EFFECT OF THE PARTICLE SIZE ON SUGARS RELEASE USING A PRESSURE COOKING PRETREATMENT IN WHEAT STRAW

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Key words: particle size, sugars, wheat straw

Introduction. Biofuels from lignocellulosic biomass fermentation represent a key potential of energy production due to its abundance, renewability and low cost. Wheat straw is one the most promising raw substrates to be utilized due to its rich composition: Cellulose (36 – 38%), Hemicellulose (26 – 32%) and Lignin (17 – 19%) (1). In order to obtain biofuels from lignocellulosic biomass, this must be first hydrolyzed by the microorganisms. Then, the released sugars can be converted into biofuels by anaerobic fermentation (2). However, conversion of lignocellulosic biomass is a challenging task due to the presence of lignin in lignocellulose, which leads a barrier that prevents plant cell destruction from fungi and bacteria. High pressure is currently one of the most utilized pretreatments of raw substrates that help to overcome this challenge (3).
In this work, we studied the influence of particle size over the maximal quantity of released sugars after a set of pressure pretreatments at different times in order to understand the behavior of this variable

Methods. Wheat straw was obtained from Guanajuato, Mexico. The material was milled using a balls mill and screened to obtain a particle size of 3 mm, 2mm and 0.2 mm respectively. A five-level-two-factor central composite design (CCD) obtained by using the "Design Expert" software (Version 8.0.7.1, Stat-Ease Inc., Minneapolis, USA) statistical package was used to find out the effect of pressure and time on release of sugars. The levels of factors used for optimization are presented in Table 1.The assay was done by using 1g of wheat straw and 20 ml of water in a 50 ml centrifuge tube. Then, the samples were well mixed and put into an autoclave by the specified time and pressure. Then, the supernatant was collected for reduced sugars determination by the DNS method described previously by Miller (4).

Table 1. Experimental design and levels of independent variables in terms of natural units

Run	Pressure (psi)	Time (min)
1	**12.5**	**33**
2	18	52
3	**12.5**	**33**
4	12.5	60
5	**12.5**	**33**
6	**12.5**	**33**
7	18	13
8	12.5	5
9	7	13
10	7	52
11	20	33
12	5	33
13	**12.5**	**33**

Results. Figures 1, 2 and 3 shows the sugars released using wheat straw having a particle size of 0.2mm, 2mm and 3mm at different pressures and times. The models of response surface predicted the maximum values of 6.6, 5.5 and 5.0 mg/ml of reducing sugars to the 3mm, 2mm and 0.2mm particle size, respectively.

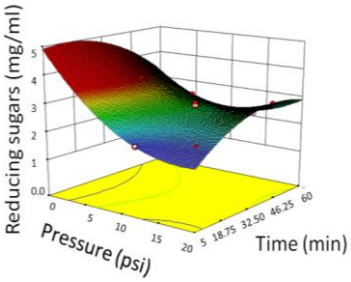

Fig.1 Predicted model of response surface using a 0.2 mm particle size in wheat straw.

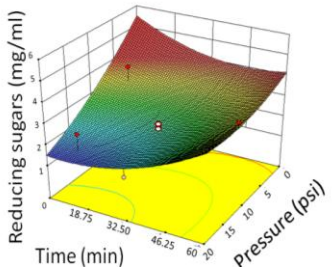

Fig.2 Predicted model of response surface using a 2 mm particle size in wheat straw.

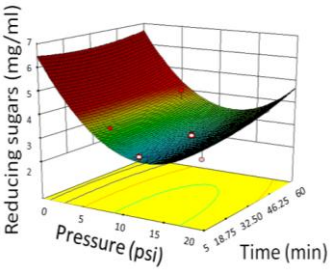

Fig.3 Predicted model of response surface using a 3 mm particle size in wheat straw.

Conclusions. According to these results, it was observed that sugars release dependents on the particle size. A larger particle size releases a higher content of sugars. The highest values of reducing sugars were obtained at lower pressures and times.

Acknowledgements. Financial support from the CONACYT project N° 150001 from Fondo Sectorial "CONACYT-SENER – Sustentabilidad Energética".

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