FibreSurf

New biotechnological tools for wood fibre modification and analysis

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Project Duration: 36 months

Project Consortium

Project Coordinator

Assoc. Prof. Harry Brumer
School of Biotechnology, Royal Institute of Technology (KTH), AlbaNova University Centre, 106 91 Stockholm, Sweden
+46 (0)8 5537 8367, harry@biotech.kth.se

Project Partners

VTT, Technical Research Centre of Finland, Dr. Elias Retulainen, Koivurannatie 1, 40101 Jyväskyla, Finland

Institute for Cell and Molecular Biosciences, University of Newcastle, Prof. Harry Gilbert, Framlington Place, NE2 4HH Newcastle upon Tyne, UK

Center for Plant Sciences, University of Leeds, Prof. Paul Knox, LS2 9JT Leeds, UK

York Structural Biology Laboratory, Dept. of Chemistry, University of York, Prof. Gideon Davies, YO10 5YW York, UK

Project Objectives

The objective of this cross-disciplinary research initiative is to unite several unique approaches for the analysis and modification of wood fibres working toward new value-added materials and biofuel applications. New biotechnological tools will be developed for the analysis, saccharification, and biomimetic application of xylans and xyloglucans, which are key hemicelluloses found in woody plants. Specifically, newly sequenced microbial genomes will be mined for enzymes specific for the degradation of these polysaccharides to facilitate cell wall degradation and improve yields of feedstock sugars. Likewise, novel carbohydrate-binding modules (CBMs) will be characterised and their specific affinities will be exploited to generate new molecular probes to dissect wood cell wall ultrastructure and follow enzymic saccharification. Finally, the ability to re-adsorb cell wall matrix polysaccharides, especially xyloglucan, onto cellulosic fibres will be used to improve the surface and mechanical properties of both virgin and recycled wood pulps.

Project Approach

This project consists of 5 work packages (WP1-5) which involve a high degree of interaction between the international partners from the U.K., Sweden and Finland.

WP1: Discovery and characterisation of novel enzymes and binding modules that attack hard- and softwood xylans (Leader: Univ. Newcastle; Partners: KTH, Univ. York)
WP2: Discovery and characterisation of novel enzymes involved in the systematic degradation of cell wall xyloglucans (Leader: KTH; Partners: Univ. Newcastle, Univ. York)
WP3: Saccharification of woody cell walls using newly discovered hemicellulases (Leader: Univ. Newcastle; Partners: Univ. Leeds)
WP4: XG-based modification of wood fibres for improved material properties (Leader:VTT; Partners: KTH, Univ. Newcastle, Univ. Leeds)
WP5: Novel XG- and XG/EXG-based systems to maintain or improve the properties of recycled wood fibre (Leaders: KTH & VTT; Partners: Univ. Newcastle, Univ. York)

The national nodes are clearly interlinked, with either bilateral or trilateral cooperation ensured through the essential transfer of research materials and personnel. The Swedish node (KTH, Coordinatator) will contribute expertice in carbohydrate enzymology (especially kinetic analysis) and biomimetic fibre modification techniques. The Finnish node (VTT) will contribute a unique knowledge of papermaking process issues such as wet web strength, formation, and fibre recycling. The British node (comprised of the Univerisities of Newcastle, Leeds, & York) brings the state-of-the-art in the discovery, characterisation and application of polysaccharide degrading enzymes and binding proteins. The consortium thus represents a complete spectrum of research expertice from carbohydrate enzymology to wood fibre science and applications.

Expected Project Impact

The key outcome of this project will be a better understanding of several processes which can improve the application and value of wood products. On one hand, studies of the enzyme systems used by cell wall-degrading microorganisms will provide an improved toolkit for biomass saccharification, thereby facilitating the use of wood material as a feedstock for microbial biorefineries, including bioethanol production. More broadly, the scope of these studies extends beyond woody energy crops, to the use of agricultural residues and wastepaper as potential sources to reduce societal demands for petrochemicals. The second aspect of this work, improving paper material properties through the addition of natural polymers, likewise has significant environmental relevance, as this can reduce raw material consumption, improve recyclability, and reduce energy demands throughout the process. By strategic examination of both soft- and hardwood fibres as raw material sources, this work also seeks to add value to key forest resources in the UK, where sitka spruce and other conifers predominate, and the Nordic countries, in which improved use of the aspen and birch components of mixed forests are receiving increasing attention.

The academic results of the project will be disseminated through top-ranking peer-reviewed journals and international conferences. Significantly, this project will interact strongly with two other networks of excellence in Sweden, the FuncFiber Center of Excellence (www.funcfiber.se) and the Center for Biomimetic Fiber Engineering (www.biomime.org), through planned joint meetings. Such interaction will facilitate the international transfer of state-of-the-art knowledge in tree genomics, biorefinery, and wood materials research, thus building a strong network of leading researchers in forest biotechnology. Information transfer to industry will occur through seminars jointly organised with the aforementioned centres and dissemination through the partners' industrial networks.

Contact

For further information, contact the project coordinator:

Assoc. Prof. Harry Brumer
School of Biotechnology
Royal Institute of Technology (KTH)
AlbaNova Univeristy Centre
106 91 Stockholm
Sweden
tel: +46 (0)8 5537 8367
harry@biotech.kth.se

http://www.biotech.kth.se/woodbiotechnology/FibreSurf/