

Canadian Centre for Swine Improvement (CCSI)

Uses of molecular information for addressing current and emerging issues for the quality of Canadian pork

Summary

Project background

Canada ranks number one among the pork exporting countries of the world. Domestically, the pork industry is also recognized as a major industry sector in agriculture. Superior pork quality and desired leanness contribute to the solid reputation of Canadian pork world wide. However, it is becoming more and more challenging to maintain this leading position especially due to new emerging requirements in the Canadian and export markets and increasing competition. The classical quantitative selection has provided opportunities for significant genetic improvement in Canadian swine populations. However, very little effort has been done towards direct improvement of meat quality. At times, there are also contradicting requirements. For example a good level of carcass leanness is required also for efficiency. However, this can automatically result in lower intramuscular fat (marbling) due to inherent genetic correlations between the two traits. Use of Candidate genes provides unique opportunities to achieve best of both, i.e. desired levels of marbling and leanness.

On Nov. 26, 2003, about 50 representatives from different segments of the pork value chain came together to discuss and seek the solutions for the current and emerging issues of pork quality. The groups included representatives from the Canadian Pork Council , the Canadian Meat Council , the Canada Pork International, the Canadian Centre for Swine Improvement, Agriculture and Agri-Food Canada, the Canadian Swine Breeders Association, the Atlantic Swine Centre, the Centre de developpement du porc du Quebec, Ontario Swine Improvement, the West Swine Testing Association. During this “Consultation Forum on Canadian Pork Quality”, the participants put intramuscular fat on the top of the list suggested for R&D activities. Intramuscular fat in Canadian pork loin is generally too low for both international and domestic markets (Murray, 2003), especially for Japanese market (Bilyea, 2003). According to the study of Lacombe Research Centre of AAFC, at least 25% pork loin in Canada contains less than 2% intramuscular fat. 2% is generally recognized as a minimum acceptance threshold for this meat quality attribute. The low content of intramuscular fat limits the market potential of Canada pork.

Recently, there are more and more concerns about the extreme leanness of Canadian hog carcass. According to the “Quebec Market Reference”, a market survey conducted by Centre de developpement du porc du Quebec (2003), 19% of hog carcasses have less backfat thickness than 13.6 mm which is the lower limit of the desired range. About 20% of hog carcasses have lean yield percentage higher than the demanded upper threshold of 62.9%. Some extreme lean pork was discounted in some region such as West Canada.

Are Canadian hog carcasses really too lean now ? The answer is perhaps no. The average lean yield percentage in Canada is about 60% whereas the most desired range according to most carcass payment grids is between 61% and 63% with an average of 62%. According to the new “OlyWest Contract”, the highest paid lean yield grid is between 60.7 and 62.99%. Increasing lean yield from 60% to 62% means \$ 4.25 more income from each hog (Sullivan, 2004). The problem is actually the low uniformity of the carcass leanness, not the average leanness. The swine industry needs to seek the carcasses that are more uniform to be within the desired range and 2% leaner.

A recently completed research project, entitled “Development of new genetic evaluation and selection methods for swine using advancements in molecular genetics” supported by the Canadian Swine Industry and CARD program of AAFC, has identified a number of genes and markers that are useful for solving the current and emerging problems identified above in Canadian swine industry, e.g. HFABP (heart fatty acid binding protein) gene and the IGF2 (insulin-like growth factor 2) gene. HFABP gene can be used for increasing intramuscular fat content up to 0.4% without changing the backfat thickness since HFABP combines and transports fatty acids in muscle tissues, not in the adipose tissue. This gene is a unique tool that can considerably increase intramuscular fat and break down the correlations between the intramuscular fat and back fat thickness. IGF2 gene can increase not only carcass lean yield by 2% but also uniformity by 25% according to results obtained in Belgium (Buys, 2003). It can bring the average lean yield of Canadian hogs right at the required level and make the carcasses much more uniform. The carcass uniformity and leanness can be further improved by using other fat-metabolism genes such as LEPT gene, LPTR gene, AFABP gene, FAT1 QTL, HDAC gene etc. since there are fatter alleles and leaner alleles on each gene locus. IGF2 gene can also be used to produce pork with desired leanness from fatter sows (Van Arendonk, 2003). Therefore, the sows can have a better body condition, and lower unwilling culling rate. This means considerable economic gain for multipliers.

The proposed research project will validate a group of useful genes under Canadian condition based on the results of DNA lab tests and their statistical data analyses, and propose a detailed guideline for use of the genes for solving current and emerging issues in Canadian swine industry, considering gene frequencies, gene effects, economic weights, inheritance mode etc. This project will contribute to the advancement of the pork production sector. It will further improve and enhance the achievements of Canadian swine industry in the international markets for the benefit of breeders, producers and processors. The ultimate beneficiary will be the Canadian consumers and tax payers who will receive the desired quality of pork for many more years to come.

Project activities

This project builds upon the activities completed in the previous project supported by CARD program for use of molecular genetic information. The recommendations are taken a step further to address current and emerging issues faced by various segments of the pork value chain, including, breeders, producers and processors. The project provides

opportunities for unique solutions to the current and emerging problems using the molecular information. For example, the use of the HFABP gene provides an opportunity to meet the current requirements for increasing intra muscular fat in loins while at the same time maintaining the desired level of leanness in the pork carcasses. It also provides opportunities to adjust the level of leanness by appropriate use of terminal sires carrying the allele of the IGF2 gene that can either increase or decrease the lean yield by about 2% in the market hogs. These estimates are based on research in European countries and the US. These genes could be either abundant or eliminated from Canadian populations and the magnitude of their effects may vary depending upon the progress already achieved through genetic selection in Canada. Therefore, there is a need for this type of a pilot project prior to their extensive use of the technology by the industry.

Main activities of the project include

- Testing for important genes in Canadian populations (e.g. those related to intramuscular fat, uniformity and leanness in commercial populations)
- Evaluation of their frequencies and effects under Canadian conditions
- Development of program and procedures for use of the information in genetic evaluations
- Development of recommendations and guidelines for addressing current and emerging issues and anticipated problems for the swine industry across Canada

Project deliverables

- Estimates of frequencies of important Candidate genes(e.g. HFABP, IGF2) in Canadian populations
- Magnitudes of their phenotypic effects of the genes on intramuscular fat and leanness under Canadian situation
- program and procedures for molecular data collection in genetic evaluation
- Breeding program plan for use of the molecular data in selection and genetic improvement
- Recommendations and guidelines for use of the information by producers and packers to adjust their production and shipments according to the market requirements. This includes the immediate guidelines how to use the suggested major-effect genes to fine-tune to carcass leanness around the population average to produce pork with desired leanness and uniformity and how to breed Canadian swine with desired intramuscularly fat and marbling by using fat and fatty acid metabolism genes, together with phenotypic information.