Universidade do Minho

Escola de Engenharia

Semana da Escola de Engenharia
October 24 - 27, 2011
FAST CHEMICAL TREATMENTS FOR LIGNO-CELLULOSIC SUBSTRATE ACHIEVEMENT FROM BREWERS´ SPENT GRAINS

Eduardo Pires[a,*] and António Vicente[a]

[a] *Departamento de Engenharia Biológica, Universidade do Minho, Campus de Gualtar.*

* *eduardo.pires@deb.uminho.pt*

KEYWORDS

Brewers´ Spent Grains (BSG), Ligno-cellulosic substrate, Yeast Immobilization.

ABSTRACT

Several chemical treatments were proposed to achieve lingo-cellulosic substrates from BSG. Both lignin and cellulose content for each treatment were analysed. The treatments proposed efficiently originated different ligno-cellulosic substrates. The ideal substrate for yeast immobilization is yet to be determined and further studies shall conclude this issue.

INTRODUCTION

Caustic (NaOH) and acid-caustic (HCl + NaOH) treatments have both been previously proposed to prepare ligno-cellulosic yeast carriers from BSG (Branyik et al., 2001). However, these treatments are time consuming (more than 24 h). Base-treated carriers are more hydrophobic if compared to acid-base treated, enhancing adhesion in one hand, but more floatable and easily washed out from the reactor in the other hand (Branyik et al., 2004). Thus, a balance between hydrophilic (cellulose) and hydrophobic (lignin) composition on carriers obtained from BSG must be idealized. Thus, the aim of this study was to idealize a fast and simple treatment on ligno-cellulosic substrate from BSG.

METHODS

Two types of BSG have been used in this work: dried BSG settle as pellets for animal nutrition and fresh BSG, right from the beer industry. Both pelleted and fresh BSG received a series of different chemical treatments (Table 1 summarizes the conditions used), as well as the treatments proposed in the literature (Branyik et al., 2001). Carriers were assessed for sugars polymers determination through high performance liquid chromatography (HPLC) (Varian, Metacarb 67H Column 300 x 6.5 mm). Briefly, approximately 0.5 g of each dried carrier was digested with sulfuric acid. The digested material was settled in glass flasks with water, autoclaved and filtered. Then, the solids were held separately for lignin content determination, while the liquid was settled in vials for sugars assessment.

Table 1 - Chemical treatments applied on Brewers´ Spent Grains (BSG) for Ligno-cellulosic yeast carrier (LCYC) preparation and bulk yield of the chemical treatments

Treatment	Description	Yield* (%) Pellets	Fresh
Caustic (Brányik et al., 2001)	NaOH 2 %; 120rpm; 30 °C; 24 h	10,0	29,6
Acid and Caustic (Brányik et al., 2001)	(HCl 3 %; 60 °C; 2.5 h) + (NaOH 2 %; 120 rpm; 30 °C; 24 h)	8,7	15,1
Fast Caustic	NaOH 3 %; 70 °C; 20 min	9,1	30,0
Double Caustic 3% & 6%	(NaOH 3 %; 70 °C; 20 min) + (NaOH 6 %; 90 °C; 20 min)	5,9	20,1
Double Caustic 3% & 3%	(NaOH 3 %; 70 °C; 20 min) + (NaOH 3 %; 90 °C; 20 min)	6,8	22,7
Double Caustic 3% & 1%	(NaOH 3 %; 70 °C; 20 min) + (NaOH 1 %; 90 °C; 20 min)	8,0	25,2
Double Caustic 0.5%	(NaOH 0.5 %; 70 °C; 20 min) + (NaOH 0.5 %; 90 °C; 20 min)	15,9	36,4
Fast Caustic and Acid	(NaOH 1 %; 70 °C; 20 min) + (HCl 1 %; 70 °C; 20 min)	8,7	30,6

* Weight of carrier obtained from 100 g of dried BSG.

Universidade do Minho

Escola de Engenharia

Semana da Escola de Engenharia
October 24 - 27, 2011

RESULTS & CONCLUSIONS

The bulk yields for the chemical treatments are displayed on Table 1. Treatments applied on fresh BSGs were significantly ($p < 0.05$) more efficient if compared to pelleted ones. Considering the materials separately, all treatments showed different ($p < 0.05$) profiles of cellulose and lignin content for both pelleted and fresh BSG (Figures 1 and 2). The coefficients of variance for cellulose (1.96% for pellet and 3.63% for fresh) and for lignin (4.69 % for pellet and 6 % for fresh) assures the reliability between the three repetitions for each treatment. Thus, heat associated with caustic treatments can greatly reduce the time reaction for lignin removal from BSG, thus creating more cellulose rich carriers. The average bulk yield for treatments applied on fresh BSG was higher compared to pelleted ones. Yeast immobilization experiments can be further held on ligno-cellulosic carriers obtained from these treatments and the ideal treatment can be chosen.

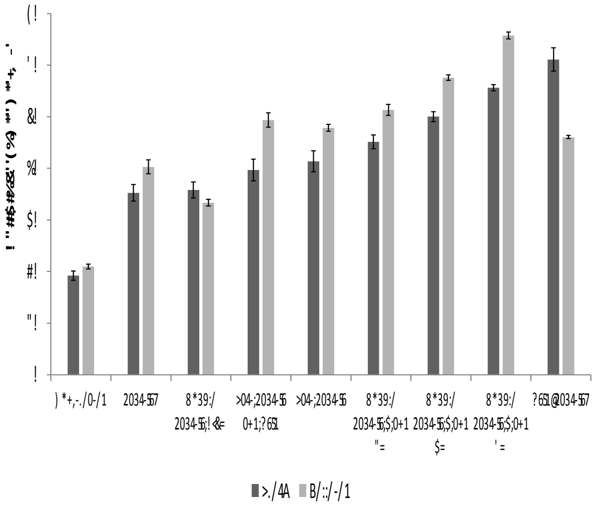

Figure 1 – Cellulose composition of 100 g dried carrier for each treatment. * Methods performed according to Bránik et al. (2001).

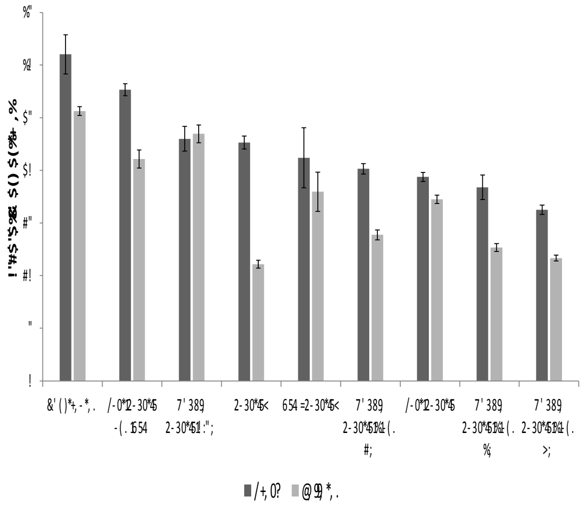

Figure 2 – Lignin composition of 100 g dried carrier for each treatment. * Methods performed according to Bránik et al. (2001).

ACKNOWLEDGEMENTS

The financial support from Fundação para a Ciência e Tecnologia (FCT) through the PhD grant SFRH / BD / 61777 / 2009 given to Pires, E. J.

REFERENCES

Branyik T., Vicente A. A., Machado Cruz J. M., Teixeira J. A., Spent grains - a new support for brewing yeast immobilisation. Biotechnology Letters 23 (2001) 1073-1078.

Branyik T., Vicente A. A., Oliveira R., Teixeira J., Physicochemical surface properties of brewing yeast influencing their immobilization onto spent grains in a continuous reactor. Biotechnology and Bioengineering 88 (2004) 84-93.

AUTHOR BIOGRAPHY

Eduardo Pires was born in Recife (Pernambuco, Brazil) and went to the Federal University of Pernambuco, where he studied Medical Technology from 2003-2007 and obtained his Master Degree in Tropical Medicine in 2009. By the end of 2009 until now, he is doing his Ph.D. project in University of Minho, Campus Gualtar, Braga, Portugal.

His e-mail address is: eduardo.pires@deb.uminho.pt