Evaluation of the potential of olive tree pruning and rapeseed straw hydrolysates as fermentation media for biotechnological processes

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Introduction

Olive tree pruning (OTP) and rapeseed straw (RS) are agricultural residues generated in significant amounts in Europe, and their reuse has been strongly encouraged for economical and environmental reasons.

In the case of olive tree pruning, over 4.8 million hectares are cultivated in Europe, most of them in the Mediterranean countries. Pruning operation generates every year a volume of lignocellulosisc residues estimated in 3000 kg/ha. The conversion of OTP into ethanol (Cara et al., 2008) and other chemical production (Castro et al., 2008) has been proposed. Rapeseed cultivation has increased in recent years due to growing demand for this feedstock for biodiesel production. Over 5 million ha of rapeseed plant were cultivated in Europe in 2009. Rapeseed straw has been proposed as raw material to produce bioethanol (Díaz et al., 2010; Castro et al., 2011).

OTP and RS contain a significant fraction of hemicellulose, a heteropolymer composed by pentose and hexose sugars. Extraction of the sugars from these residues, and subsequent use of them in fermentative processes, could be an interesting alternative for their valorization since a variety of valuable compounds may be produced by bioconversion of sugars.

Olive tree pruning **Rapeseed straw**

Objectives and Experimental

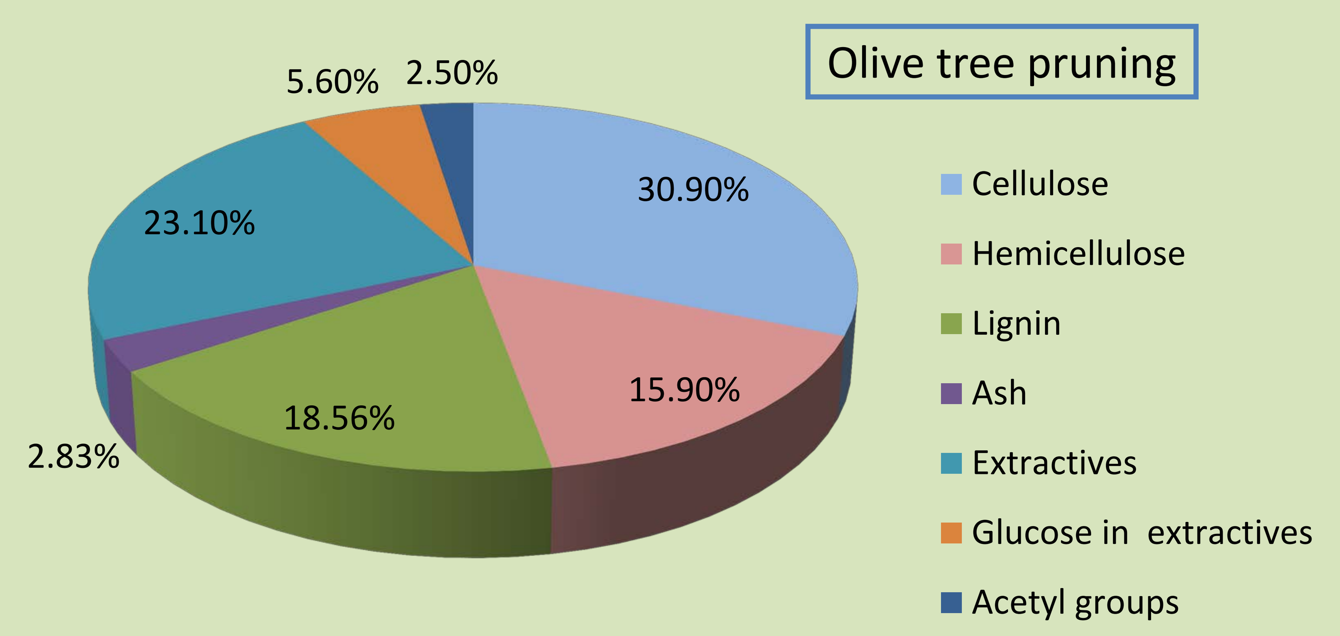
OTP and RS were submitted to an acid hydrolysis process aiming to extract hemicellulose sugars.
The possibility of using these hydrolysates as substrates for bioconversion processes was evaluated.

Hydrolysis conditions: 120 ºC, 1 h, 2% (w/w) H_2SO_4 solution. Solid-to-liquid ratio: 20% w/w (OTP) or 12% w/w (RS).

The produced hydrolysate (raw hydrolysate, RH) was concentrated about 2.5-times under vacuum at 70 °C and subsequently pretreated with activated charcoal.

All the hydrolysates (RH; concentrated, CH; and charcoal pretreated, CPH) were chemically characterized by HPLC.

Results



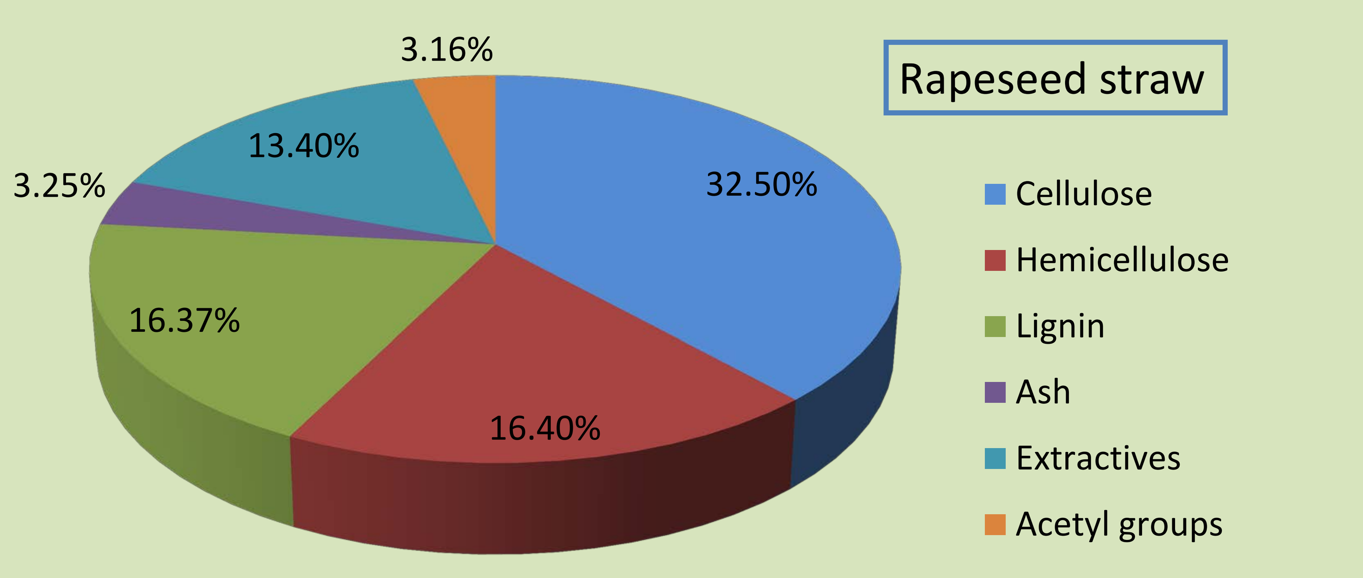


Table 2. Chemical composition of the hydrolysates produced from olive tree pruning and rapeseed straw, in the original (RH), concentrated (CH), and charcoal pretreated (CPH) forms.

	Olive tree pruning			Rapeseed straw		
	RH	**CH**	**CPH**	**RH**	**CH**	**CPH**
Sugars (g/l)						
Glucose	27.7	73.1	67.7	1.6	5.1	5.0
Xylose	15.8	41.7	37.5	11.4	38.5	36.3
Galactose	3.7	10.0	8.2	1.9	6.3	5.8
Arabinose	6.3	16.6	14.4	1.5	4.7	4.2
Mannose	0.9	2.1	1.8	0.5	1.5	1.4
Fructose	0.6	1.3	1.1	0.0	0.0	0.0
Mannitol	2.8	7.0	4.8	0.3	0.0	0.0
Inhibitory compounds (g/l)						
Furfural	0.2	0.1	0.0	0.2	0.0	0.0
Hydroxymethylfurfural	1.2	1.3	0.3	0.1	0.2	0.0
Acetic acid	5.4	8.5	8.0	4.2	6.4	5.5
Formic acid	1.7	5.7	3.5	0.5	1.5	0.0
Phenolic compounds	4.9	10.4	7.5	0.7	1.9	1.2

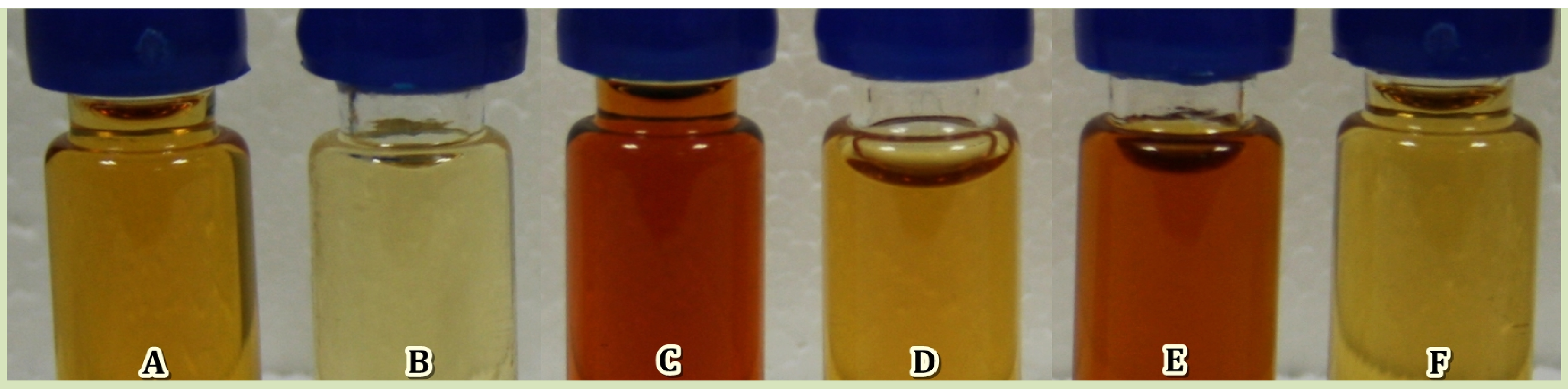


Figure 1. Color of the hydrolysates: OTP – RH (A); RS – RH (B); OTP – CH (C); RS – CH (D); OTP – CPH (E); RS – CPH (F).
RH: original hydrolysate; CH: concentrated hydrolysate; CPH: concentrated and charcoal pretreated hydrolysate.

Conclusions

Olive tree pruning hydrolysate is a sugar-rich medium with great potential for use in fermentation processes. However, a study to optimize the acid hydrolysis conditions, or other detoxification processes should be evaluated in order to obtain a hydrolysate with lower concentration of toxic compounds.

Rapeseed straw hydrolysate contains less sugar than olive tree pruning hydrolysate, but it will probably require less effort to become a medium suitable for use in fermentation processes, due to its lower content of inhibitory compounds.

These results are of relevance and contribute for the development of processes for valorization of these agricultural residues.

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