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ACID AND ENZYMATIC PRETREATMENT OF FOOD INDUSTRY BY-PRODUCTS FOR POLYHYDROXYALKANOATE PRODUCTION

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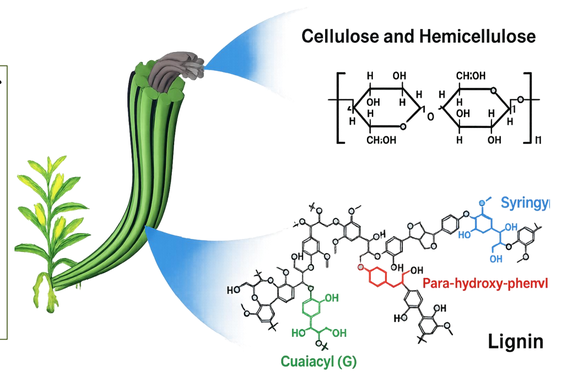
INTRODUCTION

In recent years, agro-industrial waste has attracted increasing attention as a low-cost and renewable feedstock for the production of polyhydroxyalkanoates (PHA), biodegradable and biocompatible biopolymers considered a sustainable alternative to conventional plastics. Due to the complex structure of lignocellulosic biomass and the limited availability of fermentable sugars, pretreatment is often required to enhance nutrient accessibility for microorganisms. Among the most commonly applied pretreatment methods are acid (AH) and enzymatic hydrolysis (EH), which improve the release of reducing sugars from biomass and increase its suitability for microbial conversion into value-added products such as PHA.



MATERIALS AND METHODS

MICROBIOLOGICAL ANALYSIS

PHYSICOCHEMICAL ANALYSIS

ACID HYDROLYSIS

ENZYMATIC HYDROLYSIS

DETERMINATION OF REDUCING SUGARS

RESULTS AND DISCUSSION

Table 1. Concentration of reducing sugars and COD before pretreatment and after acid and enzymatic hydrolysis.

Sample	ω / mg (red. sugars) g_{DM}^{-1}	COD / mg (org. load) g_{DM}^{-1}	
S0	29.99	250.88	
S1	68.15	377.62	AH
S1-1	74.50	480.95	Before EH (P)
S1-2	63.17	279.88	
S2	108.99	713.83	
S1-1	61.74	583.80	After EH (Z)
S1-2	41.80	236.02	
S2	91.43	846.98	

* S0 - untreated mixed waste; S1 - hydrolysate obtained by AH; S1-1 - EH of the solid pretreated mixed waste after AH; S1-2 - EH of the liquid hydrolysate after AH; S2 - EH of untreated solid mixed waste

Table 2. Physicochemical parameters of untreated mixed agroindustrial waste.

Paramets	Mixed agroindustrial waste
w (moisture) / %	79.09
w (dry matter) / %	20.91
w (volatile matter) / %	95.68
pH value / -	4.827
κ / mS cm^{-1}	2.46
γ (O_2) / mg L^{-1}	0.05
C/N / -	17.75
CFU (bacteria) / cell g_{DM}^{-1}	$8.80 \cdot 10^9$
CFU (fungi) / cell g_{DM}^{-1}	$1.81 \cdot 10^8$

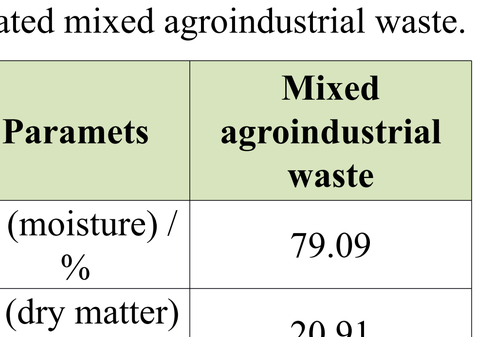


Fig 1. *T. reesei* - fungi whose cellulase was used for EH.

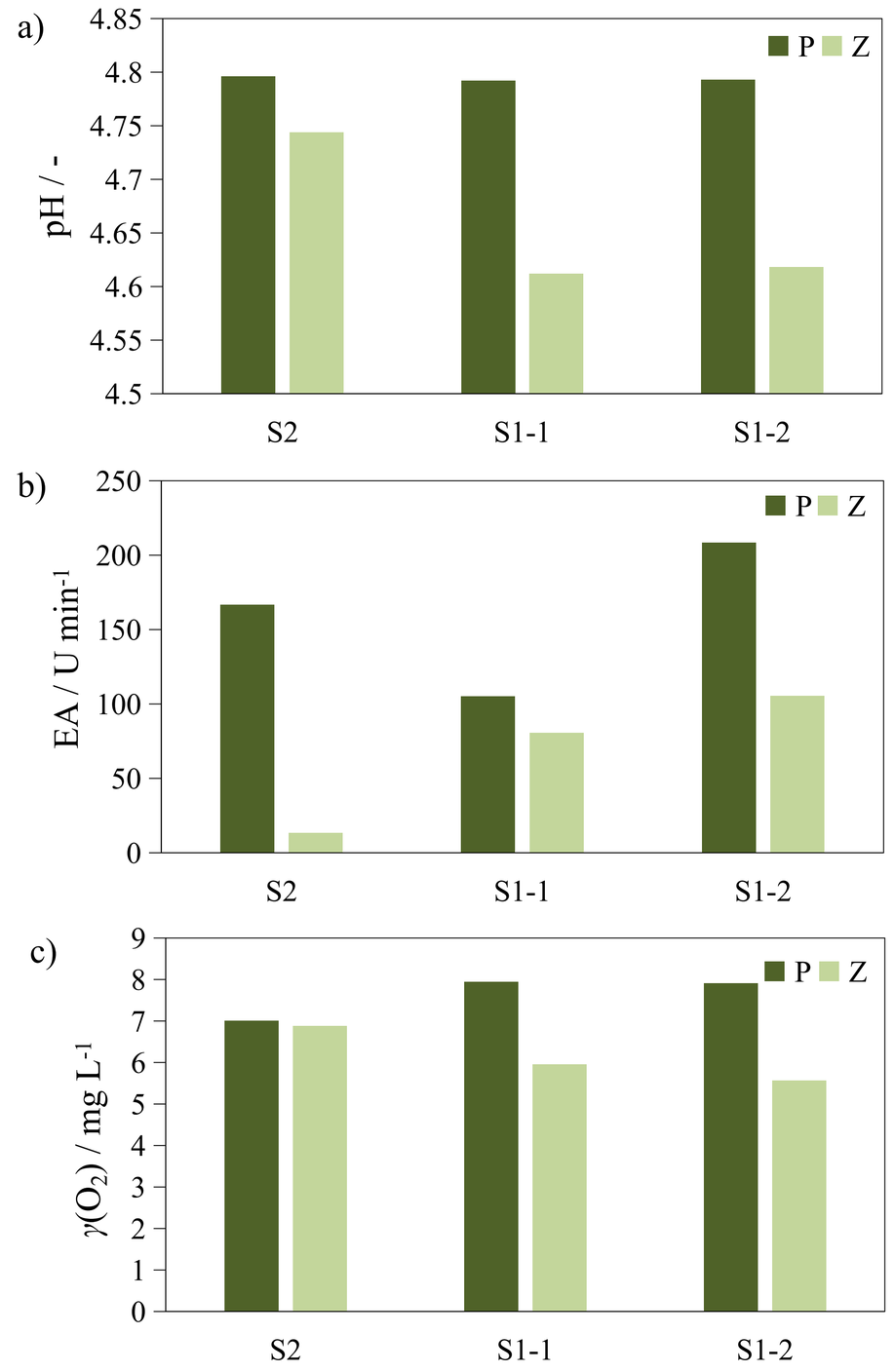


Fig 2. Changes in parameters before and after EH a) pH value; b) enzymatic activity; c) concentration of dissolved oxygen.

CONCLUSION

Acid hydrolysis proved to be an effective pretreatment method for agro-industrial waste, as it released the highest concentration of reducing sugars by disrupting the lignocellulosic structure and increasing the accessibility of cellulose to enzymatic hydrolysis. Enzymatic hydrolysis of the pretreated biomass further increased both the concentration of reducing sugars and the total organic load compared with untreated waste. These pretreatment strategies enhanced the availability of fermentable sugars, providing an efficient carbon source for microbial growth and PHA biosynthesis.

https://bio-pha-com-f-pack.eu/

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