BioSurf

Novel Production Strategies for Biosurfactants

Partners involved in the BioSurf project

Project coordinators

Dr. Steffen Rupp
Fraunhofer Institute for Interfacial Engineeringand Biotechnology IGB

Project leaders

- Prof. Christoph Syldatk - Karlsruhe Institute of Technology - Germany
- Dr. Rico Czaja - c-LEcta GmbH - Germany
- Prof. Ludo DielsFlemish Institute for Technological Reserach - Belgium
- Dr. Eddy Laeremans - Tormans Engineering Noord BVBA - Belgium
- Dirk Develter and Elke Theeuwes - Ecover Coordination Center NV - Belgium
- Dr. Michael O'Donohue and Dr. Regis Fauré - LISBP - INSA Toulouse - France

Contact information

Dr. Steffen Rupp
Fraunhofer Institute for Interfacial Engineeringand Biotechnology IGB
Nobelstrasse 12
70569 Stuttgart
Germany
+49 711 970 4045
steffen.rupp@igb.fraunhofer.de

Surfactants form an integral part of our everyday life with applications reaching far beyond our hygienic needs ranging from fuel to food additives and cosmetics all the way to compounds with antibiotic activities. Within the ERA-IB project BioSurf (http://www.biosurf.fraunhofer.de/index.html) we aimed at an increased replacement of petro-based surfactants by microbial and enzymatically synthesized surfactants generated from renewable resources.

To realize that, the consortium was composed of industrial partners focusing on the development, production and sales of ecological domestic washing laundry and cleaning products (Ecover), development of customized enzymes (c-LEcta), engineering (Tormans) and academic and research partners providing know how in the discovery process and development of biosurfactants (FhG, KIT), downstream processing/purification of surfactants (FhG, VITO) and enzyme discovery and design (LISBP, KIT).

Within the time-frame of BioSurf this consortium was able to identify novel enzymes and microorganisms for the synthesis of new surfactants and could set up more efficient biosurfactant production processes both for known and novel biosurfactants.

This included a better understanding of cellular regulatory processes of the microbial strains involved in biosurfactant production, which is required for setting up more efficient production processes. For example the biosynthetic pathway for production of mannosylerythritol lipids (MEL) was identified in the microbial strain Pseudozyma aphidis by sequencing the entire genome of the production strain and determination of its transcriptome under production conditions (Fig. 1).

In addition the production of cellobiose lipids and sophorolipids was investigated using additional fungal microorganisms. Furthermore, enzyme design using a combination of rational and or evolutionary methods was used to improve enzymes for the enzymatic synthesis of novel surfactants and modification of microbial surfactants.

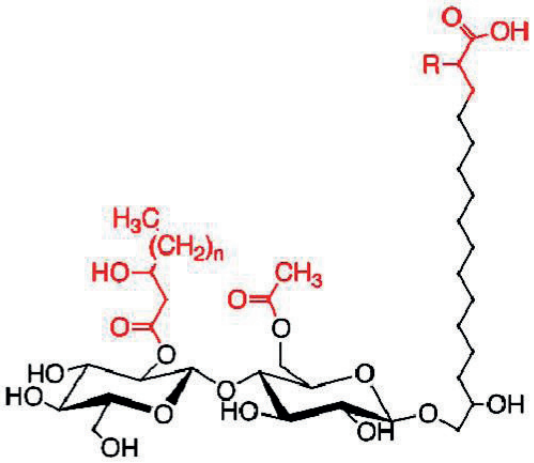
Fermentation unit for the production of sophorolipids and membrane unit for DSP

Scale-up of bioprocesses, both for fermentation and enzymatic synthesis was performed, including innovative down-stream processing (DSP) using membrane technologies and biocatalyst recycling. The BioSurf consortium was able to develop production processes for a set of novel microbial glycolipids. For example for the production of MEL yields of more than 100g / L were achieved in the fermentation process established. Chemical and enzymatic modification steps were applied to these surfactants to create an arsenal of glycolipids with finely tuned characteristics. In addition the production process of sophorolipids, surfactants already introduced to the market, was optimized focusing on DSP. New cost efficient membrane based purification processes of these biosurfactants were developed resulting in products sufficiently pure for testing in cleaning applications. The first pilot for an in situ purification (ISPR) of sophorolipids is now in the test phase.

This could result in a significant reduction of cost for the production of sophorolipids rendering the existing products less expensive and widening their application options.

To identify novel glycolipids for use in personal care and cleaning applications, enzymatic synthesis of novel types of biosurfactants was successfully established using both commercially available enzymes as well as novel enzymes developed within the consortium. Scale up of these reactions and the respective DSP was developed and gramm amounts of material could be supplied for testing to the industrial partner. With these results we have started to create a pipeline of completely novel biosurfactants with potential industrial applications.

To contribute to further communication in the Biosurfactant Community the BioSurf consortium established a new international conference on Biosurfactants which was held for the first time at the Dechema in Frankfurt on 16. - 17.05.2013.



Crystals of cellobiose lipids produced by Ustilago maydis and their chemical structure

During this two day conference the current state of the art of biosurfactants, both in research and industrial application was presented by a panel of international speakers who gave overview lectures on topics in the field of biosurfactants to show possibilities, limitations and challenges for further development of this highly interesting class of compounds.

The conference is documented at http://events.dechema.de/biosurf.html. Follow up version of the conference are planned.