RESEARCH IN BIOMASS VALORIZATION AND FORESIGHT NEEDS FOR THE SECTOR

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Presentation of MateriaNova

Created in 2000
Non profit association
Turn over 8 M €
~ 90 employees
Project financing

Ghislenghien

Mons

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Presentation of MateriaNova

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<tr>
<td>P. Dubois</td>
<td>M. Olivier</td>
<td>R. Lazzaroni</td>
<td>P. Damman</td>
<td>R. Snyders</td>
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Fundamental Research

Applied Research

INDUSTRY
Support the industrial research

- Development of industrial research (R&D)
- Proof-of-concepts
- Availability of skills, know-how and advanced analytical equipment
- Valorization of the research (dissemination and patents)
BIOMASS

Intermediate Platforms

Building Blocks

Biomass Feedstocks

Starch
Hemicellulose
Cellulose
Lignin
Oil
Protein

Syn Gas
C2
C3
C4
C5
C6

Sugars
Glucose, Fructose, Xylose, Arabinose, Lactose, Sucrose, Starch

Aromatics
Gallic, Ferulic acid, ...

Direct Polymers & Gums

H₂, methanol & higher alcohols, oxo and iso-synthesis products, Fischer-Tropsch chemicals

Glycerol, Lactic, 3-Hydroxy propionate, Malonic acid, Serine

Succinic, fumaric & malic acids, Aspartic acid, 3-Hydroxy Butyrrolactone, Acetoin, Threonine

Itaconic acid, Furfural, Levulinic acid, Glutamic acid, Xylenic acid, Xylitol/Arabitol

Citric/Acetonic acid, 5-Hydroxy methyl furfural, Lysine, Guanonic acid, Glucaric acid, Sorbitol
from synthesis to processing

- Biobased monomers for “old” polymers
- New renewable building blocs
- Bioplastics by direct fermentation
- Formulation of bioplastic and biocomposites
Bioplastics by reactive extrusion
Biocomposites with improved mechanical properties

- Biopolymers: Starch, Proteins
- Bioplastics: PLA, PBS, PU

Lazko et al., BIOPOL, Strasbourg, 29-31 August 2011.
Light-weight insulating agro-materials

- Biobased binders
- Morphology & Density control
- Mechanical properties
- Thermal & acoustic insulation
- Flame retardant & hydrophobic treatments
- Life Cycle Assessment - LCA

BIOMASS ➔ BIOSTIMULANTS
Plant biostimulants?

A definition:

Substances, microorganisms and materials with the exception of nutrients and biocides modify physiological processes of plants.

Potential benefits to growth, development and response to abiotic and biotic stress.

Economical alternative to conventional chemical products
Biomass-derived bioactive

Cell wall components are signals in the talk between plant and microorganisms

Molecular signals

Cell wall derived
Oligosaccharides and lipids

Potential Bioactive product
Biomass-derived bioactive

Fungal biomass

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<th>Stimulation of plant</th>
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Biomass-derived bioactive

- Biodegradable
- Non-toxic to the environment, safe for animals and human
- “Easy” to produce
- Valorization product of agro resources
Fungal or plant biomass / fermentation broth

- Preparation and structural analysis
- Bio-test
  - Plant cell suspension
  - Seedlings (phytotron)

Scale-up procedures

Validation

*Fields experiments*
Consortium roadmap

Fungal or plant biomass / fermentation broth

Preparation and structural analysis

Bio-test

Plant cell suspension
Seedlings (phytotron)

Scale-up procedures

Validation

Fields experiments

UK Mexico Cuba

PROTEOMICS unit

Belgium

Chile Argentina Cuba
Biomass-derived bioactive

Fungal cell wall
- Chitin
  - Chitosan
  - Chito-oligosaccharides

Plant cell wall
- Pectin
- Hemicellulosides
  - Oligogalacturonides
  - Xyloglucan oligosaccharides
Biomass-derived bioactive

- Preparation
- Bioactivity
- Developing applications
Chitosan, the deacetylated form of chitin

- Occurs as a component of crustacean shells, insect exoskeletons, fungal cell walls and plankton
- Second most abundant natural biopolymer
- Most abundant naturally occurring polysaccharide containing amino sugars
- Produced commercially by deacetylation of chitin
- Protonated in acidic to neutral solution / charge density dependent on pH and DA

Preparation - Enzymatic degradation of chitosan

Chitin → Basic or enzymatic de-acetylation → Chitosan

pH < pKa (~6.50)
**Preparation - Enzymatic degradation of chitosan**

- **Chitosan**: Variable composition
- **Chitosanase hydrolysis**: Different enzymes / degradation pattern
- **Fractionation**: Selective precipitation/ Ultrafiltration
- **Analysis of COS**: TLC, HPSEC, Mass spectrometry
**Bioactivity**

- **Multiple effect**
  - Antimicrobial activity
  - Induction of plant defences (biotic and abiotic stress)
  - Growth promoting, development and yield of crops
  - Flowering regulation

- **Bioactivity depends on**
  - Chitosan structure (DA and DP)
  - Concentration
  - Application form
  - Plant species
  - Physiological state of the plant
  - Environmental facts

  ![Diagram](foliar_formulations.png)  ![Diagram](seed_coating_film.png)
**Bioactivity**

**Plant cell oligosaccharides**

**Citrus pectin**

↓

**Oligogalacturonides**

Stimulate plant germination and growth
(soybean, tomato, tobacco, sorghum, potato)

“hormone-like” activity

Use in the propagation “in vitro” of different plants
(Sugar cane, coffee, tobacco, tomato, citrus, Anthurium, etc)

- Doses: 0.1-10 mg/L
- Water soluble, sterilization with cultivation medium
- Genetic stability of micropropagated plants
- Stimulate embryogenic callus formation
- Enhance vigour of “in vitro” plants
- Induce formation and development of plant roots

Stimulation of growth
Sorghum bicolor L. (sorghum)

Control + hormones
Control - hormones
Oligogalacturonides

Micropropagation of sugar cane

Control + Oligogalacturonides
Control

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Challenges

- Raw materials of variable composition
- Low-cost process
- Simultaneous preparation of diverse bioactive components
- Integration in main process
- Non-degradation of bioactive structure
Thanks a lot for your attention