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Quantum Genetics Canada: Biotech for better beef

Juicy, tender, well-marbled beef; putting the best beef on your plate depends on timing - and genetics. Quantum Genetics Canada Inc. is in the business of helping producers get their best product to the consumer – and increase their bottom line.

Leigh Marquess, COO of Quantum Genetics, spoke recently at an Ag-West Bio LifeScience Showcase at Innovation Place. He is one of those rare people with the ability to recognize and take advantage of opportunities, and the patience and persistence necessary to overcome the inevitable hurdles that stand in the way.

Raised on a cattle farm, Marquess attended the University of Saskatchewan (U of S) and achieved a Master's degree in molecular genetics. After completing his studies, he went home to work on the family farm. Talking to feedlot operators, he started thinking about some of the work he had done as a grad student.

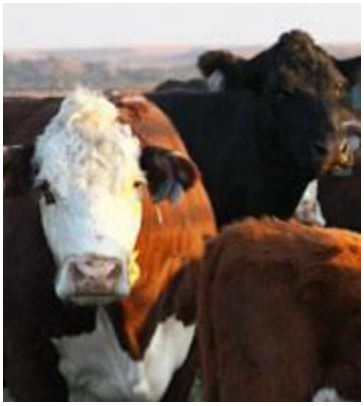
The lab at the U of S had discovered a mutation in the Leptin[1] gene, which is associated with appetite. Leptin itself was discovered in 1994 by Jeffrey M. Friedman and colleagues at the Rockefeller University. Leptin is secreted primarily by white adipose (fat) tissue and circulates to the appetite centre of the brain, where it triggers a metabolic response. If enough fat is stored, a reduction in appetite and an increase in metabolism occur, and some of the fat is burned. If little or no hormone is produced by the Leptin gene, appetite increases and metabolism decreases in an effort to build energy stores. The discovery of this gene caused a lot of excitement, with grand ideas that a simple food item – say a cookie – could control Leptin levels to make everyone thin. This proved to be an overly simplistic idea which has obviously not become reality.

The mutant gene adds an interesting twist to the formula. In studies done on cattle, given the same amount of feed, animals with the normal Leptin genotype (called homozygote wild type CC's) gain the least amount of fat, while those with the mutant gene (homozygote mutant TT's) gain the most, with the heterozygotes (CT's) in the middle. So, all things equal, some animals get fatter than others. This knowledge can be a powerful tool for cattle feedlots, whose primary role is to buy cattle and fatten them until they are ready for slaughter.

Marquess discovered cattle feeders were very interested in the information and felt that there was potential for a business using the knowledge he had gained as a grad student. In 2003, he wrote a patent for his technology, based on DNA testing for the Leptin gene in cattle and formed Quantum Genetics Canada Inc. Very quickly, an international animal health company, Merial, recognized the potential, and the companies signed a global marketing agreement, which gave Merial exclusive rights to market Quantum's patent-pending DNA test. Unfortunately, this scenario really was too good to be

true, and the companies terminated the agreement after 18 months, leaving Quantum Genetics with questions to answer before business could continue.

In their quest for answers, the company went to southern Alberta – the closest large marketplace for cattle feedlots – and worked with producers, who came to understand the value of their technology, help them improve it and create a sellable product.



Typically, feedlot production is an in-out process: A group of animals is put in a pen for approximately 150 days, and then slaughtered based on when the average animal in the pen is ready for market. However, there is a large degree of variation in the time they are actually ready. In industry studies, roughly half the animals in North America coming out of feedlots are either underfed or overfed, which means that many of the animals do not reach their potential. Quantum saw a market opportunity in improving this. Using genotyping, slaughter time can be more accurately determined, based on the genetics of individual animals.

Quantum Genetics' business is to identify SNP's[2] that show variation in economically important traits – and commercialize the use of those SNP's. They can tell which animal will gain weight faster, or gain fat faster, or have the highest marbling. And, as an example, this translates to more money for the producer, as a premium is paid for the animals that have the best marbling in their meat.

But the story gets even more complex. Zilmax®, a pharmaceutical in the class of compounds called "beta adrenergic agonists," has been given to cattle to enhance growth, increasing weight gain substantially. "It's one of the only blockbuster pharmaceuticals that has come out in the last several years," says Marquess. It has a lot of promise, but it also has drawbacks: When one of the beta adrenergic agonists is given to cattle, it can result in a loss of tenderness in the meat. Because of this reduction, everyone is now paying attention to tenderness, including packers, retailers and feedlots. Even though tenderness is not a factor in the value of the animal, there is an ongoing debate on whether the product should be used. In fact, multiple major packing plants in North America won't buy animals that have been fed Zilmax®. This leads to yet another opportunity for Quantum Genetics.

A SNP for tenderness has also been developed at the U of S. The pro-melanin concentrating hormone (PMCH) gene is found to be associated with more marbling, palatability, and tenderness in beef[3]. Animals with double A genotypes have the most tenderness and palatability, while double T homozygotes have the least, and are therefore the toughest. Heterozygotes (AT) fall in the middle.

Quantum did several studies on the effects of Zilmax®, both from the weight gain and tenderness perspectives. In studies focusing on the Leptin mutation, they discovered if a CC (homozygote mutant) was fed Zilmax®, there was no significant change in feed intake or marbling. This group of animals benefitted from the drug, without the negative side effects. However, they found that giving Zilmax® to CT's or TTs was detrimental - this is a very significant finding: without the Zilmax®, TT's gained the most; with the Zilmax®, they gained the least and ended up with less marbling. When they studied the tenderness trait, determined by WBSF[4] they discovered that the animals with the naturally tender meat (homozygote AA's) ended up tougher, but animals which are naturally tougher (PMCH TT's) have their tenderness further reduced with the feeding of Zilmax®. With this information, feedlots can determine

which animals will benefit from Zilmax®, and which should not get the drug. There is an opportunity for what Marquess refers to as "precision application of pharmaceuticals." Marquess says the study was one of the first of this kind in the cattle industry and the results are very exciting for cattle feeders who want to use this potent drug.

From biotech to business

Just identifying genetic traits is not enough; to create a business, the information has to translate into a sellable product. Quantum used the information to develop a sorting system for feedlots, integrating the information into a management plan where a feedlot will pay for the genetic screening of each individual animal.

When an animal comes into a feedlot, a tissue sample is taken using a modified ear-tagger (developed by Quantum) in order to determine their genotype. It is then fed for the majority of the stay in the feedlot with no intervention, until about 40-60 days prior to a generic slaughter date. At that point, the genetic information is considered, along with some phenotypic data, such as weight and backfat. This new sorting system can determine which, if any, growth enhancing drugs should be administered to any sub-group of animals and it can identify the optimal days needed until the slaughter. So where there would have been one slaughter date, there would now be four, optimizing every sub-group of animals and better identifying animals suitable for premium markets.

In 2006, Quantum began working with western Canadian feedlots, a market that represents about 2 to 3.5 million animals a year. Another opportunity arose: One of their Canadian customers was feeding his cattle in a U.S. feedlot, and told Marquess, "I'd like them to run your system on the cattle I'm feeding in their lot." This was the beginning of a strategic relationship with Cactus Feeders, the second largest independent feeder in the world, feeding around one million animals each year.

In Canada, says Marquess, the feedlots are typically farmer-owned, sole proprietor operations. The benefit is that the owner is the decision maker; the negative is that he may not have the background to make an informed decision, which necessitates an education process. In the US the operations are more often large agri-businesses – 10 to 100 fold larger than the average operator in Canada, which means working through layers of management and expertise.

Although Cactus Feeders was not prepared to use the technology as it stood, the company was interested. As Marquess paraphrases, "We'd like to see if we can figure out what you've got and what it's worth." Together, the companies set out to determine what hurdles needed to be overcome to create a viable product for their use.

A three-year research agreement was created, with the feedlot company as the driver. Due diligence began in April 2008, validating QGCI's discoveries on tens of thousands of animals. The sorting system was introduced recently. The implications are exciting – success means they need to genotype every animal that comes into the feed yard. This is a milestone for Quantum Genetics; Marquess notes, "A lot of time, effort and risked capital to get it to this point." He says this is just the beginning of their success story.

Flax 'disaster' leads to more opportunities

Quantum Biosciences Inc. (QBI), located at Innovation Place in Saskatoon, was formed in 2009 response to the marketing "disaster" in the flax industry that arose when the banned genetically-modified (GM) flax, CDC Triffid, was discovered in a shipment to the EU.

Triffid was developed at the U of S in the late '80s and was registered in both Canada and the U.S. Although it passed stringent food and feed safety testing, concerns arose from farmers that the EU would reject it, and, at the urging of the Canadian flax industry, the modified seed was deregistered and ordered destroyed. Triffid never made it out to farmers, but did get to seed growers. Canada was once thought to be Triffid free; however, Canada's flax crops do contain a low level.[5]

Triffid was never registered in Europe and when the grain was discovered, an embargo ensued. The Canadian government quickly negotiated a protocol with the EU to resume trade, agreeing to a very stringent allowable level of Triffid – a 0.9% threshold.

Since Quantum Genetics had been doing real-time PCR[6] since the company was formed in 2003, Quantum Biosciences had the expertise to quickly jump in and get started. Marquess says they learned quickly, however, that expertise does not translate into capacity. With hundreds of samples arriving daily and a process capability of "much less than that," the company had to spend time and money buying equipment to ramp up in order to service the volume likely to come with each crop year.

In a short time, Quantum Biosciences found that the diagnostic world is full of opportunities. The company has been asked to screen mustard for GMO canola contamination; Canadian pet food manufacturers have sent samples; they've been asked to screen wheat, corn and soybeans; an international company that produces hair removal creams has asked them to test their product in order to make claims that they are animal free. The testing can get fairly complicated, as some events in these various crops are approved by the EU, some not. "Once you get a handle on all the events, you can design assays[7] for them, and test your samples for them," says Marquess.

The two companies share 14 employees, with another three people dedicated to QBI. Since beginning operations in the fall of 2009, they have tested in excess of 7000 samples. This translates into approximately 440,000 GMO assays.

For more information about Quantum Genetics Canada please visit the company website: www.quantumgenetics.ca.

For more about Quantum Biosciences, please call 306-956-2082.

If you are a Saskatchewan life science company and are interested in being featured at an Ag-West Bio LifeScience Showcase, please contact Brad Bly, Ag-West Bio's Commercialization Manager, at 306-668-2665.

1. Leptin: Wikipedia: http://en.wikipedia.org/wiki/Leptin#Discovery
2. SNP (pronounced "snip": single nucleotide polymorphism. A SNP occurs when one nucleotide is substituted for another in the DNA sequence at a defined position within the gene.
3. Hunting Down Genes: http://www.usask.ca/beefresearch/

4: WBSF: Warner-Bratzler shear force assesses the tenderness of meat by measuring the amount of force in kilograms necessary to shear multiple 1/2 - inch core samples from each steak evaluated
http://www.beefresearch.org/CMDocs/BeefResearch/Industry%20Guide%20for%20Beef%20Aging.pdf

5. http://www.grainscanada.gc.ca/gmflax-lingm/pfsb-plcc-eng.htm

6. Real time PCR: http://en.wikipedia.org/wiki/Realtime_polymerase_chain_reaction

7. Assay http://en.wikipedia.org/wiki/Assay