

CeBiTec – Quarterly

Autumn 2015

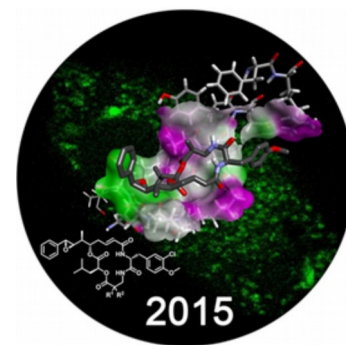
In this Issue

- Targeting cancer – Researchers from all over the world meeting in Bielefeld
- Photofuel – Biocatalytic solar fuels for sustainable mobility in Europe
- The collaborative project F2F aims at conversion of fungal biomass to fine chemicals
- Systems biology of microbial polysaccharide production – Successful continuation of a well established partnership with the industry
- Genome research with Actinoplanes will be continued at the CeBiTec
- 4th CeBiTec Students Academy – Synthetic Biology/Biotechnology
- Breaking News: iGEM 2015 very successful
- Miscellaneous
- Upcoming Events

Targeting cancer – Researchers from all over the world meeting in Bielefeld

The fight against cancer with chemotherapy frequently has many unwanted and severe side effects such as hair loss, nausea, and vomiting. Medicines that fight cancer are poisons; they do not just attack and damage the tumour, but all other cells as well. Internationally renowned scientists engaged in academic and industrial research have met in Bielefeld between September 20 and 23, 2015. At the 5th International CeBiTec Research Conference “Drug Conjugates for Directed Therapy”, they discussed strategies with which these side effects may be circumvented.

The researchers' goal is to develop methods that make it possible to combine chemotherapeutic agents with a kind of molecular address label so that they can be delivered specifically to tumour cells. In contrast to conventional chemotherapies, the majority of healthy cells would then remain unaffected. The methods combine toxic cancer medicines e.g. the fungal poison α -amanitin with pep-



tides or peptide hormones that recognize highly specific targets exposed and overexpressed mainly on the tumour cells. These peptide–drug conjugates then home in on just the cancer cells and destroy only these. “Conjugates between such chemical address labels and an anti-tumour drug could fulfil the Nobel laureate Paul Ehrlich’s



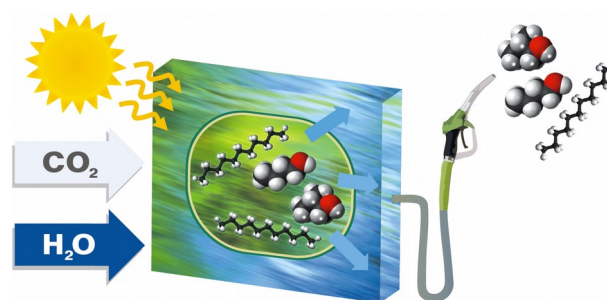
early vision of magic bullets," says Norbert Sewald, Professor of Organic and Bioorganic Chemistry at Bielefeld University and the organizer of this year's CeBiTec conference. Paul Ehrlich (1854–1915) was awarded the Nobel Prize for Physiology in 1908.

This year, the 5th International CeBiTec Research Conference was organized by the Marie Skłodowska-Curie European Training Network Magicbullet that is currently being funded by the European Union as part of the Horizon 2020 Framework Programme for Research and Innovation.

www.cebitec.uni-bielefeld.de/index.php/events/conferences/426-2015-09-20-5th-int-cebitec-research-conference
www.magicbullet.de

Photofuel – Biocatalytic solar fuels for sustainable mobility in Europe

A new European HORIZON 2020 research project with the participation of the CeBiTec is tackling the direct production of transportation fuels from sunlight, CO₂ and water with biocatalysts in closed systems. The Photofuel project will develop a next generation technology for the sustainable production of alternative, liquid transportation fuels. The challenge is to advance the base technology of microalgae cultivation in closed bioreactors by enabling phototrophic algae or cyanobacterial microorganisms to produce alkanes and alcohols, which are excreted to the culture broth for direct separation without cell harvesting. This thereby turns the microbial cells into self-reproducing biocatalysts allowing the process to directly convert solar energy, water and CO₂ into engine-ready fuels as shown in the figure.



Schematic representation of the Photofuel process. Solar energy, water and CO₂ are converted by microbial cells, grown in photobioreactors, into engine-ready fuels.

In the project coordinated by Volkswagen AG, six research institutions and six industrial partners from all parts of the value chain will participate. European research groups on biocatalyst development, algae cultivation, fuels research and sustainability assessment from Bielefeld, Florence, London, Karlsruhe, Uppsala and Paris are joining forces with car and renewable fuel producers from Sweden, Italy, Germany, Finland and Portugal.

Europe is pinning its hopes on transportation fuel from microorganism-based systems. The project started May 2015 and will have a duration of four years. It is co-funded by the EU with a total amount of almost 6 million €.

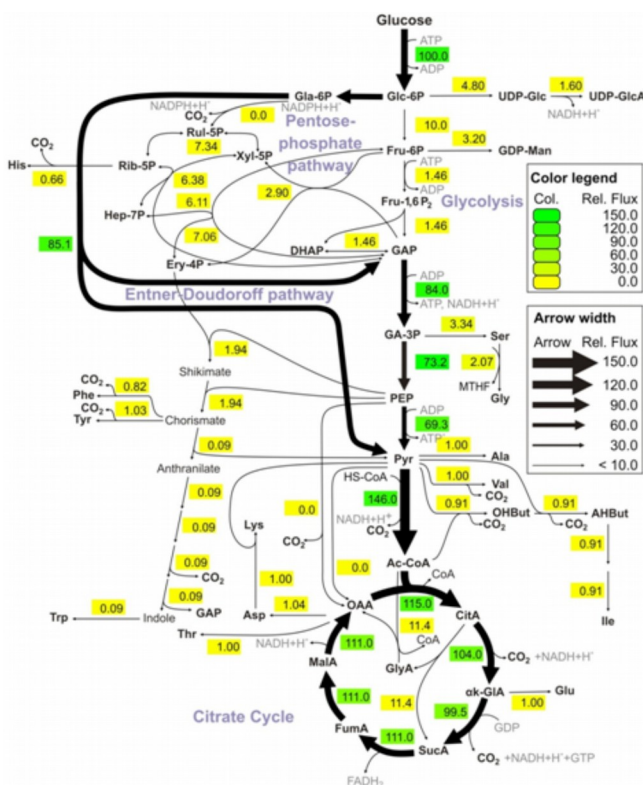
Research at Bielefeld University within this collaborative project will be performed at the CeBiTec and the Faculty of Biology in the group of Algae Biotechnology & Bioenergy. "Our task will be the participation and coordination of molecular biology research aiming for the establishment of microalgae and cyanobacteria as 'green cell factories' for the sustainable production of hydrocarbons that can be used as gasoline and diesel replacements" explains Prof. Dr. Olaf Kruse, the Scientific Director of the CeBiTec. The project will cover the whole value chain from development of microbial systems for direct fuel production, their validation on pilot scale, fuel blending and engine performance, technology risks, as well as the assessment of socio-economic and environmental impacts. The objective is to significantly improve the efficiency of solar biofuels in the future.

The collaborative project F2F aims at conversion of fungal biomass to fine chemicals

F2F is funded with about 0.75 million € in the ZIM program of BMWi. The project is coordinated by WeissBioTech GmbH, who produce enzymes in fungal fermentations. Experts in chitin (Prof. Dr. Bruno Moerschbacher, Westfälische Wilhelms-Universität Münster), bacterial consortia (Prof. Dr. Bodo Philipp, Westfälische Wilhelms-Universität Münster),

dipeptide production (Cysal GmbH) and metabolic engineering (Prof. Dr. Volker F. Wendisch, CeBiTec & Faculty of Biology) are partners in F2F. The project partners met in Münster on June 29, 2015, to kick-off the project. F2F contributes to fostering the raw material change in chemical industry from petrol oil-based substrates to renewable resources. F2F aims at valorizing fungal biomass accumulating as waste during large scale fermentation processes to produce enzymes. Specifically, research focusses on developing a strategy to convert chitin, which is a component of fungal cell walls and a recalcitrant polymer made of glucosamine monomers with variable degree of acetylation, to dipeptides, diamines and amino acids. A pre-treatment process to extract chitin from fungal biomass will be developed. To enable access to chitin as alternative carbon substrate for fermentations, the approach involves metabolic engineering of chitin-hydrolysing bacteria and producer strains as well as synthetic trophic interactions between them. Finally, a proof-of-principle of fermentative production of sought-after chemicals from fungal biomass shall be reached.

Systems biology of microbial polysaccharide production – Successful continuation of a well established partnership with the industry



Modelling of the metabolic flux in *Xanthomonas campestris* pv. *campestris* during the early logarithmic growth phase.

A long standing collaboration with the Jungbunzlauer AG (Austria) was extended for the next three years. Prof. Dr. Alfred Pühler (Senior Research Group, CeBiTec) and Prof. Dr. Karsten Niehaus (CeBiTec and Faculty of Biology) are the principal investigators of this Project. Two PhD students, within the framework of the CLIB 2021 graduate cluster, a laboratory assistant and a postdoc will work on the improvement of polysaccharide (xanthan) production by bacteria. Investigating the systems biology of xanthan production by the Gram-negative bacterium *Xanthomonas campestris* pv. *campestris* is a both promising and challenging project mainly carried out in collaboration with the industrial partner. The scientific objective of this innovative project is to provide new insights into the cellular synthesis of a major biopolymer, xanthan, which is commercially produced in large scale for applications mainly in the oil drilling and food industries, and which at the same time is involved in pathogenicity of crop plants. The project is designed to model the switch in cellular life style from growth, when putative xanthan building blocks are directed to other polysaccharides, to persistence, when xanthan is produced. Deciphering the

molecular regulation of this switch is also helpful to understand the regulation of polysaccharide production by other bacteria including the human lung pathogen *Pseudomonas aeruginosa*. A central objective in enhancing the xanthan production process will be the utilisation of carbohydrates derived from plant material. This lays ground for a more flexible, efficient, and ultimately less CO₂-consuming utilisation of raw materials, aiming at converting substrates so far regarded as fall-outs of European farming into valuable products. The techniques used within this project include genomics, transcriptomics, proteomics, metabolomics, flux-analysis and modelling of biosynthetic pathways.

Genome research with *Actinoplanes* will be continued at the CeBiTec

Actinoplanes sp. SE50/110 is known to synthesize the alpha-glucosidase inhibitor acarbose, a potent drug for the worldwide treatment of type-2 diabetes mellitus. The microbial drug acarbose is produced by the Bayer AG in Wuppertal. Already in the year 2008 the CeBiTec was approached to support acarbose research by applying omics-technologies. In the meantime the genome sequence of *Actinoplanes* sp. SE50/110 could be established, which represents the basis for carrying out research in the field of transcriptomics, proteomics and metabolomics. The aim of this research is to improve acarbose production by a deeper understanding of the acarbose biosynthesis process.

The Bayer AG now agreed to continue the collaboration for another three years. In particular, the Bayer AG will finance the position of three PhD students which will be incorporated into the existing Graduate Cluster Industrial Biotechnology of the CeBiTec. The actual acarbose research team at Bielefeld University is shown in the photo. Apl. Prof. Dr. Jörn Kalinowski and Prof. Dr. Alfred Pühler are the project leaders. Dr. Susanne Schneiker-Bekel and Dr. Marcus Persicke are involved as instructors for the former PhD student Dr. Sergej Wendler and the current PhD students Vera Ortseifen Timo Wolf and Tetiana Gren. From January 2016 on these PhD students will hand over their gained knowledge and experience to the new candidates.



4th CeBiTec Students Academy – Synthetic Biology/Biotechnology



Following the successful application for a three years extension of the support of the CeBiTec Students Academy by the Familie-Osthushenrich-Stiftung (see CeBiTec Newsletter 2014-4), the 4th CeBiTec Students Academy "Synthetic Biology/Biotechnology" was held at the CeBiTec from June 29 to July 3, 2015.

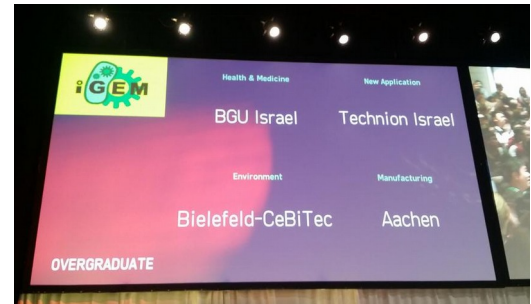
The Students Academy is a joint project of the CeBiTec, the District Council Detmold as well as the Familie-Osthushenrich-Stiftung which provides the essential financial support and is organized by Honorary Prof. Dr. Walter Arnold, Prof. Dr. Alfred Pühler and Dr. Werner Selbitschka. The one-week course is directed towards gifted and talented students originating from Ostwestfalen-Lippe of Northrhine-Westfalia who will finish their Abitur in one-years time, the general qualification for university entrance. From a total of more than 40 applications, 20 participants were accepted to the academy. All of the attendees had excellent grades in natural sciences. Remarkably, 12 of the 20 participants had A+ grades in all of the four school subjects Biology, Chemistry, Mathematics and Physics. As observed for the last year's course, more than half of the attendees were female. Lectures which were held by members of the Faculty of Biology and the Technical Faculty addressed various aspects of modern biotechnology. Relevant subjects were (i) industrial biotechnology, (ii) modern plant breeding, (iii) industrial production of pharmaceuticals, as well as (iv) synthetic biology. In addition, the novel CRISPR/CAS technique was introduced to the students. The experimental part was organized by members of the CeBiTec and dealt with the isolation, amplification as well as the sequencing of DNA. In addition, a proteomics experiment was newly introduced to the course. The knowledge acquired by the students was used for the (i) taxonomic identification of bacterial communities employing bioinformatics tools, (ii) MALDI-TOF based identification of *Xanthomonas campestris* pv. *campestris* proteins, and finally (iii) for the analysis of regulatory networks constructed by synthetic biology approaches. As part of the Students Academy, the Labor Krone, a diagnostics provider in Bad Salzuflen was visited.

Breaking News: iGEM 2015 very successful

At the 2015 Giant Jamboree from September 24 to 28, 2015, at the Hynes Convention Center in Boston, The iGEM team Bielefeld was very successful. The team won the prize for the best environment project and the following special prizes: best presentation, best integrated human practices, best new composite part and the safety commendation. Further the team was nominated for best model, best basic part, and best wiki. A more detailed article about the iGEM team 2015 Bielefeld will follow in the next CeBiTec-Quarterly.

www.igem-bielefeld.de

https://twitter.com/iGEM_Bielefeld



Miscellaneous

From August 20 to 21, 2015, the 2nd CeBiTec Retreat was held in the Evangelische Akademie Loccum. During the two days 18 scientific talks representing different research topics of the CeBiTec were given by MSc and PhD students, postdocs, and professors. Additionally, a special lecture about biocatalysis was held by Prof. Dr. Harald Gröger. The CeBiTec Retreat is the follow-up event of the retreat of the Institute for Genome Research and Systems Biology (IGS Retreat), which was held annually in previous years.

From September 9 to 15, 2015, CeBiTec scientists and about 150 participants from all five continents attended BIOFLA – VOOR, the International Conference on Flavour and Fragrance Biotechnology organized by DECHEMA, Frankfurt. Nadja A. Henke (MSc) from the Lab of Prof. Dr. Volker Wendisch received the 2nd poster prize for her contribution "Metabolic engineering of *Corynebacterium glutamicum* for production of the carotenoids canthaxanthin and astaxanthin".

Upcoming Events

- August 29–30, 2016 | Evangelische Akademie Loccum
3rd CeBiTec Retreat
- September 25–28, 2016 | Center for interdisciplinary Research (ZiF), Bielefeld University
6th International CeBiTec Research Conference – Advances in Industrial Biotechnology