IBSE

Institute of
Bioprocess Science
and Engineering

Institute of Bioprocess Science and Engineering

Annual Report 2021

March 2022

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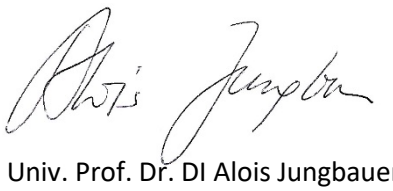
Introduction

The Institute of Bioprocess Science and Engineering (IBSE) has reached adulthood, we are now in our 3rd year and grew together. My impression is that scientists and staff identify with IBSE; they are proud to be part the of the team. This enthusiastic attitude is an important element for success. The rest of this success must be contributed by working conditions, infrastructure and management of human resource development. This is the task of the leaders of the team, but they are also constrained by external factors such as available finances, available research grants and the policy of the rectorate. In 2021 we have been evaluated by an international review panel consisting of scientists from Germany, Portugal, Sweden and the United Kingdom. Apart from the common information of hard facts on achievements in the past and future, we also had to explain the external environment in which IBSE and the team has been embedded in the past. The reviewers congratulated us on our achievements and highly appreciated the future plans with one exception. They were concerned that I have dominated the IBSE's acquiring of research grants and international network. Indeed, this might have been the view form an external evaluator. I was very active in the European Society of Bioprocess Engineering Science, as editor of Biotechnology Journal, was a member in several scientific committees of international conferences and also a frequent speaker at such events. Maybe we have forgotten to demonstrate that we have a very strong team of both young and advanced scientists with a lot of ideas and international presence. They have acquired a huge portion of research funding of IBSE. So, I am confident that IBSE has the basis to thrive and blossom further. After I have retired in 2021, Gerald Striedner and Astrid Dürauer have been appointed as head and deputy head of IBSE. They are renowned scientists in the field of bioprocess science and engineering with vast experience in team leading. IBSE is in brilliant hands and the future will tell that the concern of the reviewing board was not justified. I wish IBSE a bright future and I am convinced that it will be the organization for nurturing young talent in the field and the springboard for academia and industrial careers.



Univ. Prof. Dr. DI Alois Jungbauer
Head of the Institute of Bioprocess Science and Engineering.

Addendum to the introduction

We fully agree with Alois Jungbauer's introductory words. Our young institute has already shown its expertise in many projects, publications and presentations at international conferences. We are looking to the future optimistically and are proud to head this ambitious team of brilliant researchers. Nevertheless, things have changed and will continue to change in the future. With September 2021 Alois Jungbauer retired. The prosperous development of our institute was in large part thanks to him. Especially in the founding phase, Alois started the first activities on the institute level. He was the one who got everyone on board from the start and made a team out of us. He was the one who created a joint institute from 5 independent research groups. Anyone who knows him appreciates his indomitable optimism, his constant enthusiasm and his endless drive for innovation. All this helped to implement the new organizational unit quickly and fill it with life and motivation. Today, two years later, most of us can no longer imagine that it could be any different.

However, there are critical voices questioning how the institute would develop without Alois and this might be justified. So here are a few personal words about Alois Jungbauer.

Alois is a scientist by heart and has devoted all his energy and enthusiasm to the advancement of the field of bioprocess science and engineering; from fundamentals to application and teaching. This attitude has enabled Alois to devote himself to his tasks with almost unlimited energy and unbelievable enthusiasm. His distinct ability and pleasure in communication has certainly made a great contribution to his success here. His healthy attitude of being able to celebrate what has been achieved is a very unifying and motivating element for him and all of us and brings joy into our working world. Today, Alois can certainly be ranked among the most important and world-renowned scientists in the field. He is a role model for us and all students in the sense that for one's own development, clearly the interest in the discipline, the field of work is the key to success and should thus be the prime criterion for career selection. However, he is also a living example of the fact that brilliant professional competence is not in conflict with down-to-earthiness and joie de vivre.

Of course, we treat Alois to his well-deserved retirement, but we at IBSE are also very happy that we will be able to benefit from his expertise and network in the years to come, as he will remain active in the form of part-time employment and consultancy. With the ACIB extension application and many other activities planned, there are plenty of challenges and opportunities ahead which will benefit from his contributions.

Our goal is to continue our institute in his spirit; not only to maintain the achieved performance level but also to improve it in the interest of the students and the university.

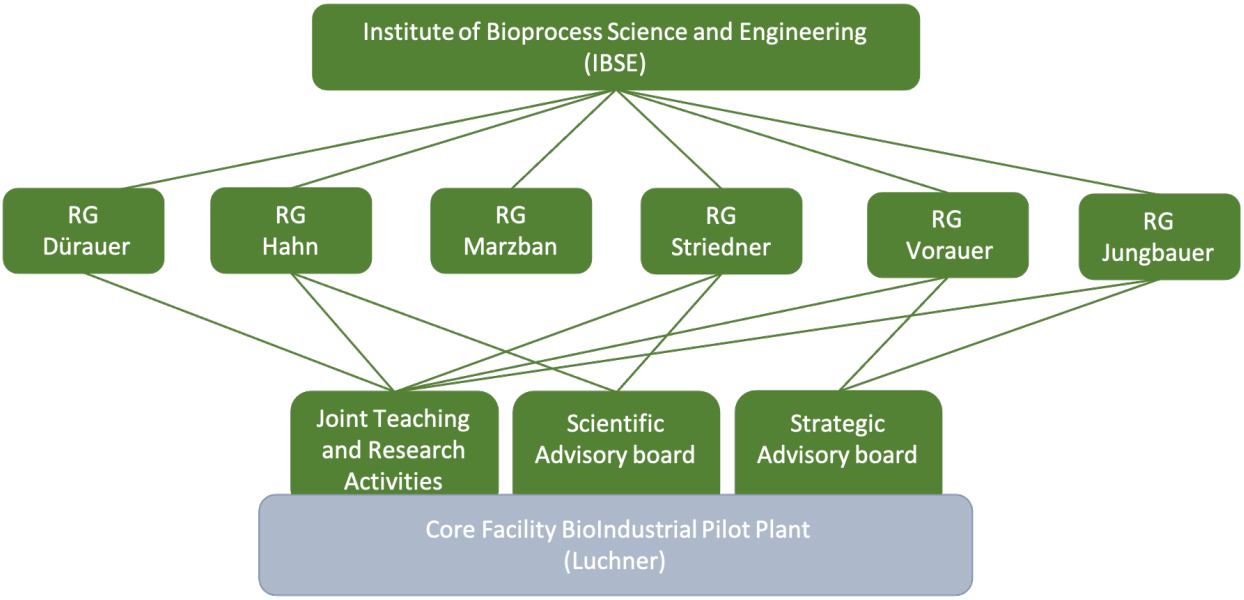
In this sense, a big thank you, Alois - for the past and the future!

Gerald Striedner

Astrid Dürauer

On behalf of the entire IBSE Team

Structure of the *Institute of Bioprocess Science and Engineering* 2021



Members of the Research Groups 2021

RG Dürauer			
Staff	**PhD student**	**BA/MA student, intern**	**Technician**
Astrid Dürauer Rupert Tscheließnig	Maximilian Krippl Ignacio Montes Serrano Bettina Motycka Valentina Ruocco	Tobias Kargl (MA) Dominik Kallinger (BA) Katharina Somogyi	Eva Berger Irfan Erdem

RG Hahn			
Staff	**PhD student**	**BA/MA student, intern**	**Technician/Student assistant**
Rainer Hahn	Jürgen Beck Markus Berg Nils Gehrmann Alexander Jurjevec Matthias Müller	Alejandro Santiago Leon (MA) Alexander Mechtler (MA) David Scheich (MA) Alexander Karner (BA) Timo Kalchmayr (intern)	Kerstin Holzer Vanessa Przybylowicz

RG Jungbauer			
Staff	**PhD-student**	**BA/MA student, intern**	**Technician**
Alois Jungbauer Nico Lingg Petra Steppert Patricia Pereira Aguilar	Johanna Bacher Alessandro Cataldo Anna Christler Gregory Dutra Mafalda Dos Santos Touraj Eslami Leo Jakob Daniel Komuczki Narges Lali Magdalena Pappenreiter Carme Pons Royo Gabriele Recanati Katrin Reiter Viktoria Mayer Alexander Zollner	Lena Achleitner (MA) Patrick Scheidl (MA) Gregor Stitz (BA) Markus Mozgovicz (MA)	Edit Felföldi Andreas Fischer Anna Carina Frank Magdalena Mosor Theresa Schaufler Willibald Steinfellner

RG Marzban			
Staff	**PhD student**	**BA/MA student, intern**	**Technician**
Gorji Marzban	Sonja Schürer-Waldheim		

RG Striedner			
Staff	**PhD student**	**BA/MA student, intern**	**Technician/ Student assistant**
Gerald Striedner Monika Cserjan Roger Dalmau Diaz Mark Dürkop Armin Khodaei Peter Satzer Birgit Wiltschi	Hana Hanaee Ahvaz Benjamin Bayer Natalia Danielewicz Mathias Fink Lisa Fohler Martin Gibisch Stephan Gutmann Marco Klanschnig Christoph Köppl Claudia Lacombe Florian Mayer Tommaso de Santis Florian Strobl Sophie Vazulka	Andreas Dietrich (MA) Benedikt Haslinger (MA) Karoline Reznar (BA) Florian Simon (MA) Anton Shpylovyi (MA)	Johanna Berein Ignasi Bofarull Manzano Stefan Bunka Moritz Dielacher Alexander Doleschal Emil Gerger Roman Liebhart Miriam Knees Lukas Leibetseder Rebecca-Oana Pitik Shirin Preinsperger Patrick Scheidl Christopher Tauer Johanna Trisko

RG Vorauer-Uhl			
Staff	**PhD student**	**BA/MA student, intern**	**Technician**
Karola Vorauer-Uhl	Sarah Übleis (Co-supervisor) Ehsan Suleiman Yuelang Yao	Konstanze Kastenhofer Magdalena Kößlbacher Simon Nendwich Jasmina Memic	Gabriele Lhota

Core Facility: BioIndustrial Pilot Plant			
Staff	**PhD student**	**BA/MA student, intern**	**Technician**
Markus Luchner Mathias Fink		Alina Destinger (MA) Lorenz Haider Magdalena Hohlrieder Marco Kaupe Alexander Mechtler	Sabine Necina Anita Zwanzleitner

IBSE goes YouTube

In 2021, together with Christoph Öhlknecht and his film crew of the Cloning Company (https://cloningcompany.at/) our Institute had its first YouTube appearance with introductory videos on each research field on YouTube and its homepage. Check it out!

Introducing the Institute of Bioprocess Science		https://youtu.be/aCNRDfV_uWA
Introducing Downstream Processing at IBSE	https://youtu.be/kUYZPx691qo	
Introducing Upstream Processing at IBSE		https://youtu.be/PyQFDXb-d6g
Introducing Modelling at IBSE	https://youtu.be/eSjz1TiAc40	
Introducing Bionanoparticles at IBSE		https://youtu.be/InsszD3V31o
Introducing Analytics at IBSE	https://youtu.be/h_O5dy57NPA	
Introducing the Core Facility BioIndustrial Pilot Plant at IBSE		https://youtu.be/3JFk_9wztHM

Success Stories

Early-stage Risk Assessment Strategy in continuous bioprocess development

Dominik Nendwich*, Magdalena Pappenreiter#, Bernhard Sissolak#, Karola Vorauer-Uhl*
*IBSE, Univ. of Natural Resources and Life sciences, Vienna
#Bilfinger Industrietechnik Salzburg GmbH

Production of biopharmaceuticals such as monoclonal antibodies continuously meet novel challenges in the shape of higher demand for flexibility and productivity all while maintaining the highest level of product quality and efficacy. Established production typically relies on the well-known but rigid batch structure, which is notoriously cautious with adaption. Newer technologies like integrated continuous manufacturing (iCM) are emerging but suffer from high research and development expenses.

Just recently, the ICH (International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use) endorsed the draft version Q13 - CONTINUOUS MANUFACTURING OF DRUG SUBSTANCES AND DRUG PRODUCTS -, following herewith the FDAs draft guidance on iCM which both describe scientific and regulatory considerations for the development, implementation, operation, and lifecycle management of continuous manufacturing. These guidelines show that sophisticated knowledge of process dynamics paired with a risk-based design is key to maintaining state of control in iCM. Specifically understanding how transient events propagate helps to identify risks to product quality and to develop an appropriate control strategy, as it is important to consider the characteristics of individual equipment as well as those of the integrated system that can affect process performance.[1]

According to these considerations, we designed an ICH Q9 - Quality Risk Management - compliant qualitative risk assessment process which is easily developable and convenient to support design decisions for the establishment of an iCM process. [2] The generated concept is based on convenient quality management tools, yet allowing flexibility regarding available process data. This approach enables risk identification and evaluation at early stages of process development (even before prototype production), while incorporating abstract considerations that are rarely identified in traditional process development which sufficiently supports high-quality development and therefore reduces R&D costs

At its core, the procedure follows the traditional sequence described in ICH guideline Q9 (see Figure 1). For initial risk identification, we use the qualitative Structured What-If technique (SWIFT) technique [3]. This flexible, high-level identification tool allows for generation of process related data in a brainstorming-like fashion by going through different scenarios and determining their consequences. A fault-tree analysis-like (FTA) approach is used to bundle scenarios contributing to a pre-defined undesired event, resulting in so-called nodes which all contributed to the undesired top-level event. Risk analysis and evaluation are then performed on each node by qualitative determination of four risk parameters which are rated using a pre-defined risk matrix and subsequently condensed into an overall risk score. Individual analysis of each node is supported by a graphical representation similar to a bowtie diagram, facilitating an overview of which scenarios it is comprised of, and how the process is already able to counteract them (Figure 2).

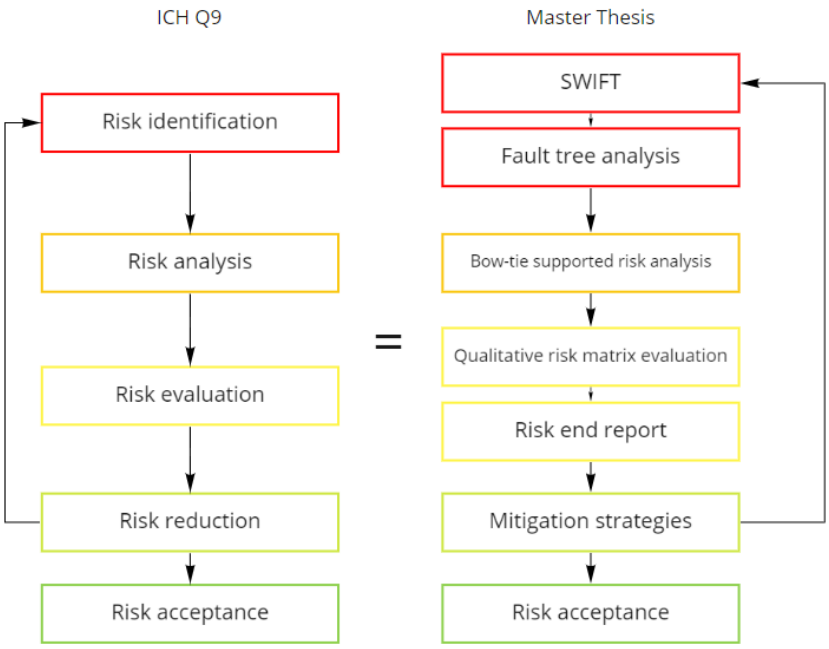


Figure 1: Sequence of the newly developed risk assessment method, in comparison to the established sequence described in ICH Q9. The overall procedure was not altered but interpreted in an innovative, new way. Master Thesis was performed by Dominik Nendwich MSc, Univ. of Natural Resources and Life sciences, Vienna.

For overall risk determination four different parameters were defined

- Severity: A measure of how fatal the consequences of an event are, including considerations of the safety measures that are activated once an event occurred (= recovery safeguards)
- Detectability: A measure of how reliable (i.e.: automated) an event can be detected by the system control. This parameter also includes consideration of the safety measures that are active to prevent the event from initially happening (= prevention safeguards).
- Occurrence: A measure of how often the event can occur.
- Complexity: A measure of how many process subunits are influenced by the event, and from how many sources the event can arise. This parameter was included to correspond to the continuous process.

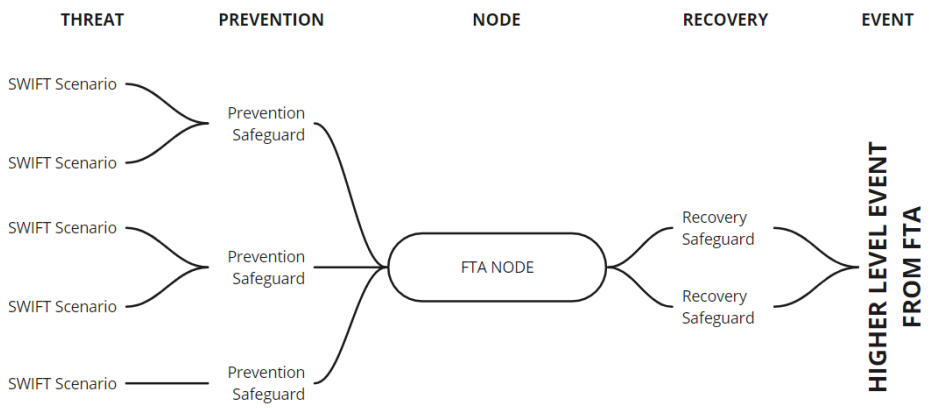


Figure 2: Template of a Bow tie diagram used in the risk assessment method. Threats from each node-related SWIFT scenario are on the leftmost side, followed by their corresponding prevention safeguards. The investigated FTA node is the central knot, followed by recovery safeguards which connect the node and its higher-level FTA event (Masterthesis Dominik Nendwch).

The four risk parameters are subsequently related using a matrix approach. However, in a 2D rendition, only two values can be related at once. A multilevel approach was developed in which one value is defined as constant while two others remain variable, allowing a combination of three values. The resulting intermediate risk value is then related to the last parameter in a second matrix, resulting in the total risk. The matrices in Figure 3 were pre-defined by the risk assessment team, assigning each parameter combination to an overall risk value of either low, medium, or high magnitude.

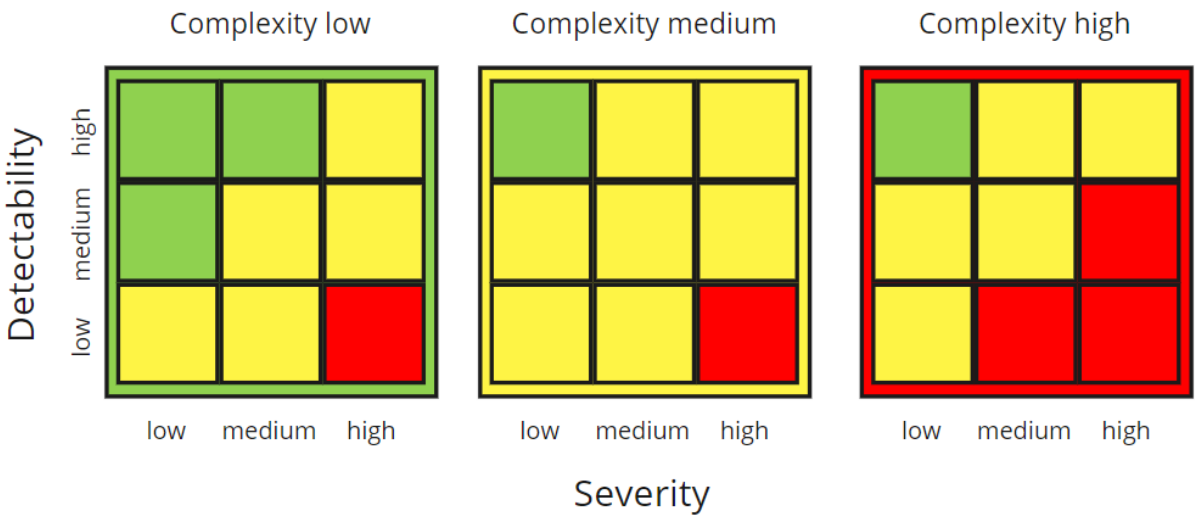


Figure 3: Combination of three risk parameters to yield an intermediate risk value. Its value is dependent on the color: green = low, yellow = medium and red = high. The fixed magnitude of complexity is indicated by the colored frame and varies with each matrix (left to right): low, medium, and high.

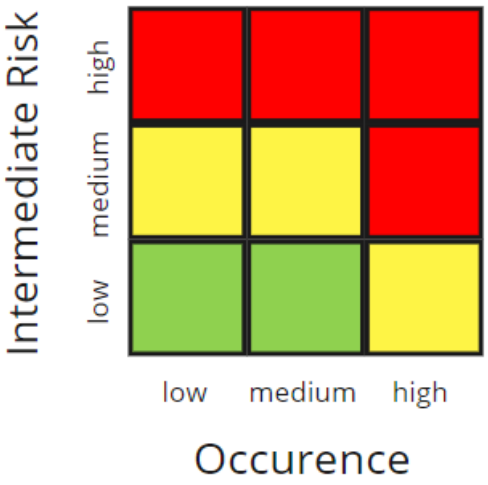


Figure 4: Final risk assessment matrix correlating all four risk parameters with each other. The overall risk is indicated by the colored tiles: green = low, yellow = medium, red = high.

In its current form, the overall method is focused on a rather specific scenario: supporting early process development. Nevertheless, since the core idea is based on the general risk management procedure, its area of application is manifold. Depending on the available data situation, the overall method, or subsections of it, can be sharpened and adapted towards present circumstances. It is also possible to focus the method only on certain areas of the target process to assess risk for this specific area. Future studies could divide the risk assessment matrix into more subdivisions, if the data situation is appropriate.

Acknowledgement: Sincere thanks to all bioprocess experts, in particular Gabriele Recanati (IBSE) and Sebastian Gomez Sanchez (Bilfinger), participating to the risk assessment team supporting the identification and evaluation of individual risks.

[1] ICH Q13 Continuous Manufacturing of Drug Substances and Drug Products
[2] ICH-Q9 Quality Risk Management
[3] Card A. J., Ward J. R., and Clarkson P. J. Beyond FMEA: The structured what-if technique (SWIFT). J of Healthcare Risk Mgmt, 31: 23-29

Chromatography modeling

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Patterns of protein adsorption in ion-exchange particles and columns: Evolution of protein concentration profiles during load, hold, and wash steps predicted for pore and solid diffusion mechanisms

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Elucidation of protein transport mechanism in ion exchanges is essential to model separation performance. In this work we simulate intraparticle adsorption profiles during batch adsorption assuming typical process conditions for pore, solid and parallel diffusion. Artificial confocal laser scanning microscopy images are created to identify apparent differences between the different transport mechanisms. Typical sharp fronts for pore diffusion are characteristic for Langmuir equilibrium constants of $K_L \geq 1$. Only at $K_L = 0.1$ and lower, the profiles are smooth and practically indistinguishable from a solid diffusion mechanism. During hold and wash steps, at which the interstitial buffer is removed or exchanged, continuation of diffusion of protein molecules is significant for solid diffusion due to the adsorbed phase concentration driving force. For pore diffusion, protein mobility is considerable at low and moderate binding strength. Only when pore diffusion if completely dominant, and the binding strength is very high, protein mobility is low enough to restrict diffusion out of the particles. Simulation of column operation reveals substantial protein loss when operating conditions are not adjusted appropriately.

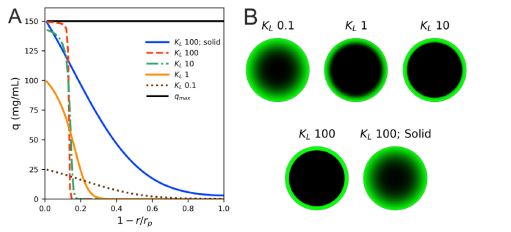

Fig. 3. A) Adsorption fronts after 90 seconds of loading for different binding strengths of pore diffusion with $D_p = 1.1 \cdot 10^{-7}$ cm²/s and solid diffusion with $D_s = 7.0 \cdot 10^{-9}$ cm²/s; B) Corresponding simulated CLSM images normalized to equilibrium capacity.

Pore and solid diffusion are distinguished by the difference in their driving force. At strong binding conditions the intraparticle profiles are characteristic for the respective mechanisms. Pore diffusion exhibits sharp fronts and solid diffusion smooth transitional profiles. When the binding strength decreases in a pore diffusion system, the profiles gradually approach the solid diffusion pattern. Eventually at very low binding strength K_L = 0.1, the profiles are practically indistinguishable when there is no diffusion to the outside of the particle. Understanding the underlying mechanism of a particular chromatographic separation process is critical. For adsorption, solid diffusion contribution accelerates mass transfer allowing to work a high flow rate. In turn, during wash and hold steps, the continuing transport can lead to substantial protein diffusion out of the particles, especially at high column saturation. The simulations performed in this work were mostly based on a single diffusion mechanism. This was necessary to identify the most prominent effects on specific operation conditions. In practical work, many resins will exhibit a parallel transport behavior. Depending on the dominance of one or the other mass transfer mechanism, which also strongly depends on buffer conditions, our calculations can contribute to better process understanding and design. (J. Beck and R.Hahn)

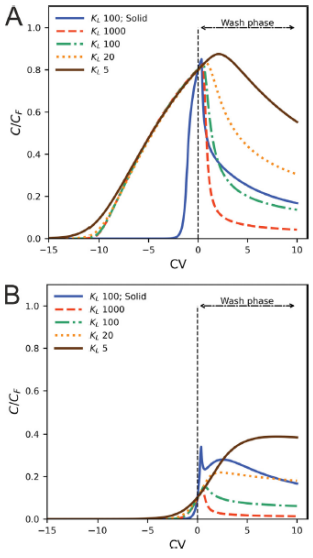

Fig. 7. Simulation of column adsorption process with wash step. Column was loaded at a residence time of 3 min with protein solution (c_F = 2.0 mg/mL, q_{max} = 150 mg/mL) to DBC 80 % (A) and DBC 10 % (B). The column was then washed for 10 CV to investigate the losses during the wash step at different binding strengths for a pore diffusion coefficient $D_p = 1.1 \cdot 10^{-7}$ cm²/s compared to solid diffusion $D_s = 7.0 \cdot 10^{-9}$ cm²/s at K_L = 100 mL/mg. The wash step starts at CV=0.

Research Studio Austria DESETCO (Novasign) to speed up bioprocess development

GERALD STRIEDNER, ASTRID DÜRAUER, MARKUS LUCHNER, MAXIMILIAN KRIPPL, BENJAMIN BAYER, ARMIN KHODAEI, ROGER DALMAU-DIAZ, TOBIAS KARGL AND MARK DÜRKOP

The "Desetco" project (funded by the FFG) started in September 2017 intending to speed up bioprocess development by applying advanced machine-learning algorithms. Currently, time to market of new pharmaceuticals is still in the range of 10-14 years. However, last year we saw SARS-CoV2 vaccines to enter the market within less than one year of development. Although high risk is put on the clinical evaluation process, the reduced timelines also test new standards. While bioprocess development and manufacturing speed was never considered a bottleneck, if significantly reduced times lines also need to be met for other life-saving medicines, industry behavior with respect to process development has to change.

The former "Desetco" project now runs under "Novasign" aiming to reduce development timelines significantly. During the last year the two showcases namely "application of hybrid modeling and intensified Design of Experiments for accelerated upstream process development" and "hybrid modeling for crossflow filtration" were finalized. After 6 publications in 2020, 4 publications followed in 2021. In one of which Novasign could highlight the advantage of using process modeling in combination with Proton Transfer Reaction – Mass Spectrometry for a soft-sensor application in a gene therapy process of Takeda. Further, the intensified Design of Experiment approach, to faster estimate process optima, finally made its way into the industry. Since 2021 Novasign is collaboration with Boehringer-Ingelheim and Bilfinger. Novasign already published an article with Bilfinger about the iDoE concept and is currently preparing a draft about the same topic with Boehringer-Ingelheim. The application of hybrid modeling for tangential flow filtration was demonstrated in a single pass tangential flow filtration publication and the work about diafiltration will be finalized soon.

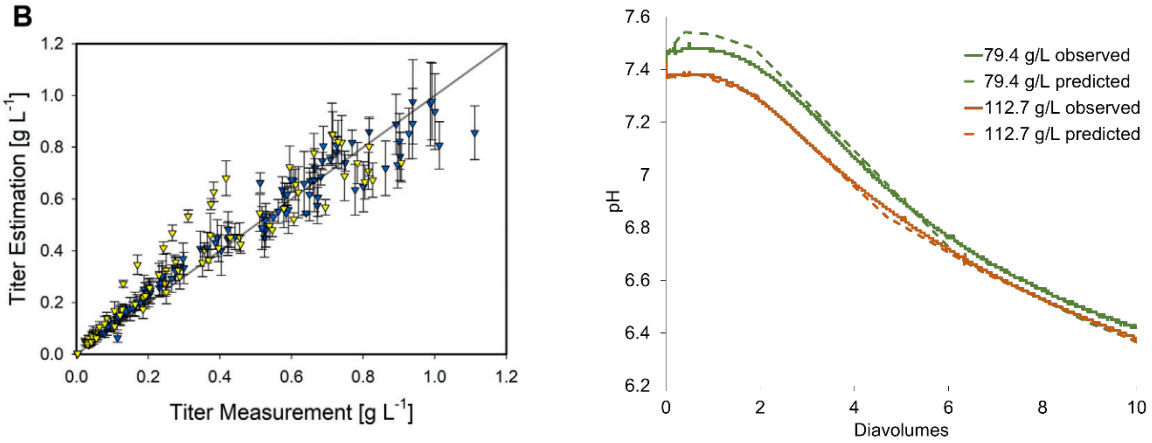

Figure 4: Two project highlights. Left: application of hybrid modeling and iDoE to predict product titer in CHO cell culture. Models were trained on 15 L iDoE runs (blue) and the model was tested to predict ordinary DoE runs (yellow). Thereby the number of experiments to screen the design space could be reduced significantly. Right: hybrid model prediction of pH behavior during Diafiltration process. The hybrid model predicts the current flux and pH based on training data combined with the Poisson Boltzmann equation and Donnan equilibrium

CD Laboratory for production of next-level biopharmaceuticals in E. coli

In 2021, the CD Laboratory running at IBSE was evaluated by the Senate of the Christian Doppler Society with the involvement of international experts. The general aim of these scientific evaluations after 5 years was to assess the overall research work and scientific quality of the CD Laboratory. Special attention was paid to whether the character of an application-oriented basic research was fulfilled and how effectively the knowledge transfer worked. Based on the research results, publication achievements and supervised bachelor, master and doctoral theses presented in the evaluation report and the evaluation event, the external scientific evaluator came to a very positive conclusion. Most important for the positive evaluation were the scientific and educational outputs of the project with 8 published manuscripts, 11 contributions to international conferences, as well as 6 manuscripts submitted for publication, currently in the review process, 2 patent submissions, 3 completed and 9 currently ongoing PhDs as well as 9 master's and 5 bachelor's theses finished so far. Furthermore, all project management relevant requirements were fulfilled in the best possible way and therefore the CD Laboratory can be continued for the full duration of 7 years as originally planned. The following pages present some of the research highlights achieved in the past year.

Variation of Fab fragment, signal peptide and host – impact on process performance and downstream operability

A set of 16 different genome-integrated host/leader/Fab clones (Table 1) were preliminary characterized in a µ-bioreactor system and for detailed studies all combinations were cultured in triplicates in a standardized fed-batch process. We applied the established in-process analytical platform for characterization on process level (growth, product yield and quality) and physiology level (transcriptome). Furthermore, end-point samples were characterized with respect to downstream operability.

E. coli strain	Translocation signal sequence	Model Fab	Abbreviation
HMS174(DE3)	OmpASS	Fabx	H<oFabx>
		BIBH1	H<oBIBH1>
		BIWA4	H<oBIWA4>
		FTN2	H<oFTN2>
	DsbASS	Fabx	H<dFabx>
		BIBH1	H<dBIBH1>
		BIWA4	H<dBIWA4>
		FTN2	H<dFTN2>
BL21(DE3)	OmpASS	Fabx	B<oFabx>
		BIBH1	B<oBIBH1>
		BIWA4	B<oBIWA4>
		FTN2	B<oFTN2>
	DsbASS	Fabx	B<dFabx>
		BIBH1	B<dBIBH1>
		BIWA4	B<dBIWA4>
		FTN2	B<dFTN2>

Table 1: List of all expression clones and abbreviations. The respective antigens are Fibroblast Activation Protein for BIBH1, Protein-x for Fabx, CD44 cell-surface glycoprotein for BIWA and TNFα tumor necrosis factor for FTN2.

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scientific reports

OPEN **High-throughput microbioreactor provides a capable tool for early stage bioprocess development**

Mathias Fink[1], Monika Cserjan-Puschmann[1*], Daniela Reinisch[2] & Gerald Striedner[1]

The first task was to evaluate the extent to which the results generated with the established µ-bioreactor fedbatch-like cultivation protocol can be transferred to fully controlled bench-top bioreactor cultivations. In µ-scale experiments, not all conditions defined in standard stirred tank lab-scale processes can be set. In contrast to lab-scale cultures, the glucose release strategy used in the µ-bioreactor cultures is limited to linear feed profiles and continuously decreasing growth rates and the maximum achievable cell density of about 10 g/L is significantly lower.

The generated results (Figure 6) showed that high-throughput µ-bioreactor cultivations can help to identify promising production clones, since the same strong dependency of Fab expression on the individual Fab molecule was observed in both systems. Importantly, the Fab expression ranking was the same for all expression systems with FTN2>BIWA4>BIBH1>Fabx in both systems (Figure 6B, D). Furthermore, even the overall ranking of host/leader combinations was the same with the highest specific Fab concentration for H<oFab> followed by H<dFab>, B<oFab>, and B<dFab>. In terms of specific Fab titers, HMS174(DE3) was the favorable expression host, and OmpA^{SS} the preferable leader sequence. There was also good transferability of cell dry mass (CDM) data from the µ-bioreactor to the benchtop system as both systems resulted in higher CDM for almost all BL21(DE3) clones compared to their respective HMS counterparts (Figure 6A, C).

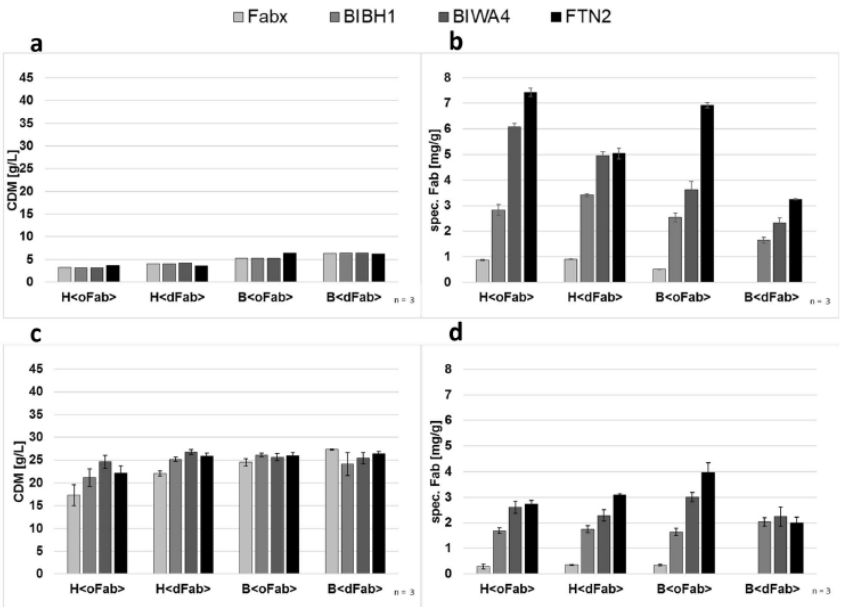


Figure 5: Final CDM and soluble Fab yields of µ-bioreactor (a and b) and lab-scale cultivations (C and D) for all host-leader-Fab combinations. Data are presented as mean ± SD. N=3 biological replicates.

The results of the benchtop cultivations fully confirmed the evaluation in the µ-scale experiments and the validity of the selected set of Fab production clones. In summary, we demonstrated that the µ-bioreactor system can be used as an efficient high throughput tool for clone- and condition screening that allows to generate meaningful data and thereby accelerate process development.

DOI: 10.1002/biot.202000562

RESEARCH ARTICLE

Biotechnology Journal

Integrated process development: The key to improve Fab production in *E. coli*

Mathias Fink[1] | Clemens Schimek[1] | Monika Cserjan-Puschmann[1] | Daniela Reinisch[2] | Cécile Brocard[2] | Rainer Hahn[1] | Gerald Striedner[1]

In clone evaluation, it is not only the product titer and product quality generated in the cultivation process that is important, but also how well the subsequent product purification works. This fact is often given little consideration as production in USP and product separation/purification in DSP are traditionally embedded in different groups and somehow are considered as separate disciplines. This arbitrary separation in the process chain thus stands in the way of efficient integrated process development. The goal of this work was to evaluate the 16 different Fab production clones described with regards to both, the influence on expression and, the DSP processability.

Significant negative effects on growth were identified due to the Fab expression, with *E. coli* HMS174(DE3) being more affected than BL21(DE3), which reached up to threefold higher biomass yields. In product yield-based host selection, HMS174(DE3) showed better performance with higher total specific yields than the BL21(DE3) counterparts. The opposite results were obtained when considering extracellular Fab fraction and extracellular DNA content, which were both significantly higher for HMS174(DE3) strains. The presence of extracellular DNA caused by cell lysis increased the viscosity of the cell broth, which negatively affects centrifugation efficiency during cell harvest. With respect to endotoxin levels, which also compromised DSP efficiency, the picture was similar, because cell lyses also led to higher values as observed for HMS174(DE3).

		total CDM [g]		*total specific Fab concentration [mg/g]*		*Extracellular fraction [%]*		*DNA [µg/mL]*	
		BL21(DE3)	*HMS174(DE3)*	*BL21(DE3)*	*HMS174(DE3)*	*BL21(DE3)*	*HMS174(DE3)*	*BL21(DE3)*	*HMS174(DE3)*
$DsbA^{ss}$	BIBH1	38.06	29.87	1.76	2.90	48	58	485	1016
	BIWA4	40.28	40.19	1.97	3.47	67	56	537	501
	FTN2	40.18	34.29	3.27	4.96	71	64	277	890
	Fabx	50.06	19.74	0.00	0.61	0	67	386	769
$OmpA^{ss}$	BIBH1	43.18	21.24	1.46	2.85	38	58	242	830
	BIWA4	40.66	26.20	2.84	4.84	67	68	245	941
	FTN2	44.30	33.78	3.60	5.18	67	64	175	942
	Fabx	36.71	12.45	0.41	0.73	51	71	332	410
		Endotoxin [EU/mL]		centrifugation efficiency [%]		viscosity [mPas] broth		viscosity [mPas] supernatant	
		BL21(DE3)	*HMS174(DE3)*	*BL21(DE3)*	*HMS174(DE3)*	*BL21(DE3)*	*HMS174(DE3)*	*BL21(DE3)*	*HMS174(DE3)*
$DsbA^{ss}$	BIBH1	4.81E+06	8.15E+06	96	90	6.15	13.35	3.95	10.66
	BIWA4	4.79E+06	7.89E+06	96	98	6.45	4.44	4.04	3.09
	FTN2	5.97E+06	8.05E+06	96	95	5.85	11.71	3.81	8.32
	Fabx	3.28E+06	7.34E+06	100	92	1.61	10.52	1.05	9.14
$OmpA^{ss}$	BIBH1	5.59E+06	5.21E+06	97	84	5.23	13.81	3.75	11.64
	BIWA4	6.03E+06	7.58E+06	95	94	6.61	10.19	4.93	8.52
	FTN2	5.79E+06	7.28E+06	97	93	5.13	10.82	3.58	9.11
	Fabx	7.67E+06	5.10E+06	80	88	10.33	13.71	8.55	12.69

Table 2. Summary of USP and DSP relevant parameters

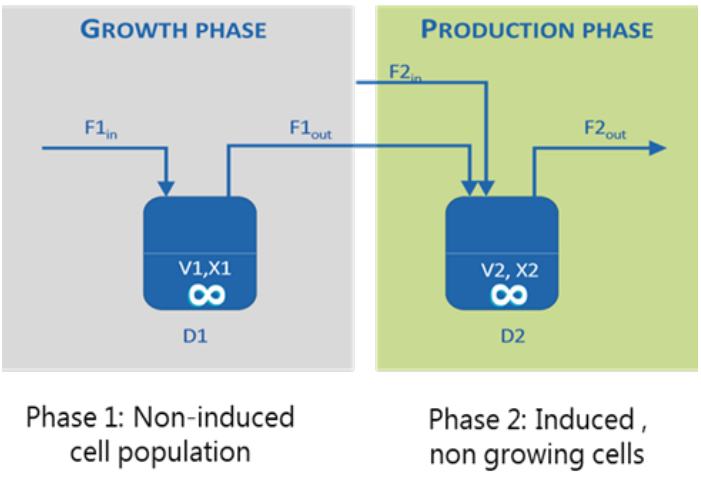
This study showed how the host strain, expressed Fab and translocation mechanism interacted and influenced the individual unit operations. Knowledge was gained on variations of product yields, cell growth and difference in DSP operability. DSP operability was shown to be generally better for BL21(DE3) strains, a performance which correlates with the observations of less affected growth, lower DNA contents and viscosity. However, the used fermentation process led to unfavorable DSP operability in terms of broth properties and product localization. The results clearly showed that decisions made in USP are fundamental for further process development, in particular for early-stage DSP unit operations (M. Cserjan, M. Fink, R. Hahn, G. Striedner).

Production of PET degrading enzymes

Enzycle (https://www.enzycle.eu/) is an EU-wide project funded by die Bio-Based Industries Joint Undertaking under the EU Horizon and innovation program. It is aimed to generate new enzymatic processes for the treatment and recycling of plastic waste fraction that could not be recycled so far. These enzymes shall be produced in recombinant microorganisms such as *P. pastoris* and *E. coli* and proof their suitability for industrial recycling processes. Targeted materials are multilayer packaging, post-consumer PET trays and clamshell containers as well as microplastics in waste water. Therefore, a currently hard-to-treat fraction of plastic waste will be valorized with a great benefit for environment.

At IBSE RG-Striedner is participating this project with the task to develop *E. coli* production strains and feasible fed-batch and continuous fermentation processes for production of the desired enzyme PHL7 a polyester hydrolase. For this means, BL21(DE3) and enGenes-X-press expression host strains were designed and evaluated. The enzyme-sequence was furthermore coupled to specific signal sequences for the translocation of the enzyme to the host's periplasm in order to enable the correct folding and to promote release of the enzyme to the cell culture supernatant.

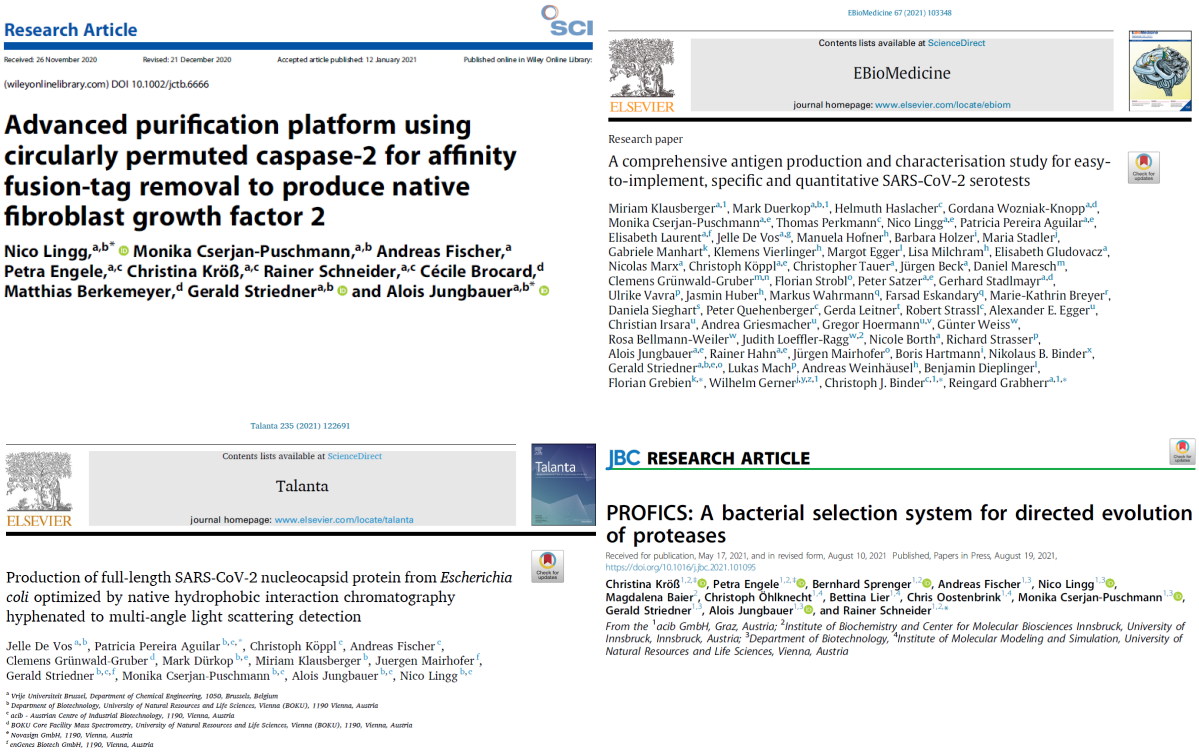
The micro-bioreactor system BioLector® was used for clone evaluation and initial condition screening and a growth decoupled enGenes-X-press strain was identified as best performing in respect of enzyme expression and enzyme activity. With this expression clone an initial characterization was done in 1.8 L benchtop bioreactor systems operated in fedbatch mode and remarkable enzyme titers in the range of 3 to 8 g/L were reached. On the basis of these experiments, ideal production conditions are now to be identified with the aid of model-based process optimization implemented in the Hybrid Modeling Toolbox developed by Novasign.



Schematic concept of 2-stage chemostat cultivation.

The ultimate goal of the project is to develop a two-stage continuous process in chemostat mode as significantly higher space-time yields may provide the basis to produce the large quantities of enzyme that are needed if PET recycling is to be carried out to the extent envisaged. The selected expression clone is perfectly suited for 2-stage continuous mode as decoupling prevents formation of non-producer populations in the production vessel and thereby high product titers are ensured (L. Fohler, M. Fink, M. Cserjan, G. Striedner)

CASPON technology – a generic manufacturing platform



Research Article

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Advanced purification platform using circularly permuted caspase-2 for affinity fusion-tag removal to produce native fibroblast growth factor 2

Nico Lingg,[a,b*] Monika Cserjan-Puschmann,[a,b] Andreas Fischer,[a] Petra Engele,[a,c] Christina Kröß,[a,c] Rainer Schneider,[a,c] Cécile Brocard,[d] Matthias Berkemeyer,[d] Gerald Striedner[a,b] and Alois Jungbauer[a,b*]

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EBioMedicine

journal homepage: www.elsevier.com/locate/ebiom

Research paper

A comprehensive antigen production and characterisation study for easy-to-implement, specific and quantitative SARS-CoV-2 serotests

Miriam Klausberger[a,1], Mark Duerkop[a,b,1], Helmuth Haslacher[c], Gordana Wozniak-Knopp[a,d], Monika Cserjan-Puschmann[a,e], Thomas Perkmann[c], Nico Lingg[a,e], Patricia Pereira Aguilar[a,e], Elisabeth Laurent[a,f], Jelle De Vos[a,g], Manuela Hofner[h], Barbara Holzer[i], Maria Stadler[i], Gabriele Manhart[k], Klemens Vierlinger[h], Margot Egger[l], Lisa Milchram[h], Elisabeth Gludovacz[a], Nicolas Marx[a], Christoph Köppl[a,e], Christopher Tauer[a], Jürgen Beck[a], Daniel Maresch[m], Clemens Grünwald-Gruber[m,n], Florian Strobl[o], Peter Satzer[a,e], Gerhard Stadlmayr[a,d], Ulrike Vavra[p], Jasmin Huber[h], Markus Wahrmann[q], Farsad Eskandary[q], Marie-Kathrin Breyer[r], Daniela Sieghart[s], Peter Quehenberger[c], Gerda Leitner[t], Robert Strassl[c], Alexander E. Egger[u], Christian Irsara[u], Andrea Griesmacher[u], Gregor Hoermann[u,v], Günter Weiss[w], Rosa Bellmann-Weiler[w], Judith Loeffler-Ragg[w,2], Nicole Borth[a], Richard Strasser[p], Alois Jungbauer[a,e], Rainer Hahn[a,e], Jürgen Mairhofer[o], Boris Hartmann[l], Nikolaus B. Binder[x], Gerald Striedner[a,b,e,o], Lukas Mach[p], Andreas Weinhäusel[h], Benjamin Dieplinger[l], Florian Grebien[k,*], Wilhelm Gerner[l,y,z,1], Christoph J. Binder[c,1,*], Reingard Grabherr[a,1,*]

Talanta 235 (2021) 122691

Contents lists available at ScienceDirect

Talanta

journal homepage: www.elsevier.com/locate/talanta

Production of full-length SARS-CoV-2 nucleocapsid protein from *Escherichia coli* optimized by native hydrophobic interaction chromatography hyphenated to multi-angle light scattering detection

Jelle De Vos[a,b], Patricia Pereira Aguilar[b,c,*], Christoph Köppl[c], Andreas Fischer[c], Clemens Grünwald-Gruber[d], Mark Dürkop[b,e], Miriam Klausberger[b], Juergen Mairhofer[f], Gerald Striedner[b,c,f], Monika Cserjan-Puschmann[b,c], Alois Jungbauer[b,c], Nico Lingg[b,c]

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JBC RESEARCH ARTICLE

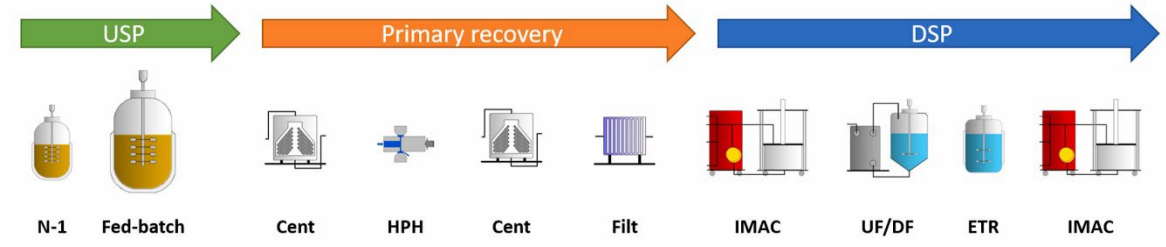
PROFICS: A bacterial selection system for directed evolution of proteases

Received for publication, May 17, 2021, and in revised form, August 10, 2021 Published, Papers in Press, August 19, 2021, https://doi.org/10.1016/j.jbc.2021.101095

Christina Kröß[1,2,‡], Petra Engele[1,2,‡], Bernhard Sprenger[1,2], Andreas Fischer[1,3], Nico Lingg[1,3], Magdalena Baier[1], Christoph Öhlknecht[1,4], Bettina Lier[1,4], Chris Oostenbrink[1,4], Monika Cserjan-Puschmann[1,3], Gerald Striedner[1,3], Alois Jungbauer[1,3], and Rainer Schneider[1,3,*]

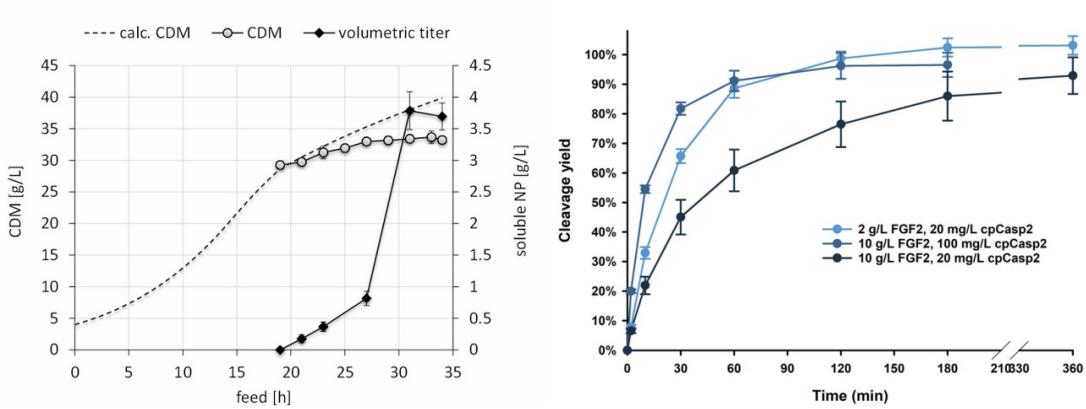
From the [1]acib GmbH, Graz, Austria; [2]Institute of Biochemistry and Center for Molecular Biosciences Innsbruck, University of Innsbruck, Innsbruck, Austria; [3]Department of Biotechnology, [4]Institute of Molecular Modeling and Simulation, University of Natural Resources and Life Sciences, Vienna, Austria

In a large consortium with the Institute of Biochemistry of the University of Innsbruck, the Institute of Molecular Simulation, and IBSE we have developed a generic manufacturing platform for production of recombinant proteins. This platform has been designed to enable therapeutic concepts which are based on non-mAb formats such as vaccines, enzymes, antibody fragments, peptides, cytokines and hormones. They suffer from slow developability and manufacturability and there is an urgent need for a generic manufacturing process. Affinity tags such as the commonly known six-His-tag can vastly simplify purification, but need to be removed for many applications such as biopharmaceuticals, when an authentic N-terminus is requested. Most proteases available for tag removal are too unspecific, too expensive or do not produce an authentic N-terminus.



Process scheme of the CASPON platform.

We have engineered a versatile enzyme based on human Caspase 2 for the generic use in bioprocesses. Based on the circularly permuted caspase-2 (Cserjan-Puschmann *et al.,* 2020) we have further improved the enzyme through a bacterial selection system, PROFICS (Kross *et al*., 2021), which now allows for the efficient removal of tags regardless of target N-terminus.



Within only 36 days, researchers at IBSE were able to produce SARS-CoV2 nucleocapsid protein with very high product titer in E. coli fermentation (left panel). The cleavage of tagged protein of interested with CASPON enzyme is a very fast process (right panel).

During the ongoing SARS-CoV2 pandemic, IBSE played an instrumental role in the production of viral antigens for the rapid development of serological assays. This SARS-CoV2 antibody test can help asses patient's immune response to the virus. Using the CASPON platform process, high soluble product titers in upstream processing could be processed to very high purities in the downstream process. This high quality nucleocapsid protein was used in collaboration between BOKU, University of Veterinary Medicine Vienna and Medical University Vienna to develop a highly reliable antibody test to help fight the pandemic. (M. Cserjan, N. Lingg, G. Striedner, A. Jungbauer)

Cserjan-Puschmann, M., Lingg, N., Engele, P., Kross, C., Loibl, J., Fischer, A., Bacher, F., Frank, A. C., Ohlknecht, C., Brocard, C., Oostenbrink, C., Berkemeyer, M., Schneider, R., Striedner, G., & Jungbauer, A. (2020). Production of Circularly Permuted Caspase-2 for Affinity Fusion-Tag Removal: Cloning, Expression in Escherichia coli, Purification, and Characterization. *Biomolecules, 10*(12), 1592. doi:10.3390/biom10121592

Kross, C., Engele, P., Sprenger, B., Fischer, A., Lingg, N., Baier, M., Ohlknecht, C., Lier, B., Oostenbrink, C., Cserjan-Puschmann, M., Striedner, G., Jungbauer, A., & Schneider, R. (2021). PROFICS: A bacterial selection system for directed evolution of proteases. *J Biol Chem, 297*(4), 101095. doi:10.1016/j.jbc.2021.101095

A new Core Facility: The BioIndustrial Pilot Plant

In 2021, the BioIndustrial Pilot Plant, previously part of the Institute, was incorporated into the organizational area of the BOKU Core Facilities and is now officially operated as “Core Facility BioIndustrial Pilot Plant”.

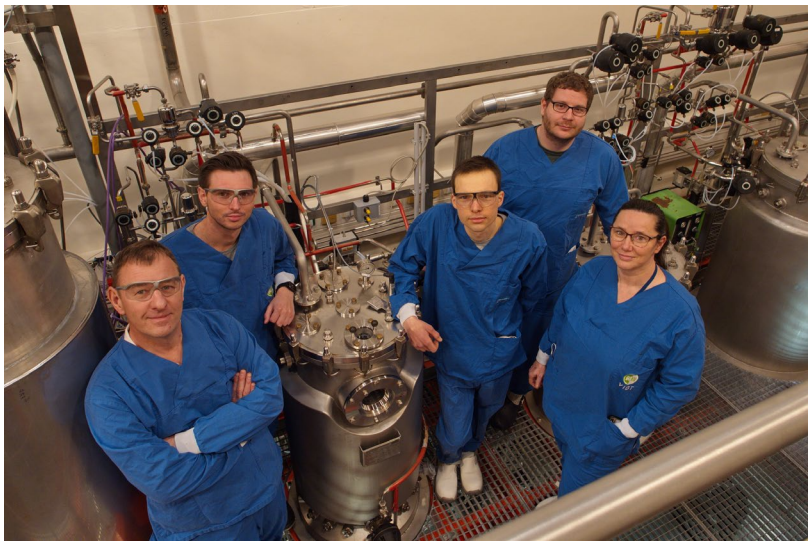
Operation in the CF BioIndustrial Pilot Plant

The very ambitious measure to transfer the organizational and financial responsibilities from institute to the university level was a joint initiative of the IBSE and the BOKU Vice Rectorate for Research. One of the goals was to improve the visibility of the pilot plant and to make it accessible to a broader range of users. This should be perfectly ensured by the organizational integration of the BioIndustrial Pilot Plant into the BOKU Core Facilities. The second main objective was to guarantee a healthy and strategically foreseeable further development of the pilot plant. This was not given with the financial possibilities of the institute since the financing of the personnel, infrastructure and operating costs was so far to a large extent project dependent.

In the discussions on the implementation of the goals between IBSE and the vice rector Christian Obinger, measures were jointly decided to ensure that teaching operations and ongoing project processing in the facility can be handled without disruptions during the transition phase. For the actual implementation, which started in February 2021, Dr. Markus Luchner, up to now operational manager of the pilot plant, and Sabine Necina, technician with many years of experience in the pilot plant, were made available by the institute of the new Core Facility. In October the Pilot Plant team was expanded to include a mechatronic engineer, namely Anita Zwanzleitner.

To ensure that the intensive cooperation between IBSE and the pilot plant in the form of scientific monitoring of the work and support in project acquisition continues, it was decided to establish a Scientific Board and to staff it with scientists from IBSE. The selection of the persons for the Scientific Board was driven by the demand to cover the scientific expertise along the bioprocess chain and to find persons with high interest in the further development of the Core Facility and the willingness to contribute. Based on these requirements, Assoc. Prof. Rainer Hahn and Prof. Gerald Striedner were selected as members of the Scientific Board. These persons have already been intensively involved with the agendas of the pilot plant and have contributed with their ideas and work performance accordingly.

For the future development and strategic orientation of the Core Facility, a further body was established in the form of the Advisory Board, which on the one hand should provide the view of external experts from the biotech industry and universities, and also access to their networks. In appointing the scientific Advisory Board, care was taken to select a representative mix of industry experts from various application areas of biotechnological production (DI Gerald Berghammer / Bilfinger Life Science / plant construction; Dr. Dietmar Katinger / Polymun Scientific / red biotechnology; Dr. Stefan Naschberger / DSM Austria / white biotechnology) and scientists with complementary expertise (Dr. Markus Gölles / automation / Bioenergy and Sustainable Technologies Graz; Prof. Georg Gübitz / white biotechnology / IFA Tulln). Prof. Alois Jungbauer, former head of IBSE, retired 09/2021 is a member of the Advisory Board and is available with his expertise and network.



From left to right: Markus Luchner, Marco Kaupe, Mathias Fink, Alexander Mechtler, Sabine Necina

Furthermore, ao.Prof. Karola Vorauer-Uhl, contribute to the Advisory Board with her expertise in Quality Management and Quality Control.

All these projects were implemented in the course of 2021. Due to the cautious planning, operation of the pilot plant and all ongoing projects (industrial cooperation, master and PhD thesis) as well as all student courses (Master Bioprocess Engineering: Bioprocess Engineering Laboratory, DocSchool: Pilot plant BioproEng, Technical University Vienna: Integrated biopharmaceutical production in pilot scale) could be carried out as planned. Thus, in conclusion, the successful transition in BOKU´s Core Facility Structure could be facilitated, which was also agreed by the Rectorate within the first annual meeting discussing future perspectives and needs of the BioIndustrial Pilot Plant. Furthermore, the first steps towards the organizational form of a Core Facility have been taken, the first Advisory Board meeting has taken place and an initial roadmap for the development of the future strategy of the Core Facility has been drawn up, which will be tackled in 2022.

More information can be found at:	https://boku.ac.at/cf/bipp
Impressions from the Core Facility BioIndustrial Pilot Plant:	https://boku.ac.at/cf/bipp/videos
Inquiries and general requests:	bipp@boku.ac.at

Overview: final theses (finished and ongoing)

PhD projects

Finished

Alessandro Luigi Cataldo (EU Projekt NextBiopharm)
Economic and ecological assessment of clean water for biopharmaceuticals.
Supervisor: Gerald Striedner, Alois Jungbauer
Finished: 2021

Suleiman Ehsan (European Union's Horizon 2020 research and innovation program94me under grant agreement No. 681137 (European AIDS Vaccine Initiative 2020). Ehsan Suleiman received funding from the PhD programme "BioTop—Biomolecular Technology of Proteins" (Austrian Science Funds, Project number: FWF W1224).
Protein-liposome conjugates as novel HIV vaccine candidates;
Supervisor: Vorauer-Uhl Karola
Finished: 2021

Mathias Fink (CD-Lab NLBP)
Fab production in E. coli - an integrated approach for detailed systems and process characterization as basis for rational design
Supervisor: Monika Cserjan, Gerald Striedner
Finished: April 2021

Maximilian Krippl (FFG Research Studio Novasign)
Hybrid-model approaches for crossflow filtration processes
Supervisor: Astrid Dürauer
Finished: December 2021

Karin Reiter (acib project 25041)
Separation of virus like particles and extracellular vesicles
Supervisor: Alois Jungbauer
Finished: April 2021

Patrick Stargardt (EU Project Rafts4Biotech/ extern Fa. enGenes GmbH)
Advancements and further characterization on growth decoupled protein expression using the phage T7 derivede GP2 protein
Supervisor: Gerald Striedner
Finished: June 2021

On-Going

Hanna Hanee Ahvaz (CD-Lab NLBP)
Development of Methods for in vivo quantification of proteolysis in E. coli expression systems
Supervisor: Gerald Striedner
Start: November 2019

Jürgen Beck
Impact of mass transfer mechanism on protein separation in two-component adsorption
Supervisor: Rainer Hahn
Start: November 2019

Markus Berg (acib project 94041)
Model based process development and scale up of primary recovery for biopharmaceutical production
Supervisor: Rainer Hahn, Astrid Dürauer
Start: January 2020

Anna Christler (acib project 25011)
Hybrid modeling approaches for preparative protein chromatography
Supervisors: Alois Jungbauer, Astrid Dürauer
Start: January 2017

Natalia Danielewicz (enGenes)
Process development for high yield fermentation of active recombinant lectins expressed in Escherichia coli
Supervisor: Gerald Striedner
Start: 2018

Gregory Silva Dutra (Marie Curie ITN A4B)
Continuous Separation of Recombinant Antibodies by non-chromatographic methods
Supervisor: Alois Jungbauer
Start: October 2018

Touraj Eslami (H2020 ITN CODOBIO, evon)
Online control of chromatographic steps using model predictive control (MPC) in continuous downstream processing
Supervisor: Gerald Ebner, Alois Jungbauer, Nico Lingg
Start: 2019

Lisa Fohler (ENZYCLE)
Fed-batch and continuous production of PET degrading enzymes in E. coli
Supervisor: Gerald Striedner
Start: July 2021

Nils Gehrmann (Sartorius)
An ultrafast antibody purification process based on membrane chromatography
Supervisor: Rainer Hahn
Start: October 2020

Martin Gibisch (CD-Lab NLBP)
Directed evolution using selective advantage for producing cells
Supervisor: Monika Cserjan, Gerald Striedner
Start: December 2020

Stephan Gutmann (CD-Lab NLBP)
Directed evolution using selective advantage for producing cells
Supervisor: Monika Cserjan, Reingard Grabherr, Gerald Striedner
Start: December 2020

Leo Jakob (BioTop)
Protein solubility in buffers with kosmotropic salts and polyols
Supervisor: Alois Jungbauer, Nico Lingg, Rupert Tscheließnig
Start: Juni 2019

Alexander Jurjevec (CD-Lab NLBP)
Polyethyleneimmine for protein extraction from bacteria
Supervisor: Rainer Hahn
Start: 2019

Daniel Komuzcki (Marie Curie ITN A4B)
Fully integrated continuous bioprocessing of recombinant proteins using mammalian cells
Supervisor: Alois Jungbauer
Start: May 2018

Christoph Köppl (acib project 94081)
Fusion Tag design for generic CASPON platform
Supervisor: Monika Cserjan, Gerald Striedner
Start: Oktober 2020

Claudia Lacombe (H2020 Fet Open PURE)
Production of ncAAs for spider silk protein modification
Supervisor: Birgit Wiltschi, Gerald Striedner
Start: November 2020

Narges Lali (H2020 ITN CODOBIO)
Residence Time distribution of pseudo-continuous methods
Supervisor: Alois Jungbauer
Start: June 2019

Florian Mayer (CD-Lab NLBP)
Influence of fermentation strategies and scale effects on Fab production in E. coli
Supervisor: Gerald Striedner
Start: July 2019

Matthias Müller (CD-Lab NLBP)
Investigation on disulfide bridge formation in peptides produced by periplasmic expression in Escherichia coli
Supervisor: Rainer Hahn
Start: Februar 2021

Bettina Motycka (BioTop)
Resolving dynamic protein conformations in multidomain enzymes with SAXS
Supervisors: Roland Ludwig, Rupert Tscheliessnig
Start: 2019

Magdalena Pappenreiter (FFG Cubic)
Development of perfusion control concepts and integrated solutions in fully continuous and automated End-to-End biomanufacturing processes
Supervisor: Alois Jungbauer
Start: January 2020

Gabriele Recanati (FFG Cubic)
Modeling, optimization and automation of a continuous manufacturing process platform for biopharmaceuticals focused on downstream unit operations
Supervisor: Alois Jungbauer
Start: November 2020

Tommaso de Santis (ENZYCLE)
Economic modeling of enzyme based plastics degradation and recycling processes
Supervisor: Gerald Striedner
Start: December 2020

Sonja Schürer-Waldheim (BioTop)
Phosphoproteomics of antibody producing CHO cell lines
Supervisors: Renate Kunert, Gorji Marzban
Start: 2019

Ignacio Montes Serrano (H2020 ITN CODOBIO)
Determination of a mathematical model for the power input in shaken microtiter plates and correlation with larger size vessels
Supervisor: Astrid Dürauer
Start: May 2019

Florian Strobl (acib project 25041)
Continuous production of biomolecules with insect cells
Supervisor: Gerald Striedner
Start: January 2016

Sophie Anna Vazulka (CD-Lab NLBP)
Host cell response to antibody fragment production in E. coli with special focus on transcriptome and translatome
Supervisor: Gerald Striedner
Start: January 2019

Yao Yuelang (Biotop Joint Project BOKU)
Effect of membrane organization on weak acid transport proteins;
Supervisor: Vorauer-Uhl Karola and Michael Sauer
Start: August 2020

Master theses

Finished

Lena Achleitner
INNOVATIVE PROCESS DEVELOPMENT AND OPTIMISATION WITH COMPUTATIONAL FLUIDS DYNAMICS FOR CONTINOUS PROTEIN PURIFICATION USING HYDROCYCLONES.
Supervisor: Alois Jungbauer
Finished: 2021

Ignasi Bofarull Manzano (Novasign)
Hybridmodeling for tangential flow filtration applied to multicomponent systems
Supervisor: Astrid Dürauer, Maximilian Krippl
Finished: March 2021

Andreas Dietrich (CD-Lab NLBP)
Influence of different fed-batch and induction strategies on cell growth, Fab production kinetics and downstream process performance in Escherichia coli lab-scale bioreactor cultivations.
Supervisor: Gerald Striedner, Monika Cserjan
Finished: November 2021

Lorenz Haider (BioIndustrial Pilot Plant)
Establishment of a changeover management system for the BioIndustrial Pilot Plant at BOKU
Co-Supervisor: Markus Luchner (Supervision IMC FH-Krems)
Finished: August 2021

Veronika Költringer Noppinger (external thesis at Novartis Austria)
Utilizing the full potential of dielectric spectroscopy as a PAT tool in cell culture fed-batch processes
Supervisor: Gerald Striedner, Christoph Posch
Finished: September 2021

Magdalena Kößlbacher (BI RCV)
Development of an analytical throughput cell disruption method
Supervisor: Karola Vorauer-Uhl
Finished: December 2021

Matthias Medl (external thesis at BIRCV)
Online Estimation of the Optical Density in a High-Throughput Fermentation Platform
Supervisor: Gerald Striedner
Finished: April 2021

Matthias Müller
Optimization of filtrations steps for E. coli homogenates
Supervisor: Rainer Hahn
Finished Jan. 2021

Dominik Nendwich (Frontrunner)
Quality risk management process in an End-to-End process train for the production of bio-pharmaceutical products
Supervisor: Karola Vorauer-Uhl
Finished: November 2021

Alejandro Santiago-Leon (CD-Lab NLBP)
Chromatographic purification of Fab fragments
Supervisor: Rainer Hahn
Finished Nov. 2021

Christopher Tauer (CD-Lab NLBP)
Downregulation of periplasmic proteases via small RNAs: effects on recombinant Fab expression in Escherichia coli.
Supervisor: Gerald Striedner, Monika Cserjan
Finished: October 2021

On-going

Nora Dürkop (BIOMIN)
Optimization of the drying process of a bacterial feed additive
Supervisor: Gerald Striedner
Start: July 2019

Benedikt Haslinger (CD-Lab NLBP)
Fermentation scale effects on downstream processability of E. coli fermentation broths
Supervisor: Gerald Striedner, Florian Mayer
Start: January 2021

Florian Kaiser
Increase of macroscopic understanding of protein refolding in batch and pilot scale manufacturing
Supervisor: Rainer Hahn
Start: Nov 2019

Tobias Kargl (FFG Research Studio Novasign)
Predictive Hybrid Modeling of Single-Pass Tangential Flow Filtration
Supervisor: Astrid Dürauer
Start: 2020

Konstanze Kastenhofer (AGES)
Brivaracetam – practical considerations for the development of a European Pharmacopoeia Monograph
Supervisor: Karola Vorauer-Uhl
Start: November 2020

Marco Kaupe (BioIndustrial Pilot Plant)
Risk-based quality assurance for process control system operations in a multipurpose Pilot Plant
Supervisor: Karola Vorauer-Uhl, Markus Luchner
Start: September 2021

Roman Liebhart (CD-Lab NLBP)
Balance between heavy and light chain for optimised Fab production in Escherichia coli: expression of additional heavy chain
Supervisor: Gerald Striedner, Monika Cserjan
Start: April 2021

Alexander Mechtler
Investigations on solid diffusion mass transfer on anion exchange chromatography resins
Supervisor: Rainer Hahn
Start: July 2020

Franz Moisi (Valneva)
Evaluation of fermentation process parameters influencing the fatty acid composition of bacterial lipoprotein
Supervisor: Gerald Striedner
Start: July 2018

Markus Mozgovicz (acib project 91023)
Adsorption effects on thermal stability of proteins
Supervisor: Alois Jungbauer, Nico Lingg
Start: March 2020

David Scheich
Experimental characterization and modelling of flow non-uniformities in small chromatography columns
Supervisor: Rainer Hahn
Start: June 2021

Patrick Scheidl (acib project 94081)
Characterization of Circularly Permuted Caspase-2 and Screening of Buffer Conditions for Affinity Fusion-Tag Removal
Supervisor: Alois Jungbauer, Nico Lingg
Start: April 2020

Anton Shpylovyi (CD-Lab NLBP)
Fermentation scale effects on product related non-canonical amino acid misincorpoartion in different E. coli strains.
Supervisor: Gerald Striedner, Florian Mayer
Start: October 2020

Florian Simon (CD-Lab NLBP)
Influence of MicL co-expression on growth and periplasmic sfGFP production kinetics in Escherichia coli lab-scale bioreactor cultivations
Supervisor: Gerald Striedner, Monika Cserjan
Start: March 2021

Lina Vranitzky (FFG Research Studio Novasign)
Intensification of the experimental design for Escherichia coli fed-batch fermentations
Supervisor: Gerald Striedner, Benjamin Bayer
Start: February 2019

Bachelor theses

Finished

Katharina Somogyi (acib project 94041)
Evaluation of commercial test systems for quantitative DNA analysis
Supervisor: Astrid Dürauer
Finished: September 2021

Alexander Karner
Slowdown of mass transfer: Adsorption of fibroblast growth factor 2 on cation exchange chromatography media in pure and crude solution
Supervisor: Rainer Hahn
Finished: June 2021

On-going

Alexandra Katholnig (HIV-Vaccine)
Optimization of N-terminal reductive alkylation of proteins for bioconjugation to liposomes;
Supervisor: Karola Vorauer-Uhl
Start: September 2019

Dominik Kallinger
Bacterial Cell disruption in a Bench-top Bead Mill
Supervisor: Astrid Dürauer
Start: November 2021

Karoline Reznar (CD-Lab NLBP)
Downregulation of the periplasmic chaperon LolA by a synthetic small regulatory RNA strategy to increase cell permeability in Escherichia coli
Supervisor: Gerald Striedner, Monika Cserjan
Start: August 2021

Scientific output

Scientific publications in peer-reviewed journals

1. Atzl, M., Muendlein, A., Winder, T., Fraunberger, P., Brandtner, E.-M., Geiger, K., Klausberger, M., Duerkop, M., Sprenger, L., Mutschlechner, B., Volgger, A., Benda, M., Severgnini, L., Jaeger, J. B., Drexel, H., Lang, A., & Leiherer, A. (2021). SARS-CoV-2 serostatus of healthcare worker in the Austrian state Vorarlberg between June 2020 and January 2021. MedRxiv, June 2020.
2. Bayer, B., Diaz, R. D., Melcher, M., Striedner, G., & Duerkop, M. (2021). Digital twin application for model-based doe to rapidly identify ideal process conditions for space-time yield optimization. Processes, 9(7). https://doi.org/10.3390/pr9071109
3. Bayer, B., Maccani, A., Jahn, J., Duerkop, M., Kapeller, E., Pletzenauer, R., Kraus, B., Striedner, G., & Hernandez Bort, J. A. (2021). Proton-transfer-reaction mass spectrometry (PTR-MS) for online monitoring of glucose depletion and cell concentrations in HEK 293 gene therapy processes. Biotechnology Letters. https://doi.org/10.1007/s10529-021-03205-y
4. Beck, J., von Lieres, E., Zaghi, N., Leweke, S., Carta, G., & Hahn, R. (2021). Patterns of protein adsorption in ion-exchange particles and columns: Evolution of protein concentration profiles during load, hold, and wash steps predicted for pore and solid diffusion mechanisms. Journal of Chromatography A, 1653. https://doi.org/10.1016/j.chroma.2021.462412
5. Bhaskara, V., Leal, M. T., Seigner, J., Friedrich, T., Kreidl, E., Gadermaier, E., Tesarz, M., Rogalli, A., Stangl, L., Wallwitz, J., Hammel, K., Rothbauer, M., Moll, H., Ertl, P., Hahn, R., Himmler, G., Bauer, A., & Casanova, E. (2021). Efficient production of recombinant secretory IgA against Clostridium difficile toxins in CHO-K1 cells. Journal of Biotechnology, 331. https://doi.org/10.1016/j.jbiotec.2021.02.013
6. Christler, A., Scharl, T., Sauer, D. G., Köppl, J., Tscheließnig, A., Toy, C., Melcher, M., Jungbauer, A., & Dürauer, A. (2021). Technology transfer of a monitoring system to predict product concentration and purity of biopharmaceuticals in real-time during chromatographic separation. Biotechnology and Bioengineering, 118(10). https://doi.org/10.1002/bit.27870
7. De Vos, J., Pereira Aguilar, P., Köppl, C., Fischer, A., Grünwald-Gruber, C., Dürkop, M., Klausberger, M., Mairhofer, J., Striedner, G., Cserjan-Puschmann, M., Jungbauer, A., & Lingg, N. (2021). Production of full-length SARS-CoV-2 nucleocapsid protein from Escherichia coli optimized by native hydrophobic interaction chromatography hyphenated to multi-angle light scattering detection. Talanta, 235. https://doi.org/10.1016/j.talanta.2021.122691
8. Fink, M., Cserjan-Puschmann, M., Reinisch, D., & Striedner, G. (2021). High-throughput microbioreactor provides a capable tool for early stage bioprocess development. Scientific Reports, 11(1). https://doi.org/10.1038/s41598-021-81633-6
9. Fink, M., Schimek, C., Cserjan-Puschmann, M., Reinisch, D., Brocard, C., Hahn, R., & Striedner, G. (2021). Integrated process development: The key to improve Fab production in E. coli. Biotechnology Journal, 16(6). https://doi.org/10.1002/biot.202000562
10. Hammerschmidt, N., Engelmaier, H., Dattenböck, C., Sencar, J., & Jungbauer, A. (2021). Structured bottom section in inclined settlers for efficient continuous solid-liquid separation and washing of the solid fraction. Separation and Purification Technology, 259. https://doi.org/10.1016/j.seppur.2020.118142
11. Jakob, L. A., Beyer, B., Janeiro Ferreira, C., Lingg, N., Jungbauer, A., & Tscheließnig, R. (2021). Protein-protein interactions and reduced excluded volume increase dynamic binding capacity of dual salt systems in hydrophobic interaction chromatography. Journal of Chromatography A, 1649. https://doi.org/10.1016/j.chroma.2021.462231
12. Jungbauer, R., Breunig, J., Schmid, A., Hüfner, M., Kerberger, R., Rauch, N., Proff, P., Drescher, D., & Becker, K. (2021). Transfer accuracy of two 3d printed trays for indirect bracket bonding—an in vitro pilot study. Applied Sciences (Switzerland), 11(13). https://doi.org/10.3390/app11136013
13. Kastenhofer, J., Cataldo, A. L., Ebner, J., Sedlmayr, V. L., Jungbauer, A., & Spadiut, O. (2021). Economic and ecological benefits of a leaky E. coli strain for downstream processing: a case study for staphylococcal protein A. Journal of Chemical Technology and Biotechnology, 96(6). https://doi.org/10.1002/jctb.6691
14. Klausberger, M., Duerkop, M., Haslacher, H., Wozniak-Knopp, G., Cserjan-Puschmann, M., Perkmann, T., Lingg, N., Aguilar, P. P., Laurent, E., De Vos, J., Hofner, M., Holzer, B., Stadler, M., Manhart, G., Vierlinger, K.,

Egger, M., Milchram, L., Gludovacz, E., Marx, N., … Grabherr, R. (2021). A comprehensive antigen production and characterisation study for easy-to-implement, specific and quantitative SARS-CoV-2 serotests. Ebiomedicine, 67. https://doi.org/ARTN 103348 10.1016/j.ebiom.2021.103348

15. Komuczki, D., Dutra, G., Gstöttner, C., Dominguez-Vega, E., Jungbauer, A., & Satzer, P. (2021). Media on-demand: Continuous reconstitution of a chemically defined media directly from solids. Biotechnology and Bioengineering, 118(9). https://doi.org/10.1002/bit.27738
16. Krippl, M., Kargl, T., Duerkop, M., & Dürauer, A. (2021). Hybrid modeling reduces experimental effort to predict performance of serial and parallel single-pass tangential flow filtration. Separation and Purification Technology, 276. https://doi.org/10.1016/j.seppur.2021.119277
17. Kröß, C., Engele, P., Sprenger, B., Fischer, A., Lingg, N., Baier, M., Öhlknecht, C., Lier, B., Oostenbrink, C., Cserjan-Puschmann, M., Striedner, G., Jungbauer, A., & Schneider, R. (2021). PROFICS: A bacterial selection system for directed evolution of proteases. Journal of Biological Chemistry, 297(4). https://doi.org/10.1016/j.jbc.2021.101095
18. Lali, N., Jungbauer, A., & Satzer, P. (2021). Traceability of products and guide for batch definition in integrated continuous biomanufacturing. Journal of Chemical Technology and Biotechnology. https://doi.org/10.1002/jctb.6953
19. Lhota, G., Sissolak, B., Striedner, G., Sommeregger, W., & Vorauer-Uhl, K. (2021). Quantification of glycated IgG in CHO supernatants: A practical approach. Biotechnology Progress. https://doi.org/10.1002/btpr.3124
20. Lingg, N., Cserjan-Puschmann, M., Fischer, A., Engele, P., Kröß, C., Schneider, R., Brocard, C., Berkemeyer, M., Striedner, G., & Jungbauer, A. (2021). Advanced purification platform using circularly permuted caspase-2 for affinity fusion-tag removal to produce native fibroblast growth factor 2. Journal of Chemical Technology and Biotechnology, 96(6). https://doi.org/10.1002/jctb.6666
21. Maghuly, F., & Marzban, G. (2021). Editorial: Omics Technologies Toward Systems Biology. In Frontiers in Genetics (Vol. 12). https://doi.org/10.3389/fgene.2021.756847
22. Montes-Serrano, I., Satzer, P., Jungbauer, A., & Dürauer, A. (2021). Characterization of hydrodynamics and volumetric power input in microtiter plates for the scale-up of downstream operations. Biotechnology and Bioengineering. https://doi.org/10.1002/bit.27983
23. Perkmann, T., Koller, T., Perkmann-Nagele, N., Klausberger, M., Duerkop, M., Holzer, B., Hartmann, B., Mucher, P., Radakovics, A., Ozsvar-Kozma, M., Wagner, O. F., Binder, C. J., & Haslacher, H. (2021). Spike Protein Antibodies Mediate the Apparent Correlation between SARS-CoV-2 Nucleocapsid Antibodies and Neutralization Test Results. Microbiology Spectrum, 9(1). https://doi.org/10.1128/spectrum.00218-21
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25. Puente-Massaguer, E., Grau-Garcia, P., Strobl, F., Grabherr, R., Striedner, G., Lecina, M., Gòdia, F., & Godia, F. (2021). Accelerating HIV-1 VLP production using stable High Five insect cell pools. Biotechnology Journal, 16(4), e2000391. https://doi.org/10.1002/biot.202000391
26. Sauer, D. G., Mosor, M., Jungbauer, A., & Dürauer, A. (2021). Separation of truncated basic fibroblast growth factor from the full-length protein by hydrophobic interaction chromatography. Separation and Purification Technology, 254. https://doi.org/10.1016/j.seppur.2020.117564
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30. Schwaiger, K. N., Cserjan-Puschmann, M., Striedner, G., & Nidetzky, B. (2021). Whole cell-based catalyst for enzymatic production of the osmolyte 2-O-α-glucosylglycerol. Microbial Cell Factories. https://doi.org/10.1186/s12934-021-01569-4
31. Spanov, B., Olaleye, O., Lingg, N., Bentlage, A. E. H., Govorukhina, N., Hermans, J., van de Merbel, N., Vidarsson, G., Jungbauer, A., & Bischoff, R. (2021). Change of charge variant composition of trastuzumab upon stressing at physiological conditions. Journal of Chromatography A, 1655. https://doi.org/10.1016/j.chroma.2021.462506
32. Stargardt, P., Striedner, G., & Mairhofer, J. (2021). Tunable expression rate control of a growth-decoupled T7 expression system by l-arabinose only. Microbial Cell Factories, 20(1). https://doi.org/10.1186/s12934-021-01512-7
33. Strobl, F., Duerkop, M., Palmberger, D., & Striedner, G. (2021). High shear resistance of insect cells: the basis for substantial improvements in cell culture process design. Scientific Reports, 11(1). https://doi.org/10.1038/s41598-021-88813-4
34. Sun, Y. N., Shi, C., Zhang, Q. L., Slater, N. K. H., Jungbauer, A., Yao, S. J., & Lin, D. Q. (2021). Comparison of Protein A affinity resins for twin-column continuous capture processes: Process performance and resin characteristics. Journal of Chromatography A, 1654. https://doi.org/10.1016/j.chroma.2021.462454
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36. Yassouridis, C., Dürauer, A., Scharl, T., Leisch, F., Brocard, C., & Tscheliessnig, A. L. (2021). Strategy to equivalence testing for development and scale up of biopharmaceutical downstream processes. Chemical Engineering Science, 235. https://doi.org/10.1016/j.ces.2021.116497

Presentations and Posters

1. Duerkop, M; Bayer, B; Dalmau-Diaz, R; Melcher, M; Striedner, G (2021): Increasing Efficiencies in Bioprocess Development and Manufacturing through Digital Process Development. Methodology and practice of digital transformation of vaccination/immunization processes in the population, 28.06.2021, Virtuell / Moskau
2. Duerkop, M; Bayer, B; Krippl, M; Duerauer, A; Striedner, G (2021): From experiments, data, hybrid models, and digital twins. Several up- and downstream success stories highlighting the benefits of using advanced process modeling. Bioprocessing, April 7, 2021, virtual
3. Duerkop, M; Bayer, B; Krippl, M; Duerauer, A; Striedner, G (2021): Hybrid Modeling for Up- and Downstream for Faster Process Development, Soft sensors and Model Predictive Control. Biological Manufacturing Asia, March 15-18, 2021, virtua
4. Fink, Mathias; Monika Cserjan; Daniela Reinisch; Cécile Brocard; Rainer Hahn; Gerald Striedner (2021): Effects of Fab expression in E. coli on up- and downstream processing relevant parameters. 13th ECCE and 6th ECAB, 20.09.-23.09, Online
5. Jakob, L. A., Beyer, B., Janeiro Ferreira, C., Lingg, N., Jungbauer, A., & Tscheließnig, R. (2021). Protein-protein interactions and reduced excluded volume increase dynamic binding capacity of dual salt systems in hydrophobic interaction chromatography. 40th International Symposium on the Separation of Proteins, Peptides & Polynucleotides, NOV 7-10, 2021, Porto, Portugal
6. Hahn, Rainer: Multicomponent Adsorption as a Hindrance of Fab Fragment Purification. 34st PREP Symposium, June 07-09, 2021, (e-PREP), USA. (invited lecture)
7. Krippl, M; Kargl, T; Duerkop M;, Dürauer, A (2021): Hybrid Modelling for Accelerated process development of ultrafiltration processes. [Poster] 13th ESBES Symposium, May 4-5, 2021, virtual
8. Krippl, M; Kargl, T; Duerkop, M; Dürauer, A (2021): Advanced Ultra- and Diafiltration Modeling: Predicting process parameters precisely and fast. Mini 4th Modelling Workshop 2021, May 25th, 2021, virtua
9. Krippl, M; Kargl, T; Duerkop, M; Dürauer, A(2021): Hybrid Modeling in Ultra- and Diafiltration: Predicting process performance and enabling digital solutions. ECAB 2021, Sept 20-23, 2021 , virtual
10. Krippl, M; Kargl,T; Duerkop,M; Dürauer, A (2021): Hybrid Modeling in Tangential Flow Filtration: From batch to continuous filtration,.Bioprocessing Summit Europe Virtual, March 16-17th, 2021, virtual
11. Lingg, N; Fischer, A; Striedner, G; Oostenbrink, C; Schneider, R; Berkemeyer, M; Jungbauer, A (2021): Affinity Tag-based Development and Manufacturing Platform for Non-platform Proteins. 34th International

Symposium on Preparative and Process Chromatography, e-PREP 2021, JUN 7-9, 2021, Baltimore, USA – online

12. Lingg, Nico (2021): Affinity tag-based development and manufacturing platform for non-platform proteins. 40th International Symposium on the Separation of Proteins, Peptides & Polynucleotides, NOV 7-10, 2021, Porto, Portugal
13. Mayer, Florian, Monika Cserjan, Christian Sam, Gerald Striedner (2021): Scale-down of high cell density Fab production in E.coli. 6th BioProScale Symposium , March 29-31, 2021, Berlin, GERMANY, online
14. Mayer, Florian, Monika Cserjan, Christian Sam, Gerald Striedner (2021): Scale-down of high cell density Fab production in E.coli. [Poster] 13th European Symposium on Biochemical Engineering Sciences (ESBES), May 4-5, 2021, online
15. Montes-Serrano, I, A. Dürauer: Experimental and simulated determination of the volumetric power input in microtiter plates as a scale-up strategy for the development of downstream operations (Poster), 13th ECCE and 6th ECAB, 20-23 September 2021, online
16. Montes-Serrano, I, A. Dürauer: Experimental and simulated determination of the volumetric power input in microtiter plates as a scale-up strategy for the development of downstream operation (Flash Talk), ISPPP 2021, 07 – 10 Nov,2021, Porto
17. Montes-Serrano, I, A. Dürauer: From micro to macro: a study on the volumetric power input in microtiter plates and its use as a strategy for scale-up in downstream processing (Poster), BioProScale 2021, 30 March - 1 April, 2021, online
18. Montes-Serrano, I, A. Dürauer: From micro to macroscale: modelling the volumetric power input in shaken microtiter plates to develop a scale-up strategy for downstream operations (Talk), ESBES 2021, 4 - 5 May, 2021, online
19. Montes-Serrano, I; Dürauer, A (2021): CFD simulations for the hydrodynamic characterization of microtiter plates for the development of a scale-up strategy of downstream processes based on volumetric power input. Mini 4th Modelling Workshop 2021, May 25th, 2021, virtual
20. Montes-Serrano, I; Dürauer, A (2021): Experimental and simulated determination of the volumetric power input in microtiter plates as a scale-up strategy for the development of downstream operations. [Poster] ECAB 2021, Sept 20-23, 2021, virtual
21. Montes-Serrano, I; Satzer, P; Jungbauer, A;. Dürauer, A (2021): From micro to macro scale: modelling the volumetric power input in shaken microtiter plates to develop a scale-up strategy for downstream operations. 13th ESBES Symposium, May 4-5, 2021, virtual
22. Montes-Serrano,I; Satzer, P; Jungbauer, A; Dürauer, A (2021): From micro to macro: a study on the volumetric power input in microtiter plates and its use as a strategy for scale-up in downstream processing. [Poster] 6th BioProScale Symposium 2021, March 29- 31, 2021, virtual
23. Sauer, D; Melcher, M; Walch, N; Scharl-Hirsch, T; Leisch, F; Jungbauer, A; Dürauer, A (2021): Real-Time Monitoring and model-based Prediction of Product Purity and Quantity throughout Downstream Processing of Biopharmaceuticals. PREP symposium 2021, June 7-9, 2021, virtual
24. Striedner, Gerald (2021): Production of Premium Quality SARS-CoV2 Antigens – An Ultra-fast Process Development Approach. Bioprocessing Summit Europe - Virtual, 16. - 17.03.2021, online

Other publications

1. Gorji Marzban & Donatella Tesei, Editorial, MDPI, Biology, Special Issue "Proteomics of Extremophiles" https://www.mdpi.com/journal/biology/special_issues/proteomics_extremophiles
2. Fatemeh Maghuly & Gorji Marzban, Editorial, Frontiers Genetics, Special Issue “Omics Technologies Toward Systems Biology” https://www.frontiersin.org/research-topics/13533/omics-technologies-toward-systems-biology

Teaching activities

#	Title	Programme	ECTS
166655	Integrated biopharmaceutical production in pilot scale	TU Vienna	6
772327	Biochemical and biotechnological methods (analytics design) (in Eng.)	BT	3
790044	Sicherheit am Arbeitsplatz	Bachelor´s FBT	2
790049	Masterseminar Angewandte Mikrobiologie (in Eng.)	Master´s FBT	2
790105	Practical course in applied microbiology	FBT	4
790107	Bachelor´s thesis seminar	Bachelor´s FBT	12
790120	Grundlagen der Bioverfahrenstechnik	Bachelor´s FBT	5.5
790321	Biotechnol. Praktikum	Master´s FBT	4.5
790350	Bioprocess engineering I (in Eng.)	BT	3
790353	Quality management in biotechnology (in Eng.)	BT	3
790358	Bioprocess engineering II (in Eng.)	BT	3
790359	Bioprocess engineering laboratory (in Eng.)	BT	5
790371	Automation of bioprocesses (in Eng.)	BT	2
790380	Engineering of biotechnological production facilities (in Eng.)	BT	2
790419	Journal club BioToP III (in Eng.)	DK BioToP	1.5
790423	Doctoral seminar BioToP III (in Eng.)	DK BioToP	1.5
790431	Pilot plant BioproEng (in Eng.)	DK BPE	8
790432	Doctoral Seminar BPE	DK BPE	0.5
790433	Journal Club BPE	DK BPE	0.5
790940	Dissertantenseminar aus Angewandte Mikrobiologie	BT	2
791432	Doctoral seminar BioproEng I (in Eng.)	DK BIOTOP	0.5
791433	Journal club BioproEng I (in Eng.)	DK BPE	3
791437	Automation and control in laboratory (in Eng.)	DK BPE	2
791438	Biothermodynamics (in Eng.)	DK BPE	2
894404	Basic course IV - bioinformatics and molecular modelling (in Eng.)	DK BIOTOP	3
894415	Instructional course IVA - molecular modelling (in Eng.)	DK BIOTOP	3

BT … Biotechnology, FBT … food and biotechnology, DK BPE … Doctoral School Bioprocess Engineering,

External Teaching Activities and Courses 2021

Organization	Title	Programme
FH-Bioengineering, Campus Wien	Qualitätskontrolle	Master Quality Management
FH-Bioengineering, Campus Wien	Qualitätskontrolle und Qualitätssicherung im Prüflaboratorium	Master Quality Management
FH-Bioengineering, Campus Wien	Downstream Processing, Protein VO	Bachelor Bioengineering
FH-Bioengineering, Campus Wien	Downstream Processing, Protein VO+UE	Master Biotechnology
IMC FH Krems	Process Control and Process Online Monitoring	Master Biotechnology
Montan Universität Leoben	Qualitätssicherung im chemischen Labor	University Course

Epilogue and outlook

At the end of the annual report, we build a bridge to the introduction and take a look to the future planned activities and goals for the next year and beyond.

In 2022, Johannes Buyel will take over the professorship in Downstream Processing at our institute. We are looking forward to this new professor bringing a new spirit and ideas to our institute. Welcome, Johannes!

For the DocSchool Bioprocess Engineering, which is coordinated by Astrid Dürauer since fall 2021 as scientific director, the first evaluation will take place in 2022 which will hopefully allow a prolongation of this successful program. The DocSchool BioproEng has recently applied for a doc.funds project at FWF. This multidisciplinary project will be focused on fundamental questions of bioprocess engineering which will be addressed by 15 PhD thesis on the metabolic, cellular and process level of bioprocesses. The topic is of course within the core research field of our institute, but the proposal is supported by a multidisciplinary faculty team from seven BOKU institutes which will allow a broader view on challenging topis in the field.

Two transnational FWF research projects starting in 2022 underline our efforts and success in strengthening our competencies in basic research for bioprocess engineering. This will further enhance the scientific quality of our work and help to increase the attractiveness of IBSE as a research partner for academia and industry.

Application preparations for the next funding period of the acib center of excellence in the FFG COMET K2 program are ongoing. IBSE researchers will be intensively involved in continuing this successful cross-university collaboration with the biotech industry.

In the area of teaching, work will focus on the redesign of the bachelor's degree program in food and biotechnology. The major goal is to enhance the “studybility” and reduce the length of study while maintaining high quality. IBSE gets involved in this process in the responsible committees and we are optimistic that in a joint effort with the willingness to question the previous and to think new, the "squaring of the circle" should be feasible.

Gerald Striedner

Astrid Dürauer

On behalf of the entire IBSE Team

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