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High pressure assist-alkali pretreatment of cotton stalk and physiochemical characterization of biomass

Shuang-kui Du^a, Xinna Zhu^a, Hua Wang^a, Dayun Zhou^b, Weihua Yang^b, Hongxia Xu^b

^a College of Food Science and Engineering, Northwest A&F University, Yangling 712100, Shaanxi, China;

^b Institute of Cotton Research of Chinese Academy of Agricultural Sciences, State Key Laboratory of Cotton

Biology, Anyang 455000, Henan, China

ABSTRACT

Ground cotton stalks were pretreated with sodium hydroxide (NaOH) at concentrations of 1%–4% (w/v), pressures of 30–130 kPa, durations of 15–75 min, and liquid/solid ratios of 10:1–30:1. Modeling of the high pressure assist-alkali pretreatment (HPAP) of cotton stalk was attempted. The levels of NaOH concentration, pressure, and duration were optimized using a Box–Behnken design to enhance the cellulose content of treated solid residue. The optimum pretreatment conditions were as follows: liquid/solid ratio, 20:1; pressure, 130 kPa; NaOH concentration, 3.0%; duration, 40 min. During the conditions, cellulose content of pretreated cotton stalk residue was 64.07%. The maximum cellulose conversion of 45.82% and reducing sugar yield of 0.293 g/g upon hydrolysis were obtained. Significant differences were observed in biomass composition and physiochemical characteristics between native and alkali-treated biomass. High NaOH concentration and pressure were conducive to lignin dissolution and resulted in increased cellulose content and conversion.

Keywords: cotton stalk; high pressure assist-alkali pretreatment (HPAP); Box–Behnken design; enzymatic hydrolysis

Corresponding author. Tel: 86-29-87092206; fax: 86-29-87092486
E-mail address: dushuangkui@hotmail.com (S.K. Du); xuhx@cricaas.com.cn (H. X. Xu)

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