Substitution of chemical phenols by plant polyphenols for processing phenolic biomaterials
Laurent Roumeas, Chahinaz Aouf, Eric Dubreucq, Hélène Fulcrand

To cite this version:
Laurent Roumeas, Chahinaz Aouf, Eric Dubreucq, Hélène Fulcrand. Substitution of chemical phenols by plant polyphenols for processing phenolic biomaterials. EcobioCap Final Meeting, Feb 2015, Montpellier, France. hal-02796378

HAL Id: hal-02796378
https://hal.inrae.fr/hal-02796378
Submitted on 5 Jun 2020
Substitution of chemical phenols by plant polyphenols for processing phenolic biomaterials

Laurent ROUMEAS, Chahinez AOUF
Eric DUBREUCQ and Hélène FULCRAND

INRA Montpellier - UMR 1083 & 1208
roumeas@supagro.inra.fr
**INTRODUCTION**

**WORLD ANNUAL PRODUCTION OF PHENOL**

2000 : 6 million tons  
2010 : 8 million tons  
2020 : 12 million tons (prediction)

**EUROPEAN PHENOL USE**

2 million tons per year ; more than 80% for plastic materials and resin

**APPLICATIONS**

- Plastic materials : thermosetting (polycarbonate, epoxy)  
- Plastic fibers : nylon (polyamide)  
- Electric isolating  
- Bactericid paint  
- Hydrophobic coating  
- Anionic detergent  
- Thermic ink  
- Insulating glue

**MARKET IN EXPANSION**

New production plant in Nanjing, China (INEOS and SINOPEC) : 400 000 tons (end 2013)

**APPLICATIONS**

- Fiber production (caprolactame, cyclohexanol and cyclohexanone)  
- Bisphenol A (BPA) and polyphenylene oxide (for epoxy and polycarbonate resins)  
- Phenolic resins (composite materials)

**ECOBIOCAP**

Substitution of chemical phenols by plant polyphenols for processing phenolic biomaterials

Laurent ROUMEAS
Need to find quickly alternatives to petroleum-based aromatic compounds to halt the massive contamination of our environment and protect human beings from its negative impacts on health.
Substitution of chemical phenol by natural polyphenols

Lignin

Condensed tannins

Extension units

Terminal unit

R¹, R² = OH or H
R³ = H, Gal
Agro-industrial wastes (wine and cider making, fruit juice)

---

<table>
<thead>
<tr>
<th>Winemaking Biomass</th>
<th>seeds</th>
<th>pomaces</th>
<th>stems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual output</td>
<td>80 000-140 000 t</td>
<td>700 000 t</td>
<td>300 000 t</td>
</tr>
<tr>
<td>Tannins (% DM weight)</td>
<td>6-16%</td>
<td>0,04-1,2%</td>
<td>3%</td>
</tr>
</tbody>
</table>

---

Pomace, fruit marcs

Sawmill co-products and forest biomass

- Barks
- Pine needles, leaves

---

Conifers (36%)

- France

French Forest
- 16 000 000 Ha
- 2,5 billions m³

---

ECOBIOCAP
Substitution of chemical phenols by plant polyphenols for processing phenolic biomaterials
Laurent ROUMEAS

26/02/2015
- From phenolic models

Gallic acid

\[
\begin{align*}
\text{C}_{6} \text{H}_{8} \text{O}_{7} & \quad \text{C}_{6} \text{H}_{8} \text{O}_{7} \\
\end{align*}
\]

Catechin

\[
\begin{align*}
\text{C}_{15} \text{H}_{14} \text{O}_{9} & \quad \text{C}_{15} \text{H}_{14} \text{O}_{9} \\
\end{align*}
\]

- From commercial extracts

Hydrolysable tannins

Condensed tannins

\[
\begin{align*}
\text{C}_{16} \text{H}_{18} \text{O}_{16} & \quad \text{C}_{16} \text{H}_{18} \text{O}_{16} \\
\end{align*}
\]
DEPOLYMERIZATION: a key step

- to get an homogeneous raw material or fine chemicals
- to get the same synthons from different tannin sources
- to suppress one step (simultaneous extraction/depolymerization)

Large scale process for production of biobased phenols
DEPOLYMERIZATION : obtention of phenolic synthons
Perspectives

- **Materials**: thermoplastic; polyester, polyamide, vinylester,... and composite
- **Fine chemistry**: Medicinal, cosmetic, Lubricant, Surfactant
Thank you for your attention!

Co-workers

Lucas Suc

Guillaume Billerach