Bioresource Technology 116 (2012) 540–544

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Short Communication

Gamagrass varieties as potential feedstock for fermentable sugar production

Jiele Xu [a], Ximing Zhang [a], Ratna R. Sharma-Shivappa [a,*], Mary W. Eubanks [b]

[a] Department of Biological and Agricultural Engineering, North Carolina State University, Campus Box 7625, Raleigh, NC 27695, USA
[b] Department of Biology, Duke University, Duke Biology Box 90338, Durham, NC 27708, USA

ARTICLE INFO

Article history:
Received 27 February 2012
Received in revised form 13 April 2012
Accepted 14 April 2012
Available online 21 April 2012

Keywords:
Bioethanol
Energy crop
Enzymatic hydrolysis
Pretreatment
Sugars

ABSTRACT

To evaluate the potential of gamagrass as a feedstock for biofuels, seven gamagrass varieties were analyzed for their chemical composition and subjected to pretreatment at 121 °C using 1% NaOH/H_2SO_4 (w/w) for 60 min and enzymatic hydrolysis for fermentable sugar production. Based on total sugar yield, the varieties Eagle Point Devil Corn and Sun Devil were selected for NaOH and H_2SO_4 pretreatment, respectively. The investigation on pretreatment conditions showed that, the conditions applied in gamagrass variety screening (121 °C, 1% NaOH/H_2SO_4, 60 min) were sufficient to maximize sugar production, such that the total sugar yield of Eagle Point Devil Corn reached 479.6 mg g^{-1} after NaOH pretreatment and that of Sun Devil reached 456.5 mg g^{-1} raw biomass after H_2SO_4 pretreatment. Compared with other potential energy crops including switchgrass and Bermuda grass, gamagrass gave a higher sugar yield after NaOH pretreatment and a comparable sugar yield after H_2SO_4 pretreatment.

1. Introduction

Although encouraging progress has been made over the past decade towards cost-effective ethanol production from grasses such as switchgrass (*Panicum virgatum*) and Bermuda grass (*Cynodon dactylon*), commercialization of ethanol production based on these herbaceous feedstocks has not been realized due to biomass recalcitrance. Since significant variations in biomass structure and composition exist among different grasses, which might substantially affect the susceptibility of grass to biochemical conversion and its sugar production ability, it is necessary to explore other under-or un-explored grasses and evaluate their potential as feedstocks for biofuels. Gamagrass (*Tripsacum dactyloides*) is a perennial warm-season C_4 grass native to the US and has the potential to produce large amounts of biomass in the southeastern part of the country. Gamagrass yields of up to 19.0 t ha^{-1} y^{-1} have been reported so far (USDA-NRCS, 2007), which are comparable with those of switchgrass and Bermuda grass (Xu et al., 2011; Keshwani and Cheng, 2009). Additionally, it has many other desirable characteristics as an energy crop, which include high carbohydrate content, adaptation to different soil and climate conditions, non-invasiveness, and easy integration into existing farming operations (Ge et al., 2012; Lemus and Parrish, 2009).

In this study, to evaluate the biofuel potential of gamagrass, seven gamagrass varieties were screened for fermentable sugar production via biochemical conversion. Sodium hydroxide (NaOH) and sulfuric acid (H_2SO_4) pretreatments were applied to improve digestibility of gamagrass and followed by enzymatic hydrolysis for sugar production. The gamagrass variety with greatest potential was determined based on the release of total sugars during biomass conversion. Because of the crucial role that pretreatment plays in reducing biomass recalcitrance, effects of pretreatment conditions on sugar production were further investigated to identify optimal process conditions. A comparison of the potential of gamagrass relative to switchgrass and Bermuda grass was also provided.

2. Methods

The study consisted of two steps: gamagrass variety screening and pretreatment optimization. During varietal screening, gamagrass was pretreated at 121 °C using 1% NaOH or H_2SO_4 (w/w) for 60 min to improve its enzymatic digestibility and the pretreated biomass was subjected to enzymatic hydrolysis at excess enzyme loadings for sugar production. The pretreatment conditions applied were determined according to our previous work with other herbaceous biomass (Xu et al., 2010a; Wang et al., 2010; Yang et al., 2009). For NaOH pretreatment, the optimal gamagrass variety was selected based on the yield of total sugars in enzymatic hydrolysis. Sugars dissolved in the prehydrolysate during NaOH pretreatment in this study were not considered for total sugar yield since the economic viability of recovering such small amounts of sugars from extremely alkaline spent liquid which also contains sugar degradation products is considered low. For H_2SO_4 pretreatment, the optimal variety was selected based on the combined yield of sugars in pretreatment and enzymatic hydrolysis as

* Corresponding author. Tel.: +1 919 515 6746; fax: +1 919 515 7760.
E-mail address: ratna_sharma@ncsu.edu (R.R. Sharma-Shivappa).

0960-8524/$ - see front matter
http://dx.doi.org/10.1016/j.biortech.2012.04.050