Improvement of delignification, desilication and cellulosic content availability in paddy straw via physico-chemical pretreatments

ABSTRACT

Aim: Paddy straw consists of cellulose and hemicellulose as their plant materials leading to their potential to produce bioethanol through several processes such as pretreatment, enzymatic hydrolysis and ethanol fermentation. Among these processes, pretreatment of paddy straw is particularly important for enzymatic hydrolysis process as they are being limited by the presence of ash and silica content. This study was set to observe the effect of different pretreatments on cellulose, hemicellulose, lignin and ash content of paddy straw. Place and Duration of Study: This study was conducted in Department of Biology, Faculty of Science, Universiti Putra Malaysia, between October 2015 and June 2016. Methodology: Pretreatments comprises the combination of physical (mechanical) and chemical treatments to modify the lignocellulosic structure while reduce lignin and separate silica content in paddy straw fibre. Paddy straw was prepared into three different sizes (2mm, 5mm and 8 mm) for physical treatment. Autoclave, boiled and four different concentrations (0.5%, 1%, 2% and 5% (v/v) and (w/v) respectively) of nitric acid and sodium hydroxide, respectively for chemical treatment were used on paddy straw. Results: Size five millimeter paddy straw showed the highest cellulose content (35.61%) compared to the other sizes and when the paddy pretreated with 2% (w/v) sodium hydroxide (NaOH), the percentage of cellulose content escalated to 72.47%. Pretreatment of 2% (w/v) NaOH have performed the most efficient delignification and desilication process (1.02% lignin; 5.44 ash content); and the performance was supported with SEM images on surface area of the paddy straw with large distortion caused by the treatment. Conclusion: Therefore, a physico-chemical pretreatment of size 5 mm and 2% (w/v) NaOH was found to be the most suitable condition to break the cellulose-lignin complex and make the paddy straw becomes feasible for biofuel production.

Keyword: Bioethanol; Delignification; Lignocellulosic biomass; Pretreatment; SEM images