Use of loin intramuscular fat content predicted with ultrasound technology in the Canadian swine improvement program

L. Maignel¹, J.P. Daigle², J. Groves¹, S. Wyss¹, F. Fortin², B. Sullivan¹

¹ Canadian Centre for Swine Improvement inc., Ottawa, Canada

² Centre de Développement du Porc du Québec inc., Quebec City, Canada
Background (1)

More and more emphasis on product quality, product differentiation and increased demand for marbled pork

- Canada exports about 60% of its pork production to more than 140 countries
- Key markets: Japan, US, Russia, South Korea, Mexico, Hong Kong
- High marbling levels required for Asian and Mexican markets (6-7% IMF)

Domestically, requirements about 2% IMF but variability exists

Cooked and Raw preferences

Agriculture and Agri-Food Canada, 2008
Background (2)

- Traditionally, Canadian hogs are produced from F1 sows and Duroc boars, well-known for good marbling levels.
- Selection for leaner carcasses in the last decades, in dam lines and sire lines.
- Probable decrease in intramuscular fat % (IMF).
- Current level of loin IMF 2 to 2.5% in commercial pigs, with large variation.
- Recent signals from the packing industry (concerns about low marbling).
IMF and Marbling

Intramuscular fat (IMF) content in the loin muscle

Fig. 1. Intramuscular fat content (%) distribution along the longissimus muscle according to anatomical site and gender. T5 = 5th thoracic rib, L4 = 3rd last lumbar vertebra. Error bars correspond to standard deviation.

IMF and Marbling

- Intramuscular fat (IMF) can be measured by chemical analysis or spectral analysis (laborious & expensive)
- Prediction using marbling scores (visual & subjective) on a loin cross-section or digital image analysis
- Both methods require animal slaughter, traceability, and cutting the loin
Approach

- IMF is heritable ($h^2 \sim 0.50$)
- Carcass measurements are expensive and tricky
- Approach: Develop an *in vivo* measurement that would be:
  - Accurate
  - Practical in farm conditions
  - Affordable
  - Used to measure all selection candidates
Prediction of loin IMF in pigs

Ultrasound technology has been used for many years in pig production, for various purposes (pregnancy checking, measurement of backfat, lean depth, loin eye area, etc.)

Loin intramuscular fat represents a different challenge, with a 3-dimensional distribution within the loin.
Prediction of loin IMF in pigs

- 1995-1997: software developed at Iowa State University to predict IMF on beef cattle, based on signal- and image-processing technologies
- 2000-2007: Research at Iowa State University to adapt technology for swine (Schwab & Baas, 2006)
- 2006-now: Biotronics Inc. (Iowa) develops a commercial toolkit for use in swine (Biosoft Toolbox II for Swine)
- 2007-2008: technology tested by senior technicians in Canada

EAAP 2011 – Stavanger, Norway
IMF scanning in swine

Equipment

- Aloka SSD-500V Scanner
- UST 5011 12.5cm 3.5 MHz
- Body composition probe

- Aquila Vet with ASP 18cm probe

- Laptop & « BioSoft ToolBox II for Swine » Software

- Sensoray Frame Grabber Board

EAAP 2011 – Stavanger, Norway
IMF scanning in swine

Image capture and analysis

10th rib
Prediction of loin IMF in pigs

2009: inclusion of IMF scanning in the Canadian Accreditation Program for Swine Technicians

National Standards Officer

Level II technicians

Level I technicians
National Standards Session – May 2011

- Annual meeting for level II technicians
- Discussions about new equipment, training sessions, new traits
- Scanning 25 pigs twice for backfat, lean depth and IMF
National Standards Session – May 2011

- 9 level II technicians accredited
- Reference measurements computed as the average of 2 senior technicians
- Comparison live/carcass data

- **Backfat**
  - Reference Fat vs. Carcass Fat
  - \( r = 0.98 \)

- **Lean Depth**
  - Reference Lean vs. Carcass Lean
  - \( r = 0.89 \)

- **Intramuscular Fat**
  - Reference Live IMF vs. chemical IMF
  - \( r = 0.85 \)
Web tools for Swine Technicians

As in beef, scans have to be analyzed remotely in order to predict loin IMF %

Images analyzed and results loaded into CCSI database within 48h

www.ccsi.ca

Image analysis
(1 technician)
# Web tools for Swine Technicians

## Scan Date Range (YYYYMMDD)

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<th>Herd</th>
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## Summary of Rejected Images

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IMF scanning status

- 13 farms providing data from 4 provinces
Genetic Parameters

- 5,853 Duroc pigs scanned for backfat (BF), muscle depth (MD), and live IMF between 2008 and 2011

<table>
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<th>Live IMF</th>
<th>BF100</th>
<th>MD100</th>
<th>AGE100</th>
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<td>AGE100</td>
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Heritabilities on diagonal; genetic correlations above diagonal
Genetic evaluations for live IMF

- Multi-trait BLUP evaluation including live and carcass traits:
  - Backfat, lean depth, loin eye area, live IMF
  - Loin pH, luminosity, colour score, drip loss, marbling score

- Specific management groups used for live IMF (to account for some ‘session’ effects)

- Daily runs available on line
Genetic evaluations for live IMF

Distribution of IMF EBVs for Duroc pigs scanned in 2010

Range of about 3%

IMF EBVs now available for most AI boars
New Research Project

Production of Highly Marbled Canadian Pork by Combining New Technologies, Quantitative Selection and Feeding

Partners
Canadian Centre for Swine Improvement
Regional Centres
Agriculture and Agri-Food Canada
Scanning of 6,000 Duroc pigs for loin IMF in breeding farms across Canada

Genetic evaluation of AI boars for IMF%

Performance testing
Carcass evaluation
Sensory analysis

<table>
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<tr>
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<th>Low IMF EBV</th>
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<tr>
<td>Alternate feed</td>
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Production of ~1350 commercial piglets born from low and high IMF EBV boars
Project objectives

• Provide objective methods to produce desired levels of loin marbling in commercial hogs at the current slaughter weight, through the optimal combination of genetics and feeding.

• Provide standard methods for the evaluation of marbling in live pigs or carcasses (including new technologies such as hyperspectral analysis)

• Provide tools for Canadian breeders and producers to meet quality requirements for high-value products in the coming years
Summary

- National database established
  - About 7,000 purebred pigs with IMF scan data
  - Web-based information system in place to centralize images and results, and improve training
  - EBVs for live IMF available daily

- Standards and technician training are key factors

- These steps are essential to develop real-time measures on portable equipment

- Potential for large meat quality datasets for genomic studies
Acknowledgements

- Participating breeders
- Regional Centres in Atlantic Canada, Quebec, Ontario, Western Canada
- Canadian Swine Technicians

- Financial support from the CAAP Program of Agriculture and Agri-Food Canada
Thank you for your attention!