

## Pretreatment of miscanthus using 1,3-dimethyl-imidazolium methyl phosphonate (DMIMMPh) ionic liquid for glucose recovery and ethanol production

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Figure S1. The solubility of miscanthus in ionic liquids

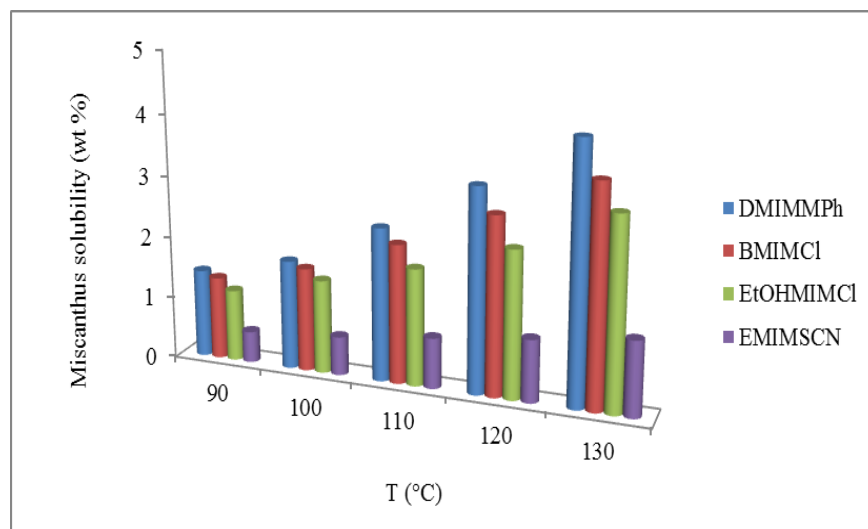


Figure S2. Microscopic images for raw miscanthus (0.2 mm size) in water (top), miscanthus dissolved in DMIMPh (middle), and for miscanthus dissolved in BMIMCl (bottom).

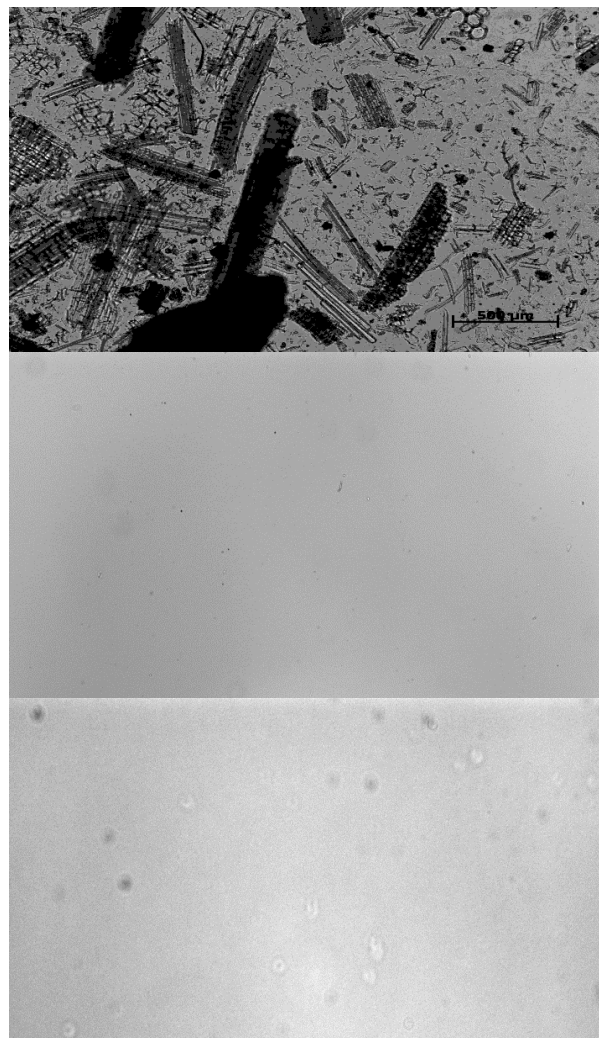
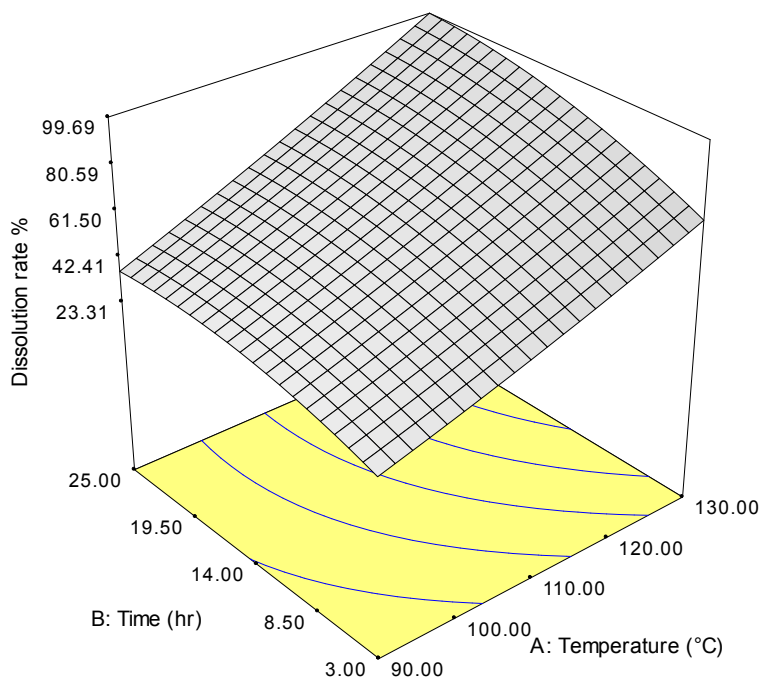
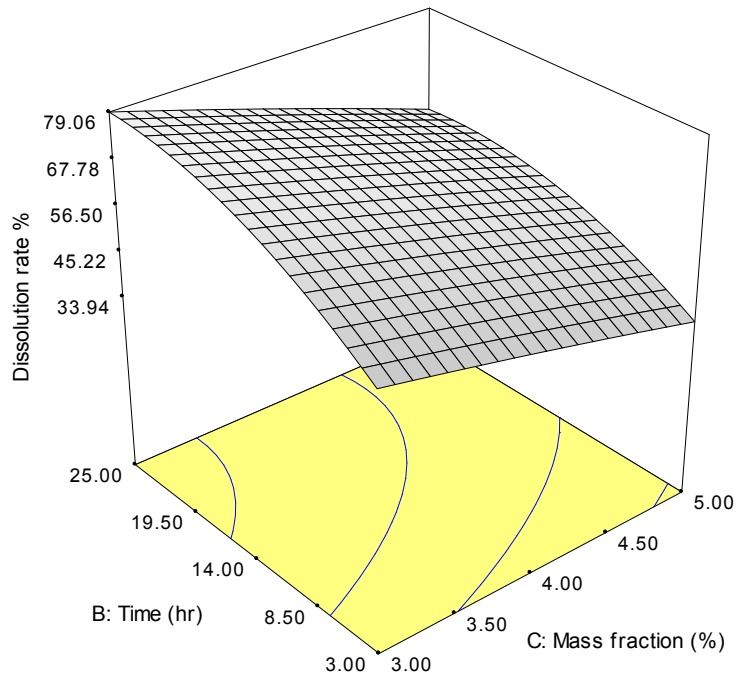


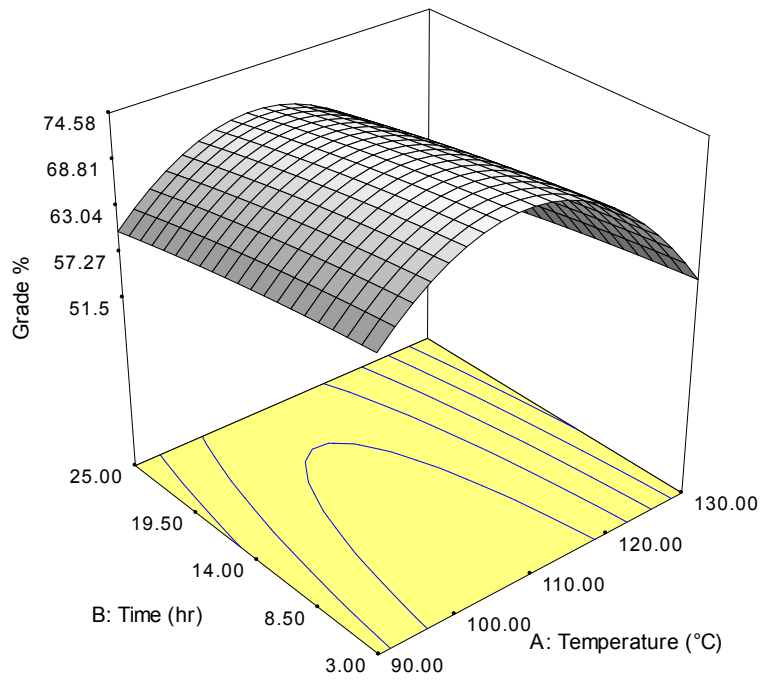
Figure S3. The response surface plots of the (a) miscanthus dissolution rate at mass fraction 4%, (b) miscanthus dissolution rate at temperature 110°C, (c) cellulose grade % at mass fraction 4%, and (d) cellulose grade % at time 14 hr resulting from the main effects of different variables, temperature, time and miscanthus mass fraction % for Miscanthus-DMIMPh mixture



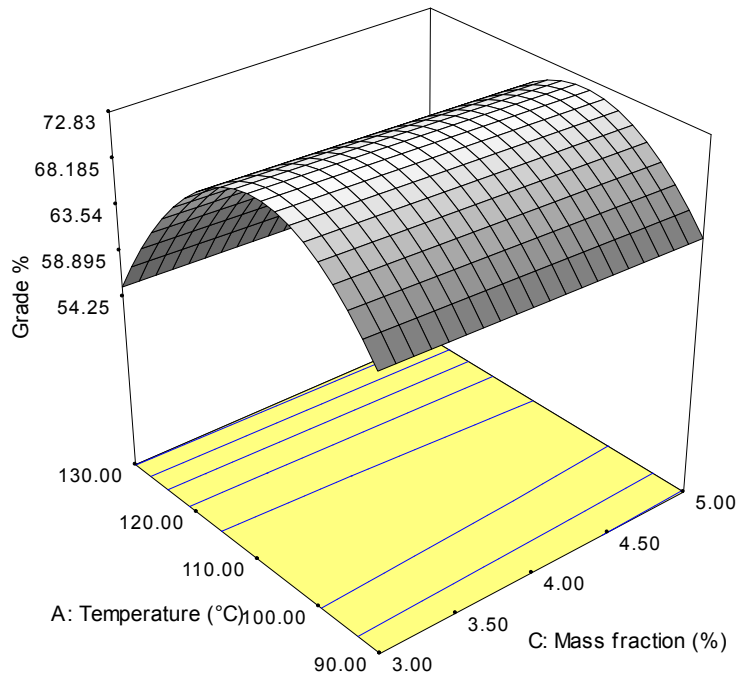
(a)



(b)



(c)



(d)

Figure S4.  $^1\text{H}$  NMR of (a) pure DMIMMPh, (b) DMIMMPh/DMSO (80:20) and (c) recycled DMIMMPh

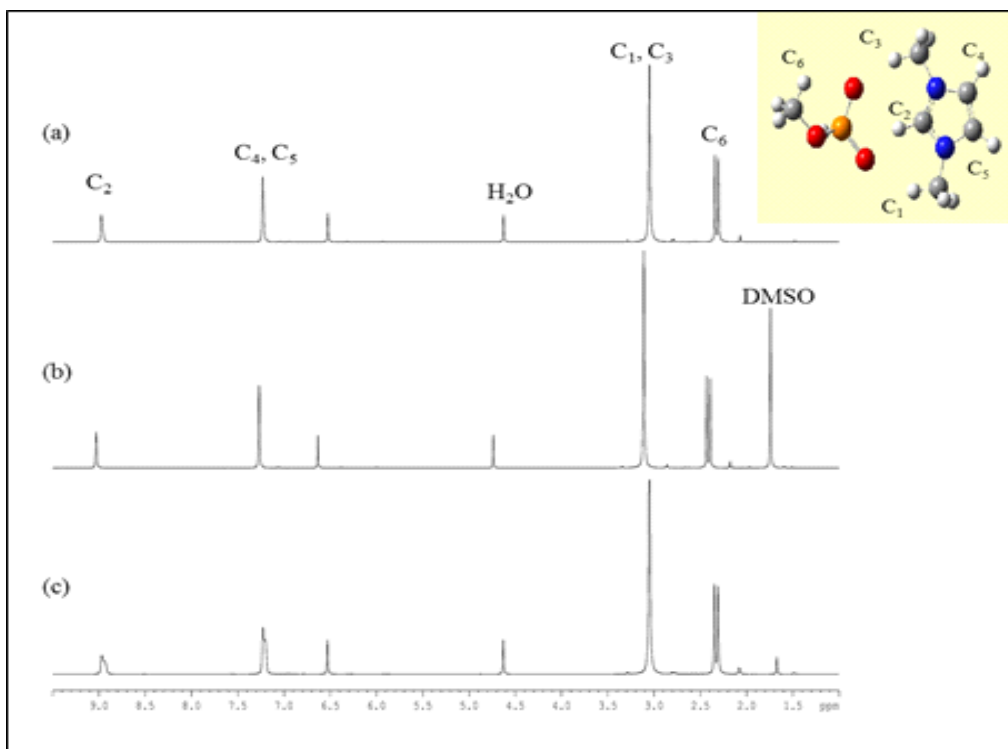


Figure S5. XRD of ■) miscanthus, ■) miscanthus residue and ■) cellulose-rich extract

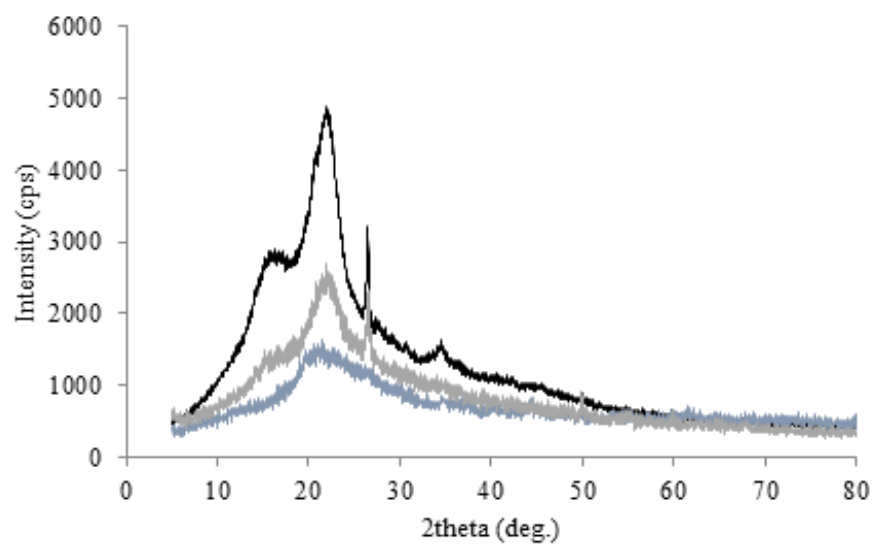


Figure S6. IR of ■) miscanthus, ■) miscanthus residue and ■) cellulose-rich extract

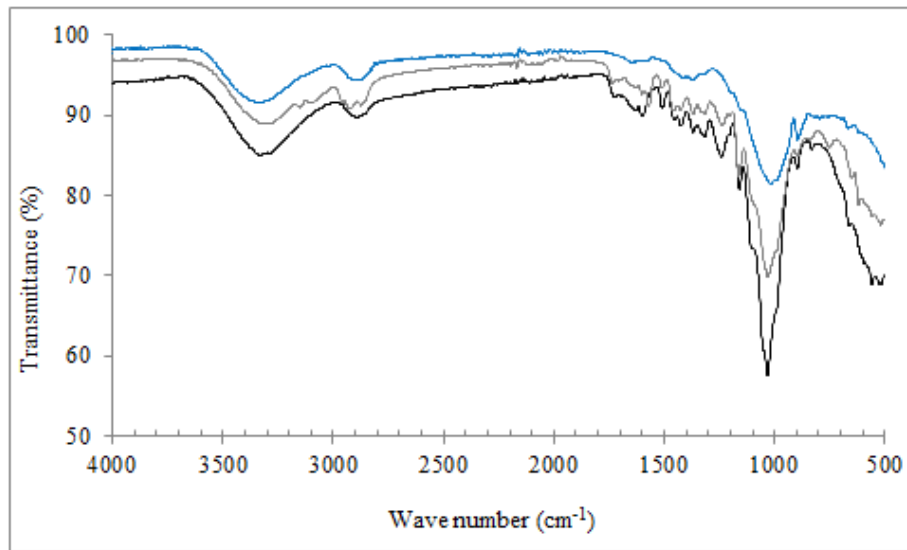




Figure S7. SEM images of (a) original miscanthus, (b) the cellulose-rich extract, and (c) miscanthus residue

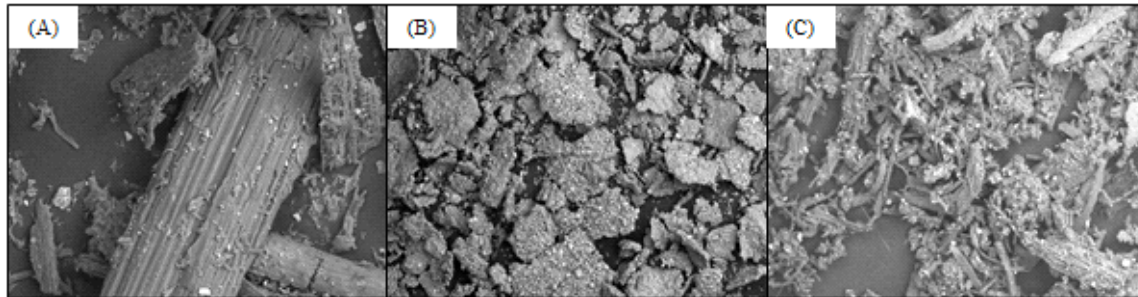


Figure S8. SEM images of A) microcrystalline cellulose and B) the cellulose-rich extract with DMIMMPH

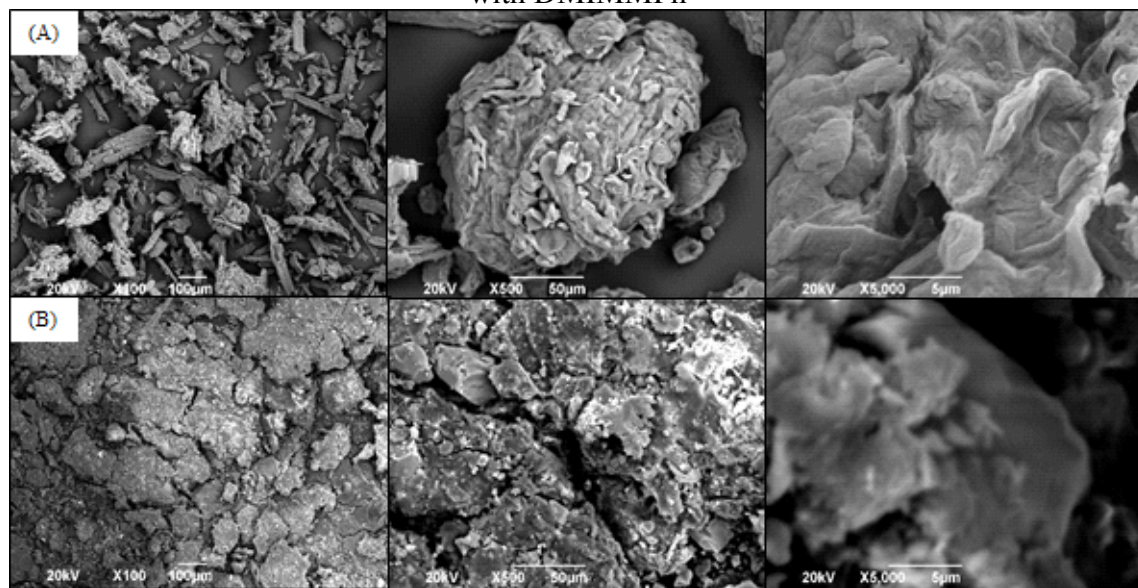


Table S1. GC operating conditions for composition analysis

Injector Temperature	250°C
Carrier Gas	Helium
Capillary column	WCOT Ulti-Metal coated with HT-SIMDIST-CB (10 m × 0.53 mm × 0.53 μm)
Flow rate	2 mL.min <sup>-1</sup>
Column Oven	100°C
Detector Type	FID
Detector Temperature	250°C

Table S2 Dissolution of different biomass species in imidazolium based ionic liquids, data from the literature

Biomass	Ionic Liquid	Solubility (wt%)	Time (hr)	Temperature (°C)	Reference
Miscanthus	EMIMOAC	5	6-8	120	22
	BMIMOAC	4	8-10	120	22
	BMIMCl	3	8	120	22
	EMIMCl	4	8	120	22
	DMIMDMP	4	10	120	22
	EMIMDMP	4	15	120	22
	EMIMHSO4	2	12-14	120	22
	BMIMSCN	<1	>24	130	22
Southern yellow pine	EMIMOAC	4.93	16	110	27
Southern yellow pine	BMIMCl	2.6	16	110	27
Wool keratin	BMIMCl	4	10	100	38
Pine	AMIMCl	1.3	24	100	39
Pine	AMIMCl	3.35	24	120	39
Poplar wood	EMIMOAC	5	12	110	40

Table S3. Factor levels of the studied variables for the miscanthus-DMIMMPH mixture

Symbol	Parameter	Unit	(-1)	(0)	(+1)
A	Temperature	(°C)	90.00	110.00	130.00
B	Time	(hr.)	3.00	14.00	25.00
C	Mass fraction	(%)	3.00	4.00	5.00

Table S4. Box-Behnken Design with different responses at different experimental combinations (Runs) for the miscanthus-DMIMMPH mixture

Exp. Run	Studied variables			Responses		
	Temperature (°C)	Time (hr.)	Mass fraction (%)	Dissolution rate %	Cellulose Grade %	Cellulose Recovery %
1	110.00	14.00	4.00	61.50	72	85.00
2	90.00	3.00	4.00	24.00	66	40.50
3	110.00	14.00	4.00	61.50	72	85.00
4	110.00	3.00	5.00	31.00	73	48.00
5	90.00	14.00	5.00	27.00	63	41.00
6	130.00	25.00	4.00	99.00	51	78.00
7	130.00	14.00	3.00	99.00	55	81.00
8	110.00	14.00	4.00	61.40	72	85.00
9	110.00	14.00	4.00	61.50	72	85.00
10	130.00	3.00	4.00	68.00	58	82.00
11	110.00	25.00	3.00	82.00	70	73.00
12	90.00	14.00	3.00	44.00	64	70.00
13	110.00	14.00	4.00	61.50	72	85.00
14	90.00	25.00	4.00	36.00	59	57.00
15	110.00	3.00	3.00	55.00	74	73.00
16	110.00	25.00	5.00	51.00	69	62.00
17	130.00	14.00	5.00	80.50	54	80.00

Table S5. Analysis of variance (ANOVA) data for the miscanthus-DMIMMPh mixture

The stastical parameters	Dissolution rate %	Cell. Grade %	Cell. Recovery %
The standard deviation	2.67	0.85	1.86
R-squared	0.9939	0.9946	0.9939
Adequate precision	38.090	35.868	32.401
The Model F-value	126.75	144.18	126.40