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ORIGINAL PAPER

# Alkali pre-treatment of *Sorghum* Moench for biogas production[‡]

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This work studies the influence of the alkali pre-treatment of *Sorghum* Moench – a representative of energy crops used in biogas production. Solutions containing various concentrations of sodium hydroxide were used to achieve the highest degradation of lignocellulosic structures. The results obtained after chemical pre-treatment indicate that the use of NaOH leads to the removal of almost all lignin (over 99 % in the case of 5 mass % NaOH) from the biomass, which is a prerequisite for efficient anaerobic digestion. Several parameters, such as chemical oxygen demand, total organic carbon, total phenolic content, volatile fatty acids, and general nitrogen were determined in the hydrolysates thus obtained in order to define the most favourable conditions. The best results were obtained for the *Sorghum* treated with 5 mass % NaOH at 121 °C for 30 min The hydrolysate thus achieved consisted of high total phenolic compounds concentration (ca. 4.7 g $L^{-1}$) and chemical oxygen demand value (ca. 45 g $L^{-1}$). Although single alkali hydrolysis causes total degradation of glucose, a combined chemical and enzymatic pre-treatment of *Sorghum* leads to the release of large amounts of this monosaccharide into the supernatant. This indicates that alkali pre-treatment does not lead to complete cellulose destruction. The high degradation of lignin structure in the first step of the pre-treatment rendered the remainder of the biomass available for enzymatic action. A comparison of the efficiency of biogas production from untreated *Sorghum* and *Sorghum* treated with the use of NaOH and enzymes shows that chemical hydrolysis improves the anaerobic digestion effectiveness and the combined pre-treatment could have great potential for methane generation.


**Keywords:** chemical hydrolysis, alkali pre-treatment, anaerobic digestion, biogas production

## Introduction

For a number of years the global community has sought energy sources which do not conflict with sustainable development. Organic wastes and energy crops are used as renewable energy sources with applications in biogas, bioethanol, and hydrogen production (da Costa Sousa et al., 2009; Wyman et al., 2005). Many studies are being directed towards incorporate biomass plants for clean energy generation. The anaerobic digestion process is a good example of the practical application of energy crops for energy production providing biogas (Amon et al., 2007).

The typical fermentation process consists of four main steps: biological hydrolysis, acidogenesis, acetogenesis, and methanogenesis (Appels et al., 2008). The first step is the most expensive and time-consuming and determines the efficiency of the entire process of biogas production (Mosier et al., 2005). As a consequence, much research is directed towards improving and simplifying the biological hydrolysis. The overall aim of this investigation is to break down the lignocellulosic structures into compounds more accessible

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