Use of novel technologies to optimize pig performance, welfare and carcass value

Brian Sullivan, Canadian Centre for Swine Improvement (CCSI)

Overview

Certain economically important traits, such as growth, feed efficiency, welfare and carcass quality, are difficult or expensive to measure in pig farms and slaughter plants. Recent technological developments have provided new opportunities to collect information on live pigs and carcasses. This project looks at validating some of the new technologies available to provide objective indicators of performance, welfare and carcass value.

Highlights

Eight pilot studies are ongoing, covering the following areas:

1. Automated recording of feed/water intake and weight/conformation
   (Centre de Développement du Porc du Québec (CDPO))
   - Individual water recording systems
     All pens in the finishing area of the Deschambault swine testing station are now equipped with individual water intake recording systems. There are still some potential improvements to the system, especially pertaining to data management, but individual water intake is now part of the standard station testing protocol. Measuring individual water intake is valuable in commercial trials as well as in research projects and represents a major step toward precision livestock farming.

   - Vision systems to predict animal weight and conformation
     Based on work done in 2014-2015, a 3D vision system to predict pig weight and conformation was developed by CDPO. The scanning by three Kinect cameras has been automated and takes only one minute per pig. Image reconstruction is used to build a 3D model of the live pig. Analyses are underway to correlate measurements on the 3D model with live weight, carcass weight, primal cuts, weights and yields. More automation will be required for image and data analysis in the coming year.

Implications for the swine industry

To prevent the spread of disease through the transportation of pigs, a more effective and quicker means of cleaning and disinfecting transport trailers will be developed. Cleaning will be achieved by a vacuum wash system and transport trailers will then be heated in order to kill any pathogens.

Collaborators

Jennifer Brown, Prairie Swine Centre
Hubert Landry, Prairie Agricultural Machinery Institute (PAMI)
Volker Gerds, VIDO-InterVac

Swine Cluster 2 | Animal Health

Second pass with the wet attachment
Dry vacuuming the bulk material on the trailer floor
Source: PAMI
2 Infrared thermography diagnostic platform for swine
(Lacombe Research and Development Centre, AAFC)
Changes in metabolic rate can be monitored using infrared thermography. A series of trials on animals to assess the potential of infrared thermography on illness detection and feed efficiency were conducted in 2015-2016. With the aim of identifying potential relationships between feed efficiency and carcass traits, the composition of carcasses from a sub-group of pigs has been evaluated. Analyses are underway.

3 Use of accelerometers to automatically assess pig behaviour and welfare
(Laval University, Sherbrooke Research and Development Centre, AAFC and University of Guelph)
The use of live or video observation to measure behaviour and welfare in animals is time consuming and tends to be subject to human error. This study proposes to validate the use of accelerometers as tools to investigate pig behaviour as they interact with their environment. Throughout 2015-2016, accelerometers were successfully fitted to different types of objects. In some cases, important modifications to objects were needed to make sure that the accelerometers would stay out of reach of the animals. Results from preliminary trials have showed that accelerometers fitted on objects can clearly indicate if animals are manipulating these objects. Trials will begin in 2016-2017 to see if accelerometers may be used to automatically measure exploratory behaviour and to determine the occupational value of enrichment objects according to their degree of cleanliness.

4 Use of 3D vision systems for rapid and objective hog carcass quality assessment
(Sherbrooke Research and Development Centre, AAFC)
There are opportunities to use computer vision systems to more accurately assess not only carcass weight and leanness, but also the weight and lean yield of each carcass cut, allowing for more efficient carcass sorting and assessment. A carcass evaluator prototype, which includes a vision system that will scan cold half-carcasses and develop 3D carcass models within a few minutes, has been designed, built and then improved. The prototype is now installed at the Sherbrooke Research and Development Centre (AAFC) and will be tested for accuracy in 2016-2017.
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5 Rapid in vivo prediction of composition and quality traits using near-infrared spectroscopy (Lacombe Research and Development Centre, AAFC)

Near-infrared reflectance spectroscopy (NIRS) has been proven to be one of the most efficient and advanced tools for the estimation of quality attributes in meat and meat products. The potential of NIRS to predict pork carcass and meat quality is being assessed. Using NIRS, pig ears and carcasses have been scanned after slaughter. Based on this information, mathematical models have been developed in order to predict carcass composition and fatty acid profile in live pigs. NIRS measurements have also been collected on the ears of live pigs a few days before slaughter. This information will be analyzed alongside measurements collected on ears after slaughter and of carcass composition.

6 Determination of age of bruises at slaughter (Sherbrooke Research and Development Centre, AAFC)

The objective of this study is to develop objective methods to count, categorize and determine the age of bruises on pork carcasses on the slaughter line. A trial involving animals has been carried out, including mixing of pens at four different times (one and two days before slaughter, in the truck and while waiting at the plant). The lesion healing process is being studied via histological and histochemical analyses of lesions at different stages. Digital image analysis is also being performed to be able to count and classify bruises according to their origin and age.

7 Application of rapid methods for non-invasive assessment of pork quality (Saint-Hyacinthe Research and Development Centre, AAFC and McGill University)

There is a need for non-invasive, reliable, objective methods that are able to determine the entire array of quality parameters while preserving the integrity of meat cuts. Two technologies, nuclear magnetic resonance (NMR) and hyperspectral imaging (HSI), are being assessed for this purpose. Up to now, reference measures of composition, fatty acid profiles and shear force have been carried out on two batches of meat samples. Their correlation with NMR measurements will be studied.

A line-scan hyperspectral imaging system was designed at McGill University to mimic commercial conditions and was used to scan loin samples. Results have been compared with reference measurements and data analysis is underway.

8 Quick, non-invasive technology for prediction of marbling in fresh loins (Centre de Développement du Porc du Québec)

Pork marbling is a key trait for slaughter plants but is not easy to predict accurately without cutting the loin muscle. Recent results indicate that induced current and resistance measurements could provide good predictions for loin marbling. Tests were carried out to develop a small-scale contactless prototype. However, some technological issues were faced when testing meat samples. Therefore, standard measurements of marbling scores and drip loss were collected on meat samples presenting a wide range of marbling. These samples were then analyzed in an induced current measurement cell and sent to a commercial lab for chemical analysis of intramuscular fat. Results should be available shortly.

Implications for the swine industry

Standard operating procedures will be provided for using novel technologies to objectively and accurately measure phenotypes for pigs’ growth, feed efficiency, welfare, carcass value and meat quality. These new traits will be useful for research projects, selection programs and/or commercial operations when applicable.

Collaborators

- Renée Bergeron  
  University of Guelph
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  Centre, AAFC
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  Lacombe Research and Development Centre, AAFC
- Jean-Paul Laforest  
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- Michael Ngadi  
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- Tim Nelson  
  PigGen Canada
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- Click here to learn more about the financial partners for Swine Cluster 2.
- Click here to learn more about the Swine Cluster 2 research program.