SUNLIBB

Sustainable Liquid Biofuels from Biomass Biorefining

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Deliverable 7.1
"Lab scale fermentation of sugars from breakdown of maize and Miscanthus optimised"

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Workpackage: **7**
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Deliverable 7.1 Lab scale fermentation of sugars from breakdown of maize and Miscanthus optimised

Task 7.2: Fermentation of sugars from C4 grass biomass

Due to delayed availability of hydrolysates from the specified materials (corn, Miscanthus and sugar cane bagasse), P2 initially used hydrolysate from spent distillers grains to provide us with information on optimisation of the fermentation of C5 sugars. In fact, a fundamental issue involved in optimisation is that of inhibition induced by the hydrolysis process. P2 (Biocaldol) is therefore working on building the resistance of their fermentation organism to minimise the impact of inhibitors.

P2 received 20L of corn acid hydrolysate from P8 and a quantity of powdered Miscanthus in the first year of the project. P2 enzyme hydrolysed the Miscanthus with difficulty in releasing adequate sugars from it (see Table 7.1). (A report on this hydrolysis and the subsequent fermentation of Miscanthus hydrolysate is available on request).

Corn acid hydrolysate had high levels of furfural and hydroxymethyl furfural (HMF) and possibly other inhibitors that made it very difficult to conduct fermentation on this feedstock. (Reports on this fermentation are also available on request). This led P2 to the conclusion that inhibition from enzyme or acid hydrolysis is likely to be a major problem.

P2 did manage to obtain distiller's spent grain liquor and conducted enzyme hydrolysis followed by fermentation with their ethanologenic thermophile. P2 had a 16.6 g/l total sugar release (C5 and C6) from the hydrolysis with an ethanol yield of 0.41 g ethanol/g sugar utilised in the fermentation (see table 2 below).

Table 7.1

	Glucose (g/l)	Glycerol (g/l)	Galactose + Mannose (g/l)	Arabinose (g/l)	Xylose (g/l)	Fructose (g/l)	Acetic Acid (g/l)	HMF (g/l)	Furfural (g/l)
Corn hydrolysate	6.30	0.20	3.20	3.80	29.8	0.10	4.80	1.05	0.92
Miscanthus enzyme hyrolysate*	3.55	0.20	-	0.56	1.76	-	-	-	-

* 10% w/v of Miscanthus used in the enzyme hydrolysis mix [Accellerase Duet, 2 ml (v/v) + Accellerase XC, 1.2 ml (v/v)]

Table 7.2

Temp. (°C)	pH	Dilution rate (h^{-1})	Cell biomass (g/l)	Total sugar in the feed (g/l)	Residual Glucose (g/l)	Residual Xylose (g/l)	Residual Arabinose (g/l)	Total residual sugar (g/l)	Ethanol yield (g/g)
65	6.2	0.225	4.4	16.6	0.09	0.71	0.63	1.43	0.41

P2 believed that we could map the results for spent grain liquor to those of hydrolysates of corn, Miscanthus and sugar cane bagasse. It must be emphasised that the hydrolysis of C5 sugars from the hemicelluloses fraction of biomass is relatively easier than hydrolysis of C6 sugars from the cellulosic fraction of biomass.

Hydrolysate is going to be sent from P8 during late 2011 to both P2 and P5 for further studies. The hydrolysate will originate from maize. The pilot biorefinery at York (P1) should be up and running by January 2012, when maize and Miscanthus hydrolysates for fermentation will be supplied to P2 and P5. Professor Polikarpov (CeProBIO coordinator) has provided some sugarcane bagasse samples that are being processed by P1, and plans to produce sugarcane hydrolysates for use in SUNLIBB in the coming year.