BIOGRAPHICAL SKETCH

NAME: Powers, Robert

eRA COMMONS USER NAME (credential, e.g., agency login): rpowers

POSITION TITLE: Professor of Chemistry

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	END DATE MM/YYYY	FIELD OF STUDY
Rutgers University, New Brunswick, NJ	BA	05/1984	Chemistry
Purdue University, West Lafayette, IN	PHD	12/1989	Chemistry
National Institutes of Health/National Institute of Diabetes and Digestive and Kidney Diseases (NIH/NIDDK), Bethesda, MD	Postdoctoral Fellow	05/1993	Protein NMR

A. Personal Statement

I have 10 years of experience in the pharmaceutical industry in drug discovery research and more than 30 years of experience in nuclear magnetic resonance (NMR) spectroscopy and structural biology. I have also developed new NMR techniques for drug discovery. As a postdoctoral fellow at the National Institutes of Health (NIH), I contributed to the development of multidimensional NMR techniques for the determination of protein NMR structures and solved one of the first high-resolution protein structures (IL-4) by NMR. As an associate director at Wyeth Research (Cambridge, MA), I managed a group of eight NMR structural biologists that utilized NMR to solve the structure of numerous protein and protein-ligand co-structures for drug discovery. I also developed and patented mass spectrometry (MS)/NMR and Multi-Step NMR screening assays for drug discovery. As a professor at the University of Nebraska-Lincoln, I expanded my structural biology and ligand-affinity screening expertise to include metabolomics (MVAPACK), bioinformatics (CPASS, PROFESS), and functional genomics (FAST-NMR). As Principal Investigator (PI) or co-Investigator on several previous university- and NIH-funded grants, I developed NMR and mass spectrometry metabolomics techniques and applied metabolomics and proteomics to study (i) *S. epidermidis*, *S. aureus* and *S. mitis-oralis* adaptability and viability, (ii) antibiotic activity and resistance in tuberculosis and *Mycobacterium smegmatis*, (iii) drug activity in *Aspergillus nidulans*, (iv) identified biomarkers for MS, (v) the role of MUC1, DNAJA1, and ketone bodies in pancreatic cancer, and (vi) the molecular mechanism of neurotoxins in Parkinson's disease, (vii) drug resistance in pancreatic cancer, and (viii) biomarkers for wine classification or wheat cultivars, among other projects. I have successfully administered these prior projects, which included mentoring students, managing the budget, collaborating with other researchers, and directing and contributing to the research efforts. As Director of the Systems Biology core and Co-Director of the Metabolomics and Proteomics Core, I routinely enable investigators to include metabolomics and proteomics in their research programs. In summary, I have a demonstrated record of successful and productive research projects in the development and application of NMR and MS for metabolomics, biomarker discovery, and disease diagnosis and the application of bioinformatics for the analysis of the metabolome. As such, my expertise and experience have prepared me to successfully lead the proposed project.

Ongoing and recently completed projects that I would like to highlight include:

R01 AI148160-01
Gennis (PI), Role: co-investigator
7/1/2020 - 6/30/2026
The roles of aerobic and anaerobic respiration in *S. aureus* pathogenesis

Natl Strategic Rsch Inst (NSRI)
Berkowitz (PI), Role: co-investigator
10/01/2018-09/30/2023
Medical Countermeasure Drug Discovery and Development, Phase 3

P20 GM113126-01
Takacs (PI), Role: Director Systems Biology Core
08/15/2016-07/31/2022

Nebraska Center for Integrated Biomolecular Communication

NSF/ABI 1660921
Powers (PI)
05/15/2017-04/30/2022
ABI Innovation: A Metabolomics Toolkit for NMR and Mass Spectrometry

1. K. T. Liermann-Wooldrik, A. Chatterjee, E. A Kasomacek, M. S. Myers, O. Adebisi, L. Monga, L. Mei, M. Takacs, P. Dussault, D. Draney, **R. Powers**, J. W. Checco, C. Guda, T. Helikar, D. Berkowitz, K. W. Bayles, A. H Epstein, L. Cary, D. J. Murry, R. E. Oberley-Deegan * (2025) "Identification of potential prophylactic medical countermeasures against acute radiation syndrome (ARS)", *International Journal of Molecular Sciences*, 26(9), 4055; PMC in progress
2. D. Cochran, P. G. Takis,* J. L. Alexander, B. J. Mullish, N. Powell, J. R. Marchesi and **R. Powers*** (2024) "Evaluating Protocols for Reproducible Targeted Metabolomics by NMR", *Analyst*, 149,5423-5432; PMC11587611.
3. C. P. Jurich, M. J. Jeppesen, I. T. Sakallioglu, A. De Lima Leite, J. D. Yesselman,* and **R. Powers*** (2024) "A simulated LC-MS dataset for assessing the metabolomics data processing pipeline implemented into MVAPACK", *Analytical Chemistry*, 96(32):12943-12956; PMC11610799.
4. G. J. Gouveia, T. Head, L. Cheng, C. S. Clendinen, J. Cort, X. Du, A. Edison, C. Fleischer, J. Hoch, N. Mercaldo, W. Pathmasiri, D. Raftery, T. Schock, J. Shearer, L. Sumner, P. G. Takis, V. Copie,* H. R. Eghbalnia,* and **R. Powers*** (2024) "Perspective: Use and Reuse of Metabolomics Data: what works and what remains challenging", *Metabolomics*, 20(41); PMID:38480600.

B. Positions, Scientific Appointments and Honors

Positions and Scientific Appointments

2024-	External Advisory Committee, Biomedical Technology Development and Dissemination Center (RM1), Development of cutting-edge NMR hardware, Magnet Lab, Tallahassee, FL
2024-	Editorial Board, Frontiers in Pharmacology
2023-	Charles Bessy Professorship, University of Nebraska-Lincoln, Lincoln
2023 - 2023	Organizing Committee, Metabolomics Association of North America (MANA) conference
2022-	Chair, External Advisory Board, Network for Advanced NMR (NAN)
2021 -	Member, NIH/NCI Metabolomics Quality Assurance & Quality Control Consortium (MQACC)
2021	Organizer of Workshop and Interactive Forums, MANA 2021 virtual conference
2020 - 2022	Board member, Metabolomics Association of North America (MANA)
2020 -	Member, The National Institute of Antimicrobial Resistance Research and Education
2019 -	Scientific Advisor Board Member, Olaris Therapeutics, Inc., Framingham, MA
2019 -	Scientific Advisor Board Member, Nexomics Biosciences, Inc., Rocky Hill, NJ
2019 -	Editorial Board, Scientific Reports
2019 - 2020	Local Section Board Member, Nebraska Local Section, American Chemical Society
2019 - 2019	Organizing Committee, Metabolomics Association of North America (MANA) conference
2019 -	Member, Metabolomics Association of North America (MANA)
2018 -	Editorial Board of Chemical Biology Section, Molecules
2018 -	Executive Board Member, Nebraska Drug Discovery & Development Pipeline
2016 -	Director Systems Biology Core Facility, Nebraska Center for Integrated Biomolecular Communication, University of Nebraska-Lincoln, Lincoln, NE
2016 - 2016	Session Chair, Small Molecule NMR Conference (SMASH) 2016
2015 - 2018	Chair, External Advisory Committee, National Magnetic Resonance Facility, Madison, WI
2014 -	Member, Metabolomics Society
2014 - 2014	Organized Metabolomics Workshop, International Council on Magnetic Resonance in Biological Systems
2013 -	Professor of Chemistry, University of Nebraska-Lincoln, Lincoln, NE
2013 - 2014	Local Section Board Member, Nebraska Local Section, American Chemical Society
2012 -	Co-Director Metabolomics and Proteomics Core, Redox Biology Center, University of Nebraska-Lincoln, Lincoln, NE
2012 -	Editorial Board, F1000 Research
2012 - 2019	Editor-in-Chief, Current Metabolomics and Systems Biology

2012 - 2015	Advisory Committee, Northeast Structural Genomics
2012 - 2014	Advisory Committee, Holland Computing Center, University of Nebraska-Lincoln, Lincoln, NE
2011 -	Founding Member, The International Chemical Biology Society
2011 -	Associate Editor, Journal of Integrated Omics
2011 - 2016	Editorial Board, Journal of Structural and Functional Genomics
2011 - 2011	Organizing Committee Member, Great Plains Regional Annual Symposium on Protein and Biomolecular NMR
2010 -	Member, Cancer Genes and Molecular Regulation Program, University of Nebraska Medical Center
2010 -	Member, Nebraska Gateway for Nutrigenomics, University of Nebraska-Lincoln
2009 -	NIH/NSF Reviewer: Fellowship: Macromolecular Structure and Function (ZRG1 F04B); Mentored Research Scientist Development Award in Metabolomics (K01) (ZRG1 IMST-K0); Ruth L. Kirschstein National Research Service Awards for Individual Postdoctoral Fellows (ZRG1 FO4B-D); Fellowship: Biophysical, Biochemical, and Materials Sciences (ZRG1 F04B-D); Fellowship: Chemistry, Biochemistry, Biophysics, and Bioengineering (ZRG1 F04-D); New Technology for Proteomics and Glycomics (SBIR) (ZRG1 IMST-K); NIH Pathway to Independence Award (ZGM1 TRN-Y); Macromolecular Structure and Function B Study Section (MSFB); Tools and Technologies for the Characterization of Glycans (ZRG1 IMST-L); Molecular Transducers of Physical Activity Metabolomics and Proteomics Chemical Analysis Sites (U24) (ZRG1 IMST-K); Member Conflict: Biological Chemistry and Macromolecular Biophysics (ZRG1 BCMB-D), NSF Bio Advisory panel , NIH/NSF
2009 - 2013	Associate Professor of Chemistry, University of Nebraska-Lincoln, Lincoln, NE
2009 - 2013	Advisory Committee, Functional Genomics Consortium, Kansas State University
2008 -	Editorial Advisory Board, Comb. Chem. High Throughput Screening
2008 -	Member, Redox Biology Center, University of Nebraska-Lincoln
2007 -	Member, Faculty of 1000 Biology
2006 - 2009	Adjunct Assistant Professor, Basic Biomedical Sciences, Sanford School of Medicine, University of South Dakota, Vermillion, SD
2005 -	Member, Nebraska Academy of Sciences
2003 - 2009	Assistant Professor of Chemistry, University of Nebraska-Lincoln, Lincoln, NE
1999 - 2002	Associate Director, Wyeth Research, Cambridge, MA
1997 - 1999	Senior Scientist II, Wyeth-Ayerst Research, Pearl River, NY
1996 -	Member, New York Academy of Sciences
1995 - 2000	Adjunct Assistant Professor, New York Medical College, Valhalla, NY
1994 - 1997	Senior Scientist I, Wyeth-Ayerst Research, Pearl River, NY
1992 - 1994	Senior Scientist, American Cyanamid, Pearl River, NY
1986 -	Member, American Chemical Society
1986 -	Member, American Association for the Advancement of Science

Honors

2024	National Strategic Research Institute (NSRI) Fellow
2023	Sigma Xi, The Scientific Research Honor Society
2017	UNL College of Arts and Sciences Original Research and Creative Activity Award, University of Nebraska-Lincoln
2016	Fellow, American Association for the Advancement of Science
2014	ACS Outreach Volunteer of the Year and ACS Chemistry Ambassador, American Chemical Society
2000	Team of the Year Award, Team Co-leader, Wyeth
1998	Teamwork Award, Wyeth
1985	Phi Lambda Upsilon, National Chemistry Honor Society

C. Contribution to Science (h-index 65, i10-index 174, 9 patents, 204 publications, 10 book chapters, 17,051 citations, *corresponding author)

1. New cancer therapeutics were focused on binding to and disrupting DNA structure and DNA translation. Thus, in my undergraduate/graduate studies (1980-1989), my research investigated the sequence and

structural dependence of drug interactions with DNA as related to cancer treatment and understanding the mechanism of cancer development. I used two-dimensional NMR, computer modeling, complete relaxation matrix (MORASS), and manual DNA synthesis to determine high-resolution structures of DNA-drug complexes. A central finding was the application of 31P NMR to analyze and incorporate structural information about the phosphate ester backbone and helix twist based on 31P chemical shifts and heteronuclear coupling constants (3JP-H3'). My research took place during the early stages of NMR being developed as a valuable structural biology tool and represents some of the first DNA-drug structures determined by NMR, which positively influenced further use of NMR-based structural biology as a valuable asset for structure-based drug design.

a. **Powers R**, Gorenstein DG. Two-dimensional 1H and 31P NMR spectra and restrained molecular dynamics structure of a covalent CPI-CDPI2-oligodeoxyribonucleotide decamer complex. *Biochemistry*. 1990 Oct 23;29(42):9994-10008. PubMed PMID: 2271635.
b. **Powers R**, Jones CR, Gorenstein DG. Two-dimensional 1H and 31P NMR spectra and restrained molecular dynamics structure of an oligodeoxyribonucleotide duplex refined via a hybrid relaxation matrix procedure. *J Biomol Struct Dyn.* 1990 Oct;8(2):253-94. PubMed PMID: 2268403.
c. **Powers R**, Olsen RK, Gorenstein DG. Two-dimensional 1H and 31P NMR spectra of a decamer oligodeoxyribonucleotide duplex and a quinoxaline ((MeCys3, MeCys7)(TANDEM) drug duplex complex. *J Biomol Struct Dyn*. 1989 Dec;7(3):515-56. PubMed PMID: 2627298.
d. Roongta V, **Powers R**, Jones C, Beakage MJ, Shields JE, Gorenstein DG. Solution conformation of a synthetic fragment of human pituitary growth hormone. Two-dimensional NMR of an alpha-helical dimer. *Biochemistry*. 1989 Feb 7;28(3):1048-54. PubMed PMID: 2713357.

2. My postdoctoral training (1990-1993) took place at NIH with Drs. Clore and Gronenborn during a very exciting time for the field—the development and application of triple-resonance and multidimensional NMR for determining high-resolution structures of proteins and for the analysis of protein dynamics. I produced 1) one of the first high-resolution structures of a protein by NMR (interleukin-4); 2) one of the first NMR analyses of protein dynamics for a critical HIV protein (Ribonuclease H domain) during the peak of the AIDS epidemic; 3) a critical software tool (PIPP) that became the standard for analyzing multidimensional NMR datasets; and 4) contributions to constant-time and 4D pulse sequence development. This research resulted in some highly cited papers (157 to 897), demonstrating its importance in furthering the field. Research outcomes further enabled the routine use of NMR as a valuable tool for structural biology.

a. **Powers R**, Garrett DS, March CJ, Frieden EA, Gronenborn AM, Clore GM. The high-resolution, three-dimensional solution structure of human interleukin-4 determined by multidimensional heteronuclear magnetic resonance spectroscopy. *Biochemistry*. 1993 Jul 6;32(26):6744-62. PubMed PMID: 8329398.
b. **Powers R**, Garrett DS, March CJ, Frieden EA, Gronenborn AM, Clore GM. Three-dimensional solution structure of human interleukin-4 by multidimensional heteronuclear magnetic resonance spectroscopy. *Science*. 1992 Jun 19;256(5064):1673-7. PubMed PMID: 1609277.
c. Garrett DS, **Powers R**, Gronenborn AM, Clore G. A Common Sense Approach to Peak Picking in Two-, Three-, and Four-Dimensional Spectra Using Automatic Computer Analysis of Contour Diagrams. *Journal of Magnetic Resonance*. 1991 April 10; 95(1):214. PubMed PMID: 1609277.
d. **Powers R**, Gronenborn AM, Clore GM, Bax A.* Three-Dimensional Triple Resonance NMR of 13C/15N Enriched Proteins using Constant-Time Evolution. *Journal Of Magnetic Resonance*. 1991; 94:209-213.

3. I worked for ten years in the pharmaceutical industry (1992-2002), where I established and led the Protein NMR group at Wyeth, which was responsible for using NMR structural biology and ligand affinity screening to assists in identifying, evaluating and evolving chemical leads. Rational drug-design or structure-based drug design was the primary approach utilized by the pharmaceutical industry to develop new drugs. The success of the approach was dependent on obtaining protein-ligand structures. Thus, I utilized NMR to solve the structure and dynamics of over two dozen protein and protein-ligand co-structures of therapeutic importance and targets for drug discovery, with notable structures including FGF-2 (oncology), RGS4 (CNS), MMP-1 and MMP-13 (oncology, arthritis), ZipA and ACP (infectious disease), and IL-13 (asthma); developed methods for NMR-based ligand-screening (MS/NMR); and contributed to methods to expedite structure determination (AutoAssign, AutoStructure, Hyper). My research also resulted in some highly cited papers (108 to 362) and led to seven patents. The outcome of my research enabled the discovery of numerous drug-like leads that included new drug applications and investigational new drugs.

a. Moy FJ, Haraki K, Mobilio D, Walker G, Tabei K, Tong H, Siegel MM, **Powers R***. MS/NMR: a structure-based approach for discovering protein ligands and for drug design by coupling size exclusion chromatography, mass spectrometry, and nuclear magnetic resonance spectroscopy. *Anal Chem.* 2001 Feb 1;73(3):571-81. PubMed PMID: 11217765.

b. Chen JM, Nelson FC, Levin JI, Mobilio D, Moy FJ, Nilakantan R, Zask A, **Powers R**.* Structure-Based Design of a Novel, Potent, and Selective Inhibitor for MMP-13 Utilizing NMR Spectroscopy and Computer-Aided Molecular Design. *J. Am. Chem. Soc*. 2000; 122(40):9648-9654.
c. Zimmerman DE, Kulikowski CA, Huang Y, Feng W, Tashiro M, Shimotakahara S, Chien C, **Powers R,** Montelione GT.* Automated analysis of protein NMR assignments using methods from artificial intelligence. *J Mol Biol.* 1997 Jun 20;269(4):592-610. PubMed PMID: 9217263.
d. Moy FJ, Safran M, Seddon AP, Kitchen D, Böhlen P, Aviezer D, Yayon A, **Powers R.*** Properly oriented heparin-decasaccharide-induced dimers are the biologically active form of basic fibroblast growth factor. *Biochemistry*. 1997 Apr 22;36(16):4782-91. PubMed PMID: 9125499.

4. I have been a professor in the UNL Department of Chemistry for 20 years. I continue to employ NMR to explore the structure, function and ligand interactions of various proteins related to human health. My current research focuses on the development and implementation of NMR- and MS-based methods for metabolomics—a rapidly expanding field currently lacking established protocols, methods, and software. To address these gaps, I have overseen research for the 1) optimization of protocols for the preparation of metabolomics samples; 2) development of the MVAPACK metabolomics software platform, the PCA/PLS tools to determine the statistical significance of class separation in scores plots, an algorithm to simultaneously correct for phase errors and normalize NMR spectra to reduce within group variability, a generalized adaptive intelligent binning routine for multidimensional data, an algorithm for multi-block OPLS-DA, validation tools for PLS/OPLS, impact of noise and methods to remove noise from metabolomics data, and a deterministic Poisson-gap scheduling routine for non-uniform data sampling; 3) integration of NMR and MS datasets; and 4) validating and establishing best-practices. Many of these recent papers are among my most cited papers (upwards of over 1000 citations).

   a. S. T. Ovbude, S. Sharmeen, I. Kyei, H. Olupathage, J. Jones, R. J. Bell, **R. Powers**, and D. S. Hage (2024) "Applications of Chromatographic Methods in Metabolomics: A Review", *Journal of Chromatography B*, 1239:124124; PMC11618781.
   b. E. R. Andersson,* A. L. Bayless,* (24 other authors), **R. Powers**, T. Gebregiworgis* (2025) "Securing the Future of NMR Metabolomics Reproducibility: A Call for Standardized Reporting", *Analytical Chemistry*, 97(38):20655; PubMed PMID: in progress
   c. **R. Powers*** *et al.* (25 other authors) (2024) "Best Practices in NMR Metabolomics: Current State", *TrAC Trends in Analytical Chemistry*, 171, 117478; PMC11999570.
   d. D. Cochran, M. Noureldein, D. Bezdkova, A. Schram, R. Howard, and **R. Powers*** (2024) "A Reproducibility Crisis for Clinical Metabolomics Studies", *TrAC Trends in Analytical Chemistry*, 180, 117918; PMC11999569

5. I have applied these NMR and MS metabolomics methods to a variety of human health issues, including pancreatic cancer, Parkinson's disease, multiple sclerosis, and staph and tuberculosis (TB) infections. This has led to insights about the mechanisms of resistance in pancreatic cancer, the role of MUC1 in pancreatic cancer, the value of ketonic diet in diminishing cancer cachexia, a mechanism of toxin induced Parkinson's disease, a diagnostic method for multiple sclerosis, the identification of a mechanism of action for an established TB drug, mechanism of resistance to cancer therapy (e.g., gemcitabine), and the identification of potentially new TB drugs, and insights to survivability, viability, and biofilm formation in S. aureus.

   a. E. Przygrodzka, F. Binderwala, **R. Powers**, R. M. McFee, A. S. Cupp, J. R. Wood, J. S. Davis (2025) "Metabolic control of Luteinizing Hormone-responsive ovarian steroidogenesis", *J. Bioc. Chem.*, 301(1), 108042; PMC11732475.
   b. F. Bhinderwala, H. E. Roth, M. Filipi, S. Jack, and **R. Powers*** (2024) "Potential Metabolite Biomarkers of Multiple Sclerosis from Multiple Biofluids", *ACS Chemical Neuroscience*, 15(6):1110-1124; PMC11586083.
   c. D. Murthy, **R. Powers**, (34 other authors) and P. K. Singh* (2024) "Cancer-associated fibroblast-derived acetate promotes pancreatic cancer development by altering polyamine metabolism via the ACSS2-SP1-SAT1 axis", *Nature Cell Biology*, 26,613-627; PMC11021164.
   d. I. T. Sakallioglu, B. Tripp, J. Kubik, C. A. Casey, P. Thomes, and **R. Powers*** (2023) "A Multiomics Approach Captures Hepatic Metabolic Network Altered by Chronic Ethanol Administration", *Biology*, 12(1):28; PMC9855439.

Complete List of Published Work in MyBibliography

https://www.ncbi.nlm.nih.gov/myncbi/robert.powers.1/bibliography/public/

https://scholar.google.com/citations?user=bJ9tsA0AAAAJ&hl=en