UNIVERSITÄT BIELEFELD

CeBiTec Center for Biotechnology

CeBiTec – Quarterly

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CeBiTec Advisory Board Meeting 2025

On 11 and 12 February 2025, the CeBiTec Advisory Board (Figure 1) met for its 10th meeting at CeBiTec. On the first day of the meeting, various talks were given in which the current status of CeBiTec and new scientific projects were presented. After Volker Wendisch, who attended the advisory board meeting for the first time as scientific director, presented the status of CeBiTec in terms of new members, the new composition of the Executive Board, consortium projects with CeBiTec participation, third-party funding and publication performance, various projects were presented.

Professor Romy Schmidt-Schippers lectured on 'Improving plant resilience to environmental oxygen deficiency through optimised oxygen sensors 'Advances in translational pangenomics'. New catalytic reactions and new enzymes through enzyme engineering were the focus of Professor Stephan Hammer's lecture. The focus area 'Microbiology in a data-driven world' was presented by Professor Andrea Bräutigam, and Dr Tobias Busche gave an overview of the technical possibilities in the field of next-generation sequencing, which are available at CeBiTec and in the Omics Core Facility, which is currently under construction.

On the second day, (post)-doctoral students from CeBiTec presented their scientific projects to the Advisory Board. The Advisory Board then presented its impressions to the CeBiTec Executive Board and the Vice Rector for Research and Research Networking, Prof. Christiane Fuchs, and

made recommendations for future strategic development. The Advisory Board once again emphasised the importance of CeBiTec as a lighthouse project of Bielefeld University, whose appeal is based on excellent international research in numerous third-party funded projects.

Figure 1 | The CeBiTec Advisory Board

The 10th meeting of the Advisory Board was held under special circumstances in that this meeting would have been the last for Dr Rolf Apweiler, the long-standing spokesperson, who unfortunately had to cancel at short notice. We would like to thank Dr Apweiler for his 13 years of service as a member of the Scientific Advisory Board. From the end of 2016 to the beginning of 2025, he acted as spokesperson for the Advisory Board. Advisory Board member Prof. Dr Tobias Erb, who stood in for Dr Apweiler and did a fantastic job of chairing the Advisory Board meeting in his role as spokesperson, agreed to succeed Dr Apweiler as Advisory Board spokesperson, to the great delight of the CeBiTec Executive Board.

(L. Wobbe)

Sustainable production of the aromatic drug precursors tyramine and tyrosol by engineered *Corynebacterium glutamicum*

Sara-Sophie Poethe and Nora Junker (equal contributors) with Florian Meyer and Volker F. Wendisch established biosynthesis of tyramine by decarboxylation of L-tyrosine in a *de novo* fermentation approach using simple nitrogen and sustainable carbon sources. A phylogenetic analysis of aromatic L-amino acid decarboxylases (AADCs) revealed potential candidate enzymes with a preference for L-tyrosine over L-phenylalanine and L-tryptophan. The highest tyramine titer of 1.9 g L^{-1} was obtained with the L-tyrosine producing strain AROM3 overexpressing the tyrosine decarboxylase gene of *Levilactobacillus brevis*. *De novo* production from the alternative carbon sources ribose and xylose was also enabled. Additionally, up-scaling of tyramine production from xylose to a 1.5 L bioreactor batch fermentation was demonstrated to be stable, highlighting the potential for sustainable tyramine production.

Nora Junker and Sara-Sophie Poethe (equal contributors) from the Wendisch Lab engineered

two routes of tyrosol production, one of which was based on tyramine production. Extension of this pathway by heterologous overexpression of tyramine oxidase gene *tyo* from *Kocuria rhizophila* yielded 1.9 g L^{-1} tyrosol. They identified the furfural dehydrogenase FudC as a major enzyme involved in reducing the product of the Tyo_{Kr} reaction, 4-OH-phenylacetaldehyde, as its gene deletion reduced tyrosol production by 75%.

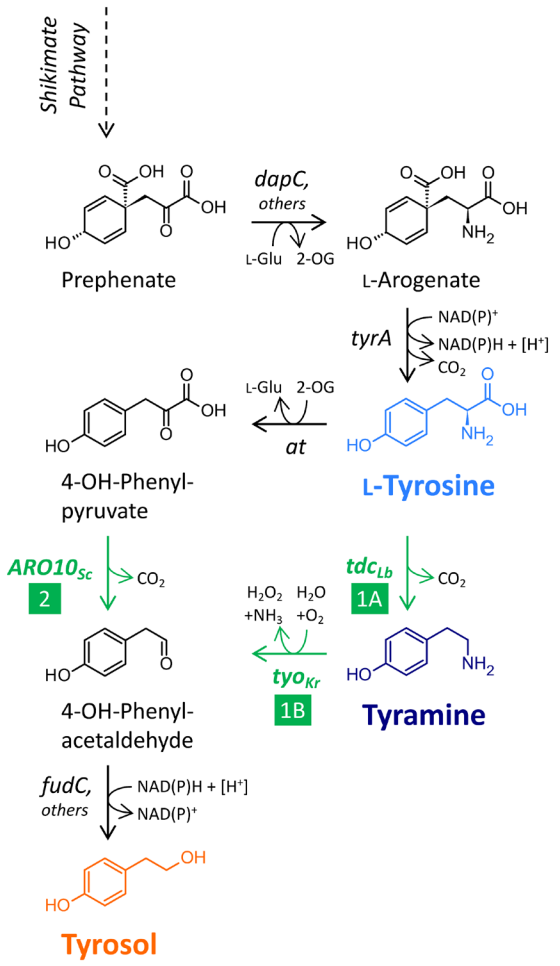

Figure 2 | Heterologous key enzymes (green) of the engineered pathways to tyramine (1A) and tyrosol (1B and 2).

Engineering the alternative route via 4-OH-phenylpyruvate yielded a surprise.

Although *C. glutamicum* lacks prephenate dehydrogenase as it synthesises L-tyrosine in the L-arogenate pathway, unexpectedly, heterologous expression of *ARO10* from *Saccharomyces cerevisiae*, which encodes a phenylpyruvate decarboxylase, was sufficient to establish tyrosol production in strain AROM3. However, they had to invoke a source for the substrate of the $Aro10_{Sc}$ reaction, namely 4-OH-phenylpyruvate. Genetic and biochemical evidence revealed that 4-OH-phenylpyruvate is synthesised from L-tyrosine by native aminotransferases (*at*). However, the inherent instability of 4-OH-phenylpyruvate limited the pathway flux and only about 1.3 g L^{-1} tyrosol accumulated.

A microbial consortium was designed and tested in a division of labour approach for tyrosol production. To this end, the route via tyramine involving L-tyrosine decarboxylase and tyramine oxidase lent itself ideally. Indeed, co-cultivating L-tyrosine producing strains that either expressed the L-tyrosine decarboxylase gene tdc_{Lb} or the tyramine oxidase gene tyo_{Kr}, reached the highest titer of almost 2 g L^{-1}, i.e., higher than the monoculture with cells expressing both tdc_{Lb} and tyo_{Kr}.

Poethe S-S, Junker N, Meyer F, Wendisch VF (**2024**). *Appl Microbiol Biotechnol*, ***108***, 499. DOI: 10.1007/s00253-024-13319-8

Junker N, Poethe S-S, Wendisch VF (**2025**). *Biotechnol Biofuels Bioprod*, ***18***, 4. DOI: 10.1186/s13068-025-02641-6

(N. Junker, S.-S. Poethe & V.F. Wendisch)

Dr Hanna Schilbert receives the award of the Bielefeld University Society to honour the best doctoral theses of 2024

The award ceremony occurred at the university's Centre for Interdisciplinary Research (ZiF) on May 5th. The awards are assigned to the best doctoral theses per faculty. The title of Dr Schilbert's dissertation work from the Faculty of Biology was

‘Molecular and bioinformatic identification and analysis of genomic loci controlling seed protein quality in rapeseed (*Brassica napus* L.)’. The thesis was successfully defended in December 2023 and was evaluated with "*summa cum laude*".

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After an initial postdoc phase in the group ‘Genetics and Genomics of Plants’, which thematically continued the PhD thesis, and about 10 years at Bielefeld University and the CeBiTec, Dr Schilbert is now a postdoc in the Stetter group at the Institute for Plant Sciences at the University of Cologne.

(B. Weisshaar)

Empowering Early Career Female Scientists: The ECFS Seminar Series

The ‘Early Career Female Scientist (ECFS)’ Seminar Series highlights the contributions of talented women in life science. The seminar aims to enhance the visibility of female scientists and promote their professional development, while providing networking opportunities for local CeBiTec early career scientists. The series invites women in the early stages of their careers to present their work and share insights into their career paths.

Initiated in 2023 by Dr Nadja Henke and Dr Hanna Schilbert, the ECFS Seminar Series is now organised by Merve Saudhof, Dr Magdalena Miklaszewska, and Sara-Sophie Poethe.

The ECFS organising team presenting the idea of the seminar series at the CeBiTec Advisory Board meeting.
©ECFS organising team.

This semester, we welcomed Juniorprof. Dr Julie Zedler (Friedrich Schiller University Jena) and Dr Tegan M. Haslam (Georg-August University of Göttingen), who presented their research on biotechnological pigment production in cyanobacteria and the moss *Physcomitrium patens* as a plant model organism, respectively.

Each seminar is followed by a career discussion panel with the speakers, covering topics such as navigating academic careers, the status of women in science, and challenges in academia. A new feature of these networking events is that they are open to students and early career scientists of all genders. This inclusive approach has been warmly received at recent seminars. For example, Dr Julie Zedler shared her experiences as a Junior Professor, while Dr Tegan M. Haslam

offered valuable advice on securing research fellowships.

Career discussion panel with Dr Julie Zedler.
©ECFS organising team.

The next ECFS seminars will take place in the upcoming winter semester, and we are pleased to welcome Levin Joe Klages and Sanja Zenker to our organisation team. For information about the ECFS series and details of future events, please visit the CeBiTec website. If you are interested in inviting an early-career female speaker together with us, you are welcome to contact us.

(S. Poethe, M. Miklaszewska & M. Saudhof)

CeBiTec member Prof. Daniel Merkle contributes to the EU project CORENET on chemical reservoir computing

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Within the Horizon-Europe project CORENET (Complex Chemical Reaction Networks for Breakthrough Scalable Reservoir Computing), computer scientist **Prof. Daniel Merkle**—a CeBiTec member whose **Algorithmic Cheminformatics** group is located at Bielefeld University's **Faculty of Technology**—collaborates with Universidad Autónoma de Madrid, Radboud Universiteit, IBM Research – Zürich and the Spanish National Research Council (CSIC). The consortium investigates how networks of chemical reactions, implemented on microfluidic chips, can be used for information processing.

CORENET studies whether time-dependent concentration patterns that emerge in carefully designed "chemical reservoirs" can perform useful computations. An incoming pulse of molecules triggers a cascade of reactions; the resulting concentration profile constitutes the computational output. This concept offers an alternative to conventional silicon-based logic without invoking direct analogies to neural tissue.

Prof. Merkle's group provides the formal design and analysis framework for these reaction networks. Their modelling approaches are rigorously rooted in mathematics—especially graph theory, algorithmics and combinatorial optimisation—and implemented in a methodology known as **graph transformation**. By representing reactions as rule-based graph operations, the group can systematically expand very large chemical spaces and identify plausible motifs or pathways that meet predefined performance criteria.

Microfluidic prototypes of the reservoirs are fabricated by project partners, while IBM Zürich develops optical and electrochemical systems that translate transient chemical signals into digital data. Continuous exchange of simulation results and experimental measurements establishes an *in-silico / in-vitro* feedback loop that refines both the theoretical designs and the

physical devices.

Potential applications under consideration include pattern recognition in sensor data, low-power edge computing and control tasks in environments where conventional electronics are unsuitable—for example, chemically harsh industrial settings or biologically sensitive contexts. CORENET thereby strengthens Bielefeld University's research portfolio at the intersection of computer science, chemistry and biotechnology and provides a platform for further interdisciplinary developments in Algorithmic Cheminformatics.

(D. Merkle)

Heyer group and international partners publish study on the application of metaproteomics in the 'One Health' framework in 'Microbiome'

© R. Heyer

The One Health concept refers to an approach to balance the health of humans, animals, and environmental systems, which are intricately linked through microbiomes. These microbiomes influence everything from antibiotic resistance and disease emergence to soil fertility and water quality.

The comment article "Metaproteomics in the One Health framework for unravelling microbial effectors in microbiomes" by Prof. Robert Heyer and an international team from Germany, Italy, France, Belgium, Spain, Luxembourg and the Netherlands delves into how metaproteomics—study of proteins in microbial communities—offers a groundbreaking methodological approach in One Health research.

There, controlling the composition of microbiomes through microbial effectors, including virulence factors, toxins, antibiotics, non-ribosomal peptides, and viruses, holds immense potential.

However, the mechanisms by which these effectors shape microbiomes and their far-reaching consequences for host and ecosystem health remain poorly understood. By analysing protein expression and activity, metaproteomics offers a novel methodological framework as it provides insights into microbial dynamics or metabolic functions, and enables the detection of viruses, antimicrobial resistance proteins, and non-ribosomal peptides. The article highlights the potential of metaproteomics in elucidating microbial effectors and their impact on microbiomes and discusses their potential for modulating microbiomes to foster desired functions.

"The application of metaproteomics in One Health research can be a step toward precision microbiome management, where we can monitor or even engineer microbial communities for better health outcomes and environmental resilience.", emphasises Robert Heyer.

Heyer, R., Wolf, M., Benndorf, D. *et al.* **(2025)** Metaproteomics in the One Health framework for unraveling microbial effectors in microbiomes. *Microbiome* ***13***, 134 DOI: 10.1186/s40168-025-02119-5

(R. Heyer)

Impressum

CeBiTec / Universität Bielefeld
Dr Lutz Wobbe
Universitätsstr. 27
33615 Bielefeld, Germany

Concept & Idea:
Dr Stefan Weidner