

Fungal Biology

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Monika Schmoll • Christoph Dattenböck
Editors

Gene Expression Systems in Fungi: Advancements and Applications



Editors

Monika Schmoll
AIT Austrian Institute of Technology
Tulln, Austria

Christoph Dattenböck
AIT Austrian Institute of Technology
Tulln, Austria

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Preface

Strain improvement with fungal gene expression systems has a tradition of decades regarding modern fermentation industry and even millennia when we think of brewing processes for beer, wine or enzymatic processes in baking. Genetic engineering techniques developed in the last century have revolutionized fermentation industry and enabled production of enzyme mixtures and secondary metabolites with strongly increased efficiency, first by random mutagenesis, but soon also with knowledge-based targeted genome modification. Thereby, economic and optimized production of various compounds originating from diverse organisms became possible in filamentous fungi, from novel, thermostable, or cold active enzymes to potent antibiotics and antibodies to efficient anticancer drugs. At the same time, these possibilities opened up new challenges to be solved, like precise regulation of gene expression during the growth phase for optimized product yield and expression of heterologous proteins with unusual characteristics in a production organism.

This volume aims to give a broad overview on gene expression systems in biotechnological workhorses for production of enzymes and metabolites from the phyla of ascomycetes and basidiomycetes and the subphylum mucoromycotina. Additionally, we include model organisms that have provided valuable insights into the physiology of fungi, also with respect to industrial applications and, for example, the corn smut fungus *Ustilago maydis* as an alternative expression system. For the diversity in potential fungal hosts for production of a given compound, strain collections and for fungi particularly the Fungal Genetics Stock Center represent an invaluable resource for research and application, which is discussed in a dedicated chapter.

The “Tools” section summarizes current and versatile methods for strain manipulation, such as high throughput construction of genetically modified fungi and strategies for activation of silent secondary metabolite gene clusters and targets for improvement such as the mechanism of carbon catabolite repression. However, also novel strategies and tools that became available in recent years or have raised increased attention are highlighted. The use of inteins in protein synthesis is one example of such intriguing avenues for protein expression, and signal transduction pathways of fungi still remain to be exploited further for optimization of production processes.

In the last few years also, sexual development was achieved with industrial fungi, which were believed to develop only clonally for decades. *Trichoderma reesei* was the first one, for which this tool became available and more and more others are following thanks to considerable effort of the fungal scientific community. In this volume we included two chapters on the perspectives and challenges of application of sexual development for strain improvement.

Last but not least, the section on “Challenges” aims to provide insight into the perspectives and needs in industry and discusses safety issues with recombinant production organisms.

With this volume we aim to provide a profound resource for scientists in research and industry alike as well as for students starting their work on application-oriented research with fungi. We intend to inspire researchers to combine classical and novel strategies to meet the challenges with fungal biotechnology in economical and environmentally safe production of the diverse products that make our life more convenient like enzymes or to even save it with novel antibiotics and drugs.

Tulln, Austria

Monika Schmoll
Christoph Dattenböck

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Contributors

Gunseli Bayram Akcapinar, Ph.D. Microbiology Group, Research Area Biotechnology and Microbiology, Institute of Chemical Engineering, Vienna University of Technology, Vienna, Austria

George D. Ashton School of Life Sciences, University of Nottingham, Nottingham, UK

Hoda Bazafkan Department Health and Environment, Bioresources, AIT Austrian Institute of Technology, Tulln, Austria

Mojca Benčina Laboratory of Biotechnology, National Institute of Chemistry, Ljubljana, Slovenia

J. Philipp Benz Holzforschung München, TUM School of Life Sciences Weihenstephan, Technische Universität München, Freising, Germany

Robert H. Bischof Research Division Biotechnology and Microbiology, Institute of Chemical Engineering, Technische Universität Wien, Vienna, Austria

Austrian Centre of Industrial Biotechnology (ACIB) GmbH c/o Institute of Chemical Engineering, Technische Universität Wien, Vienna, Austria

Katherine A. Borkovich, Ph.D. Department of Plant Pathology and Microbiology, University of California, Riverside, CA, USA

Axel A. Brakhage, Ph.D. Department of Molecular and Applied Microbiology, Leibniz Institute for Natural Product Research and Infection Biology (HKI), Jena, Germany

Chia-Ling Chen Institute of Molecular Biology, Academia Sinica, Taipei, Taiwan

Yu-Chien Chuang Institute of Molecular Biology, Academia Sinica, Taipei, Taiwan

Pramote Chumnanpuen Department of Zoology, Faculty of Science, Kasetsart University, Bangkok, Thailand

Árpád Csernetics, Ph.D. Department of Microbiology, Faculty of Science and Informatics, University of Szeged, Szeged, Hungary

Daniel Cullen, Ph.D. USDA Forest Products Laboratory, Madison, WI, USA

Paul S. Dyer, B.A., M.A., Ph.D. School of Life Sciences, University of Nottingham, Nottingham, UK

Skander Elleuche, Dr. rer. nat. Institute of Technical Microbiology, Hamburg University of Technology (TUHH), Hamburg, Germany

Michael Feldbrügge, Dr. Heinrich Heine University Düsseldorf, Institute for Microbiology, Düsseldorf, Germany

Bioeconomy Science Center (BioSC), c/o Forschungszentrum Jülich, Jülich, Germany

Juliane Fischer, M.Sc. Department of Molecular and Applied Microbiology, Leibniz Institute for Natural Product Research and Infection Biology (HKI), Jena, Germany

Institute of Microbiology, Friedrich Schiller University, Jena, Germany

Eleni Gomes, Ph.D. Laboratory of Biochemistry and Applied Microbiology, Rua Cristóvão Colombo, IBILCE/Unesp, Campus of São Jose do Rio Preto, SP, Brazil

Anna Gryshyna, M.Sc., M.S. Department of Chemistry and Biomolecular Sciences, Macquarie University, Sydney, NSW, Australia

Loreta Gudynaite-Savitch, Ph.D. Iogen Corp., Ottawa, ON, Canada

University of Ottawa, Department of Biology, Ottawa, ON, Canada

Thomas Haarmann, Ph.D. AB Enzymes GmbH, Darmstadt, Germany

Kristiina Hildén, Ph.D. Division of Microbiology and Biotechnology, Department of Food and Environmental Sciences, University of Helsinki, Helsinki, Finland

Chiaki Hori, Ph.D. Riken Biomass Engineering Group, Yokohama, Japan

Liisa Kautto, Ph.D. Department of Chemistry and Biomolecular Sciences, Macquarie University, Sydney, NSW, Australia

Daniel Kiesenhofer, Mag. Institute of Chemical Engineering, Vienna University of Technology, Vienna, Austria

Kanokarn Kocharin Bioresources Technology Unit, National Center for Genetic Engineering and Biotechnology (BIOTEC), Pathum Thani, Thailand

Nada Kraševc Laboratory for Molecular Biology and Nanobiotechnology, National Institute of Chemistry, Ljubljana, Slovenia

Guofen Li Department Health and Environment, Bioresources, AIT Austrian Institute of Technology, Tulln, Austria

Wan-Chen Li Taiwan International Graduate Program in Molecular and Cellular Biology, Academia Sinica, Taipei, Taiwan

Institute of Life Sciences, National Defense Medical Center, Taipei, Taiwan

Institute of Molecular Biology, Academia Sinica, Taipei, Taiwan

Sara Casado López, M.Sc. Fungal Physiology, CBS-KNAW Fungal Biodiversity Centre, Fungal Molecular Physiology, Utrecht University, Utrecht, The Netherlands

Robert L. Mach, Ph.D. Institute of Chemical Engineering, Vienna University of Technology, Vienna, Austria

Astrid R. Mach-Aigner, Ph.D. Institute of Chemical Engineering, Vienna University of Technology, Vienna, Austria

Miia R. Mäkelä, Ph.D. Division of Microbiology and Biotechnology, Department of Food and Environmental Sciences, University of Helsinki, Helsinki, Finland

Susanna Mäkinen, M.Sc. Roal Oy, Rajamäki, Finland

Kevin McCluskey, M.S., Ph.D. Department of Plant Pathology, Throckmorton Plant Sciences Center, Kansas State University, Manhattan, KS, USA

Gábor Nagy, Ph.D. Department of Microbiology, Faculty of Science and Informatics, University of Szeged, Szeged, Hungary

Helena Nevalainen, Ph.D. Department of Chemistry and Biomolecular Sciences, Macquarie University, Sydney, NSW, Australia

Ildikó Nyilasi, Ph.D. Department of Microbiology, Faculty of Science and Informatics, University of Szeged, Szeged, Hungary

Tássio Brito de Oliveira, M.Sc. Laboratório de Ecologia e Sistemática de Fungos, IB/Unesp – Campus of Rio Claro, SP, Brazil

Guillermo Ladino Orjuela, M.Sc. Laboratory of Biochemistry and Applied Microbiology, Rua Cristóvão Colombo, IBILCE/Unesp, Campus of São Jose do Rio Preto, SP, Brazil

Shouqiang Ouyang, Ph.D. Department of Plant Pathology and Microbiology, University of California, Riverside, CA, USA

Marja Paloheimo, M.Sc. Roal Oy, Rajamäki, Finland

Tamás Papp, Ph.D. Department of Microbiology, Faculty of Science and Informatics, University of Szeged, Szeged, Hungary

Gyungsoon Park Plasma Bioscience Research Center, Kwangwoon University, Seoul, Republic of Korea

Robyn Peterson, Ph.D. Department of Chemistry and Biomolecular Sciences, Macquarie University, Sydney, NSW, Australia

Stefanie Pöggeler Department of Genetics of Eukaryotic Microorganisms, Institute of Microbiology and Genetics, Georg-August University-Göttingen, Göttingen, Germany

Jonas Ramoni, M.Sc. Research Division Biotechnology and Microbiology, Institute of Chemical Engineering, Technische Universität Wien, Vienna, Austria

Andre Rodrigues, Ph.D. Laboratório de Ecologia e Sistemática de Fungos, IB/Unesp – Campus of Rio Claro, SP, Brazil

Aroa Rodriguez-Iglesias Department Health and Environment, Bioresources, AIT Austrian Institute of Technology, Tulln, Austria

Parveen Sarkari, Dr. Institute for Microbiology, Heinrich Heine University Düsseldorf, Düsseldorf, Germany

Kerstin Schipper, Dr. Institute for Microbiology, Heinrich Heine University Düsseldorf, Düsseldorf, Germany

Bioeconomy Science Center (BioSC), c/o Forschungszentrum Jülich, Jülich, Germany

Monika Schmoll, Ph.D. Department Health and Environment, Bioresources, AIT Austrian Institute of Technology, Tulln, Austria

Volker Schroeckh Department of Molecular and Applied Microbiology, Leibniz Institute for Natural Product Research and Infection Biology (HKI), Jena, Germany

Tanja Seibert, M.Sc. Holzforschung München, TUM School of Life Sciences Weihenstephan, Technische Universität München, Freising, Germany

Max Planck Institute of Molecular Plant Physiology, Potsdam, Germany

Bernhard Seibold Research Division Biotechnology and Microbiology, Institute of Chemical Engineering, Technische Universität Wien, Vienna, Austria

Austrian Centre of Industrial Biotechnology (ACIB) GmbH c/o Institute of Chemical Engineering, Technische Universität Wien, Vienna, Austria

Verena Seidl-Seibold Research Division Biotechnology and Microbiology, Institute of Chemical Engineering, Technische Universität Wien, Vienna, Austria

Osman Ugur Sezerman, Ph.D. Department of Biostatistics and Medical Informatics, Acibadem University, Istanbul, Turkey

Outi-Maaria Sietiö, M.Sc. Division of Microbiology and Biotechnology, Department of Food and Environmental Sciences, University of Helsinki, Helsinki, Finland

Roberto Da Silva, Ph.D. Laboratory of Biochemistry and Applied Microbiology, Rua Cristóvão Colombo, IBILCE/Unesp, Campus of São Jose do Rio Preto, SP, Brazil

Angelica Rodrigues de Souza, Ph.D. Laboratory of Biochemistry and Applied Microbiology, Rua Cristóvão Colombo, IBILCE/Unesp, Campus of São Jose do Rio Preto, SP, Brazil

Eva Stappler Department Health and Environment, Bioresources, AIT Austrian Institute of Technology, Tulln, Austria

Miklós Takó, Ph.D. Faculty of Science and Informatics, Department of Microbiology, University of Szeged, Szeged, Hungary

Nils Thieme, M.Sc. Holzforschung München, TUM School of Life Sciences Weihenstephan, Technische Universität München, Freising, Germany

Csaba Vágvölgyi, D.Sc., Ph.D. Faculty of Science and Informatics, Department of Microbiology, University of Szeged, Szeged, Hungary

Jari Vehmaanperä, Ph.D. Roal Oy, Rajamäki, Finland

Wanwipa Vongsangnak Faculty of Science, Department of Zoology, Kasetsart University, Bangkok, Thailand

Ronald P. de Vries, Ph.D. Fungal Physiology, CBS-KNAW Fungal Biodiversity Centre, Fungal Molecular Physiology, Utrecht University, The Netherland

Ting-Fang Wang, Ph.D. Taiwan International Graduate Program in Molecular and Cellular Biology, Academia Sinica, Taipei, Taiwan

Institute of Molecular Biology, Academia Sinica, Taipei, Taiwan

Theresa C. White, Ph.D. Iogen Corp., Ottawa, ON, Canada

Monsanto Canada Inc., Ottawa, ON, Canada