Curriculum Vitae

Date last update: 14/10/2024

Personal Information

Name	**Bin Liu**
Birth	October 2, 1991 (China)
Address	Room 202, Building 6, Key Laboratory of Environmental Biotechnology Research Centre for Eco-Environmental Sciences Chinese Academy of Sciences Shuangqing 18, Haidian District, 100085, Beijing, China
Email	binliu(at)rcees.ac.cn or 6303997(at)gmail.com
Tel	+86 13259816398
Web	home page

University Education

Ph.D. in Microbiology (*Magna cum laude*, with great honors)

10/2016 – 10/2020 Helmholtz Centre for Environmental Research – UFZ, Leipzig
in cooperation with Deutsches Biomasseforschungszentrum (DBFZ)
Department of Environmental Microbiology
Group Microbiology of Anaerobic Systems
PhD thesis: Applied microbial ecology of anaerobic reactor microbiomes
Advisors: Prof. Hauke Harms, Dr. Sabine Kleinsteuber and Dr. Heike Sträuber

M.S. Science in Agronomy (Final grade with distinction: 3.8/4.0)

09/2014 – 06/2016 China Agricultural University, Beijing
College of Agronomy and Biotechnology
Topic 1: Microbial community dynamics during composting of biogas residues
Topic 2: Anaerobic digestion of lignocellulose and dynamics in reactor microbiomes
Advisor: Prof. Zongjun Cui

B.S. Environmental Sciences and Business Administration (Double degree)

09/2010 – 06/2014 China Agricultural University, Beijing
College of Resources and Environmental Sciences
College of Economics and Management
Advisor: Prof. Yahai Lu

09/2009 – 06/2010 College of Science
Major: Engineering Mechanics

Research Positions

Assistant Professor

04/2024 – Key Laboratory of Environmental Biotechnology, Research Centre for Eco-Environmental Sciences, CAS, China

ERC-funded Postdoctoral Fellow

03/2021 – 03/2024 Rega Institute for Medical Research, KU Leuven, Belgium
Topic 1: How does spatial structure in the form of mucin microbeads alter interaction dynamics of a defined human gut bacterial community
Advisor: Prof. Karoline Faust
Collaborators: Faust Lab (Daniel Garza, Anna Krzynowek), Didier Gonze (Université Libre de Bruxelles, Belgium), Annelies Geirnaert (ETH Zurich, Switzerland), Raes Lab, KU Leuven (Emma Hernandez-Sanabria, Jeroen Raes)
Topic 2: Using microfluidic systems to study the role of spatial heterogeneity on commensal gut bacterial fitness
Collaborators: Ma Lab, Zhejiang University, China (Hengyi Dai, Bin Ma)
Topic 3: Characterizing the fast and slow growth modes of *Roseburia intestinalis*
Collaborators: Govers Lab, KU Leuven (Sander Govers, Kaat Sondervorst)

Research Associate

10/2020 – 03/2021 Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany
Topic: Microbial community dynamics in anaerobic chain elongation systems
Advisor: Dr. Sabine Kleinsteuber
Collaborators: Ulisses Nunes da Rocha (UFZ); Lars Angenent (Uni. Tübingen, Germany), Florian Centler (Uni. Siegen, Germany), Denny Popp (Uni. Leipzig, Germany), Fan Lyu (Uni. Tongji, China), Jonas Kasmanas (Uni. São Paulo, Brazil), Shiladitya Ghosh (Jadavpur University, India)

Funding

- 100-talent program of Chinese Academy of Sciences, 1.5 million CNY, project leader
- European Research Council (ERC), European Union's Horizon 2020, 801747, Ecosystem in a box: Dissecting the dynamics of a defined microbial community in vitro, 2019 – now, 1.5 Million Euros, sub-project leader (200K Euros)
- Helmholtz Association, Germany, VH-NG-1248, Micro 'Big Data': Mining Microbial Functional Hotspots in Terrestrial Environments, 2018 – 2023, 1.8 Million Euros, participant
- Research Foundation-Flanders (FWO), Belgium, FWO cooperation project, NSFC-FWO (China-Belgium), VS01021N, Role of spatial scaling on competitive co-occurrence in the microbiome, 2021.01 – 2022.12, 50K CNY, project leader
- China Scholarship Council, PhD project, 01606350010, Applied Microbial Ecology of Anaerobic Reactor Microbiomes, 2016 – 2020, 450K CNY, project leader

Fellowships and Awards

- 2021-2024 ERC Grant (EcoBox project) for Postdoctoral Position

- 2022 NSFC – FWO Mobility Project (China-Belgium), Project leader
- 2016 CSC Fellowship, Chinese Government (four years of stipend funding)
- 2014 University Award: first prize scholarship
- 2010 University Award: second prize scholarship

Supervision Activity

Co-supervision of PhD student

- Eliseo Molina (visiting student, Institute of Biotechnology-UNAM, Mexico)
  Topic: Design and construct UnaG/IFGP2.0-tagged *Bacteroides* strains
- Tinh Van Nguyen (KU Leuven, supervised by Prof. Dirk Springael and Prof. Karoline Faust)
  Topic: Thermophilic microbial chain elongation for *n*-caproate from polymeric carbohydrates

Co-supervision of Master and Bachelor students

- Gerits Gertjan (KU Leuven, supervised by Prof. Kristel Bernaerts and Prof. Karoline Faust)
  Topic: Understanding the growth kinetics of the human gut acetogen *Blautia hydrogenotrophica*
- Linglong Yu (Uni Tübingen, supervised by Prof. Lars Angenent and Dr. Heike Sträuber)
  Topic: Producing medium-chain carboxylates from varying substrate mixtures of xylan and lactate
- Anamarija Ridl (Erasmus student from Croatia, supervised by Dr. Heike Sträuber)
  Topic: Enriching microbial chain-elongating species from bioreactors operated with corn silage

Research Interests

My research focuses on the ecology and physiology of bacterial communities in anaerobic systems, such as the human gut and anaerobic digesters. My passion with community ecology is to understand how species interactions at different scales of biological complexity combine to generate collective behaviors. I am also interested in understanding the mechanisms of bacterial growth and response to stress, which holds the potential to predict and further control bacterial communities.

Journal Publications

Postdoctoral work: synthetic ecology of the human gut microbiota

1. **Liu, B.**, Garza, D.R., Saha, P., Zhou, X. and Faust, K (2024). Exploiting gut microbial traits and trade-offs in microbiome-based therapeutics. Nature Reviews Bioengineering, Vol. 2, pp. 364–366.

2. **Liu, B.#**, Garza, D.R.#, Gonze, D., Krzynowek, A., Simoens, K., Bernaerts, K., Geirnaert, A. and Faust, K. (2023). Starvation responses impact interaction dynamics of human gut bacteria *Bacteroides thetaiotaomicron* and *Roseburia intestinalis*. *ISME J,* Vol. 17, pp. 1940–1952.
   We built an *in vitro* system with mucin beads and two representative human gut bacteria, which allowed us to explore how nutrient levels and pH affect their physiology and interactions. We showed how the resulting complex dynamics can be resolved through the innovative use of flow cytometry, transcriptomics, and mathematical modelling.

3. Garza, D.R.#, **Liu, B.#**, van de Velde, C., Gonze, D., Bernaerts, K. and Faust, K. (2024). Flexible metabolic strategies lead to alternative community types in a synthetic human gut community. Submitted to *Science* (# contributed equally)

We investigated responses to the variation in microbial communities and gut environment for representative species of different trophic layers in the gut microbiome, and showed that these species have flexible metabolic strategies, which lead to alternative community types *in vitro*.

4. **Liu, B.**, Sondervorst, K., Govers, S. and Faust, K. (2024). Distinct cell biological response to nutrient depletion in human gut bacteria *Bacteroides thetaiotaomicron* and *Roseburia intestinalis*. *Submitted.*

5. **Liu, B.**, Dai, H., Centler, F., Ma, B. and Faust, K. (2024). Role of spatial heterogeneity on commensal gut bacteria fitness. *in prep.*

6. Garza, D.R., Gonze, D., Zafeiropoulos, H., **Liu, B.** and Faust, K. (2023). Metabolic models of human gut microbiota: advances and challenges. *Cell Systems*, Vol. 14, pp. 109–121.

7. Nguyen,T.V., Viver, T., Mortier, T., **Liu, B.**, Smets, I., Bernaerts, K., Faust, K., Lavigne, R., Poughon, L., Dussap, C.G. and Springael, D. (2022). Isolation and characterization of a thermophilic chain elongating bacterium that produces the high commodity chemical *n*-caproate from polymeric carbohydrates. *Bioresource Technology*, Vol. 367, No. 128170.

PhD work: microbial chain elongation for the production of medium-chain carboxylates

1. **Liu, B.**, Sträuber, H., Saravia, J.P., Harms, H., Sandra, G.S., Kasmanas, J.C., Kleinsteuber, S. and da Rocha, U.N. (2022). Machine learning-assisted identification of bioindicators predicts medium-chain carboxylate production performance of an anaerobic mixed culture. *Microbiome* Vol. 10, No. 48.
We developed a machine learning framework to quantitatively predict ecophysiological functions of microbial chain elongation communities. This work was highlighted by UFZ as a press released.

2. **Liu, B.**, Sträuber, H., Centler, F., Harms, H., da Rocha, U.N. and Kleinsteuber, S. (2023). Functional redundancy secures resilience of chain elongation communities upon pH shifts in closed bioreactor ecosystems. *Environmental Science & Technology* Vol. 57, pp. 18350–18361.
We highlighted that naturally enriched communities are robust and resilient toward perturbations due to their functional redundancy in a lactate-based microbial chain elongation system.

3. **Liu, B.**, Popp, D., Müller, N., Sträuber, H., Harms, H. and Kleinsteuber, S. (2020). Three novel *Clostridia* isolates produce *n*-caproate and *iso*-butyrate from lactate: comparative genomics of chain-elongating bacteria. *Microorganisms* Vol. 8, No. 1970.
After more than 700 days of enrichment, we were the first to report three novel chain-elongating strains of *Clostridia* that produce *n*-caproate and *iso*-butyrate from lactate.

4. **Liu, B.**, Popp, D., Sträuber, H., Harms, H. and Kleinsteuber, S. (2020). Draft genome sequences of three *Clostridia* isolates involved in lactate-based chain elongation. *Microbiology Resource Announcements* Vol. 9, No. e00679-20.
We built up a genome-assembly working pipeline and reported the high-quality genomes of our three novel isolates by combining Nanopore long-read with Illumina short-read sequencing.

5. **Liu, B.**, Kleinsteuber, S., Centler, F., Harms, H. and Sträuber, H. (2020). Competition between butyrate fermenters and chain-elongating bacteria limits the efficiency of medium-chain carboxylate production. *Frontiers in Microbiology*, Vol. 11, No. 336.
During long-term reactor operation under constant conditions, we found out that chain-elongating bacteria were outcompeted by butyrate-producing bacteria in a continuous bioreactor system.

6. Lian, S., Nikolausz, M., Nijenhuis, I., da Rocha, U. N., **Liu, B.**, Corrêa, F.B., Saraiva, J.P. and Richnow, H.H. (2020). Biotransformation of hexachlorocyclohexanes contaminated biomass for energetic utilization demonstrated in continuous anaerobic digestion system. *Journal of Hazardous Materials*, Vol. 384, No. 121448.

7. Ghosh, S., Baleeiro, F.C.F., **Liu, B.**, Chowdhury, R., Kleinsteuber S. and Sträuber, H. (2023). Enhancement of butanol production by *Clostridium acetobutylicum* through the reinforcement of butyric acid flux *in situ* by synergistically grown *Clostridium tyrobutyricum*: experiments and mathematical modeling. *in submission*

8. **Liu, B.**, Popp, D., Sträuber, H., Harms, H. and Kleinsteuber, S. Metagenome-assembled genomes of anaerobic microbiota provide insights into the ecophysiology of lactate-based chain elongation. *in prep.*

Other publications:

1. Yu, J., Liang, Y., Zhao, L., Yao, Z., **Liu, B.**, Yuan, X., Du, Y., Feng, J., Cui, Z. (2024). Improving hydrolysis and acidification by regulating the oxygen status and solid content of lignocellulosic waste: Emphasis on the unsealed environment and harnessing the potential of microbial communities. *Chemical Engineering Journal*, Vol. 499, No. 156073.

2. Meng, X. #, **Liu, B. #**, Zhang, H., Wu, J., Yuan, X. and Cui Z. (2019). Co-composting of the biogas residues and spent mushroom substrate: physicochemical properties and maturity assessment. *Bioresource Technology*, Vol. 276, pp. 281–287. (# these authors contributed equally)

3. Meng, X., **Liu, B.**, Chen X., Luo, X., Yuan, X., Wang, X., Zhu, W., Wang, H. and Cui, Z. (2018). Effect of pig manure on the chemical composition and microbial diversity during co-composting with spent mushroom substrate and rice husks. *Bioresource Technology*, Vol. 251, pp. 22-30. (highly-cited)

4. Yu, J., Zhao, Y., **Liu, B.**, Zhao, Y., Wu, J., Yuan, X., Zhu, W. and Cui, Z. (2016). Accelerated acidification by inoculation with a microbial consortia in a complex open environment. *Bioresource Technology*, Vol. 216, pp. 294–301.

5. Hua, B., Dai, J., **Liu, B.**, Zhang, H., Yuan, X., Wang, X. and Cui. Z. (2016). Pretreatment of non-sterile, rotted silage maize straw by the microbial community MC1 increases biogas production. *Bioresource Technology*, Vol. 216, pp. 699–705.

6. **Liu, B.**, Han, Y., Yuan, X., Zhu, W., Wang, X. and Cui. Z. (2016). Effects of five fungal chaff pretreatment methods on substrate properties and growth of rice seedlings. *Scientia Agricultura Sinica*, Vol. 49, No. 16, pp. 3098-3107. (in Chinese)

Invited Conference/Workshop Presentations

- 09/2023, EMBL Symposium, The human microbiome, Heidelberg, Germany (poster)
- 02/2023, "Therapeutic Promise of the Microbiome: The 2022 Dr. Paul Janssen Award Symposium", organized by The New York Academy of Sciences – virtual. (invited participant)
- 08/2022, "Impact of mucus beads on the growth dynamics of *Bacteroides thetaiotaomicron*", 18th

International Symposium on Microbial Ecology (ISME18), Lausanne, Switzerland (poster pitch)

- 05/2022, "Synthetic ecology of the human gut microbiota", the 1st Europe-China Eco-Environmental Forum for Young Scholars – virtual. (invited speaker)
- 11/2021, The ASM Ambassador program represents: early career flash talks, online. (judging panel)
- 10/2020, "Machine learning-assisted identification of bioindicators predicts medium-chain carboxylate production performance of an anaerobic mixed culture", International Chain Elongation Conference 2020 – virtual, organized by Wageningen University & Research. (oral presentation)
- 03/2020, "Lactate-based microbial chain elongation for *n*-caproate production: genomic and metabolic features of three novel *Clostridiales* isolates", 6th Joint Conference of the DGHM & VAAM, Leipzig, Germany. (poster)
- 07/2019, "Resilience of chain-elongating reactor microbiota upon temperature perturbation", International Workshop on Valorization of Agricultural Residues via Anaerobic Digestion: from Biogas to Carboxylates, DBFZ, Leipzig, Germany. (oral presentation)
- 06/2019, "Resilience of chain-elongating reactor microbiota upon temperature perturbation", 16th IWA World Congress on Anaerobic Digestion, Delft, the Netherlands. (oral presentation)
- 05/2019, "The best bet to boost reactor microbiomes not being lazy", 31st Chinese-German Chemical Association Annual Conference, Leipzig, Germany. (poster)
- 08/2018, "Dynamics of a chain-elongating reactor microbiome producing medium-chain fatty acids from lactic acid and xylan", 17th International Symposium on Microbial Ecology (ISME17), Leipzig, Germany. (poster)
- 06/2018, "Chain elongation with lactate producing medium-chain carboxylates by a semi-continuously fed anaerobic reactor microbiome", the 2nd International Conference on Anaerobic Digestion Technology, Chiangmai, Thailand. (oral presentation)
- 04/2018, "Dynamics of a chain elongating reactor microbiome producing medium-chain carboxylates", Annual Conference of the Association for General and Applied Microbiology 2018, Wolfsburg, Germany. (poster)
- 10/2017, "Chain elongation with lactate producing medium-chain carboxylates by a semi-continuously fed anaerobic reactor microbiome", 2017 Biotechnology Symposium – Innovative Molecular Compounds, Leipzig University (BIOCITY), Germany. (poster)

Seminars and Lectures

- 09/2023, "Summer School: Design and Control of Microbial Communities", Leuven, Belgium
- 11/2021, "Summer School on Microbial Time Series Analysis", Leuven, Belgium
- 07/2020, "pH determines biodiversity and performance in chain elongation microbial communities within temporal dynamics", department seminar, UFZ, Germany.
- 05/2019, "Keeping the reactor microbiome out of the comfort zone: how the dilution rate steers medium-chain carboxylic acid production", department seminar, UFZ, Germany.
- 01/2019, "Chain elongation with lactate producing medium-chain carboxylates", Fudan University, Shanghai, China.
- 05/2018, "Gas Fermentation – DECHEMA", Frankfurt, Germany.
- 01/2018, "Chain elongation with lactate producing medium-chain carboxylates by a semi-continuously fed anaerobic reactor microbiome", department seminar, UFZ, Germany.
- 01/2017, "Applied microbial ecology of anaerobic reactor microbiomes", department seminar, UFZ, Germany.
- 08/2015, "General knowledge of biogas science", Lecture for Clean Energy Program in Developing Countries (30 hours), Zhuozhou, Hebei province, China.

Methods

- Isolation, enrichment and cultivation of anaerobic microorganisms
- T-RFLP, qPCR, Sanger sequencing, Illumina Miseq sequencing, Nanopore sequencing
- 16S rRNA amplicon sequencing, metagenomic sequencing and RNA-seq analysis
- Prokaryotic genome mining for functional genes
- Flow cytometry
- Microscopy (confocal; fluorescence)
- Metabolomics: UPLC, HPLC, GC
- Intermediate level in R (statistics, visualization)
- Other programming languages: Python, C, C++ , MATLAB and bash (basic knowledge)
- Machine learning, statistical and kinetic modelling (beginner)

Reviewing activities

I have reviewed eight articles from journals of ISME J, Microbiology spectrum, Microorganisms etc.

Professional Activities

Association for General and Applied Microbiology (VAAM, Germany), 2017 to present, member

Federation Of European Microbiological Societies (FEMS), 2017 to present, member

the International Society for Microbial Ecology (ISME), 2021 to present, member

Early career editorial board member, Resources, Environment and Sustainability

References

1. Karoline Faust, PhD (Postdoc supervisor)
   Organization: Rega Institute for Medical Research, KU Leuven
   Position: Head of Lab of Microbial Systems Biology
   Role: Senior editor at ISME J., editor at mSystems
   Email: karoline.faust@kuleuven.be
   Telephone: +32 16-322698

2. Hauke Harms, PhD (PhD supervisor)
   Organization: Helmholtz Centre for Environmental Research – UFZ
   Position: Head of the Research Unit Environmental Engineering and Biotechnology
   Head of Department of Environmental Microbiology
   Chairman of the Scientific Advisory Board of the Max-Planck-Institute for Marine Microbiology
   Member of the Supervisory Board of DSMZ
   Email: hauke.harms@ufz.de
   Telephone: +49 341 235-1260

3. Sabine Kleinsteuber, PhD (PhD supervisor)
   Organization: Helmholtz Centre for Environmental Research – UFZ
   Position: Head of Microbiology of Anaerobic Systems Group
   Email: sabine.kleinsteuber@ufz.de
   Telephone: +49 341 235-1325