



ANNUAL REPORT

2016
2017

Facilitating
Research
for the Swine
Sector



Swine Innovation Porc



Swine Innovation Porc

**Swine Innovation Porc increases
Canadian swine industry competitiveness
through a national R&D structure**

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Message from the Chair

Swine Innovation Porc has been working hard over the past year to continue bringing R&D solutions to enhance the competitiveness and sustainability of the Canadian swine sector. Earlier in 2017, our national five-year research program Swine Cluster 2 received an additional \$2.4 million dollars in contributions from the federal government (\$1.8 million) and industry (\$600,000) to extend activities ongoing within the program. Swine Cluster 2 comes to a close in one year and we look forward to communicating the results of this research to our industry and producer partners.

In addition to working on Swine Cluster 2, our organization has been preparing for future opportunities, including a possible third Cluster program initiative. Part of these preparations involved carrying out extensive consultations with the swine sector regarding its research priorities in the short and long term. We would like to thank all of those that participated in our two priority-setting workshops held in June 2016. The feedback gained from these events allowed us to build a relevant snapshot of the industry's needs for the next five years and provide a basis for a call for letters of intent, which was launched in October 2016.

Our organization, which was founded in 2010, has already demonstrated its success in managing the Swine Cluster program. Therefore, our Board has been very active this year in developing strategies regarding the sustainability of Swine Innovation Porc and thus allow us to even better serve the Canadian pork industry. Several options have been discussed on how to ensure that research and knowledge transfer projects are developed in a timely manner in order to address burning issues as they arise. To this end, we will work on increasing and strengthening our partnerships with the Canadian swine industry.

Another part of our strategic planning involves research infrastructure. Swine Innovation Porc is committed to playing a major role in bringing representatives together from Canadian swine related research institutions in order to discuss common issues and find solutions to these challenges. We look forward to meet again with these representatives in 2017 and 2018.

On behalf of the Board of Directors, I want to thank Agriculture and Agri-Food's Minister Lawrence MacAulay for allowing activities within Swine Cluster 2 to be extended. I would also like to thank our management team for their hard work as well as the Board's dedication in ensuring that the most relevant R&D initiatives move forward for the benefit of the pork value chain. We are looking forward to working even closer with our partners over the next months and years to ensure we continue to fulfil our role as the national facilitator of swine research in Canada.

Stewart Cressman
Chair



Management Report

Our organization has seen a number of achievements over the past months in delivering an R&D portfolio that will provide tangible benefits for the Canadian swine sector. This year, we received an approval of an extension of funding for activities within Swine Cluster 2, finalized the identification of national priorities for the next five years, and launched a call for proposals for the next potential round of Cluster funding.

The extension of funding for our current research program provided an additional \$2.4 million investment in areas of nutrition, welfare, health, meat quality, new technologies as well as towards activities related to on-farm demonstration. This on-farm demonstration component will bring research results directly to a number of end-users across Canada to assist in the adoption of the new knowledge and technologies developed through our R&D program. The overall budget for the Swine Cluster 2 program now totals \$19.7 million: Agriculture and Agri-Food Canada, through its AgriInnovation Program, has contributed \$14.8 million and \$4.9 million is provided by provincial pork producer organizations and private partners. We invite you to read about these projects in this report.

The team was very active in 2016-2017 in enhancing collaboration and coordination within the research community and with industry partners. Please refer to the Communication and Collaboration section of this report to learn more about our networking meetings initiative, as well as our consultations with stakeholders regarding research priorities for the next five years.

Finally, preparations for a potential Swine Cluster 3 research program began in earnest in 2016. First of all, we participated in AAFC's 2.5 day workshop on the next policy framework, where Swine Innovation Porc was actively engaged in providing input for the next program. Also, a call for letters of intent was launched in October 2016. For this, 64 proposals were received and an Evaluation Committee met early in 2017 to review the potential projects. Even though a large number of the proposals were considered valuable and interesting, the Committee had to make difficult choices and accept a portion of these. We believe the high number of submissions speaks to both the strong intellectual capacity existing throughout Canada as well as the increased recognition of Swine Innovation Porc as a facilitator for R&D.

In addition to all of this work, a number of governance meetings have taken place throughout the year. The dedication of our Board of Directors and management team have allowed our successes to happen. In this regard, we have also received recognition from AAFC regarding the excellence of Swine Innovation Porc in managing Swine Cluster 2. We are proud of our hard work and we are dedicated to continuing delivering our services to our stakeholders. Thank you once again to our partners in government, industry and the research community for your collaboration and we look forward to continuing to work together in making the swine sector stronger.

Abida Ouyed
Assistant Manager

Board of Directors

From left to right:

Darcy Fitzgerald
Director
Alberta Pork

Neil Ketilson
Treasurer
Sask Pork

Mike Teillet
Director
Manitoba Pork

Raphaël Bertinotti
Director
Quebec Pork Sector

Arno Schober
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Ontario Pork

Stewart Cressman
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Ontario Pork Sector

Jean-Paul Laforest
Director
Chair of the
Science Advisory
Body

Normand Martineau
Vice-Chair
Les Éleveurs de porcs
du Québec

Tim Seeber
Director
Prince Edward Island Pork
& Porc NB Pork

John Webb
Director
Pork Value Chain



Swine Innovation Porc

Our Vision

Swine Innovation Porc increases Canadian swine industry competitiveness through a national R&D structure

Our Mission

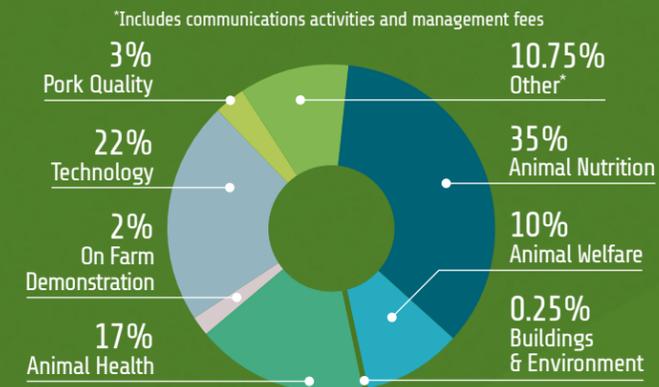
Swine Innovation Porc is committed to provide national leadership in coordinating and facilitating research, knowledge transfer and commercialization initiatives to enhance the competitiveness of the Canadian swine industry



RESEARCH & DEVELOPMENT



FUNDING ALLOCATION



Swine Cluster 2 Driving Results Through Innovation

Swine Cluster 2 is a five-year research program (2013-2018) that includes 21 projects within seven main areas:

- Animal nutrition
- Animal welfare
- Animal health
- Technology
- Pork quality
- Buildings and Environment
- On-farm demonstration



These projects fall within two themes:

- 1) reducing production and feed input costs, and
- 2) increasing product attributes and prices.

In addition to research and development projects, a third theme, "enhancing the adaptability and sustainability of the swine sector," allows Swine Innovation Porc to carry out activities to enhance collaboration between researchers and find ways to address emerging issues in the swine sector.

The total budget for this program is \$19.7 million: Agriculture and Agri-food Canada, through its AgriInnovation Program, has contributed \$14.8 million and \$4.9 million is provided by provincial pork producer organizations and private partners.

Innovative piglet management strategies for optimum performance up to slaughter weight and profitable pork production

- ▶ Denise Beaulieu and Andrew Van Kessel, University of Saskatchewan
- ▶ J. Jacques Matte, Sherbrooke Research and Development Centre, AAFC
- ▶ Kees de Lange, Jim Squires, Julang Li, Niel Karrow, Vahab Farzan, Robert Friendship, University of Guelph
- ▶ Frédéric Guay, Laval University
- ▶ Martin Nyachoti, University of Manitoba
- ▶ Ruurd Zijlstra, University of Alberta

Overview

The swine industry will face a number of challenges in the foreseeable future. Among these is the high cost of feed ingredients, which has historically represented the largest portion of operating costs. Furthermore, the use of in-feed antibiotics is increasingly being restricted as producers respond to public concerns. Therefore, novel nutritional strategies must, in addition to minimizing costs, maintain or even possibly promote animal health and resistance to infectious challenges. To address these challenges researchers are working on three focus areas:

- 1) Nutritional strategies for newborn piglets
- 2) Low cost post-weaning nutritional strategies
- 3) Novel bioactive feed supplements

Highlights

1 Nutritional strategies for newborn piglets (J. Matte and F. Guay)

Previous research has demonstrated that, as for iron, piglets are likely to suffer from a deficit in vitamin A, vitamin D, and copper until weaning. For the present project, researchers hypothesize that a supplementation of vitamin A, vitamin D and copper, combined with colostrum in early lactation could be beneficial to optimize piglet health and growth performance.

The first step was to determine the best way to provide copper and vitamins A and D to piglets. Results available so far indicate that oral administrations of these supplements as well as UVB light exposure were efficient ways of increasing these micronutrients in piglets up to weaning. Also, it appears that piglet microbiota can be altered by supplementing sow diets daily with vitamins A and D and organic copper

during late pregnancy and lactation. Therefore, the combination of supplementing sow diets and providing piglets with these micronutrients was used for the next steps of the project.

The second step was performed in research conditions and aimed at determining the impact of supplementing both sow and piglets with vitamins A and D and copper in addition to colostrum (for the piglets only). Preliminary results have showed a considerable drop of copper concentrations in the livers of piglets during the post-weaning period (23 to 42 days), despite being fed a very high level of dietary copper. These results are unexpected and intriguing. This drop of post-weaning copper reserves may be explained by the presence of high levels of dietary zinc and copper.

The third step repeated the same protocol as above, however more piglets were used and the work was carried out in semi-commercial conditions.



Station for exposing piglets to UV radiation, which was measured by placing a device next to the piglet. Source: Sherbrooke Research and Development Centre, AAFC



Preservation jars are being used for small-scale screening of various acids and bacterial inoculants on the preservation and chemical composition of high moisture barley and wheat. Source: University of Saskatchewan

2 Low cost post-weaning nutritional strategies

- Pre-treatment of feed ingredients to enhance value (D. Beaulieu, A. Van Kessel, M. Nyachoti)

A series of experiments are being conducted to establish the efficacy of ensiling or acidifying high moisture cereal grains and protein co-products as well as adding enzymes in order to reduce anti-nutritional factors and improve nutritive value, health and performance of pigs while reducing costs.

Feeding trials with nursery piglets using ensiled barley and wheat were carried out. Results have showed that formulating post weaning diets using ensiled grains at a low moisture content, particularly wheat, improved the feed intake and growth performance of piglets. More importantly, grains fermented at low moisture content could be included in standard dry diets without additional drying.

Digestibility and nursery feeding trials were also conducted to evaluate the effects that adding acid and/or enzymes to high moisture wheat or barley upon storage may have on the performance and gut health of weanling pigs. Preliminary results have showed that feeding acid-preserved wheat to newly weaned piglets does in fact improve feed efficiency. This improvement is comparable to the advantages gained with direct acidification of diets. However, more work is required to develop protocols that will reduce corrosion of the bins used to store the acid preserved grains.

On the other hand, when included in post-weaning diets, fermented soybean meal, obtained from five different sources, was ineffective in improving post weaning performance or affecting the parameters associated with piglet gut health beyond that observed with conventional soybean meal.



Masters student Bonjin Koo working with piglets. Source: University of Manitoba

Preservation of inoculated moisture grain in barrels. Source: University of Manitoba



Inoculation of high moisture cereal grain with two types of lactic acid. Source: University of Manitoba



- Simple versus complex post-weaning diets
(K. de Lange, V. Farzan and M. Nyachoti)

Ability to deal with disease stress

Researchers have performed a number of studies to evaluate the impact of feeding inexpensive nursery diets on the piglet's ability to deal with disease stress and on how to improve their robustness.

Algae meal

Researchers have found that including 3.12% of algae meal in a nursery pig diet had no effect on feed intake, provided omega-3 fatty acid enrichment, promoted normal growth and improved piglet health status. Algae meal may be a more environmentally-friendly alternative to using supplements such as fish oil and appears to have similar positive health effects. For example, supplementing fish oil and algae meal in low quality diets reduced fever during a simulated immune system challenge. As more research is conducted regarding algae meal, it may become a more cost-effective way to boost nursery diet quality and piglet health.

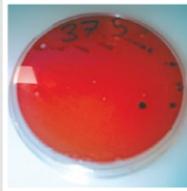
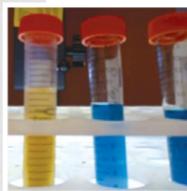
Epidemiology study: impact of simple nursery diet under commercial farming conditions

Seven commercial farms with moderate to high health status were enrolled in this study. A total of 774 pigs in 13 cohorts were monitored from birth up to slaughter. On each farm, half of the enrolled piglets were assigned to a simple nursery diet, i.e. low-level animal protein, while the other half received conventional feed. Both diets were fed in three phases over the six-week nursery period. After this period, all pigs were fed the grower-finisher diets common to each farm.

The use of a low complexity nursery feed program in a commercial setting is shown to have no negative impacts on pig growth and performance up to slaughter weight. Interestingly, the pigs that were fed a low complexity diet appeared to have compensatory growth before the end of the nursery phase. This is surprising because complete compensatory growth was not observed until the grower phase in prior experimental trials. The cost of feed per pig during the nursery period was reduced (for the low complexity diet) by \$2.81 per pig. While the complexity of the nursery diet did not influence carcass quality traits and health indicators, the low complexity diet might increase the risk of *Salmonella* shedding in pigs. However, several genetic variants in immune system genes were found to be associated with *Salmonella* shedding.



Source: University of Guelph



Salmonella culturing. Source: University of Guelph



Piglets involved in the project. Source: University of Manitoba



Margaret Ainslie, MSc graduate student. Source: University of Guelph



Feed enzymes

Researchers conducted a feeding trial over four weeks with weaning pigs to investigate the effects of diet complexity and use of the enzyme supplement multicarbohydase. Results have shown that piglets given a diet formulated to mimic conventional nursery diets and piglets fed with a simple diet had comparable body weights at the end of the trial. The simple diet consisted primarily of corn, wheat, and soybean meal. Using simplified nursery diets has reduced feed costs in a four-week nursery production by improving feed efficiency compared to a conventional complex nursery diet. This reduction of feed cost was evaluated at \$2.87 per pig. Furthermore, the addition of feed enzymes (multicarbohydase; 0.1%) improved nutrient digestibility, intestinal morphology, and feed efficiency for all diets tested in this study.

3 Novel bioactive feed supplements

- Epidermal growth factor (J. Li)

The efficiency of the hormone EGF (porcine epidermal growth factor) produced using a newly generated yeast was examined in a three-week long feeding trial with post weaning piglets. Piglets received either 0, 20, 40 or 80 ug/ kg of body weight per day of EGF.

Results revealed that EGF had a positive effect on the overall average daily gain of piglets as well as on feed efficiency, with effects increasing according to the dose received as per dosage amounts tested in this trial.

- Prebiotics and organic acid salts (R. Zijlstra)

Aiming at reducing post-weaning diarrhea without using antibiotics, a nursery feeding trial was conducted to evaluate the impact of diets supplemented with prebiotics (3 types) or with an organic acid salt. This trial was conducted under poor sanitary conditions.

Following the start of the trial, post-weaning diarrhea increased and then declined, but did not differ among diets. Supplementing with an organic acid salt (1.20% potassium di-formate) enhanced the average daily gain by 13%, feed efficiency by 7.5%, body weight at the end of nursery by 8.5%, in addition to the apparent total tract digestibility of dry matter, crude protein and gross energy by 3%. Supplementing with prebiotics that includes glucan and zinc (2 types) had the same increase in apparent total tract digestibility of dry matter, crude protein and gross energy, but

did not affect the growth of the piglets. Finally, supplementing with the prebiotic that includes mannan oligosaccharides (MOS) did not affect piglet performance nor digestibility of the diet. Organic acid salts may therefore serve as a partial replacement for antibiotics in diets after weaning.

Implications for the swine industry

New feeding strategies are being developed for newborn and newly weaned piglets. The following has been learned so far:

- Low complexity diets allow a reduction of feed cost during the nursery period of about \$2.80 per pig. These diets have no negative impacts on pig growth and performance up to slaughter weight. However, the low complexity diet may increase the risk of *Salmonella* shedding in pigs.
- To avoid deficits in vitamin A, vitamin D, and copper in piglets until weaning, providing an oral supplementation of these three micronutrients to piglets as well as exposure to UVB light, combined with supplementing sow diets with vitamins A and D and organic copper during late pregnancy and lactation periods shows to be an efficient strategy.
- Feeding ensiled wheat, at low moisture content, has a positive impact on feed intake and growth performance in piglets.
- Feeding acid-preserved wheat to the newly weaned piglet improves feed efficiency.
- Feeding a specific porcine epidermal growth factor (EGF) that is produced with a newly generated yeast has positive impacts on piglet growth rate and feed efficiency.
- Organic acid salts may serve as a partial replacement for antibiotics in diets after weaning.

Collaborators

- Nathalie Bissonnette** Sherbrooke Research and Development Centre, AAFC
- Jérôme Lapointe**
- Martin Lessard**
- Guylaine Talbot**

Increasing sow milk yield and piglet growth via low-cost feeding and management strategies during gestation and/or lactation

Overview

Pork producers restrict gestating sows' feed intake in order to prevent excessive body weight gain and the associated negative consequences on mammary development, locomotion, farrowing and feed intake during lactation. Aggression and stereotypies (repetitive, rhythmic or invariable behaviours that may indicate discomfort) associated with restricted feeding are a welfare concern, and aggression can become a greater problem when sows are housed in groups. Another challenge is sows that do not produce enough milk to sustain optimal growth for their piglets. This is a problem that has been amplified in recent years due to hyperprolific sow lines. Therefore, researchers are working on developing low-cost feeding and management strategies for gestating sows as a way to reduce aggression, maintain optimum production and increase sow milk yield during lactation.



Milking a teat.
Source: Sherbrooke Research and Development Centre, AAFC

- ▶ Denise Beaulieu, University of Saskatchewan
- ▶ Chantal Farmer, Sherbrooke Research and Development Centre, AAFC

Highlights

Reducing aggression

In order to reduce aggression and maintain optimum production in gestating sows, researchers are investigating if processing straw into feed can improve its satiating effect by altering its fibre content and structure.

Up to now, the results from two completed experiments have demonstrated that using heat and moisture to process straw changed fermentability and the net energy content of the straw. Moreover, differential results were obtained depending on the source of the straw.

Experiments conducted so far include:

- Evaluating (*in vitro*) solubility characteristics of wheat and oat straw that were processed using various approaches and combinations of temperature, moisture and pressure.

- Determining the digestible energy (DE) and net energy (NE) content of processed wheat and oat straws in finishing pigs.
- A third experiment is ongoing, where gestating sows are fed with diets supplemented with wheat or oat straw processed and compressed using a 'briquette maker'. Results should be available in early 2018.

Implications for the swine industry

- A processing methodology has been developed to improve fermentation and potentially satiety characteristics of different straws. This could eventually be used in feeding gestating sows to control/reduce aggression.
- Achieving a certain backfat thickness of gilts by applying appropriate feeding strategies during gestation would promote mammary development.
- Administering the phytoestrogen genistein to gestating sows increased carcass fat content of neonatal piglets but had no beneficial effects on sow lactation performance or foetal growth.

Collaborators

Jennifer Brown Prairie Swine Centre

Jérôme Lapointe Sherbrooke Research and Development Centre, AAFC
Marie-France Palin

Maximizing mammary development

A series of studies focusing on mammary development were conducted to improve milk yield and piglet growth. Researchers focused on two main areas that may impact mammary development:

Gilt body condition

The following results were obtained from two studies involving gilts:

- Mating 'thin' gilts with a backfat thickness as low as 12 to 15 mm did not present any negative effect on mammary development, as long as they are fed to increase their backfat thickness during gestation.
- At the end of gestation, gilts that are too thin (backfat thickness of 15 mm and below) will have less-developed mammary glands.
- Feeding level in gestation is critical to achieve optimal mammary development in late gestation and maximize future potential milk yield.

These studies were the first to investigate the impact of backfat thickness on mammary development in late gestation. For this, the following methodology was developed:

- Providing different feeding levels in gestation to gilts of similar body weight and backfat thickness at mating in order to obtain three different groups of backfat thickness at the end of gestation.
- Separating gilts at mating based on backfat thickness to create three body condition groups and then feeding gilts to maintain the differences in their body condition until the end of gestation.

Use of the phytoestrogen genistein

A study was carried out to see if providing genistein to late-pregnant sows could stimulate foetal growth and mammary development. Even if there was an increase in the carcass fat content of neonatal piglets when using genistein, the overall results did not support the use of such a treatment in commercial swine units to improve sow and piglet performance.

For this study, sows were divided in two groups: a control group and a group receiving two intramuscular injections of 220 mg of genistein daily (from day 90 of gestation to farrowing).

Briquette maker used for processing and compressing straw.
Source: University of Saskatchewan

Newborn piglets.
Source: Sherbrooke Research and Development Centre, AAFC



Straw briquettes coming out of the briquette maker.
Source: University of Saskatchewan



Feeding programs for growing-finisher pigs to enhance global competitiveness: Opportunities across Canada

- ▶ Eduardo Beltranena, Alberta Agriculture and Forestry and University of Alberta
 - ▶ François Dubeau, University of Sherbrooke
- ▶ Marie-Pierre Létourneau-Montminy and Frédéric Guay, Laval University
 - ▶ Martin Nyachoti, University of Manitoba
- ▶ Candido Pomar, Sherbrooke Research and Development Centre, AAFC
- ▶ James Squires, Kees de Lange, Julang Li, Ira Mandell, Bob Friendship, University of Guelph
 - ▶ Ruurd Zijlstra, University of Alberta

Overview

Feed cost is by far the greatest cost of pig production (65-70%) and growing-finisher pigs account for about 80% of feed consumed. The continued high cost of feed demonstrates the need to develop cost-effective feeding strategies for growing-finisher pigs to ensure the long-term competitiveness of the Canadian pork industry. Researchers are working on four strategic areas to address this issue:

- 1) Novel feedstuffs and enhanced nutritional values
- 2) Precision feeding of individual pigs
- 3) Validation of feeding strategies
- 4) Optimizing feeding strategies for groups of pigs

This report highlights activities from three of these strategic areas.

Highlights

1 Novel feedstuffs and enhanced nutritional values

The nutrient content of emerging ingredients is being characterized in detail to develop unique Canadian databases. Researchers have also been exploring different means to maximize nutrient utilization from such ingredients and dietary inclusion levels.

- Characterize the nutritive value of emerging feedstuffs (M. Nyachoti and J. Squires)

Low-fat corn Dried Distillers Grains with Solubles (DDGS)

Digestibility trials with growing pigs were conducted to compare standard DDGS with low-fat DDGS. As presented in Table 1, low-fat corn DDGS has a higher concentration of digestible amino acids and energy than regular DDGS. Low-fat DDGS samples had also greater standardized ileal digestibility content of indispensable protein and crude protein than the regular DDGS.

Table 1: Digestible energy (DE), crude protein and standardized ileal digestibility of lysine, methionine and threonine of standard DDGS and of low-fat DDGS (2 samples)

	Standard DDGS	Low-fat DDGS	
		Sample 1	Sample 2
DE (Kcal/kg)	3614	4494	4555
Crude protein (%)	30.1	42.3	43.1
Standardized ileal digestibility			
Lysine (g/kg)	4.9	6.1	7.4
Methionine (g/kg)	4.6	6.8	7.4
Threonine (g/kg)	6.8	9.5	10.1

Providing an adequate supply of energy in swine diets is not only the most expensive component of feed but it is the greatest contributor to the growth and efficiency of pork production. These data suggest low-fat DDGS could replace a significant amount of corn and soybean meal compared to regular DDGS. The next logical piece of research is to investigate and determine the most economic and optimal amount to include in pig diets in order to replace corn and soybean meal.

Hemp co-products

The net energy (NE) content of the hemp co-products outlined in Table 2 were determined.

Table 2: Net energy (NE) content of hemp hulls, extruded hemp hulls and blended hemp hulls and peas

	NE (Kcal/kg)
Hemp hulls	2375
Extruded hemp hulls	2320
Blended hemp hulls & peas	2399

The relatively high NE content of hemp hull and processed hemp hull products may be attributed to the high levels of residual oil in these ingredients.

Camelina cake

Trials were conducted with growing pigs to characterise camelina cake. Results are presented in the following table (table 3)

Table 3: Digestible energy (DE), metabolizable energy (ME), net energy (NE) and standardized ileal digestibility of lysine, methionine and threonine of camelina cake

	Camelina cake
DE (Kcal/kg)	3755
ME (Kcal/kg)	3465
NE (Kcal/kg)	2383
Standardized ileal digestibility	
Lysine (g/kg)	10.0
Methionine (g/kg)	1.6
Threonine (g/kg)	8.9

The average standard ileal digestibility of indispensable amino acids in camelina cake fed to growing pigs was 67.2%, while the digestibility of dispensable amino acids was 58.8%.

- Means to enhance nutrient utilization and maximum inclusion rates (R. Zijlstra, M-P Létourneau-Montminy, J. Squires, J. Li)

Nutrient digestibility of mash, steam pelleted and extruded barley and faba bean

Researchers carried out a digestibility trial with growing pigs to evaluate the nutritional quality of barley and faba bean in mash, steam pelleted and extruded forms. Results have showed that steam pelleting and extrusion enhances the nutritional quality of both faba bean and barley, with a greater increase for faba bean. These two processing methods increase the digestibility of amino acid and energy of faba bean and the digestibility of energy of barley in growing pigs. Steam pelleting and extrusion is more efficient in faba bean because its protein and starch matrix is more resistant to digestion than barley.

Digestibility of starch, energy, and amino acids, and characterization of undigested starch of pulse and cereal grains

Researchers carried out a digestibility trial with growing pigs to 1) determine the digestibility of starch, energy, and amino acids and 2) characterize undigested starch using confocal laser scanning of pulse and cereal grains. Results have shown that the accuracy of formulating pig diets containing pulse and cereal grains based on net energy values can be enhanced if starch is defined in two fractions:

- fraction digested by enzymes, and
- fermentable fraction.

More specifically, results have shown that the apparent ileal digestibility of starch in cereals is greater than in pulses. However, for both feedstuffs, the apparent total tract digestibility of starch was 99%, which means that starch was almost completely degraded.

Fermentation of soybean meal

Researchers have further improved the fermentation procedure of feed stuff (soybean meal) to allow larger scale-, and less energy required-fermentation to make it more production applicable and environmental friendly. Fermentation procedures were optimized to allow at least 2 kg of soybean to be fermented at 50% moisture levels, which resulted in eliminating allergen proteins. In addition, fermentation also decreased oligosaccharides in soybean meal. Results of the animal trial, which will examine if fermented soybean meal improves digestibility for growing pigs, will be available in 2018.

Addition of the enzyme xylanase in high-fibre diets

Trials have been conducted with finishing pigs to compare two high-fibre diets to a classic, low-fibre corn and soybean meal diet. All three diets were tested with and without the addition of the enzyme xylanase. The impacts of these diets on the ileal digestibility of nutrients, growth performance, and carcass quality were studied.

Preliminary results showed that the high-fibre diets improved the apparent ileal digestibility of acid-detergent fibres and lipids, without the addition of xylanase. In fact, xylanase increased the digestibility of neutral-detergent fibres only in a non-starch polysaccharides (NSP) soluble diet. Neither the diet nor the xylanase influenced the digestibility of crude protein, calcium, phosphorus, NSP soluble, NSP insoluble, energy or ash. Therefore, these results demonstrate that it is possible to feed pigs with high-fibre diets without modifying nutrient digestibility.

Results of the growth trial showed that high-fibre diets reduces feed intake and average daily gain over the first 14 days of the trial, but did not affect feed efficiency. Knowing that fibre may reduce feed intake, high-fibre finishing diets should therefore include enough essential nutrients to maintain weight gain. Finally, measurements taken on the carcasses indicated that carcasses of pigs fed a high-fibre diet contained more unsaturated fat, but at a level that is still acceptable for the slaughterhouse.

The high-fibre diets that were tested in this trial included by-product feedstuffs containing either soluble non starch polysaccharides (wheat middling, bakery meal and canola meal) or insoluble non starch polysaccharides (DDGS and canola meal).

2 Precision feeding of individual pigs

- Improving phosphorus efficiency in sustainable pig precision farming systems (C. Pomar)

Researchers developed mathematical models representing the metabolism of phosphorus and calcium in order to estimate individual pig requirements. It has been found that using phosphorus and calcium depletion-repletion sequences is a good strategy for reducing calcium and phosphorus intake. However, before using this kind of dietary strategy, which increases dietary phosphorus and calcium efficiency without affecting pig growth performance and bone mineralization, more work needs to be done to better understand the digestive and metabolic adaptations that develop.

- Amino acids and formulating low protein diets to reduce feed cost and improve farm sustainability (C. Pomar)

Researchers have reviewed certain nutritional concepts in order to develop precision feeding strategies. Researchers therefore confirmed that:

- Precision-fed pigs use amino acids more efficiently than pigs fed with conventional diets, partly due to the fact that nutrient efficiency is not constant across animals and is affected by production conditions.
- The content of amino acids found in the feed has an impact on the composition of the protein in the pig's body.
- Restricting amino acids in feed affects body proteins differently depending on the type of body protein.

3 Validation of feeding strategies

- Model validation and intact males (I. Mandell and J. Squires)

An initial evaluation was carried out on the potential of certain feed additives to control boar taint, and therefore improve the quality of meat produced by intact male pigs. *In vitro* results have showed that diatomaceous earth, bentonite, spent filter aids, and a hydrated sodium- calcium aluminosilicate (Jumpstart 360) were the most effective feed additives for binding androstenone and skatole, two compounds responsible for boar taint in intact male pigs.

Three feeding trials took place after this evaluation. None of the binding agents were able to decrease levels of androstenone. In the second trial, the binding agents were added to the diets when boars reached either 70 or 90 kg body weight and were fed up to slaughter. Feeding the pigs with hydrated sodium-calcium aluminosilicate decreased the levels of androstenone in plasma and had no impact on growth and meat quality characteristics. A third trial was then conducted to evaluate using wood charcoal, a new binding agent which is a feed ingredient approved by the Canadian Food Inspection Agency. Binding agents had no effect on concentrations of androstenone and skatole and reduced weight gains.

As a result, the 'ideal protein' concept used to formulate feeds in conventional systems does not apply to precision feeding.

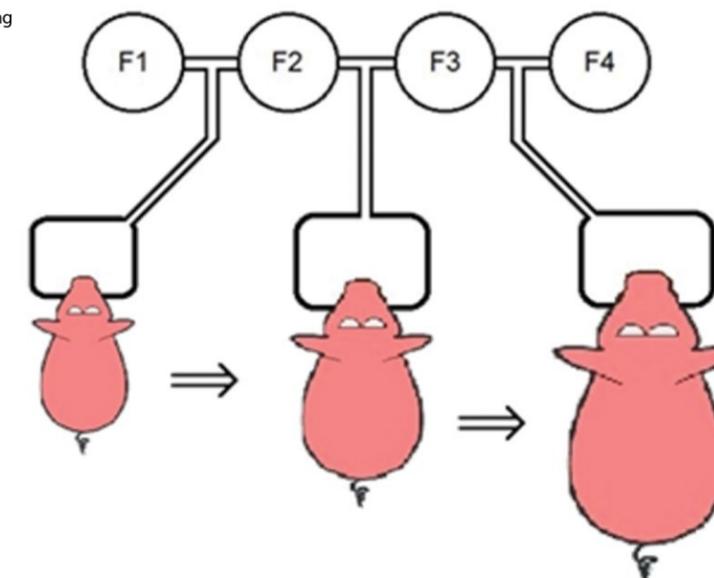
Also, revising these concepts in the model estimating real-time nutrient requirements of pigs will further improve the efficiency of precision feeding. Precision feeding, at this time, already reduces feeding costs by more than 8%, protein intake by more than 25% and nitrogen excretion by more than 38%, and all of this without affecting animal performance.

- Optimal management of farm resources (F. Dubeau)

Recently, the most interesting model for precision feeding was obtained when blending two feeds during the growing-finishing phase in order to meet each individual pig needs. This mathematical model reduced feed costs by 4.1%, phosphorus excretion by 3.3 %, and nitrogen excretion by 14.8 %.

Researchers also developed a novel feeding system called the Hybrid Feeding System. This new model combines phase-feeding with a precision feeding system using two feeds. In the Hybrid Feeding System, for instance, if three phases are used, two feeds will be blended during each phase. Between two consecutive phases, one feed would stay the same and one would change. Therefore, four different feeds would be used when using three phases. This new mathematical model reduced feed costs by 5.2 %, phosphorus excretion by 2.2 %, and nitrogen excretion by 17.8 %.

Hybrid Feeding System. Source: University of Sherbrooke.



- Nutrition and gut health (R. Friendship)

Two of the most important pathogens affecting growth performance in the grower-finisher barn are known to be *Brachyspira* and *Salmonella*. In this study, researchers investigated the prevalence of *Salmonella* on 12 farms, and could recover *Salmonella* on all studied farms. Further, the increased amount of antibodies against *Salmonella* found in pigs at the end of the nursery phase (>50%) demonstrates how widespread *Salmonella* is in the Ontario swine population and the importance of the nursery stage in the epidemiology of this disease.

- Low energy feeds (E. Beltranena)

The objective of this experiment is to compare growth performance, dressing percentage and carcass characteristics of growing-finishing pigs. These pigs were fed low or high feed energy levels, had either two or three feeder spaces per pen, and were housed at two different stocking densities.

Researchers have previously shown that feeding low, constant net energy (2.1 Mcal net energy) diets to growing-finishing pigs resulted in more than \$10 profit per pig (gross revenue after subtracting feed costs) than feeding higher energy levels (2.2, 2.3, 2.4 Mcal). However, pigs must be able to increase feed intake to make up for the lower energy density. In crowded pens, there may not be enough access to feeders for pigs to take advantage of low energy diets. Additional feeders and higher energy diets may compensate for the detrimental effects of pen crowding. Results will be available in 2018.

Implications for the swine industry

New feeding strategies are being developed for growing-finishing pigs. The following has been learned so far:

- Low-fat DDGS could eventually replace significant amounts of corn and soybean meal in growing-finishing diets. More research is needed to investigate the optimal and economical inclusion levels.
- Steam pelleting and extrusion can enhance nutritional quality of both faba bean and barley.
- Formulating pig diets containing pulse and cereal grains based on net energy values can be done with more accuracy if starch is defined by its enzymatically-digestible and fermentable fractions.
- Fermentation of soybean meal can eliminate allergens and decrease oligosaccharides.
- High-fibre finishing diets can be fed to pigs without modifying nutrient digestibility. Knowing that fibre may reduce feed intake, high-fibre diets should therefore include enough essential nutrients to maintain weight gain.
- Researchers have developed a novel precision feeding system: the Hybrid Feeding System. This allows feed costs to be reduced by 5.2 %, phosphorus excretion by 2.2 %, and nitrogen excretion by 17.8 %.
- The net energy (NE) content of camelina cake, hemp hull, extruded hemp hull, and a blended hemp hull/pea product is now known.
- The digestibility of the crude protein and amino acids in camelina cake is now known.

Collaborators

Ines Andretta	UFRGS (Universidade Federal do Rio Grande do Sul), Brazil
Jean-Pierre Dussault	University of Sherbrooke
Luciano Hauschild	UNESP (Universidade Estadual Paulista), Brazil
Agnès Narcy	INRA (Institut national de la recherche agronomique), France
Miranda N. Smit	Alberta Agriculture and Forestry
Malachy G. Young	Gowans Feed
José Luis Landero	Consulting
Xun Zhou	

Feeding organic minerals to gilts and sows: effects on milk quality and litter performance

► Chantal Farmer, Sherbrooke Research and Development Centre, AAFC

Overview

This project was part of a larger project, where the effects of a partial substitution of inorganic minerals with an organic source on performance and physiological status of sows and their piglets was studied.

For this study, researchers focused on the impact of substituting 50% of inorganic minerals (Cu, Zn and Mn) with organic minerals on milk composition of sows over their two first parities.

Highlights

The Availa®Sow premix, which contains trace elements in organic form, was used at a rate of 750 mg / 1000 kg of feed that was provided to gilts at of 25 kg body weight until completion of the second lactation. The composition of sows' milk, including dry matter, fat, protein, lactose, somatic cells and Immunoglobulin A (IgA), was determined in samples collected on day 7 of lactation for both the first and second parities.

It was observed that this feeding strategy had no significant effect on the composition of sow milk.

Implications for the swine industry

Even if this feeding strategy could potentially have a beneficial effect on sow longevity, results demonstrated no benefits for sow milk composition.

Collaborators

Mark E. Wilson	Zinpro Corporation
Dan Bussièrès	Groupe Cérès
Frédéric Guay	Laval
Jean-Philippe Martineau	University



Determining the optimum space allowance for nursery pigs

► Jennifer Brown, Prairie Swine Centre

Overview

Very few research results are available on the effects of space allowances on nursery pigs, even though the quantity of space provided to pigs substantially affects animal welfare by influencing behaviour, stress and social interactions. Space allowance also has a significant economic impact on productivity and the total pig throughput possible on a farm.

Highlights

This study examines six different space allowances for nursery pigs ($k = 0.0230, 0.0265, 0.0300, 0.0335, 0.0370, \text{ and } 0.0390$) and is being carried out in two phases. Phase I is being done at a research barn and Phase II at two commercial farm sites. Data have been collected on productivity, piglet postures, injury, as well as on room climate.

For Phase I, the effects of space allowance were compared in large and small pen group sizes (10 and 40 pigs per pen) over four seasons. Additional data on piglet stress physiology and immune competence were also collected. Phase I results showed significant changes in piglet posture due to changes in space allowance, but no clear effect on growth was found.

Preliminary results from Phase 2 suggest that the space allowance of $k = 0.0335$, as specified in the 2014 Code of Practice for the Care and Handling of Pigs, is reasonable. In Phase 2 (commercial farms) it was found that lower space allowances resulted in reduced growth. Final results will be available in 2018 once all analyses are completed.



Piglet pen during the nursery density trial.
Source: Prairie Swine Centre

Implications for the swine industry

A precise value will be produced for the minimum space allowance for nursery pigs. This would allow an optimal and scientifically defensible balance to be reached between profitability and animal welfare.

Collaborators

Denise Beaulieu	University of Saskatchewan
Yolande Seddon	University of Saskatchewan
Dan Bussi�eres	Groupe C�er�s Inc.
Sandra Edwards	Newcastle University, UK



Researcher working with a producer.
Source: Doug Richards, Prairie Swine Centre

Overview

Canadian pork producers are being required to transition to group sow housing in order to meet consumer and retailer demands, as well as to comply with the revised Code of Practice for the Care and Handling of Pigs (2014). However, this change requires major renovations to existing buildings, or replacement with new buildings, as well as significant changes to daily management. The cost and uncertainty involved are daunting. This project aims to gather the best possible information by documenting four barn conversions as they go through the process of conversion. Information from ten sites that have already converted to group sow housing is also being collected.

The project's website www.groupsowhousing.com now provides information from 10 different farms where sows are housed in groups. The website provides immediate access to comprehensive and sound information that includes pictures, descriptions of the conversion process, interviews with producers, and other material pertinent for producers.

Highlights

Interest in group sow housing is increasing as producers begin planning for the transition. The majority of producers making the transition have selected electronic sow feeding (ESF) systems. The primary reasons for choosing these systems is because they allow greater control of individual feeding and can accommodate higher sow numbers per square foot than other systems. However, many producers do not have the essential information on hand regarding the need for a separate training area or on how to manage gilts during the training period when implementing ESF systems.

National sow housing conversion project

► Jennifer Brown, Prairie Swine Centre



ESF feeders.
Source: Doug Richards, Prairie Swine Centre



Sows using environmental enrichment at Hog-Tied Farms.
Source: Doug Richards, Prairie Swine Centre

Arguably, producers who have already implemented group sow housing successfully are potentially the best resource to provide other producers with credible information on what is needed for the transition. Up to now, eleven farm sites across the country have been identified and these producers' experiences have been documented in the form of interviews, photos and video footage of barns, housing plans, management and staff training and detailed costs of the transition. Scientific research on the management of group housing is also being collated and distributed to producers via the project's website and newsletter, as well as in presentations.

Implications for the swine industry

Accurate scientific information and resources will be produced in order to achieve a smoother, more efficient transition towards group sow housing. Producers will be given the information necessary to be able to manage sows effectively in groups while maintaining or improving productivity.

Collaborators

Laurie Connor	University of Manitoba
Qiang Zhang	University of Manitoba
Murray Elliott	FGC Groenenstage Constr. Ltd.
Mark Fynn	Manitoba Pork Council
S�bastien Turcotte	Centre de d�veloppement du porc du Qu�bec
Lee Whittington	Prairie Swine Centre

Optimizing flooring and social management of group housed gestating sows

► Laurie Connor, University of Manitoba



Taking backfat measurements. Noel Generoso. Source: University of Manitoba.

Overview

This project addresses three specific knowledge gaps related to the management of gestating sows in groups as recommended in the revised Code of Practice for the Care and Handling of Pigs (2014).

Highlights

1 What are the most effective concrete floor slat and gap width ratios for comfort and well-being of sows as well as ease of manure management?

Two flooring types, selected from preliminary kinematics assessments, are being evaluated in group pens holding sows over two gestation periods:

- Slats at 105 mm (4") with a gap of 19 mm (0,75")
- Slats at 125 mm (5") with a gap of 25 mm (1") (this one is often used in commercial barns)

Starting with nulliparous gilts, each animal was evaluated for lameness, hoof lesions, postural changes, space utilization within the pen and limb weight distribution using a force-plate scale during two sequential gestations. Reproductive performance and culling rate were recorded. Assessment of pen cleanliness and air quality will provide information on floor porosity for effectiveness of manure removal. Outcomes will provide recommendations on slat and gap widths of concrete slatted floors for sow comfort and pen environment.

In addition, the chemical and physical properties of rubberized and synthetic concrete overlay materials are also being evaluated (e.g. material hardness, resistance to water, surface friction, ease of cleaning and adhesion). More information will therefore be available about the potential impact of these materials on sow comfort, pen hygiene and materials durability.

2 What sow mixing strategies after weaning provide the best results for reproductive performance, low economic risk and sow well-being?

The research examined mixing sows into gestation groups at three different times:

- At weaning
- Post-insemination
- Late mixing (at four weeks post-breeding, after confirmation of pregnancy)

Tests were carried out using three different housing system variations:

- Partially-slatted floors with Electronic Sow Feeding (ESF) systems
- Straw-bedded floors with ESF systems
- Fully slatted floors with walk-in/lock-in free access stalls

The study measured aggression levels in sows over a two-day period after mixing. Measures of salivary cortisol were recorded from four identified sows per pen before and after mixing. Injury and lameness scores were also assessed pre- and post-mixing. Daily ESF entry data was collected to determine if individual sows fed more than once and if the order of sows using the ESF changed over time. Measurements related to sow reproductive performance were also taken.

Researchers are also updating a mathematical model to determine the economic risks related to sow mixing strategies. A cost-benefit analysis of the different post-weaning sow grouping times carried out with this mathematical model will provide producers with a valuable decision making tool based on economic risk assessments.



Saliva sampling for measuring cortisol. Lindsey Lippens. Source: University of Manitoba.



Colour coded pigs for behaviour observations. Source: University of Manitoba



Wrapping an accelerometer onto the rear leg of a sow on a force plate scale. Source: University of Manitoba



Assessing sow foot health. Source: University of Manitoba



Sow using rope enrichment. Source: University of Manitoba

3 What environmental enrichment strategies can be incorporated into slatted-floor pen systems for sow groups?

There are three phases involved and data analysis is ongoing:

Phase I: Screening a selection of five enrichment devices which included:

- Wood blocks hung horizontally or hung at an angle touching the floor
- Three items hung together (chain, rope and wood block)
- Straw in a metal rack or on the floor

Phase II: Examining the effectiveness of enrichment devices in reducing aggression, stress and stereotypic behaviors as well as increasing sow activity and productivity through:

- Constant provision of a single enrichment device
- Thrice-weekly rotation of three enrichment devices
- Thrice-weekly rotation of three enrichment devices, with an associative stimulus (e.g. bell rung prior to enrichment delivery)
- No enrichment

Phase III: Exploring the effect of enrichment devices on increasing the use of loafing areas in the free-access stall housing system and evaluating the type of enrichment best suited to sows (consumable vs manipulable), the distribution in the pen and the influence of social interactions (dominant or subordinate sows) on the use of enrichment devices.

Implications for the swine industry

Practical and scientifically validated recommendations and guidelines will be provided about flooring, mixing and enrichment strategies in order to help pork producers remain productive, proactive and profitable when making the transition to sow group housing.

Collaborators

Derek Brewin	University of Manitoba
Qiang Zhang	University of Manitoba
Jennifer Brown	Prairie Swine Centre
Nicolas Devillers	Sherbrooke Research and Development Centre, AAFC
Yolande Seddon	University of Saskatchewan

Monitoring the effects of transport on the behaviour, physiology, carcass and meat quality of pigs through the study of truck micro-climate, vibrations and cooling systems

► Luigi Faucitano, Sherbrooke Research and Development Centre, AAFC

Overview

This study is working on evaluating the impacts of ventilation, in warm conditions and combined with water misting, on the behaviour, physiology, carcass and meat quality of pigs waiting to be unloaded at the slaughterhouse. Researchers are also looking into assessing the impacts of vibration during transport to the slaughterhouse on the posture of the pigs (for example, standing, sitting or lying down).



Ventilation system.
Source: Sherbrooke Research and Development Centre, AAFC

Highlights

Cooling system

Preliminary results have shown that the use of a fan-assisted misting bank appears to improve thermal comfort and reduce dehydration in pigs that are kept in a stationary truck before unloading.

During the summer of 2015, and using two identical pot-belly trailers, twelve loads of 191 pigs each (six loads per trailer) were transported over a two-hour period to the slaughter plant. On arrival at the plant, the trailers remained stationary for 30 minutes before unloading. During this period, one trailer was exposed to external forced ventilation

and misting for 10 minutes using fan-mister banks located near the unloading dock. The other trailer (the control) was not exposed to any cooling procedure at all over that 30-minute wait.

In each trailer, 12 pigs were equipped with gastro-intestinal tract temperature monitors. Analysis of data from these temperature monitors seemed to show that the pigs in the control trailer had reached a higher body temperature than those exposed to the cooling treatment.

Implications for the swine industry

- More details will be available in 2018 about the impact that the studied cooling system has on pigs.
- Results of the study on the impact of vibration during transport will be communicated.
- New knowledge will also be developed about vehicle design features in order to limit animal losses during transport and to improve pork quality.

Collaborators

Trevar Crowe	University of Saskatchewan
Nicolas Devillers	Sherbrooke Research and Development Centre, AAFC



Combined water sprinkling and ventilation system.
Source: Sherbrooke Research and Development Centre, AAFC

Epidemiology of porcine reproductive and respiratory syndrome virus (PRRSv) among swine herds, an applied research program supporting PRRS control projects

► Sylvie D'Allaire, University of Montreal



Suckling piglets.
Source: University of Montreal

Overview

Porcine reproductive and respiratory syndrome (PRRS) has a major economic impact on the swine industry. The important diversity observed in PRRS North American strains, combined with the multiple different ways it can be transmitted between herds, make the control of the disease very difficult. Virus sequencing is now viewed as an essential tool to better manage PRRS in Canada and, to help interpret results on sequences for surveillance purposes, a PRRS classification system is under development. This system will allow strains to be grouped to better observe their movements over time and help detect emerging strains. Moreover, through an improved integration of these laboratory results and epidemiological data, the most likely sources of infection of breeding herds will be identified to provide essential information to improve control strategies.

Highlights

PRRS Sequence Database

In 2016-2017, more than 545 virus sequences from herds in Quebec, along with information about locations, were validated and included in the PRRS sequence database in near real-time. PRRS virus reference strains from Europe, as well as some sequences from other Canadian provinces, were also included in the database. Since the beginning of the present study, a total of 2070 sequences have been included in that database.

PRRS Control Projects

This project aims to support ongoing PRRS Area Regional Control and Elimination (ARC&E) programs. In particular, the diversity of the PRRS virus within and outside some of these ARC&E programs is being studied. The diversity of the PRRS virus seems to have decreased globally within the studied ARC&E programs and this decrease seems to be mainly due to vaccination. Indeed, a higher proportion of PRRS vaccine-like strains were found in herds participating

in ARC&E programs. Also, albeit to a lesser extent, the diversity of circulating wild type strains in ARC&E program herds was lower than in other herds.

Most likely source of virus introduction into a herd

In the study, researchers examined how virus strains could enter into pig herds. They identified approximately 100 breeding sites on which a PRRS virus strain had recently been introduced. For each virus strain that was identified as 'new' to the herd, researchers checked the database and were able to identify and study two to three other herds that had a similar PRRS virus strain. Researchers discovered that more than half the time when there was 'new' strain identified in a herd, the closest herd having a similar PRRS virus strain was located more than 9 km away. This demonstrates that long-distance PRRS virus transmission is frequent.

Preliminary analysis also showed that sharing employees between herds occurs frequently, which can increase the risk of PRRS virus transmission. When an employee works with more than one herd, respecting biosecurity rules, particularly the entrance protocol, is crucial in avoiding the transmission of PRRS.

Implications for the swine industry

- The movement of the PRRS virus between farms often occurs via long-distance processes such as vehicle or transport of animals, and hence should be considered when implementing a PRRS regional control program.
- Having employees that work on several herds may increase the risk of PRRS virus transmission. Following biosecurity measures is crucial in reducing this risk.

Collaborators

Julie Arsenault	University of Montreal
Marie-Ève Lambert	University of Montreal
Zvonimir Poljak	University of Guelph

Towards the development of a method for determining the antimicrobial susceptibility of *Brachyspira*

► Joseph E Rubin, University of Saskatchewan

Overview

Since 2008, *Brachyspira*-associated disease has re-emerged as a serious cause of morbidity and economic loss to the Canadian swine industry. The identification of a novel species of *Brachyspira*, named '*Brachyspira hampsonii*', which causes severe disease in pigs, is also concerning. Through this research, laboratory tools are being developed to allow the Canadian swine industry to effectively combat *Brachyspira*-associated disease.

Highlights

The *Brachyspira* Research Group at University of Saskatchewan has worked to develop standardized methods for conducting tests to determine if antibiotics are effective against this type of bacteria. Since beginning this investigation, researchers have successfully addressed some basic questions about the growth characteristics of *Brachyspira* which need to be understood before clinical laboratory testing can begin. To date, the research team has achieved the following:

- Described the growth characteristics of these bacteria
- Developed methods for quantifying their density within a culture (*in vitro*)
- Measured the effect of antibiotics on the bacteria's ability to multiply (*in vitro*)
- Identified phenotypic variabilities among the isolates tested, which suggests that there may be some microbial resistance present.

Researchers are now analyzing the effectiveness of using different antibiotics on a collection of *Brachyspira* isolated from sick pigs. This collection is composed of 95 isolates collected over a seven-year period (2009 to 2016) along with five reference strains. The collection includes five species: '*Brachyspira hampsonii*', *Brachyspira hyodysenteriae*, *Brachyspira pilosicoli*, *Brachyspira murdochii*, *Brachyspira innocens*.

Implications for the swine industry

As a service to the Canadian swine industry, the *Brachyspira* Research Group at University of Saskatchewan aims to implement a program of testing the effectiveness of antibiotics against *Brachyspira* in order to enhance already-provided diagnostic services. This program will provide swine veterinarians with additional information to help them select the most effective and appropriate therapy to treat swine herds.

Collaborators

John Harding
Janet Hill

University
of Saskatchewan



A gram stain of *Brachyspira hampsonii*. Source: University of Saskatchewan

Performing susceptibility testing in the lab. Michelle Sniatynski. Source: University of Saskatchewan

Reading susceptibility test in the lab. Michelle Sniatynski. Source: University of Saskatchewan

New tools to enable effective genomic selection for disease resilience

► Graham Plastow, University of Alberta

Overview

Using traditional breeding approaches to improve pig health is very challenging due to the fact that health traits can be quite difficult to measure. Genomic research can help us better understand the biology of the immune system when animals respond to infection. Therefore, genomics offers the opportunity to improve health through breeding and to eventually be able to select for animals that are more resilient to disease.

Identifying genetic variation in immune response in pigs is the first step and this has been done for specific pathogens in different disease "models". Therefore, building on previous projects and focusing on PRRS (porcine reproductive and respiratory syndrome) together with other common pig pathogens, researchers are working on:

- Identifying regions of the genome that have an impact on immune response and disease resilience, including fetal resilience to PRRS as well as a 'natural disease model'.
- Identifying gene expression biomarkers for disease resilience.
- Identifying SNP markers, genomic regions and quantitative trait loci (QTLs) that affect sow lifetime productivity in commercial environments.
- Establishing a series of assays to learn more about the immune response of pigs exposed to various diseases and support the identification of biomarkers of disease resilience.

A 'natural challenge' model has been developed in this study, where researchers analyze data from high health status pigs that are challenged by being exposed to multiple diseases in a test barn. This will help researchers to identify genetic variation involved in resilience, which is defined as the ability to face diseases and quickly recover performance. Up to now, data from 1500 pigs have been collected. Understanding the genetic relationships between immune response and other phenotypes such as carcass and meat quality measurements are also being addressed.

Highlights

Several genomic regions have been identified that may contribute to variation in fetal death and viability in host response to PRRS virus infection in pregnant animals. The results provide new evidence about the genetic basis of fetal response to PRRS virus challenge, and may ultimately lead to new options to reduce the impact of PRRS.

The data obtained from the 'natural challenge' model have shown significant variation in growth, mortality and morbidity among these pigs. This indicates that the natural challenge model was successfully

implemented. Therefore, using data from these pigs, researchers will work on characterizing disease resilience traits to eventually be able to predict disease resilience using different tools such as SNPs or other biomarkers and assays.

Several new assays, including High Immune Response (HIR™), Disease Resistance Assay for Animals (DRAA), natural antibody and total immunoglobulin (IgG), have been established. These will be used to analyze samples from pigs involved in the natural challenge model. The results will increase knowledge about the immune response in these challenged pigs and support the identification of biomarkers of disease resilience.

As HIR™ phenotyping progresses, individuals with a balanced and robust immune response will be classified as high immune responders, potentially identifying animals with the ability to withstand pathogen-challenge by making strong and appropriate immune responses. These animals may also display production related advantages compared to pigs classified as average or low, as observed in previous experiments.

Implications for the swine industry

If successful, the implementation and integration of developed tools (such as HIR™ technology) into commercial pig breeding programs is expected to yield both health and production benefits. Ultimately, genomic tools will be delivered to enable the selection of commercial pigs that are more resilient to diseases while maintaining reproductive and production performance.

Collaborators

John Harding	University of Saskatchewan
Michael Dyck	University of Alberta
Bonnie Mallard	University of Guelph
Frédéric Fortin	Centre de développement du porc du Québec
Bob Kemp	PigGen Canada

Bio-exclusion and bio-containment strategies to control epidemics resulting from airborne viral and bacterial transmission

► Caroline Duchaine, Centre de recherche de l'Institut universitaire de cardiologie et de pneumologie de Québec – affiliated with Laval University

Overview

The airborne transmission of pathogens among pig herds can be an economic burden for producers and it is not always completely stopped by biosecurity measures. HEPA filter systems have proven to be an efficient tool against pathogen transmission, but are expensive. Therefore, the effectiveness of less expensive filter systems in preventing the transmission of airborne viruses and bacteria need to be studied in an environmentally controlled and standardized environment.

This project wrapped up in early 2017. The following summarizes the work that was done as well as the key outcomes.

Highlights

In 2015, researchers completed a literature review titled 'Air filtration as bio-exclusion and bio-containment strategies for Canadian pig buildings', which served as a base for the project's next steps. This literature review is available on our website.

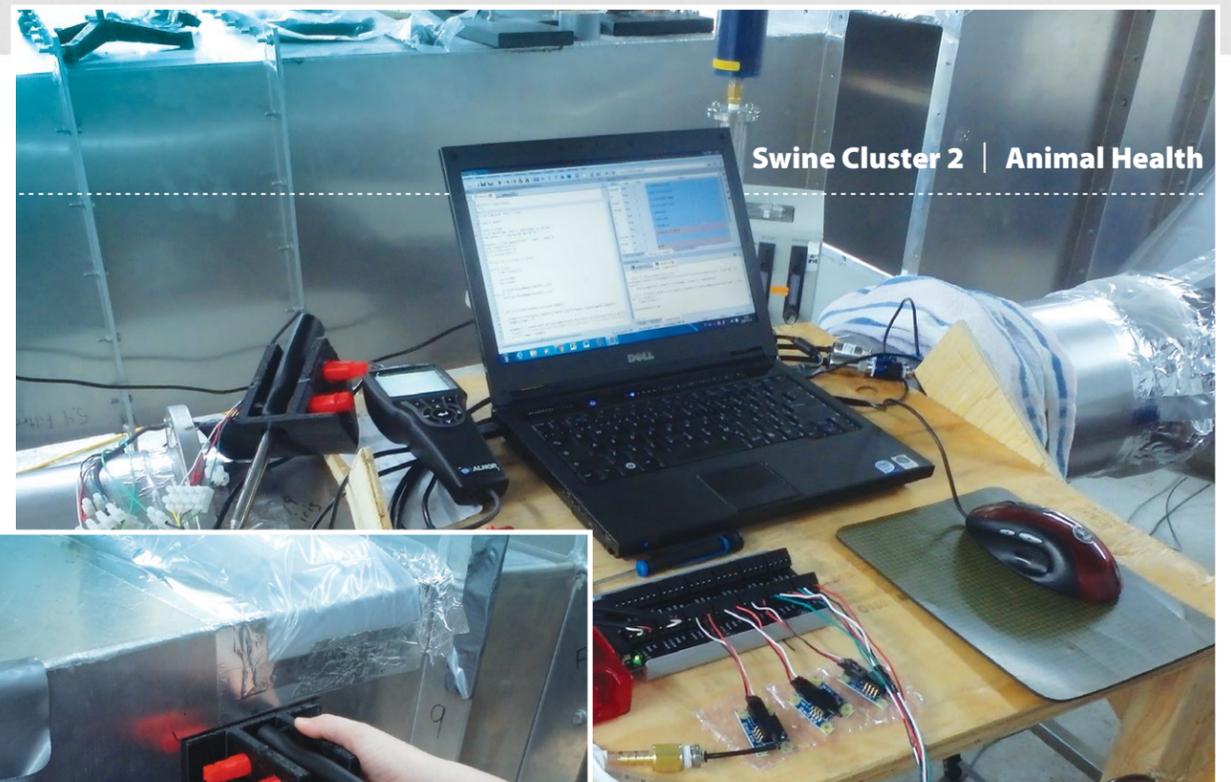
A new testing platform was designed and built in 2016 to evaluate the capture efficiency of different pre-filter and filter combinations for influenza, PRRSV and virulent *Streptococcus suis* serotype 2 models. Specifically, this new platform consists of:

- A test duct complying with the Standard 52.2 of the American Society of Heating, Refrigerating & Air-Conditioning Engineers (ASHRAE)
- A mixing chamber where two aerosol generators are connected for the co-aerosolization of standard dust and microorganisms
- Sampling probes suitable for collecting viable/infectious microorganisms
- A data acquisition system to continuously record temperature, relative humidity and pressure of the platform

Viruses and bacteria that affect pigs often travel on dust. Therefore, the mixing chamber of the platform was designed to reproduce real-life conditions in pig barns by allowing particles to be obtained, which includes dust and microorganisms (phages and bacteria), of a size close to those found in and around pig barns.

Air filtration systems composed of different combinations of MERV (Minimum Efficiency Reporting Value) rated pre-filters and filters were studied, such as the following combinations:

- 1) MERV 8 pre-filter + MERV 14 filter
- 2) MERV 8 pre-filter + MERV 16 filter



Set-up used to collect data from testing platform. Source: CDPQ



Verifying ASHRAE standards. Source: CDPQ

Implications for the swine industry

- This newly developed platform is a tool that can be used to design affordable filtration systems.
- It will also allow the capture efficiency of commercial filters to be evaluated regarding airborne viruses and bacteria. This data is not mentioned or unknown by the manufacturer.
- In the future, this platform could help pig producers to choose economically suitable air filtration systems and to determine if used filters (e.g. 6-month old filters) are still as efficient as new ones to capture airborne viruses (e.g. PRRSV).
- Finally, it has been hypothesized that old filters may be a source of airborne viruses and bacteria by the re-emission of collected dust into the environment. This "particle re-emission" hypothesis might be studied using the new platform.

Collaborators

Laura Batista Batista & Asociados

Stéphane Godbout Institut de recherche et de développement en agroenvironnement

Marie-Aude Ricard Centre de développement
Jean-Gabriel Turgeon du porc du Québec



Testing platform. Source: CDPQ

Sampling probes inside the testing platform. Source: CDPQ

Development of a multiplex Luminex immunoassay for serologic diagnosis and subtyping of swine influenza virus (SIV) infections

► Yohannes Berhane, National Centre for Foreign Animal Diseases, Canadian Food Inspection Agency

Overview

For serologic diagnosis of swine influenza, most laboratories use ELISA (enzyme-linked immunosorbent assay) based assays. However, the currently used ELISA-based assays don't have the capability to diagnose and, at the same time, subtype different swine influenza infections. The assay to be developed in this project is a multiplex fluorescent microsphere immunoassay to be used to identify the antibody response to SIV infections and classify this antibody response as either a H1 or H3 subtype. It would also be used to identify the antibody response to Type 1 and 2 Porcine Reproductive and Respiratory Syndrome virus (PRRSv) and Porcine Circovirus (PCV2) infections. This work would therefore allow the detection of antibodies due to infection caused by almost all of the viruses involved in the Porcine Respiratory Disease Complex (PRDC).

Highlights

PRDC is caused by the interaction of multiple infectious agents that include Type 1 and 2 PRRSv, SIV, PCV2 and other bacterial pathogens. This has a significant economic impact on North America's swine industry.

The development of the immunoassay, which originally focused on SIV, was modified to include additional virus that are part of the Porcine Respiratory Disease Syndrome (PRDC).

The development and validation of the multiplex immunoassay will continue in 2017-2018.

Implications for the swine industry

A multiplex immunoassay will be developed to 1) rapidly and cost-effectively identify antibody responses to Type 1 and 2 PRRSv, PCV2 and SIV infections and 2) subtype the antibody response to SIV to either a H1 or H3 subtype.

Collaborators

Shawn Babiuk	National Centre for Foreign Animal Diseases, Canadian Food Inspection Agency
John Pasick	National Centre for Foreign Animal Diseases, Canadian Food Inspection Agency
André Broes	Biovet
Davor Ojkic	University of Guelph

Dynamics of influenza infection in swine populations

► Zvonimir Poljak, University of Guelph

Overview

The influenza virus continues to have a major impact on Canadian swine production. Significant genetic diversity and the emergence of new variants have complicated the control of this virus. For this project, researchers have analyzed the diversity of influenza A viruses in swine in Canada. They have also studied the circulation of influenza A viruses and have worked on developing a real-time outbreak detection system.

Highlights

Diversity of influenza A viruses in swine in Canada

Characterizing the swine influenza A viruses circulating in herds using genomic analysis and then grouping them according to their characteristics can help control this disease.

Researchers conducted a comprehensive genomic analysis of 16 influenza A virus samples from different clinical outbreaks within swine herds in Alberta, Manitoba, Ontario, and Saskatchewan in 2014. Out of the 16 influenza A virus samples, three were identified as H1N2 and 13 as H3N2. All H3N2 viruses belonged to cluster IV.

Circulation of influenza A viruses in swine herds

Results have showed that even in herds where new animals are rarely introduced, such as closed farrow-to-finish herds, growing pigs continuously circulate the influenza A virus. Sows were also detected to be positive and, in rare instances, they could repeatedly test positive for the influenza A virus.

Real-time outbreak detection system

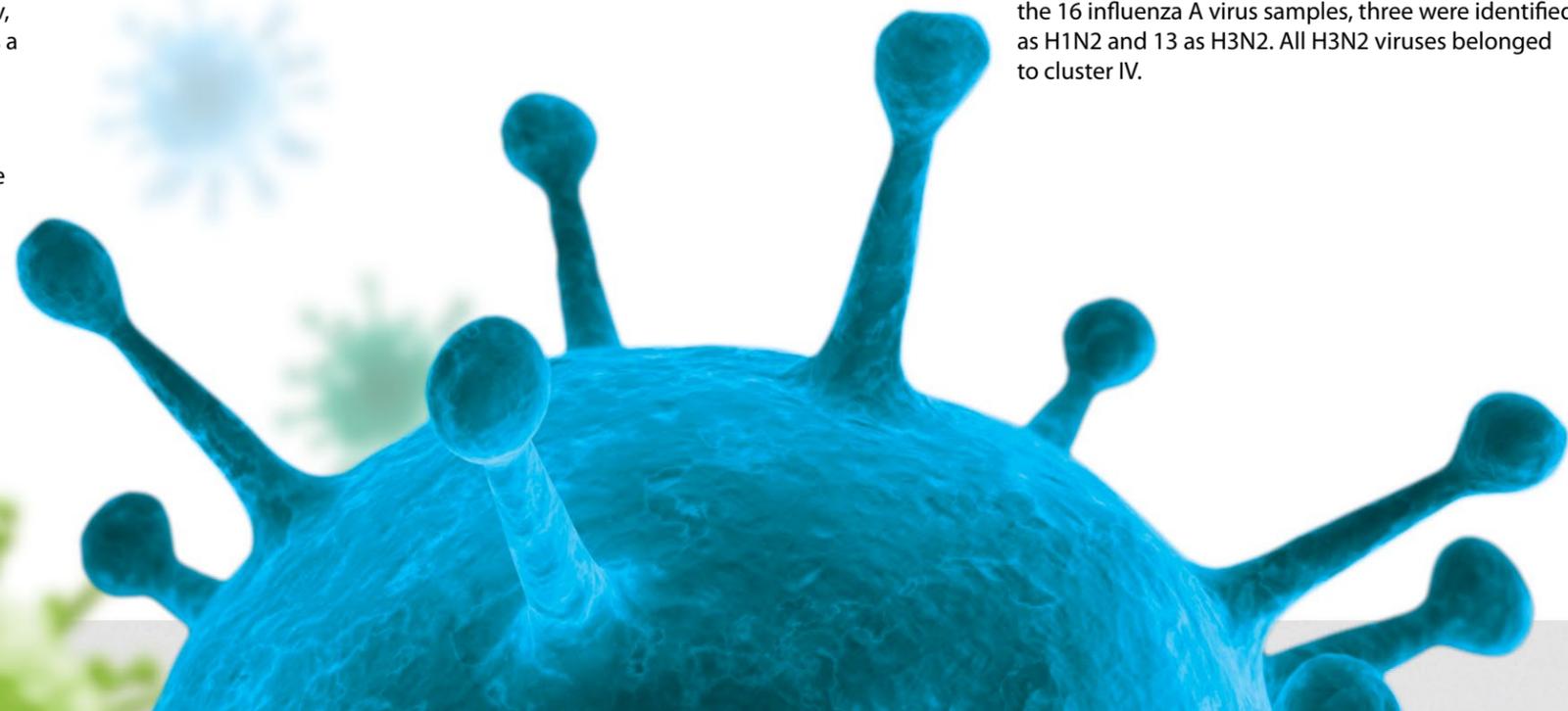
Part of this research is also focused on processing and summarizing the laboratory swine influenza information in a user-friendly report for producers, swine veterinarians, and regulatory experts. Different approaches have been used to display trends, detect the weeks and months where more samples have been submitted to laboratories and/or results of laboratory analysis have showed more positive samples to swine influenza. Different statistical models have been tested for short-term forecasting. Among all those tested, one statistical model in particular has showed the highest accuracy (this one is based on 'random forest' model).

Implications for the swine industry

A better understanding of current influenza strains in Canada as well as the circulation of the virus at the herd level have been gained and can be utilized in infection control. A near real-time analysis and reporting system based on laboratory data has been implemented and will be extended to other pathogens.

Collaborators

Rob Deardon	University of Calgary
Robert Friendship	University of Guelph
Helena Grgic	University of Guelph
Eva Nagy	University of Guelph



Technology and methodology development for improved biosecurity in livestock transport vehicles – Phase 2: Preliminary system development and data acquisition

Overview

The health of pigs during transport is potentially compromised by the spreading of pathogens due to the insufficient cleaning of livestock transport trailers. Currently, cleaning these vehicles is accomplished manually by hosing down and scrubbing the inside of a trailer. This process can take up to eight hours and still provide questionable results. To combat this problem, a vacuum wash system is being developed in order to clean transport trailers to a higher standard. Additionally, to ensure that all dangerous pathogens are deactivated, the effect of heating trailers to high temperatures is being investigated. The combination of both processes will lead to an overall higher quality of swine health, a quicker cleaning of transport trailers, as well as environmental benefits from using less water to clean them.

Inside of trailer.
Source: PAMI



Trailer wash facility.
Source: PAMI



Condition of floor after flood wash.
Source: PAMI



► Terry Fonstad, University of Saskatchewan

Highlights

Verification that heat can inactivate pathogens

Researchers have found that the time and temperatures necessary to deactivate porcine epidemic diarrhea virus (PEDv) is 75°C for 15 minutes. Among the variety of pathogens tested, PEDv was the most heat resistant. Researchers have also discovered that fecal matter serves as an excellent insulator. Therefore, pathogens that are present in the center of clumps of organic matter are much harder to destroy through heat. However, if efficient washing methods are used prior to heating, clumps of organic material should not be present.

Results have also shown that during a typical thermal assisted drying and decontamination (TADD) cycle, the large majority of interior surfaces of livestock transport trailers do in fact reach 75°C for 15 minutes. However, there may be some interior surfaces that do not reach this recommended temperature and time for deactivating PEDv. These areas were found predominantly at the front of the trailer, which is furthest away from the heat source. It is likely that only small adjustments are required to be made to the TADD cycle to achieve the desired surface temperatures for the desired amount of time.

Vacuum system development

The trailer wash system (vacuum and pressure wash) has the potential to reduce trailer cleaning time and improve conditions for workers. It now includes a hose that is 76.2 mm (3 in) in diameter (instead of a 101.6mm (4 in) diameter hose, as was previously used). Initial testing has shown that even when dealing with wet straw, the 76.2 mm diameter hose would not clog. The reduced hose diameter promotes lightness and mobility of the entire system, and should ease automation as well.



Second pass with the wet attachment to perform a pressure wash combined with vacuuming.
Source: PAMI

Trailer inventory and evaluation

The results of the trailer inventory have shown that the triple deck triaxle trailer is the most common design used in Canada. In general, the presence of more decks means that more time will be required to clean the trailer. Additionally, straight deck trailers are cleaned in less time than potbelly trailers.

Dry vacuuming the bulk material on the trailer floor.
Source: PAMI



Implications for the swine industry

- A more effective and quicker means of cleaning and disinfecting transport trailers is being developed to prevent the spread of disease through the transportation of pigs.
- Cleaning will be achieved by using both a vacuum wash system and by heating the trailers to inactivate pathogens.
- The protocol for heating trailers to ensure all pathogens are eliminated is 75°C for a 15-minute period.

Collaborators

Jennifer Brown	Prairie Swine Centre
Hubert Landry	Prairie Agricultural Machinery Institute
Volker Gerdt	VIDO-InterVac



Truck wash equipment.
Source: PAMI

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

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))



Water dispensers.
Source: 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.

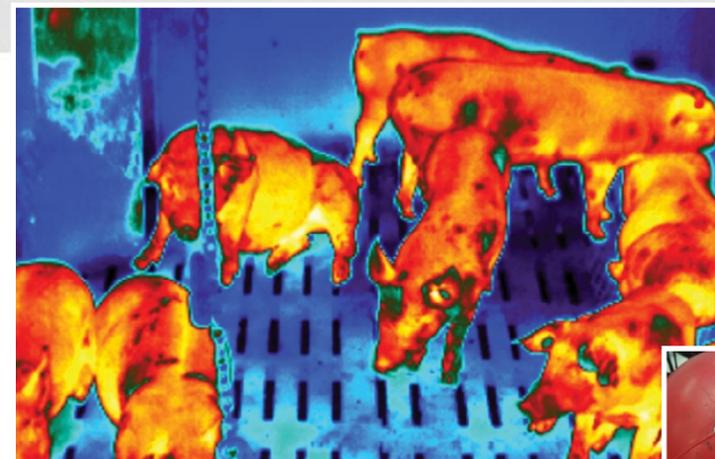
- Individual water recording systems

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 Kinect² 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.



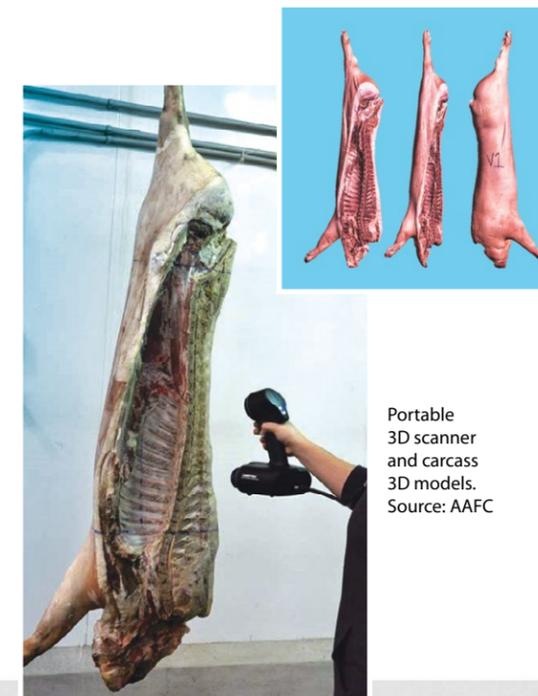
Infrared imagery. Source: CCSI

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.



Portable 3D scanner and carcass 3D models.
Source: AAFC

3 Use of accelerometers to automatically assess pig behaviour and welfare

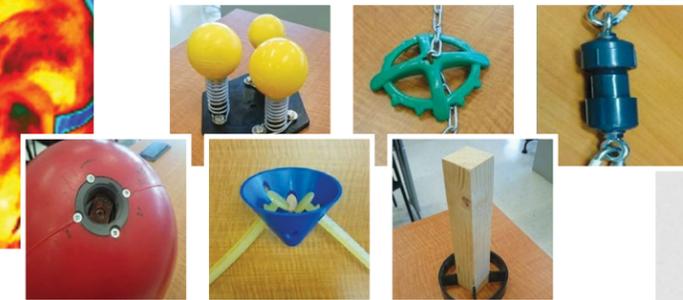
(Laval University, Sherbrooke Research and Development Centre, AAFC and University of Guelph)

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.



Enrichment objects. Source: CCSI



Near-infrared reflectance spectroscopy (NIRS). Source: AAFC

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)



Collecting skin samples at lesion sites. Source: 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).

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.



Nuclear magnetic resonance equipment. Source: CCSI

Line-scan hyperspectral imaging system. Source: CCSI

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.

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

Renée Bergeron	University of Guelph
Nicolas Devillers	Sherbrooke Research and Development Centre, AAFC
Luigi Faucitano	Sherbrooke Research and Development Centre, AAFC
Candido Pomar	Sherbrooke Research and Development Centre, AAFC
Frédéric Fortin	Centre de Développement du Porc du Québec
Patrick Gagnon	Centre de Développement du Porc du Québec
Claude Gariépy	Saint Hyacinthe Research and Development Centre, AAFC
Marie-Rose Van Calsteren	Saint Hyacinthe Research and Development Centre, AAFC
Manuel Juarez	Lacombe Research and Development Centre, AAFC
Bethany Uttaro	Lacombe Research and Development Centre, AAFC
Nigel Cook	Alberta Agriculture
Jean-Paul Laforest	Laval University
Michael Ngadi	McGill University
Tim Nelson	PigGen Canada
Bernardo Predicala	Prairie Swine Centre

Assessing pork belly quality. Source: AAFC



A pilot study to establish a gene panel for the identification of low-stress pigs

► Ray Lu, University of Guelph

Overview

Pigs experience stress as a part of their routine life, which includes social stress such as feeding competition and aggression as well as environmental stressors like extreme temperatures, reduced space and new environments. Stress not only impacts the animal's immune system and general health, it also affects animal growth performance and meat quality, increases injuries and the cost of production.

Researchers have recently identified genetic variations that could allow mice to be more resistant to stress. As mice and pigs have very similar hormonal regulation, the researchers' goal is to apply the knowledge learned in mice to pigs. They will look for naturally occurring genetic variations that would allow pigs to better deal with stress.

Highlights

This project has only just started at the end of 2016. So far, researchers have standardized all major experimental protocols. They have also discovered a new SNP (single-nucleotide polymorphism) existing predominantly in Yorkshire pigs that may be related to stress resistance.

Implications for the swine industry

This is the very first step toward the development of a molecular toolbox that will identify stress-linked genetic variations and could eventually be used to breed low-stress pigs.

Collaborators

Renée Bergeron	University of Guelph
Nicolas Devillers	Sherbrooke Research and Development Centre, AAFC
Mohsen Jafarikia	Canadian Centre for Swine Improvement
Brian Sullivan	
Dave Vandenbroek	Alliance Genetics Canada



Source: AAFC Lacombe

Overview

Marbling, or the visible intramuscular fat found in pork meat, is a major contributor to the natural flavours and juiciness of cooked pork. Marbling as well as other quality attributes, such as colour, drip loss and tenderness, is considered or required by customers in Canada and abroad when buying pork meat. In most Canadian packing plants, meat quality (including colour and marbling) is evaluated using visual assessment, which has many drawbacks in terms of time, consistency and subjectivity. Therefore, there is a need to develop new technology to objectively assess meat quality traits in order to provide consistent, quantifiable differentiation points useful for pork grading and product sorting. The main challenge is to find which technologies would provide an accurate prediction of the quality of the loin without cutting it.

Source: Canada Pork International & CCSI

Objective methods for the evaluation of marbling and other meat quality traits

► Laurence Maignel, Canadian Centre for Swine Improvement (CCSI)

Highlights

In the spring of 2016, a project involving the detailed evaluation of hog carcasses began, where a number of different reference measurements and X-ray scans were carried out. These carcass measurements and scans have formed a very valuable data set that allowed tests to be conducted with several new pieces of equipment. In addition, many meat quality measurements have been taken, including the subjective and objective assessment of colour and marbling in various sites of the main commercial cuts. About 200 carcasses had been measured as of March 2017.

Implications for the swine industry

Recommendations will be provided to primary processing plants about objective, quick and accurate methods and technologies for the evaluation of marbling and other pork quality attributes. The focus of these recommendations will be on pork grading and product sorting.

Collaborators

Michael Young	Canada Pork International
Manuel Juarez	Lacombe Research and Development Centre, AAFC
Bethany Uttaro	



Source: AAFC Lacombe

Increasing Canadian pork consumption, market share and competitiveness through enhanced nutritional values and overall quality with a functional molecule in pork meat

- ▶ Claude Gariépy, Saint-Hyacinthe Research and Development Centre, AAFC
- ▶ Brian Sullivan, Canadian Centre for Swine Improvement

Overview

The functional molecule studied in this project is carnosine, a naturally-occurring molecule found in meat, poultry and in certain fish but not in foods of plant origin. Carnosine possesses many interesting qualities such as antioxidant and anti-aging properties.

In this project, levels of carnosine have been measured in purebred pigs in Canada and the effects of this molecule on meat quality traits have been studied. Further analyses are being carried out to identify genetic reasons as to why some animals have a higher content of this molecule. It is also being tested if levels of carnosine can be enhanced through feeding pigs. Meat quality as well as sensory analyses are being done on pork samples from these animals.

In addition, work has been done to better understand the public's perception and interest in this new product (for example, carnosine-enhanced pork). The information gathered will be used to create strategies to motivate the consumption of enhanced pork by health-conscious consumers.

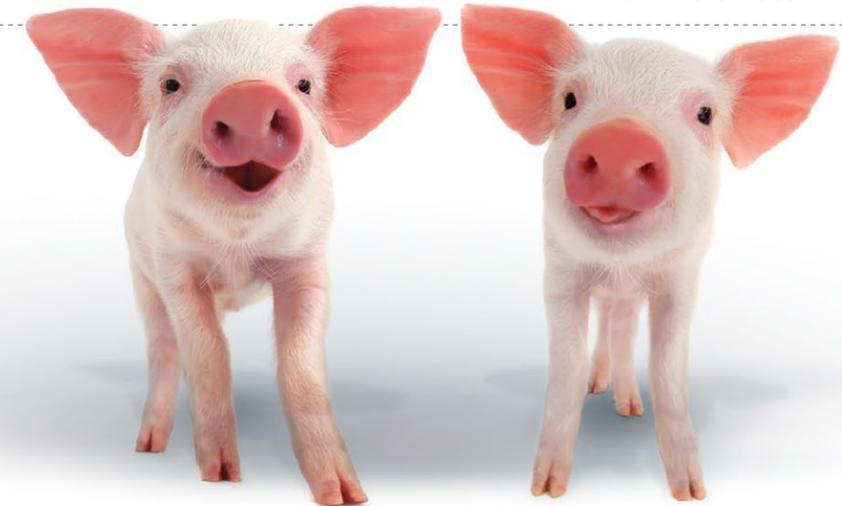
Highlights

Feeding trial with pigs

To see if carnosine levels could be enhanced in pork meat through feeding, a nutritional test was conducted on 80 pigs. Starting at body weights of 65 kg, pigs received a supplement of beta-alanine in varying amounts in their diets over an eight-week period (carnosine is formed of beta-alanine-L-Histidine). The meat from these pigs was analyzed and showed that the supplement did not increase carnosine content, but decreased lipid and protein oxidative damage. These results will be useful in identifying alternative dietary strategies to increase carnosine in pork.

Identification of polymorphisms

Twenty-seven polymorphism (SNP) were identified in different carnosine-related genes with the most promising associations observed for SNP SLC15A4 c.658A>G. For this polymorphism, animals with the AA genotype had higher muscle carnosine content and pH 24 h values and lower color b*, color L*, drip loss, cooking loss and glycolytic potential values when compared with AG pigs. Therefore, the SLC15A4 c.658A>G SNP could potentially be used in selection programs to increase carnosine content and improve pork meat quality. However, the high frequency of the c.658A allele in Duroc (0.99) and Landrace (0.91) would limit potential meat quality improvements for these breeds. Additional work is needed to determine allele frequencies and confirm associations in other breeds.



Surveys to gauge public perception

Given the publicity on the possible links between red meat consumption and health risks, it is unclear whether the idea of increasing the healthiness of pork (thus creating a 'functional food') would be well received by the public. We know that pork can be made into such a functional food by increasing its carnosine content. However, it is important to know whether the public understands the benefits of functional foods and whether they are interested in buying functional foods. It is also necessary to understand the consumer characteristics, such as individual attitudes towards health, which would influence decisions to purchase a functional pork product and thus help establish market potential. Therefore, a survey was conducted in Canada where 992 participants responded.

Preliminary results suggest that consumers who have a higher knowledge about nutrition and are more health conscious are more interested in consuming carnosine-enhanced pork. Being female, having no children in the household, earning a higher income, living in the city, and holding a positive attitude towards biotechnology all contribute to a higher probability of purchasing carnosine-enhanced pork.

Implications for the swine industry

- While the supplement beta-alanine did not increase carnosine content in pork, results from this experiment will help identify other alternative feeding strategies to increase carnosine levels.
- The SLC15A4 c.658A>G SNP is associated with an increase in carnosine content and improved pork meat quality.
- Certain health-conscious segments of the population are more likely to purchase carnosine-enhanced pork. More analysis will be done to determine the market potential for such a product.

Collaborators

Marie-Ann Binnie	Canadian Pork Council
Frédéric Fortin	Centre de développement du porc du Québec
Ellen Goddard	University of Alberta
Marie-France Palin	Sherbrooke Research and Development Centre, AAFC
Candido Pomar	
Michael Young	Canada Pork International

Investigation of strategies to mitigate accelerated deterioration of pig buildings

► Bernardo Predicala, Prairie Swine Centre

Overview

Swine building environments, especially during harsh Canadian winters, can be very destructive to barn infrastructure (i.e., walls, eaves, ceiling, attic, plenum, etc.). Varying thermal conditions, high levels of moisture and corrosive gases such as hydrogen sulfide and ammonia, the presence of dust and microorganisms causing decay are all possible destructive factors that make swine barns highly susceptible to accelerated deterioration. Therefore, producers are looking for ways to address these issues to extend the life of their barns, and to avoid doing costly renovations every few years to keep the barns in operation.

This project was formulated to gather and identify potential solutions applicable to Canadian conditions to mitigate the accelerated deterioration of swine buildings. To achieve this, a literature review and an information survey will be carried out. A compiled list of potential solutions will then be assessed based on overall effectiveness, cost, and suitability for application in Canadian swine barns.

Highlights

About 35 relevant published scientific papers, technical bulletins and handbooks have been compiled and reviewed so far. It has been learned that timber (wood), concrete, and steel (metal) are the most commonly used materials found in agricultural building structures. The degradation of wood structures is mainly caused by either biotic agents or external abiotic factors. Biotic agents include fungi, bacteria and insects while external abiotic factors may include solar radiation, wetting and drying by precipitation, changes in relative humidity and

temperature, abrasion from windblown particulates, atmospheric pollution, and human activities such as application of chemicals for cleaning, sanding and power washing, among others. Metal structural components naturally corrode over time due to a process known as electrochemical oxidation; however, the rate of corrosion tends to accelerate due to prolonged exposure to corrosive agents in farm buildings. The rate of corrosion is influenced by high humidity levels and the presence of different microorganisms that produces aggressive metabolites such as aerobic, anaerobic and sulphate-reducing bacteria. The information on the types of structural members commonly used in barn infrastructures and their respective causes of rapid deterioration will be used to identify potential strategies/measures to address the issues associated with rapid building deterioration.

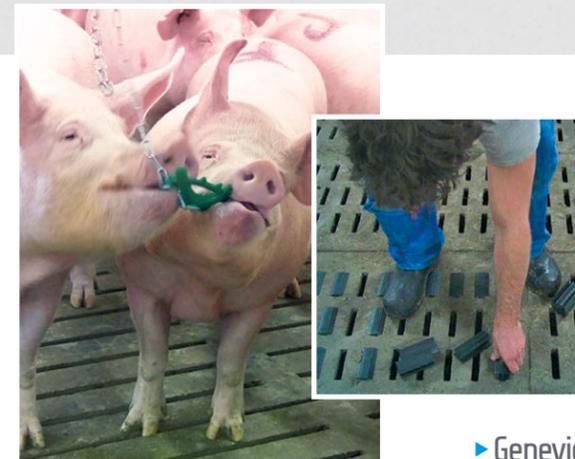
The project is ongoing and results should be available around the beginning of 2018.

Implications for the swine industry

A list of promising solutions to rapid barn deterioration and their applicability to Canadian swine barns will be provided. This will help producers to extend the useful life of their barns and avoid costly recurring renovations.

Collaborators

Sébastien Turcotte Centre de développement du porc du Québec



Source: Doug Richards, Prairie Swine Centre

Overview

This project is built on results from research projects and aims to increase the speed of adoption of new technologies and management strategies. To reach this goal, this project has partnered with a number of pork producer and related organizations throughout Canada. These organizations have agreed to implement new technologies and management strategies in becoming demonstration sites for these innovations. Information is being regularly collected to better understand the process and challenges related to adopting and using new technologies and strategies on these demonstration sites. This information will then be shared with the Canadian pork industry to increase the adoption of these technologies/strategies.

Ongoing activities

This project only just started at the end of 2016 and consists of:

1 Demonstrating

Environmental enrichment for gestating sows

Environmental enrichment (such as hanging chains or pieces of wood in pig pens) has been implemented on six farms (Alberta, Saskatchewan, Ontario and Québec). The experience has been positive for all farms and sows seem to enjoy playing with the enrichment objects!

Strategies to improve the laying areas for gestating sows

The installation of slat gap covers (see photo) is being implemented on three farms (Saskatchewan, Ontario and Québec).

Parity-segregated phase feeding for pregnant sows

Phase feeding for older sows (one at the beginning and one at the end of gestation) has been implemented on one farm (Ontario).

From Innovation to Adoption: On-Farm Demonstration of Swine Research

► Geneviève Berthiaume, Centre de développement du porc du Québec

► Ken Engele, Prairie Swine Centre

Water management strategies

Two different water conservation strategies are being examined. Nipple drinkers with side panels have been installed on in a finishing operation in Saskatchewan. In addition, water bowls will replace nipple drinkers in a nursery facility in Quebec. Both projects have the overall goal of reducing water wastage.

Rapid assessment of trailer cleanliness

Rapid assessment of surface cleanliness of swine transport trailers using the ATP bioluminescence method will be implemented in two transport companies (Saskatchewan and Québec).

2 Auditing On-Farm Best Management Practices

A total of 16 farms will be audited regarding management practices. Once the audits are completed, an individual report will be provided to each farm detailing their barn's performance and benchmarks will be created to compare the participating farms and suggest improvements. Results from these audits will also provide information on the rate and process of adoption. Participating farms will be located in Prince Edward Island, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia (two farms per province).

3 Holding events on transitioning gestating sows to group housing systems

Three events are planned for fall 2017, one in Alberta, one in Manitoba and one in Quebec. The event in Alberta is made possible through collaboration with the Swine Cluster 2 project 'National sow housing conversion project' led by Jennifer Brown.

Reports and information regarding these activities will be posted on the For Producers section of our website (www.swineinnovationporc.ca) once available. Check back regularly for updates!



Swine Innovation Porc's kiosk at Banff Pork Seminar 2017.
Source: Swine Innovation Porc

Communication & Collaboration



Advisory group meeting for the truck wash project in October 2016 in Winnipeg.
Source: Swine Innovation Porc

Networking meetings

One of Swine Innovation Porc's main roles is to enhance collaboration within the research community as well as with industry. One way to achieve this is through networking meetings, where researchers, particularly those who work in different institutions and provinces, come together to collaborate and coordinate. In the last year, industry partners have been invited to a number of these meetings, which has allowed a real channel for back-and-forth communication to take place between scientists and those who will benefit from the science. In 2016-2017, eight of these meetings took place throughout the country (in Alberta, Manitoba, Ontario and Quebec).

Setting priorities for national pork research

In order to prepare for another potential five-year research program, we have extensively consulted industry and academic representatives for input regarding research priorities. These consultations took place in the form of creating a sub-committee of our Board, a working group of high-level industry representatives, a survey of participants at the Banff Pork Seminar and finally, in 2016, one Eastern and one Western workshop. These two events, which took place in Ottawa and Winnipeg respectively, brought together almost 70 representatives throughout the pork value chain and participants were asked to brainstorm and report their thoughts about national priorities. The feedback obtained from these workshops and other consultations has provided valuable insight into the needs of the industry as well as what research is needed to address these needs. The resulting list of priorities has been used as the basis of developing a possible Swine Cluster 3 program, but will change and be updated as the needs of the pork industry evolve.

A few numbers:



National swine research priorities workshops

Participants by section of the pork value chain



Swine Cluster 2 researcher presenting at Banff Pork Seminar 2017.
Source: Swine Innovation Porc



National swine research priorities workshop held in Ottawa in June 2016.
Source: Swine Innovation Porc

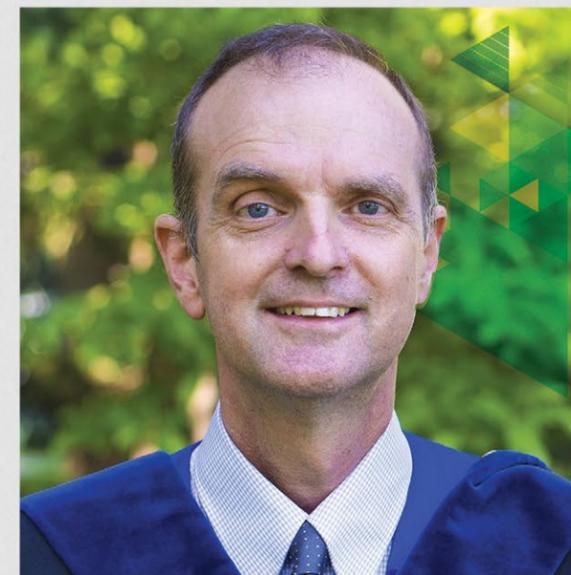


Networking meeting for project on nutrition (piglets and growing-finishing pigs) held in December 2016 in Montreal.
Source: Swine Innovation Porc



Bruce Cochrane interviewing the Chair of Swine Innovation Porc.
Source: Swine Innovation Porc

National swine research priorities workshop held in Winnipeg in June 2016.
Source: Swine Innovation Porc



Source: University of Guelph

In Memoriam

Kees de Lange was an internationally renowned expert in swine nutrition and had been very active in Swine Innovation Porc's research activities, specifically in our programs Swine Cluster 1 (2010-2013) and Swine Cluster 2 (2013-2018). His knowledge, advice and input were highly valued by our organization and we were greatly saddened by his passing in 2016.

The following is an extract from the obituary published in the newspaper Guelph Today on August 3, 2016:

*'de LANGE, Cornelis (Kees) Franciscus Maria
Passed away peacefully at his home in Guelph, Ontario
on August 1, 2016 surrounded by his loving family.*

Kees was born on April 19, 1961 in De Weere, The Netherlands, and grew up in the farming community before beginning his studies at the University of Wageningen. In 1985, he immigrated to Canada to pursue a PhD in Animal Nutrition at the University of Alberta. After completing his degree he began a distinguished career in agriculture, working in the Ontario feed industry and applied research at the Prairie Swine Centre in Saskatchewan, prior to becoming a professor of Swine Nutrition at the University of Guelph in 1994. Always passionate about his work, Kees made a lasting impression as a teacher and mentor to many undergraduate and graduate students, while publishing numerous scientific papers and book chapters, and serving on a number of international committees. Beyond his work, Kees especially enjoyed the Canadian outdoors and trips abroad with his family. He will be fondly remembered for the many hours spent with his family and friends cycling, canoeing, hiking and camping.'

Science Advisory Body

The Science Advisory Body (SAB) is a committee that evaluates the scientific integrity of research proposals submitted to Swine Innovation Porc. Members of the SAB are recognized professionals who are well-known in their fields and represent a diverse range of expertise within swine research. This committee reviews research proposals, offers scientific expertise, gives technical advice and ultimately provides the Board of Directors with their recommendations. The following individuals are the current members of the Science Advisory Body:

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Brad Chappell

Veterinarian
Swine Health
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Graham Plastow

Professor
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Marcos Alvarez

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- Canada Pork International
- Canadian Centre for Swine Improvement
- Canadian Pork Council
- Centre de développement du porc du Québec
- Centre de recherche de l'Institut Universitaire de Cardiologie et de Pneumologie de Québec, associated with Laval University
- FGC Groenenstige Construction Ltd
- Group Cérés
- Guelph Research and Development Centre, AAFC
- Health Canada, Nutrition Research Division
- Institut de recherche et de développement en agroenvironnement
- Lacombe Research and Development Centre, AAFC
- Laval University
- Manitoba Pork
- McGill University
- National Centre for Foreign Animal Diseases, Canadian Food Inspection Agency
- PigGen Canada
- Prairie Agricultural Machinery Institute
- Prairie Swine Centre
- Saint Hyacinthe Research and Development Centre, AAFC
- Sherbrooke Research and Development Centre, AAFC
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- Leibniz Institute for Farm Animal Biology, Research Unit Muscle Biology and Growth (Germany)
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