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Action FP0602

2007 - 2011

Biotechnology for lignocellulose biorefineries

FPS

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Participating countries:
AT, BE, BG, CZ, DK, FI, FR, DE, GR, HU, IL, IR, IT, NO, PT, RO, SK, SL, ES, SE, CH, TR, UK
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An integrated biorefinery is an overall concept where biomass feedstocks are converted into a spectrum of valuable products. Lignocellulosic raw materials (wood and annual plants) provide an extensive source not only for present fibre products, but also for a large number of intermediates, specialty chemicals or fuels. Biorefineries combine and integrate various technologies, among them also biotechnical methodologies. European scientists and industry already have a strong position within white biotechnology directed towards upgrading of lignocellulosic raw materials.

The Action aims at developing innovative biosciences and technologies required to build and implement advanced lignocellulose biorefineries. The primary objective is to develop environmentally sound and cost-effective biotechnical tools and production technologies to be exploited in the production of fibres, chemicals and bioenergy. This Action will strengthen the position of Europe in the areas of white biotechnology and lignocellulose-based biorefineries. The participating experts are active in a broad range of related scientific fields (enzymology, genetics, biochemical engineering, polymer chemistry, fibre technologies). The Action will contribute to the development and implementation of biorefineries, thereby assisting the member countries to achieve the targets set by the European Commission for sustainable energy supply and bio-based economy.

Objectives:

- to develop environmentally sound and cost-effective biotechnical tools and production technologies
- to exploit novel biotechnical tools for the development of new production technologies for fibres, chemicals and bioenergy
- to strengthen the scientific excellence in the area and to disseminate this knowledge to European scientists, industry and other share holders
- to stimulate new interdisciplinary scientific networks in Europe, as well as to link nationally funded activities in the focus areas

Working Group 1

The focus of is on improving the action of enzymes and microorganisms. Hydrolytic enzymes can be separately used to carry out specific modifications in the fibre substrates to achieve improved processes or product properties, or in concert to enhance the hydrolysis of lignocellulosic biomass into fermentable sugars. Research on the fundamental understanding of the action and further engineering of hydrolytic and oxidative enzymes will be carried out. Of particular importance is the design of novel metabolic pathways followed by advanced fermentation technologies for the production of useful metabolites from renewable raw materials. Fermenting organisms, such as yeast, will be genetically improved to produce higher yields of energy carriers or novel chemical building blocks from carbohydrates present in the lignocellulosic raw materials.

Working Group 2

Enzymatic engineering of fibres focuses on the improvement of present processes or products or design of completely new products. There is a significant potential for an extended use of fibres and other wood constituents for advanced materials and composites. Research on application of new biotechnologies in pulp and paper production will include *e.g.* flexible manufacturing processes with radically reduced energy consumption or improved recyclability of fibres. Targeted methods for introducing novel functionalities into fibres are of special interest, especially with regard to extending the uses of paper for novel areas, such as carriers for printed electronic circuits or novel consumer products. Other potential new uses include nanocomposites based on cellulose microfibrils or whiskers, and cellulose derivatives for various types of products and diverse applications.

Working Group 3

Research on the production of biofuels and sugar-based platform chemicals will promote a bio-based economy by complementing and substituting petroleum-based raw materials by renewable lignocellulosic raw materials. Chemical products derived from lignocellulosic polymers and components can be used for a large number of applications. The target is to develop methods and applications for both large-volume and special-use products prepared from the main wood polymers, cellulose, hemicelluloses, wood extractives and lignin. Applying various fractionation techniques and improved pre-treatments, as well as hydrolysis and fermentation techniques, the carbohydrates will be more efficiently converted into relevant products. In addition to fuels, various biopolymers are among interesting products.

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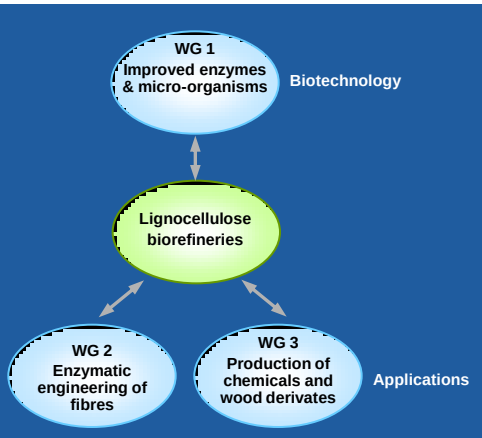

Figure 1: Structure of the Action.

Specific objectives:

WG 1:

- to produce and characterize novel enzymes to be used for the modification of lignocellulosic raw materials
- to increase basic knowledge and to improve the action of hydrolytic and oxidative enzymes in lignocellulosic matrices
- to improve the performance of cell factories, such as yeast

WG 2:

- to develop novel bioprocesses for pulp and paper industry, especially for energy saving
- to develop new enzyme-based methods for functionalization of fibres
- to develop novel fibre products especially for packaging and biocomposite applications

WG 3:

- to develop novel fractionation and hydrolysis processes based on combined thermochemical and enzymatic processes
- to develop novel enzymatic methods for upgrading the components of lignocellulosic raw materials; cellulose, hemicelluloses and lignin
- to improve the production processes of lignocellulose based energy carriers or chemicals
- to evaluate various biorefinery concepts

Working Group 1

Development of novel biotechnical tools (enzymes and micro-organisms)

WG leader:
Prof Claus Felby (cf@life.ku.dk)

Working Group 2

Enzymatic engineering of fibres and fibre-based products for the manufacture of paper, board and composite products

WG leader:
Dr Anna Suurnäkki (anna.suurnakki@vtt.fi)

Working Group 3

Production of biofuels, polymers and chemicals from sugars and components derived from lignocellulosic raw materials

WG leader:
Dr Claudia Crestini (crestini@stc.uniroma2.it)

Main activities:

- Dissemination of scientific results in workshops
- Scientific collaboration, networking
- Short term scientific missions
- Training schools

Main achievements

Networking and dissemination of scientific results

The partners have carried out high quality research on biotechnology and biorefineries and shared their knowledge and results in several meetings and workshops.

New collaborative research projects applied and started

Efficient networking has lead to new national and European project applications in the participating research organizations and universities. Especially in the field of enzymology and bioenergy, new research activities have already been initiated.

Young scientists actively involved

A total of 25 STSM's have been successfully carried out resulting in scientific publications and close collaboration between partners. The ESR have also participated actively in workshops.

Socio-economic impacts

Most important future impacts are due to new knowledge leading to the implementation of biotechnical processes for the production of second generation biofuels and in novel biorefining process concepts.

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