THERMOCHEMICAL PRETREATMENT FOR ENZYMATIC HYDROLYSIS OF WATER HYACINTH

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Keywords: pretreatment, enzymatic hydrolysis, water hyacinth.

Introduction. Higher quantities of lignocellulosic biomass wastes are accumulated yearly. Water hyacinth is considered as a contaminant of lakes and rivers. Its high growth rate causes problems in aquatic systems. However, it can be used as raw material for production of some sugars and compounds with high value. An adequate pretreatment is important to increase the enzymatic hydrolysis efficiency (1-2).
The goal of this work was to determine the conditions of a thermochemical pretreatment before the enzymatic hydrolysis of the lignocellulosic material of water hyacinth

Methods. Stem and leaf of water hyacinth (WH) were manually separated, dried and pulverized. The pretreatment was evaluated with dilute sulfuric acid. Fifty milligrams of powdered WH were mixed with 5ml of 0 to 9% (w/v) sulfuric acid (H_2SO_4) and autoclaved at 120°C for 30 min. After that, the autoclave was suddenly depressurized (in less than 30 s). For enzymatic hydrolysis, 0.8 ml/g dry matter of cellulase complex (Novozyme) was added to the reaction mixture. The enzymatic reaction was carried out at 50°C for 2h at 150rpm. Reducing sugars were determined using dinitrosalicylic acid (DNS) and sugar monomers were analyzed by HPLC. The experimental values of reducing sugar release rates were adjusted to an adsorption-reaction model (3). The estimated parameters were compared among leaf and stem by *Student t-test* $\alpha \leq 0.05$.

$$\upsilon = \frac{\upsilon_{\max}\left[H^+\right]}{k + \left[H^+\right]}$$

υ_{max} is the maximum rate of reducing sugars release, and k is the concentration of sulfuric acid (% w/v) corresponding to the 50% of υ_{max}.

Results. The estimated parameters υ_{max} and k were 628.12 mg/gh, 1.4 % fir steams and 590.53 mg/gh, 0.74 % for leaves (Fig. 1). υ_{max} for steams and leaves were not significant; while there were for the k value.
Table 1 summarizes the concentration of glucose, xylose and arabinose after the thermochemical pretreatment (TP) and the TP followed by enzymatic hydrolysis. TP alone was mainly responsible of pentoses release, whilst glucose was mainly released by the enzymatic treatment. Similar behavior was obtained with steams and leaves.

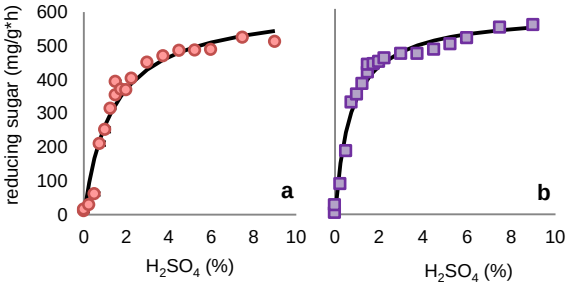

Fig.1. Kinetics of release of reducing sugars during the thermochemical pretreatment with H_2SO_4 (0-9%p/v). a) Stems. b) Leaves.

Table 1. Monomers obtained only pretreatment and pretreatment followed by enzymatic hydrolysis.

		glucose (mg/g)	xylose (mg/g)	arabinose (mg/g)
Pretreatment	stem	15.6	67.5	45.4
	leaf	18.5	50.7	41.0
Pretreatment followed by enzymatic hydrolysis	stem	160.4	46.1	43.0
	leaf	86.1	26.0	34.4

Conclusions. The obtained results suggest the use of sulfuric acid at 2.8% and 1.48 for thermochemical pretreatment of stems and leaves respectively to obtain an extract rich in pentoses (xylose and arabinose). Further extraction of glucose was achieved with the enzymatic treatment after the thermochemical pretreatment.

Acknowledgements. This work was supported by ICyTDF.

References.

1. Nigam J.N. (2002). *Journal of Biotechnology*. (97): 107-116.
2. Gunnarsson C. C., Mattsson C. (2007). *Waste Management*. (27):117-129.
3. Bailey J.E., Ollis D.F., (1986). The kinetics of enzyme-catalyzed reactions: *Biochemical Engineering Fundamentals*. Bailey J.E. McGraw-Hill Chemical Engineering Series. United States of America. pág. 86-156.