CEITEC
MASARYK UNIVERSITY

Technology Transfer Scouting Report

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15/01/2018

CONTENT

1. Aims of the report

The current report is desgined to update on activities related to TT at CEITEC MU. Further, this report should be supportive material for setting up a technology transfer strategy at CEITEC MU. Last but not least, it points to the services demanded by researchers.

2. Overview of Meetings with Research Group Leaders and Their Timeline

During the period from September to December 2017, I have contacted all group leaders from „Genomics and Proteomics of Plant Systems“, „Structural Biology“ and „Molecular Medicine“, as well as all heads of Core Facilities.

All group leaders from „Genomics and Proteomics of Plant Systmes“ readily engaged in commnucation and I was able to meet them personally and had an introductory meeting (1 hour on average) by the end of October 2017.

Only three group leaders from „Structural Biology“ replied to my introductory emails. I had introductory meetings with Richard Stefl in November and Robert Vacha in December. Pavel Plevka expressed a desire to meet when his work load allows.

Four group leaders from „Molecular Medicine“ found time and desire to accept my invitation for an introductory meeting. I met Michal Smida and Marek Mraz in November, and Marry O’Connel in October. Ondrej Slaby has been postponing the meeting despite several attempts to set a date in person and by email.

I met the following heads of core facilites in October: Natalia, Boris, Michal, Martin, Radovan, Jiri and Zbynek. The rest never replied to my emails.

I have not contacted the group leaders from „Brain and Mind Research" since my scientific background and market knowledge do not allow me to accurately evaluate any potential inventions.

I am planning to contact all group leaders whom I have not had a chance to meet once a clear technology transfer strategy, incl. the specific roles and duties of the technology transfer manager has been devised and clearly communicated to all personnel.

3. Technology Transfer Awareness of Individual Research Groups

3.1. STRUCTURAL BIOLOGY

3.1.1. Robert Vácha Research Group

The main line of research in the group is centered around the elucidation of key protein-membrane and protein-protein interactions that regulate cellular signaling, transport and are important part of the human immune system. Change in these interactions can result in lethal diseases ranging from cancer to Alzheimer's disease. Previously the group has computationlly identified a particular lipid that regulates the accumulation of proteins during the onset of Alzheimer's disease. Currently, several groups are working to validate the relevant protein – lipid interactions. The lipid levels can be used in early diagnostic of Alzheimer's disease. Moreover, if the interaction can be manipulated by small molecules, the possibility to identify such chemicals can lay the foundation of a line of research with a significant commercial potential.

The research group is actively exploring the relation between protein sequences and their assembly or preferred membrane composition and morphology. Such molecular information can be used to understand protein localization in cells, evaluate the risk of the diseases, develop new therapeutic peptides (antimicrobial peptides, sensors, target specific drug

carriers), and suggest new treatment strategies (including lipid diet and altering lipid metabolism. A numer of computationaly derived peptides are being tested for antimicrobial actitivty in vitro. Of special interest are peptides that can form membrane pores as primary mechanism of action and their interactions with membrane lipids. If the molecular basis of these interaction are understood this can be the basis of strategies to treat fugal skin infections.

The group is well aware of the commercial potential of the ongoing research projects and have previously identified, but not contacted, several small European companies that are involved in similar activities. The TTO has been previosly advised regarding a potential patent application for antimicrobial peptides, but this has not been followed up due to the preliminary nature of the results according to the TTO.

The research has a good tech transfer potential and should be further supported by all means.

3.1.2. Richard Štefl Research Group

The group is interested in the role of RNA in gene expression, development and human diseases and studies the interplay between chromatin and gene expression. Even though the conducted research is predominantly basic in nature, the high standards and international recognition of the group makes it a potentially valuable partner for companies with R&D activties in need of specific expertise.

To meet its need of phosphorylated long-peptides for structural biology studies, the group has developed an enzymatic method to phosphorylate multiple amino acids. Such peptides can be chemically synthesized but at a significantly higher price. The group is interested in patenting the invention.

A valuble partner for technogy transfer activities.

3.2. MOLECULAR MEDICINE

3.2.1. Mary O'Connell Research Group

The activities of the group revolve around identification of novel RNA editing/RNA modification events and investigating the biological function of nucleotide modification in innate immunity and disease.

In general, its a hot topic but presently there is nothing immediately suitable for technology transfer. The research activities should be monitored closely and potentially matched with the interests of commercial partners investigating the field.

The group is open to engage in technology transfer activities and some potential avenues for applied research have been discussed, such as the use of modified oligos to trigger immune response for biotechnological applications. However, these do not fall in the immediate circle of research interests and not considered.

3.2.2. Michal Šmída Research Group

The group leader has substantial interests in doing more applied research and be as close as possible to an actual application of his research efforts. This has been a major driving force to shift the focus from basic research to more applied projects. Currently, a major interers is targeted gene editing and whole-genome knockout screens using CRISPR/Cas9 technology for prediction of novel targeted therapies. The screen conditions are currently being optimized. If successful the screen has the potential to identify many targets that can be further validated and used to screen against commercial chemical libraries.

The group is also engaged in repurposing of approved drugs for personalized therapy in solid and hematological cancers. At the moment a relatively small library is being used but a bigger collection of FDA approved drugs is being acquire. Drug repurposing is a hot topic and potential discoveries are likely to be of immediate interest of pharmaceutical companies.

The group is relatively new but in a long run has a good potential to deliver promising targets that might attract interests from pharmaceutical companies. If the screens are successful, the group would not have the capacity to follow up all targets. One way to approach this is to look for commercial partners willing to validate the targets and conduct chemical screens against them.

The group has previously contacted the TTO regarding the development and optimization of tumor therapy using genetically engineered T cells to carry chimeric antigen receptors (CAR-T cell therapy). This is heavily regulated field and the group and its collaborates were interested to know whether their activities would potentially infringe existing patents.

No previous contacts with companies but has previously observed colleagues in Vienna who established a spin off. In general, a valuable tech transfer partner who should be encouraged and supported.

3.2.3 Marek Mraz Research Group

The research group is investigating the use of micro RNA as diagnostic tools to define prognosis and response to therapy. Marek has successfully engaged in tech transfer activities based on two inventions around microRNA 150 and microRNA 34a. The first one is developed in collaboration with Janssen, whereas the second one is being offered to potentially interested partners for evaluation (a meeting with Biovendor took place in January).

Marek has been identifying and contacting potentially interesting companies alone. He would appreciate certain help in arranging contacts with companies, negotiations and training.

A lot of the activities related to achieving a certain proof of concept require repetitive work which can be stimulated if a certain amount of money is allocated at the right time for consumables and salaries.

3.3. GENOMICS AND PROTEOMICS OF PLANT SYSTEMS

3.3.1. Jiří Fajkus Research Group

The research directions of the group are centered around structure, evolution and maintenance of telomeres and their roles in chromosome stability and plant speciation. The field has a potential applied side related to plant breeding. Nevertheless, the primarily focus of the group is basic research and any activities beyond that might not be well incorporated.

Within a recent OPVV project proposal the group has been engaged with PSI and the Potato Research Institute.

The group would definitely benefit from exposure to tech transfer training.

3.3.2. Vanesa Beatriz Tognetti Research Group

The primary focus of the group is investigating the crosstalk between reactive oxygen species and hormonal homeostasis (auxin and cytokinin). Given the crucial role of these signaling mechanisms in adaptation to the environment, the research is perfectly situated to deliver novel traits for abiotic resistance.

The group has been successful in obtaining promising results by manipulating the expression levels of specific chloroplast transporters in Arabidopsis resulting in tolerance to environmental stress and higher seed yield. The TTO has not been contacted yet due the desire to validate the results further.

Vanesa is a strong supporter of tech transfer related research as exemplified by previous patents and applied discoveries.

3.3.3. Tomasz Nodzynski Research Group

The main interest of the group is regulation of cell polarity and trafficking of PIN auxin transporters. The research is exclusively basic in nature but taking into account the

fundamental role of the plant hormone auxin in virtually all developmental and growth processes any ground breaking discoveries might have unexpected applied potential.

For example, upon structural elucidation of auxin trafficking by PIN transporters, the accumulated knowledge can be used to systematically mutate specific amino acid residues or design high-throughput chemical screens aimed to discover novel biostimulants. The group has previously noted that overexpressing PIN-GFP results in bigger plants. Since this was a side observation, it was not followed up further but such beneficial traits are of potential commercial interest and might be interesting to explore further.

Tomasz does not have any established contacts with companies but is interested to get the know more about the industry. Moreover, there is a clear desire to engage in more applied research.

3.3.4. Helene Robert Boisivon Research Group

The research in the group has a strong fundamental basis built over the years, which is now being channelled in directions of potential agricultural importance based on the trends and needs of the sector. A big part of the research activities are centered around investigating the effect of high temperature on flower development and seed set. The majority of the work has been done in the model species Arabidopsis but more work is planned in the commercial crop oil seed rape. The long-term goal of the group is to discover traits that can ensure optimal seed yield under increased temperatures which are predicted to be a limiting factor for agriculture under the climate change scenario. Such traits can be of interest to big agribiotech players as well as trait discovery companies.

Helene is open to industry collaborations and eager to engage in contracted research. The research of the group has a good applied potential that can be a good selling point for the whole department of „Genomics and Proteomics of Plant Systems“.

3.3.5. Jan Hejátko Research Group

The groups is investigating the multiple roles of the plant hormone cytokinin in relation to plant growth and development, interaction with other hormones (e.g. auxin), environmental stimuli and phosphorelay signalling. This diverse range of topics reflects the strong expertise present in the group and the proactive attitude towards exploring promising research directions. Part of the previous efforts have been focused on more applied research as exemplified by a recent patent on the effects of cytokinin on cell wall properties and an on-going collaboration with IPK on Arabidopsis mutants impaired in light and ethylene signalling that show improved drought tolerance. Moreover, the group is currently exploring the possibility to use aptamers as cytokinin sensors in plant, which if successful might be of potential commercial interest.

The accumulated knowledge can be channeled in various directions with strong applied potential. Particularly relevant is to explore the structural aspects of cytokinin signalling in order to design screening strategies for novel biostimulants.

The groups is actively exploring the commercial landscape and looking for opportunities to engage in collaborations with the private sector. Jan has been in contact with the Canadian company Abcann Medicinals, which is interested to optimize growth conditions for cannabis in order to improve yield.

3.3.6. Karel Říha Research Group

The research activities of the group focus on genome stability, regulation of meiosis, and role of RNA decay in genome regulation. Despite the primarily fundamental interest in understanding the molecular mechanisms behind these processes, there is a good appreciation of the applied potential of the research results and awareness about the interests of industrial stakeholders. For example, upon characterization of the evolutionary conserved DNA repair

complex Ku in Arabidopsis, the group engaged in a chemical screen for inhibitors of mammalian KU, which if successful will deliver lead compounds of interest to pharmaceutical companies. Moreover, due to the high evolutionary conservation of KU any potential lead compounds can be used to manipulate genome editing and thus ultimately impact plant breeding strategies.

Another potentially fruitful line of applied research that can be built upon the existing expertise in the group is exploring the chemical space for activators of the NMD pathway in order to establish broad-spectrum resistance to pathogens.

The group can accommodate collaborative research projects with industrial partners and is interested to establish links with breeding companies irrespective of their geographical location.

3.3.7. František Foret Research Group

The research group is developing novel techniques for separation of nucleic acids, proteins and small molecules based on electrophoretic and microfluidic systems, electrochemical and optical methods and nanotechnologies. The group is perhaps the most experienced research group in technology transfer at CEITEC MU and has been engaged in collaborations with industry for decades. František puts a lot of emphasis on patents and IP rights when training his students. Unfortunately the group is not physically part of CEITEC MU which makes any potential spill over effects nearly impossible.

The group has been in contact with numerous companies over the years. Several of the most memorable examples that had been communicated with the Technology Transfer Manager are Agilent, Biovendor, 908devices, HMT Japan.

The group has been involved in designing a portable device for detection of methanol poisoning. This attracted a lot of attention during a recent mass poisoning with fake alcohol

but has not been successfully commercialized. Currently, this is responsibility mainly of the co-owner of the utility model, the company Watrex Praha.

Currently, the group is trying to commercialize a novel nanofibre material for enrichment of phospho-containing compounds together with the Czech company Pardam.

3.3.8. Martin Lysák Research Group

The group investigates genome evolution using bioinformatics tools. Most of the work is done on Brassicaceae which in combination with the widely sought bioinformatics expertise might easily give a slightly applied edge on the research efforts. Nevertheless, the research is exclusively fundamental and collaborations with industrial partners have never been explored.

Applied research is not seen as a priority but if there is an interesting opportunity to engage in a research collaboration with an industrial partner on a topic of a mutual interest such activity would be welcomed. Suitable industrial partners might be small breeding companies with in-house R&D activities.

3.4. CORE FACILITIES

3.4.1. Core Facility Proteomics

The well-equipped proteomics facility and the extensive expertise in sample preparation and data analysis have a good potential to attract industry players who do not have access to certain technologies and know how. Nevertheless, currently the number of industry collaborations is limited.

In a long run, the facility is interested in establishing long-term collaborations with industrial partners who would like to engage in explorative, research-based collaborations rather than processing big number of samples without any added scientific value.

Previously, Biovendor has analysed a small number of samples at the facility. In collaboration with the University of Ceska Budovice, waste material from the potato processing industry

was analysed for the presence of proteins with antimicrobial properties. The project was abounded 6 years ago after initial discussions with a Swedish company. Similar idea to look for value proteins in hemp processing left overs was also discussed.

3.4.2. Plant Sciences Core Facility

The facility is equipped with modern LED growth cabinets which allows simultaneous variation of numerous environmental parameters.

There is a major trend worldwide to grow plants under LED lights, which might fuel interest of external users to explore the right growth conditions for specific species in collaboration with experienced plant scientists. Numerous companies that produce LED lights for agricultural purposes face the very same problem. The optimal light spectrum for particular plant species e.g. tomato and lettuce is not well defined. Such companies look for optimised light „recipes“ for each plant species they focus on. There is a limited number of companies that provide such information and given that the LED market is forecasted to grow the demand will outpace the supply in the near future.

The Plant Science Core Facility is ideally suited to offer such services, which can lay the foundation of a startup company with virtually no investment required.

3.4.3. Josef Dadok National NMR Centre

The NMR Centre features several high-end machines which can be used for various purposes. The wide range of possible applications in fact has a negative impact on developing a specific expertise which might give the facility a competitive advantage to other facilities operating the same equipment.

Currently, the facility is exploring the ideas to develop lipoprotein profiling and metabolite profiling and concentrate on medical applications.

The facility is processing samples for several companies such as „Polymer Institute Brno“, „Ratiochem“, „Lunaria“ and „CF Plus“.

A Dutch startup company (ZoBio, The Netherlands) was interested to use one of the machines for 2-3 months in order to analyze a protein structures. The collaboration was in an advance stage when they found an alternative partner and terminated the negotiations.

3.4.4. Core Facility Cryo-Electron Microscopy and Tomography

The facility operates high-end cryo-electron microscopy which is expected to be in high demand in the coming years. Pharmaceutical companies that outsource their microscopy analysis will seek such services. One of the current clients of the facility EYEN, for example, is doing contracted research for Merck.

The facility is also actively working with FEI which was recently bought by Thermo Fisher.

Despite the significant potential to engage in collaboration with industry, the facility would like to ensure that a fully working service and sufficient manpower is in place before proactively looking for new clients.

As an interesting example, the Okinawa Institute of Science and Technology Graduate University, Japan established its first startup (www.okinawa-pt.com) around Cryo-EM technology and structural biology expertise in 2014 and is currently providing services worldwide.

3.4.5. Core Facility Cellular Imaging

The facility is equipped to very high standards and features a wide range of techniques.

Martin is well aware of the concept of technology transfer and tries to engage in collaborations with industrial partners on all occasions. He has contacts with TESCAN and tries to maintain them alive by inviting company representatives for official events and training sessions at CEITEC MU. Possible collaborations can revolve around benchmarking their instruments and exchanging ideas about the needs of the research community.

3.4.6. Core Facility Genomics

The facility is equipped to the highest international standards. Currently the facility is developing expertise with nanopore sequencing, which might comprise the backbone of future collaborations with industrial partners.

Part of the facility is acting as a diagnostic laboratory and significant manpower is dedicated to maintaining GLP.

Clinical trials might be an option to engage in industrial collaborations for which working relations with groups from the University Hospital will be crucial since most companies are interested in clinical samples rather than sequencing services.