Case Study
Expertise to entrepreneurship

When Associate Professor, Claus Tittiger, of the University of Nevada, Reno (UNR) Department of Biochemistry and Molecular Biology agreed to join the Strategic Research Program organized through the University’s Technology Transfer Office (TTO), he had limited expectations. Primarily, he saw it as an opportunity to approach business entities for new funding sources for his research. Contrary to his expectations, what began as a somewhat hesitant endeavor soon burgeoned into another realm – demonstrating the benefits to research of engaging industry.

After several months of engagement through the Strategic Research Program, including over 100 industry engagements to gather feedback guiding research strategy, 2013 looks to be a momentous year. Tittiger’s lab is abuzz with activity: in partnership with postdoctoral scholar, Dr. Rubi Figuero-Teran, the Technical Lead and entrepreneurial champion of the project, preparations are underway to put the innovative technological processes into mass production mode with the launch of their own specialized chemical production company – EscaZyme Biochemicals.

In keeping with colleagues in other university departments, Tittiger comes from a background of years of pure research, but is now a convert and believer that industry opportunities open up new horizons and provide a stimulus and focus to broaden and deepen his work, rather than confining research according to perceived market needs. This is quite the change for an academic who only recently stated that his research was not market driven, and that he was trying to generate information that someone else could use.

“It has become increasingly evident – the new reality is that I have to do applied research. Basic research is a luxury you have to be able to afford. If we are more aware of what industry wants, we can direct our research to something more applied,” he explained.

Tittiger’s expertise is in the use of functional genomics, molecular biology, and biochemical techniques to better understand pine bark beetles and their interactions with host trees. He has been working with bark beetles since the late 1990’s after being stimulated by the devastation to pine forest ecologies and local economies caused by the rampant spread of bark beetle disease. A specific goal from the onset has been the development of technology to regulate beetle populations without harming the host trees.

The technology, generated primarily by Tittiger’s and Figuero-Terans’ research, is based on the beetles’ production of *pheromones* and is linked to their ability to metabolize toxic resin released by host trees to deter pests. The pheromones are used for aggregation and successful mating in a habitual cycle that allows the beetles to survive and thrive.
According to Tittiger:

“Research in my lab has focused on understanding various aspects of the bark beetles’ biochemistry in order to better develop targeted control strategies. Because they spend the majority of their life cycle sequestered under bark beneath the surface of their host trees, they are difficult to control by conventional methods…

“The tree makes resin to kill the beetles. The beetle then makes a detox chemical through pheromone production. We anticipated that if we could shut down pheromone production, we would have a process that worked [as] effectively as birth control.”

In natural balance, the beetles help maintain the forest by attacking older, weaker trees allowing new trees to replace them. It is thought that warmer temperatures, resulting from global warming, have caused beetle populations to become abnormally large to the point that their impact has reached disastrous proportions.

Tittiger’s work first came to the attention of the TTO when he sought input to obtain a patent for one of his research team’s discoveries. As yet, there is no easy answer on the market to stop the scourge of bark beetle disease, and TTO personnel were quick to recognize the commercial potential of work with bark beetle pheromones.

His research got a boost from the input of Figuero-Teran whose doctoral dissertation involved the investigation of enzymes involved in pheromone biosynthesis and the detoxification process. Her work led to the discovery and characterization of new enzymes that were found to catalyze useful reactions to create value added chemicals. These chemicals had potential applications in a variety of settings.

“We realized one enzyme could be really useful for pest control... Pheromone chemicals smell nice – like sweet pine. They are used by pest-control companies to create lure-traps. They’re also used in the scents and flavors industry,” Tittiger explained.

As scientists, Tittiger and Figuero-Teran had not undertaken any specific market research before approaching the TTO, but their hope was that the use of a natural process to extract pheromones would have some commercial potential. They anticipated value added chemicals might be cheaper to produce by the enzyme process, and as a “natural” product, would have a branding advantage in the market, but had no evidence to support this supposition.

As hoped, early market investigation showed that competitive chemicals were manufactured through a multiple step process using organic synthesis. This process was labor intensive and involved significant time, costs, and safety risks due to the use of hazardous chemicals and protocols. In contrast, the Tittiger and Figuero-Teran process was relatively simple. They employed the newly discovered enzymes in a single step, avoiding the use of toxic solvents. Their chemicals had high specificity resulting in reduced need for a post-production purification process. As their experience was in working at micro-levels for UNR research purposes and not in the processes required for mass production of commercially viable chemicals, Tittiger and Figuero-Teran had no idea as to the actual cost of the mass production of their method.
In partnership with the TTO, the pair entered the project into the Strategic Research Program, looking at both the pest control and flavor and fragrance industries. The initial response was not as enthusiastic as hoped and proved part of a steep learning curve for the team. They found industry contacts already well versed in their own methodologies for producing the required chemicals en mass through organic synthesis. Another deterring factor was that of existing perception. Feedback from the pest control industry revealed the opinion that beetles need to be destroyed, not deterred.

“We knew the cost of pheromones and lures is more expensive than tree poison. It has therefore been challenging to get on the same page,” said Tittiger.

The UNR team’s natural process, as it stood, merely warned beetles off a tree. To kill them required further intervention, such as the application of funnel traps placed in threatened trees.

“We prepared a market list for further research that led to the discovery that existing industry expertise was in the process, not the product,” said Figuero-Teran.

Establishing the commercial viability of their discovery was a daunting prospect for two scientists with no business or market analyses skills or experience. According to Figuero-Teran:

   “Initially we weren’t sure how commercial our discovery was going to be because we had enzymes and could produce compounds, but we really needed to persevere with our market research to identify our competitors and details such as their product pricing levels.

   “We discovered the first compound [that] we are thinking of producing naturally . . . for the pest control market could fetch as much as $1,200 per gram due to the degree of difficulty in making it through a dangerous and highly labor-intensive synthetic process. The initial feedstock to make it using enzymes by our process was only $35. So we decided there might be commercial interest in our technology and [that] we would try to get the patent . . . right now we have a provisional patent.”

The TTO appointed business student, David Maine, as project manager to assist with setting up project meetings, carrying out systematic market research, and developing an industry contact list. The TTO also found the team an industry mentor, retired Shell Chemical executive, Chuck Walker, who was able to bring guiding expertise to the table by helping the pair understand industry requirements and processes. The role of the industry mentor in the TTO programs is to help take research ideas to market, either in a compatible field or as a business start-up. Walker’s vast experience allowed him to pinpoint objectives and simplify strategies. The whole team has found his input invaluable. As Maine said:

   “I take his reactions and comments very seriously. He teaches me how to interact . . . through Chuck, I’ve learned to simplify explanations and help focus the team.”

While working on developing industry contacts, Maine found numerous questions coming to mind regarding the bigger picture. For example, he asked whether the research team should develop more pheromones from different bugs, and considered the issue of when they would need to apply for grants, and from whom.
Maine identified specific challenges that would need to be met in the development of business strategy. One of those was the difficulty of developing an economic model based on the use of the natural process for chemical production.

“It’s hard to prove the natural process is cheaper than the engineered product already available. We didn’t have a lot of the calculations we needed particularly in relation to the scale-up process required if we were to go into mass production,” Maine explained.

Maine’s hope was for an improved strategic plan that would allow the research to be directed in a manner that ensured more applied technologies.

“It should be more market driven as they should now understand the market need for the products of their research,” he said.

In summer 2011, Tittiger went to an academic conference in Vancouver and met with owners of Canadian pheromone producing companies. They explored the possibility of licensing UNR’s technology for their own use and development.

“Making such contacts always provides the chance [that] they might want to use our technology at some point in the future. We had the potential to partner with companies but were not, at the time, far enough along to get [an] agreement,” said Tittiger. “I was able to offer expertise. Our experiments were, and still are, micro-level as far as volume goes. It was my feeling [that] existing chemical production companies could help us learn how to scale-up, and maybe we could apply our research to find something they needed.”

Early talks were fruitful in providing direction and indicators to identify what it would take to bring the technology to market. Tittiger described:

“We talked to several companies and asked them for input. We found we needed a non-disclosure agreement so our talks could be confidential and they wouldn’t be able to use the IP or our material without agreement. We also found they wanted us to develop our team a little more.

“TTO mentor, Chuck Walker, was a great help to us thanks to his industry knowledge. We were looking at a possible partnership with a company, but knew we would have to deal with IP issues and the reality that the scents and flavor industry is very secretive, so the benefits were, and still are, all potential at that stage.”

For her part, Dr. Figuero-Teran described:

“Our involvement with the TTO’s strategic research program really helped us . . . putting the numbers together, the cost of producing compounds, and in realizing what was really important if you were thinking about commercializing a product. We’ve learned a lot.”

Tittiger is in full agreement:

“I was able to describe the chemical process but not the cost analyses. Through the interception of the TTO and our resultant contact with relevant companies, we were able to work on the cost analyses.”
Although the details of scale-up are still under investigation, they have been able to estimate that by using their enzyme based technology, they should be able to produce and provide a purer version of their first target chemical than is currently commercially available. And at least less than 50% of the current market price.

The pair emphasized the sense of having taken on something quite beyond their normal sphere of operations, and that new horizons had opened up thanks to the TTO guidance. As Dr. Figuero-Teran explained:

“Learning everything takes time when you need to talk to customers, and we were having to learn a whole different language from the one [that] we normally used and a whole different way of looking at things...

“The most important thing I’ve learned was [that] in the future, we need to do experiments looking at [our research] in a commercial way, and not just because it’s fun – partially in terms of looking for future funding opportunities but also, significantly working with industry to produce something of greater impact for humanity.”

After completing her doctorate, Figuero-Teran was able to get a grant to continue the same work for Tittiger’s lab. Once a post-doc, she saw her “job,” as she put it, as: “finding my own niche, opening up doors.”

She notes how her work changed perspective at this stage, though still fundamentally working in the same area of research:

“Now, I’m always considering whether results have commercial potential.”

As the technical lead, she worked with Maine to get project resources together.

“We worked at getting all the groundwork done, so when we came to talk with companies and industry, we would know the necessary numbers they’d require and be able to help the business side understand the science side and co-operate together.”

She explained that before her TTO experience, she would have made mistakes by approaching the wrong people – such as other scientists whom she saw as her opposite number – and would give away too much scientific detail without being able to satisfy the business needs.

“I would have made a lot of mistakes otherwise - burned bridges by saying things like ‘I have this and this, are you interested?’ I’ve learned to be more secretive and let them come to us if possible.”

She finds that learning business language and etiquette takes ongoing effort, but observing how TTO executives work and having an experienced mentor like Walker has been quite helpful.

“He has played devil’s advocate and made me realize how important it is to get it right and to have numbers ready,” she said.

By autumn, following Tittiger’s suggestion, the team was able to secure $50,000 National Science Foundation (NSF) Innovation Corps (I-Corps) funding to pursue a program designed to validate opportunities in a recognized, effective way providing a yes/no decision as to whether a startup company was viable.
As part of the I-corps program, they attended training at the University of Michigan accompanied by Dan Langford, TTO Manager of Industry Partnerships. Alongside 24 other successful applicants from across the country, the team worked on their Business Model Canvas and validated their assumptions against over 100 industry engagements.

Dr. Figuer-Teran explained that their expectation was to find a market and start a biochemical company, but sourcing the market took most of their focus. As Tittiger put it:

“We had technology, we had a product – we thought we would just go out there and sell it.”

Langford was pleased with the team’s achievements:

“I was particularly impressed by their willingness to try cold calling, engaging industry and having useful communications with potential customers.”

Further lessons emerged from the experience. For example, Figuero-Teran spoke to a company representative who wanted the UNR product on the simple basis that it had something to do with the compound his company was producing, though he had no appreciation of the specific technology or its potential applications.

“I’ve learned that it’s necessary for me to get information from companies before considering selling our technology to them,” she said.

Tittiger learned to keep an open mind when investigating commercial opportunities. The process of discovering which markets were genuinely viable could throw up surprises. The team found themselves wavering between selecting pest control and flavors and fragrances as their primary market choice. Secondary choices included cleaning products, anti-microbial applications, as well as pharmaceutical, polymer and enzyme production.

Part of the overall TTO program has been to investigate all of these things. The team has found that the learning experience of focusing their market research has been extremely valuable. As Tittiger explained:

“Whether or not we start a company, we’ve learned a lot from this process. We have come away with clear objectives.”

Likewise, Figuero-Teran commented that overall, partnering with the TTO has been an excellent experience: “It’s given me a whole new perspective. I’ve had to step out of my field and gain the kind of business insight that is really of use in today’s economy.”

Following the I-Corps program the team was joined by MBA student, Jennifer Ott. With a past record in marketing and a degree in Chemistry, Ott applied to the TTO to act as Chief Executive Officer for the proposed biochemical start-up company – her first tasks being to set up a model for the business and continue to move the research results into the commercial market. EscaZyme Biochemicals is a finalist in the 2013 Sontag business plan competition.