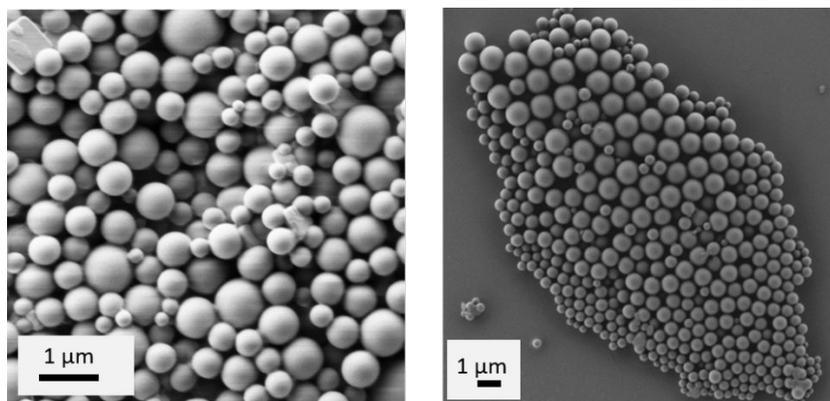


Figure S3. SEM images of polystyrene nanoparticles prepared by free-radical miniemulsion polymerization of styrene, stabilized with the SMS-derived biobased surfactant.

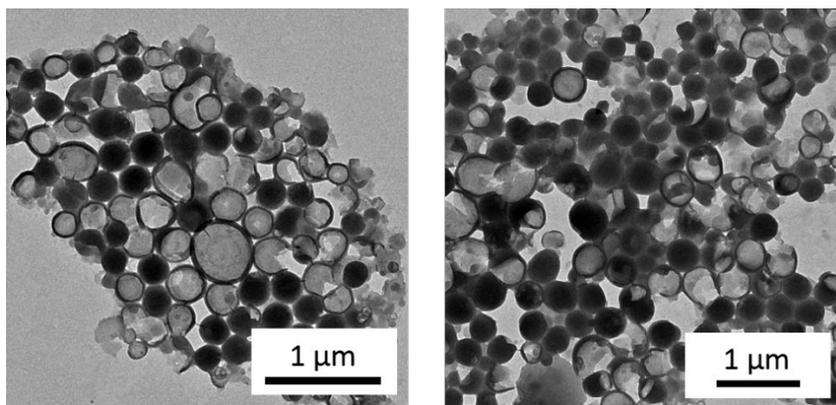


Figure S4. TEM image of nanocarriers obtained from SMS-derived lignin (from Organosolv process).

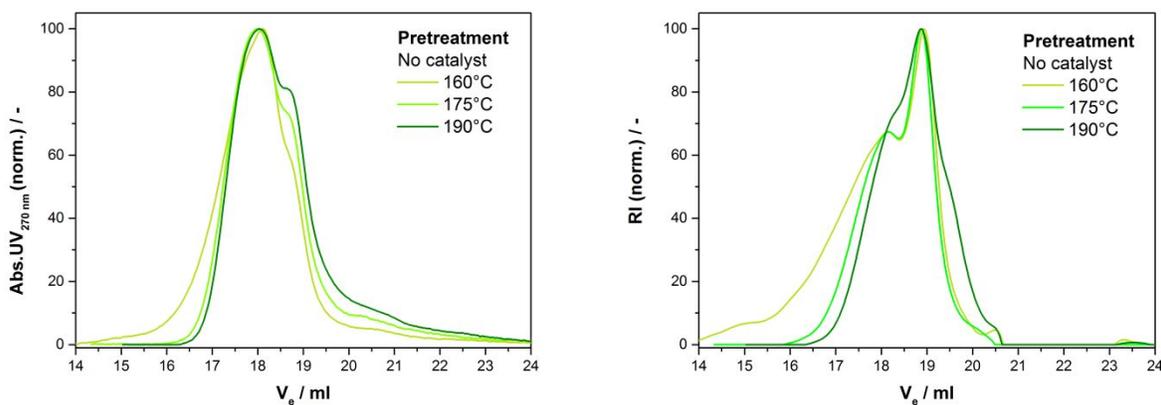


Figure S5. SEC elugrams using UV-detection (270 nm, left) or RI-detection (right) from extracts obtained from thermochemical pretreatments under 160°C, 175°C or 190°C without catalyst.

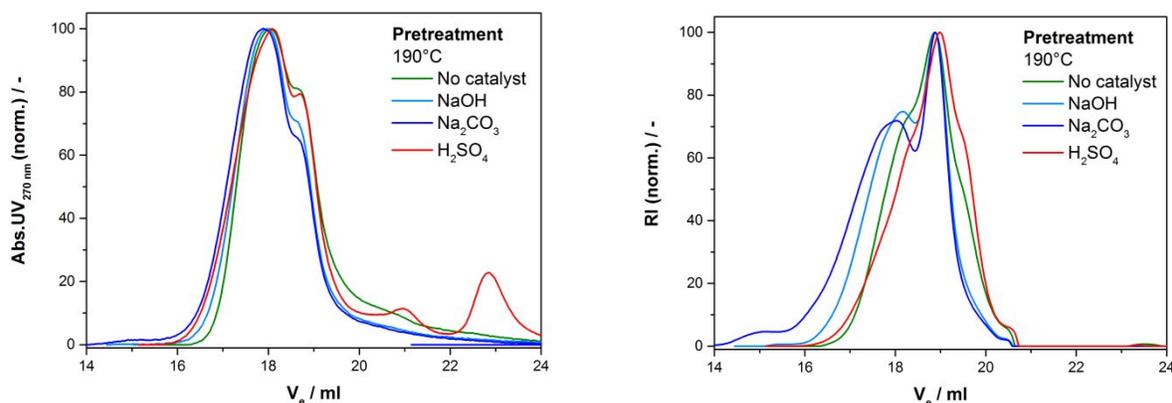
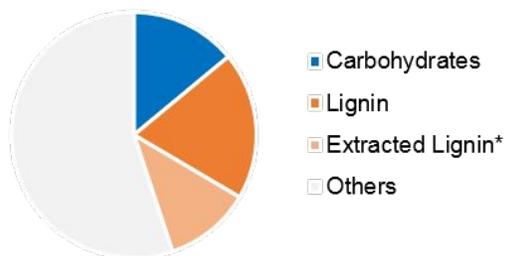


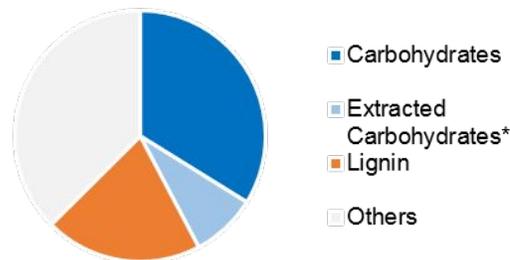
Figure S6. SEC elugrams using UV-detection (270 nm, left) or RI-detection (right) from extracts obtained from thermochemical pretreatments under 190°C using different catalysts.

a) Pristine SMS



*Organosolv extraction (Water-EtOH 50:50)

b) SMS - Wheat Straw (4/6)



* Thermochemical pretreatment (190°C, Catalyst: H₂SO₄)

Figure S7. Composition of pristine SMS and a SMS-wheat straw mixture (ratio 4:6). All fractions are given in weight % of dry mass. The carbohydrates include glucan, xylan, arabinan, glucose, xylose and arabinose. Exemplarily, a) the amount of lignin isolated using Organosolv extraction (EtOH-Water 50:50) or b) the amount of isolated carbohydrates applying a thermochemical pretreatment (190°C, catalyst: H₂SO₄) is shown.

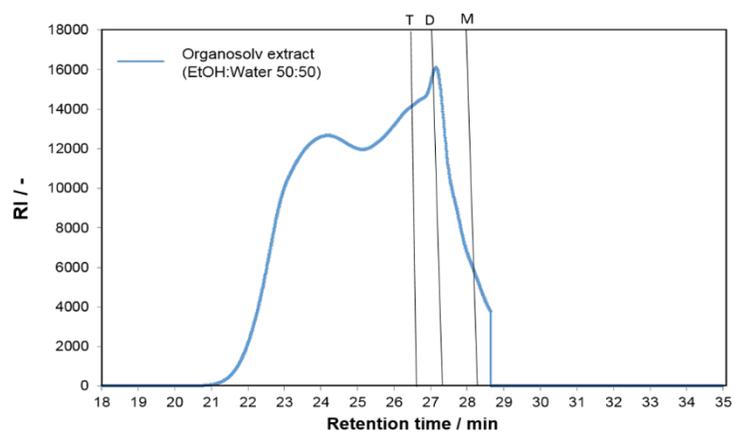


Figure S8. SEC elugram of “organosolv extract” obtained after extraction with an EtOH-water mixture (50:50). (M = Monomer; D = Dimer; T = Trimer)