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MICHAEL F. FREEMAN

EDUCATION

Johns Hopkins University, Baltimore, Maryland, USA
Ph.D. Biology, 2008

University of Massachusetts, Amherst, Massachusetts, USA
B.S. Biochemistry and Molecular Biology, 2001
GPA: 3.9/4.0

RESEARCH EXPERIENCE

2016-present **Assistant Professor at the University of Minnesota**
Department of Biochemistry, Molecular Biology, and Biophysics & The Biotechnology Institute

2010-2015 **Post-doctoral Research with Professor Jörn Piel**
Eidgenössische Technische Hochschule (ETH) Zurich, Zurich, Switzerland
University of Bonn, Bonn, Germany
Discovery and Elucidation of Marine Natural Products

2008-2010 **Post-doctoral Research with Professor Craig A. Townsend**
Johns Hopkins University, Baltimore, Maryland, USA
Regulation of β-Lactam Antibiotics in Streptomyces

2001-2008 **Graduate Research with Professor Craig A. Townsend**
Johns Hopkins University, Baltimore, Maryland, USA
Characterization of Enzymes Involved in Thienamycin Biosynthesis

1999-2001 **Undergraduate Research with Professor Craig T. Martin**
University of Massachusetts, Amherst, Massachusetts, USA
Directed Evolution of T7 RNA Polymerase Promoters

RESEARCH FUNDING

2018-2019 *Co-PI*, University of Minnesota Biocatalysis Initiative for Advancing Biomanufacturing for the Environment, Health and Industry
2017-2019 University of Minnesota Biocatalysis Initiative for Advancing Biomanufacturing for the Environment, Health and Industry
2011-2014 Human Frontier Science Program (HFSP) Long-Term Fellowship
Harnessing the Bacterial Biodiversity of Marine Invertebrates

Publications ***** *Equal contribution of authors,* [§] *Co-corresponding authors,* [†] *Corresponding author*

20. Song, H, van der Velden, NS, Shiran, SL, Bleiziffer, P, Zach, C, Sieber, R, Imani, AS, Krausbeck, F, Aebi, M, **Freeman, MF**, Riniker, S[§], Kuenzler, M[§], Naismith, JH[§] (**2018**) A molecular mechanism for the enzymatic methylation of nitrogen atoms within peptide bonds, *Sci. Adv.* 4(8): eaat2720. DOI: 10.1126/sciadv.aat2720.

19. Miller, FS, **Freeman, MF**[†] (**2018**) Impact of synthetic biology on secondary metabolite biosynthesis, *Modern biocatalysis: Advances towards synthetic biological systems*. RSC Publishing Cambridge, UK. Chapter 11: 287-320. DOI: 10.1039/9781788010450.

18. **Freeman, MF**[†] (**2018**) Cobalamin-dependent C-methyltransferases from marine microbes: accessibility via rhizobia expression, *Methods Enzymol.* 604:259-286. DOI: 10.1016/bs.mie.2018.02.013.

17. Imani, AS, **Freeman, MF**[†] (**2018**) RiPPing apart the rules for peptide natural products, *Syst. Synth. Biotechnol.* 3(2): 81-82. DOI: 10.1016/j.synbio.2018.03.002.

16. van der Velden, NS, Kaelin, N, Helf, MJ, Piel, J, **Freeman, MF**[§], Kuenzler, M[§] (**2017**) Autocatalytic backbone N-methylation in a family of ribosomal peptide natural products, *Nat. Chem. Biol.* 13(8): 833-835. DOI: 10.1038/nchembio.2393.
[News and Views: *Nat. Chem. Biol*. **2017** 13: 821-822.]
[Highlight: *Angew. Chem. Int. Ed. Engl.* **2017** 56: 2-5.]

15. Morinaka, BI, Verest, M, **Freeman, MF**, Gugger, M, Piel, J (**2017**) An orthogonal D_2O-based induction system provides insights into D-amino acid pattern formation by radical *S*-adenosylmethionine peptide epimerases, *Angew. Chem. Int. Ed. Engl.* 56: 762-766. DOI: 10.1002/anie.201609469.

14. **Freeman, MF**[§], Helf, MJ, Bhushan, A, Morinaka, BI, Piel, J[§] (**2017**) Seven enzymes create extraordinary molecular complexity in an uncultivated bacterium, *Nat. Chem*. 9: 387-395. DOI: 10.1038/nchem.2666.
[Research Highlight: *Nat. Chem. Biol.* **2017** 13: 129.]
[Leading Edge: *Cell* **2017** 169: 373.]

13. **Freeman, MF**, Vagstad, AL, Piel, J (**2016**) Polytheonamide biosynthesis showcasing the metabolic potential of sponge-associated uncultivated 'Entotheonella', *Curr. Opin. Chem. Biol.* 31: 8-14. DOI: 10.1016/j.cbpa.2015.11.002.

12. Buller, AR, **Freeman, MF**, Schildbach, JF, Townsend, CA (**2014**) Exploring the role of conformational heterogeneity in *cis*-autoproteolytic activation of ThnT, *Biochemistry* 53(26): 4273-4281. DOI: 10.1021/bi500385d.

11. Morinaka, BI, Vagstad, AL, Helf, MJ, Gugger, M, Kegler, C, **Freeman, MF**, Bode, HB, Piel, J (**2014**) Radical *S*-adenosyl methionine epimerases: regioselective introduction of diverse D-amino acid patterns into peptide natural products, *Angew. Chem. Int. Ed.* 53(32): 8503-8507. DOI: 10.1002/anie.201400478.

10. Cai, X, Teta, R, Kohlhass, C, Cruesemann, M, Ueoka, R, Mangoni, A, **Freeman, MF**[§], Piel, J[§] (**2013**) Manipulation of regulatory genes reveals complexity and fidelity in hormaomycin biosynthesis, *Chem. Biol.* 20(6): 839-846. DOI: 10.1016/j.chembiol.2013.04.018.

9. **Freeman, MF***, Gurgui, C*, Helf, MJ, Uria, AR, Oldham, NJ, Sahl, HG, Matsunaga, S, Piel, J (**2012**) Metagenome mining reveals polytheonamides as posttranslationally modified ribosomal peptides, *Science* 338: 387-390. DOI: 10.1126/science.1226121.
[Concentrates: *Chem. Eng. News* **2012** 90(3): 26.]

8. Buller, AR, Labonte, JW, **Freeman, MF**, Wright, NT, Schildbach, JF, Townsend, CA (**2012**) Autoproteolytic activation of ThnT results in structural reorganization necessary for substrate binding and catalysis, *J. Mol. Biol.* 422(4): 508-518. DOI: 10.1016/j.jmb.2012.06.012.

7. Labonte, JW, Kudo, F, **Freeman, MF**, Raber, ML, Townsend, CA (**2012**) Engineering the synthetic potential of β-lactam synthetase and the importance of catalytic group dynamics, *MedChemComm.* 3: 960-966. DOI: 10.1039/C2MD00305H.

6. Buller, AR, **Freeman, MF**, Wright, NT, Schildbach, JF, Townsend, CA (**2011**) Insights into cis-autoproteolysis reveal a reactive state formed through conformation rearrangement, *Proc. Natl. Acad. Sci. U.S.A.* 109(7): 2308-2313. DOI: 10.1073/pnas.1113633109.

5. Bodner, MJ, Li, R, Phelan, RM, **Freeman, MF**, Moshos, KA, Lloyd, E, Townsend, CA (**2011**) Definition of the common and divergent steps in carbapenem β-lactam antibiotic biosynthesis, *ChemBioChem.* 12(14): 2159-2165. DOI: 10.1002/cbic.201100366.

4. Gulder, TAM, **Freeman, MF**, Piel, J (**2011**) The catalytic diversity of multimodular polyketide synthases: natural product biosynthesis beyond textbook assembly rules, *Top. Curr. Chem.* (pp. 1-53) Springer-Verlag Berlin Heidelberg. DOI: 10.1007/128_2010_113. DOI: 10.1007/128_2010_113.

3. Bodner, MJ, Phelan, R, **Freeman, MF**, Li, R, Townsend, CA (**2010**) Non-heme iron oxygenases generate natural structural diversity in carbapenem antibiotics, *J. Am. Chem. Soc.* 132(1): 12-13. DOI: 10.1021/ja907320n.

2. Raber, ML, **Freeman, MF**, Townsend, CA (**2009**) Dissection of the stepwise mechanism to β-lactam formation and elucidation of a rate-determining conformational change in β-lactam synthetase, *J. Biol. Chem.* 284(1): 207-217. DOI: 10.1074/jbc.M805390200.

1. **Freeman, MF**, Moshos, KA, Bodner, MJ, Li, R, Townsend, CA (**2008**) Four enzymes define the role of coenzyme A in thienamycin biosynthesis, *Proc. Natl. Acad. Sci. U.S.A.* 105(32): 11128-11133. DOI: 10.1073/pnas.0804500105.
[Research Highlight: *ACS Chem. Biol.* **2008** 3(9): 522.]

Patents

3. Kuenzler, J., van der Velden, N, **Freeman, MF**, Piel, J, Aebi, N, Kaelin, N, Novel Multiply Backbone N-Methyl Transferases and Uses Thereof, WO2017EP58327, October 12, **2017**.

2. Piel, J, Gurgui, C, **Freeman, MF**, Uria, AR, Helf, MJ, Biosynthetic Gene Cluster for the Production of Peptide/Protein Analogues, WO2013034579 A1, March 14, **2013**.

1. Townsend, CA, Bodner, MJ, Phelan, RM, **Freeman, MF**, Method for Late Introduction of the (8R)-Hydroxyl Group in Carbapenem Beta-lactam Antibioitc Synthesis, EP2513112 A2, October 24, **2012**.

Oral Presentations

Freeman, MF Invited speaker, SIMB Annual Meeting, Chicago, IL, August 16, **2018**.

Freeman, MF Invited speaker, ASBMB / Experimental Biology 2018, San Diego, CA, April 23, **2018**.

Freeman, MF MinnCrest training seminar "How to start a lab?", University of Minnesota, April 18, **2018**.

Freeman, MF Invited speaker, MycoNet seminar, University of Minnesota, MN April 11, **2018**.

Freeman, MF BTI lunch training seminar, University of Minnesota, MN, March 26, **2018**.

Freeman, MF Invited speaker, ACS National Conference, New Orleans, LA, March 22, **2018**.

Freeman, MF Invited speaker, Developmental Biology Center Seminar, University of Minnesota, December 7, **2017**.

Freeman, MF Invited speaker, Bug Club, University of Minnesota, October 13, **2017**.

Freeman, MF BMBB annual retreat, Itasca State Park, University of Minnesota, October 1, **2017**.

Freeman, MF Joint Symposium on Microbial Biotechnology, University of Minnesota, August 8, **2017**.

Freeman, MF Invited speaker, Biofilm club, University of Minnesota, April 4, **2017**.

Freeman, MF Directing Biosynthesis V, Norwich England, March 22, **2017**. (*Lightning talk*)

Freeman, MF Co-organizer, 2017 Microbial Factories Symposium, University of Minnesota, February 6, **2017**.

Freeman, MF Invited speaker, Microbial Communication Colloquium, Friedrich Schiller University, Jena, Germany, November 30, **2016**.

Freeman, MF Invited speaker, Mini-symposium: Structural aspects of synthetic biology systems, University of Minnesota, St. Paul, Minnesota, USA, August 3, **2016**.

Freeman, MF Invited Speaker, Biofilm Club Symposium, University of Minnesota, St. Paul, Minnesota, USA, May 20, **2016**.

Freeman, MF Invited Speaker, Science on the Spot, University of Minnesota, St. Paul, Minnesota, USA, April 14, **2016**.

Freeman, MF Invited Speaker, Host: Prof. Dr. Yaniv Brandvain. PBS Colloquium, University of Minnesota, St. Paul, Minnesota, USA, April 5, **2016**.

Freeman, MF Invited Speaker, Host: Prof. Dr. Michael H. Walter. University of Northern Iowa, Cedar Falls, Iowa, February 29, USA, **2016**.

Freeman, MF BMBB annual retreat, Itasca State Park, University of Minnesota, September 25, **2015**.

TEACHING

2017, Fall	BioC3960 Research Topics in Biochemistry, Guest lecturer, University of Minnesota
2017, Summer	Co-director of MCSB graduate research course, Itasca Biological Station, University of Minnesota.
2017, Spring	BioC5309 Biocatalysis and Biodegradation, Guest lecturer, University of Minnesota
2016-present	Research mentor to post-docs (*2*), Ph.D. students (*3*), Master's students (*1*), undergraduates (*5*), and High School students (*4*).

AWARDS AND HONORS

2016-2017	Residence Workplace Agreement, The Institute of Microbiology, Eidgenössische Technische Hochschule (ETH) Zurich, Zurich, Switzerland
2015	ETH Institute of Microbiology Performance Award
2011-2014	Human Frontier Science Program (HFSP) Long-Term Fellowship recipient *Harnessing the Bacterial Biodiversity of Marine Invertebrates*

SERVICE

2018-2019	HHMI Faculty Fellows for Inclusive Excellence Program
2018	LSSURP mock graduate student interviewee
2018	Session leader in round-table discussion for MinnCRest event: 'How to start your new lab?'
2016-present	Mentor for Minnetonka Research – Minnetonka High School
2016-present	Manuscript reviewer for *Nat. Chem. Biol. (2), Angew. Chem. Int. Ed., Metab. Eng., Nucleic Acids Res., ACS Chem. Biol., Biochemistry (2), Chem. Eur. J.*
2016-present	Ph.D. thesis committee member (*6*)
2016-present	BMBB graduate student recruitment committee
2016-present	Microbial Engineering graduate student recruitment committee
2016-2017	Co-organizer: Biocatalysis Initiative – Microbial Factories Symposium
2016	Outside reviewer for NSF Career Award
2015	AAAS Webinar: Careers for US Scientists in Europe and China

MEMBERSHIPS

2018-present	Society for Industrial Microbiology and Biotechnology
2018-present	University of Minnesota Biotechnology Training Grant mentor
2018-present	American Chemical Society (ACS)
2017-present	American Society for Biochemistry and Molecular Biology (ASBMB)
2017-present	Royal Society of Chemistry (RSC)
2017-present	American Society of Pharmacognosy
2016-present	Microbial and Plant Genomics Institute faculty member, University of Minnesota
2016-present	Microbial Engineering graduate program faculty member, University of Minnesota
2016-present	Minnesota Craniofacial Research Training Program (MinnCRest) mentor, University of Minnesota
2015-2016	American Association for the Advancement of Science (AAAS)