Use of Ultrasound Technology on live pigs for increasing marbling in pork loins

Project proposal for ACAAF program
Summary

Background

During the last decades, pigs have been selected strongly for leanness and growth. Therefore, backfat thickness, as an indicator of body fat proportion, has been reduced by about 40% between 1980 and 2006. This trend was in agreement with consumers' requirements moving towards leaner pork meat. However, increasing leanness had negative consequences on intramuscular fat which is known to be an important component of pork quality. Intramuscular fat, commonly known as marbling, significantly affects the taste and important attributes of eating quality such as tenderness, juiciness and flavour. Marbling is also negatively related to the incidence of pale, soft, exudative (PSE) pork.

Pork loins must have at least 2% fat in lean meat, else, the cooked meat will be too dry and tasteless. However, a large proportion of the pork coming to the supermarkets is below this threshold. About 50% of the pork produced in Canada is exported and Japan is considered as one of the gold markets for Canadian pork. Consumer surveys in Japan have indicated that the Japanese consumers would like have much higher levels of intramuscular fat, at least 3% or more, otherwise we risk loosing our market share. Therefore there is an urgent need to increase the level of intramuscular fat in Canadian pig populations for domestic as well as international markets.

Increase in intramuscular fat can not be achieved just by reversing the selection against backfat or just by increasing fat content in the feed as lower backfat levels are also required for higher carcass yield and feed efficiency. The challenge therefore is to increase the intramuscular fat while keeping up the desirable levels of lower backfat. New advances in genetic selection methods offer the opportunity to do exactly that.

In fact, Intramuscular fat (IMF) is known to be highly heritable (about 50% of its variation could be attributed to genetics). Therefore, there is a good possibility to increase IMF at a faster rate through genetic selection. However, so far this has been considered as a trait that can be recorded accurately only in the pork carcasses. This requires sacrificing the animals and the pigs that are scored are no longer available for breeding. Furthermore, the currently prevalent measures such as subjective visual scoring of the loin or a chemical analysis of a loin sample are very expensive, and can be done on a limited number of animals; reducing the opportunities for genetic selection.. Recent advancements in the real-time ultrasound technology offer new opportunities to address this issue. Different ultrasonic equipments aiming at measuring intramuscular fat in the loin of live animals have been developed. University of Iowa recently released a new software package designed to predict intramuscular fat in beef cattle, based on the use of basic ultrasound equipment used with specific image analysis software. From there, a toolkit was developed for similar measurements in swine. This opens opportunities to monitor and quickly improve the level of intramuscular fat in pigs. If the technology proves successful, the IMF can be measured as a routine on all live animals that are tested for growth, backfat and muscle depth at about 100 kg live weight. This would allow for a larger number of selection candidates, speed up the genetic progress and allow development of customised selection indices to increase intramuscular fat while keeping up the desired genetic selection against backfat.

Project objectives

It is essential for an effective genetic improvement of intramuscular fat that accurate and standard methods are developed for recording. These data then need to be used in appropriate genetic algorithms for genetic evaluation of pigs and their selection.

The proposed project will be a joint collaborative effort of national scope. The work will be carried out in close collaboration between CCSI and regional centres. The staff of Centre de Developpement du Porc du Quebec (CDPQ) has already obtained specialised training in use of ultrasound technology for measurement of IMF. The work will be extended to all regions across Canada

The main objectives of the project are as follows:
- Evaluation of the accuracy of live measurements vs carcass measurements
- Fine tuning and standardization of the method for live measurements
- Estimation of genetic parameters and development of adjustment factors for genetic evaluations
- Development of programs for computing estimate breeding values using BLUP methodology
- Development of recommendations, guidelines and web-based tools for effective use of the technology

Project design

The project will start with the training of technicians involved in this new program, in order to take appropriate image capture on live pigs. During the first year of the project, a total of about 1,000 purebred pigs will be measured in 5 to 10 farms across Canada, using Biotronics Swine Toolbox technology. Images will be centralized and analyzed in duplicate. A sample of 150 pigs will be tracked at the slaughterhouse in order to record individual visual NPPC marbling scores of loins, as well as chemical intramuscular fat percentage. Repeated measurements will also be taken in order to develop adjustment factors for live IMF to a standard weight. During the second year of the project, CCSI will analyze the complete data set, develop adjustment factors and estimate genetic parameters and correlations with other traits under selection.

Deliverables:

The project will provide the following:

- Validation of a new technology providing valuable information on loin IMF in live pigs as a major component of meat quality
- Training of Canadian swine technicians for measuring live IMF in addition to backfat and muscle depth
- Web-based user interface for data recording and transfer
- A large and innovative data set for loin IMF measured on Canadian live pigs
- Reports, scientific and extension papers on this new technology and its potential for selection of meat quality in pigs
- Development of a new genetic evaluation system for loin IMF based on live measurements
- Tools and recommendations for Canadian breeders for an optimal use of IMF in swine breeding programs