

Conceptual framework and pioneering research for advanced understanding of lignin

Description

The 2024 Marcus Wallenberg Prize is awarded to Professors Wout Boerjan and John Ralph for their groundbreaking research leading to a greater understanding of lignin biosynthesis and structural diversity. Both scientists developed and innovatively applied advanced analytical techniques in ways that greatly alter our view of lignin biosynthesis and structure in trees. Their research provides a basis for development of wood deconstruction processes and new applications for lignin, the most abundant source of natural aromatics in the biosphere.

Lignin is a wood component important for the strength and resistance to microbial decay. Thanks to the chemical structure of lignin, it's an interesting material for scientists and chemists when developing new biobased applications. To be successful in separating and utilizing lignin it's necessary to understand how it's built, its chemical structure and the functionality it provides as basis for chemicals and materials. Understanding how the different lignin structures are formed during the tree growth is necessary in order to know how to best take the wood components apart from each other.

Professor Boerjan has provided deep insights into the biosynthesis of the lignin building blocks using a specific mass-spectrometer method. His innovative approach to study genomics has led to the discovery of a key enzyme for understanding how the wood formation process works.

Professor Ralph has developed breakthroughs in understanding the lignin subunit structure as well as linkages and composition of lignin using advanced Nuclear Magnetic Resonance (NMR) methods. His characterization of a broad selection of plants revealed large variation and novelty in the composition of lignin subunits.

Professor Boerjan and Professor Ralph have jointly provided a conceptual framework for lignin biosynthesis, polymerization and manipulation, and they have also demonstrated the potential for flexibility in lignin structure.

This is essential information for scientists developing the lignin extraction from wood through traditional pulping (with wood fiber as main product) as well as for the development of biorefinery concepts for the production of chemical building blocks from wood. The work by the laureates also brings even greater

importance to the development of new lignin-based applications — when new materials or chemicals are developed based on process and modification of lignin, it's essential to understand the structures and variations in the component. Established industrial companies of various sizes and start-ups close to research are developing renewable solutions based on lignin in order to reduce the need for fossil raw-materials.

For the scientific motivation and elaboration of the 2024 Marcus Wallenberg Prize, please read the enclosed full motivation document.

The Marcus Wallenberg Prize 2024 will be presented by HM the King of Sweden at a ceremony in Stockholm in November this year.

Key facts about the laureates

Wout Boerjan was born in 1963, he completed his undergraduate studies in Ghent University, Belgium in 1985 and his PhD in Plant Biotechnology in Ghent under the supervision of Prof. Marc Van Montagu and Prof. Dirk Inzé in 1993. In January 1994, he became a group leader in the Lab of Genetics at Ghent University, and from June 1996, group leader in the Department of Plant Systems biology, VIB, Ghent University. He is also a professor at Ghent University. In 2009, Wout Boerjan was named “Forest Biotechnologist of the Year”. He is an elected EMBO member and visiting professor at Tokyo University of Agriculture and Technology, Japan. In 2019, he received an ERC-Advanced-Grant to discover metabolites and their biosynthetic pathways in the model tree poplar. In 2020, he received the Excellence Prize in Applied Sciences from the Fund for Scientific Research Flanders (FWO).

John Ralph was born in 1954 and studied Chemistry at Canterbury University, New Zealand, graduating in 1976. In 1982 he earned his Ph.D. in the topic of Chemistry/Forestry, University of Wisconsin-Madison, USA. During this time, he already studied lignins using NMR under the supervision of Professor Raymond A. Young and Dr. Larry L. Landucci. He was a Research Scientist at the Forest Research Institute, Rotorua, New Zealand before moving to the USA. After a brief period as Scientific Head of the Research Laboratory for NMR at the University of California Berkeley he continued his career in Madison, Wisconsin, USA. From 1988 to 2008 he was a Research Chemist at the USDA-ARS, U.S. Dairy Forage Research Center. He then moved to University of Wisconsin-Madison as a Full Professor in the Departments of Biochemistry and Biological Systems Engineering and was the Plants Area lead in the US Department of Energy's (DoE) Great Lakes Bioenergy Research Center from 2008 to 2017. John Ralph was recipient of the 2023 Lifetime Achievement Award from the International Symposium of Wood, Fiber, and Pulp Chemistry. He is a Distinguished Professor, Tokyo University of Agriculture and Technology, Japan.

Official Press Release in two language versions, and the Full Prize motivation:

[**MWP 2024 Press release ENGLISH**](#)

[**MWP 2024 Pressmeddelande Tillkännagivande SWEDISH**](#)

[**MWP 2024 Award – Full motivation**](#)

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[Wout Boerjan](#)

[John Ralph](#)

[Example laboratory](#)