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***In-situ* deep eutectic solvent pretreatment to improve lignin removal from garden wastes and enhance production of bio-methane and microbial lipids**

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**Abstract**

Biomass pretreatment can improve the conversion efficiency of bioenergy production. Liquid hot water (LHW) pretreatment is a truly green pretreatment due to its zero chemical use, but has the disadvantages of low lignin removal and pseudo-lignin formation. A modified liquid hot water (MLHW) process based on *in-situ* synthesis of deep eutectic solvent (DES) could efficiently improve delignification of *Roystonea regia* leaves (LR) and leaf sheaths (LSR). LSR was less recalcitrant than LR, and its characteristics of higher porosity (34.8%) and thinner cell walls (5.2  $\mu\text{m}$ ) for LSR contributed it higher lignin removal (53.6%) and lower choline chloride (ChCl) consumption ( $\text{H}_2\text{O}$ -ChCl mass ratio of 2:1) than those (44.6% and 1:2) from LR. Moreover, a great improvement of 309.0% in bio-methane yield was achieved for the MLHW-treated LSR. In addition, *in-situ* DES in MLHW had

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