EFFECT OF HIGH-SOLIDS LOADING ON ENZYMATIC HYDROLYSIS USING PRETREATED AUTOHYDROLYSIS COCONUT SHELL

Héctor A. Ruiz [1,2], Aloia Romaní [2], Fabiano A. Gonçalves [2,3], Everaldo S. dos Santos [3], Gorete R. de Macedo [3], José A. Teixeira [1]

[1] Autonomous University of Coahuila, School of Chemistry, Food Research Department, Saltillo, Coahuila, México, 25280

[2] University of Minho, Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, Braga, Portugal, 4710-057

[3] Federal University of Rio Grande do Norte, Department of Chemical Engineering, Natal, Brazil, 59078-970

hector_ruiz_leza@uadec.edu.mx,

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Introduction. Lignocellulosics materials (LCM) represent a potential source for use in biomass conversion to bioethanol and so it is an alternative fuel for the replacement of gasoline (1). According to FAO statistics, Brazil in 2011 produced 2.9 million tons of coconut, generating important amounts of shell (2). Then, the coconut shell can be considered a potential LCM for bioethanol production. Several advantages have to work with high solid loading on enzymatic hydrolysis. For example, increases productivity and glucose concentration and reduces water and energy input into the process. Moreover, that autohydrolysis process is a promising pretreatment that caused relocalization of lignin on the surface improving the accessibility of the cellulose component (3).
The aim of the present work was to evaluate the effect of operating conditions (enzyme and substrate loading) of autohydrolysis pretreated coconuts shell on the enzymatic hydrolysis.

Methods. The material composition containing mainly cellulose (32.88 %), hemicellulose (26.5 %) and Klason lignin (25.44 %). The coconut shell pretreatment using autohydrolysis process was previously evaluated (data not shown), resulting in the best condition (200 ºC/ 50 min), The cellulose content in the solid residue was of 42 %, xylan 1.35 %, and klason lignin 41.28%. In order to relate the dependent variable glucose concentration (g/L), and independent variables solids loading (5-20 %), and enzyme loading (5-30 FPU/g of solid) in the enzymatic hydrolysis, a 2^n central composite design was used. The reactions of hydrolysis were performed according to Ruiz et al. (4) at 50 ºC during 72 h, using commercial cellulase (Cellic CTec2) and β-glucosidase (Novozyme 188), the enzyme activities were 122 FPU/mL 509 UI/mL, respectively. The β-glucosidase enzyme was added at a ratio of 2:1 U of β-glucosidase to FPU of cellulase.

Results. The maximum hydrolysis yields were 67% and 60.3% for the autohydrolysis pretreated coconut shell and the productivity were 0.54 and 0.58 (g/L·h), respectively and are presented in Table 1.

Table 1. Productivity and maximum yield of enzymatic hydrolysis at 72 h.

Conditions	Productivity (g/L·h)	Yield(%)
(12.5 %, 17.5 FPU/g)	0.54	67
(12.5 %, 30 FPU/g)	0.48	60.3

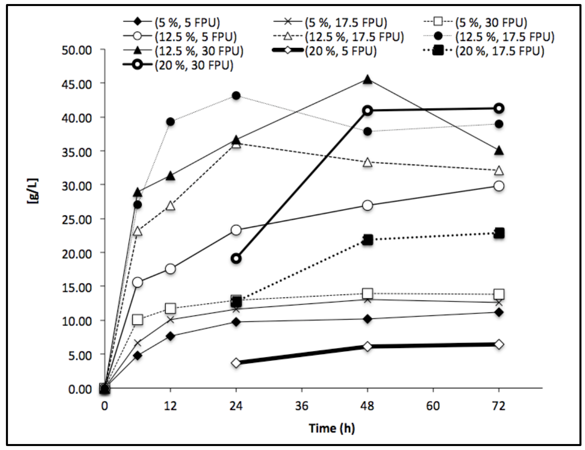

Fig.1 Kinetics profile of cellulose hydrolysis for all the operational conditions using autohydrolysis pretreated coconut shell as substrate.

The profile of enzymatic hydrolysis (cellulose to glucose) is shown in Fig. 1. The maximum glucose production were 45.6, 43.2 and 41.2 g/L, corresponding to the operational condition of 12.5 %-30 FPU/g; 12.5 %-17.5 FPU/g and 20 %-30 FPU/g.

Conclusions. This work demonstrates the suitability of coconuts shell pretreated by autohydrolysis. However, the enzymatic hydrolysis was affected probably by several factors as lignin content, inhibition by glucose and adsorption of cellulases into lignin, decreasing the conversion.

References.

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