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Ionic liquids-based hydrolysis of *Chlorella* biomass for fermentable sugars

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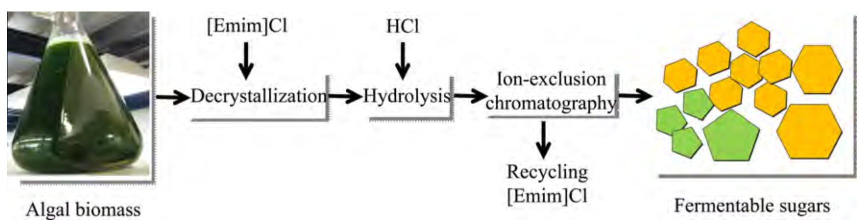
HIGHLIGHTS

- ▶ Ionic liquids-based catalyst was used to hydrolyze algal biomass.
- ▶ The amount of HCl loading was very low, and ionic liquids could be recycled.
- ▶ High-yielding soluble sugars were obtained without the addition of enzyme, but at mild condition.
- ▶ Glucose in *Chlorella* biomass hydrolysate could be conversed into ethanol at high yield.

GRAPHICAL ABSTRACT



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ABSTRACT

An ionic liquids-based chemical hydrolysis strategy was developed to obtain high-yielding soluble sugars from *Chlorella* biomass. Initial ionic liquids dissolution and subsequently HCl catalyzed hydrolysis could dissolve 75.34% of *Chlorella* biomass and release 88.02% of total sugars from *Chlorella* biomass. The amount of HCl loading was 7 wt.% relative to *Chlorella* biomass weight, which was much lower (only 14.6%) than that in HCl/$MgCl_2$-catalyzed system with similar sugars release (Zhou et al., 2011). Ionic liquids in the hydrolysates were recycled and fermentable sugars were evaluated by converting to bioethanol after separated by ion-exclusion chromatography. This ionic liquids-based hydrolysis strategy showed the great potential to produce fermentable sugars from algal biomass.

1. Introduction

The utilization of algal biomass as sustainable feedstock to produce biofuels has attracted much interest in recent years. Extensive research and development programs have been initiated worldwide to convert algal biomass to methane (Nallathambi Gunaseelan, 1997; Yen and Brune, 2007); biodiesel (Lardon et al., 2009; Vijayaraghavan and Hemanathan, 2009); bioethanol (Thu et al., 2009; Wang et al., 2011) and biohydrogen (Akkerman et al., 2002; Ghirardi et al., 2000), etc.

Chlorella biomass consists of about 40–70% carbohydrate, 10–20% protein and residual low-molecular weight compounds such as fatty acids, free amino acids, and amines. The high content of carbohydrate makes *Chlorella* biomass a potential biomass feedstock for fermentable sugars which could be converted to biobased products (Brennan and Owende, 2010). However, as with many other biomass feedstocks, the natural character of physiochemical, structural and compositional features of algal biomass makes them confer a notorious resistance to hydrolysis and saccharification.

At present, the main method for hydrolysis and saccharification of biomass has focused on thermochemical pretreating the biomass material (Mosier et al., 2005) and subsequently, enzymatic hydrolyzing the pretreated materials to their component sugars

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