

## Emerging Technologies/Producer Initiatives—Delivery to Consumers

*Dr. Bob Church  
University of Calgary*

Canada has been a world leader in the development of superior livestock genetics over the past several decades. A large proportion of the improvement in the many performance traits that has led to significant efficiencies at the farm level can be directly traced to genetic advancement. Canada is now a major exporter of genetics world-wide. In large part, this has been the result of superiority in applied technologies, systems and infrastructure.

As evidenced by the first case of BSE five years ago, a disease outbreak can seriously threaten Canada's livestock industry if proper controls are not in place to proficiently trace and eventually eradicate a disease from the animal population. In addition to wanting assurance of a safe food supply, the consumer has become more conscious of the health benefit or detriment from the food they consume. Links between animal leath and human health are growing concerns, and the presence of residue from animal treatments that could potentially impact human health are further threats to the animal agricultural industry.

The science of genomics has been making considerable progress over the last few years, particularly with the sequencing of the bovine genome and the development of the high-throughput, lower-cost genotyping and gene expression technologies (SNP's – Single Nuclei Polymorphisms). With the most recent developments using the 50,000 SNP panel, it has led to significant increases in accuracy of genetic and genomic selection strategies. The race is on internationally to capitalize on these advances.

The country with the most comprehensive DNA bank and most accurate phenotypes (animal pedigrees and performance measures) will have a competitive advantage in terms of genomic research and development. Canada will only remain a world leader if it can make a rapid and successful transition to the new situation.

New genomic technologies are rapidly being modified and refined with the net result being sequencing that goes beyond SNP genotyping. Different genotyping technologies are needed to do whole-genome association studies and also to do fine mapping/candidate gene studies. Much of the data that is being used to improve the accuracy of these new technologies is coming out of good quality reference sequences from the International HapMap Project. The very interesting new data has shown that there is considerably more genetic variation within species than was previously thought. Companies that are very active in these areas include Affymetrix, Illumina, Applied Biosystems, Sequenom and Chronix Biomedical, with more companies getting started on providing components such as the pipeline software for analyzing specific databases as they become available. Getting the whole sample production pipeline working efficiently is critical as the costs for running these systems is currently high.

The completion of the entire bovine genetic sequencing provides a breakthrough opportunity to develop a clearer picture of actual genetic merit that can be used to address these concerns. To date, DNA technology has been limited, and has only allowed for the collection of partial genetic data that

could be applied to these objectives. Data developed by the proposed Genomic Centre will be used for genetic analysis and for marketing purposes to complement expected progeny differences. However, the rapid advances in total genomics and DNA typing technology mean that this information could be used to select desired animals for breeding purposes, and further, to identify and verify animals possessing beneficial health traits within the population.

The latest research shows that both humans and animals demonstrate a profile of serum nucleic acids (SNAs). Healthy individuals show a range of SNAs that can be used for defining a “healthy profile”. All the individuals tested thus far, falling outside the determined range, have been associated with clinical disease. These observations were made possible by the recent major advances in nucleic acid sequencing. The healthy profiles required the analysis of thousands of sequences previously not possible by conventional approaches. Chronix Biomedical offers the analysis as The Serum Genome Test. The company intends to translate its findings into inexpensive screening tests for screening humans and livestock for healthy profiles.

Breed associations have a pivotal role to play in this process. Registered purebred cattle have provided the base for the Canadian cattle herd and breeders have been responsible for the genetic improvements in the bovine population. Through the Animal Pedigree Act, purebred associations have been given the responsibility of maintaining accurate pedigree records and managing that intellectual property on behalf of their members. Those pedigrees and related genetic data are internationally recognized as credible animal identification by each breed’s counterpart associations around the world.

Within the Canadian cattle industry today, purebred associations have amassed an incredible genetic

resource: generations of accurate pedigrees dating back to the late 19th century, and over twenty years of collected DNA samples in storage. Taking advantage of these resources would allow Canada to get a jump-start on total genomics research and application.

At the present time, however, breed associations rely on members for funding, and do not have the resources to take advantage of this opportunity. For individual breeders, the effort to complete the proper and adequate records to maintain pedigreed cattle is demanding and time consuming. The extra cost to maintain registered papers on purebred cattle has been borne by purebred breeders and in recent years, has been prohibitive enough that many breeders, thus adding to the financial burden of testing, record keeping and registering animals.

The science exists to identify healthy and genetically superior animals in the Canadian bovine population and to establish a standard that will set us apart from the rest of the world. The logical place to implement such a program is with the animals in the population that can be identified and are registered with proven pedigrees and existing DNA records. To be effective, all animals in that population need to be tested and it is not reasonable, nor practical to expect the economic burden to be borne solely by the breeders of registered animals.