

Neal C. Connors, Ph.D. – Phoenix BioConsulting, LLC

Microbial Fermentation • Industrial Microbiology • Bioprocess Development • Biotechnology

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PROFESSIONAL SUMMARY

- Senior scientist with three decades of experience in the fermentation/industrial microbiology/biotechnology fields; bench-top through pilot scale and manufacturing.
- Consultant for an assortment of clients of varying sizes with various scientific and business needs.
- Experience with a diverse bioprocess development portfolio: fermentation and strain improvement (classical and/or recombinant) for producing bioactive natural products (e.g., Cancidas®), renewable chemicals (glucaric acid and 3-hydroxybutyrolactone) therapeutic protein and monoclonal antibody production by mammalian cell culture (HEK-293, CHO, hybridomas), bacterial and yeast expression systems, whole-cell biocatalysis for the production of chiral intermediates, fermentation of pathogenic bacteria for polysaccharide vaccine development.
- Group leader of 2-5 research staff. Veteran of inter-disciplinary and inter-departmental project teams charged with bioprocess and pre-clinical phase drug development. Professional development of associate staff members.
- Contributing author on numerous peer-reviewed papers, book chapters, patents, and conference abstracts.
- Society for Industrial Microbiology and Biotechnology, former president and director; *Journal of Industrial Microbiology and Biotechnology* editorial board; *Enzyme and Microbial Technology* editorial board.
- Mentor and advisor to junior staff members and undergraduate students.

SCIENTIFIC/LEADERSHIP EXPERIENCE and HIGHLIGHTS

Phoenix BioConsulting, LLC. Fanwood, NJ (January 2009 – Present)

Owner/President

- *Bridging the Expertise Gap* between what a company has in-house and what they need to move a technology forward or trouble-shoot existing technology or processes.
- Scientific consulting for numerous companies in the microbial fermentation, industrial microbiology, and biotechnology sectors (research project leadership/guidance, business development, due diligence, subject-matter expert, expert witness).
- Short and long-term assignments; flexible and cost-effective alternative to employing full-time, permanent senior scientific staff.
- Example Projects:
 - Key consultant for the Institute for Life Science Entrepreneurship (ATCC Center for Translational Microbiology) developing industrial microbiology products and services.
 - Directing classical strain development for an anti-fungal natural product at a CRO for a small company developing novel anti-infectives.
 - Due diligence and research project planning for the development of a re-purposed natural product (structural analogue) for a large VC prior to investment.
 - Process development and documentation improvement for an organic vermin control product produced by fermentation resulting. Company has since exited in a multi-million dollar sale to a major consumer products company.

- Consultant/advisor to an algal biotech start-up, currently with a marketed product line.
- Founder and (initially) key consultant to Kalion, Inc. – synthetic biology start-up currently scaling up the production of glucaric acid – a versatile C-6 diacid supporting the developing bioeconomy.
- Strain and process development consulting for a start-up producing a commodity biochemical by microbial fermentation. Company is currently producing product at full-scale manufacturing.
- Platform technology transfer for contract research organization producing proteins by transient transfection of HEK-293 cells. Company built a new facility to produce proteins using cell culture and microbial systems.
- Natural product manufacturing strategy development for an agricultural products company. Company has since purchased a brown-field facility.
- Development of a pre-clinical candidate therapeutic protein.
- Scale-up and troubleshooting for academic research group producing biofuels with a photosynthetic microbe.
- Classical strain improvement strategy development for an organic pesticide produced by fermentation.
- Scale-up trouble shooting for large company producing vaccine antigens by heterologous expression in yeast.
- Patent litigation/lost revenue case expert witness (Canadian Federal Court – expert witness statement, direct and cross examination; Goodmans, LLP).
- Inventorship arbitration expert witness (International Chamber of Commerce – expert witness statement, rebuttal, direct and cross examination; Finnegan, Henderson, Farabow, Garrett & Dunner, LLP).
- Patent infringement/invalidity case expert witness (International Trade Commission – expert witness statement, rebuttal, deposition, direct and cross examination; Adli Law Group/DNL Zito).

Institute for Life Science Entrepreneurship. Kean University, Union, NJ (September 2017 – Present)
 Director, Research (*consultant*) – ATCC Center of Translational Microbiology

- Leading the development of Industrial Microbiology products and services.
- Currently developing a suite of biocatalysis products and services in collaboration with ATCC.

Drew University, Research Institute for Scientists Emeriti (RISE), Madison, NJ (February 2012-Present)
 Associate/Fellow

- Provide undergraduate students with the unique opportunity to carry out laboratory research projects with an industrial scientist in the general field of using microbes as “miniature factories” to produce products of interest.
- Mentored numerous students in laboratory research projects on the production of antibiotics, biocatalysts, and renewable chemicals produced by natural and genetically engineered bacterial strains.
- My students have won research grants, published in a peer reviewed journal, and presented work at the Society for Industrial Microbiology and Biotechnology annual meeting (Philadelphia, PA, New Orleans, LA, and Denver, CO.)
- Mentored students in the Honors Seminar course; a “student-led”, semester long course for freshman allowing students to delve deeper into a topic of interest. Students have published their papers in the *Drew Review*.

Kalion, Inc. Milton, MA (January 2010 – August 2017)

Co-Founder and Chief Technology Officer

- Capital-lite, angel-backed, industrial biotech start-up commercializing glucaric acid and 3-hydroxybutyrolactone production by fermentation of metabolically engineered *E. coli* strains.
- Contributed to business plan development, process development strategy and time lines, and attracted \$2.5M in dilutive and non-dilutive funding (NSF Phase I STTR and DOE/BETO grants).
- Establish and manage outsourcing partnerships and external collaborations:
 - University of Georgia’s Bioexpression and Fermentation Facility (Athens, GA) for bioprocess development and molecular biology-based strain engineering
 - Seprosys (La Rochelle France) for purification process development to produce high-purity glucaric acid in the free di-acid form
 - Interek Pharmaceutical Services (Whitehouse, NJ) for analytical testing to verify high purity and identify the type and amount of impurities
 - Warner Babcock Institute (Wilmington, MA) for developing novel glucaric acid applications to generate a market pull for glucaric acid
 - U. of Akron, Dept. of Polymer Engineering (Arkon, OH) development of glucaric acid-based, water-borne, thermoset coating as part of an NSF STTR phase I grant.
- Identified and implemented strain engineering (central metabolism) and fermentation development strategies to increase glucaric acid production from glucose or myo-inositol as the substrate.
- Positioned company for partnerships with a major API manufacturer and bioproducts/biomaterials producer.

Massachusetts Institute of Technology Professional Education – Fermentation Technology Course, Cambridge, MA (July 2012 – Present)

- Teach statistical experimental design as part of a week-long short course on fermentation technology taught to industry professionals.

Society for Industrial Microbiology and Biotechnology (non-profit professional organization)

Past-president/President/President-elect (July 2010 – August 2013), Board of Directors (July 2006 – July 2009)

- Provide leadership to a non-profit professional society serving over 1000 members. Expanded SIMB’s presence in industry and increased membership and meeting attendance. Planning initiative developed to fully leverage social media (LinkedIn, Facebook).

Bioprocess R&D, Merck Research Laboratories, Merck & Co., Rahway, NJ (1991-2008)

Sr. Research Biochemist, Research Fellow, Sr. Research Fellow, Sr. Investigator

- Established and led small scale protein production team charged with providing 10s-100s mg of pre-clinical therapeutic proteins for evaluation (biophysical, PK/PD, efficacy). ~350 proteins delivered during 18 month time frame. Protein production carried out using HEK-293 transient transfection, CHO cells, hybridoma cultivation, and *Pichia pastoris* expression systems. Established outsourcing partnerships for non-core activities.
- Led fermentation and strain improvement efforts – well plate and shake-flask through pilot fermentor scale – for a variety of anti-bacterial, anti-fungal, statins, ion-channel inhibitors, and immunoregulant natural products produced by actinomycetes and filamentous fungi. Led development of the *Glarea lozoyensis* fermentation process for producing Cancidas®, first in class systemic anti-fungal
- Established a robust, high-throughput (1000-2000) microbial screening platform using 24 deep well plates, commercially available liquid handing equipment (TECAN), bioassays where applicable, and high-throughput HPLC.

- Whole-cell biocatalysis for the production of chiral intermediates. *Pseudomonas putida* dioxygenase bioconversion process converting indene to the corresponding chiral diol, an intermediate in Crixivan®
- Fermentation of *Neisseria meningitidis* (A, C, Y, W135 serotypes) for polysaccharide vaccine development.
- Group leader of 2-5 associate scientists – foster creativity, independence and provide career development opportunities. Lead by example style.
- Inter-departmental/inter-disciplinary team member - process development scientists, biologists, engineers, and chemists collaborating on early drug development.
- Oversaw outsourcing of R&D activities to US and emerging market vendors.
- Implementation of value stream mapping and 5S principles to improve efficiency and decrease cycle times.

EDUCATION

Ph.D. Microbiology (1991). The Ohio State University, Columbus, OH. Thesis title: Studies on the biochemistry and physiology of anthracycline biosynthesis by streptomycetes.

B.S. Biology, chemistry minor (summa cum laude, 1984). Norwich University, Northfield, VT

PROFESIONAL AFFILIATIONS

Editorial boards: *Journal of Industrial Microbiology and Biotechnology* and *Enzyme and Microbial Technology*

Former President: Society for Industrial Microbiology and Biotechnology (July 2010 – August 2013).

Board of Directors: Society for Industrial Microbiology and Biotechnology (August 2006-August 2009)

Program Chair: Society for Industrial Microbiology and Biotechnology Annual Meeting and Exhibition (July 2006)

Program Chair: Recent Advances in Fermentation Technology (RAFT V, November 2003).

Session organizer for several SIMB annual meetings.

PUBLICATIONS

Brockman IM, Stenger AR, Connors NC, Prather KLJ (2015) Improvement of glucaric acid production in *E. coli* via dynamic control of metabolic fluxes. *Metabolic Engineering Communications*. 2:109-116.

Junker B, Walker A, Hesse M, Lester M, Vesey D, Christensen J, Burgess B, Connors N (2009) Actinomycetes scale-up for the production of the antibacterial, nocathiacin. *Biotechnology Progress* 25(1):176-188.

Junker B, Walker A, Hesse M, Lester M, Christensen J, Connors N (2009) Pilot-scale process development and scale up for antifungal production. *Bioprocess and Biosystems Engineering*. 32(4):443-458.

Singh SB, Herath K, Yu NX, Walker A, Connors N. (2008) Biosynthetic studies of nocathiacin I. *Tetrahedron Letters*. 49(43):6265-6268.

Jayasuriya H, Herath K, Ondeyka JG, Zhang C, Zink DL, Brower M, Galliot FP, Greene J, Birdsall G, Venugopal J, Ushio M, Burgess B, Russotti G, Walker A, Hesse M, Seeley A, Junker B, Connors N, Salazar O, Genilloud O, Liu K, Masurekar P, Barrett JF, Singh SB. (2007) Isolation and structure elucidation of thiazomycin – a potent thiazolyl peptide antibiotic from *Amycolatopsis fastidiosa*. *Journal of Antibiotics*. 60(5):554-564.

Junker B, Walker A, Connors N, Seeley A, Masurekar P, Hesse M. (2006) Production of indole diterpenes by *Aspergillus alliaceus*. *Biotechnology and Bioengineering*. 95:919-937.

Junker B, Hesse M, Burgess B, Masurekar P, Connors N, Seeley A. (2004) Early phase process scale-up challenges for fungal and filamentous bacterial cultures. *Applied Biochemistry and Biotechnology*. 119: 241-277.

Petersen L, Olewinski R, Salmon P, Connors N. (2003) Novel proline hydroxylase activities in the pneumocandin-producing fungus *Glarea lozoyensis* responsible for the formation of trans 3- and trans 4-hydroxyproline. *Applied Microbiology and Biotechnology*. 62:263-267.

Petersen L, Hughes D, Hughes R, DiMichele L, Salmon P, Connors N. (2001) Effects of amino acid and trace element supplementation on pneumocandin production by *Glarea lozoyensis*: impact on titer, analogue levels, and the identification of new analogues of pneumocandin B0. *Journal of Industrial Microbiology and Biotechnology*. 26:216-221.

Pollard D, Buccino R, Connors N, Kirschner T, Olewinski R, Saini K, Salmon P. (2001) Real-time analyte monitoring of a fungal fermentation at pilot scale using in-situ mid-infrared spectroscopy. *Bioprocess and Biosystems Engineering* 24:13-24.

Connors N, Petersen L, Hughes R, Saini K, Olewinski R, Salmon P. (2000) Residual fructose and osmolality affect the levels of pneumocandins B0 and C0 produced by *Glarea lozoyensis*. *Applied Microbiology and Biotechnology* 54:814-818.

Zhang J, Roberge C, Reddy J, Connors N, Chartrain M, Buckland B, Greasham R. (1999) Bioconversion of indene to trans-1S,2S-bromoindanol and 1S,2R-indene oxide by a bromoperoxidase/dehydrogenase preparation from *Curvularia protuberata* MF5400. *Enzyme and Microbial Technology*. 24:86-95.

Buckland BC, Drew SW, Connors NC, Chartrain MM, Lee C, Salmon PM, Gbewonyo K, Galliot P, Singhvi R, Olewinski RC, Sun WJ, Reddy J, Zhang J, Zhou W, Jackey BA, Goklen KE, Junker B, Greasham RL. (1999) Microbial conversion of indene to indandiol: a key intermediate in the synthesis of CRIXIVAN®. *Metabolic Engineering*. 1:63-74.

Sun WJ, Salmon P, Wilson J, N. Connors. (1998) Crotonic acid-directed biosynthesis of the immunosuppressants produced by *Streptomyces hygroscopicus* var. *ascomyceticus*. *Journal of Fermentation and Bioengineering*. 86:261-265.

Connors N, Prevoznak R, Chartrain M, Reddy J, Singhvi R, Patel Z, Olewinski R, Salmon P, Wilson J, Greasham R. (1997) Conversion of indene to cis-(1S),(2R)-indandiol by mutants of *Pseudomonas putida* F1. *Journal of Industrial Microbiology and Biotechnology*. 18:353-359.

Connors N, Prevoznak R, Brix T, Seeley A, Gbewonyo K, Greasham R, Salmon P. (1995) Effects of medium sterilization on the production of zaragozic acids by the fungus *Leptodontidium elatius*. *Journal of Industrial Microbiology*. 15:503-508.

Connors NC, Strohl WR. (1993) Partial purification and properties of carminomycin 4-O-methyltransferase from *Streptomyces* sp. C5. *Journal of General Microbiology*. 139:1353-1362.

Strohl WR, Connors NC. (1992) Significance of anthraquinone formation resulting from the cloning of actinorhodin genes in heterologous streptomycetes. *Molecular Microbiology*. 6:147-152. (Including the journal cover photograph).

Strohl WR, Bartel PL, Li Y, Connors NC, Woodman RH. (1991) Expression of polyketide biosynthesis and regulatory genes in heterologous streptomycetes: a review. *Journal of Industrial Microbiology*. 7:163-174.

Bartel PL, Connors NC, Strohl WR. (1990) Biosynthesis of anthracyclines: analysis of mutants of *Streptomyces sp.* C5 blocked in daunomycin biosynthesis. *Journal of General Microbiology*. 136:1877-1886.

Connors NC, Bartel PL, Strohl WR. (1990) Biosynthesis of anthracyclines: enzymic conversion of aklanonic acid to aklavinone and ϵ -rhodomycinone by anthracycline-producing streptomycetes. *Journal of General Microbiology* 136:1887-1894.

Connors NC, Bartel PL, Strohl WR. (1990) Biosynthesis of anthracyclines: carminomycin 4-O-methyltransferase, the terminal enzymic step in the formation of daunomycin. *Journal General Microbiology*. 136:1895-1898.

Piret J, Resendiz B, Mahro B, Zhang JY, Serpe E, Romero J, Connors NC, Demain AL. (1990) Characterization and complementation of a cephalosporin-deficient mutant of *Streptomyces clavuligerus* NRRL 3585. *Applied Microbiology and Biotechnology*. 32:560-567.

Bartel PL, Zhu CB, Lampel JL, Dosch DC, Connors NC, Strohl WR, Beale JM., Floss H. (1990) Biosynthesis of anthraquinones by interspecies cloning of actinorhodin biosynthesis genes in streptomycetes: clarification of actinorhodin gene functions. *Journal of Bacteriology*. 172:4816-4826.

BOOK CHAPTERS

Wang F, Chen L, Connors N, Mach H. (2009) Antibody expression in mammalian cells – transient transfection. In: An Z (ed) *Therapeutic monoclonal antibodies: from bench to clinic*, John Wiley and Sons, Inc., Hoboken, NJ pp 555-572.

Connors N, Pollard D. (2004) Pneumocandin B0 production by fermentation of the fungus *Glarea lozoyensis*: physiological and engineering factors affecting titer and structural analogue formation, In: An Z (ed) *Handbook of Industrial Mycology*, Marcel Dekker, Inc., New York, NY pp 515-538.

Connors N. (2003) Culture medium optimization and scale-up for microbial fermentations. In: Parekh SR, Vinci VA (eds.) *Handbook for Industrial Cell Culture: Mammalian, Microbial, and Plant Cells*, Humana Press Inc., Totowa, NJ pp 171-193.

Strohl WR, Bartel PL, Connors NC, Zhu CB, Dosch DC, Beale JM, Floss HG, Stutzman-Engwall K, Otten SL, Hutchinson CR. (1989) Biosynthesis of natural and hybrid polyketides by anthracycline-producing streptomycetes, In: Hershberger CL, Queener SW, Hegeman G (eds.), *Genetics and Molecular Biology of Industrial Microorganisms*, American Society for Microbiology, Washington, D.C. pp 68-84.

PATENTS

Buckland B, Connors N, Chartrain M, Galliot FP, Greasham R, Jackey B, Heimbuch B, Lee C, Olewinski R, Roberts FE, Reider P, Verhoeven T, Senanayake C. (1999) Conversion of indene to (1S)-amino-(2R)-indanol free of any stereoisomer, by combination of dioxygenase bioconversion and chemical steps. U.S. Patent 5,858,737.

Connors NC. (1998) *Pseudomonas putida* strain with dioxygenase activity. U.S. Patent 5,824,540.

Chartrain M, Connors N, Garrity G, Olewinski R, Verhoeven T, Zhang J. (1995) Quantitative conversion of indene to (1S,2R) indene oxide and (1S,2R)-indandiol by combination of haloperoxidase bioconversion and chemical steps. U.S. Patent 5,605,819.

CONFERENCE, UNIVERSITY, and INSTITUTE PRESENTATIONS

Connors N, Prather D, Watson A, Prather KLJ. (2016) *E. coli* strain engineering approaches for improving glucaric acid production. Society for Industrial Microbiology and Biotechnology Annual Meeting and Exhibition, New Orleans, LA.

Connors N, Prather D, Watson A, Prather KLJ. (2015) Bioprocess-based production of glucaric acid by recombinant *E. coli* strains. Society for Industrial Microbiology and Biotechnology Annual Meeting and Exhibition, Philadelphia, PA.

Connors N (2013) A biotech industry in the clouds. Roquette University's, "Developments in Green Chemistry and Fermentation Symposium", Geneva, IL.

Connors N. (2011) The Impact of Fermentation on the United States Department of Energy's List of the Top Value Added Chemicals from Biomass. Peking University School of Environment and Energy, Shenzhen, China.

Connors N. (2007) Fermentation of *Glarea lozoyensis* for the production of pneumocandin B0: the natural product precursor of the potent antifungal agent CANCIDAS®. Symposium on Industrial and Fermentation Microbiology, University of Wisconsin, La Crosse.

Vesey D, McLaughlin K, Walker A, Junker B, Connors N. (2006) A 24 deep-well plate cultivation format for classical strain improvement of natural products. Natural Products Discovery and Production: New Challenges; New Opportunities. Santa Fe, NM.

Connors N. (2006) Statistical experimental design using commercially available software. University of Hawaii, Department of Oceanography.

Connors N. Fermentation process development: producing beneficial products by fermentation of bacteria and fungi. University of Hawaii, Department of Oceanography (2006).

Connors N, Vesey D, Walker A, Junker B. (2005) A 24 deep-well plate cultivation format for classical strain development: matching technology with a natural product-based drug's probability of success. Society for Industrial Microbiology Annual Meeting, Chicago, IL.

Connors N. (2005) Natural Product-Based Pharmaceuticals Made by Fermentation of Bacteria and Fungi. Norwich University, Department of Biology.

Walker A, Vesey D, Greene J, Masurekar P, Connors N. (2004) Production of indole diterpenes by *Aspergillus alliaceus*. Society for Industrial Microbiology Annual Meeting. Anaheim, CA.

Connors N. (2001) Natural product fermentation development: factors affecting titer and analogue formation. Society for Industrial Microbiology Annual Meeting, St. Louis, MO.

Connors N, Petersen L, Olewinski R, Pollard D, Hunt G, Salmon P. (2000) Physiological aspects of pneumocandin production by fermentation of *Glarea lozoyensis*. Society for Industrial Microbiology Annual Meeting, San Diego, CA.

Connors N. (2000) Production of natural product pharmaceuticals by fermentation of bacteria and fungi: understanding the key physiological factors affecting titer and analogue formation. Virginia Commonwealth University, Dept. of Medicinal Chemistry.

Connors N, Petersen L, Hughes R, Hunt G, Pollard D, Masurekar P, Olewinski R, Salmon P, Buckland B. (1998) Physiological aspects of pneumocandin production by fermentation of *Glarea lozoyensis*. Society for General Microbiology Symposium, University of East Anglia, UK.

Connors NC, Chartrain M, Lee C, Reddy J, Singhvi R, Olewinski R, Salmon P, Wilson J, Greasham R. (1997) Strain improvement for the bioconversion of indene to cis-(1S),(2R)-indandiol: a key raw material for the chemical synthesis of an HIV-1 protease inhibitor. Recent Advances in Fermentation Technology II, San Diego, CA.

CONFERENCE (POSTER) ABSTRACTS

Connors E, Gullo V, Connors N. (2017) Producing analogues of the natural product antibiotic teixobactin via directed biosynthesis. Society for Industrial Microbiology and Biotechnology Annual Meeting and Exhibition, Denver, CO.

Stenger D, Connors N. (2016) Glucaric acid production by a recombinant *E. coli* strain: investigation of myo-inositol oxygenase soluble expression. Society for Industrial Microbiology and Biotechnology Annual Meeting and Exhibition, New Orleans, LA.

Stenger D, Connors N. (2015) Glucose auto-feeding for glucaric acid production by a recombinant *E. coli* strain. Society for Industrial Microbiology and Biotechnology Annual Meeting and Exhibition, Philadelphia, PA.

Walker A, Russotti G, Ushio M, Junker B, Connors N. (2005) Nutrient shot and water addition as methods for reducing broth viscosity and gassed agitator power draw. Society for Industrial Microbiology Annual Meeting, Chicago, IL.

Walker A, Connors N. (2004) An HPLC data capture and analysis program facilitating microbial culture screening. Genetics and Molecular Biology of Industrial Microorganisms/Biotechnology of Microbial Products Meeting, San Diego, CA.

Buckland B, Robinson D, Aunins J, Junker B, Connors N, Greasham R, Zhou W, Xie L, Seifert D, Zhang J, Vandusen W. (2000) Advances and challenges in fermentation and cell culture process development. American Chemical Society 219th National Meeting, San Francisco, CA.

Connors N, Petersen L, Hughes R, Saini K, Olewinski R, Salmon P. (1999) Altering medium osmolality affects the production of pneumocandins B0 and C0 by *Glarea lozoyensis*. Recent Advances in Fermentation Technology III, Sarasota, FL.

Petersen L, Olewinski R, Salmon P, Connors N. (1999) Hydroxyproline synthesis in *Glarea lozoyensis* and its impact on pneumocandin biosynthesis. Recent Advances in Fermentation Technology III, Sarasota, FL.

Dickens M, Fulton T, Salmon P, Connors N. (1999) Metabolic engineering of glycerol metabolism in *Hypoxylon sp.* Recent Advances in Fermentation Technology III, Sarasota, FL.

Pollard D, Buccino R, Connors N, Hunt G, Kirschner T, Olewinski R, Saini K, Sun WJ, Salmon P. (1999) Analyte monitoring of pilot scale fungal fermentations using in situ mid infrared spectroscopy. Recent Advances in Fermentation Technology III, Sarasota, FL.

Petersen L, Hughes R, Salmon P, Connors N. (1998) Pneumocandin production by fermentation of *Glarea lozoyensis* is affected by trace element and amino acid supplementation. Society of Industrial Microbiology Annual Meeting, Denver, CO.

Sun WJ, Salmon P, Wilson J, Connors N. (1998) Crotonic acid-directed biosynthesis improves the purity of immunomycin produced by fermentation of *Streptomyces hygroscopicus var. ascomyceticus*. Society of Industrial Microbiology Annual Meeting, Denver, CO.

Connors N, Prevoznak R, Chartrain M, Reddy J, Singhvi R, Patel Z, Olewinski R, Salmon P, Wilson J, Greasham R. (1996) Conversion of indene by mutants of *Pseudomonas putida* F1. Genetics and Molecular Biology of Industrial Microorganisms, Bloomington, IN

Connors NC, Prevoznak R, Brix T, Seeley A, Gbewonyo K, Greasham R, Salmon P. (1995) Effects of medium sterilization on the production of zaragozic acids by the fungus *Leptodontidium elatius*. Recent Advances in Fermentation Technology, San Diego, CA.

Connors NC, Strohl WR. (1991) Analysis of anthracycline production by *Streptomyces sp. C5*. International Symposium on the Biology of Actinomycetes, Madison, WI.

Strohl WR, Bartel PL, Li Y, Connors NC, Kleman G. (1990) Expression of polyketide biosynthesis and regulatory genes in heterologous streptomycetes. Society for Industrial Microbiology Annual Meeting.

Bartel PL, Connors NC, Hutton JS, Strohl WR. (1989) Characterization of *Streptomyces sp. C5* mutants altered in daunomycin production. Annual Meeting of the American Society for Microbiology, New Orleans, LA.

Connors NC, Bartel PL, Strohl WR. (1988) In vitro biosynthesis of polyketides by anthracycline-producing streptomycetes. Annual Meeting of the American Society for Microbiology, Miami, FL.

Serpe E, Romero J, Mahro B, Resendiz B, Zhang JY, Connors NC, Demain AL, Piret J. (1988) Complementation by gene cloning of a β -lactam non-producing mutant strain of *Streptomyces clavuligerus*. 4th American Society for Microbiology Conference on the Genetics and Molecular Biology of Industrial Microorganisms, Bloomington, IN.

Bartel P, Zhu CB, Lampel J, Strohl W, Connors N, Beale J, Floss H. (1988) Biosynthesis of "hybrid" anthraquinone by interspecies cloning of DNA encoding actinorhodin biosynthesis genes in anthracycline-producing streptomycetes. Annual Meeting of the American Society for Microbiology, Miami, FL.

Bartel P, Zhu CB, Lampel J, Strohl W, Connors N, Beale J, Floss H. (1988) Biosynthesis of "hybrid" anthraquinone by interspecies cloning of DNA encoding actinorhodin biosynthesis genes in anthracycline-producing streptomycetes. Abstracts of International Symposium on the Biology of the Actinomycetes, Madison, WI.

Zhu CB, Bartel P, Lampel J, Strohl W, Connors N, Beale J, Floss H. (1988) Complementation of a *Streptomyces galilaeus* mutant with actinorhodin pathway DNA and the production of new "hybrid" compounds. Society for Industrial Microbiology Annual Meeting.

Strohl WR, Bartel PL, Connors NC, Zhu CB, Dosch DH, Beale JB, Floss HG, Stutzman-Engwall KJ, Hutchinson CR. (1988) Biosynthesis of natural and hybrid polyketides by anthracycline producing streptomycetes. American Society for Microbiology Conference on the Genetics and Molecular Biology of Industrial Microorganisms, Bloomington, IN.