

University of Groningen

Biochemical characterization of β -galactosidases and engineering of their product specificity

Yin, Huifang

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2017

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Yin, H. (2017). *Biochemical characterization of β -galactosidases and engineering of their product specificity*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Acknowledgements

Looking back to the days that I spent in the Netherlands, I found that I have deeply fallen in love with this flat country. In the past four years, I enjoyed myself with the stunning tulip fields many times, the beautiful islands, and the quiet, peaceful countryside. Most importantly, I have met so many wonderful and friendly people who made my life so joyful and encouraged me to continue my research and pursue my dreams. I appreciate all the help they provided to me, and I would like to express my gratitude to them.

First of all, I would like to give my sincerely gratitude to my promotor, Prof. Lubbert Dijkhuizen. Thank you very much for giving me this opportunity to work in the Microbial Physiology group. I was so confused after the first year of my PhD, had lost confidence in myself, and had no idea about my future. At this very moment, Prof. Lubbert Dijkhuizen gave me the opportunity to work in his group, and let me choose the topics by myself. He always encouraged me to be independent in research and pursue my dreams bravely, and to be strong in life. I enjoyed all the inspired work discussions with him. I was deeply touched by his intelligence, kindness, and enthusiasm. I appreciate all his kind guidance and support to my PhD. The memory is unforgettable and I will cherish forever.

I would like to give my appreciation to my co-promotor Dr. Sander S. van Leeuwen. You are very friendly and really helpful to me, and I cannot finish my PhD without your help. Thanks for all the help with the structural analysis of the oligosaccharides. I really enjoyed the nice discussions and guidance about the analysis of the oligosaccharide structures.

For Prof. Johannes P. Kamerling, I am truly grateful for your constructive suggestions and kind guidance to my research. I am greatly impressed by his profound knowledge and critical attitude to research.

My grateful thanks go to Dr. Tjaard Pijning. He is a very helpful collaborator and very experienced in elucidating protein structure-function relationships. His

comments on the manuscripts helped me a lot. I also would like to thank him for the design of the beautiful thesis cover.

I would like to thank the members of the reading committee Prof. D.B. Janssen, Prof. G.J. Boons, and Prof. P. de Vos, who devoted their valuable time to reading my thesis, providing comments on the thesis, and approval of the thesis for public defence.

I would like to thank Xiangfeng Meng for all the help with the mutagenesis and the inspiring discussions on research. My thanks also go to Yuxiang Bai for all the help that he provided for me.

I would like to thank Alicia Brandt for the guidance with the growth of Bifidobacteria and all the useful suggestions.

I would like to thank Hien Pham and Sebastiaan van Kessel for being very nice office mates, and providing a quiet and friendly environment in our office.

I would like to express grateful thanks to all other previous and present MicFys members: Slavko, Lara, Ana, Mirjan, Hans-Jörg, Jelle, Evelien, Rachel, Sahar, Cecile, Vincent, Laura, Joana, Tim, Markus, Rivca, Geralt, Pieter, and Ahmed. It is a great honor for me to be one of the MicFys Group. I could not make it without the great support from them. I also would like to acknowledge Lotteke, Sonja, Weronika, Raj, Franz, Ruslan, Boqun, Maria, Dirk for all the support and great time that we had for my first year of PhD.

Grateful thanks go to our secretaries Bea, and Anmara for their very kind help. I would also like to give my thanks to Engel Vrieling for his help in the registration and providing me with helpful suggestions.

Thank Yuxiang, Xiangfeng, Hien, Markus, and Rivca for all the leisure time that we had during lunch. Thank Hien for the memorial trips with me and the great

view that we saw together. Thank my “office girls”- Lotteke, Sonja, and Weronika, for all the girl’s nights, trips, high tea, movie nights that we spent together, and made my life in Groningen so cheerful. I would like to give my thanks to my travel companions: Haiyang Wu, Chao Guo, Guangxing Zhu, Yuan Yang, and Yi Zhang. I really enjoyed the time that I spent together with you.

I would like to thank my paranymphs Hien and Markus, thank you very much for arrange all the things for me.

I also gave my great appreciation to Chinese Scholarship Council (CSC) and University of Groningen for funding me to study and doing research in the Netherlands. I also appreciate the efforts of the Education Section of Chinese Embassy in the Netherlands. I would also like to thank Prof. Lushan Wang and Prof. Guanjun Chen at Shandong University for their help during my master study.

My thanks go to my friend Min Wu, thank you very much for taking care of me and accompany me at my difficult times. You are always a loyal friend and so supportive.

My thanks also go to my friend Bin Jiang, thank you very much for the unforgettable momery and all the passion that you share with me.

I am grateful to all my Chinese friends and GBB colleagues: Qian Li, Haojie Cao, Yanglei Yi, Zhibo Li, Yanping Geng, Youtao Liu, Xuewen Zhang, Mengqiu Ge, Miao Wang, Pu Yang, Jinfeng Shao, Cunliang Geng, Jingjing Deng, Xin Zhao, Yi Zhang, Zhongzheng Bian, Peng Chen, Jing Du, Haigen Fu, Shan Ge, Chao Guo, Yukun Guo, Gang Huang, Guowei Li, Jinlan Wang, Ruiqian Li, Boqun Liu, Haifeng Liu, Qiuyan Yang, Binbin Sheng, Yuliang Sun, Tiantian Su, Xueying Liu, Rong Wang, Taojun Wang, Jing Wan, Haiyang Wu, Jiquan Wu, Yanli Wu, Gang Xiang, Ling Xiao, Zhengdao Yang, Yuan Yang, Ning Zeng, Jielin Zhang, Kaixu

Zhang, Wanli Zheng, Guangxin Zhu, Cong Duan, Qikai Guo, Ang Sha, Jiacong Wei, Chunxu Song, Lin Li, Lijuan Xing, Peiliang Zhao, Peng Wang, Lin Chen, Yanan Wang, Wei Wang, Yan Shao, Shili Chen, Bingqian Yan, Yanmei Liu, Yang Jiang. I wish all of you a bright future and good luck in life.

I especially want to thank my dearest parents, and my sister. Thank you very much for the unconditional love, support, encouragement, and understanding. I am grateful to all the other members in our big family, thank you very much for all your support.

I also would like to thank all the other people who helped me. Best wishes to all of you.

Huifang Yin

尹慧芳

University of Groningen

August 2017

Curriculum Vitae & Publications



Huifang Yin was born on 9th October 1987 in Zibo, Shandong Province, China. After obtaining the B.Sc of Life Science at Shandong University in July 2010, she continued a master study with a full scholarship at the same university, studying microbiology. She got a four-year scholarship from China Scholarship Council (CSC) in May 2013. After she obtained the M.Sc diploma in Shandong University, she went to the Netherlands for a Ph.D. study at University of Groningen since September 2013. Under the supervision of Prof. Lubbert Dijkhuizen and Dr. Sander. S. van Leeuwen, she worked on the project “Biochemical Characterization of β -Galactosidases and Engineering of Their Product Specificity”.

Publications

- [1] Yin, H., Pijning, T., Meng, X., Dijkhuizen, L. and van Leeuwen, S. S. (2017) Biochemical characterization of the functional roles of residues in the active site of the β -galactosidase from *Bacillus circulans* ATCC 31382. *Biochemistry* **56**, 3109-3118.
- [2] Yin, H., Pijning, T., Meng, X., Dijkhuizen, L. and van Leeuwen, S. S. (2017) Engineering of the *Bacillus circulans* β -galactosidase product specificity. *Biochemistry* **56**, 704-711.
- [3] Yin, H., Bultema, J. B., Dijkhuizen, L. and van Leeuwen, S. S. (2017) Reaction kinetics and galactooligosaccharide product profiles of the β -galactosidases from *Bacillus circulans*, *Kluyveromyces lactis* and *Aspergillus oryzae*. *Food Chem.* **225**, 230-238.
- [4] Meng, X., Pijning, T., Tietema, M., Dobruchowska, J. M., Yin, H., Gerwig, G. J., Kralj, S. and Dijkhuizen, L. (2017) Characterization of the glucansucrase GTF180 W1065 mutant enzymes producing polysaccharides and oligosaccharides with altered linkage composition. *Food Chem.* **217**, 81-90.
- [5] Meng, X., Pijning, T., Dobruchowska, J. M., Yin, H., Gerwig, G. J. and Dijkhuizen, L. (2016) Structural determinants of alternating ($\alpha 1 \rightarrow 4$) and ($\alpha 1 \rightarrow 6$) linkage specificity in reuteransucrase of *Lactobacillus reuteri*. *Sci. Rep.* **6**, 35261.