Biocatalysts and Biocomposites
in the context of Colombian Biorefineries

UNIVERSIDAD NACIONAL DE COLOMBIA
SEDE MANIZALES
Instituto de Biotecnología y Agroindustria - IBA

Carlos Eduardo Orrego
Director
Instituto de Biotecnología y Agroindustria
Food & Fruit Research Group

OUTLINE

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- BIOREFINERY
- BIOCOMPOSITES
- NATURAL FIBER AND BIOCOMPOSITES
- ENZYME IMMOBILIZATION
- INSIGHTS FROM AN OUTSIDER

ENZYME MARKET

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WORLD ENZYME DEMAND (US$ x 10^9)			
Market year	**2012**	**2017**	**2022**
Industrial enzymes	**3.63**	**4.76**	**6.30**
Speciality enzymes	**1.50**	**2.19**	**3.20**
World enzyme demand	**5.13**	**6.95**	**9.50**

Grand View forecasts the global enzymes market to rise to $17.5 billion in 2024 from **$8.18 billion in 2015** According to this firm **Biofuel enzymes market** was worth over USD 500 million.

Latin America region is projected to be the fastest-growing market from 2016 to 2021. However, it is still in the early growth phase.

3.59

2.16

1.97

PLASTICS AND COMPOSITES MARKET

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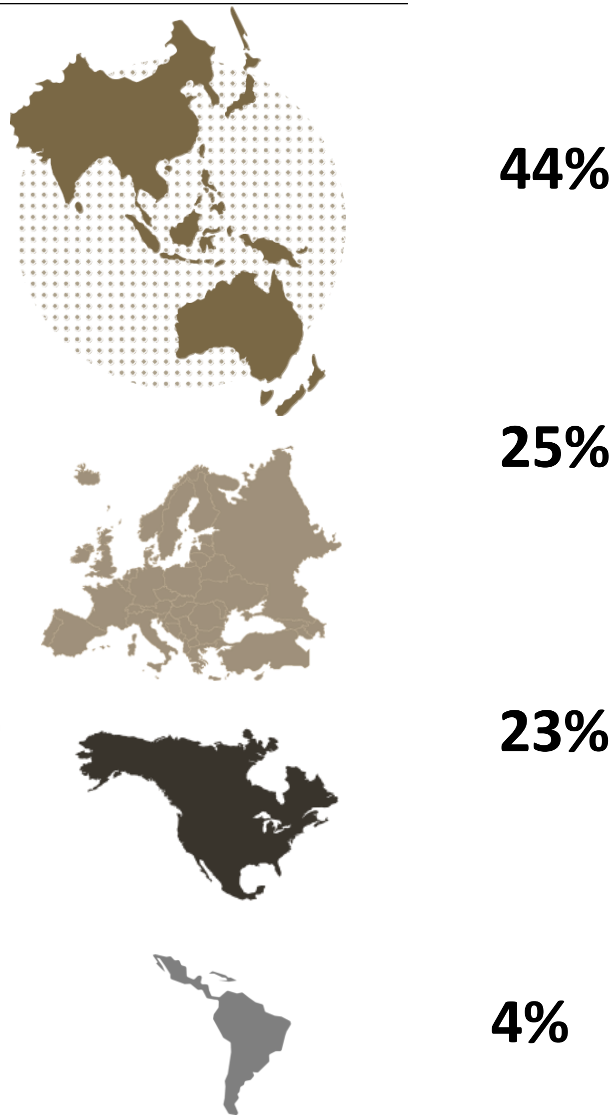
WORLD PLASTICS AND PACKAGING DEMAND (US$ billon)		
Market year	2013-15	2020-24
Plastic	234	654
Packaging	270	375
Composites	42	131

Plastics market in 2013.



Global biocomposites market is estimated at $438 million in 2015 and is expected to reach $648 million in 2020.

BIOREFINERY

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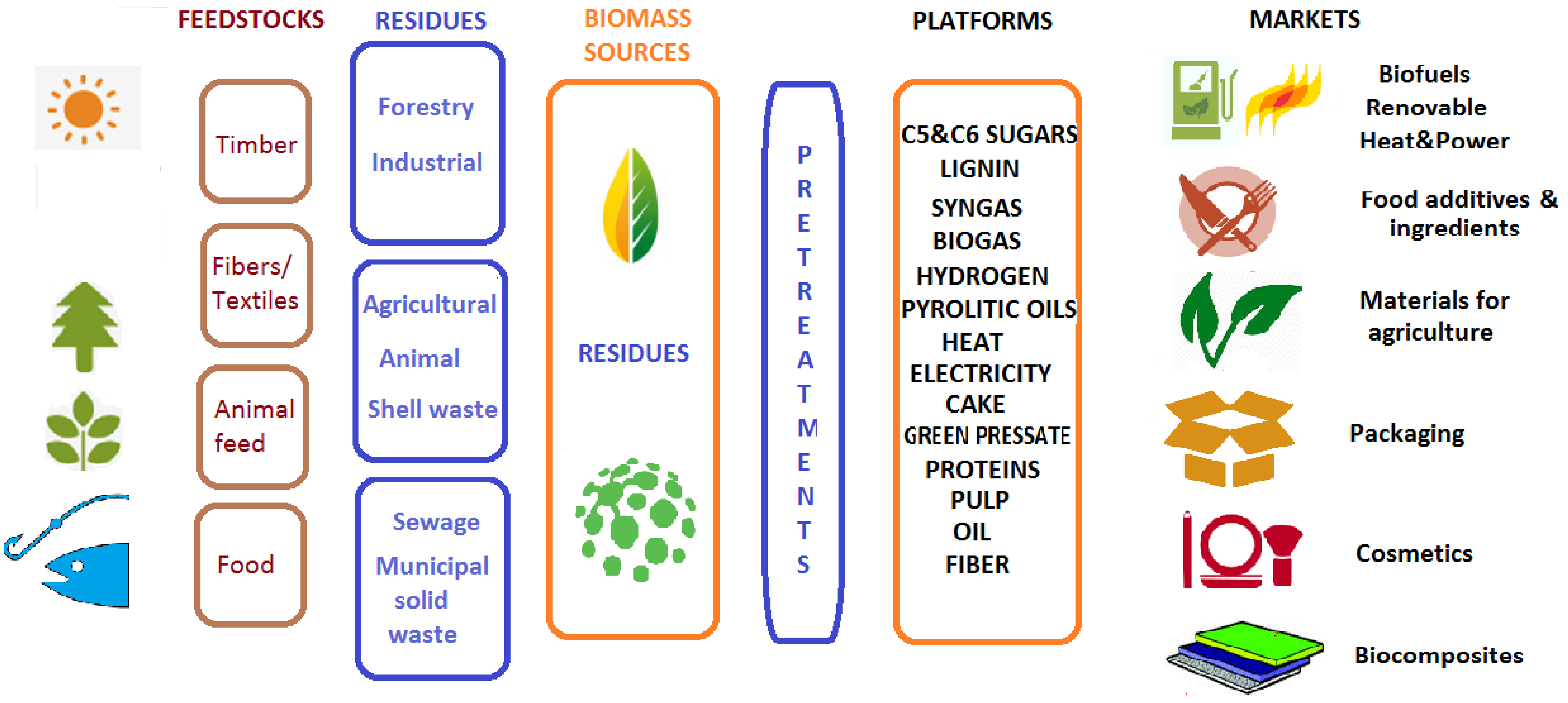


BIOCOMPOSITES

APPLICATIONS

- Marine
- Furniture
- Packaging
- Automotive
- Construction

PERFORMANCE

- Good mechanical & thermal properties
- Low water absorption
- Homogeneity

SUSTAINABILITY

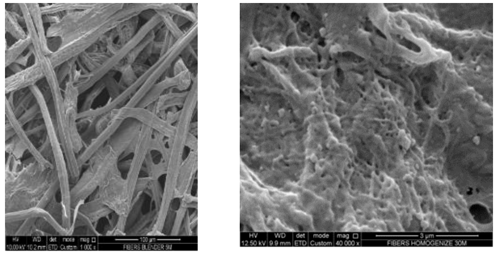
- Recyclable
- Renovable
- Compostable
- Env. Friendly

COMPETITIVITY

- Price
- Processability
- Legislation
- Supply

NATURAL FIBERS AND BIOCOMPOSITES

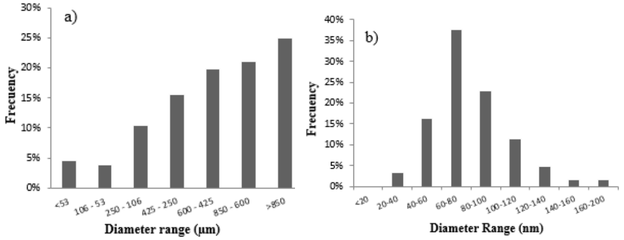
Scanning Electron Microscopy



SEM Raw material after: Mechanical and chemical treatment (a), Homogenized fiber at 30 min (b).

Raw Material: Stalk

Stalks after mechanical chemical and treatments



Size distribution of the diameter of stalks after: Mechanical and chemical treatment (a), Homogenized fiber at 30 min (b).

Average diameter and size distribution fibers ImageJ Software

Cellulose nanofibers from passion fruit stalks

Bioactive peptides from rice bran using immobilized protease

NATURAL FIBERS AND BIOCOMPOSITES

Chemical treatment

Hand lay-out polyester

Agricultural residues

Physical treatment

Bio-epoxy foams

Universidade do Minho
Prof. Raul Fangueiro

Clemson University
Prof. Srikanth Pila

- Isolation of cellulose nanofibers from passion fruit stalks
- Biocomposites from agricultural residues/natural fibers and polymeric matrices

ENZYME IMMOVILIZATION

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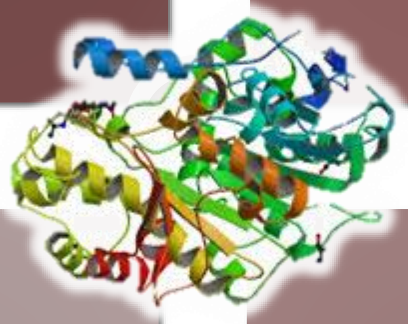
BIODIESEL

- BUTYL OLEATE SYNTHESIS
- ETHYL ESTERS

EMULSIFERS

- MONO AND DI-GLYCERIDES



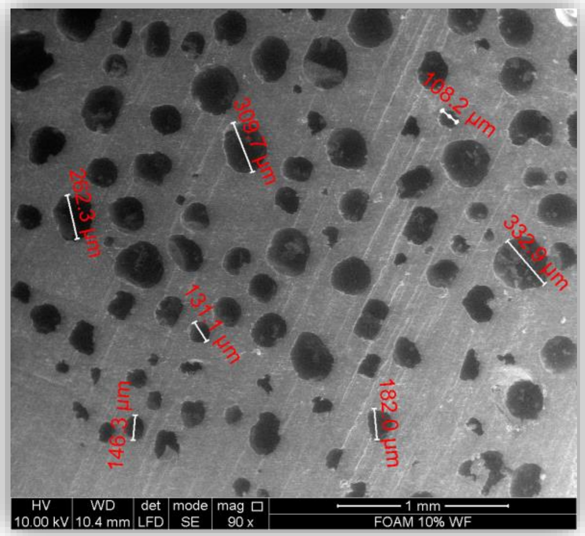
HYBRID MATRIX

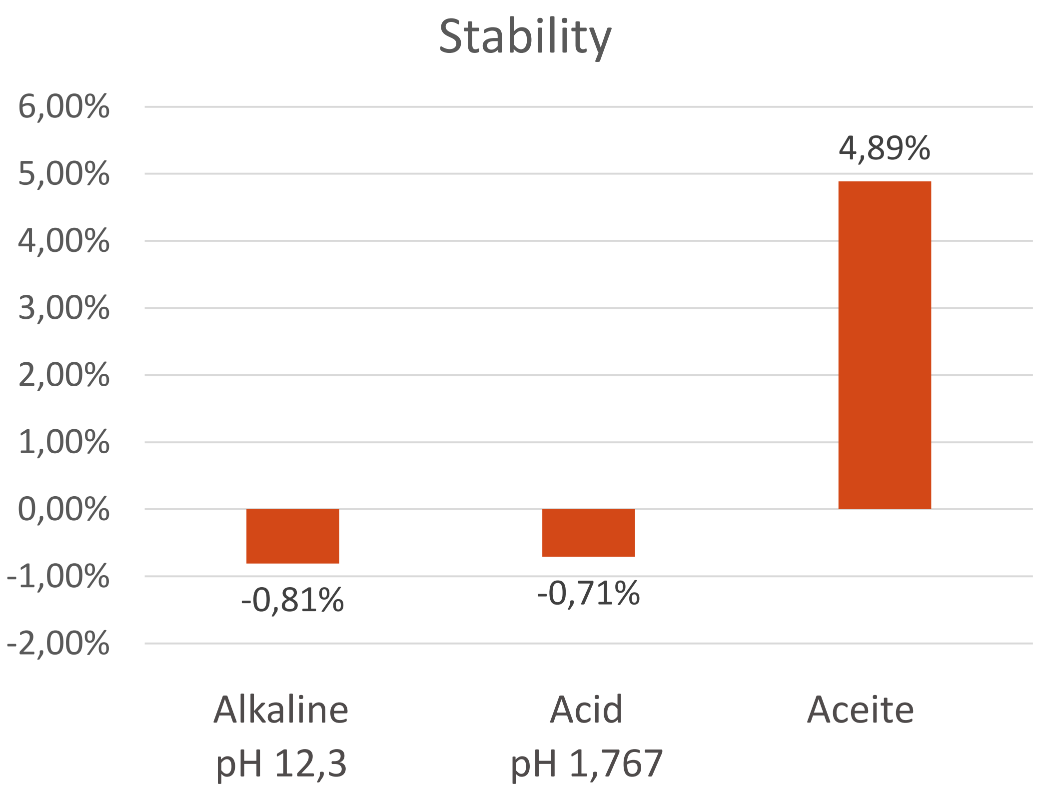
- CHEAP
- WATER INSOLUBLE
- POL&BIOPOL
- FIBER FILLED

FOOD INGREDIENTS

- PEPTIDES
- FOS

ENZYME IMMOBILIZATION AND BIOCOMPOSITE





INSIGHTS FROM AN OUTSIDER

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- If technology and market allow, it seems to be logical to separate instead of breaking sophisticated biomolecules of biomass sources.

- Despite much research, the efficiency of the enzymes system for the deconstruction of plant polysaccharides is low and the amount of enzyme required is large.

- Currently, the competitiveness of most biorefinery processes needs to be supported by legislative provisions.

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ceorregoa@unal.edu.co

Thanks