Utilisation of ethylene glycol- based deep eutectic solvent for enhancing cellulose enzymatic digestibility of vine shoot biomass

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INTRODUCTION

- Vine shoots (VS) is a grape crop waste resulting from the pruning of grapevines, with no industrial use at present.
- VS could be used in a biorefinery strategy, provided that their main components can be recovered and used separately.
- Deep Eutectic Solvents (DES) are considered green solvents, able to fractionate biomass[1]. Among them, Choline Chloride : Ethylen glycol (ChCl:EG) has shown promising results in delignification[2].

OBJECTIVES

- Assess the performance of the pre-treatment of vine shoots using a DES composed of choline chloride and ethylene glycol (ChCl:EG).
- Quantify the amount of lignin extracted by DES pre-treatment.
- Evaluate sugar released from pre-treated vine shoots by enzymatic hydrolysis (EH).

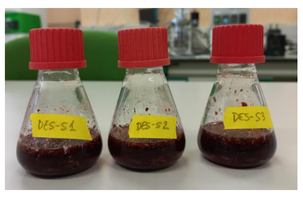
MATERIALS AND METHODS

DES PREPARATION

Choline chloride + Ethylene glycol
1:2 molar ratio
Synthesis at 60ºC and 100 rpm, 60 min

DES PRE-TREATMENT

OVEN TEMPERATURE (◦C) FOR 17 H	SOLID LOAD (%)	PARTICLE SIZE (mm)
120	5	2
		0.5
	10	2
		0.5
150	5	2
		0.5
	10	2
		0.5
	30	2
		0.5

COMPOSITIONAL ANALYSIS[3]

- Ash quantification
- Water & etanol extraction
- 2-step hydrolysis:

- Filtrate → sugars, acetic acid, soluble lignin
- Solid residue → insoluble lignin

Enzymatic saccharification
5% wt. solids load
Cellulase blend, 15 FPU/g substrate
50ºC, 150 rpm, 72 h

$$OY_i = \frac{(Sugar\ released\ by\ EH - Sugar\ in\ enzyme)}{Sugar\ in\ the\ raw\ biomass} \times 100$$

VS + DES MIXTURE → OVEN (120 or 150 ºC at 17 h) → VACUUM FILTRATION (0.45 µm)

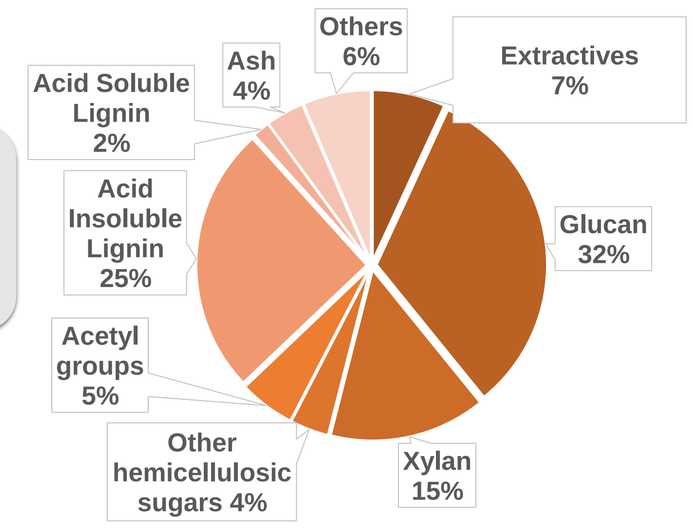
SOLID
- Washed with water until neutral Ph.
- Dried at 40ºC

→ ENZYMATIC SACCHARIFICATION / COMPOSITIONAL ANALYSIS

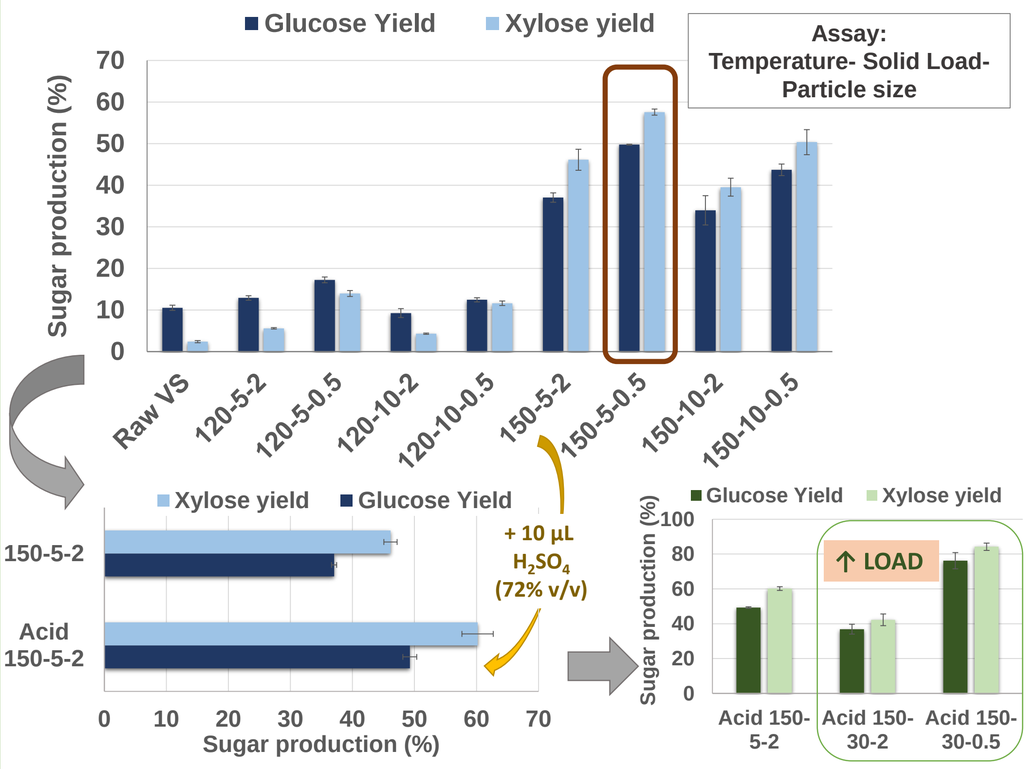
FILTRATE
- Addition of water
- Refrigeration
- Centrifugation (9,000 rpm, 15 min)
- Pellet washed twice

RESULTS

MAIN COMPONENTS OF VINE SHOOT



SUGAR PRODUCTION AFTER ENZYMATIC HYDROLYSIS OF VS PRE-TREATED WITH DES



DESLIGNIFICATION AFTER DES PRE-TREATED

ASSAY	DESLIGNIFICATION (%)
120-5-2	16.54
120-5-0.5	16.31
120-10-2	16.30
120-10-0.5	16.29
150-5-2	20.74
Acid 150-5-2	29.20
150-5-0.5	28.38
150-10-2	16.85
150-10-0.5	21.77
Acid 150-30-2	0.00
Acid 150-30-0.5	5.45

CONCLUSIONS

- Pre-treatment with the DES ChCl:EG is a selective method able to partially solubilize the lignin from biomass.
- Pre-acidification of DES at pH ≈ 4 improves the process.
- Increasing the solids loading or particle size of the biomass led to a certain decrease in saccharification efficiency.
- The best condition tested are: **DES acidified, 150ºC, 5% solids load and 0.5 mm particle size**; reaching almost 50% and 60% for glucan and xylan, respectively.
- In addition, delignification was able to reach almost 30% of the lignin in the raw material.

Acknowledgements

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