Environmental Engineering and Management Journal

March 2012, Vol.11, No. 3, Supplement, S66
http://omicron.ch.tuiasi.ro/EEMJ/

"Gheorghe Asachi" Technical University of Iasi, Romania

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BIOMETHANE PRODUCTION FROM TOBACCO PLANTS WITH MODIFIED CELL WALL

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Abstract

Plant biomasses represent an abundant source of lignocellulosic material for renewable biofuel production. The conversion of plant cell wall polysaccharides into simple fermentable sugars (saccharification) is typically regarded as a major bottleneck for the bioconversion process. The recalcitrance to saccharification is largely due to the complex structure of the cell wall that is composed of a cellulose-hemicellulose network embedded in a matrix of pectin that limits the exposure of cellulose to hydrolysis. It has been previously demonstrated that the modification of homogalacturonan, the main component of pectin, by the expression of an attenuated variant of the polygalacturonase II of the fungus *Aspergillus niger* (hereafter named PG plants), improves enzymatic saccharification with respect to the unmodified plants.

In this work, two transgenic tobacco PG plants (lines PG16 and PG7, expressing respectively high and low level of the transgene), were used to evaluate the effect of cell wall modifications on anaerobic fermentation of plant tissues into methane gas.

To this aim, samples of both transgenic and wild type plants were incubated (at 35°C) in closed reactors in the presence of an anaerobic sludge as inoculum. Control tests lacking plant biomass or containing a corresponding amount of glucose (instead of plant biomass) were also setup. Each condition was tested in triplicate to evaluate its reproducibility. The reactors were analyzed at regular intervals for organic acids (the main intermediates resulting from the fermentation of saccharification products) and methane gas, the end-product of anaerobic degradation of plant biomasses.

The production rate of organic acids (namely acetate, propionate, and butyrate) with PG16 modified tobacco was substantially higher than with the wild-type, confirming that the expression of *An*PGII can enhance the rate of saccharification. Interestingly, the final conversion yield of tobacco plants (both modified and wild-type) into methane was over 90% (on a COD basis) and only slightly lower than that observed with pure glucose. In conclusion, these results suggest that residuals from tobacco plants have a high potential for conversion into biofuels.