eman ta zabal zazu

UPV EHU

CAMPUS OF INTERNATIONAL EXCELLENCE

BioRP
Biorefinery Processes Research Group

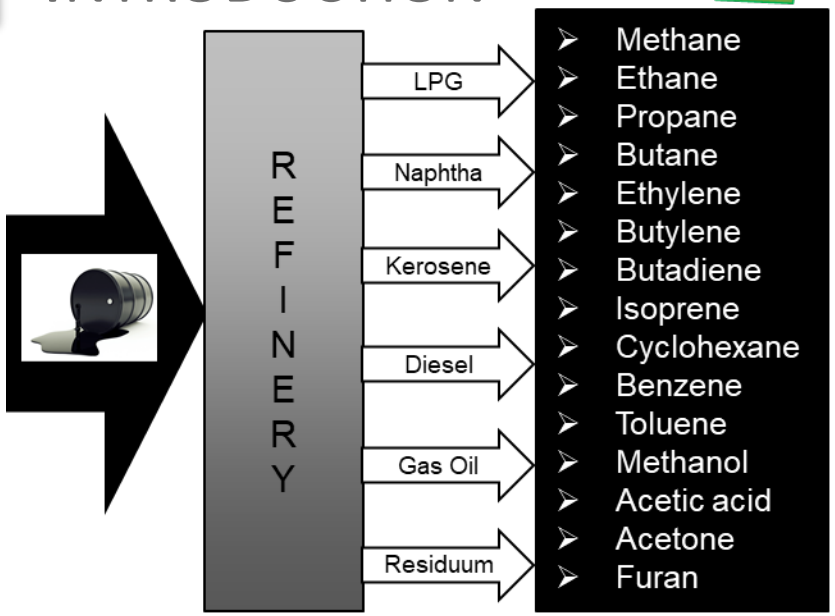
INTEGRATED MULTIPRODUCTS BIOREFINERY

F. HERNÁNDEZ-RAMOS, A. MORALES, R. FERNÁNDEZ-MARÍN, L. SILLERO, I. DÁVILA, X. ERDOCIA, M. GONZALEZ, R. LLANO-PONTE, J. LABIDI

University of Basque Country

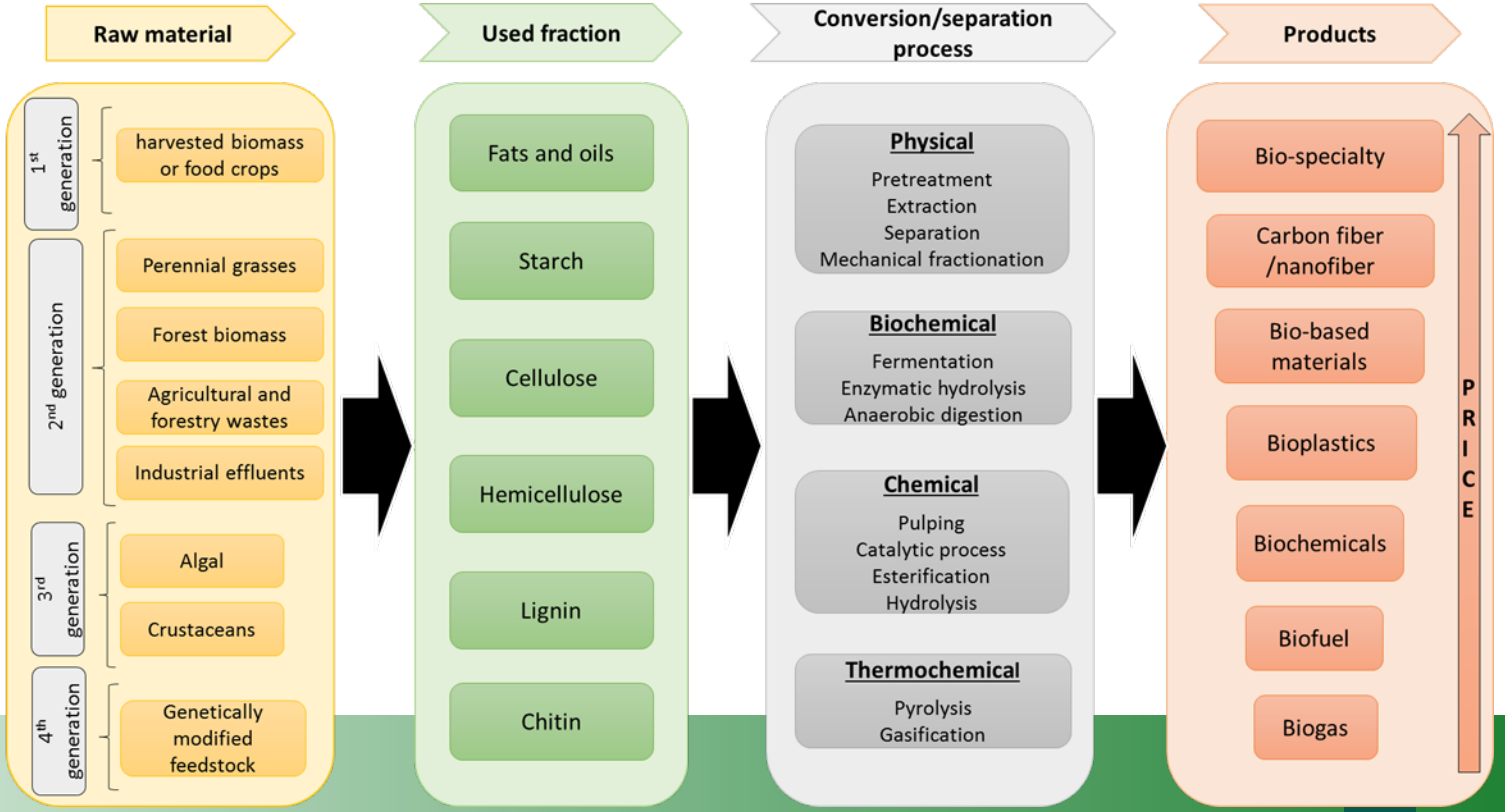
9th International Conference on Sustainable Solid Waste Management , CORFU 15-17 June 2022

INTRODUCTION



Demand of natural and environmentally more sustainable products.

BIOREFINERY



Environmental problems

Depletion of crude oil

INTRODUCTION

Almonds

Prunus amgdalus

Spain:

- First country in cultivated area (661.000 ha)
- One of the major producers of almond

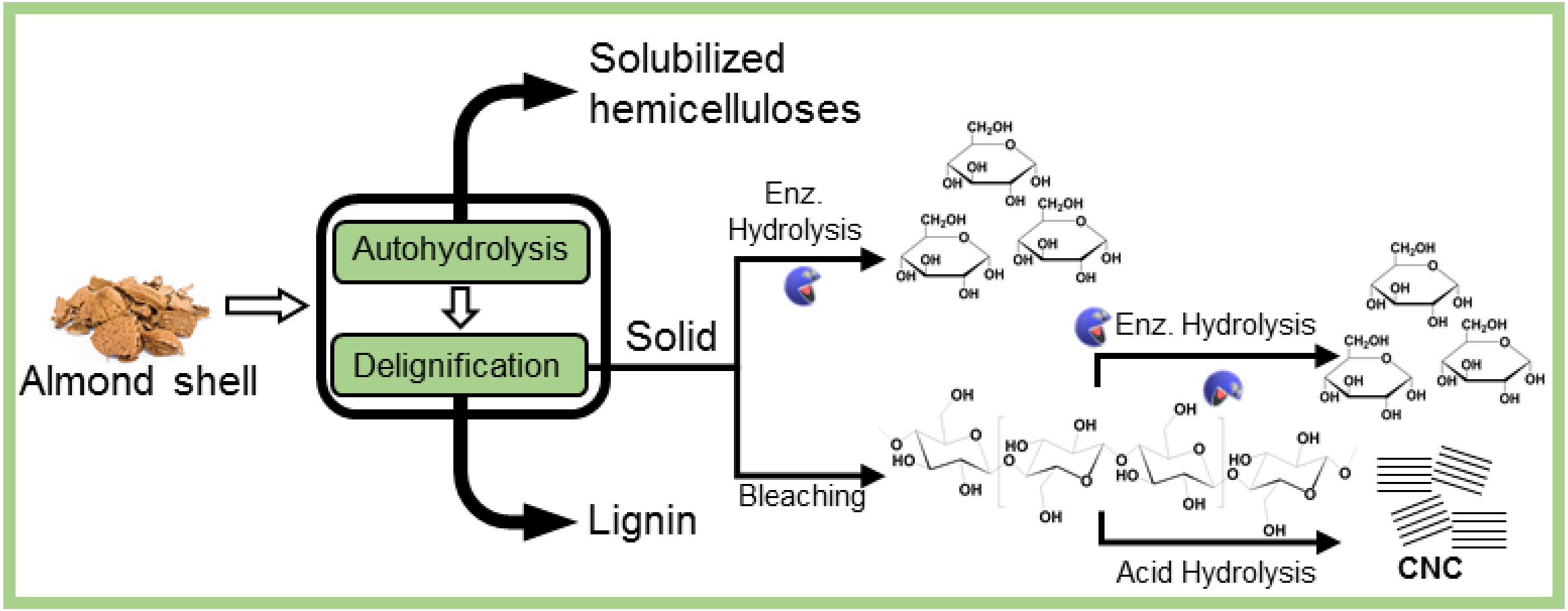
70-150 million Kg residue/year

Present use: energy production

➢Characterization of Almond shells

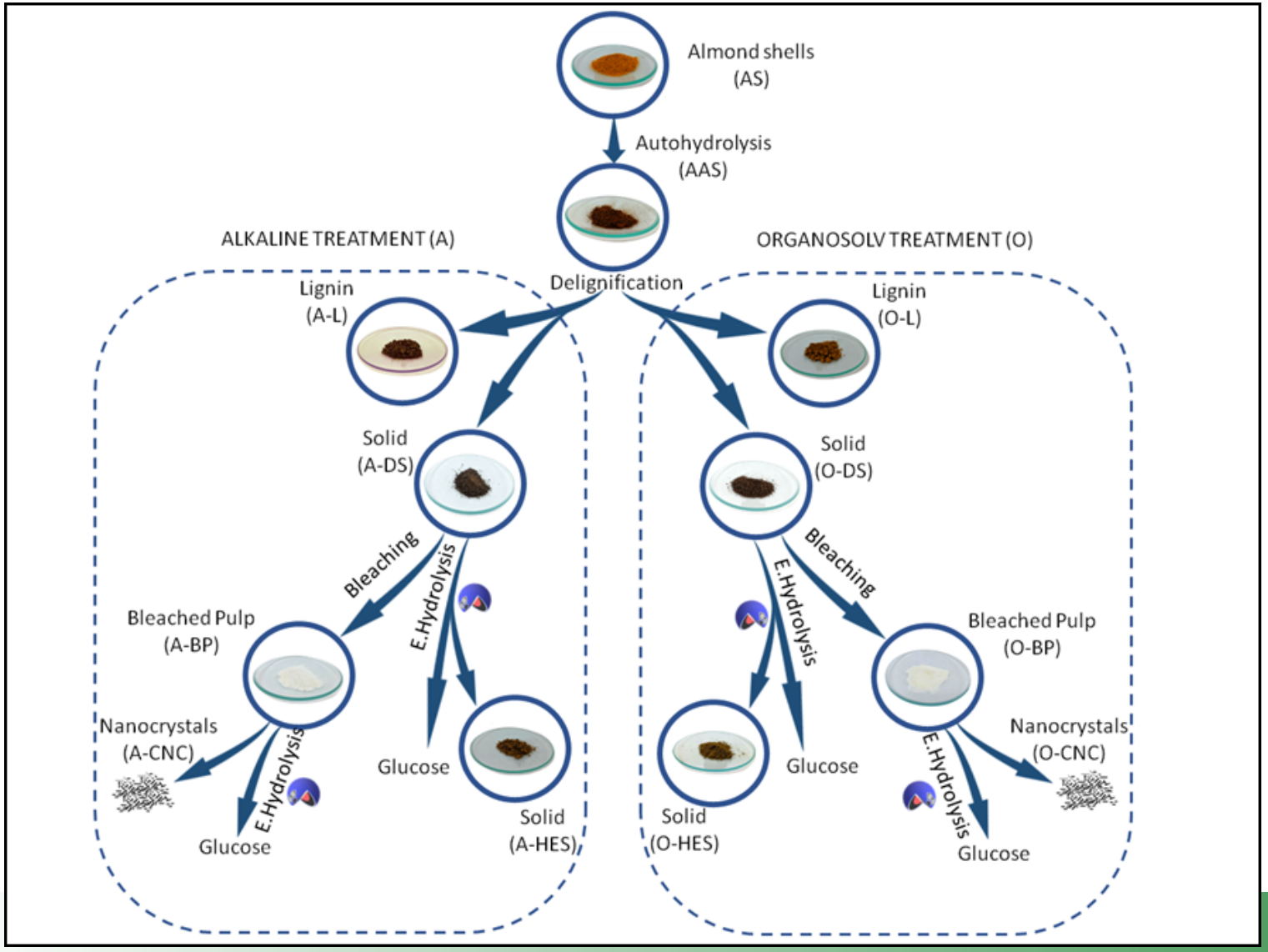
Component	Raw material	
	Almond shells	Maritime pine
Cellulose	18.19±0.19	34.05±0.05
Hemicellulose	35.99±1.23	18.07±0.22
Lignin	31.24±0.29	30.36±0.68
Extractives	3.11±0.32	5.40±0.14
Ashes	0.81±0.09	0.32±0.11

BIOREFINERY OF ALMOND SHELL



Morales A. et al. 2020, Ind. Crop. Prod. 315, 123896

Biorefinery of Almond Shell

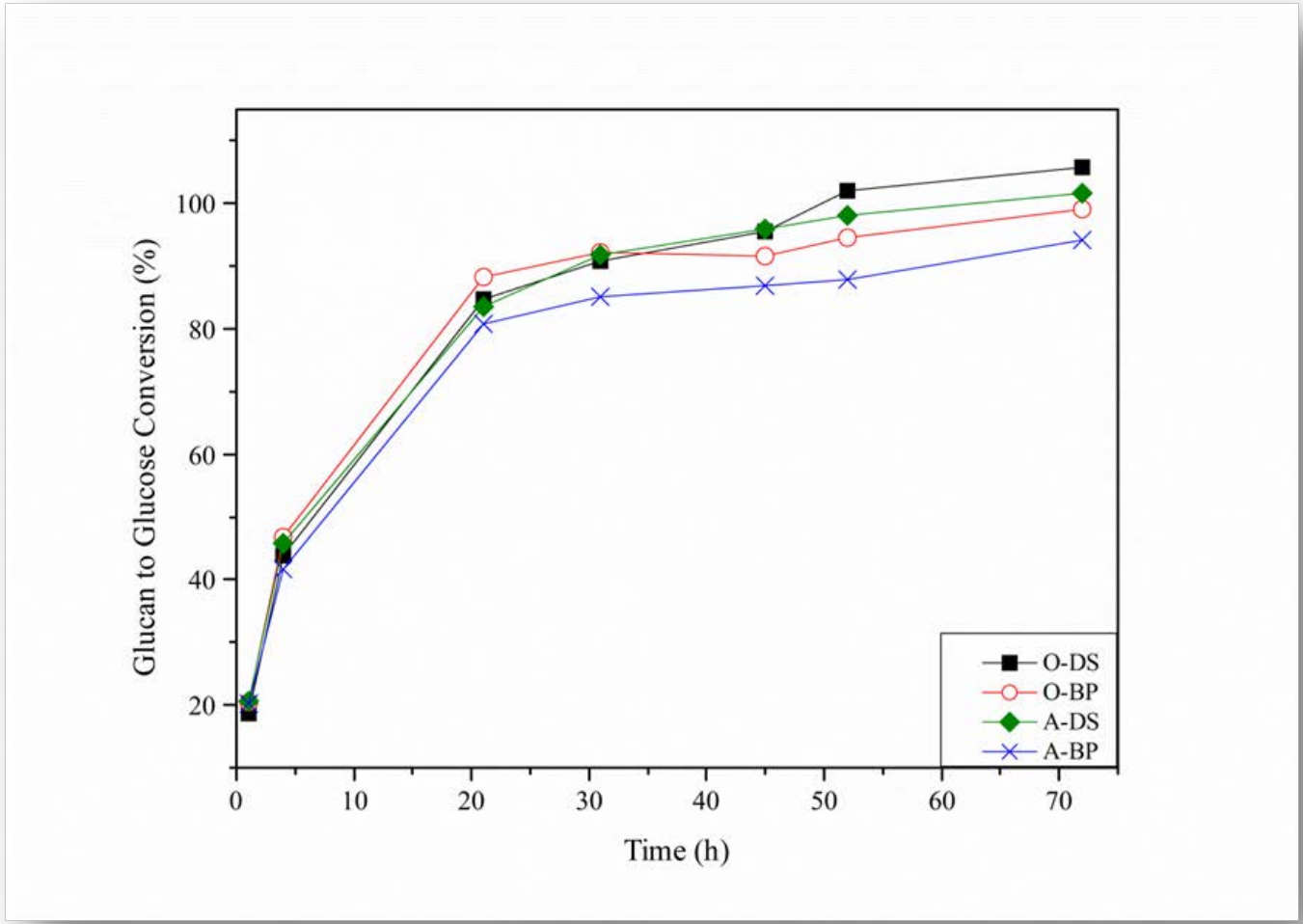


RESULTS

Composition of the solids after autohydrolysis, delignification, bleaching and enzymatic hydrolysis.

	Composition (wt.%)			Loss during the Treatment (wt.%)		
Treatment	**Lignin**	**Glucan**	**Hemicelluloses**	**Lignin**	**Glucan**	**Hemicelluloses**
AAS: Autohydrolysis Solid	38.98	31.26	11.12	24.77	0	80.19
O-DS: Organosolv delignified solid	38.41	46.32	10.11	35.09	2.39	40.11
A-DS: Alkaline delignified solid	34.66	50.38	0.15	37.12	0	99.06
O-BP: Organosolv Bleached Pulp	0	63.23	0.86	100	2.21	93.91
A-BP: Alkaline Bleached Pulp	0	75.06	0	100	1.15	100
O-HES: Organosolv post enzymatic hydrolysis solid	76.11	8.22	0	56.00	96.07	100
A-HES: Alkaline post enzymatic hydrolysis solid	78.08	4.39	0	27.40	97.19	100

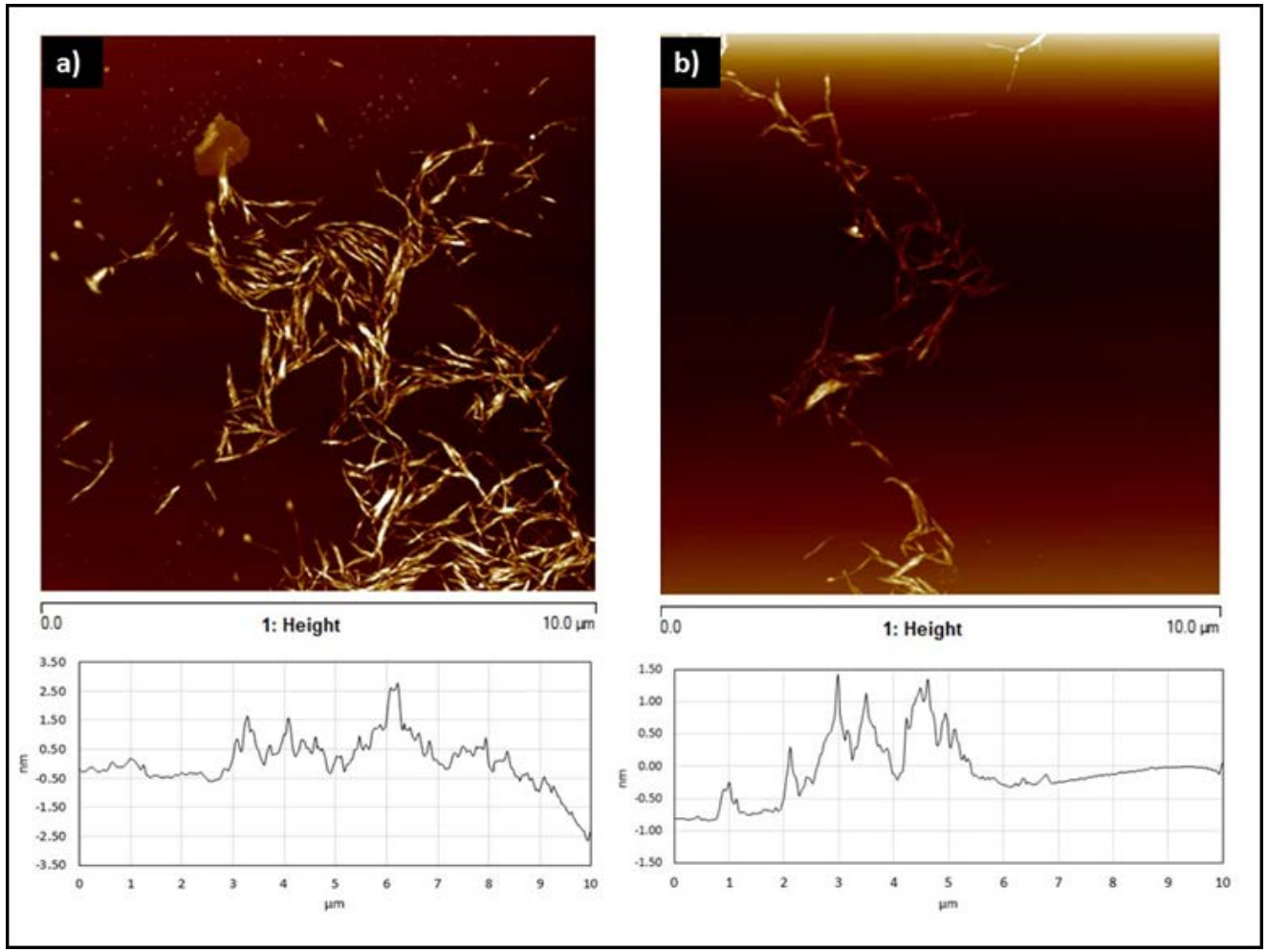
RESULTS



O-DS: Organosolv delignified solid,
O-BP: Organosolv Bleached Pulp
A-DS: Alkaline delignified solid
A-BP: Alkaline Bleached Pulp

Glucan to glucose conversion during the enzymatic hydrolysis of differently pretreated Almond Shells

CELLULOSE CNC



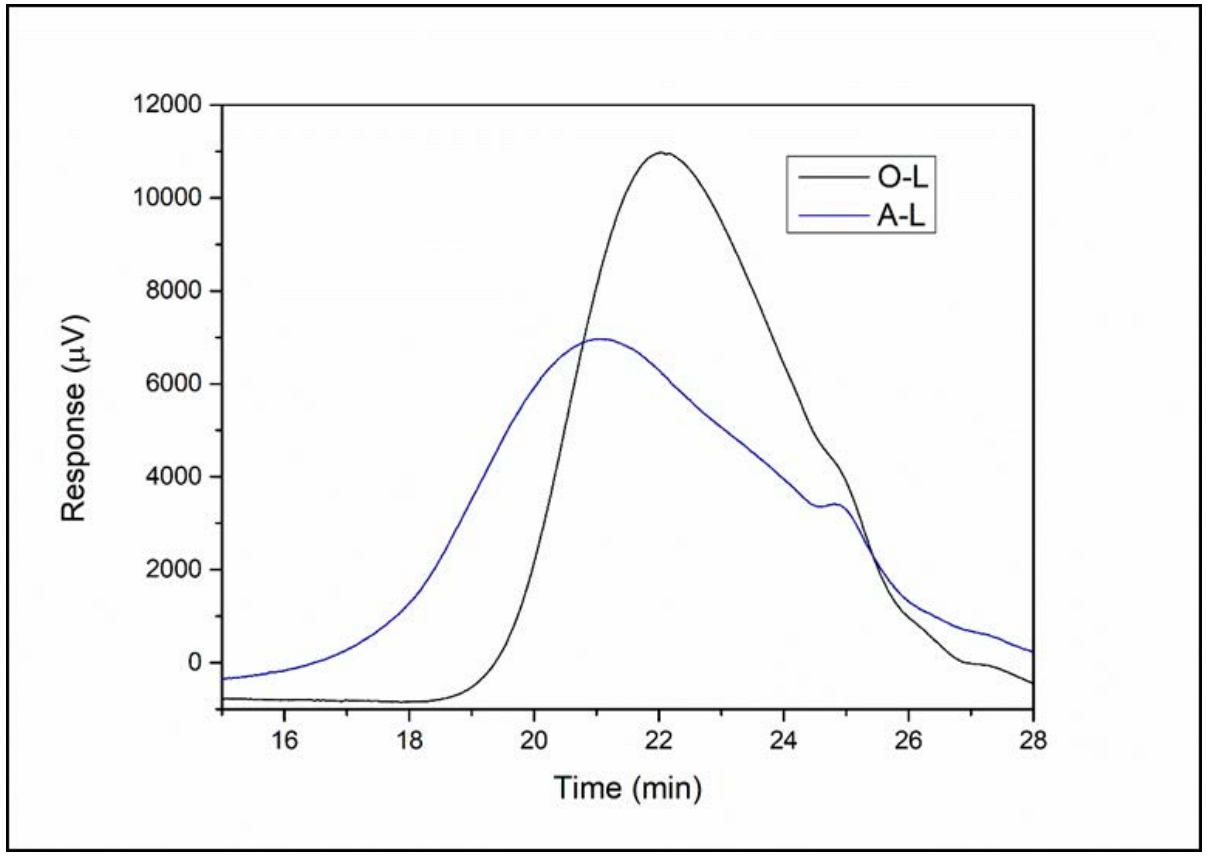
O-CNC were slightly shorter in length than A-CNC (average 773.80 ± 77.03 nm and 860.09 ± 38.64 nm, respectively), whereas the width of O-CNC was higher than in A-CNC (average 70.05 ± 7.18 and 61.01 ± 5.37 nm, respectively)

AFM images and profile of the height values along the sample in the marked area of 2D AFM images of a) O-CNC b) A-CNC

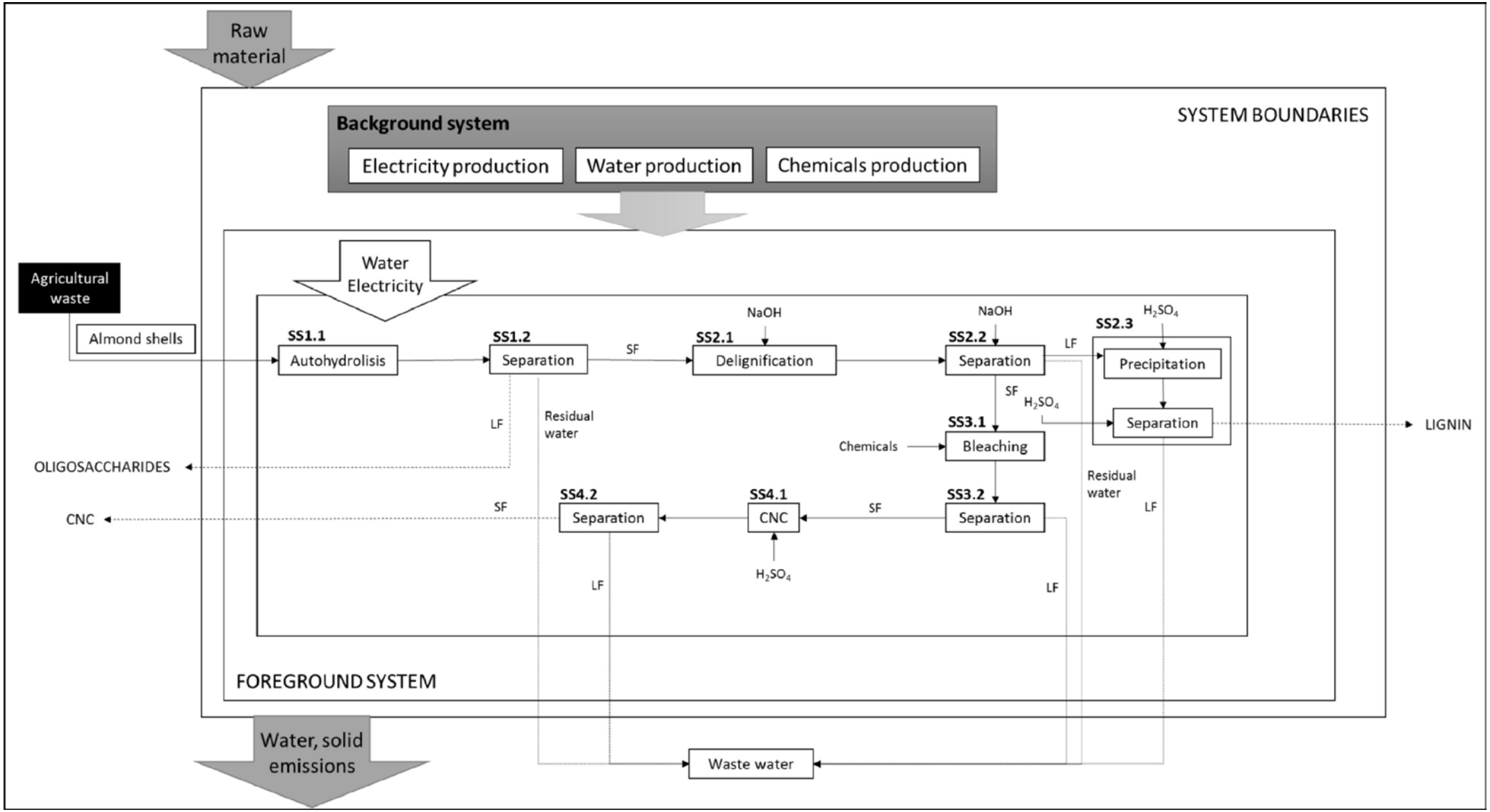
LIGNIN

Molecular weight

Sample	Mn	Mw	Mw/Mn
O-L	1555	6997	4.50
A-L	1615	23182	14.35



LCA

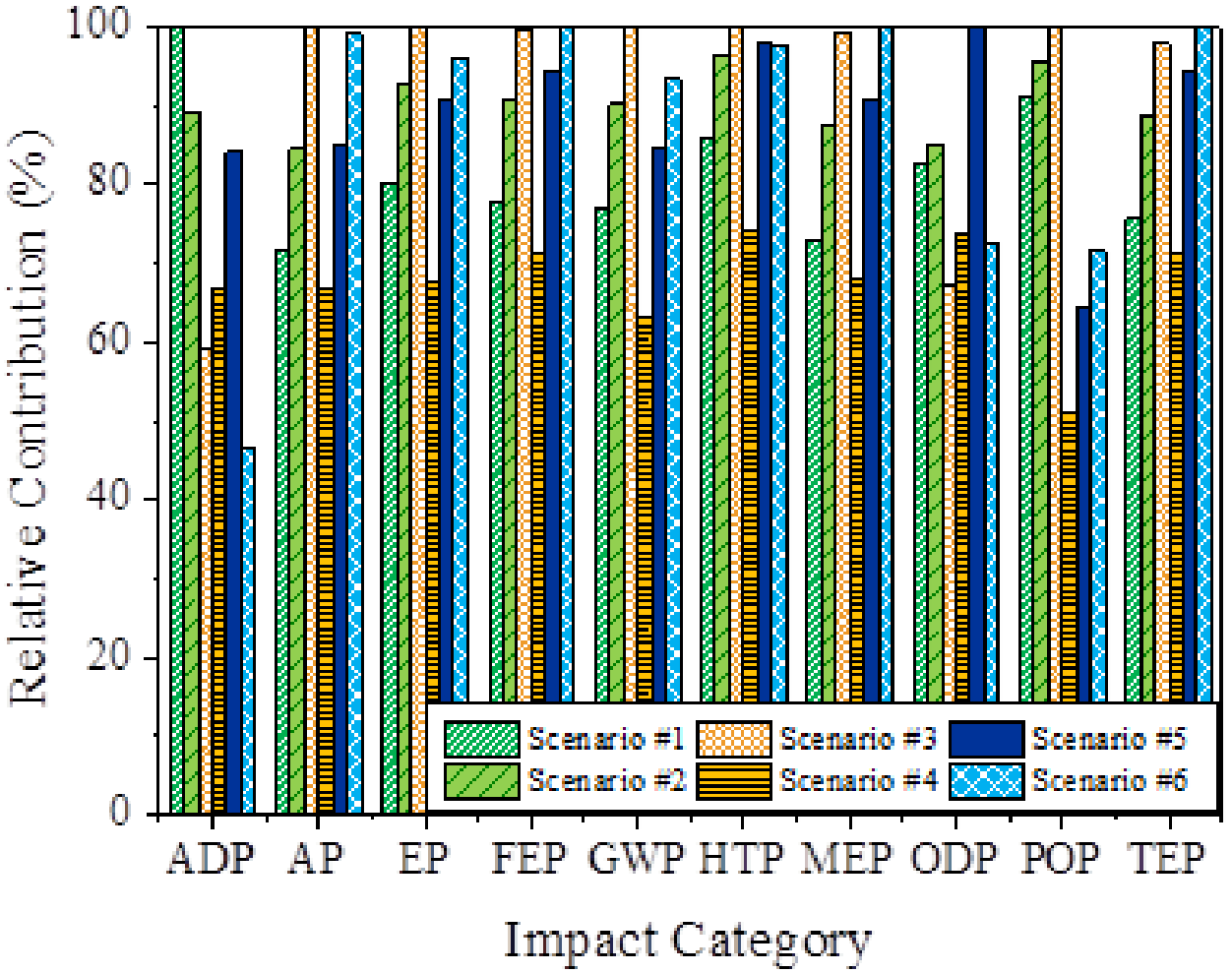


L. Sillero et al. Life Cycle Assessment of various biorefinery approaches for the valorisation of almond shells, Sustainable Production and Consumption (2021), 28, 749-759.

LCA SCENARIO

Subsystem		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario
SS1	Autohydrolysis (SS1.1)	●	●	●	●	●	●
	Separation 1 (SS1.2)	●	●	●	●	●	●
SS2	Organosolv delignification (SS2.1)	●	●	●			
	Alkaline delignification (SS2.1)				●	●	●
	Separation 2 (SS2.2)	●	●	●	●	●	●
	Lignin precipitation & separation (SS2.3)	●	●	●	●	●	●
SS3	Bleaching (SS3.1)	●	●		●	●	
	Separation 3 (SS3.2)	●	●		●	●	
SS4	CNC production (SS4.1)	●			●		
	Separation 4 (SS4.2)	●			●		
SS5	Enzymatic hydrolysis (SS5.1)		●	●		●	●
	Separation 5 (SS5.2)			●			●

LCA



Scenario 4 >>> lowest environmental impacts

eman ta zabal zazu

UPV EHU

CAMPUS OF INTERNATIONAL EXCELLENCE

BioRP

Biorefinery Processes Research Group

THANK YOU

CONTACT US AT:

Jalel.labidi@ehu.eus