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

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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

Nine pilot studies, along with a commercial trial and demonstration activity, are ongoing and cover the following areas:

1. Automated recording of feed/water intake and weight/conformation
   (Centre de Développement du Porc du Québec (CDPQ))

   The project has taken major steps towards precision livestock farming, such as installing new individual water intake recording systems (smart drinkers) and a 3D vision system to predict pig weight at the Deschambault swine testing station. These new tools have become part of the regular station protocol and will be used to automatically collect new data in future research projects.

- Individual water recording systems

  At the Deschambault swine testing station, daily water intake patterns can be studied on a pen and individual basis and links with other traits such as feed intake, growth performance, carcass quality and health status can be explored. Since November 2015, pigs at the testing station have been raised in a disease-challenged environment and water intake data has been collected on 1000 individual pigs. Data analysis is underway and a technical report is under preparation.

  Smart drinkers are also being tested in an environment closer to commercial conditions at Prairie Swine Centre.

- Vision systems to predict animal weight and conformation

  A specific setup was developed by CDPQ to collect images and create 3D models of live pigs. This setup consists of 3 Kinect cameras used simultaneously in a small pen designed to restrain a pig while it is being scanned, which takes about one minute. 3D image processing was carried out on a subset of pigs, including the validation of individual images and statistical analyses to correlate measurements collected on the 3D-modelled pig with live weight, carcass weight, primal cut weights and primal cut yields. Preliminary results have led to recommendations which will improve the 3D image capture setup and explore ways to automate 3D image processing.
2 Infrared thermography diagnostic platform for swine
(Lacombe Research and Development Centre, AAFC)

Infrared thermography was adapted to be used for collecting data on individual pigs or groups of pigs. This was done by developing data and image processing tools as well as software required to make the technology useful for providing indicators of health, welfare and performance. This is a promising development, since infrared thermography can only be useful if there are proper interfaces in place to collect data and provide real-time objective indicators.

Trials involving vaccination and/or metabolic challenges were carried out to evaluate the accuracy of thermography cameras to identify sick pigs and to classify animals based on feed efficiency. The data are now being analyzed.

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. Accelerometers have been successfully fitted to different types of objects and these objects were made available to pigs as part of the trials. Preliminary results have showed that the frequency and the duration of the use of these objects decrease with time. For the suspended piece of wood, the decrease of use was considerably slower than for the other objects. The plastic ball was particularly interesting to the pig on the first day of the trial, but the rate of decrease in interest seemed faster than for other objects. Comparisons between accelerometer and video data to assess pig behaviour and welfare are still at a very early stage and results will be available in 2018.

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 first carcass evaluator prototype was designed, built and tested, but produced disappointing results. Therefore, researchers have instead been using a portable 3D scanner to assess the carcasses. Results obtained with this new scanner will be compared to results obtained from carcass dissection.
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 have been scanned on live pigs as well as after slaughter. The technology has allowed pigs to be classified according to carcass composition (fat and lean content) and certain meat quality attributes, including fatty acid 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).

Color measurements carried out with a spectrophotometer allowed lesions to be identified that were either less than 7 hours old or more than 25 hours old. These results were validated by examining variations in the expression of 6 genes involved in the lesion healing process.

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 and hyperspectral imaging, are being assessed for this purpose.

Up to now, reference measurements of composition, fatty acid profiles and shear force have been carried out on three batches of meat samples. Their correlation with nuclear magnetic resonance measurements (including relaxation measurements and solid fat content) is under analysis. Preliminary results show promising relationships with water holding capacity and meat firmness.

A line-scan hyperspectral imaging system was designed at McGill University to mimic commercial conditions and was used to scan loin samples. This work studied the possibility of determining the intramuscular fat content in both frozen and thawed pork loins from the longitudinal (naked or internal) section by using the near-infrared reflectance hyperspectral imaging technique. Information about both the chemical properties (spectral) and physical properties (image texture) of the meat were extracted and then compared to reference measurements. The data analysis is underway.
8 Quick, non-invasive technology for prediction of marbling in fresh loins  
(Centre de Développement du Porc du Québec (CDPQ))

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 65 loin 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. Preliminary results did not show a good prediction of marbling. This could be explained by the fact that the measurements taken using induced current might have been influenced by other factors such as temperature, drip loss, etc. More research is required.

9 Objective method for pork belly quality assessment and sorting  
(Lacombe Research and Development Centre, AAFC)

Pork belly prices have escalated over the last few years due to consumer high demand. However, belly quality is still measured using subjective and time-consuming manual methods. Developing an instrument based on the latest findings in pork belly softness could lead to an automated system for belly classification. An angle-adjustable conveyor belt prototype was designed and built to evaluate its potential use for classifying pork bellies based on objective softness traits. Different angles were tested to optimize the settings in terms of accuracy and speed. Preliminary tests have shown potential for the development of an automated commercial system. The settings for the prototype (angle and speed) were tested using 200 bellies from commercial pigs. Another 300 bellies will be used to test its accuracy.

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

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| Tim Nelson | PigGen Canada |
| Bernardo Predicala | Prairie Swine Centre |

Assessing pork belly quality. Source: AAFC
Additional project information
Click on the links below for further information on this project

Farmscape Interviews:
- **Wider Adoption of Technology Reduces Costs, Improves Value**
  - June 1, 2017
- **Adoption of Technology Key to Maintaining Competitive Positioning**
  - May 10, 2017
- **Novel Technologies Offer Opportunity to Improve Competitiveness**
  - May 9, 2017
- **Novel Technologies Being Adapted to Improve Competitiveness of Canadian Pork Industry**
  - December 1, 2014

Peer-reviewed articles and abstracts:
2016

2015

Additional resources:
2016
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2015

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