

Press release

August 24, 2021

Valorization of wood hemicelluloses in an integrated biorefinery

On June 25, 2021, Juliette Francillon defended a doctoral thesis from the Université Grenoble Alpes prepared under the supervision of the Professor Christine Chirat (Grenoble INP-Pagora/LGP2) and of Dr Claire Boisset, Research Engineer (Cermav/CNRS). She presented the results of her research entitled *Study of the molecular diversity of soluble hemicellulose oligosaccharides from wood autohydrolysates*.

Facing climate change and the near end of the oil age led us to rethink our consumption patterns and energy models, to insure a sustainable future for human beings. In this way, the biorefinery plays an important role and is a key concept to bring a part of the solution, exploiting the potential of biomass, which is renewable and widely available, for energy production and chemicals, materials, human health, and agri-food products manufacturing. Hence, this project aims at valorizing wood hemicelluloses in the frame of a lignocellulosic biorefinery integrated in a kraft pulp mill.

Hemicelluloses are complex heteropolysaccharides accounting for up to one third of wood and are among the most abundant biopolymers on Earth. Both softwood and hardwood chips industrial mixtures were used for hemicelluloses oligomers extraction prior to the kraft process through a low-tech and green process (without using any chemicals) named autohydrolysis. This pretreatment step allows for the solubilization of oligosaccharides, monosaccharides, lignin fragments and other small molecular weight organic compounds. The chemical composition of these wood hydrolysates depends on wood species and autohydrolysis severity. The main objective of the thesis is to design a sort of universal scheme of analytical methods that can be applied to any kind of hydrolysate in order to identify, quantify and isolate its hemicelluloses families.

The study of the molecular diversity of soluble oligosaccharides containing liquors produced at two temperature levels (170 and 150°C) is based on several purifications' steps before analysis. First of all, membrane filtration is used with different molecular weight cut-offs to classify and separate oligomers and impurities according to their size. In a second part, soluble lignin and sugar degradation products generated during autohydrolysis are removed by adsorption on activated charcoal. Less polydisperse and 99% pure oligosaccharides mixtures are thus obtained thanks to the optimization and combination of these two techniques of purification. Nevertheless big losses of hemicelluloses are triggered by these treatments between 70 and 80% compared to the raw hydrolysate.

In the end, the last chapter of experiments deals with the final purification and characterization steps of these purified samples which are performed by size exclusion liquid chromatography and mass spectrometry analyses. This chromatographic technique operating at low pressure is an interesting tool for the separation of neutral oligomers from hexuronic acid substituted oligomers in both hardwood and softwood extracts. Also, elimination of recalcitrant lignin carbohydrates complexes was achieved for some fractions as well as the isolation of specific bioactive molecules of low degree of polymerization (potential nutraceutical applications).

The Laboratory of Pulp and Paper Science and Graphic Arts (LGP2) is a joint research unit (UMR 5518) run by the CNRS, Grenoble INP and the Agefpi. It conducts its scientific activities in conjunction with the academic community of Grenoble Alpes University. It is Quality Safety Environment certified and includes three teams: *Biorefinery: chemistry and eco-processes* – *Multiscale biobased materials* – *Surface functionalization through printing processes*. Their research strives to meet society's expectations when it comes to sustainable development (green chemistry, clean processes, recycling, biobased materials, renewable energy) and traceability & safety (functional materials, smart paper and packaging). lgp2.grenoble-inp.fr



Contact

presse.pagora@grenoble-inp.fr

Web

<https://lgp2.grenoble-inp.fr/en/the-laboratory/media>

Contact LGP2 Christine.Chirat@grenoble-inp.fr - **Logo** logo-lgp2.eps

The Laboratory of Pulp and Paper Science and Graphic Arts (LGP2) is a joint research unit (UMR 5518) run by the CNRS, Grenoble INP and the Agefpi. It conducts its scientific activities in conjunction with the academic community of Grenoble Alpes University. It is Quality Safety Environment certified and includes three teams: *Biorefinery: chemistry and eco-processes* – *Multiscale biobased materials* – *Surface functionalization through printing processes*. Their research strives to meet society's expectations when it comes to sustainable development (green chemistry, clean processes, recycling, biobased materials, renewable energy) and traceability & safety (functional materials, smart paper and packaging). lgp2.grenoble-inp.fr