



NATIONAL/INTERNATIONAL COOPERATION: THE KEY TO BIOREFINERY RESEARCH

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BIOREFINERIES: GENERAL CONCEPTS

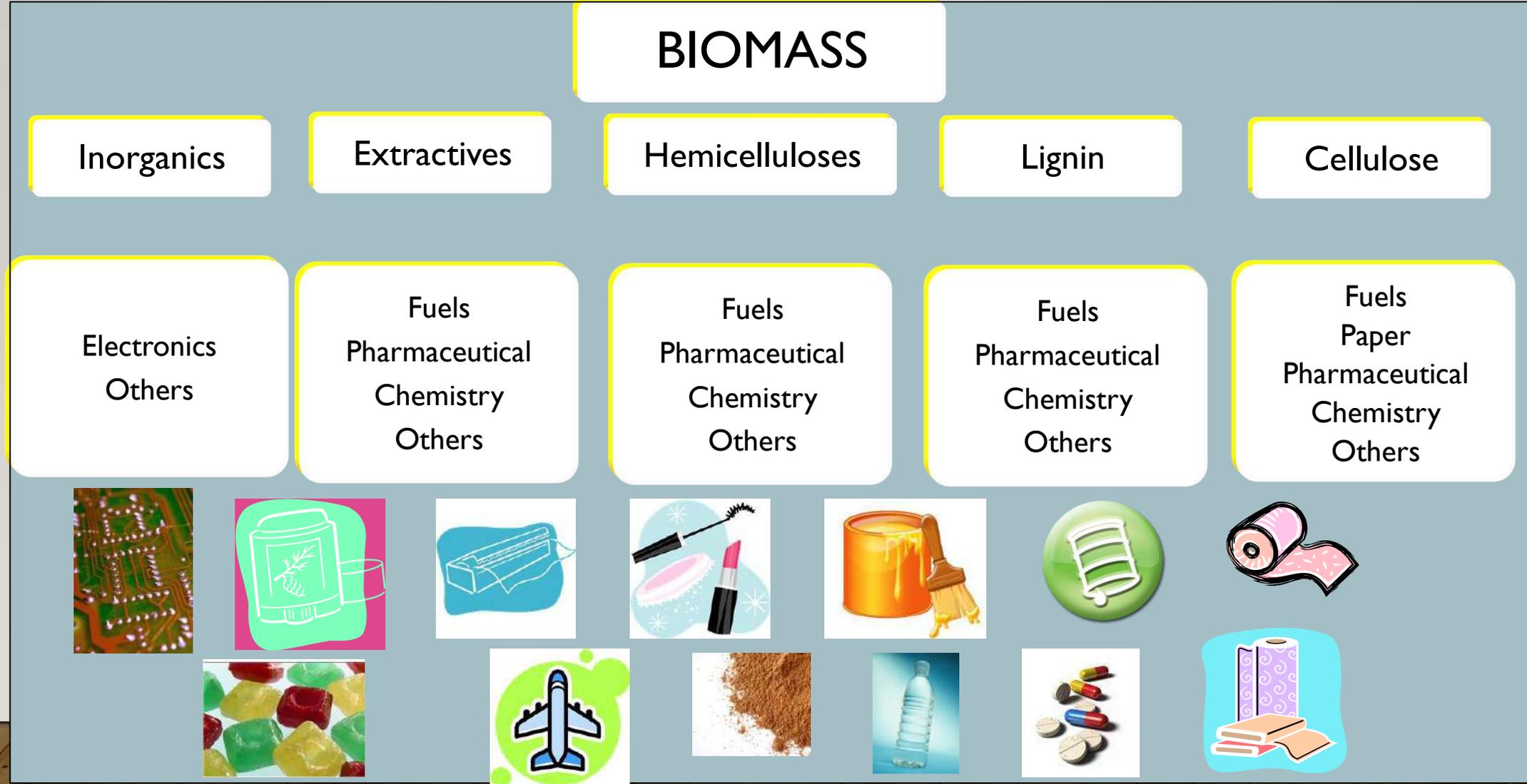


BIOREFINERY

- Structure that integrates processes for the production of fuels and chemical products from biomass
 - Polymers, plastics, ethanol, biogas, other fuels, others.
- Similar concept to oil refineries
 - But using renewable resources



Chemical platform biorefinery: Products



Some of
our
works

PROCESS
DEVELOPMENT AND
OPTIMIZATION

Soda
Hydrothermal
Solvents
Supercritical fluids
Microemulsions

BIOMATERIALS

Composite materials
Microfibrilated Cellulose (CMF)
Nanofibrilated Cellulose (CNF)
Phenol-formaldehyde resins
Bioplastics (biopolilactic acid, biopoliethylene)

BIOPRODUCTS

Xilitol
Vanillin
Levulinic acid
Lactic acid
Bioethanol



COOPERATION PROJECTS RELATED TO BIOREFINERIES



MINCYT-CONICET-CAPES (2015-2016)

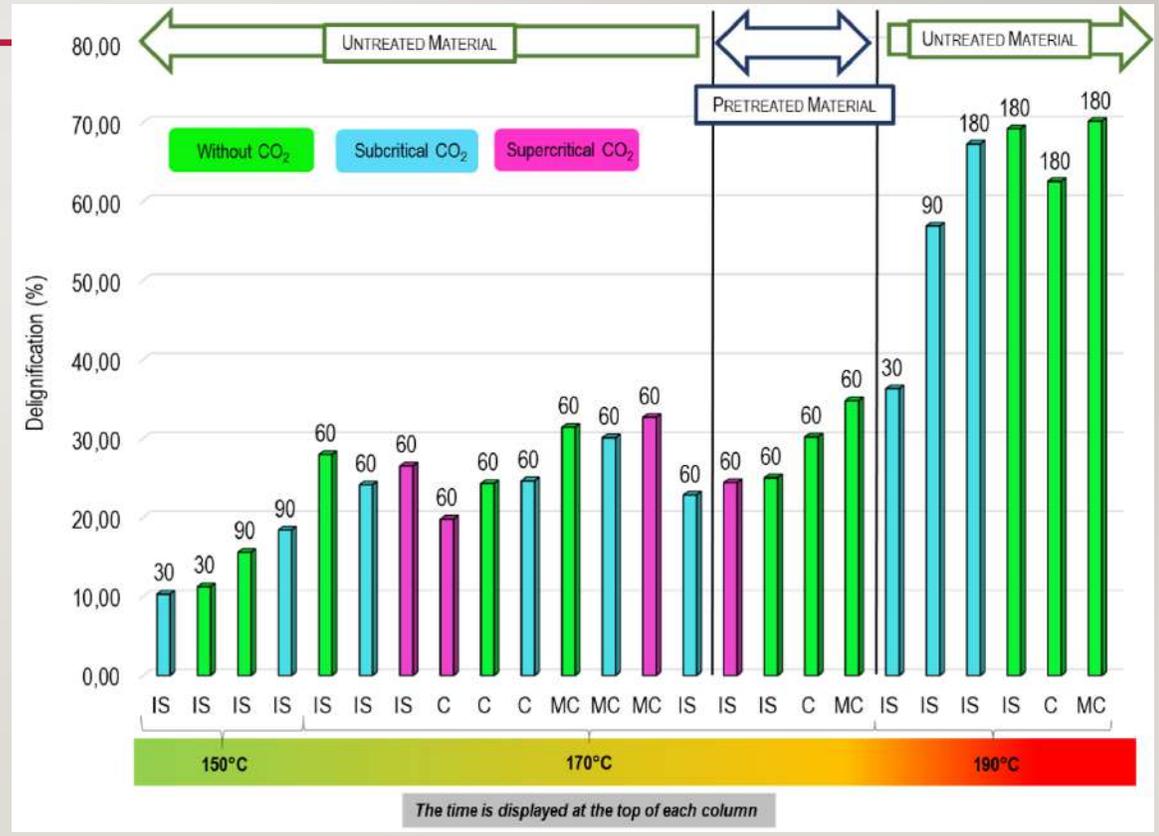
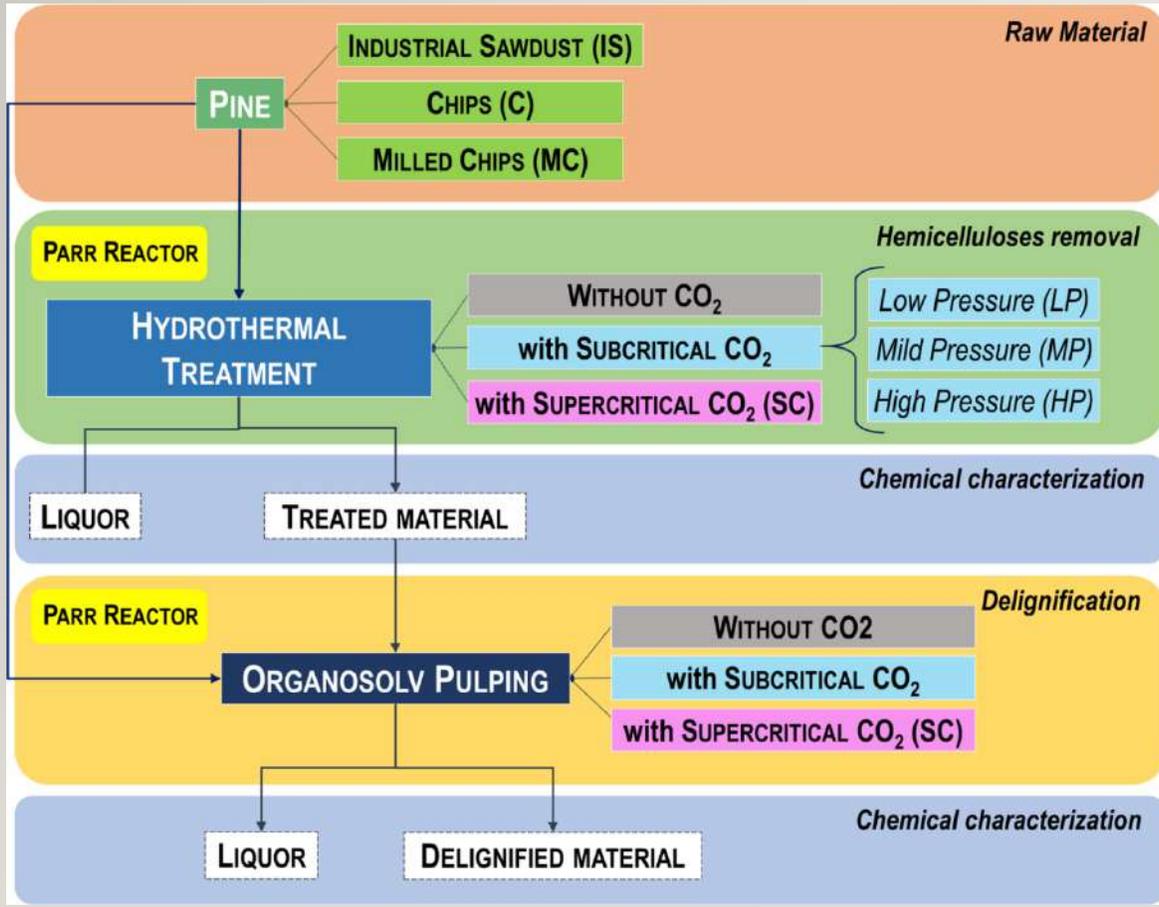
- **High-value by-products from the biorefinery of agro- and forest-industrial waste**

- Instituto de Materiales de Misiones, Argentina

- Instituto de Química de São Carlos, Universidade de São Paulo



Hydrothermal treatment and organosolv pulping of softwood assisted by carbon dioxide

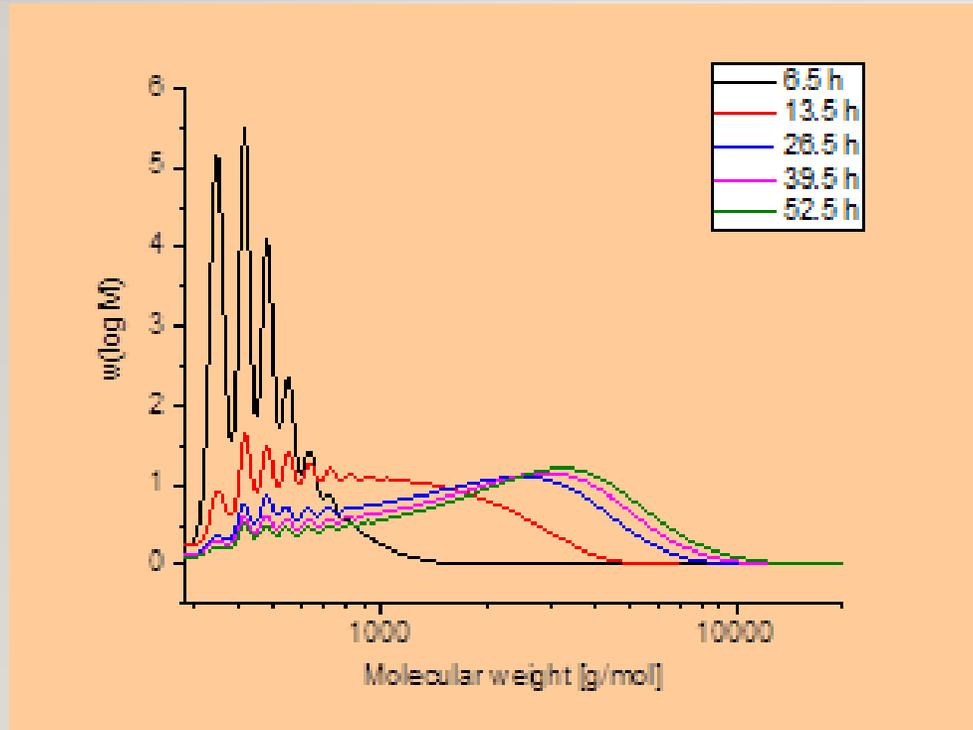


MINCYT-BMBF (2016-2018)

Added Value for Lignocellulosic based Waste Material – Application in Polymers for Coatings, Adhesives and Bioplastics

- IMAM Misiones, Argentina
- Fraunhofer Institut for Wood Research, WKI, Germany

Use of carboxylic acid mixtures derived from biomass treatment for lactic acid based polyols



We produced a polymer of LAC from pine sawdust, which could be used as wood adhesive or as intermediates for coating resins.

Figure 2. Molar mass distribution through time production (in the presence of OXA and 1,3 propanediol)

XYLITOL IN COATING RESINS

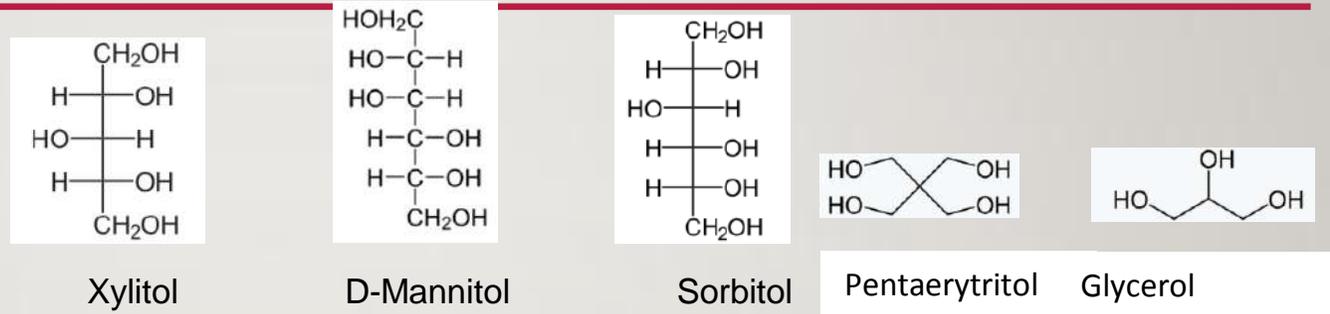
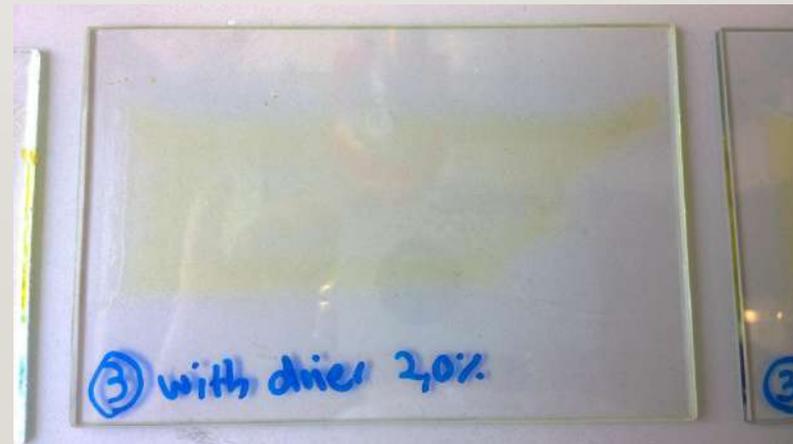


Figure 1. Chemical structure of conventional polyols.

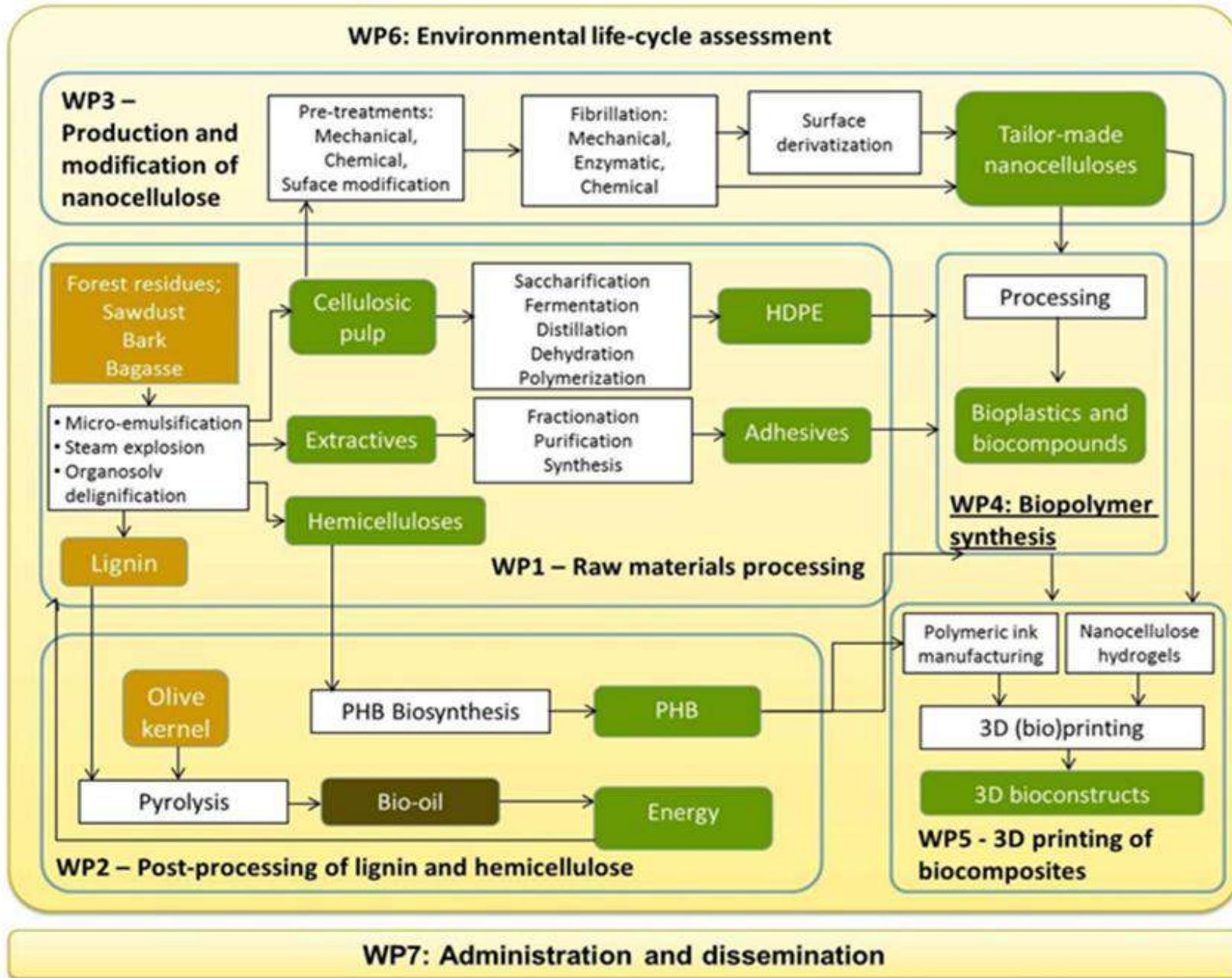


ERANET-LAC

- **ValBio 3D - Valorization of residual biomass for advanced 3D materials**
 - Instituto de Materiales de Misiones, Argentina
 - VTT Ltd., Finland
 - Fraunhofer Institute for Wood Research, Germany
 - Peruvian Life Cycle Network (PLCN), Peru
 - RISE PFI, Norway
 - University of la Frontera (UFRO), Chile
 - Santa Ana Biorefinery, Argentina



WP6: Environmental life-cycle assessment



Lignocellulosics as sustainable resources for production of bioplastics – A review

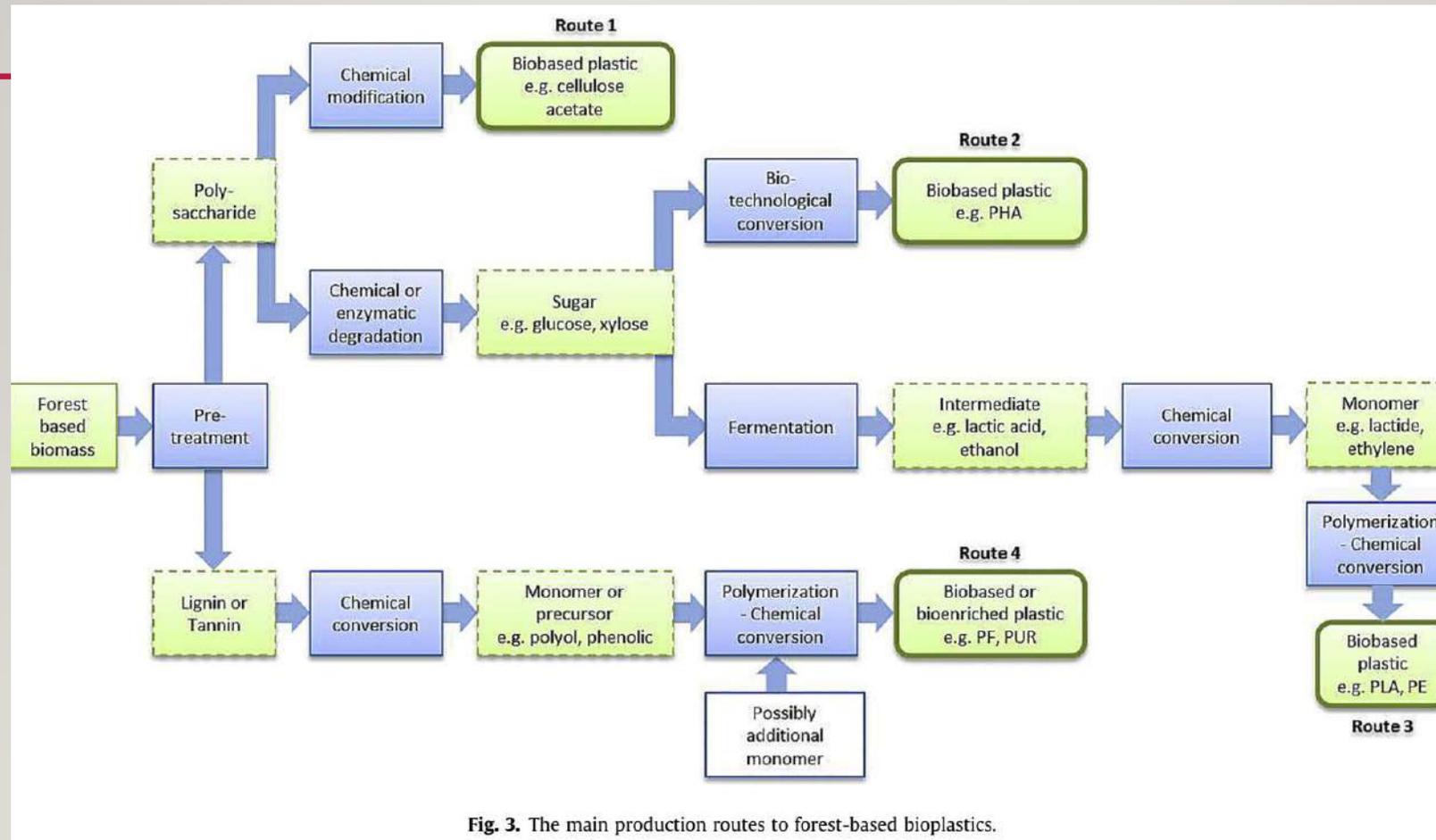
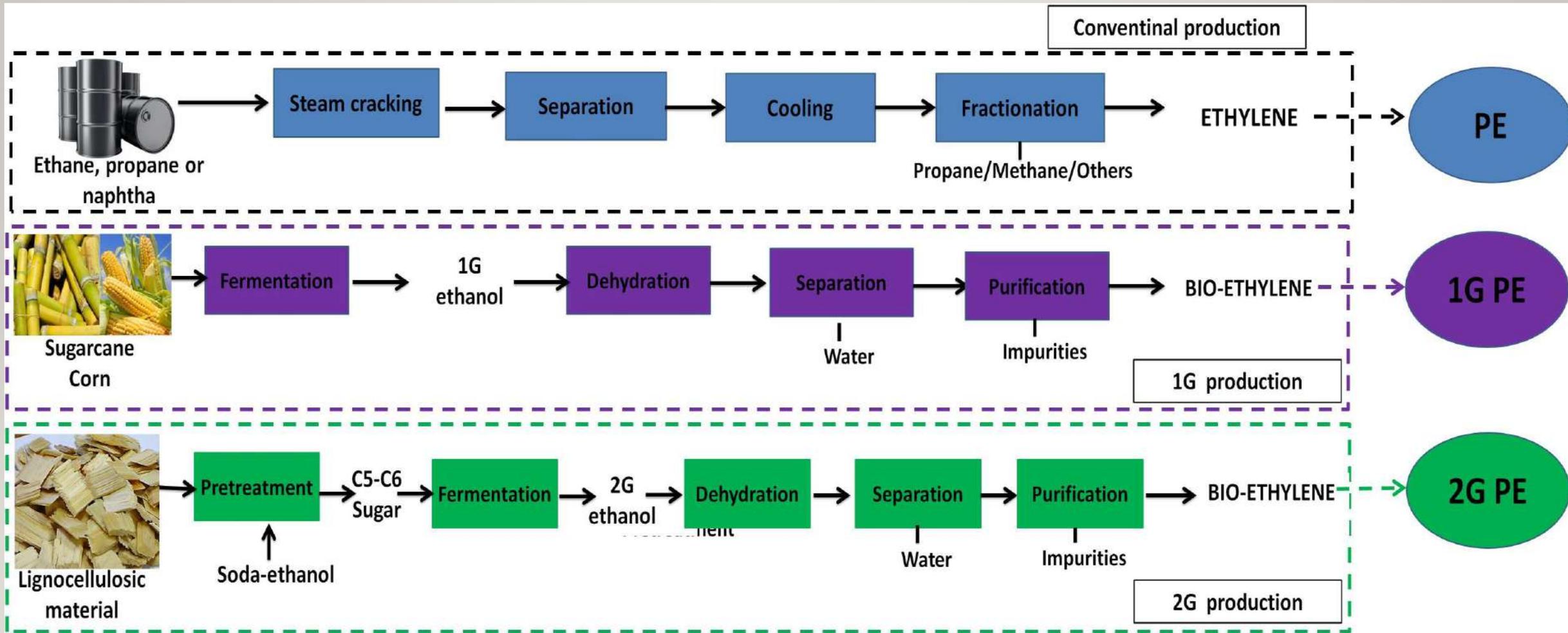


Fig. 3. The main production routes to forest-based bioplastics.

Review: bio-polyethylene from wood wastes



VALBIO3D Meetings



Lima, Perú, March 2017



Trondheim, Norway, September 2017



Temuco, Chile, March 2018



Espoo, Finland, September 2018



Puerto Iguazu, Argentina, March 2019

December 2019,
Brunswick, Germany

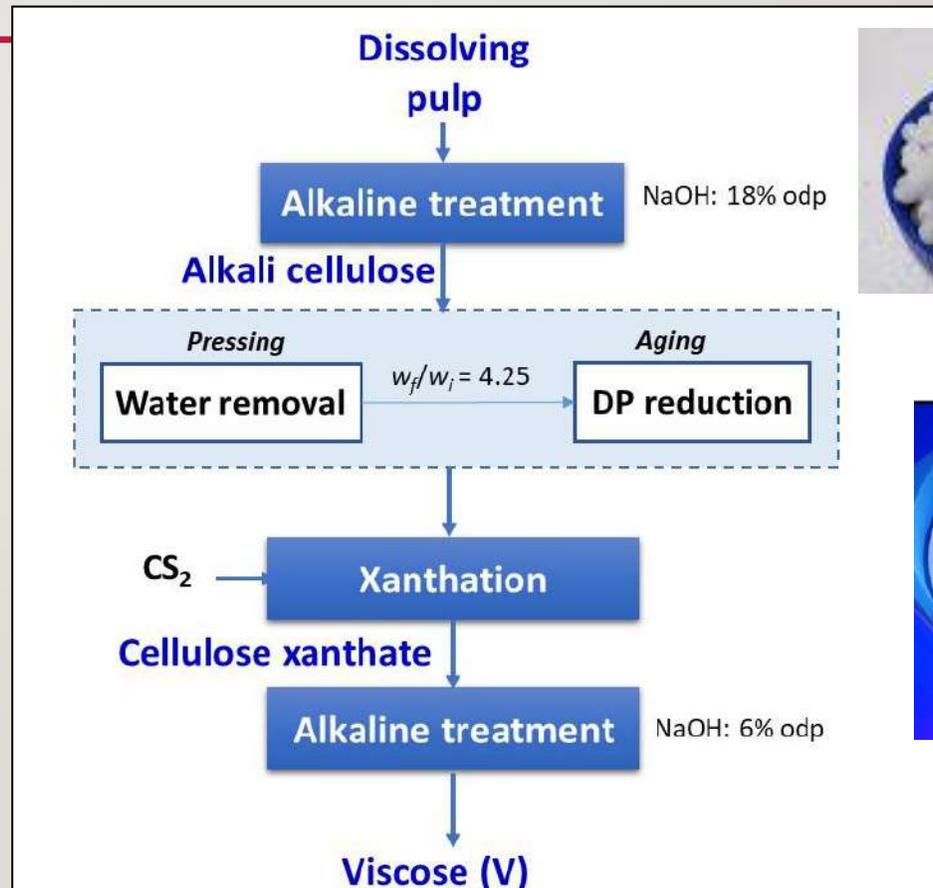
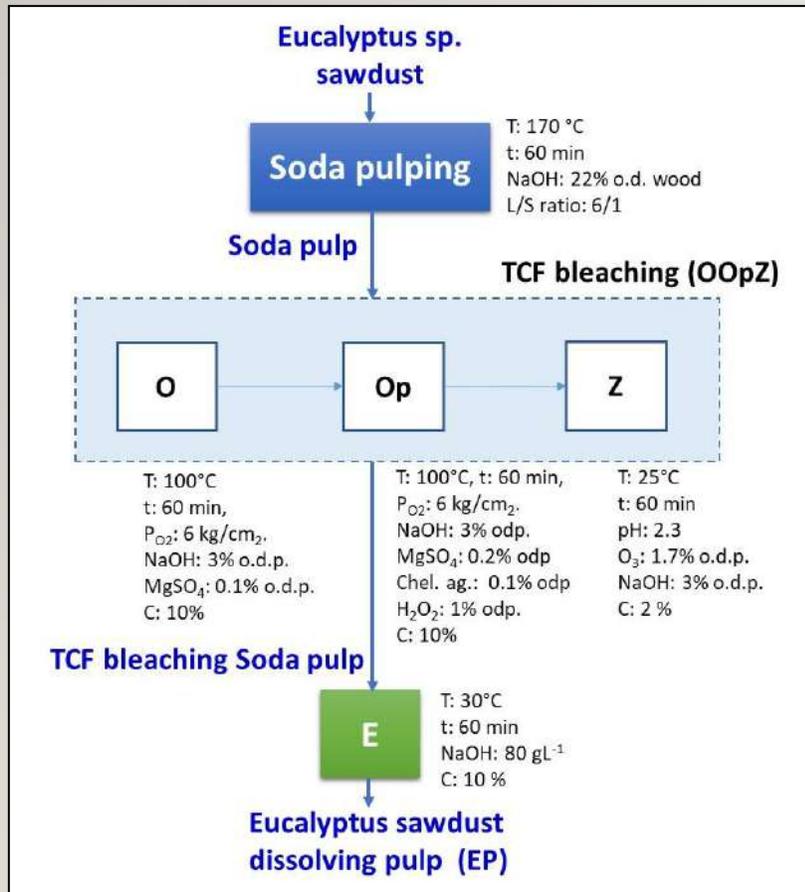
PICT RAÍCES (2017-2019)

Composite materials of cellulose regenerated with cellulose nanofibers

- IMAM Misiones, Argentina
- ITC, UNL, Santa Fe, Argentina
- Auburn University, USA



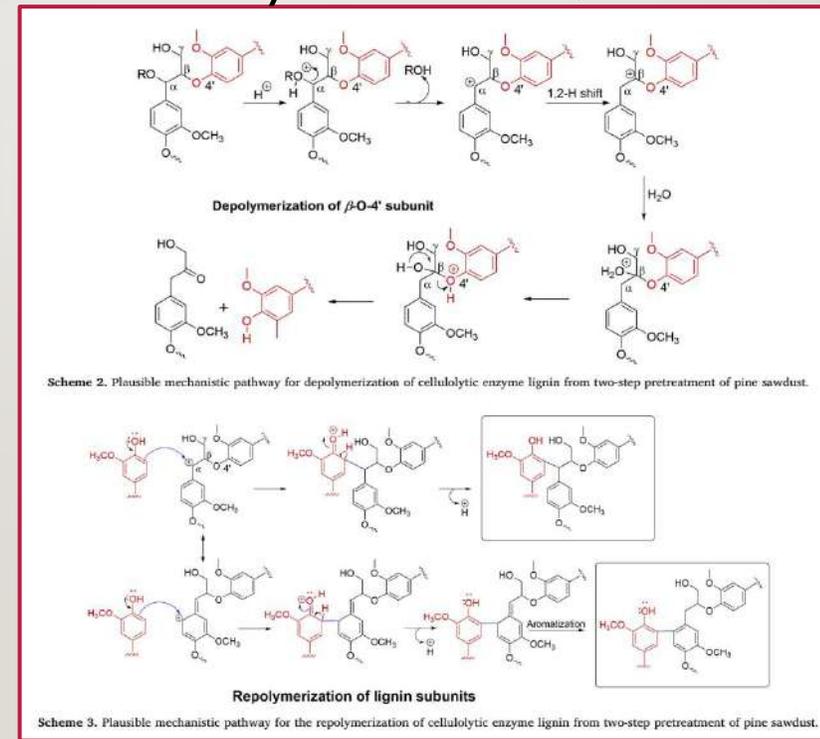
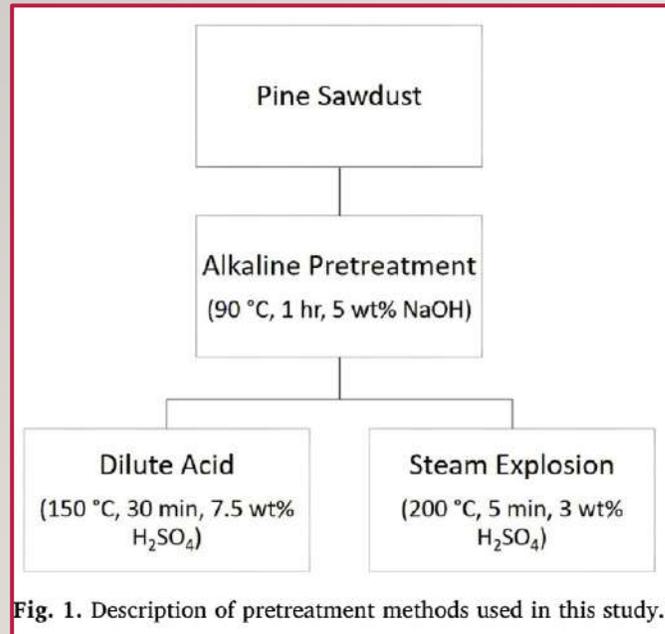
Dissolving pulp from eucalyptus sawdust and its application in cellulosic beads and films



Effects of one-step alkaline and two-step alkaline/dilute acid and alkaline/steam explosion pretreatments on the structure of isolated pine lignin

Fulbright scholarship

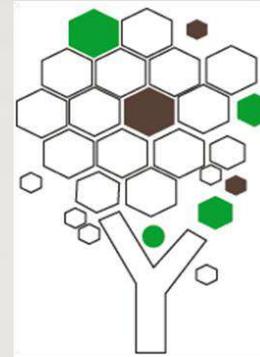
- Instituto de Materiales de Misiones, Argentina
- University of Tennessee, USA



CYTED NETWORKS



PROVALOR



PROVALOR
CYTED

NANOCELIA



Optimization of sequential alkaline-acid fractionation of pine sawdust for a biorefinery

- Instituto de Materiales de Misiones, Argentina
- Instituto de Química de São Carlos, Universidade de São Paulo
- Universidad Nacional de La Plata

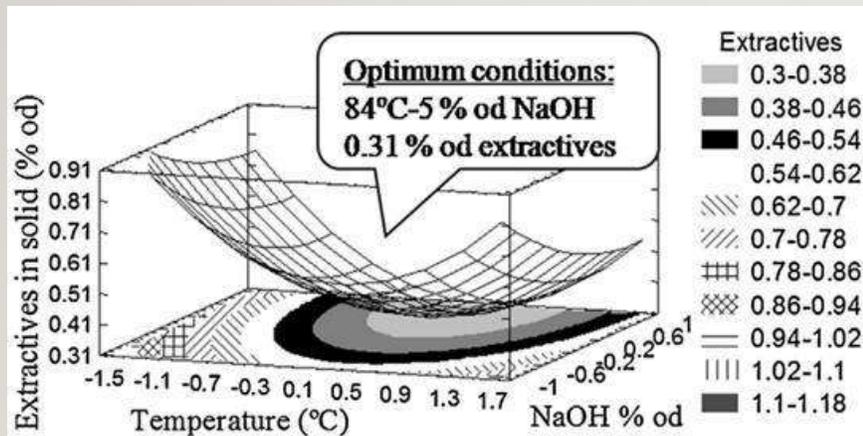


Fig. 2. Response surface for extractives removal (temperature and NaOH concentration are as codified variable).

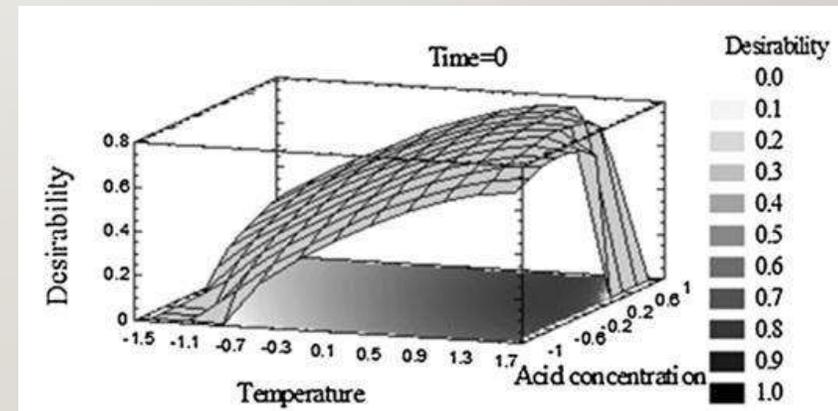
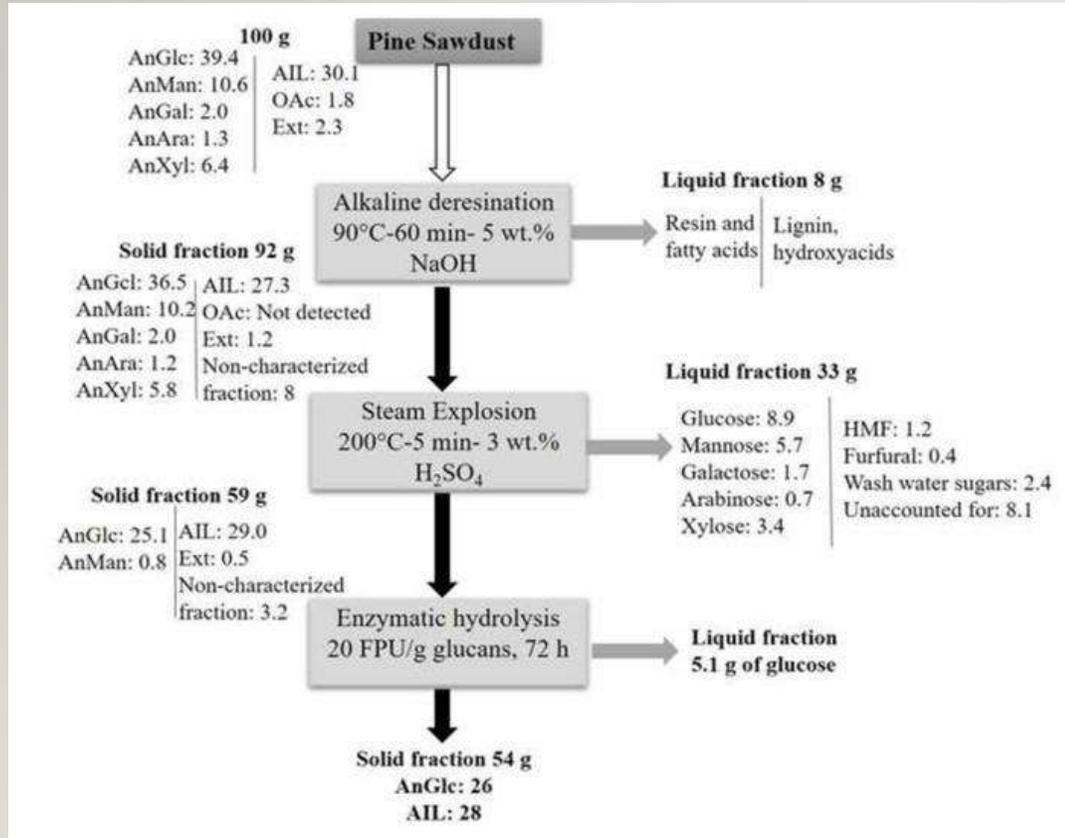


Fig. 5. Surface response and contour lines plot of the desirability function for maximization of sugars extracted from hemicelluloses (temperature, time and H_2SO_4 concentration are as codified variable).

Hemicellulose extraction from pine sawdust by steam explosion with sulfuric acid

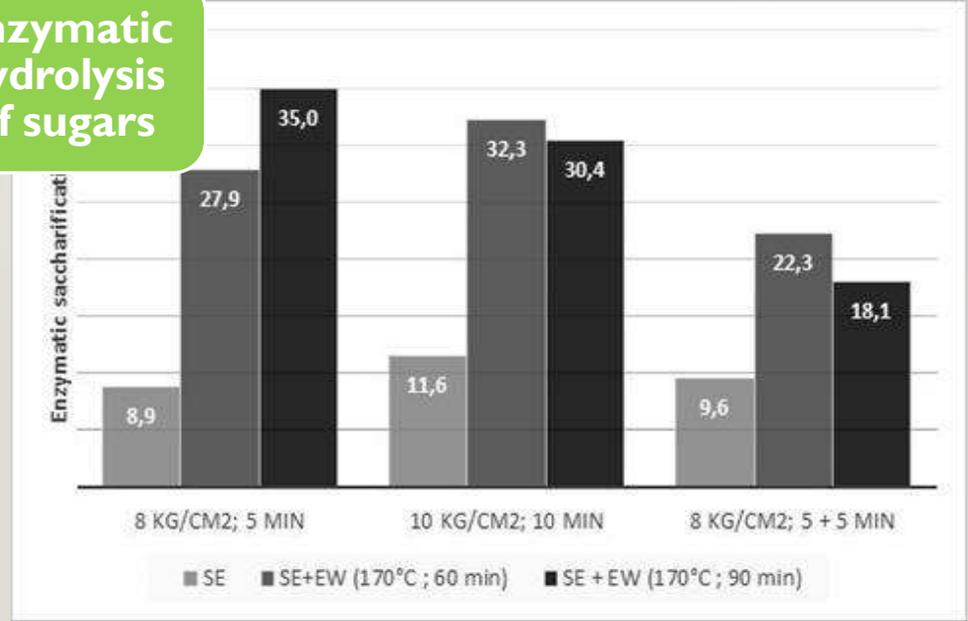


- Instituto de Materiales de Misiones, Argentina
- Universidade Federal de Parana
- Universidad Nacional de La Plata



Fractionation of pinus radiata wood by combination of steam explosion and organosolv delignification

- Instituto de Materiales de Misiones, Argentina
- INIA, Madrid



Physical and chemical characteristics of pretreated slash pine sawdust influence its enzymatic hydrolysis

- Instituto de Materiales de Misiones, Argentina
- Universidade de Coimbra

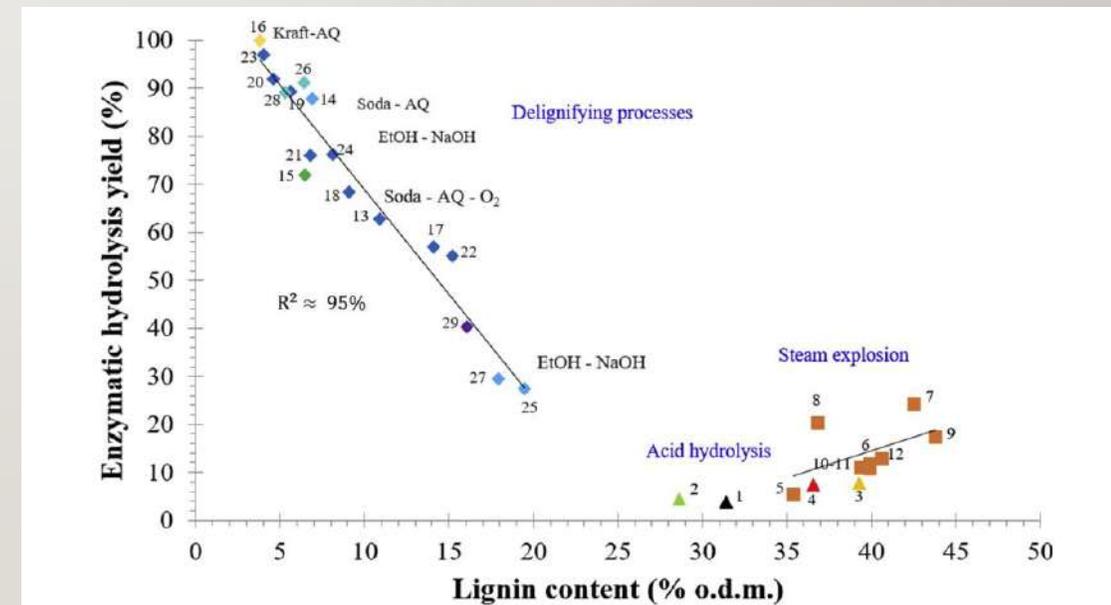
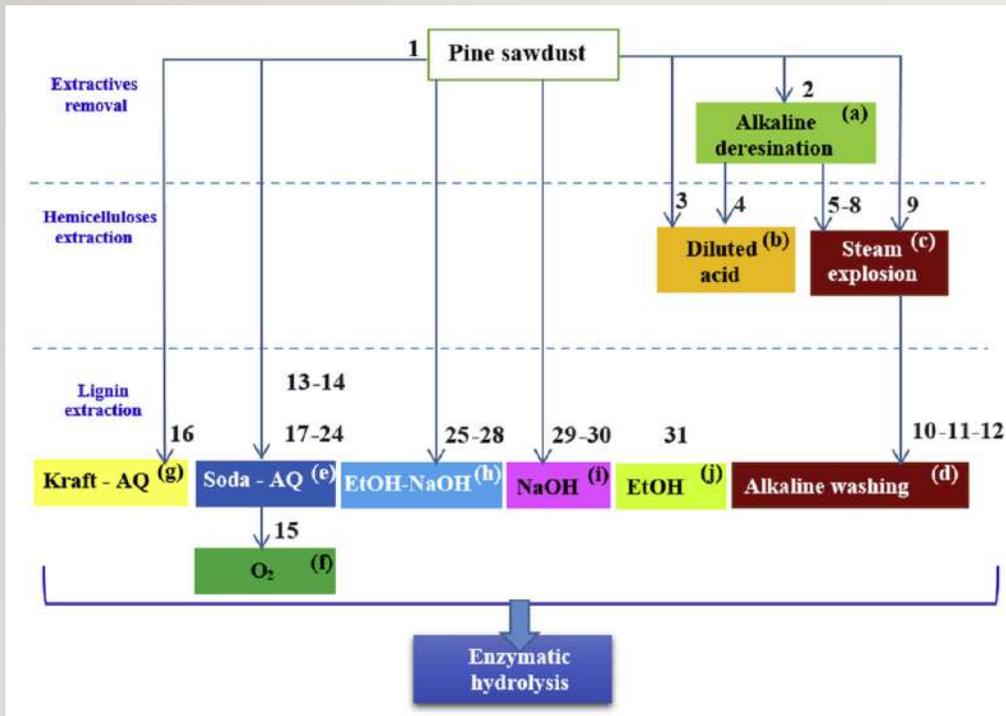
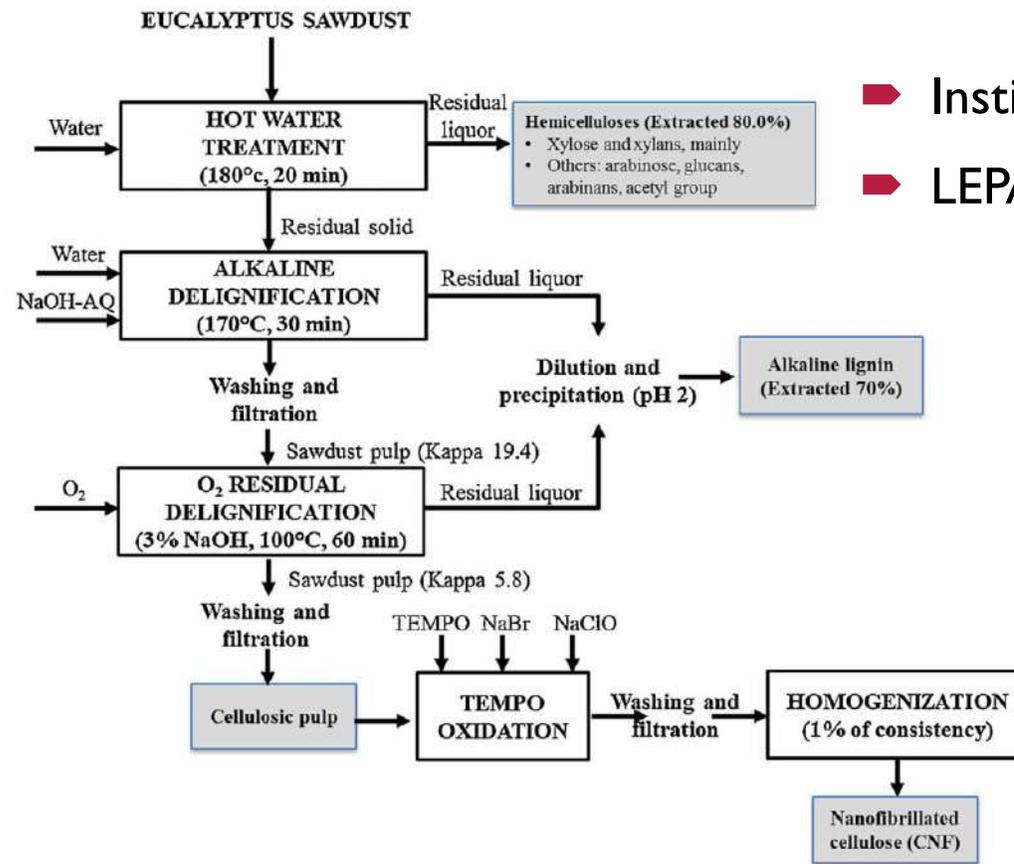


Fig. 3. Enzymatic hydrolysis yield at 72 h in function of lignin content in the treated fibrous materials.

Nanofibrillated cellulose (CNF) from eucalyptus sawdust as a dry strength agent of unrefined eucalyptus handsheets



- Instituto de Materiales de Misiones, Argentina
- LEPAMAP, Universitat de Girona

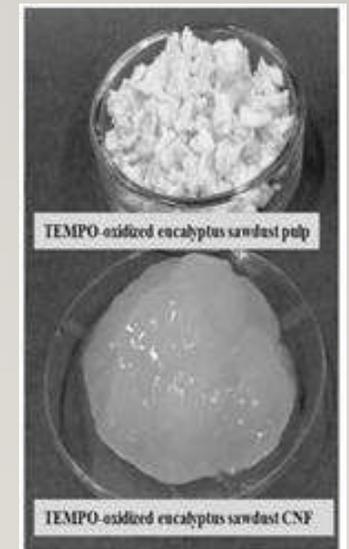
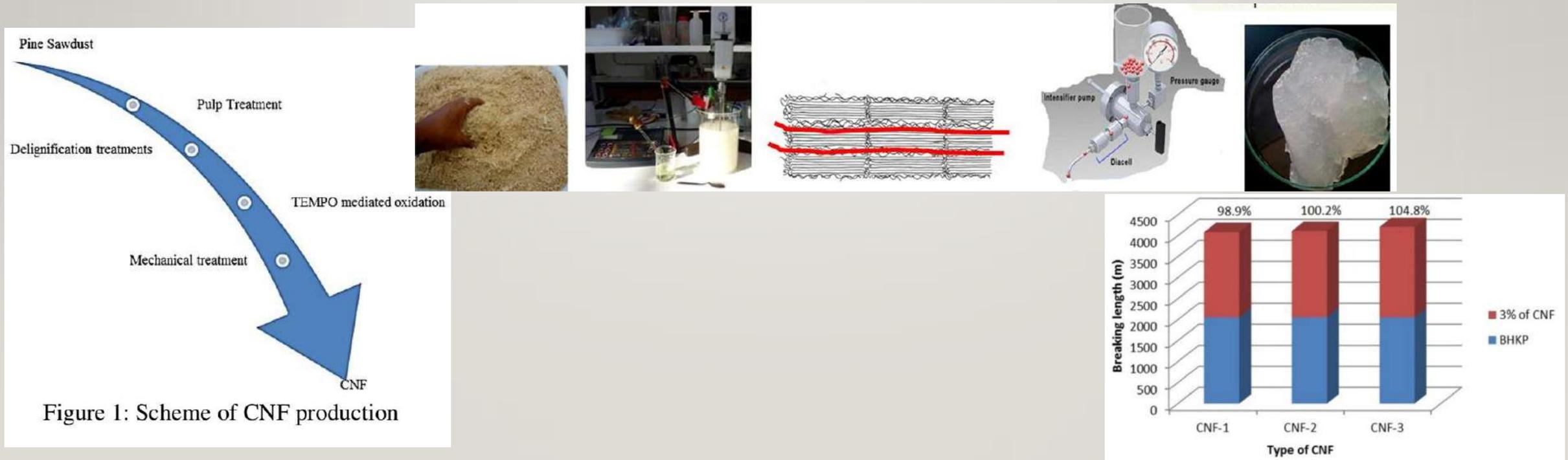


Fig. 1. Schematic process used to obtain nanofibrillated cellulose from eucalyptus sawdust applying the biorefinery concept.

From pine sawdust to cellulose nanofibers

- Instituto de Materiales de Misiones, Argentina
- LEPAMAP, Universitat de Girona



Techno-economic assessment of carboxylic acids, furfural, and pellets production in a pine sawdust biorefinery

➤ Instituto de Materiales de Misiones, Argentina

➤ Universidad de la República



UNIVERSIDAD DE LA REPÚBLICA URUGUAY

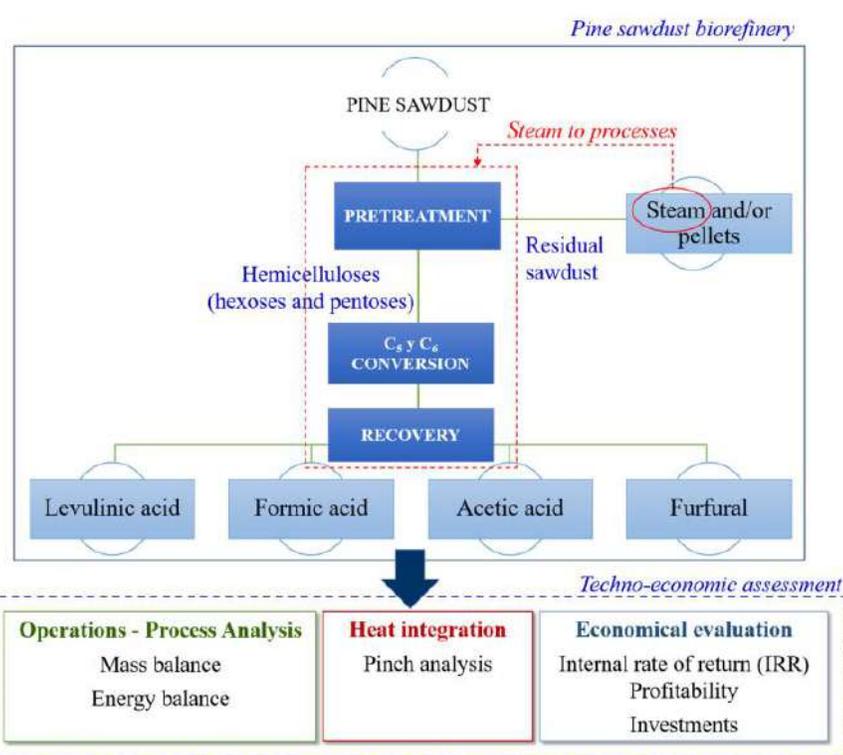


Figure 1. Techno-economic assessment for the proposed biorefinery of pine sawdust.

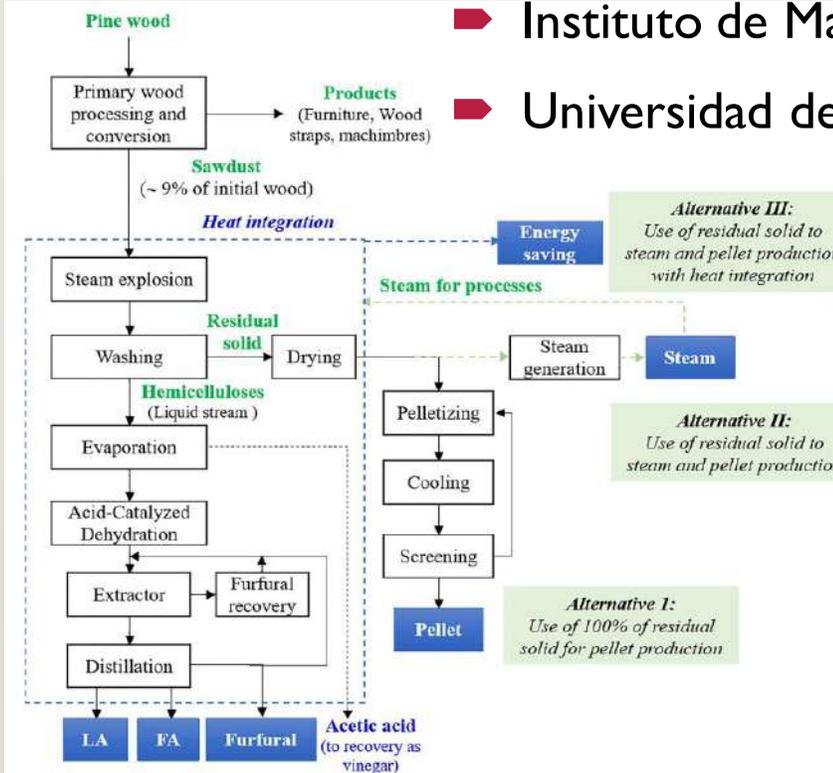
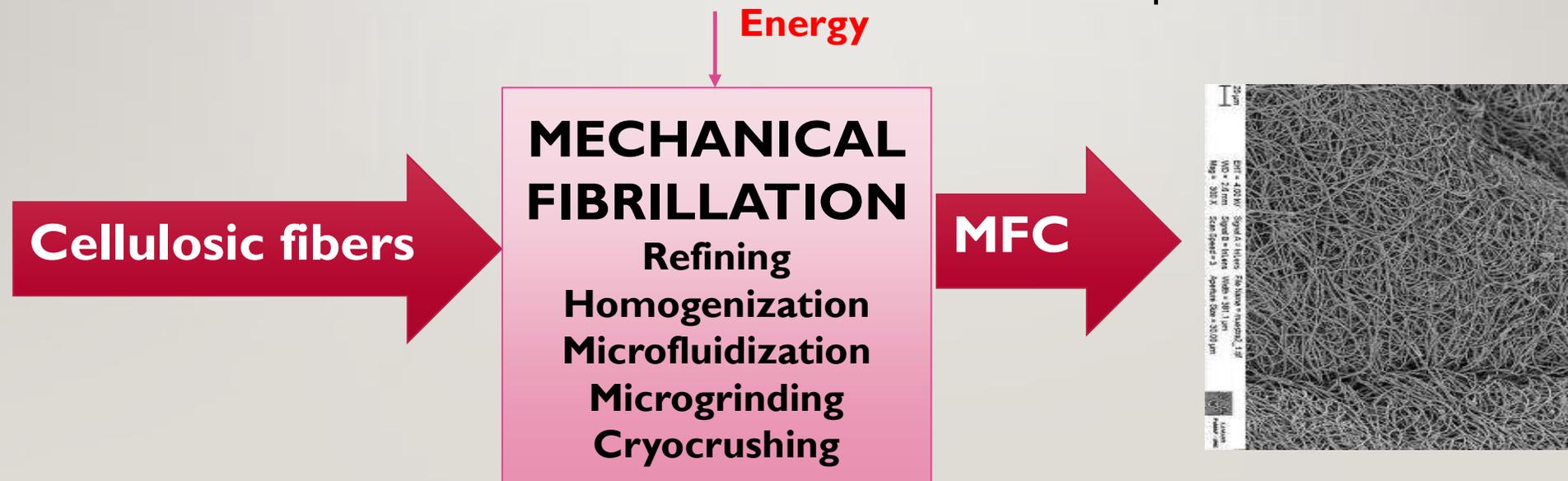


Figure 2. Simplified block flow diagram of the processes for different alternatives (LA: levulinic acid; FA: formic acid).

The best alternative for the valorization of pine sawdust obtained an IRR of about 17%.

Relationship between the characteristics of microfibrillated cellulose (MFC), pulps, and raw materials

- Instituto de Materiales de Misiones (IMAM), Argentina
- Laboratorio de Productos Forestales, Universidad de Concepción, Chile

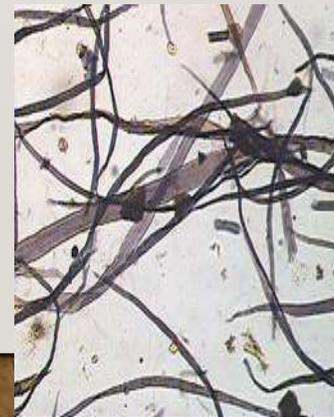
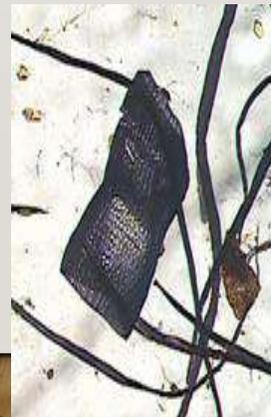


INSTITUTO DE MATERIALES DE MISIONES UNAM-CONICET



- **IMAM:** 71 people in three locations (Posadas, Oberá, and Eldorado): 29 researchers, 27 graduate students, 5 support professionals, 1 administrative
- **Pulp and Paper Program (18):** 6 researchers, 4 postdoctoral fellows, 6 doctoral students, 4 undergraduate student, 1 administrative

LABORATORY OF MICROSCOPIC STUDIES



LABORATORY OF CHEMICAL ANALYSIS



LABORATORY OF INSTRUMENTAL ANALYSIS



LABORATORY OF BIOTECHNOLOGY



LABORATORY OF NANOTECHNOLOGY



LABORATORY OF PULP PREPARATION



LABORATORY OF PHYSICAL TESTING



PROCYP

- **Research:** Biorefinery, Fibrous raw materials, Clean technologies of pulping and bleaching, Wood chemistry, Wood-plastic composites, Paper Recycling.
- **Teaching:** doctoral courses, a Master degree in Sciences and Technology of Fibrous Materials, Pulp and Paper courses in Chemical Engineering and a Technical degree in pulp and paper, online courses for the industry.

Project Team

Director
PhD María C. Area



Researchers



Dr Fernando
Felissia



Dr Evangelina
Vallejos



MSc Dora
Bengoechea

Postdoctoral fellows



Laura
Covinich



Julia
Kruyeniski



Nanci
Ehman



Nicolás
Clauser

Doctoral students



Rocío
Cardozo



Carolina
Mendieta



Giselle
González



Juan
Dominguez



Camila
Imlauer



Julieta
Benítez

Undergraduate Students

Iván Boczkur

Leandro Hanke

Agustina Ponce de León

Alejandra Ramírez

CONTACT



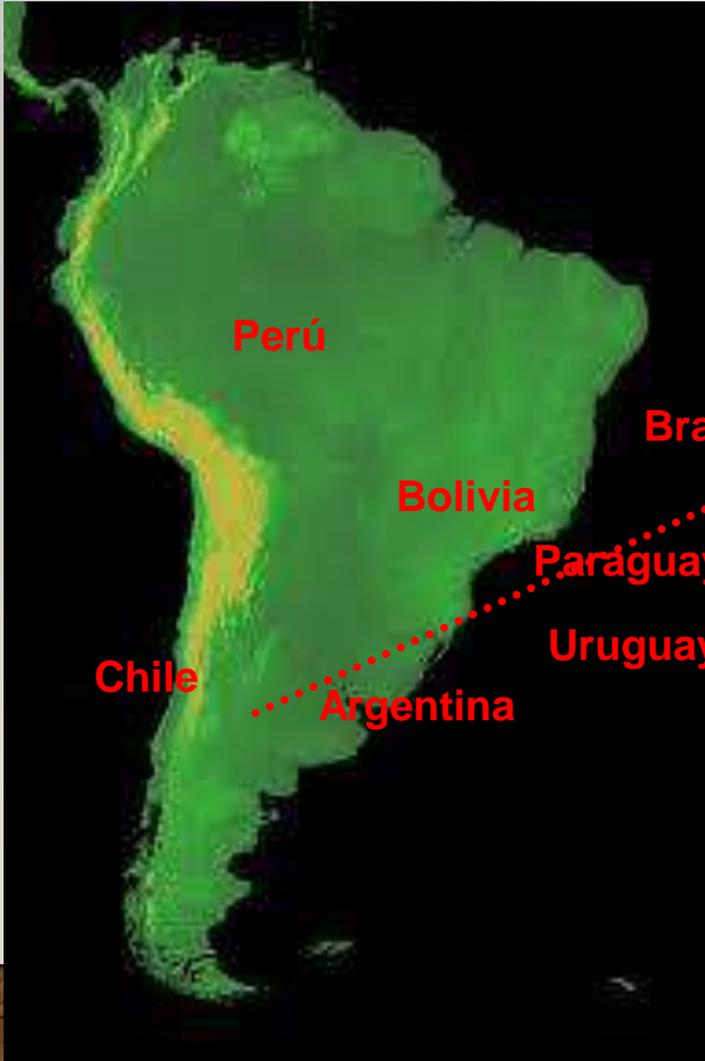
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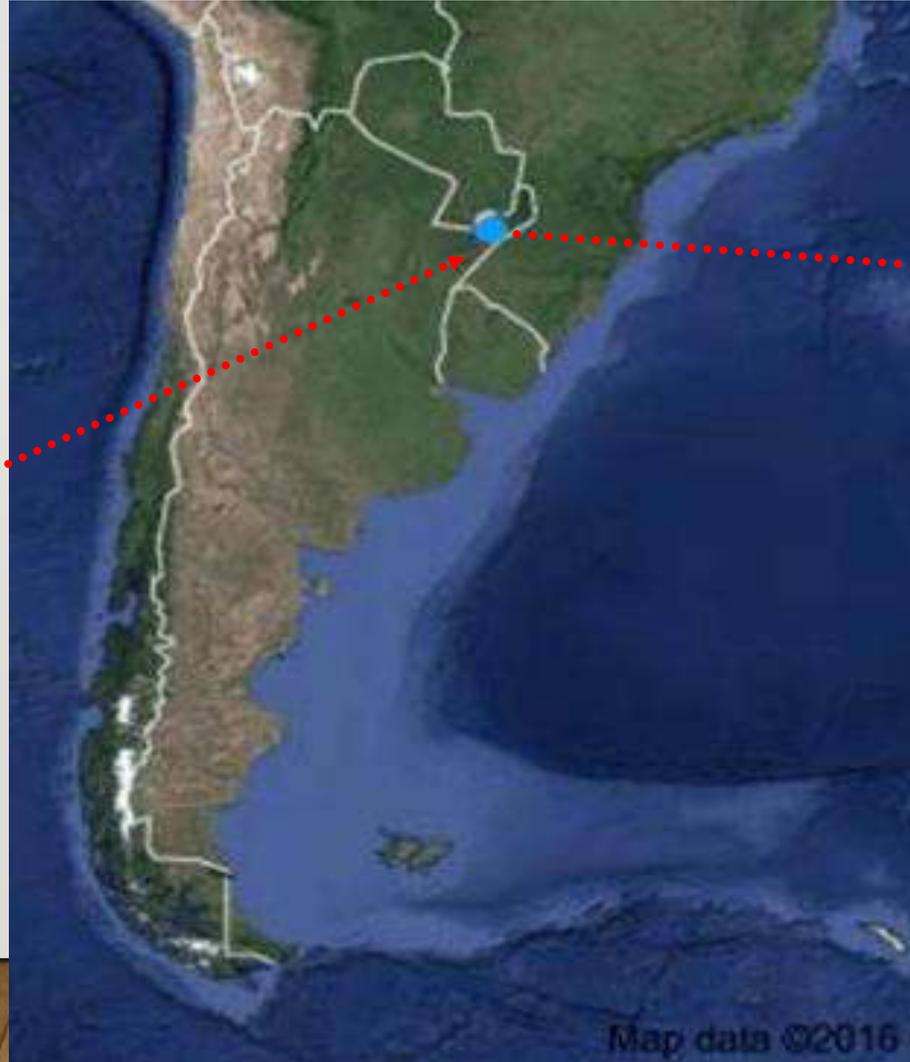
<http://procyp.unam.edu.ar/>

MISIONES, ARGENTINA: LOCATION

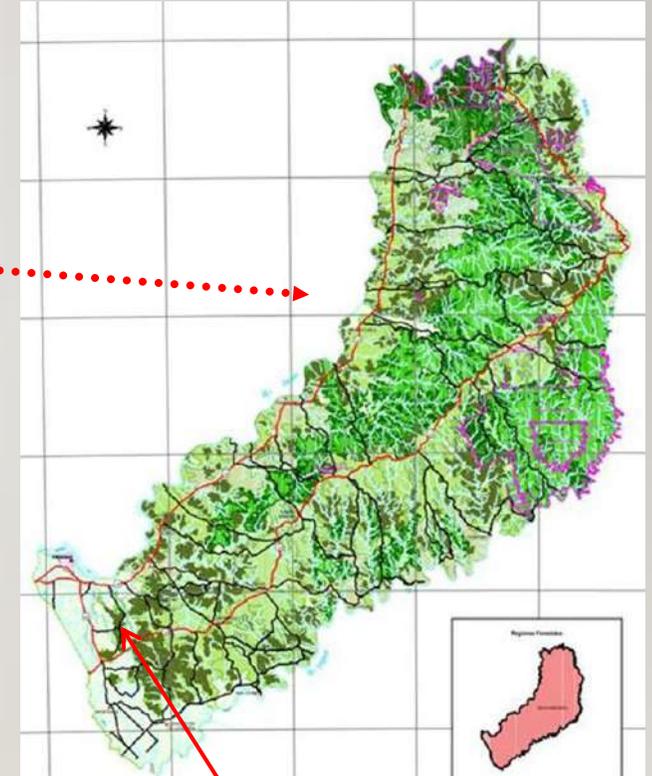
South America



Argentina



Misiones



Posadas



IGUAZÚ FALLS IN MISIONES



<http://sevensnaturalwonders.org/iguassu-falls-pictures/>



**THANK YOU FOR
YOUR ATTENTION!**
