

## **Jian Liu, Ph.D.**

John A. and Deborah S. McNeill, Jr. Distinguished Professor  
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### **SUMMARY**

Dr. Jian Liu has been working with heparin for more than 25 years. His expertise is in structural characterization of heparin and heparan sulfate, biosynthetic mechanism of heparin and enzymatic synthesis of heparin. He has invented an enzyme-based method to prepare heparin and heparan sulfate from bacteria polysaccharides. His method could potentially manufacture heparin in a confined facility to improve the safety of heparin drug.

### **APPOINTMENT**

- 2014-present**     **John A. and Deborah S. McNeill, Jr. Distinguished Professor**, Eshelman School of Pharmacy, University of North Carolina at Chapel Hill, NC, USA
- 2013-present**     **Founder and acting chief scientific officer**, Glycan Therapeutics, LLC, Chapel Hill, NC
- 2011-2013**        **Professor** (with tenure) of Chemical Biology and Medicinal Chemistry, Eshelman School of Pharmacy, University of North Carolina at Chapel Hill, NC
- 2006-2011**        **Associate Professor** (with tenure) of Medicinal Chemistry and Natural Products, Eshelman School of Pharmacy, University of North Carolina at Chapel Hill, Chapel Hill, NC
- 2009-2010**        **Visiting Associate Professor**, Department of Chemistry and Chemical Biology, Rensselaer Polytechnic Institute, Troy, NY
- 2000-2006**        **Assistant Professor** of Medicinal Chemistry and Natural Products, School of Pharmacy, University of North Carolina at Chapel Hill, Chapel Hill, NC
- 1999-2000**        **Research Scientist**, Biology Department, Massachusetts Institute of Technology, Cambridge, MA
- 1998-2000**        **Research Fellow**, Molecular Medicine Unit, Beth Israel Hospital, Boston, MA

### **TRAINING**

- 1993-1999**        **Postdoctoral Research Associate**  
Department of Biology, Massachusetts Institute of Technology  
Cambridge, MA 02139

*Mentor:*            Professor Robert D. Rosenberg

**1989-1993**      **Ph.D. in Medicinal Chemistry and Natural Products**  
College of Pharmacy, The University of Iowa, Iowa City, Iowa.  
*Thesis Advisor:* Professor Robert J. Linhardt

**1984-1987**      **M.S. in Biochemistry**, Nankai University, Tianjin, China.  
**1980-1984**      **B.S. in Chemistry**, Nankai University, Tianjin, China.

## **FUNDING**

### ***Active***

- 1) National Heart, Lung and Blood Institute. 1R01HL094463-09, July 1 of 2018 to June 30 of 2022. Project title: “In vitro synthesis of recombinant heparan sulfate” (Principal Investigator, Jian Liu). Direct cost \$345,426/yr for 4 years, 15% effort.
- 2) National Heart, Lung and Blood Institute. R01 HL144970, January 15 of 2019 to December 31 of 2021. Project title: “Synthesis and pharmacological evaluation of homogeneous ultra-low molecular weight heparins” (PI: Jian Liu). Direct cost \$228,000/yr for 3 years, 10% effort.
- 3) Glycan Therapeutics, LLC, July 4, 2019 to June 30th, 2021. Project title: “Development of a New Carbohydrate-based Anticoagulant Drug” (NIH SBIR grant R44HL139187-02, PI Dr. Vijay Pagadala). Role in the project: Co-PI. Direct cost \$164,000/yr for two years, 5% effort.
- 4) National Science Foundation, DMR-1933525, 9/1/2020 to 8/30/2024. Project title: “GlycoMIP-Automating the Synthesis of Rationally Designed Glycomaterials” (PI, Dr. Maren Roman). Role in the project: Co-PI. Direct cost \$50,000/yr 1 and yr 5, \$100,000/yr2-yr4, 5% effort
- 5) National Aging Institute, RF1AG069039, 9/15/2020 to 8/30/2023. Project title: “Heparan sulfate 3-O-sulfation in transcellular propagation of tauopathy in Alzheimer's Disease” (PI Dr. Chunyu Wang). Role in the project: Co-PI. Direct cost \$60,000/yr for four years.
- 6) National Institute for General Medical Sciences, 2R01GM072667-14. 1/1/2021 to 12/31/2024. Project title: Enabling synthesis and biological studies of homogeneous heparan sulfate and chondroitin sulfate glycol-polypeptides and proteoglycans” (PI Dr. Xuefei Huang). Role in the project: Co-PI. Direct cost \$60,000/yr for four years.

### ***Completed***

- 1) National Institute of Cancer. 1U01 CA221235, July 1, 2017 to June 30, 2019. Role in the project Co-PI. Project title: “Sequencing glycosaminoglycans using recognition tunneling nanopores”, 5% effort.
- 2) National Institute of General Medical Sciences. 1R41GM123792, September 1, 2017 to August 31, 2019. Role in the project: PI. Project title: “Developing heparan sulfate glycan array”, 4% effort.
- 3) Vesta Therapeutics, Inc., 8/1/10 – 12/31/19. Project title: “Grafting strategies for liver cell therapies” (Principal Investigator, Lola Reid). Role in the project: Co-PI, 10%

- 4) National Heart, Lung and Blood Institute. 1R01 HL 130864-01, March 1, 2016 to January 31, 2020. Project title: “Liver-mediated Clearance of low molecular weight heparins” (Principal Investigator, Edward Harris). Role in the project; Co-PI. Direct cost, \$60,000/yr for four years, 4% effort.
- 5) National Institute of General Medical Sciences. U01 GM116262, July 1, 2015 to June 30, 2019. Project title: “Expedited synthesis of glycosaminoglycans containing defined sulfation domains” (Principal Investigator, Linda Hsieh-Wilson). Role in the project: Co-PI. Direct cost, \$60,000/yr for four years. 4% effort.
- 6) US Food and Drug Administration, U19FD004994-01, September 1 of 2013 to August 31 of 2019. Project title: “Probing the heparin structural elements for high risk of heparin-induced thrombocytopenia (HIT)” (Principal Investigator). Total cost \$255,000/yr, 9% efforts.
- 7) National Science Foundation, CHE-1111550, July 1 of 2011 to June 30 of 2015 (no cost extension). Project title: “Synthesis of homogeneous heparan sulfate proteoglycans” (Principal Investigator, Xuefei Huang). Role in the project: Co-PI. Direct cost \$29,000/yr for three years, 3% effort.
- 8) UNC Eshelman Institute for Innovation Award. October 1, 2015 to September 30, 2018. Project title: “Developing carbohydrate-based medicines” Role in the project: PI. Direct cost \$250,000/yr for three years. No salary support.
- 9) National Heart, Lung and Blood Institute. U01HL117659-01, August 15 of 2013 to May 31 of 2018. Project title: “Targeted anticoagulant therapy for sickle cell disease” (Principal Investigator, Ken Ataga). Role in the project: collaborator, 10% effort.
- 10) National Heart, Lung and Blood Institute. 1R01HL096972-01, August 1 of 2009 to April 30 of 2015 (no cost extension). Project title: “Development of a Bioengineered Heparin from a Non-Animal Source” (Principal Investigator, Robert J Linhardt). Role in the project: Co-PI. Direct cost \$100,000/yr for Yr 1-Yr3 and \$75,000/yr for Yr4-Yr5, 5% effort.
- 11) National Institute of Allergy/Infectious Diseases, R01 AI50050-01, July, 2001 to May, 2006. Project title: “Specificity of Heparan Sulfate for Herpes Infection”. (Principal Investigator) direct cost \$625,000 for five years, 40% effort.
- 12) American Heart Association Mid-Atlantic Affiliate, grant-in-aid 0355800U, July 1 of 2003 to June 30 of 2005. Project title: “Understanding the biosynthesis of anticoagulant heparan sulfate”. (Principal Investigator) direct cost \$120,000 for two years, 10% effort.
- 13) Pharmacy Foundation of North Carolina, seed grant, Feb. 1 to Dec. 31, 2004. Project title: “Investigation of the Molecular Mechanism of the Biosynthesis of Anticoagulant Heparan Sulfate”. (Principal Investigator) direct cost \$9,500.
- 14) American Heart Association, MidAtlantic grant-in-aid 0855424E, July 1 of 2008 to June 30 of 2010. Project title: “Investigation of the substrate specificities of heparan sulfate biosynthetic enzymes” (Principal Investigator). Direct cost \$60,000/yr for two years, 5% effort.
- 15) Zacharon, Inc, June 1 of 2009 to May 31 of 2010. Project title: “Inhibition of heparan sulfate biosynthetic enzymes by small molecules” (Principal Investigator). Direct cost \$20,000.
- 16) National Institute of Allergy/Infectious Diseases, 2R01AI050050, July of 2001 to January of 2011. Project title: “Structural specificity of heparan sulfate for herpes infection” (Principal Investigator). Direct cost \$226,000/yr for five years, 15% effort.
- 17) National Institute of Allergy/Infectious Diseases, 3R01AI050050-07S1, February 1 of 2008 to January 31 of 2011. Project title: “Structural specificity of heparan sulfate for herpes

- infection” (Principal Investigator). Direct cost \$33,000/yr for three years. This grant is to support Ms. Courtney Jones’ PhD studies.
- 18) National Institute of Allergy/Infectious Diseases, 1R21AI074775-01A2, August 1 of 2009 to July 31 of 2011. Project title: “Glycomics of Heparan Sulfate in Bacterial Pathogenesis” (Principal Investigator). Direct cost, \$150,000/yr1 and \$125,000/yr2, 10% effort.
  - 19) National Institute of Allergy/Infectious Diseases, 3R01AI050050, September 18 of 2009 to August 31 of 2010. Project title: “Structural specificity of heparan sulfate for herpes infection” (Principal Investigator). Direct cost \$99,760. This grant is to purchase a LC/MS system.
  - 20) National Heart, Lung and Blood Institute. 1R01HL094463-01, February 13 of 2009 to July 31 of 2013. Project title: “In vitro synthesis of recombinant heparan sulfate” (Principal Investigator). Direct cost \$280,000/yr for 4 years, 15% effort.
  - 21) National Institute of General Medical Sciences, 1R01GM093131-01, May 1 of 2010 to April 30 of 2014. Project title: “STRUCTURE AND FUNCTION OF 3-O-SULFATION IN HEPARAN SULFATE” (Principal Investigator, Jeff Esko). Role in the project: Co-PI. Direct cost \$16,000/yr for two years, 3% effort.
  - 22) National Institute of General Medical Sciences, 1R01GM090257-01, September 30 of 2009 to August 31 of 2011. Project title: “An artificial Golgi: Controlled GAG synthesis and screening” (Principal Investigator, Robert J Linhardt). Role in the project: Co-PI. Direct cost \$55,000/yr1 and \$65,000/yr 2, 3% effort.
  - 23) National Institute of General Medical Sciences, 1U01GM102137-01A1, September 1 of 2013 to May 31 of 2017. Project Title: “Uncovering the controlling mechanisms in heparan sulfate biosynthesis” (Principal Investigator, Jian Liu). Direct cost \$245,000/yr for four years, 10%.
  - 24) National Heart, Lung and Blood Institute. 2R01HL062244-09A1, January 1 of 2013 to December 31, 2016. Project title: “Synthetic Heparan Sulfate: Probing Biosynthesis to Prepare Defined Drugs” (Contact PI, Robert Linhardt). Direct cost \$75,000/yr for four years. Role in the project: one of three MPIs, 5%.
  - 25) National Heart, Lung and Blood Institute. R01HL056819, August 1, 2013 to May 31, 2017. Project title: “ In situ regeneration of bioactive surfaces: rechargeable antithrombogenic films” (Principal Investigator, Elliot Chaikof). Role in the project: Co-PI. Direct cost \$25,000/yr for four years, 2.5% effort.
  - 26) National Institute of Heart, Lung and Blood Institute. 1R41HL139187, September 1, 2017 to May 31, 2018. Role in the project: PI. Project title: “Development of a new carbohydrate-based anticoagulant drug”, 10% effort.

***Serve as a sponsor for graduate student fellowship***

- 1) National Institute of Allergy/Infectious Diseases, R01 AI50050S1, June 2004 to May 2005. Project title: “Specificity of Heparan Sulfate for Herpes Infection”. A supplement fellowship to support Tanya Scarlett. Direct cost \$25,048.
- 2) American Heart Association, MidAtlantic Affiliate, July 2005 to June 2007. Project title: “Understanding the substrate recognition mechanism of heparan sulfate 3-O-sulfotransferase”. A predoctoral fellowship to support Ding Xu. Direct cost \$40,000.

- 3) National Institute of General Medical Sciences, F31GM090647, Jan 1 of 2010 to Dec 31 of 2012. Project title: "Investigation of the inhibitor of heparanase" (P.I. Sherket Peterson). Direct cost \$35,000/yr for three years.
- 4) National Institute on Aging, F31AG040927-01, September 1 of 2011 to August 31 of 2014. Project title: "Contribution of structural motifs to heparin clearance" (P.I. Elizabeth Pempe). Direct cost \$29,000/yr for three years.
- 5) National Heart, Lung and Blood Institute, F31HL120598-01, July 1 of 2013 to August 31 of 2016. Project title: "Chemical and enzymatic synthesis of multi-domain heparin mimetics" (P.I. Timothy O'Leary). Direct cost \$32,042/yr for three years.
- 6) US Pharmacopeia Global Predoctoral Fellowship, December 10 of 2015 to December 30 of 2016. Project title: "Developing a new approach to determine the molecular weight of heparins" (Awardee: Katelyn Arnold). Direct cost \$30,000.
- 7) US Pharmacopeia Global Predoctoral Fellowship, January 1, 2017 to December 31, 2017. Project title: "Predicting the molecular weight of low molecular weight heparins using a computer model" (Awardee: Katelyn Arnold). Direct cost \$25,000.
- 8) PhRMA (Pharmaceutical Research and Manufacturers of America) Foundation predoctoral fellowship, January 1, 2018 to December 31, 2019. Project title: Targeting Sterile Inflammation with Sulfated Carbohydrates" (Awardee: Katelyn Arnold). Direct cost \$40,000.
- 9) AFPE (American Foundation for Pharmaceutical Education) predoctoral fellowship, September 1, 2018 to August 31, 2020. Project title: Targeting Sterile Inflammation with Sulfated Carbohydrates" (Awardee: Katelyn Arnold). Direct cost \$20,000.

### **HONORS AND AWARDS**

- 2010** Distinguished Faculty Award from Chinese-American Chemistry & Chemical Biology Professor Association, presented to outstanding faculty members of Chinese ethnics in US and China. Four awards (two from US and two from China) are given each year.
- 1996-1998** Postdoctoral Fellowship from American Heart Association Massachusetts and Rhode Island Affiliates, presented to outstanding physicians and scientists engaging in cardiovascular research.
- 1991-1993** Predoctoral Fellowship from American Heart Association Iowa Affiliates, presented to outstanding M.D. and Ph.D. candidates engaging in cardiovascular research.

### **SERVICE**

- Louisiana Board of Regents' Research Competitiveness Subprogram (2007)
- American Heart Association, Co-Chair and member for Region II Basic Cell Peer Review Committee 2 (2008 – 2009)
- American Heart Association, Chair for Region II Basic Cell Peer Review Committee (2010-2011)
- National Institutes of Health, Member for Drug Discovery and Development (DDD) study section (Nov, 2008 – 2009).
- National Science Foundation of China, Biochemistry Division (May, 2009)

National Institutes of Health, Member for Shared Instrumentation study section (July, 2009)  
US Pharmacopeia, Member for “Unfractionated Heparins Expert Ad Hoc Advisory Panel”  
(November, 2009-August, 2012)  
March of Dimes Foundation, *adhoc* grant reviewer (January, 2010).  
National Science Foundation, neural system cluster *adhoc* grant reviewer (April, 2010)  
National Institute of General Medical Sciences sponsored workshop entitled “Expanding the  
chemical space for carbohydrates: Road map to automated synthesis” (March 2011).  
National Institute of General Medical Sciences sponsored working group entitled “10K Glycan  
Array Working Group” (Sept 2011).  
Heparin Symposium Organizer for American Chemical Society-Carbohydrate Chemistry  
Division, April 8 to 9, 2013, New Orleans, LA.  
National Science Foundation, chemistry of life processes program, *adhoc* grant reviewer (March,  
2013)  
Invited by American Society for Biochemistry and Molecular Biology (ASBMB) to speak at US  
congressional briefing about the impact of sequestration on scientific research, Capital Hill,  
Washington DC, November 13, 2013  
US Food and Drug Administration, independent site visit reviewer to evaluate FDA research  
programs, March 12, 2014.  
Israel Science Foundation, grant reviewer (March, 2014).  
National Institutes of Health, *adhoc* member for Synthetic and Biological Chemistry A Study  
Section, June 2014.  
National Institutes of Health, *adhoc* member for special emphasis panel of vascular and  
hematology review group, February 19, 2015.  
Grant reviewer for US-Israel Binational Science Foundation, February, 2016.  
National Institutes of Health, *adhoc* member for special emphasis panel of carbohydrate  
synthesis, April 1, 2016.  
National Institutes of Health, *adhoc* member for special emphasis panel of Accelerating  
Translation of Glycoscience, March 30-31, 2016.  
National Institutes of Health, *adhoc* member for SBCA study section, June 7-8, 2017.  
National Institutes of Health, *adhoc* member for NHLBI Special Emphasis Panel, Factor VII  
Immune Responses, December 1-2, 2017.  
National Institutes of Health, *adhoc* member for ZRG1 IMST-B (51) and (52) Glycoscience U01  
review, February 15-16, 2018.  
Arthritis Research UK, mail grant reviewer December 2017.  
National Institutes of Health, *adhoc* member for ZRG1 MDCN-P (52) for Amyloid, April, 2018  
Polymorphisms and Glycosylation in Alzheimer's Diseases, July 17, 2018.  
External Advisory Board member for the NHLBI sponsored Center for the Investigation of FVIII  
Immune Response in Patients with Hemophilia A, 2018-2023.  
National Institutes of Health, *adhoc* member for ZRG1 IMST-U (51) R U01 RFA Panel: Tools  
and Technologies for the Analysis of Glycans, February 13, 2019.  
American Heart Association, October 18, 2019, American Heart Association Fellowships Basic  
Cell-Proteins and Crystallography 2 Peer Review Committee.  
American Heart Association, March 4, 2020, American Heart Association Transformational  
Project Award Basic Cell Sciences Peer Review Committee.  
National Institutes of Health, *adhoc* member for IMST (10) study section to review SBIR/STTR  
applications, March 18, 2020.

American Heart Association, March 10, 2021, American Heart Association Fellowships Basic Cell-Proteins and Crystallography 2 Peer Review Committee

## **LIST OF PUBLICATIONS**

### ***Research Articles (\* denotes corresponding author)***

1. Liao, Y-E., Xu, Y., Arnold, K., Zhang, F., Li, J., Linhardt, R.J., Xu, D., Pawlinski, R., **Liu\*, J.** (2022) Neutralizing extracellular histone and HMGB1 by heparan sulfate octadecasaccharide (18-mer) protects against sepsis, submitted.
2. Francisco, A.B., Li, J., Farghli, A.R., Kanke, M., Shui, B., Soloway, P.D., Wang, Z., Reid, L.M., **Liu\*, J.** and Sethupathy\*, P. (2022) Chemical, molecular, and single cell analysis reveal chondroitin sulfate proteoglycan aberrancy in fibrolamellar carcinoma *Cancer Res Commun.* accepted.
3. Ni, M., Stancanelli, E., Kayal, Y., Candido, M., Guerrini, M., Vlodavsky, I., Naggi, A., **Liu, J.**, and Petitou\*, M. (2021) Chemoenzymatic synthesis of D-Glucaro- $\delta$ -lactam containing oligosaccharides as putative heparanase inhibitors *ChemistrySelect* 6: 11690-11695.
4. Stancanelli, E., Liu, W., Wander, R., Li, J., Wang, Z., Arnold, K., Su, G., Kanack, A., Pham, T.Q., Pagadala, V., Padmanabhan, A., Xu, Y. and **Liu\*, J.** (2022) Chemoenzymatic synthesis of homogeneous heparan sulfate and chondroitin sulfate chimeras. *ACS Chem*, accepted.
5. Wang, Z., Arnold, K., Dhurandhare, V.M., Xu, Y., Pagadala, V., Labra, E., Jeske, W., Fareed, J., Gearing, M., and **Liu\*, J.** (2022) Analysis of 3-*O*-sulfated heparan sulfate using isotopically labeled oligosaccharide calibrants. *Anal Chem* 94: 2950-2957. PMID: 35107975
6. Wander, R., Kaminski, A.M., Wang, Z., Stancanelli, E., Xu, Y., Pagadala, V., Li, J., Krahn, J.M., Pham, T.Q., **Liu\*, J.**, and Pedersen, L.C. (2021) Structural and substrate specificity analysis of 3-*O*-sulfotransferase isoform 5 to synthesize anticoagulant heparan sulfate *ACS Catalysis* 11, 14956-14966. PMID: 35223137; PMCID: PMC8865405.
7. Ham, H.O., Haller, C.A., Su, G., Dai, E., Patel, M.S., Liu, D.R., **Liu, J.**, Chaikof\*, E.L. (2021) A rechargeable anti-thrombotic coating for blood-contacting devices *Biomaterials* 276 121011. PMID: 34303154;PMCID: PMC8405571
8. Li, J., Su, G., Xu, Y., Arnold, K., Pagadala, V., Wang, C. and **Liu\*, J.** (2021) Synthesis of 3-*O*-sulfated heparan sulfate oligosaccharides using 3-*O*-sulfotransferase isoform 4 *ACS Chem Biol.* 16, 2026-2035. PMID: 34351732; PMCID: PMC8526403
9. Wang, Z., Dhurandhare, V.D., Mahung, C.A., Arnold, K., Li, J., Su, G., Xu, D., Maile, R. **Liu\*, J.** (2021) Improving the sensitivity for quantifying heparan sulfate from biological samples *Anal. Chem.* 93, 11191-11199. PMID: 34355888; PMCID: PMC8454094

10. Wander, R., Kaminski, A.M., Xu, Y., Pagadala, V., Krahn, J.M., Pham, T.Q., **Liu\*, J.**, and Pedersen, L.C. (2021) Deciphering the substrate recognition mechanisms of the heparan sulfate 3-*O*-sulfotransferase-3 *RSC Chem Biol.*, 2: 1239-1248. PMID: 34458837; PMCID: [PMC8341778](#)
11. Zhang, X., Liu, X., Su, G., Li, M., **Liu, J.**, Wang, C., and Xu\*, D. (2021) Cystatin C is a pH-dependent heparan sulfate binding protein *Commun. Biol.* 4, 198 doi: 10.1038/s42003-021-01737-7. PMID: 33580179; PMCID: [PMC7881039](#)
12. Gunn, K.H, Gutgsell, A.R., Xu, Y., Johnson, G.V., **Liu, J.**, Neher\*, S.B. (2021) Comparison of angiopoietin-like protein 3 and 4 reveals structural and mechanistic similarities *J. Biol. Chem.* 296:100312. doi: 10.1016/j.jbc.2021.100312. Liu, J., Schleyer, Bryan, T.L., Xie, C., Seabra, G., Xu, Y., Kafle, A., Cui, C., Wang, Y., Yin, K., Fetrow, B., Henderson, P.K.P., Fatland, P.Z., **Liu, J.**, Li, C., Guo, H., Cui\*, L. (2021) Ultrasensitive small molecule fluorogenic probe for human heparinase *Chem. Sci.* 12, 239-246. PMID: 34163592; PMCID: [PMC8178809](#)
13. Yang, W., Eken, Y., Zhang, J., Cole, L.E., Ramadan, S., Xu, Y., Zhang, Z., **Liu, J.**, Wilson, A.K., Huang\*, X. (2020) Chemical synthesis of human syndecan-4 glycopeptide bearing *O*-, *N*-sulfation and multiple aspartic acids for probing impacts of the glycan chain and the core peptide on biological functions. *Chem. Sci.* 11, 6393 –6404. PMID: 34094105; PMCID: [PMC8159385](#)
14. Elli, S. Stancanelli, E., Wang, Z., **Liu, J.** and Guerrini\*, M. (2020) Novel heparin antithrombin binding octasaccharide: conformation and molecular recognition characterization. *Chemistry* 26: 11814-11818. PubMed PMID: 32515841
15. Lin, Y., Xu, Y., Kaminski, A. Chang, X., Pagadala, V., Horton, M., Su, G., Wang, Z., Lu, G., Conley, P., Zhang, Z., Pedersen\*, L.C., and **Liu\*, J.** (2020) Using an engineered 6-*O*-sulfotransferase to improve the synthesis of anticoagulant heparin. *Org. Biomol. Chem.* 18:8094-8102. PubMed PMID: 33026409; PubMed Central PMCID: PMC7646985.
16. Wang, Z., Arnold, K. Xu, Y., Pagadala, V., Su, G., Myatt, H., Linhardt, R.J., and **Liu, J.\*** (2020) Quantitative analysis of heparan sulfate using isotopically labeled calibrants. *Commun. Biol.* 3:425 (PMID: 32753592 and PMCID: [PMC7403576](#))
17. Kelly, U., Grigsby, D., Cady, M.A., Landowski, M., Skiba, N.P., **Liu, J.** Remaley, A.T., Klingeborn, M., Rickman\*, C.B. (2020) High-density lipoproteins are a potential therapeutic target for age-related macular degeneration. *J. Biol. Chem.* 295, 13601-13616.
18. Arnold, K., Xu, Y., Liao, Y-E., Cooley, B.C., Pawlinski, R., and **Liu, J.\*** (2020) Synthetic anticoagulant heparan sulfate attenuates liver ischemia reperfusion injury. *Scientific Reports* 10, 17187. PubMed Central PMCID: PMC7566620
19. Li, J., Sparkenbaugh, E.M., Su, G., Zhang, F., Xu, Y., Xia, K., He, P., Baytas, S., Pechauer, S., Padmanabhan, A., Linhardt, R.J., Pawlinski\*, R., **Liu, J.\*** (2020) Enzymatic synthesis of



- chondroitin sulfate E to attenuate bacteria lipopolysaccharide-induced organ damage. *ACS Central Sci.* 6: 1199-1207. (PMID: 32724854 and PMCID: [PMC7379384](#))
20. Horton, M., Su, G., Yi, L., Xu, Y., Pagadala, V., Zhang, F., Pierce, K., Linhardt, R.J., **Liu\*, J.** (2020) Construction of heparan sulfate microarray for investigating the binding of specific saccharide sequences to proteins. *Glycobiology* 1-12 (doi: 10.1093/glycob/cwaa068).
  21. Miller, R.L\*., Guimond, S.E., Schorer, Zhbkova, O., Tyler, P.C., Xu, Y., **Liu, J.**, Chopra, P., Boons, G.-J., Grabarics, M., Manz, C., Hoffman, J., Karlsson, N., Turnbull, J.E., Struwe, W.B., Pagel, K. (2020) Shotgun ion mobility mass spectrometry sequencing of heparan sulfate saccharides. *Nat Commun.* 11:1481. (PMID: 32198425 and PMCID: [PMC7083916](#))
  22. Zhang, X., Ong, C., Su, G., **Liu, J.** and Xu\*, D. (2020) Characterization and engineering of S100A12-heparan sulfate interactions. *Glycobiology* 30: 463-473.( PMID: 31942981 and PMCID: [PMC7305801](#))
  23. Arnold, K., Xu, Y., Sparkenbaugh, E.M, Li, M., Han, X., Zhang, X., Xia, K., Piegore, M., Zhang, F., Zhang, X., Henderson, M., Pagadala, V., Su, G., Tan, L., Park, P.W., Stravitz, R.T., Key, N.S., Linhardt, R.J., Pawlinski, R., Xu, D., **Liu, J.\*** (2020) Design of anti-inflammatory heparan sulfate to protect against acetaminophen-induced acute liver failure. *Sci Transl Med* 12, eaav8075. (PMID: 32188725 and PMCID: [PMC7315409](#))
  24. Zhao, J., Zhu, Y., Song, X., Xiao, Y., Su, G., Liu, X., Wang, Z., Xu, Y., **Liu, J.**, Eliezer, D., Ramlall, T.E., Lippens, G., Gibson, J., Zhang, F., Linhardt, R.J., Wang, L., Wang, C\*. (2020) 3-O-sulfation of heparan sulfate enhances tau interaction and cellular uptake. *Angew Chem Int Ed* 59:1818-1827 (PMID: 31692167 and PMCID: PMC6982596).
  25. Dhurandhare, V.M., Pagadala, V., Ferreira, A., Muynck, L.D., **Liu, J.** \* (2020) Synthesis of 3-O-sulfated disaccharide and tetrasaccharide standards for compositional analysis of heparan sulfate *Biochemistry* 59(34):3186-3192. PubMed PMID: 31608625; PubMed Central PMCID: PMC7269455.
  26. Tykesson\*, E., Maccarana, M., Thorsson, H., **Liu, J.**, Malmstrom, A., Ellervik, U., Westergren-Thorsson, G. (2019) Recombinant dermatan sulfate is a potent activator of heparin cofactor II-dependent inhibition of thrombin. *Glycobiology* 29: 446-451.
  27. Yu, Y., Williams, A., Zhang, X., Fu, L., Xia, K., Xu, Y., Zhang, F., **Liu, J.**, Koffas, M., and Linhardt\*, R.J. (2019) Specificity and action pattern of heparanase Bp, a  $\beta$ -glucuronidase from *Burkholderia pseudomallei* *Glycobiology* 29: 572-581 (PMID: 31143933 and PMCID: [PMC6639543](#)).
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163. Wang, Z., Arnold, K., Dhurandhare, V.M., Xu, Y., and **Liu\***, J. (2021) Investigation of the biological functions of heparan sulfate using a chemoenzymatic synthetic approach. *RSC Chem. Biol.* 2: 702-712. PMID: 34179782; PMCID: [PMC8190904](#)
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165. **Liu\***, J., Li, J., Arnold, K., Pawlinski, R., Key\*, N.S. (2020) Using heparin molecules to manage COVID-2019. *Res. Pract. Thromb. Haemost.* 4: 518-523. PMID: 32542212 PMCID: [PMC7264589](#)
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182. **Jian Liu\*** and Lars C. Pedersen (2007) Anticoagulant heparan sulfate: Structural specificity and biosynthesis. *Appl. Microbiol. Biotechnol.* 74:263-272.
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184. Robert D. Rosenberg\*, Nicholas W. Shworak, **Jian Liu**, John J. Schwartz, and Lijuan Zhang (1997) Heparan sulfate proteoglycans of the cardiovascular system: specific structures emerge but how is synthesis regulated? *J. Clin. Invest.* 99: 2062-2070.
185. Robert J. Linhardt\*, **Jian Liu** and Xue-jun Han (1993) Mapping and sequencing of oligosaccharides by electrophoresis. *Trends Glycosci. Glycotechnol.* 5: 181-192.

### ***Refereed book chapters***

186. Jine Li, Rylee Wander, Yongmei Xu and **Jian Liu\*** Enzyme-Based Methods to Synthesize Homogeneous Glycosaminoglycan Oligosaccharides, 2021. In: Barchi, Jr., Joseph (ed.), *Comprehensive Glycoscience*, 2nd edition. vol. [2], pp. 706-714. Oxford: Elsevier.
187. Prestegard, J.H., **Liu J.**, Widmalm, G. Oligosaccharides and Polysaccharides (Varki A, Cummings RD, Esko JD, Stanley P, Hart GW, Aebi M, Darvill AG, Kinoshita T, Packer NH, **Prestegard JH**, Schnaar RL, Seeberger PH, editors.) *Essentials of Glycobiology*. 3rd edition. Cold Spring Harbor (NY) (2017): Cold Spring Harbor Laboratory Press; 2015-2017. Chapter 3
188. Tim O'Leary and **Jian Liu\*** (2012) Uronyl 2-*O*-sulfotransferase in *Handbook of Glycosyltransferases and Their Related Genes* (N. Taniguchi and M. Fukuda Eds.) Springer-Verlag, Tokyo, in press.
189. Tim O'Leary and **Jian Liu\*** (2012) Heparan sulfate D-glucosaminyl 3-*O*-sulfotransferase in *Handbook of Glycosyltransferases and Their Related Genes* (N. Taniguchi and M. Fukuda Eds.) Springer-Verlag, Tokyo, in press
190. Renpeng Liu and **Jian Liu\*** (2010) Enzymatic synthesis of heparin, in *Sustainable Biotechnology-Sources of Renewable Energy* (O.V. Sigh and S.P. Harrey Eds.), in press.
191. Courtney L. Jones, Ding Xu and **Jian Liu\*** (2010) Structure, Biosynthesis and Function of Glycosaminoglycans, in "Carbohydrates, Nucleosides, & Nucleic Acids" (C.H. Wong and G.P. Wang, eds), *Comprehensive Natural Products Chemistry II* series (L. Mendor and H.-W. Liu, editor in-chief) Vol 6, in press.
192. Fikri Y. Avci, Paul L. DeAngelis, **Jian Liu**, and Robert J. Linhardt\* (2007) Enzymatic synthesis of glycosaminoglycans: improving on nature, in *Frontiers in Carbohydrate Chemistry*, pp 253-284.
193. **Jian Liu\*** and Robert D. Rosenberg (2001) Heparan sulfate D-glucosaminyl 3-*O*-sulfotransferase, in *Handbook of Glycosyltransferases and Their Related Genes* (N. Taniguchi and M. Fukuda Eds.) Springer-Verlag, Tokyo pp 475-483. (Book Chapter)



194. Robert J. Linhardt\*, Ali Al-Hakim and **Jian Liu** (1991) Acidic polysaccharides: Their modification and potential uses, in *Biotechnology and Polymers* (C. G. Gebelein Ed.) Plenum Press, New York, 155-165. (Book Chapter)

### Patents:

1. Robert D. Rosenberg, Nicolas W. Shworak, **Jian Liu**, Linda M.S. Fritze, John J. Schwartz, and Lijuan Zhang Heparan sulfate D-glucosaminyl 3-O-sulfotransferases, and uses therefor, **US Patent 6,861,254 B1**.
2. **Jian Liu**, Guoqing Xia, Jinghua Chen, , Mike Duncan, Anders Mamlström, Deepak Shukla, Vaibhav Tiwari Heparan sulfate 3-O-sulfotransferase Isoform 5 generates both an antithrombin-binding site and an entry receptor for herpes simplex virus-1, US patent **20060165673 (7,531,338)**.
3. **Jian Liu**, Jinghua Chen, Robert J. Linhardt, Fikri Y. Avci, and Eva M. Munoz Enzymatic synthesis of sulfated polysaccharides, US Patent **20090197308 (US patent serial #11/920,319)**.
4. **Jian Liu**, Jinghua Chen, Courtney Jones, Yongmei Xu Enzymatic synthesis of sulfated polysaccharides without iduronic acid residues, US Patent **20090035787. (US patent serial # 12/178,434)**
5. **Jian Liu** and Yongmei Xu Chemoenzymatic synthesis of homogeneous ultra-low molecular weight heparins, **US patent serial # 61/426,921**.
6. Stavros Garantziotis, John W. Hollingsworth, Bryan P. Toole, and **Jian Liu** Use of antagonists of hyaluronan signaling, US Patent (**US 9,717,752B2**), date of patent: August 1, 2017.
7. **Jian Liu**, Yongmei Xu, Edward Harris and Robert Linhardt Reversible heparin molecules and methods of making and using the same, US Patent (**US 9,951,149B2**), date of patent: April 24, 2018.
8. **Jian Liu**, Zhangjie Wang, Po-Hung Hsieh and Yongmei Xu SHORT ACTING SYNTHETIC HEPARIN, US patent application # US [62/469,643](#)
9. **Jian Liu**, Jine Li and Guowei Su ENZYMATIC SYNTHESIS OF CHONDROITIN SULFATE, US patent application # **US 62/528,243**.
10. **Jian Liu**, Katelyn Arnold, Yongmei Xu, Rafal Pawlinski, and Ding Xu SULFATED OLIGOSACCHARIDES HAVING ANTI-INFLAMMATORY ACTIVITY, US patent application **US 62/581,443**.

### INVITED LECTURES

1. Frontiers in carbohydrate synthesis symposium, virtual meeting, January 29-30, 2021, National Institutes of Health (Served as a member of discussion panel).
2. The biology of glycosaminoglycans in health & diseases, virtual meeting, September 18, 2020, National Institutes of Health.
3. NIH Common fund Glycoscience conference, virtual meeting, June 16-17, 2020, National Institutes of Health.
4. 25<sup>th</sup> International Symposium on Glycoconjugates, Milan, Italy, August, 2019
5. University of Maryland, MD, USA, September 2019.
6. Huanan Chinese Medical University, China, June, 2019.
7. American Association for the Study of Liver Diseases (AASLD) annual meeting, Nov 9-13, 2018, San Francisco, CA.
8. Gordon Research Conference on metals in medicine, Andover, NH, June 25, 2018. (The lecture was delivered by Katelyn Arnold)
9. GlycoT 2018, the 11<sup>th</sup> International Symposium on Glycosyltransferases, Qingdao, China, June 19-23, 2018.
10. Prince of Songkla University, Hat-Yai, Thailand, September 2018.
11. University of Nottingham, UK, December 2017.
12. ACS Southeastern regional meeting, Charlotte, NC, November 2017.
13. Gordon Research Conference on Carbohydrates, June, 2017.
14. Department of Biochemistry, University of Nebraska at Lincoln, Feb 22, 2017. Title “Developing a chemoenzymatic method to prepare carbohydrate-based medicines”.
15. Department of Chemistry, University of New Mexico, January 20, 2017. Title “Developing a chemoenzymatic approach to prepare carbohydrate-based medicines”.
16. Heparin Centennial Symposium, Oct 28-29, 2016, Loyola University. Title: “Using a synthetic approach to probe the structure and function relationship of heparin.”
17. Heparin’s centenary, September 14, 2016, Milan Italy. Title “Chemoenzymatic synthesis of low-molecular weight heparins”.
18. University of Lund, May 25, 2016, Lund, Sweden. Title “Chemoenzymatic synthesis of low-molecular weight heparins”.
19. 5<sup>th</sup> International Research Conferences on Multiple Hereditary Exostoses, May 19 to 22, 2016, West Palm Beach, Florida. Title “Investigation of the biological function of heparan sulfate using a chemoenzymatic synthetic approach”.
20. University of Louisiana Medical Center, November 2015. Title: “Chemoenzymatic synthesis of low-molecular weight heparins”.
21. PacifiChem, Honolulu, HI, December 2015. Title: “Developing a chemoenzymatic method to prepare heparins”.
22. Biochemical Society Focused Meeting/Carbohydrate active enzymes in medicine and biotechnology, August 19-21, University of St. Andrews, UK. Title: “Chemoenzymatic synthesis of heparins”.
23. University of Liverpool, August 2015. Title: “Chemoenzymatic synthesis of low-molecular weight heparins.”
24. University of Georgia, April 2015. Title: “Development of carbohydrate-based medicines”.
25. Blood Research Institute, Milwaukee, WI, April 2015. Title: “Chemoenzymatic design of low-molecular weight heparins”.
26. Consortium for Functional Glycomics, May 2014. “Developing a chemoenzymatic approach to prepare heparan sulfate”, Washington DC.

27. 3<sup>rd</sup> Multistep enzyme catalyzed processes congress, Madrid, Spain, April 2014. Title: "Chemoenzymatic synthesis of low-molecular weight heparins".
28. American Chemical Society/Carbohydrate Chemistry Division annual meeting, Dallas, TX, March 2014. Title: "Chemoenzymatic synthesis of low-molecular weight heparins".
29. 21<sup>st</sup> Symposium on glycosaminoglycans, Lovenno, Lake Como, Italy, September 2013. "Design of homogeneous low-molecular heparin with reversible anticoagulant activity".
30. The 17<sup>th</sup> European Carbohydrate Symposium, Tel-Aviv, Israel, July 7-11, 2013. Title: "Rationale Design of Homogeneous Low-molecular Weight Heparin".
31. 2013 International Symposium on Chemical Glycobiology, Shanghai, China, June 29<sup>th</sup> to July 1<sup>st</sup>, 2013. "Rationale design of homogeneous low molecular weight heparins".
32. Glyco22, Dalian, China, June 22<sup>nd</sup> to 28<sup>th</sup>, 2013. "Enzymatic synthesis of heparin and heparan sulfate".
33. 20<sup>th</sup> Symposium on glycosaminoglycans, Lovenno, Lake Como, Italy, September 2012. "Uncovering the control mechanism for the enzymatic synthesis of heparin".
34. Ocean University of China, Qingdao, China, June 2012. Title: "Chemoenzymatic synthesis of heparin".
35. Georgia State University, Atlanta, GA, November 2011. Title: "An enzymatic approach to synthesize heparan sulfate glycome".
36. 19<sup>th</sup> Symposium on Glycosaminoglycans, Lovenno, Lake Como, Italy, September 2011. Title: "Enzymatic synthesis of heparin and heparan sulfate".
37. 7<sup>th</sup> Canadian National Carbohydrate Symposium, Banff, Canada, May 2011. Title: "Enzymatic synthesis of heparin and ultra-low molecular weight heparins".
38. 9<sup>th</sup> Carbohydrate Bioengineering Meeting (Keynote speaker), Lisbon, Portugal, May, 2011. "Enzymatic synthesis of heparin and ultra-low molecular weight heparins".
39. University of Alabama, Birmingham, AL, January 2011. Title: "Developing a chemoenzymatic approach to synthesize heparan sulfate".
40. Academia Sinica, Taiwan, December 2010. Title: "Enzymatic synthesis of heparin and heparan sulfate".
41. American Chemical Society/Carbohydrate Chemistry Division annual meeting, Boston, MA, August 2010. Title: "Developing an enzymatic approach to synthesize heparan sulfate".
42. International Carbohydrate Symposium Satellite meeting, Taipei, Taiwan, July 2010. Title: "Developing an enzymatic approach to synthesize heparan sulfate oligosaccharides".
43. Shandong University, Jinan, China, September, 2009. Title: "An enzymatic approach to synthesize heparin".
44. Jiangnan University, Wuxi, China, April 2009. Title: "Developing an enzymatic approach to synthesize polysaccharide-based therapeutics".
45. University of Georgia, Athens, GA, September, 2008. Title: "Enzymatic synthesis of heparan sulfate".
46. Chinese Glycobiology conference, Jinan, China, July, 2008. Title: "Developing an enzymatic approach to synthesize heparin-based drugs". (Keynote speaker)
47. University of California at Davis, Davis, CA, April, 2008. Title: "An enzymatic approach to design polysaccharides drugs".
48. University of Toledo, Toledo, OH, March, 2008. Title: "Using a glycomics approach to develop polysaccharide-based drugs".
49. National Institute of Environmental Health Sciences, LSB retreat, September, 2007. Title: "Using a glycomics approach to develop polysaccharide-based drugs".

50. Tsinghua University, Taiwan, April, 2007. Title: "An enzymatic approach to synthesize heparan sulfate with specific functions".
51. Ohio State University, Columbus, Ohio, October 2006. Title: "Enzymatic synthesis of anticoagulant heparan sulfate".
52. University of Illinois at Chicago, Chicago, Illinois, September 2006. Title: "Heparan sulfate: The roles in regulating blood coagulation and assisting viral infections".
53. University of Iowa, Iowa City, IA, February 2006. Title: "Enzymatic synthesis of anticoagulant drugs".
54. University of Illinois at Chicago, Chicago, Illinois, September 2004. Title: "Investigation of the structural and functional relationship of heparan sulfate".
55. University of Arkansas, Little Rock, Arkansas, April 2004. Title: "The biological functions and the fine structures of heparan sulfate".
56. Rensselaer Polytechnic Institute, Troy, New York, October 2003. Title: "Heparan sulfate: from an anticoagulant to a viral receptor".
57. Georgia State University, Atlanta, Georgia, October 2003. Title: "Cell surface heparan sulfate: from an anticoagulant to a viral receptor."
58. Virginia Commonwealth University, Richmond, Virginia, May 2002. Title "Specificity of heparan sulfate in assisting herpes simplex viral infection".
59. American Association for Pharmaceutical Sciences, Denver, Colorado, October 2001. Title "Heparan sulfate: a potential new receptor for gene delivery".
60. National Institute of Environmental Health Science, Research Triangle Park, April 2001. Title "The role of heparan sulfate in assisting viral infections".

### ***Oral Presentations at Professional Meetings***

1. 244<sup>th</sup> American Chemical Society National Meeting, Philadelphia, PA, Aug 2012. Title: "Uncovering a biphasic catalytic mode of C<sub>5</sub>-epimerase for the biosynthesis of heparan sulfate".
2. US Pharmacopeia 5<sup>th</sup> Workshop on the characterization of heparin products, Rockville, MD, Aug 2012. Title: "Chemoenzymatic synthesis of homogeneous ultra-low molecular weight heparins".
3. Annual meeting for the Society for Industrial Microbiology, Washington, DC, Aug 2012. Title: "Chemoenzymatic synthesis of homogeneous ultra-low and low molecular weight heparins".
4. Proteoglycan Gordon Conference, Andover, NH, July 2012. Title: Understanding the control mechanism for the enzymatic synthesis of heparin.
5. 2<sup>nd</sup> International Conference on Drug Discovery & Therapy, Dubai, UAE, February, 2010. Title: "An enzymatic approach to synthesize heparin".
6. Carbohydrates Gordon Conference, Tilton, NH, June 2009. Title: "Enzymatic synthesis of heparan sulfate and heparin".
7. 67<sup>th</sup> Harden Conference, Cambridge, UK, March 2009. Title: "Developing an enzymatic approach to synthesize heparan sulfate".
8. Glycobiology Gordon Conference, Ventura, CA, January 2009. Title: "Engineering sulfotransferases to modify heparan sulfate".
9. Ehrlich II International Conference, Nuremberg, Germany, October 2008. Title: An enzymatic approach for developing heparan sulfate-based drugs".

10. Rensselaer Nanotechnology in Glycomics Symposium, Troy, NY, July 2008. Title: “Enzymatic synthesis of heparan sulfate and heparin”.
11. Carbohydrate Gordon Conference, Tilton, NH, July 2007. Title: “Engineering the specificity of sulfotransferases to synthesize specific heparan sulfate structures”.
12. Rensselaer Glycomics Symposium, Albany, NY, July 2006. Title: “Enzymatic synthesis of heparan sulfate.”
13. International Carbohydrate Symposium, Whistler, BC, July 2006. Title: “Enzymatically redesigning of biologically active heparan sulfate.”
14. Proteoglycan Gordon Conference, Andover, NH, July 2004. Title: “Crystal structure and mutational analysis of heparan sulfate 3-*O*-sulfotransferase isoform 1”.
15. Proteoglycan Gordon Conference, Andover, NH, July 2002. Title: “Heparan sulfate 3-*O*-sulfotransferase isoform 5 generates both an antithrombin-binding site and an entry receptor for herpes simplex virus-1”.

### Previous and Current Fellows/Trainees

Total number of pre-doctoral and post-doctoral individuals sponsored *in the past* = **22**

1. **J. Chen, PhD** (postdoctoral fellow, 2001-2005) is now a professor at Jiangnan University, China.
2. **S. C. Edavettal, PhD** (PhD graduate student, 2000-2004) is now a senior scientist at Merck Inc., West Point, PA.
3. **M.B. Duncan, PhD** (PhD graduate student, 2001-2006) is now an assistant professor of medicine at the Medical College of Georgia, Augusta, GA.
4. **R. Copeland, PhD** (PhD graduate student, 2001-2006) is now a postdoc at Johns Hopkins University, Baltimore, MD.
5. **D. Xu, PhD** (PhD graduate student, 2002– 2006) is now an assistant professor at the State University of New York at Buffalo. Dr. Xu was supported by a predoctoral fellowship from American Heart Association, MidAtlantic Affiliate.
6. **M. Chen, PhD** (PhD graduate student, 2003-2008) is now a biostatistician at Yahoo, Co, CA.
7. **T. Burch, PhD** (PhD graduate student, 2002-2008) is now a postdoctoral fellow at Eastern Medical College of Virginia, VA.
8. **Renpeng Liu, PhD** (PhD graduate student, 2004 -2010) is a postdoctoral fellow New England BioLab, MA.
9. **Heather Bethea, PhD** (PhD graduate student, 2004-2010) is now a postdoctoral fellow at the University of North Carolina.
10. **Courtney Jones** (PhD graduate student, 2004 to 2011) is now a postdoctoral fellow at North Carolina Central University.
11. **Sherket Peterson** (PhD graduate student, 2007 to 2012) is now a postdoctoral fellow at Johns Hopkins University. Dr. Peterson was supported by predoctoral fellowship of Ruth L. Kirschstein Individual National Research Service Award from National Institutes of Health (F31GM090647).
12. **Kai Li** (Post-doctoral fellow, 2009 to 2011) is now a scientist at North Carolina State University.
13. **Xianxuan Zhou** (Post-doctoral fellow, 2009 to 2012) is a professor in the College of Biotechnology and Food Engineering, Hefei University of Technology, China
14. **Juzheng Sheng** (Post-doctoral fellow, 2009 to 2012) is an associate professor in the College of Pharmacy, Shandong University, China.

15. **Ryan Bullis** (PhD student, 2008 to 2013) is current a postdoctoral fellow at the University of North Carolina.
16. **Elizabeth Pempe** (PhD student, 2009 to 2013) is now a postdoctoral fellow at the University of North Carolina. Dr. Pempe was supported by predoctoral fellowship of Ruth L. Kirschstein Individual National Research Service Award from National Institutes of Health grant (F31AG040927-01) till 2014.
17. **Chunhui Liu, PhD** (Visiting Scholar, 2011 to 2013) is now an associate professor at Shandon University, China.
18. **Kasemsiri Chandarajoti** (PhD student, 2009 to 2014) is now a postdoctoral fellow at the University of North Carolina. Dr. Chandorajoti was supported by a predoctoral fellowship from Thai government till 2014.
19. **Shuqin Xu, PhD** (Postdoctoral fellow, 2013-2014) is now an assistant professor at Jiangnan University, China.
20. **Wenfang Duo, PhD** (Postdoctoral fellow, 2013-2015) is now an associate professor at Jiangnan University, China.
21. **Vijay Pagadala, PhD** (Postdoctoral fellow, 2013-2015) is now a principal scientist at Glycan Therapeutics, LLC, USA.
22. **Wen Zhou, PhD** (Postdoctoral fellow, 2012-2014) is now an associate professor at Shanghai Jiaotong University, China.
23. **Tim O'Leary, PHD** (graduate student, 2010-2020) is now am postdoctoral research associate Scripps Research Institute, Florida
24. **Po-Hung Hsieh** (graduate student, 2011 to 2016) is now a research fellow in clinic chemistry at the University of Chicago.
25. **Zhengjie Wang** (visiting scholar, 2015-present) is now a postdoctoral fellow at the University of North Carolina.
26. **Susan Woody** (Pharm D/MS student, 2011-present) is now a student of Medical School, East Carolina University.
27. **Jianhong Yang** (visiting scholar, 2015-present) is now an associate professor of Changchow University, China.
28. **Wei Liu** (visiting Scholar, 2016-2017) is now an associate professor of China Pharmaceutical University, China.
29. **Evangeline Chai** (visiting pharmacy student from University College of London, UK, 2016) is now a Pre-Registration Pharmacist at Sengkang Health, Singapore.
30. **Sonja Pocek** (visiting pharmacy student from University of Belgrade, Serbia, 2016) is now a Master of Pharmacy at Special hospital SVETI VID, Serbia.
31. **Lin Yi** (visiting scholar 2018-2020, from Soochow University, China) is now a lecturer at Soochow University.
32. **Hongtao Zhang** (visiting scholar, 2018-2019 from Jiangnan University, China) is now an associate professor as Jiangnan University.
31. **Guowei Su** (postdoctoral fellow, 2016-2020) is now a principal scientist at Glycan Therapeutics, LLC, USA.
32. **Truong Pham** (Technician, 2009-2020) is now a protein specialist at Glycan Therapeutics, LLC. USA.
33. **Jin Yan** (undergraduate research assistant, 2018-2020) is now a graduate student at University of California at Santa Barbara.
34. **Yiyun Pan** (undergraduate research assistant, 2017-2019) is now a research assistant at Harvard University.
35. **Maurice Horton**, PhD (graduate student, 2017-2020)

Total number lab members *currently* supported = **10**

1. **Yongmei Xu, PhD** (Research associate professor, 2019 - present).
2. **Katelyn Arnold** (research assistant professor, 2020-present).
3. **Jine Li** (research assistant professor, 2019-present).
4. **Maulik Patel** (pharmacy student, 2017-present).
5. **Vijay Dhurandhare** (postdoctoral fellow, 2018-present).
6. **Zhangjie Wang** (postdoctoral fellow, 2019-present)
7. **Rylee Wonder** (graduate student, 2018-present)
8. **Yien Liao** (graduate student, 2019-present)
9. **Hannah Myatt** (undergraduate student, 2020-present)
10. **Eduardo Stancanelli** (postdoctoral fellow, 2020-present)