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Production, purification and characterisation of oligosaccharides from olive tree pruning autohydrolysis

Cristóbal Cara[a,b], Encarnación Ruiz[a,b,*], Florbela Carvalheiro[c], Patrícia Moura[c,d], Ignacio Ballesteros[e], Eulogio Castro[a,b], Francisco Gírio[c]

[a] Department of Chemical, Environmental and Materials Engineering, University of Jaén, Campus Las Lagunillas, 23071 Jaén, Spain
[b] Campus de Excelencia Internacional Agroalimentario, ceiA3, Jaén, Spain
[c] LNEG, Bioenergy Unit, Estrada do Paço do Lumiar, 22, 1649-038 Lisboa, Portugal
[d] CiiEM, Center for Interdisciplinary Research Egas Moniz, Quinta da Granja, Monte de Caparica, 2829 – 511 Caparica, Portugal
[e] CIEMAT, Renewable Energies Department, Avda. Complutense, 22, 28040 Madrid, Spain

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ABSTRACT

The production of oligosaccharides (OS) by olive tree pruning autohydrolysis in the range 170–230 °C was studied. The best results in terms of maximum yield of OS along with a low amount of byproducts were obtained at 180 °C. After purification by preparative gel filtration chromatography a range of OS-fractions with average degree of polymerisation (DP) from 25 to 3 was selected for further characterisation. Gluco- and xylooligosaccharides were the predominant OS in these fractions. OS yields in the range 80–90% were obtained for fractions with average DP between 25 and 7, practically free of low molecular compounds. Both OS total yields and xylooligosaccharides proportion decreased for lower DP fractions while monosaccharides and other products concentrations increased. OS production and the recovery of other high value compounds can be envisaged as an interesting contribution to develop an olive-biomass biorefinery.

1. Introduction

Biomass obtained by pruning of olive trees constitutes an abundant and renewable agricultural residue in the Mediterranean countries for which no industrial applications were yet consistently envisaged. Nowadays, the normal practice is to dispose this biomass residue in the field, which poses environmental problems and represents an economic misuse. In the lack of alternatives, conversion into fuel ethanol has been proposed (Manzanares et al., 2011). This conversion process requires a pretreatment step to make cellulose susceptible for enzymatic saccharification (Hendriks and Zeeman, 2009). A number of processes have been assayed in our laboratories for fractionating olive tree residues, including steam explosion (Cara et al., 2008a; Ballesteros et al., 2011), dilute acid treatment (Cara et al., 2008b; Romero et al., 2007), alkaline delignification (Cara et al., 2006), organosolvolysis (Díaz et al., 2011) or liquid hot water (Cara et al., 2007), also called autohydrolysis.

Liquid fractions (hydrolysates) obtained after pretreatment contain a mixture of sugars whose conversion into ethanol is not as easy as that of glucose released from pretreated solids (Díaz et al., 2009). In the case of a hydrothermal pretreatment under conditions of moderate severity, hydrolysates contain the sugars mainly in the oligomeric form. These compounds possess economic interest as they can be used for several marketable applications (Mussatto and Mancilha, 2007; Patel and Goyal, 2011).

Obtaining valuable co-products coupled to ethanol production process is a characteristic feature of the biorefinery concept, which tries to integrate in a single facility the production of power, heat, chemical products and biofuels with lignocellulosic materials as a starting point in a similar way as oil refinery operates (Arato et al., 2005; Zhang et al., 2011). Industrial scale biorefineries can contribute greatly to make economically feasible second generation ethanol due to the simultaneous production of several other added-value products. For example, previous works have identified a number of compounds exhibiting antioxidant activity in the liquid fractions obtained after olive tree biomass hydrothermal pretreatment (Castro et al., 2008; Conde et al., 2009). The extraction of oligosaccharides from these fractions could also constitute an important step towards the development of the industrial biorefinery. Lama-Muñoz et al. (2012), in a work with alperujo (the olive oil by-product) concluded that this raw material represents a good

* Corresponding author at: Department of Chemical, Environmental and Materials Engineering, University of Jaén, Campus Las Lagunillas, 23071 Jaén, Spain.
Tel.: +34 953212779.
E-mail address: eruiz@ujaen.es (E. Ruiz).

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