



ANNUAL REPORT

2017
2018

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

“Innovation drives success.”

This is a statement that we at Swine Innovation Porc have taken to heart since our beginnings in 2010. We have now completed two research programs, involving 35 different projects and a \$31.7 million investment from government and industry that has produced numerous results and tangible benefits for the Canadian pork sector. We are currently moving towards our third national, multidisciplinary program: Swine Cluster 3, an up to \$18.7 million investment in research from 2018 to 2023.

While it is imperative that Swine Innovation Porc continues to deliver its national research 5-year program, we have been working on strategies to find additional ways to implement research that will provide timely and innovative solutions to enhance the competitiveness and sustainability of the Canadian pork industry. One outcome of this exercise is the creation of strategies for Research and Development as well as Knowledge Transfer. Both of these are available on our website at www.swineinnovationporc.ca.

In addition to developing these strategies, we have implemented an initiative that brings representatives together from Canadian swine related research institutions in order to work on finding solutions to common issues. This initiative is one example as to how Swine Innovation Porc can help increase national collaboration, which has the goal of strengthening Canada’s ability to deliver research solutions to industry’s challenges.

As we move forward, strengthening relationships with our private partners is always top of mind. We increased our communication efforts and we look forward to regularly publicizing results from past and future research. To make this possible, our partners in the research community have carried out world-class research and have been active in publishing their results.

On behalf of the Board of Directors, I want to thank Agriculture and Agri-Food’s Minister Lawrence Macaulay for renewing the government’s investment in the cluster program. We are confident that this continuous investment in research and development will increase the pork value chain’s profitability and resilience. I also want to highlight the dedication and commitment of our Board of Directors to bring Swine Cluster 2 to a successful close while at the same time continue planning for the future. Finally, thank you as well to the management team for their hard work and dedication.

Stewart Cressman
Chair

Management Report



The year 2018 marks the end of our second national research program, Swine Cluster 2.

This \$19.7 million multi-disciplinary program has generated a number of innovative research results that will provide practical solutions for the Canadian swine sector. I invite you to read about these results in the Research and Development section of this report.

While activities within Swine Cluster 2 have been winding down, we have been actively preparing for our third national research program: Swine Cluster 3. In 2017, researchers from a variety of disciplines submitted proposals to Swine Innovation Porc. A vigorous peer review process was then implemented, where over 100 evaluations on scientific merit of proposals were received. This evaluation of scientific merit, along with an extensive review of the alignment of proposals with the industry's priorities, has allowed us to develop a research program that is relevant to the industry, timely and scientifically sound. The number of high-quality proposals received demonstrates the extensive knowledge base Canada has in swine-related research. We are proud to collaborate with the research community and industry to put together a research program that will bring results-driven research to our pork sector.

A major part of delivering research programs is to ensure the communication of results and the transfer of new knowledge to end users. We have been working hard on increasing our communications by implementing a number of initiatives, including:

- **Partnerships with media** (such as Bruce Cochrane and Geoff Geddes): On average, two media reports per week have been communicated on supported research. This has been made possible only by the generous collaboration of the research community.
- **Public event 'PED and pig health: Where do we go from here?'**: Held in conjunction with the Banff Pork Seminar in January 2018, this event brought together five experts who presented about current health challenges facing the swine sector.
- **Networking meetings**: Throughout Swine Cluster 2, 16 of these meetings took place which allowed researchers across the country to come together and improve collaboration and project coordination.

To learn more about our communication activities, please consult our Communication and Collaboration section on page 57.

All of what has been accomplished would not be possible without the active participation and dedication of our Board of Directors and management team. Also, thank you once again to our partners in government, industry and the research community. Your collaboration and involvement is key to making the swine sector even stronger and we look forward working again together in the next cluster program.

Abida Ouyed
Acting General Manager

Board of Directors

From left to right:

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Manitoba Pork

Raphaël Bertinotti

Director
Quebec Pork Sector

Arno Schober

Director
Ontario Pork

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New Brunswick Pork

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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



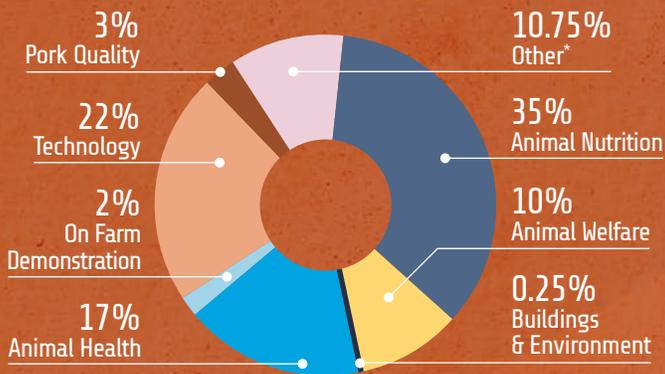
RESEARCH & DEVELOPMENT



Swine Cluster 2 Driving Results Through Innovation

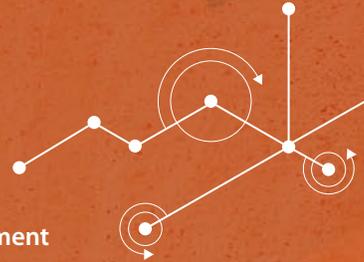
FUNDING ALLOCATION

*Includes communications activities and management fees



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



across Canada and around the world

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.

Part of this includes ensuring results are widely communicated to stakeholders and facilitating the adoption of new knowledge and technology by the end user through demonstration activities.

TOTAL BUDGET

\$19.7 million

\$14.8
million

Agriculture and Agrifood Canada

\$4.9
million

Producers and industry

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

► Sixteen researchers from six different research institutions worked in collaboration on this project

The high cost of feed ingredients is a major challenge for the swine industry and has historically represented the largest portion of operating costs. In addition, the use of in-feed antibiotics is increasingly being restricted. 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 worked on the subprojects below.

Supplementing newborn piglets with vitamins A and D, copper and colostrum

J. Jacques Matte,
Sherbrooke Research and Development Centre, AAFC

Frédéric Guay,
Laval University

Results showed that providing an oral supplementation of a bovine colostrum extract before weaning increased piglet weight gain up to 8 weeks of age.

In addition to supplementing with a bovine colostrum extract, researchers found that the following strategy is an efficient way to avoid certain vitamin deficits in piglets:

- Provide piglets (until weaning) with an oral supplement of vitamin A, vitamin D, and copper; and
- Expose piglets with exposure to UVB light; and
- Supplement sow diets (during late pregnancy and lactation) with vitamin A, vitamin D, and copper

Why was this study done?

Previous research has demonstrated that piglets are likely to suffer from a deficit in vitamin A, vitamin D, and copper until weaning. Therefore, researchers wanted to evaluate if using certain supplements could optimize piglet health and growth performance.

What was done and what was the outcome?

The first step was to determine the best way to administer copper and vitamins A and D. Results showed that providing these supplements orally to piglets and sows, combined with exposing piglets to UVB light, was the most efficient way to increase these micronutrients in piglets up to weaning. This strategy also has the potential to influence the piglet microbiome and improve homogeneity of birth weight within litters.



UVB Meter. Source: Sherbrooke Research and Development Centre, AAFC



Piglets and colostrum feeder. Source: Sherbrooke Research and Development Centre, AAFC

The second and third steps were performed in research and semi-commercial conditions respectively and aimed at determining the impact of giving piglets a bovine colostrum extract as well as supplementing both sows and piglets with vitamins A and D and copper. Results showed that oral supplementation of bovine colostrum extract before weaning increased piglets' weight gain up to 8 weeks of age. It also had a positive effect on the piglet immune system.

Researchers also found that there was a considerable drop in piglets' copper reserves after weaning, even if a very high level of dietary copper was provided. These results were unexpected and merit further investigation.

Collaborators

Nathalie Bissonnette Sherbrooke Research
Jérôme Lapointe and Development
Martin Lessard Centre, AAFC
Guyline Talbot

Fermenting and acidifying grains and co-products for weanling pig diets

Denise Beaulieu and Andrew Van Kessel,
 University of Saskatchewan

Martin Nyachoti,
 University of Manitoba

Results about fermented grains showed that:

- High moisture grains can be fermented by using bacterial inoculants. They can then be incorporated in standard dry diets.
- Including fermented low moisture grains into diets, particularly wheat, improved feed intake and growth performance of piglets.

Results about acid-preserved grains showed that:

- Weanling pigs fed with acid-preserved wheat or barley had equivalent performance to pigs fed with acidified diets.

Why was this study done?

Researchers wanted to evaluate the efficacy of 1) ensiling (fermenting) and 2) acidifying high moisture cereal grains and protein co-products in order to reduce anti-nutritional factors and improve nutritive value, health and performance of pigs while reducing costs.

What was done and what was the outcome?

A series of experiments were conducted with weanling piglets.

Fermentation (ensiling) of grains and co-products

It was demonstrated that fermenting high moisture grains (27% moisture), using lactic acid bacteria inoculants, provided good preservation for the grains. These grains could be incorporated into standard dry feeding systems.

Work undertaken at University of Saskatchewan: Preservation of inoculated moisture grain in barrels (above). Inoculation of high moisture cereal grain with two types of lactic acid (below).
 Source: University of Manitoba



Feeding trials showed that using fermented low moisture grains, especially wheat, improved feed intake and growth performance of piglets. Fermentation also improved nutrient and energy digestibility of diets containing barley. Additionally, fermented barley was beneficial for the gut health of piglets infected with *E. coli*.

These results are promising but more research and a cost-benefit analysis related to the use of fermented grains on the farm would be needed.

Finally, it was shown that, when included in post-weaning diets, fermented soybean meal obtained from five different sources was ineffective in improving post-weaning performance. This also did not show any impact on piglet gut health beyond what was observed with conventional soybean meal.

Acidification of grains before storage

It has been previously demonstrated that the acidification of weanling pig diets improves performance. Results of this project showed that feeding acid-preserved wheat or barley to weanling pigs also improved performance. Interestingly, the level of piglet performance obtained with acid-preserved wheat or barley was comparable to the ones obtained with direct acidified diets.

Researchers also looked at the interaction between acidification and the particle size of the grains. Results showed that when using acid-preserved barley, fine grinding was not necessary.

The acidification of high moisture grains (>15%) provides producers with another tool to utilize low quality (high moisture) grains. However, it is not recommended to use pure propionic acid, as it is too corrosive. More work would be required to identify storage methods which effectively preserve the grain and limit corrosion of the bins used to store acid-preserved grains.

Simple versus complex post-weaning diets

Kees de Lange and Vahab Farzan,
University of Guelph

The results showed that a low complexity nursery diet containing only plant-based protein, used in a commercial setting, had no negative impact on pigs' immune response against *Salmonella*.

Why was this study done?

It was previously demonstrated that low complexity nursery diets had no negative impacts on pig growth and performance up to slaughter weight and carcass quality while reducing feed cost by \$2.81/pig. To go even further, researchers wanted to investigate the impact low complexity nursery diets would have on *Salmonella* shedding and antibody response in pigs from weaning to market. They also wanted to identify the related genetic variants.

What was done and what was the outcome?

As part of an epidemiology study, eight commercial farms with moderate to high health status were enrolled. A total of 809 pigs in 14 cohorts were monitored from birth up to slaughter. On each farm, half of the enrolled piglets was assigned to a simple nursery diet, i.e. plant-based protein, while the other half received conventional feed (complex diet).



Source:
University
of Guelph

Results showed that the low complexity diet had no negative impact on pigs' antibody response to *Salmonella* but that it may increase risk of *Salmonella* shedding. Furthermore, the results of this epidemiology study have contributed to the identification of several genetic variants that may be associated with *Salmonella* infection in pigs.

Although low complexity diets seem to have no negative impact on health and, as previously reported, had no adverse impact on growth performance and carcass quality, there might be variation from farm to farm. A careful future evaluation is therefore recommended.

Collaborators

Brandon Lillie University
Robert Friendship of Guelph

Weanling pigs: Epidermal growth factor supplement

Julang Li,
University of Guelph

Results suggest that supplementing piglets with recombinant porcine EGF (epidermal growth factor) enhanced early weaned piglet growth. However, the EGF product developed during this project has not yet been approved for use in animal production in Canada.

Why was this study done?

EGF is a powerful factor that naturally presents in sow's milk and stimulates gut health and development in newly-weaned piglets. Researchers aimed at using yeast to produce recombinant porcine EGF and to test its efficiency with piglets.

What was done and what was the outcome?

The EGF-producing yeast *Pichia pastoris* was utilized to produce recombinant EGF by fermentation. At the end of the process, the yeast was removed, leaving only the EGF product.

Two trials using this product were performed with live pigs. All pigs were fed common pig starter diets of high quality, but devoid of blood plasma. Diets were then supplemented with EGF and/or phytase. A control group did not receive any supplementation.

Results revealed that the recombinant EGF and phytase could improve growth parameters in post-weaning pigs. However, the recombinant EGF would have to be registered as livestock feed before it can be used.

Alternatives to soybean meal in nursery diets

Ruurd Zijlstra,
University of Alberta

Results from several studies showed that:

- Including 40% raw field pea in nursery diets maintained growth but reduced feed efficiency.
- Including 15% chickpea in nursery diets increased feed intake and pig growth performance. This also maintained feed efficiency.
- Replacing digestible whole grains with fermentable whole grains in nursery diets had a positive impact on weanling pigs' gut health and growth performance. However, the amount of fermentable carbohydrates used in diets should be carefully measured to prevent reduction in feed intake and growth performance.

Why was this study done?

A number of Canadian crops and plant-based co-products have the potential to serve as alternatives to soybean meal in nursery pig diets. However, if some of these alternative feedstuffs are to be used in these diets, residual protein content and an abundance of toxic fermentation products would increase in the piglets' gut, due to their lower protein digestibility. Through this project, researchers wanted to examine the impact that such protein alternatives would have on disease susceptibility and growth performance, especially in diets without antibiotics. They also wanted to study if the inclusion of fermentable carbohydrates could reduce the amount of protein toxic fermentation products in the gut.

What was done and what was the outcome?

Several feeding trials with nursery pigs were carried out to test field pea, chickpea and whole grains use in diets.

Field pea

Nursery diets were formulated by substituting the soybean meal and a portion of the wheat by 40% of field pea, either raw, cold pelleted, steam pelleted or extruded. Results showed that including this amount of field pea maintained growth but decreased feed efficiency compared to diets containing soybean meal. Also, it was found that processing field pea did not have any impact on feed efficiency.

Chickpea

Researchers evaluated the effect that increasing the amount of dietary chickpea would have on nutrient digestibility and growth performance of nursery pigs. Results showed that substituting 15% of soy bean meal and wheat grain with chickpea in nursery diets increased feed intake, growth performance and sustained feed efficiency. However, increasing the amount of chickpea to 30% reduced piglets' growth performance.

Whole grains

Two protein sources and three cereal grains were studied. These sources varied widely in composition and were classified as either fermentable or digestible based on their β -glucan and total dietary fiber (TDF): wheat (digestible: 14% TDF and 1% β -glucan), digestible hulless barley (15% TDF and 5% β -glucan) and fermentable hulless barley (18% TDF and 7% β -glucan).

Both types of hulless barley, which contains a higher level of β -glucan, increased feed efficiency and dry matter digestibility of weaned pigs. It also improved growth performance, regardless of protein source.

Another trial was conducted to study the impact of replacing wheat in nursery diets with one of five whole grains containing either low, moderate or high portions of fermentable carbohydrates, as follows:

- low-fermentable wheat
- low-fermentable hulled barley
- moderate-fermentable hullless barley
- high-fermentable and high-amylose hullless barley
- high-fermentable and high- β -glucan hullless barley

Results showed that replacing wheat by barley (hulled and hullless) in nursery diets reduced energy and protein digestibility. Hullless barley, which contains more fermentable carbohydrates, also reduced feed intake. While both types of barley can replace wheat in nursery diets, the amount of fermentable carbohydrates in diets should be measured to prevent reduction in feed intake and growth performance.

Organic acid, prebiotics and enzymes to reduce post-weaning diarrhea

Ruurd Zijlstra,
University of Alberta

Results showed that, for weaning pigs:

- Formic acid dietary supplementation increased nutrient digestion and growth performance.
- Benzoic acid supplementation increased growth performances.
- Adding a combination of benzoic acid and enzyme blend to diets enhanced nutrient utilization and reduced post-weaning diarrhea.

Why was this study done?

Post-weaning diarrhea can result in high rates of mortality and morbidity. Aiming at reducing post-weaning diarrhea without using antibiotics, nursery feeding trials were conducted to evaluate the impact that several organic acids, prebiotics and enzymes would have on weaning pigs.



Source: University of Guelph

What was done and what was the outcome?

Three prebiotics (0.02% -glucan + Zn, 0.05% -glucan + Zn, and 0.25% mannan oligosaccharides [MOS]); and a formic acid (1.20% potassium di-formate) were studied under poor sanitary conditions.

It was found that supplementing diets with formic acid enhanced the pigs' average daily gain, feed efficiency and body weight at the end of the nursery stage. It also increased diet digestibility. Also, using two prebiotics including glucan and zinc (2 types) increased diet digestibility, but did not affect piglet growth. Finally, supplementing with the prebiotic that includes mannan oligosaccharides (MOS) did not affect piglet performance nor digestibility of the diet.

In another trial, benzoic acid (an organic acid) and an enzyme blend (including β -glucanase, phytase, xylanase and α -amylase) were studied. Researchers saw that supplementing with benzoic acid enhanced pigs' average daily gain and feed intake. Interestingly, supplementing with a combination of benzoic acid and the enzyme blend increased diet digestibility and reduced the incidence of post-weaning diarrhea.

Oral vaccine to reduce post-weaning diarrhea

Robert Friendship and Vahab Farzan,
University of Guelph

The plant-based ETEC vaccine showed some promise in reducing signs of post-weaning diarrhea.

Why was this work done?

Post-weaning diarrhea can be caused by enterotoxigenic *E. coli* (ETEC) and has historically been difficult to prevent. Researchers wanted to verify if the use of plant-based oral vaccine could provide protection against ETEC.

What was done and what was the outcome?

Experimental challenge studies were conducted to determine the efficacy of a plant-based oral vaccine, which contains the *E. coli* FaeG protein. The vaccine showed some promise in reducing signs of post-weaning diarrhea. However, more work is needed before it could be commercially used in a farm situation.

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

► Denise Beaulieu, University of Saskatchewan

► Chantal Farmer, Sherbrooke Research and Development Centre, AAFC



Sow mammary glands.

Source: Sherbrooke Research and Development Centre, AAFC

Results of this study demonstrated that:

- Including oat straw (preferably processed) into sow diets during late gestation improved indicators of satiety in sows and piglet growth rates before weaning.
- Achieving a certain backfat thickness of gilts at the end of gestation by applying appropriate feeding strategies during gestation promoted mammary development.

Why was this study done?

Pork producers restrict feed intake of gestating sows to prevent excessive body weight gain and the associated negative consequences on

farrowing, post-partum feed intake, reproductive performances, and locomotion. Aggression associated with restricted feeding is a welfare concern, and can become a greater problem when sows are housed in groups.

Another challenge is that sows do not produce enough milk to sustain optimal growth of their piglets. This is a problem that has been amplified in recent years due to the use of hyperprolific sow lines. Therefore, researchers worked 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.

What was done and what was the outcome?

Reducing aggression

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

Two initial experiments demonstrated that using heat and moisture to process straw changed its fermentability and net energy content. Based on these results, a feeding trial with gestating sows was conducted. Gestating sows were fed with diets supplemented with wheat or oat straw processed and compressed using a “briquette maker” from day 85 of gestation to farrowing. These animals were compared to one group of sows that were not fed straw along with sows fed unprocessed straw.

Supplementing with oat straw, processed or not, improved indicators of satiety in sows and piglet weight gain before weaning. Also, processing straw demonstrated some additional improvements. There is also some potential in using the straw “briquettes” as environmental enrichment for sows during gestation.

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:

1 Gilt body condition

The following results were obtained from two studies involving gilts:

- At the end of gestation, gilts that are too thin (backfat thickness of 15 mm and below) will have less-developed mammary glands.
- Adequate feeding during gestation is critical to achieve optimal mammary development in late gestation and maximize future potential milk yield.
- Gestation feeding appears more important than backfat at mating for mammary development in late gestation.

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



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

2 Use of the phytoestrogen genistein

A study was carried out to see if providing genistein to late-pregnant sows could stimulate fetal growth and mammary development.

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

Even if there was an increase in the carcass fat content of neonatal piglets when using genistein in gestation, the overall results did not support the use of such a treatment in commercial swine units to improve sow and piglet performance.

Collaborators

Jennifer Brown	Prairie Swine Centre
Jérôme Lapointe	Sherbrooke Research and Development Centre, AAFC
Marie-France Palin	Development Centre, AAFC

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



Feeding programs for growing–finishing pigs to enhance global competitiveness: Opportunities across Canada

► Twelve researchers from seven different research institutions worked in collaboration on this project

Feed cost is by far the greatest cost of pig production (65-70%) and growing-finishing pigs account for about 80% of feed consumed. The continued high cost of feed demonstrated the need to develop cost-effective feeding strategies for growing-finishing pigs to ensure the long-term competitiveness of the Canadian pork industry. To address these challenges, researchers worked on the subprojects below.

Nutritional value of emerging Canadian feedstuffs

Martin Nyachoti,
University of Manitoba

Kees de Lange,
University of Guelph

Ruurd Zijlstra,
University of Alberta

More information is now available on nutritive value of the following feedstuffs:

- Canola meal
- Hemp co-products
- Camelina cake
- Low-fat corn Dried Distillers Grains with Solubles (DDGS)
- Faba bean, field pea and chick pea
- Wheat millrun

Why were these studies done?

The nutrient content of some ingredients has been characterized to develop unique Canadian databases. Researchers have also explored different means to maximize nutrient utilization from such ingredients and dietary inclusion levels.

What was done and what was the outcome?

Canola meal (M. Nyachoti)

Canola meal is widely used as a protein source but also contains relatively high levels of fiber. Energy values of fibrous or high protein ingredients are often overestimated by digestible energy (DE) and metabolizable energy (ME) systems. Therefore, the energy value of canola meal was evaluated using net energy (NE) system to provide a more accurate estimate of the energy available for pigs.

The NE of canola meal determined in this study was, on average, 2099 kcal/kg (as-fed basis).

Table 1: NE of canola meal

NE (Kcal/kg)	2099
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Hemp co-products (M. Nyachoti)

The following information was determined:
 1) the net energy content of hemp co-products,
 2) the digestibility of phosphorus in hemp hulls and extruded hemp hulls, as well as 3) the impact that supplementing with microbial phytase may have on phosphorus digestibility.

Table 2: Net energy (NE) content and digestibility of phosphorus, with or without phytase, of hemp co-products.

	Hemp hulls		Extruded hemp hulls		Blended hemp hulls & peas
	Without phytase	With phytase	Without phytase	With phytase	
NE (Kcal/kg)	2375		2320		2399
ATTD ¹ of phosphorus	18.8%	44.5%	22.5%	45.5%	
STTD ² of phosphorus	22.0%	48.5%	26.3%	48.6%	

¹ Apparent total tract digestibility

² Standardized total tract digestibility

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.

It was found that supplementing with phytase increased the digestibility of phosphorus in both hemp hulls and extruded hemp hulls. It also increased calcium digestibility.

Camelina cake (M. Nyachoti)

Trials were conducted with growing pigs to characterise camelina cake. Results are presented in Table 3.

Table 3: Digestible energy (DE), metabolizable energy (ME), net energy (NE) and digestible content of lysine, methionine and threonine of camelina cake.

	Camelina cake
DE (Kcal/kg)	3755
ME (Kcal/kg)	3755
DE (Kcal/kg)	2383
Digestible content	
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%.

Low-fat corn Dried Distillers Grains with Solubles (DDGS) (K. de Lange)

Digestibility trials with growing pigs were conducted to compare standard DDGS with low-fat DDGS. As presented in Table 4, 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 4: Digestible energy (DE), crude protein and standardized ileal digestibility of lysine, methione 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. This data suggests that 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.

Faba bean, field pea and chick pea (R. Zijlstra)

In Canada, the net energy system is gradually being adopted by the pork industry. Currently, in North America, only total starch is considered in feed evaluation and formulation. Defining two different fractions of starch may enhance accuracy when predicting the net energy value of feedstuffs: 1) the fraction digested by enzymes (in the small intestine), and 2) fermentable fraction (in the large intestine). Therefore, researchers wanted to characterize some Canadian pulses and cereal grains and study how processing can increase nutritional value, particularly starch digestibility.

Faba beans, field peas and chick peas have a lower starch digestibility than cereal grains (wheat, barley and corn), but can be increased by the following processing methods:

- Grinding: Fine grinding of field pea increased the amount of starch digested by enzymes and reduced starch fermentation.
- Heat processing methods: Steam pelleting and extrusion increased starch digestibility of grounded faba bean and barley. These heat processing methods had more impact in faba bean because its starch matrix is more resistant to digestion than barley.

Wheat millrun (R. Zijlstra)

It was found that processing wheat millrun through extrusion increased its digestibility (amino acids and energy). This process modified the properties of nutritional components of millrun, making them more available to the pigs.

Fermentation of soybean meal

Julang Li,
University of Guelph

Researchers improved a fermentation procedure for soybean meal in order to increase its nutritive value for pigs.

Why was this study done?

Soybean meal is a plant-based protein source commonly used in swine diets. However, its use has been restricted in pigs, especially those of younger age, due to the presence of anti-nutritional factors as well as allergens and relatively high levels of non-starch polysaccharides.

Therefore, using enzymes and/or bacteria to ferment soybean meal is an attractive approach to improve its nutrient value.

What was done and what was the outcome?

Researchers improved the fermentation procedure for soybean meal to allow it to be done on a larger scale that is less energy intensive, and thus more practical for farmers and more environmental friendly. To achieve this, 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.

A digestibility trial to examine if fermented soybean meal improves nutrient digestibility for growing pigs was carried out. Results showed that fermentation of soybean meal by a specific bacteria increased the digestibility of protein and ash, suggesting an improved nutritive value for pigs.

High-fibre diets for growing-finishing pigs

Marie-Pierre Létourneau-Montminy,
Laval University

Results showed that pelleting is an interesting process to improve the nutrient digestibility of both classic corn-soybean meal diets and diets containing co-products with high levels of fiber.

Why was this study done?

In Eastern Canada, co-products like bakery meal, corn DDGS and wheat middlings can be interesting alternatives to replace a part of soybean meal and corn in growing-finishing diets when prices are high. However, these ingredients are high in fiber, which has low digestibility and could negatively impact the digestibility of other nutrients. Researchers wanted to verify if xylanase and/or pelleting could help to successfully integrate these ingredients in growing-finishing pig diets.

What was done and what was the outcome?

A digestibility trial was conducted with growing pigs to study a high-fiber diet, a high-fiber diet with xylanase and a classic, low-fibre corn and soybean meal diet. All three of the tested diets were either in mash or pelleted form, for a total of six diets studied. The impacts of these diets on the digestibility of nutrients were studied.

The two high-fiber diets that were tested in this trial included co-product feedstuffs containing soluble non-starch polysaccharides. They were composed of corn, soybean meal, wheat middling, DDGS and bakery meal, either with or without xylanase.

This trial showed that pelleting was an interesting process to improve nutrient digestibility. Pelleting increased the digestibility of classic corn-soybean meal diets, but also of diets containing co-products with high level of fiber. Even if pelleting represented an additional cost, these results showed that it was worth it as more nutrients were made available to the pigs.

Xylanase, however, did not improve the use of nutrients in the tested high-fiber diet. It may be more interesting to use xylanase when including by-products that have a higher xylans or arabinoxylans content, such as wheat DDGS.

Low energy feed for growing-finishing pigs

Eduardo Beltranena,
Alberta Agriculture and Forestry

Results showed that providing lower net energy diets (2.2 Mcal NE) to growing-finishing pigs resulted in greater profitability, even when pigs were crowded together.

Why was this study done?

It was previously shown that feeding low, constant net energy diets (2.1 Mcal NE) to growing-finishing pigs resulted in more than \$10 profit per pig (gross revenue after subtracting feed costs) than feeding higher energy levels (2.4 Mcal NE). However, pigs must be able to increase feed intake to make up for the lower energy density. Researchers wanted to verify if, in crowded pen conditions, there was enough access to feeders for pigs to take advantage of low energy diets.

What was done and what was the outcome?

A feeding trial was conducted with 1920 pigs. Gilts and barrows were fed low (2.2 Mcal NE) or high (2.35 Mcal NE) energy levels and had either two or three feeder spaces per pen. These pigs were housed at two different stocking densities (18 or 22 pigs per pen).

For the overall trial, pigs fed low energy diets consumed more feed and had a reduced feed efficiency compared to pigs given high energy diets. However, their average daily gains were similar. In pens with three feeders, pigs ate and grew more than in pens where only 2 feeders were available. Pigs in lower stocking density pens had higher average daily gain than the ones in more crowded pens. Surprisingly, there were no interactions between the different items studied (NE level, stocking density and number of feeder spaces).

Regarding cost vs. benefit, the income margin after subtracting feed cost (ISFC) per hog was calculated. Knowing that the low NE diets cost, on average, \$21.87 less per tonne, the ISFC per pig was \$1.82 greater feeding the low energy diet than for the high energy diet. The ISFC was also \$1.98 greater for pigs housed at a lower stocking density. The number of feeder spaces per pen did not affect the ISFC.

Collaborators

Miranda N. Smit	Alberta Agriculture and Forestry
Malachy G. Young	Gowans Feed
José Luis Landero	Consulting
Xun Zhou	

Precision feeding for growing-finishing pigs

Candido Pomar,
Sherbrooke Research and Development Centre, AAFC

François Dubeau,
University of Sherbrooke

Results from this project include:

- Knowledge was gained on how individual growing finishing pigs use phosphorus and calcium present in their diets.
- The 'ideal protein' concept used to formulate feeds in conventional systems does not apply to precision feeding.
- A new mathematical feed formulating model demonstrated potential in reducing feed costs by 5.2 %, phosphorus excretion by 2.2 %, and nitrogen excretion by 17.8 %.



Finisher pigs. Image: Public Domain

Why was this study done?

Precision livestock farming is viewed as a tool to enhance sustainability and competitiveness of the swine industry by providing each pig, on a daily basis, with a diet containing an optimal concentration of nutrients.

Results have demonstrated that feeding growing-finishing pigs individually with daily tailored diets can reduce lysine intake by more than 25% and feed costs by more than 8%. Therefore, the objectives of this project were to:

- Refine a previously-developed mathematical model regarding nutrient requirements for growing-finishing pigs, along with use of these nutrients by these animals.
- Improve an existing mathematical model regarding the formulation of feed to be used in precision feeding of growing-finishing pigs.

What was done and what was the outcome?

Pig nutrient requirements and metabolism

Researchers worked on determining the efficiency of dietary phosphorus and amino acids. To do this, they developed mathematical models representing the metabolism of phosphorus and calcium in order to estimate individual pig nutrient requirements.

It was 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, more work needs to be done to better understand the digestive and metabolic adaptations that develop.

Researchers reviewed certain nutritional concepts in order to develop precision feeding strategies. Therefore, it was confirmed that:

- Precision-fed pigs use amino acids more efficiently than pigs provided 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.

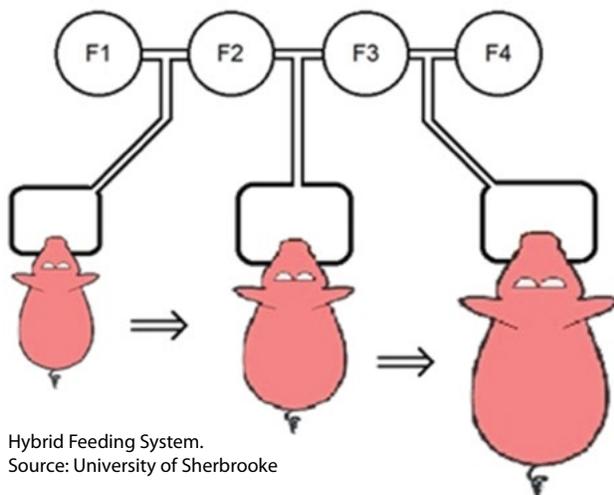
As a result, the 'ideal protein' concept used to formulate feeds in conventional systems does not apply to precision feeding.

These results suggest that changes in body composition in pigs are induced by changes in dietary levels of amino acids. Therefore, growth could be modulated according to the optimal body composition desired by the consumer.

System for formulating feed

Based on previous work, researchers developed a feed formulation system called the Hybrid Feeding System. This new model combines phase-feeding with a precision feeding system using two feeds.

For instance, in the Hybrid Feeding System, 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.



Hybrid Feeding System.
Source: University of Sherbrooke

This new mathematical model reduced feed costs by 5.2 %, phosphorus excretion by 2.2 %, and nitrogen excretion by 17.8 %.

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

Nutritional approach for controlling boar taint

Ira Mandell and Jim Squires,
University of Guelph

Different feeding additives were tested to control boar taint. However, while some additives showed promise, boar taint was not able to be effectively controlled in this experiment.

Why was this study done?

Uncastrated male pigs can produce meat having an unpleasant odour and flavor, known as 'boar taint.' Researchers evaluated certain feed additives for controlling boar taint and for providing alternatives to surgical and chemical (immunocastration) castrations.

What was done and what was the outcome?

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. Based on the dietary concentrations as well as the length of time the feed additives were given to the pigs, the tested feed additive did not allow boar taint to be controlled effectively. Further work would be needed.

Growing better pigs - a review of nurseries in Ontario

Robert Friendship and Vahab Farzan, University of Guelph

Results showed that, in participating nurseries:

- Piglet average daily gain ranged from 300 to 600 g/day
- Age at weaning influenced the average daily gain
- Diarrhea and meningitis were the most commonly reported diseases

Why was this study done?

If a pig has grown poorly or was sick during the nursery phase it can affect performance and health during the growing-finishing phase. The nursery is the most challenging stage of production because the immunity gained from colostrum begins to disappear by 3 weeks of age and weaning involves a number of stressors. Therefore, researchers wanted to determine benchmarks for weight gain, mortality and morbidity in Ontarian nurseries.

What was done and what was the outcome?

Forty-seven nursery barns in Ontario representing a variety of farm types across a wide geographical area were visited. The following actions were carried out on these farms:

- A management survey was completed.
- A group of 20 piglets was weighed, and blood and fecal samples collected twice.
- Treatments received by these pigs, as well as mortality, were recorded.

Average daily gain

Results showed that performance in nurseries varied and that there was room for improvement to have “better” pigs when starting the growing-finishing phase. Among the participating farms, piglet average daily gain (ADG) ranged from 300 to 600 g/day, with an average of 452 g/day. It was also found that the age at weaning influenced ADG.

Table 1: Average daily gains according to weaning age

Age at Weaning	ADG
Less than Day 21	420 g/day
Between Day 21 and Day 28	455 g/day
Later than Day 28	491 g/day

Mortality rates

Regarding mortality, it was found that the mortality rate ranged from 0.1% to 7.5%, where most groups recorded mortality between 2% to 3%. For 12 of the nurseries, data was available regarding feed efficiency and other information. After analysis, the average feed conversion rate for these farms was found to be 1.66, the growth rate was 480 g/day, and mortality was 2.2%.

Diseases in the nursery

The most commonly reported diseases were:

- Diarrhea (generally thought to be caused by enterotoxigenic *E. coli*)
- Meningitis (considered caused by *Streptococcus suis*)

The most commonly reported diseases resulting in mortality were:

- Streptococcal meningitis
- Post weaning diarrhea

PRRS (porcine reproductive and respiratory syndrome) and influenza were also commonly mentioned. In addition, medication use varied from no antibiotics used to multiple antibiotics used at a treatment level to the entire nursery.

Researchers also found that:

- Supplementing flavomycin in nursery diets was ineffective for the control of *Salmonella* in pigs.

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

► Chantal Farmer, Sherbrooke Research and Development Centre, AAFC

Even if substituting inorganic minerals with organic minerals could have a beneficial effect on sow longevity, results demonstrated that this feeding strategy does not offer any benefits in terms of sow milk composition.

Why was this study done?

The use of organic instead of inorganic minerals has recently received a lot of attention. It was previously shown that feeding organic minerals could have a beneficial effect on lameness and longevity of sows, but the potential impact on their milk composition and growth of their litters was not known.

This work was part of a larger project that looked at how the performance and physiological status of sows and their piglets could be affected by partially substituting inorganic with organic minerals. For this study, researchers focused on evaluating the impact of substituting 50% of inorganic minerals (Cu, Zn and Mn) with organic minerals on sow milk composition over the two first parities.

What was done and what was the outcome?

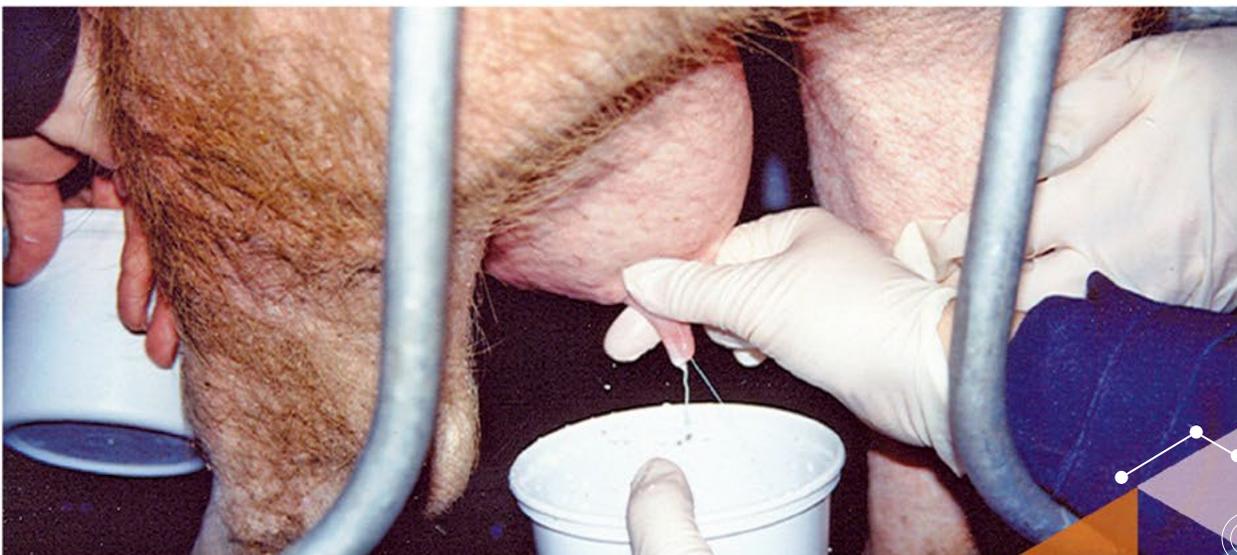
The Availa®Sow premix, which contains trace elements in organic form, was used at a rate of 750 mg / 1000 kg of feed that was provided to gilts as of 25 kg body weight until completion of their second lactation. The composition of sow milk, including dry matter, fat, protein, lactose, somatic cells and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

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

Collaborators

Mark E. Wilson	Zinpro Corporation
Dan Bussi�eres	Groupe C�er�es
Fr�ed�eric Guay	Laval
Jean-Philippe Martineau	University

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



Determining the optimum space allowance for nursery pigs

► Jennifer Brown, Prairie Swine Centre

This study showed that the minimum space allowed for nursery pigs, as recommended in the *Code of Practice for the Care and Handling of Pigs* (2014), provides a reasonable balance between production costs and pig welfare.

Researchers showed that decreasing the space allowance for nursery pigs from the current Code requirement of $k = 0.0335$ by 20% ($k = 0.0265$), which is the maximum short-term decrease allowed, resulted in reductions in average daily gains on commercial farms. In addition, it was found that lower space allowances impacted animal behaviour in studies carried out on both commercial and research farms.

Why was this study done?

Space allowance has a significant economic impact on productivity and the total pig throughput possible on a farm, as well as on the behaviour and welfare of pigs. Therefore, researchers wanted to examine various space allowances in order to find an optimal balance between production costs and pig welfare.

What was done and what was the outcome?

This study examined six different space allowances for nursery pigs ranging from k values of 0.0230 to 0.0390 (equivalent to approximately 2.5 to 3.7 ft²/pig at 26 kg body weight) and was carried out in two phases.

In Phase I, which was carried out at a research barn, there was no measurable impact of space allowance on average daily gain (ADG). However, in Phase II, which was performed on two commercial barn sites, there was a clear effect of space allowance on ADG, where space allowances below $k = 0.0335$ resulted in reduced growth.

Both phases of the study showed similar changes in pig behaviours. At lower space allowances, sitting behaviour (associated with poor welfare) was increased, while lateral lying (associated with comfort) was decreased. In addition, as piglets aged there was a significant



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

reduction in overlying behaviour, and an increase in lateral lying. In nursery weeks 3 and 5, the fact that there was more overlying behaviour at lower space allowances compared to higher space allowances suggests that this was a space-saving behaviour used to cope with limited space. Ear and tail lesions also increased in week 5, indicating that the impact of space restriction is greater in the late nursery period than at weaning.

Collaborators

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



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

Comprehensive and reliable information from 12 different farms with group sow housing is now available online at www.groupsowhousing.com. The project documents a wide range of herd sizes and renovation budgets, providing Canadian producers with pictures, testimonials from fellow producers, as well as other practical material about the conversion to group sow housing.

Why was this work done?

The transition from stalls to groups is gradually taking place across the country. In 2018, it was estimated that roughly 25% of the Canadian sow herd was managed using group housing. To comply with the Code of Practice for the Care and Handling of Pigs (2014), it is expected that close to 100% of sows will be in group housing by 2024. This change requires major renovations to existing buildings, or replacement with new buildings, as well as significant changes to daily management. This also represents an important investment by producers. Arguably, those who have already successfully implemented group sow housing are the best resource to provide other producers with credible information on what is needed for this important transition.

What was done and what was the outcome?

This project gathered the best possible information from 12 farms where sows were housed in groups. The conversion of six barns was documented as they went through the process. Information from six sites that had already converted to group sow housing was also collected. A range of locations, feeding systems and farm sizes was sought.

The actual costs of transition reported by producers ranged from \$250 to \$500 per sow place. This was much lower than initial estimates, largely because producers did much of the work themselves and kept existing floors, feed lines, electrical and ventilation 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

Electronic Sow Feeders (ESF) and free-access ESF were the most common feeding systems used by the farms studied. In addition, two of the farms used competitive feeding systems. While individual feeding systems such as ESF systems may have a higher initial capital cost than competitive feeding, it has the long-term benefit of automatically tracking sows as well as potential feed cost and labour savings. In contrast, competitive systems have reduced initial costs for installation but require more floor space and daily management, with less flexibility to manage sows individually.

Collaborators

Laurie Connor	University of Manitoba
Qiang Zhang	FGC Groenestage Constr. Ltd.
Murray Elliott	Manitoba Pork Council
Mark Fynn	Centre de développement du porc du Québec
Sébastien Turcotte	Prairie Swine Centre
Lee Whittington	

Optimizing flooring and social management of group housed gestating sows

► Laurie Connor, University of Manitoba

This study demonstrated that, for sows housed in groups:

- Flooring with narrower gaps and slats seems to reduce feet lesions and increase the standing comfort of the sows while not significantly impacting the ease of manure removal.
- Three strategies for the timing of mixing sows can result in similar reproductive performance and well-being: 1) early mixing (at weaning), 2) mixing after insemination, or 3) late mixing.
- Enrichment has a beneficial impact on sow behaviour by providing manipulable objects to positively occupy their time and promote exercise.
- Rotating enrichment devices increases their use by sows.

Why was this study done?

Canadian pig producers have been transitioning to group housing over the past few years. The strategies used for managing group-housed sows can have an impact on the cost and type of barn renovation needed and on sow welfare. This project addressed three specific knowledge gaps related to the management of gestating sows in groups, as recommended in the *Code of Practice for the Care and Handling of Pigs* (2014).

What was done and what was the outcome?

Research question: 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?

Based on detailed evaluations of different slatted floor configurations, two flooring types were evaluated in group pens holding sows over two gestation periods:

- Test floor: slats at 105 mm (4") with a gap of 19 mm (0.75") (slightly narrower than commonly used)
- Control floor: Slats at 125 mm (5") with a gap of 25 mm (1") (typical in commercial barns)

Overall, when measuring sow lameness, behaviour, reproductive performance and culling rates, there were minimal differences seen between sows evaluated on the test floor versus the control floor. However, sows on the test floor had fewer feet lesions and showed less hind-limb discomfort than those on the control floor.

Evaluation of air quality, sow cleanliness and floor friction demonstrated that manure removal was not compromised by the narrower gaps and slats of the test floor.

In addition, researchers evaluated the physical properties of rubberized and synthetic concrete overlay materials. The rubber overlays tested were softer than concrete which would increase sow comfort, and had greater surface friction which would reduce slippage. Additionally, the overlay materials had similar bacteria counts as concrete after pressure washing. While the material showed good resistance against pressure washing, more study would need to be done to assess its durability and longevity.



Straw used as enrichment. Source: University of Manitoba

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

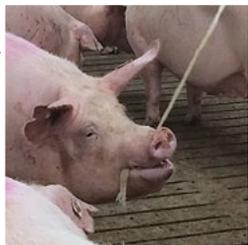
Three different timings for mixing sows were examined:

- Early mixing (at weaning)
- Post-insemination mixing (within seven to eight days of weaning)
- Late mixing (at four weeks post-breeding, after confirmation of pregnancy)

Assessing sow foot health.
Source: University of Manitoba



Sow using rope enrichment.
Source: University of Manitoba



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



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

Swine Cluster 2 | Animal Welfare



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

Overall there were no differences in reproductive performance between sow mixing strategies. These results demonstrate that, with good management, individual feeding and adequate floor space, sows can be successfully grouped at weaning, after insemination or after the confirmation of pregnancy without compromising reproductive performance. Also, the type of group housing system used (with walk-in-lock-in stalls or electronic sow feeders) did not seem to have any impact on the outcomes of the mixing strategy. This knowledge will provide options for those wanting to maximize group housing of gestating sows, and thereby reduce stall usage.

Researchers also updated a model to determine the economic risks related to management modifications. Based on the number of piglets born alive, the economic risk was similar between the three tested sow mixing strategies.

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

Researchers screened several different enrichment devices, such as hanging wooden blocks, three items hung together (chain, rope and wood block) and straw. They also studied different enrichment strategies, including the constant provision of one enrichment device, the rotation of three enrichment devices and no enrichment.

Results showed that enrichment had a positive impact on sow behavior and that all tested enrichment devices can be used with sows. Sows tended to interact more with the devices when they were changed regularly (rotation).

Sows tended to prefer chopped straw over the other devices. Straw provides the advantage of being both malleable and consumable, but can be challenging to use due to concerns over manure management and biosecurity.

A follow-up study with fibre enrichments noted that dominant sows had greater access to enrichment, suggesting the more valued enrichment resulted in greater competition. Further investigation is needed to better understand the importance of social status and different forms of enrichment.

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

This study showed that using a fan-misting bank on stationary pig trailers prior to unloading at the slaughter plant significantly improves internal trailer conditions and pig comfort.



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

ventilation, followed by 10 minutes of ventilation and water misting, and then finally 10 minutes of ventilation using the fan-mister banks located near the unloading dock. The second trailer (the control) was not exposed to any cooling procedure at all over the 30-minute wait.

The results of this study indicated that employing a fan-misting bank efficiently reduced the temperature within the compartments of the trailer. For the pigs, it also resulted in better thermal comfort as well as a reduction in dehydration at slaughter. However, the effects of the fan-misting bank varied between the different compartments of the trailer. This suggests a need for improvements to be made to trailer design, especially regarding the pattern of side ventilation openings and internal gate types, in order to increase the efficiency of this cooling system. Finally, it was found that the cooling system had no major impact on carcass or meat quality.

Why was this study done?

Researchers wanted to evaluate, in warm conditions, the impact that ventilation and water misting would have on the behaviour, physiology, carcass and meat quality of pigs waiting to be unloaded at the slaughterhouse. Researchers also wanted to assess the impact of vibration during transport to the slaughterhouse on the posture of the pigs (for example, standing, sitting or lying down).

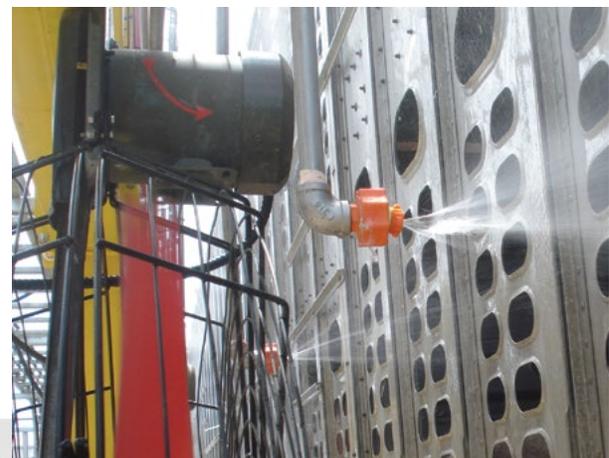
What was done and what was the outcome?

Over the summer of 2015, two identical pot-belly trailers were used to transport twelve loads of pigs (six loads per trailer) to the slaughter plant. Upon arrival, the trailers remained stationary for 30 minutes prior to unloading. During this period, one trailer was exposed to 10 minutes of fan-assisted

Collaborators

Trevor 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 and Marie-Ève Lambert, University of Montreal

Researchers from the Laboratoire d'épidémiologie et de médecine porcine (LEMP):

- Managed a PRRS virus sequence database of more than 6000 sequences.
- Developed a classification system for PRRS viral strains and identified nearly 40 different groups allowing the study of the geographical spread of the disease over time.
- Developed a monitoring system based on sequencing data to detect new PRRS virus introductions into breeding herds.
- Collected a large amount of data on movements occurring on herds with a new PRRS virus introduction.
 - Significant number of individuals (employees, visitors) and vehicles (deliveries, feed and manure management, pig transportation) were circulating on pig sites. Therefore, if any biosecurity measures are breached on the farm, this could result in the PRRS virus being introduced.
 - Sharing employees between sites might represent an increased risk of the PRRS virus being introduced since entrance protocol was respected less by employees than by visitors.

Why was this study done?

PRRS has a major economic impact on the swine industry. Virus sequencing is an essential tool to better manage PRRS in Canada. This research project aimed at developing and applying a new methodology integrating traditional and molecular data to assess various aspects of the transmission of the PRRS virus.

What was done and what was the outcome?

PRRS Sequence Database

Over the course of this project, more than 2500 additional sequences, along with information on location and herd characteristics, were included in the PRRS sequence database in near real-time. Now with more than 6000 open reading frame 5 sequences, this database is particularly useful to support PRRS control and research projects.

Suckling piglets.
Source: University of Montreal

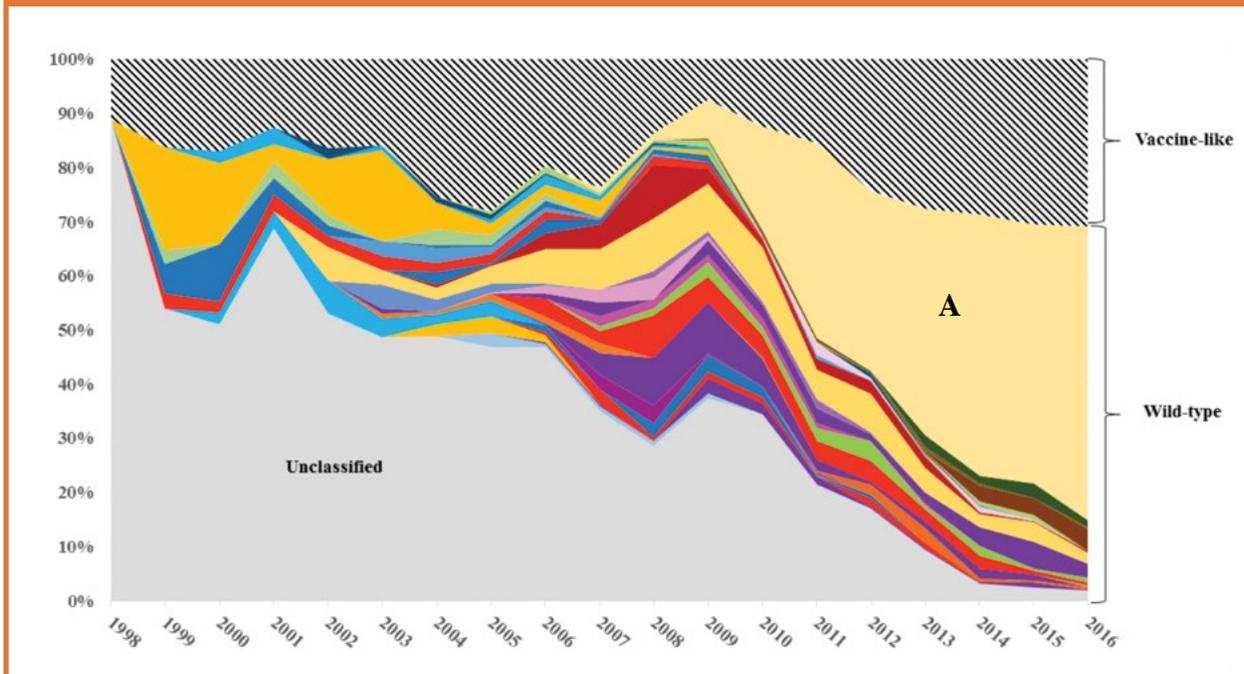


Classification system of PRRS virus strains for ongoing surveillance

Nearly 40 different large genetic groups of the virus were identified using the system developed by the research team. This classification system helped in the assessment of the spatial and temporal dispersal

of strains (Figure 1) which also shows that a group has expanded considerably and will need further subgrouping (A). For regional PRRS control, knowing the type of strains circulating within and across regions might be useful to avoid the introduction of a new strain within a specific region.

Figure 1: Temporal variation of genetic groups (color bars) revealed by the classification.



First data on PRRS virus introductions into breeding herds at the provincial level

In this study (2014-2107), researchers identified 165 breeding sites where a PRRS virus strain had recently been introduced. The year 2015-2016 had the highest number of cases (Figures 2 and 3). It is recommended that this system be maintained in the future in order to continue to assess trends.

Figure 2: New introductions of PRRS virus in breeding herds according to month

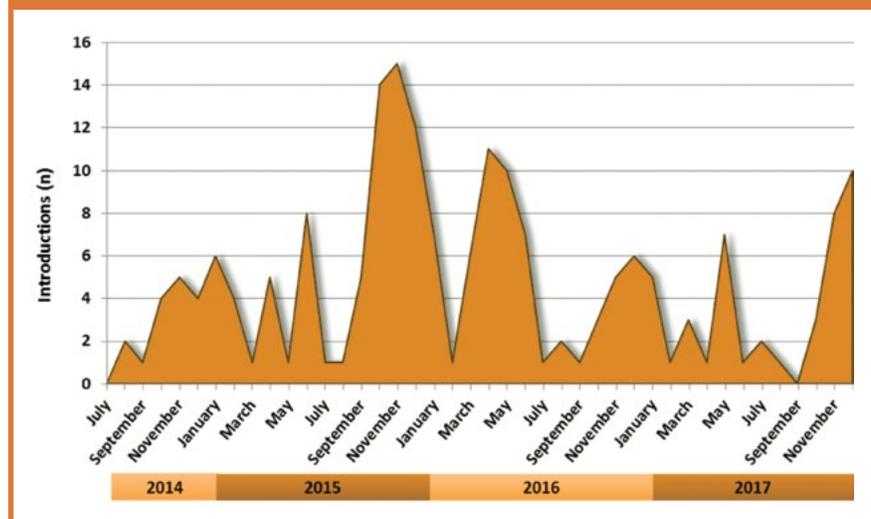
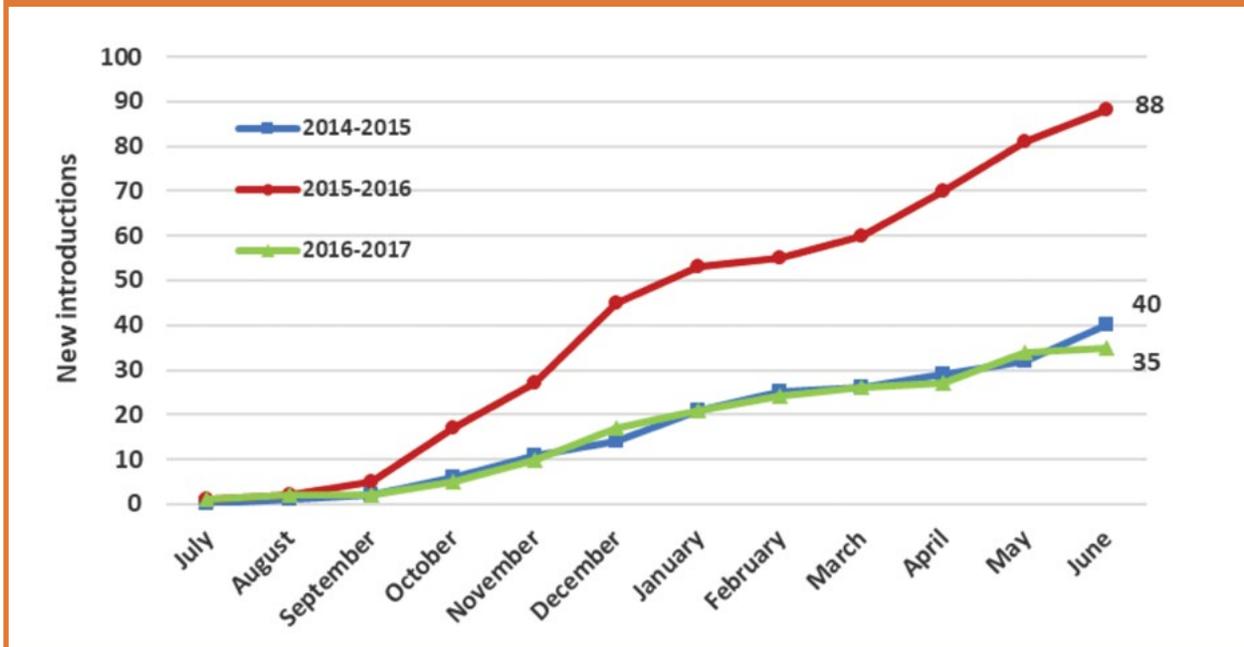


Figure 3: Cumulative number (165) of newly introduced PRRS virus into breeding herds according to month and year



Most likely source of virus introduction into a herd

Most herds with PRRS virus introductions were also investigated for the most likely source of infection. For each virus strain identified as ‘new’ to the herd, researchers checked the PRRS sequence database and were able to identify and study two to three other herds that had similar PRRS virus strains. Preliminary results showed that most of these herds shared either the same pig owner (30%), the same site owner (19%), or were located within 2.5 km of each other (25%). Furthermore, related herds investigated were mostly located in the same region as the herd where a ‘new’ strain was introduced (68%).

In the majority of cases, a high frequency of movement was observed either involving people, dead animal disposal, deliveries, manure or pig movement. For example, there had been an average of 7 pig movements (and a maximum of 16) in the month prior to the new PRRS virus strain being

introduced. Moreover, during that same month, an average of 8 people (and a maximum of 29) had access to the site. For the same period, in more than a half of the cases, at least one employee or visitor had visited at least one other pig site, and even up to 4 other pig sites. Therefore, sharing employees between sites represents an increased risk of PRRS introduction. Based on the analysis, biosecurity (especially the entrance protocol) was less respected by employees than by visitors.

Data will be further analyzed to learn more about the most frequent sources of contamination of breeding herds.

Collaborators

- Julie Arsenault** 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

Researchers have successfully developed a new susceptibility method to identify the most effective antimicrobials for treating specific strains of *Brachyspira*. This test will help swine health practitioners be able to select the most effective and appropriate therapy to treat swine herds. Researchers hope to offer this test to the Canadian swine industry by early 2019.

Why was this study done?

Since 2008, *Brachyspira*-associated disease has re-emerged as a serious cause of morbidity and economic loss in Canadian swine herds. The identification of a novel specie of *Brachyspira*, named '*Brachyspira hamptonii*', which causes severe disease in pigs, is also concerning. Through this project, researchers wanted to develop tools to help combat *Brachyspira*-associated disease.

What was done and what was the outcome?

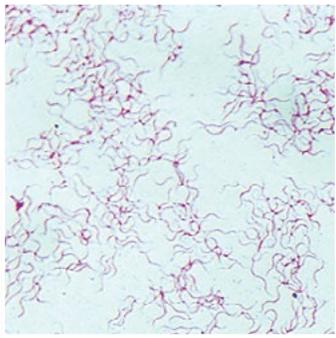
The *Brachyspira* Research Group at University of Saskatchewan worked to develop standardized methods for conducting tests to determine if antibiotics were effective against this type of bacteria. Researchers first addressed some basic questions about the growth characteristics of *Brachyspira* that needed to be understood before clinical laboratory testing could begin. Then, they successfully developed a new susceptibility method to identify the most effective antimicrobials for treating specific strains of *Brachyspira*. They started pilot trials with several swine veterinarians in the fall of 2017 and hope to offer this test to the whole industry in early 2019.

The research group has also begun to further study the genetic determinants of *Brachyspira*'s resistance to antibiotics, and will continue to expand upon this work.

Collaborators

John Harding
Janet Hill

University
of Saskatchewan



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



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



Technicians and students working on the project at the Deschambault test station in Quebec. Photo: CDPQ

New tools to enable effective genomic selection for disease resilience

► Graham Plastow, University of Alberta

Genetics plays a significant role when infection or disease occurs in an animal. In this project, researchers identified several genomic regions that may contribute to the susceptibility and/or the resilience of the swine fetus against viral infection when the pregnant sow is infected with PRRS (porcine reproductive and respiratory syndrome) virus.

Also, initial results from a number of analytical methods (assays) suggest that it may be possible to select for disease resilience within nucleus herds in order to improve the health of commercial pigs.

Why was this study done?

Using traditional breeding approaches to improve pig health is very challenging due to the fact that health traits can be difficult to measure. Genomics offers the opportunity to improve health through breeding and eventually be able to select for animals that are more resilient to disease. Such animals would not be resistant to pathogens, but rather they would be able to recover more effectively from infection and continue to perform at levels close to uninfected pigs.

What was done and what was the outcome?

Identifying genetic variation in the immune response of pigs was the first step in this project. Focusing on PRRS, along with other common pig pathogens, researchers identified several genomic regions that may contribute to variation in the viral load and/or survivability of the fetus when the pregnant female is infected with PRRS. The results provided new evidence about the genetic basis of the fetus' response when challenged with the PRRS virus, and may ultimately lead to alternative strategies to control PRRS.

A 'natural challenge' model was developed by the research team with support from PigGen Canada and other funders and used in this study, where the researchers analyzed samples from high health status pigs that were then challenged by being exposed

to multiple diseases in a test barn. Data from 2000 pigs have been collected so far and researchers are working on characterizing disease resilience traits. The goal is to eventually be able to predict disease resilience using different tools such as SNPs or other biomarkers and assays. This 'natural challenge' will be continuing until 2019.

In addition, several new assays were established to analyze samples from pigs involved in the 'natural challenge' model. These assays include:

- High Immune Response (HIR)
- Disease Resistance Assay for Animals (DRAA)
- Natural antibody (NAb)
- Total immunoglobulin (IgG)

Initial results suggest that the HIR, DRAA and NAB are promising new tools to explore disease resilience. These may eventually lead ways to select for disease resilience within nucleus herds in order to improve the health of commercial pigs. These analyses will also continue until 2019.

Genotypes, which will eventually be used for a Genome Wide Association Study, were used with the first pigs involved in the 'natural challenge' to determine the heritability of various resilience traits. Preliminary results demonstrate there is a moderate heritability for disease resiliency (0.2 to 0.3 heritability).

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

Jack Dekkers Iowa State University

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

A testing platform was developed that can be used as a tool to design affordable filtration systems. This platform will:

- Allow the capture efficiency of commercial filters regarding airborne viruses and bacteria to be evaluated.
- Help pig producers in the future 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. porcine reproductive respiratory syndrome (PRRS)).

Why was this study done?

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, researchers wanted to study the effectiveness of less expensive filter systems to prevent the transmission of airborne viruses and bacteria in a controlled and standardized environment.

What was done and what was the outcome?

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.

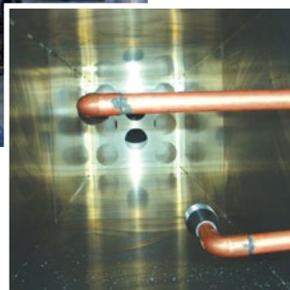
A new testing platform was designed and built in 2016 to evaluate the capture efficiency of different pre-filter and filter combinations for PhiX174 and Phi6 phages and *Streptococcus thermophilus* which are non-pathogenic models of Influenza and PRRS virus and *Streptococcus suis* serotype 2, respectively. Specifically, this new platform consists of a test duct, a mixing chamber, sampling probes, and a data acquisition system. As viruses and bacteria that affect pigs often travel on dust, the platform's mixing chamber was designed to reproduce real-life conditions in 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:

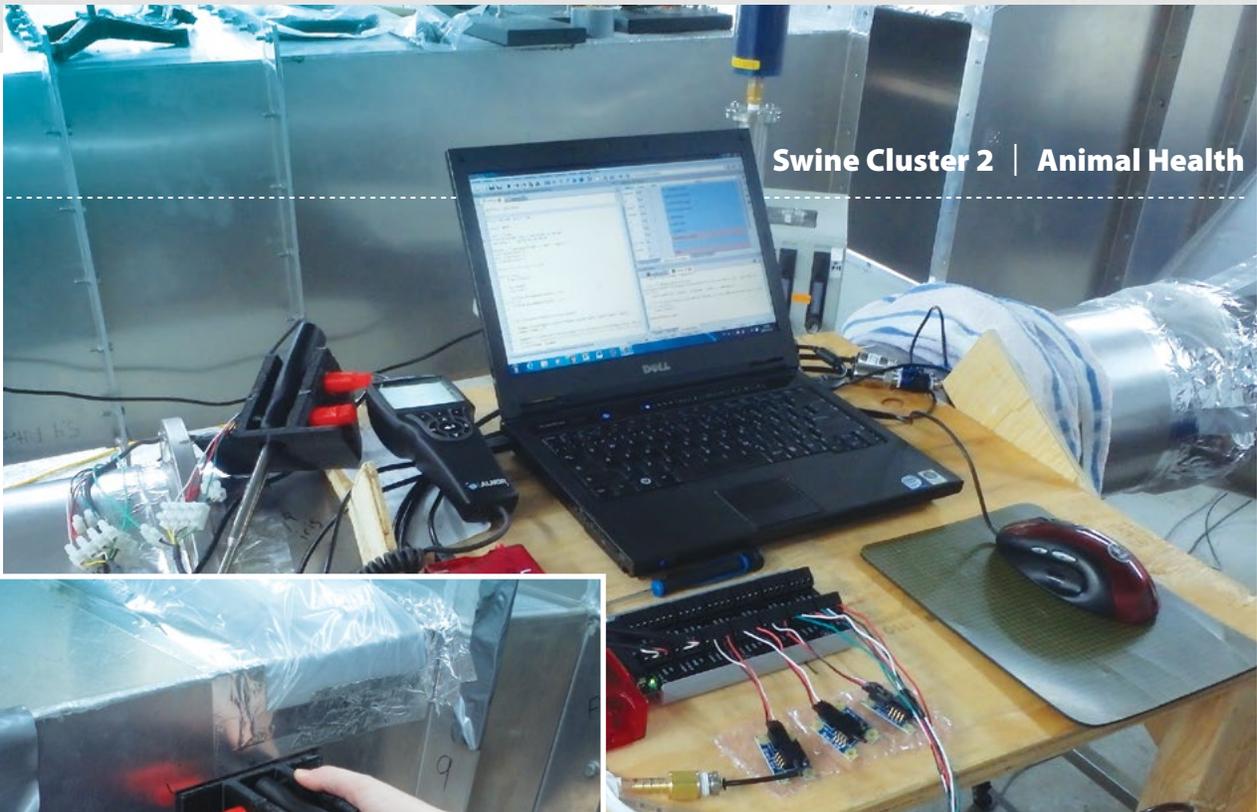
- MERV 8 pre-filter + MERV 14 filter
- MERV 8 pre-filter + MERV 16 filter



Testing platform.
Source: CDPQ



Sampling probes inside the testing platform.
Source: CDPQ



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



Verifying ASHRAE standards. Source: CDPQ

Tests were conducted at an average temperature of 24°C and average relative humidity of 65%. The following was found:

- The combination of the MERV 8 pre-filter and MERV 16 filter demonstrated the highest capture efficiency against Influenza and PRRS virus models.
- The combination of the MERV 8 pre-filter and MERV 14 filter was as efficient in capturing the *Streptococcus suis* serotype 2 model as the MERV 8 and 16 combination.

When testing filters and pre-filters, researchers used viral models that mimicked pathogens affecting pigs. These viral and bacterial models are not harmful for animals or humans and, therefore, do not require any biosecurity nor bio-containment measures to be taken. This is an innovative strategy and has the advantage of reducing cost and simplifying the testing procedure.

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 |

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

A new, innovative diagnostic test was developed to detect, all at once, the presence of four pathogens: SIV, Type 1 and 2 PRRS virus (porcine reproductive and respiratory syndrome), and PCV2 (porcine circovirus).

This test (assay) could replace 4 different assays that are currently being used in diagnostic labs.

Why was this study done?

The Porcine Respiratory Disease Complex (PRDC) has a significant economic impact on North America's swine industry.

It is known that PRDC is caused by the interaction of multiple infectious agents that include Type 1 and 2 PRRS, SIV, PCV2, as well as other bacterial pathogens.

Therefore, researchers aimed at developing a 'multiplex fluorescent microsphere immunoassay,' a type of diagnostic test, to be used to identify and classify the antibody response to SIV infections as either a H1 or H3 subtype. Initially, this project focused on SIV, but it was modified to include other viruses that are part of the PRDC.

What was done and what was the outcome?

A multiplex fluorescent immunoassay to detect antibody response to SIV, PRRSv type 1 and 2 and PCV2 was successfully developed and validated.

This new assay is now commercially available. While more work will be needed to classify the antibody response to SIV as either a H1 or H3 subtype, it is now possible to detect antibodies due to infection caused by almost all of the viruses involved in the PRDC. The assay should save labor, time, and cost compared to traditional methods.

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

The results of this study showed that:

- There is a great diversity of Influenza A viruses circulating in Canada.
- Infection of one Influenza A virus does not guarantee protection from other viruses of the same sub-lineage.

Why was this study done?

The influenza virus has a major impact on Canadian swine production. Significant genetic diversity and the emergence of new variants have complicated the control of this virus. Therefore, to have a big picture of swine influenza A in Canada, researchers analyzed the diversity of these viruses across the country. On a smaller scale, they also studied the circulation of influenza A viruses in some herds and worked on a real-time outbreak detection system.

What was done and what was the outcome?

Diversity of influenza A viruses in swine in Canada

Researchers conducted a comprehensive genomic analysis of 16 influenza A virus samples. These samples were from clinical outbreaks that took place in 2014 within swine herds in Alberta, Manitoba, Ontario, and Saskatchewan. Out of the 16 influenza A virus samples, three were identified as H1N2 and 13 as H3N2. All H3N2 viruses belonged to cluster IV. The diversity of these viruses was greater than expected.

Circulation of influenza A viruses in swine herds

Results have shown 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. Also, some nursery pigs repeatedly tested positive for the same virus. Therefore, if pigs are infected with one Influenza A virus, it does not guarantee the future protection of an animal against that specific virus and even one from the same sub-lineage.

Real-time outbreak detection system

Part of this research also focused on processing and summarizing laboratory swine influenza information in a user-friendly report for producers, swine veterinarians, and regulatory experts. These reports display trends regarding periods where more samples were submitted to laboratories and/or when there were more samples that tested positive for swine influenza. This data may then be processed using a specific statistical model to forecast influenza outbreaks.

Collaborators

Rob Deardon University of Calgary

Robert Friendship University
Helena Grgic of Guelph
Eva Nagy

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

► Terry Fonstad, University of Saskatchewan

This study demonstrated that:

- Heating trailers at 75°C consistently for 15 minutes can inactivate pathogens and therefore increase biosecurity.
- When compared to current washing procedures, the trailer vacuuming and washing system prototype can:
 - Remove more material from the trailer before washing
 - Use less water
 - Contain waste
 - Improve worker operating conditions

However, in order for the system to be commercially viable, it would need to be automated.

Why was this study done?

The health of pigs during transport is potentially compromised by the spreading of pathogens due to the difficulty of disinfecting livestock transport trailers. The main goals of this project were to 1) develop a vacuum wash system in order to rapidly clean transport trailers to a higher standard and 2) investigate if heating trailers would ensure the deactivation of all pathogens.

What was done and what was the outcome?

Verification that heating trailers can inactivate pathogens

Researchers found that heating trailers to a temperature of 75°C and maintaining this for 15 minutes was necessary to deactivate the porcine epidemic diarrhea (PED) virus, which is very resistant to heat.

Next, using a temperature data collection system installed within the trailers, the procedure was applied during typical 'thermal assisted drying and decontamination' (or 'trailer baking') cycles of commercial livestock transport trailers. Results showed that 87% to 99% of interior surfaces of trailers did in fact reach 75°C for 15 minutes. Consequently, up to 13% of the trailer surface areas did not meet the required conditions for deactivating PED virus. Improving the configuration of side panels to facilitate airflow and refining the heating air distribution both showed potential in ensuring that 100% of the trailer met the required conditions. Researchers also discovered that fecal matter served as an excellent insulator. Therefore, using efficient washing methods prior to heating is essential in order to remove all clumps of organic material that may contain pathogens.

Trailer wash facility.
Source: PAMI



Condition of floor after flood wash.
Source: PAMI



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

Vacuum wash system development

The trailer vacuum wash system prototype was tested by a swine transport company in Saskatchewan. After each trial, improvements were implemented and the system was tested again. A second operator was of great help to maneuver the hose while the first operator vacuumed bedding and waste from the trailer. The system would definitely need an automated carrier for the hose to be efficiently operated by only one person.

Operators from the swine transport company reported that vacuuming and washing with the tested system removed significantly more material from the trailer and required significantly less water than the current method in use.

Collaborators

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

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



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)



Water dispensers. Source: CDPQ

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 provided new opportunities to collect information on live pigs and carcasses.

This project looked at validating some of the new technologies available to provide objective indicators of performance, welfare and carcass value.

Pilot studies on both live pigs and carcasses, along with a commercial trial and demonstration activity, were carried out as described below.

Fifteen researchers from ten different institutions worked in collaboration on this project.

Automated recording of individual water usage

Frédéric Fortin and Patrick Gagnon,
Centre de développement du porc du Québec
(CDPQ)

Results of this study showed that recording systems for water usage per pen could be an interesting option for commercial farms. Water intake (per pen) can be used to predict growth and feed conversion. It can also be an early indicator of health issues, as intake drops up to three days prior to disease symptoms.

Why was this work done?

Collecting individual water intake data can help to detect potential health or welfare issues in addition to providing behaviour measurements. Monitoring water usage may also be a valuable approach towards more sustainable pig production and resistance to heat or drought.

What was done and what was the outcome?

New individual water intake recording systems (smart drinkers) were installed at the CDPQ Deschambault swine testing station in Québec. These smart drinkers allowed water intake patterns to be studied on a barn, pen and individual basis and links with other traits such as feed intake, growth performance, carcass quality and health status can be explored.

Water intake from about 700 pigs was analyzed and a good correlation between water and feed intake was found. However, there was a large seasonal effect, with pigs eating less and drinking more in summer months. While water intake can be used to predict growth and feed conversion at the pen level, individual pig usage is less accurate, largely due to a large variation in wastage.

Water intake can also be used at the pen or barn level as an indicator of health issues. Warning levels can be set up and were shown to predict health issues up to three days prior to animals showing symptoms.

Recording systems for water usage per pen could be an interesting option for commercial use as they do not require electronic identification of individual pigs and can be done with a simpler version of the smart drinker.

Automated recording of pig body temperature using infrared technology in the eye area

Frédéric Fortin and Patrick Gagnon,
Centre de développement du porc du Québec
(CDPQ)

Researchers found that measuring the temperature of the pigs' eye area using infrared thermography was a practical method to take pig temperature, a promising indicator of health, stress and performance.

Why was this work done?

The value of infrared thermography (IRT) in pig production and research resides in its ability to provide temperature information on animals non-invasively. However, there is a need to define standard measurement sites in order to optimize the use of the IRT data as a predictor of health, stress and performance. Thus, the principal objective of this study was to estimate pig temperature in barn conditions using infrared thermography on a specific area near the eye.

What was done and what was the outcome?

This study was carried out in two phases. For Phase 1, manual and automated IRT pictures were taken to measure temperatures of pigs' eyes and ears. Pictures taken automatically from above the water bowl showed that eye temperature was easier to obtain.

For Phase 2, promising results were obtained with a new water bowl designed specifically to hold the IRT cameras securely and at different heights. However, some practical issues would still need to be addressed before implementing this system in commercial barns. For example, software should be enhanced to automatically compare images and temperature.



Vision systems to predict animal weight and conformation

Frédéric Fortin and Patrick Gagnon,
Centre de développement du porc du Québec
(CDPQ)

Three vision systems to predict animal weight and conformation were tested during this study. They all showed promise but would need to be improved for use on the farm.

Why was this work done?

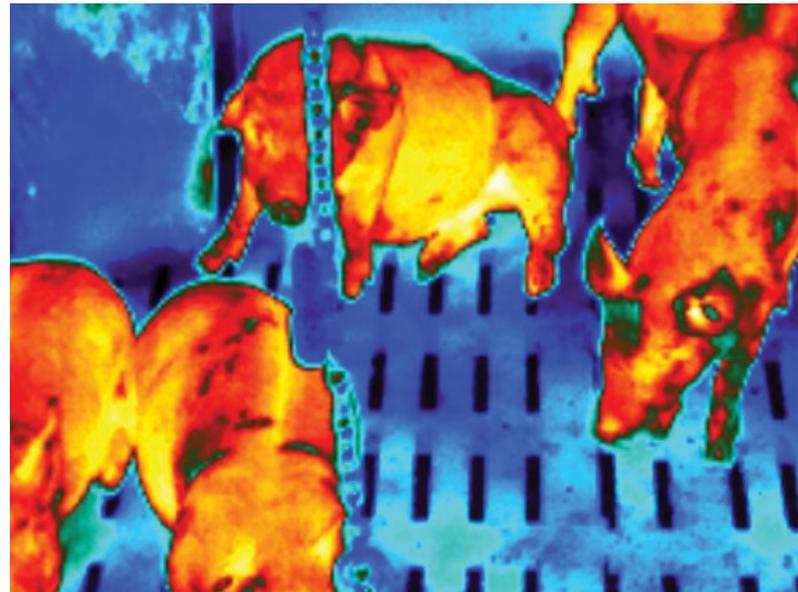
Predicting live weight, carcass weight and cut weights is of interest to assess the value of a hog. Computer vision tools provide the possibility to do so frequently for each pig, without any animal handling. The objective of this study was to test and evaluate different weight prediction systems in order to determine their ease of use, functionality and reliability on commercial farms.

What was done and what was the outcome?

The OptiSort hog sorter, based on a 2D image analysis, was first tested. The predicted weights provided by the OptiSort system were quite good compared to scale weights, but only for live weights up to about 105 kg.

A specific setup was then developed by CDPQ to collect images and create 3D models of live pigs. This setup consisted of three Kinect 2 cameras used simultaneously in a small pen designed to restrain a pig during scanning, which takes about one minute. Results showed that the vision system, in its current form, cannot provide accurate predictions of pig weight and conformation. Improving the 3D image capture setup and exploring ways to automate 3D image processing would be needed.

A portable device called PigWei was also tested. This technology was initially developed for Iberian pigs in Spain and was adapted to be effective with Canadian pig breeds. The PigWei instrument was found to be easy to use and practical. However, results showed that some improvements are still needed for the instrument to be practical in the commercial farm environment and effective with Canadian pig breeds.



Infrared imagery. Source: CCSI

Infrared thermography diagnostic platform for swine

Nigel Cook,
Alberta Agriculture and Forestry

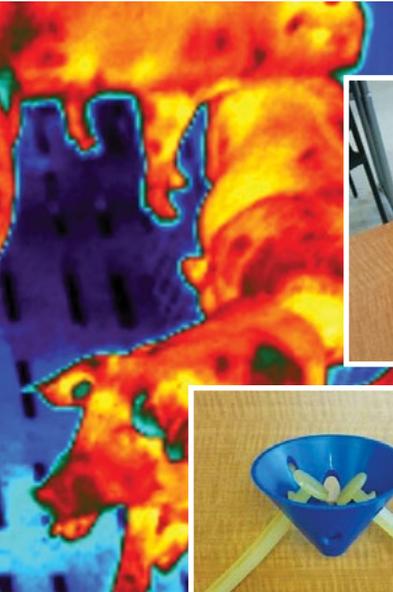
It is still inconclusive if infrared thermography (IRT) could be a useful tool to measure animal health or feed efficiency.

Why was this work done?

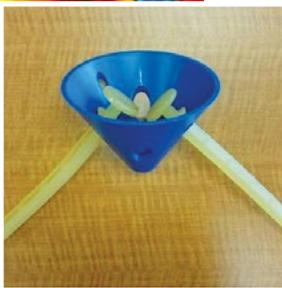
Infrared thermography (IRT) for medical applications was developed in the 1950s and has been adapted to many different areas since then. With this study, researchers aimed at developing approaches for using IRT to monitor pig performance, welfare, and carcass value.

What was done and what was the outcome?

An IRT system has been installed at the Lacombe Research and Development Centre (AAFC) pig barn to collect infrared thermography images. Several trials were carried out to evaluate the accuracy of IRT to identify sick pigs, classify animals based on feed efficiency and establish a relationship between temperature measured by IRT and stress. The data are still being analyzed.



Enrichment objects.
Source: CCSI



was considerably slower than for the other objects. Pigs seemed to like the piece of wood because of its destructible nature, which can also sustain interest overtime. Objects placed on the floor were manipulated more often if they were fixed. Results also showed that a daily wash of soiled objects or a daily replacement of destructible objects was unnecessary.

Finally, researchers were unable to successfully automate the analysis of behaviour based on the data collected by the accelerometers attached to enrichment objects. This method showed some potential, but much more work would be needed to improve the results compared to a video analysis.

Collaborators

Renée Bergeron	University of Guelph
Nicolas Devillers	Sherbrooke Research and Development Centre, AAFC

Use of accelerometers to automatically assess pig behaviour and welfare

Jean-Paul Laforest,
Laval University

Researchers were unable to successfully automate the analysis of behaviour based on data collected by accelerometers attached to enrichment objects.

Why was this work done?

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. With this study researchers wanted to validate the use of accelerometers as tools to investigate pig behaviour as they interact with their environment.

What was done and what was the outcome?

Accelerometers were attached to different types of objects that were made available to pigs during the trials.

Results showed that the frequency and duration of the use of these objects decreased with time. For the suspended piece of wood, the decrease of use

Use of 3D vision systems for rapid and objective hog carcass quality assessment

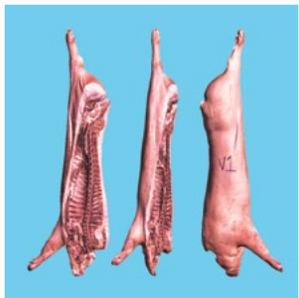
Candido Pomar,
Sherbrooke Research and Development Centre, AAFC

The 3D vision system was shown to be a promising tool to predict weight of primal, commercial and detailed cuts as well as meat weight and lean content. Algorithms are currently being developed using detailed data collected from this study.

Why was this work done?

In packing plants, the value of hog carcasses is currently being predicted by using simple measurements at a standardized site of the carcass. 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 efficient carcass sorting and valorization.

With this study, researchers wanted to test and validate a 3D portable scanner as a tool to assess carcass/cuts weight and leanness, and to calibrate the algorithms used to predict carcass quality.



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



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

Using near infra-red spectroscopy to predict carcass traits from pig ears

Manuel Juarez,
Lacombe Research and Development Centre, AAFC

Using near infra-red spectroscopy on carcass ears was successful in classifying carcasses according to their composition (different fat and lean contents) and certain meat quality attributes, including fatty acid composition.

Why was this work done?

Current methods to measure fat content and fatty acid composition are time consuming and costly. Near infrared reflectance spectroscopy (NIRS) is a sensitive, fast, and non-destructive technology that has shown great potential for predicting the fatty acid profile of fat.

With this study, the researchers' goal was to determine if NIRS data collected from pig ears could be used to classify carcasses according to various carcass traits.

What was done and what was the outcome?

Using NIRS, pig ears were scanned on live pigs as well as after slaughter. Carcass traits were measured and statistical models were developed. Using data collected after slaughter, statistical models allowed carcasses to be classified, with good accuracy, according to their fat and lean content as well as to certain meat quality attributes. However, when using data from live pigs, the accuracy was substantially lower.

What was done and what was the outcome?

Researchers used a portable 3D scanner (GoScan50 by CreaForm) to capture 3D images of 200 half-carcasses. The carcasses were then split into primal cuts (loin, ham, shoulder, belly) and scanned independently. The carcass was then fully cut into commercial cuts according to the Canadian Pork Buyer's Guide (2011) and different measurements were taken on these cuts. Results obtained with this new scanner will be compared to results obtained from carcass dissection.

This study provided detailed data on 200 half-carcasses and analysis of this data is underway. Algorithms will be developed and automated to provide prediction models using 3D scanning, which will allow weight to be predicted for primal and commercial cuts as well as detailed cuts, meat weight (fat and lean) and lean content.

Determining the age of bruises at slaughter

Luigi Faucitano,
Sherbrooke Research and Development Centre, AAFC

Using a spectrophotometer to assess the color of lesions demonstrates potential in objectively determining lesion age on the slaughter line.

Why was this work done?

Lesions are commonly assessed on the carcass using pictorial standards or by giving a score based on their number and type. However, no reliable technique exists for determining the age of skin lesions in pigs. As injuries can occur at any moment during the marketing process, knowing the time of infliction may be very helpful to reduce or prevent their occurrence. The objective of this study was therefore to develop objective methods to count, categorize and determine the age of bruises on pork carcasses on the slaughter line.

What was done and what was the outcome?

A trial involving animals was carried out, including mixing pens at four different times: one and two days before slaughter, in the truck and while waiting at the plant. An assessment of carcass lesions was then carried out.

Results showed that assessing the color of lesions with a spectrophotometer appears to be a suitable and rapid technique for discriminating between lesions less than seven hours old (occurring between loading and slaughter), and lesions that are more than 25 hours old (originating from the farm). Also, an analysis of gene expression and inflammation response in the skin lesion at slaughter supported the spectrophotometric color results obtained in this study. This relationship shows the potential of these techniques for the validation of line-speed, objective determination of lesion age.

Using a spectrophotometer to assess bruising colour on a carcass.
Sabine Conte.
Source: AAFC



Application of rapid methods for non-invasive assessment of pork quality - Nuclear Magnetic Resonance

Claude Gariépy,
Saint Hyacinthe Research and Development Centre, AAFC

Results of this study showed that nuclear magnetic resonance could be used to predict fat consistency in pork.

Why was this work done?

Pork with firm fat is generally what consumers and the pork industry are looking for. Conventional methods to determine fat consistency of meat, such as fat hardness, fatty acid composition, and unsaturated fatty acid content, are generally laborious, time-consuming, and destructive to the samples. Through this work, researchers investigated the possibility of determining parameters related to fat consistency, using time-domain nuclear magnetic resonance.

What was done and what was the outcome?

Solid fat content, which is an indicator of fat consistency, was measured by time-domain nuclear magnetic resonance at different temperatures. The solid fat content measurements were then correlated to fat hardness, fatty acid composition, and unsaturated fatty acids content.

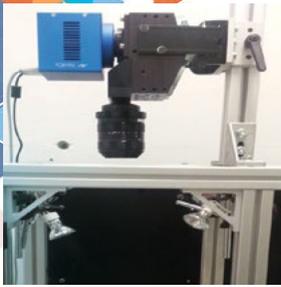
Results showed that solid fat content measurements could be used to predict fat hardness, the content of some major fatty acids, and unsaturated fatty acids content in pork.

Collaborator

Marie-Rose Van Calsteren
Saint Hyacinthe Research and Development Centre, AAFC



Nuclear magnetic resonance equipment.
Source: CCSI



Line-scan hyperspectral imaging system. Source: CCSI

Hyperspectral imaging for marbling assessment

Michael Ngadi,
McGill University

Results of this study showed that hyperspectral imaging was a promising technology for assessing marbling in pork and that further validation was required.

Why was this work done?

Intramuscular fat (marbling) is a key meat quality trait for most export and domestic markets. Conventional methods for determining intramuscular fat content in meat are not suited for applications on the slaughter line. With this study, researchers wanted to investigate the possibility of determining the intramuscular fat content by using near-infrared hyperspectral imaging.

What was done and what was the outcome?

A line-scan hyperspectral imaging system was designed at McGill University to mimic commercial conditions and was used to scan loin samples. Both frozen and thawed pork loins samples were analyzed with this system. Information about both the chemical properties (spectral) and physical properties (image texture) of the meat were extracted. This information was then compared to reference measurements to establish calibration models. Good correlations for marbling were obtained, for both frozen and thawed samples. However, further validation would be required.

Quick, non-invasive technology for predicting marbling in fresh loins

Frédéric Fortin,
Centre de développement du porc du Québec (CDPQ)

Results of this study showed that resistivity measurements did not correlate well with pork loin marbling.

Why was this work done?

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. The goal of this study was therefore to test a technology to predict marbling levels in uncut loins.

What was done and what was the outcome?

Standard measurements of marbling scores and drip loss were collected on 65 loin samples. These samples were then analyzed in an induced current measurement cell and sent to a commercial lab for intramuscular fat analyses. Results showed that this method did not demonstrate an adequate prediction of marbling. More research would be required.

Objective method for pork belly quality assessment and sorting

Bethany Uttaro,
Lacombe Research and Development Centre, AAFC

Results of this study suggested that:

- The drop angle of pork belly could be utilized for sorting bellies based on firmness.
- Using normal behavior of bellies in response to gravity would be a simple solution to automate sorting for firmness.

Why was this work done?

Soft fat poses a problem for bacon processing because the bellies are difficult to handle and to slice. Thus, processors manually assess bellies to sort out those that are unsuitable for bacon production. The objective of this study was to develop an instrument that could eventually lead to an automated system for belly firmness classification and sorting.

Assessing pork belly quality. Source: AAFC



What was done and what was the outcome?

Results from various trials suggested that the drop angle of pork belly could be utilized as a method for sorting bellies based on firmness. The following practical considerations were highlighted regarding the use of that method:

- High conveyor incline angles resulted in handling problems.
- The bending location of 24 cm from the caudal end of the primal belly appears to be appropriate for almost all bellies.
- Belly angle was related to floppiness assessments performed at the middle of the ribbed belly. It would therefore be possible to sort bellies for firmness very early on the production line.

A simple solution for automating the sorting of bellies appeared to be using their normal behavior in response to gravity as they exit a conveyor belt. Firm bellies would continue and be received by another conveyor, while very soft ones would bend and fall on a lower-level conveyor or bin below.

Commercial trials: Automated recording of individual water intake and of pig body temperature

Bernardo Predicala,
Prairie Swine Centre

Why was this work done?

Technologies developed or tested in pilot studies must be applied in environments closer to commercial conditions. In this context, Prairie Swine Centre (PSC) conducted preliminary commercial trials on two selected technologies:

- Individual water consumption system, and
- Infrared thermography system to measure body temperature

What was done and what was the outcome?

Both systems were installed in a grow-finish room. The smart drinkers were a simplified version of the one developed in the pilot study. Low-resolution infrared cameras were installed on top of drinkers in order to collect images of an individual pig while drinking. In addition, two high-resolution cameras were installed to provide group pictures.

To assess whether the two novel technologies were capable of detecting pigs that may be stressed due to routine husbandry practices, two types of stressors (exercising and mixing of unfamiliar pigs) were introduced. Depending on the stressor, results showed that water intake increased (exercising) or decreased (mixing). Data from the infrared thermography system showed that mixing unfamiliar pigs caused an increase in pig body temperature.

Further work on implementing these two novel technologies in other parts of the barn would be of interest, along with conducting an economic analysis.

Demonstration of using genomics to predict and enhance pig performance and carcass value

Brian Sullivan,
CCSI

Results of this demonstration showed that most genomic-estimated breeding values had a higher correlation with future phenotypes than traditionally estimated breeding values.

Why was this work done?

This project focused on the use of novel technologies to make it practical, affordable and accurate to measure various traits. Generated data can contribute to the application of genomics, especially for traits that are difficult or expensive to measure. The goal of this study was to compute genomic evaluations and demonstrate the potential for predicting and enhancing traits related to pig performance and carcass value.

What was done and what was the outcome?

Approximately 22,000 animals were genotyped for this study. Genomic evaluations were run on 19 traits, and various groups were used to validate the predictive value of progeny genomic estimated breeding values (GEBVs). The GEBVs were calculated before performance testing to validate the prediction accuracy of GEBV for future performance of pigs and compare it with predictions based on traditional BLUP evaluation of parents. Almost all GEBV showed higher correlation with adjusted phenotypes than EBVs.

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

► Ray Lu, University of Guelph

In this study, seven possible genetic markers related to stress resistance were identified in Yorkshire piglets. This work shows promise in eventually being able to use genetic markers to select for low-stress pigs.

Why was this study done?

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 was to apply the knowledge learned in mice to pigs.

What was done and what was the outcome?

Researchers identified six genetic markers in Yorkshire pigs and discovered a new one (a single-nucleotide polymorphism (SNP)) that may be related to stress resistance. This SNP predominantly exists in that breed.

They also studied how 85 Yorkshire piglets responded to stress. To do so, they performed behavioral tests and measured levels of the stress hormone cortisol. They also determined the piglets' genotype, especially for the seven genetic markers potentially related to pig stress response.

Results showed that the studied Yorkshire piglets had different genotypes for the seven genetic markers of interest and had differing behavioral and hormonal responses to stressful situations. This means that it could eventually be possible to use genetic markers to select for low-stress pigs. However, more work needs to be done before low-stress pigs can be genetically selected, such as examining pigs from other breeds and genetic backgrounds.

Collaborators

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





Source: AAFC Lacombe

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

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

A literature review on methods to objectively predict marbling and other meat quality traits has been carried out and is now available online at www.swineinnovationporc.ca.

Why was this study done?

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 for new technology to objectively assess meat quality traits in order to provide consistent,

Source: Canada Pork International & CCSI

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.

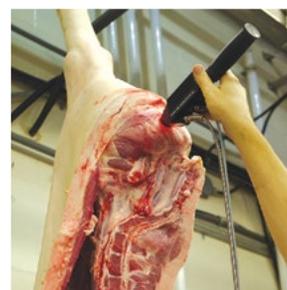
What was done and what was the outcome?

The research team carried out an extensive literature review on methods available to predict marbling and other meat quality traits, including novel technologies that might already be ready for application. Tools in development or already available in other industries and other productions (beef, lamb, poultry, fish, etc) were also reviewed, as some technologies developed for other products may easily be adapted to be used on pork. This literature review is now available on our website.

In addition, statistical analyses were performed on carcass data in order to identify measurements having a high potential to predict meat quality traits. For this, data from more than 500 carcasses from another project titled "Optimizing Canadian pork quality through integrated management strategies" led by the Western Swine Testing Association were used. However, more work is required before firm conclusions may be made.

Collaborators

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



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

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.

Some outcomes of this study include:

- A method to identify swine with high levels of muscle carnosine has been developed.
- A genetic marker (the SLC15A4 c.658A>G SNP) has been associated with an increase in carnosine content and improved pork meat quality.
- Only a few (8.5%) of surveyed pork consumers had previously heard of carnosine but they showed a willingness to pay more for carnosine-enhanced pork.

Why was this study done?

In this project, purebred pigs in Canada were measured for their levels of carnosine. The effects of this molecule on meat quality traits were studied and researchers also verified if levels of carnosine can be enhanced through pig nutrition.

In addition, work has been done to better understand public 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.

What was done and what was the outcome?

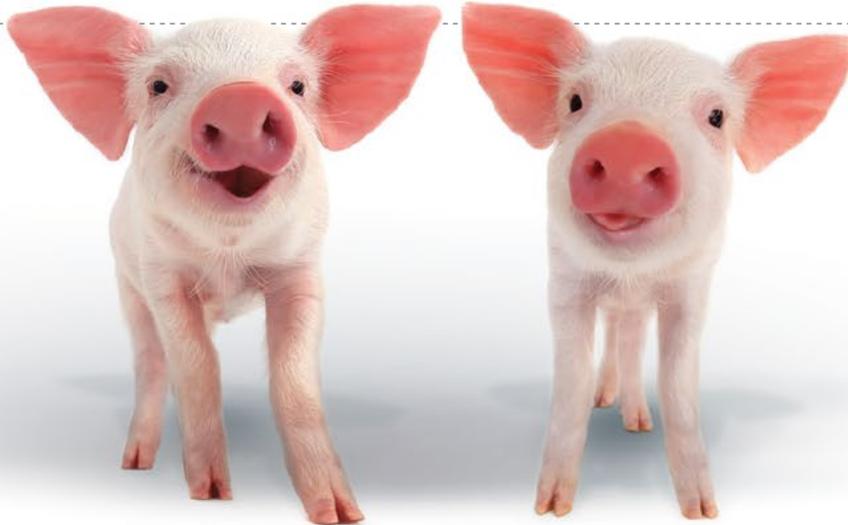
Identification of genetic markers

Twenty-seven genetic markers (SNPs) were identified in different carnosine-related genes with the most promising associations observed for SNP SLC15A4 c.658A>G. For this SNP, when compared with pigs having the AG genotype, animals with the AA genotype had the following benefits:

- Higher muscle carnosine content
- Higher pH 24 h values
- Lower color b* and color L*
- Lower drip and cooking loss
- Lower glycolytic potential values

Therefore, the SLC15A4 c.658A>G SNP could potentially be used in selection programs to increase carnosine content and improve pork meat quality. However, many Duroc and Landrace pigs already had the genotype AA, limiting the potential meat quality improvements for these two breeds. Results also showed that the sex of animals did not influence the level of carnosine present in the muscle.

Researchers also developed a molecular method to identify this SNP in swine.



Feeding trial with pigs

To see if carnosine levels could be enhanced in pork meat through feeding, a nutritional test was conducted. Pigs received a supplement of beta-alanine in varying amounts in their diets over an eight-week period. The meat from these pigs was analyzed and showed that the supplement did not increase carnosine content, but had other benefits, such as decreased lipid and protein oxidative damage. These results will be useful in identifying alternative dietary strategies to increase carnosine in pork.

Surveys to gage public perception

Given recent publicity on the possible links between red meat consumption and health risks, it was unclear whether the idea of increasing the healthiness of pork through higher carnosine levels would be well received by the public. Therefore, two consumer surveys were conducted in Canada. Results of the first survey suggested that consumers who were more health conscious and had more knowledge in general about nutrition were more interested in consuming carnosine-enhanced pork. Results of the second survey showed that only 8.5% of the surveyed pork eaters had heard of carnosine. Interestingly, these same respondents all showed a willingness to pay more for carnosine enhanced pork. Thus, communicating the benefits of carnosine to consumers will certainly be an important aspect of implementing a marketing strategy for carnosine-enhanced pork.

Collaborators

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

Investigation of strategies to mitigate accelerated deterioration of pig buildings

► Bernardo Predicala, Prairie Swine Centre



Swine buildings.
Source: Prairie Swine Centre

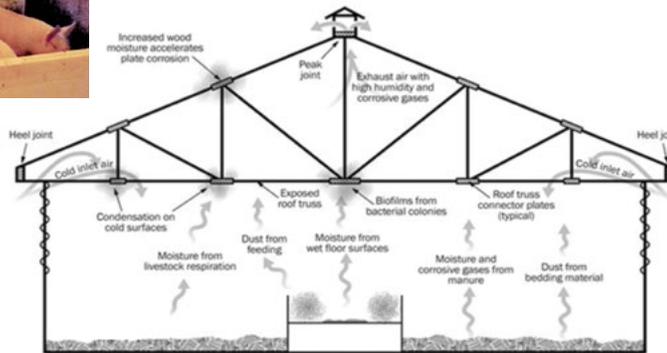


Figure 1. Sources of moisture, corrosive agents and dust that cause corrosion. Adapted from Beadle, 2016. Source: S. Beadle, 2017: "Corrosion of Roof Truss Connector Plates in Farm Buildings." Ontario Ministry of Agriculture, Food and Rural Affairs website

Based on a literature review and national survey, the following solutions seem to be the most promising to mitigate the rapid deterioration of Canadian swine buildings:

- Improving building ventilation systems, including environmental control and air treatments
- Applying surface treatments to reduce corrosion of building materials
- Having an effective building maintenance program

Why was this study done?

Swine barns are highly susceptible to accelerated deterioration because of varying thermal conditions, presence of dust and decay microorganisms, and high levels of moisture and corrosive gases such as hydrogen sulphide and ammonia especially during the winter months. With this project, researchers wanted to identify potential solutions to mitigate the accelerated deterioration of Canadian swine buildings.

What was done and what was the outcome?

A comprehensive literature search and an information survey of various stakeholders were carried out. Results confirmed that wood, concrete and steel (metal) were the most commonly used materials in agricultural building structures.

This work also showed that wood structures were degraded by a number of various factors, including the presence of fungi, bacteria, insects, solar radiation, as well as wetting and drying by precipitation, changes in relative humidity and temperature, application of chemicals for cleaning, sanding and power washing. As per metal structural components, the rate of corrosion was accelerated by high humidity levels and the presence of different microorganisms.

Based on this information and considering Canadian conditions, the following solutions have been identified as the most promising to mitigate the accelerated deterioration of pig buildings:

- Change certain techniques related to ventilation, environmental control and air treatments
- Improve the efficiency of corrosion protection for building materials
- Perform effective building maintenance

Collaborators

Sébastien Turcotte Centre de développement du porc du Québec

Stéphane Godbout Institut de recherche et de développement en agroenvironnement (IRDA)

Development of a rapid on-site diagnostic test for Porcine Epidemic Diarrhea Virus (PEDv)

► David Alton, Aquila Diagnostic Systems

This study resulted in the development of a molecular diagnostic tool for the detection of PEDv.

Why was this study done?

PEDv-related disease has been a challenge for North American pig production over the last few years and has caused significant losses for producers. One way to control the spread of PEDv is to quickly determine if pigs are infected prior to transporting them.

This project was initiated by Swine Innovation Porc in order to address the industry's need for a rapid, accurate on-farm test for PEDv.

What was done and what was the outcome?

The first phase focused on the test design, optimization, and determination of its sensitivity and specificity. A step-by-step laboratory analysis was performed to develop a PED test that is highly sensitive and capable of detecting the presence of synthetic viral RNA (ribonucleic acid) on both instruments found in clinical labs as well as on a portable instrument that can be used in the field.

The test itself is a RT-qPCR (reverse-transcriptase quantitative polymerase chain reaction) assay commonly used to detect RNA viruses, combined with hydrogel technology previously developed to adapt molecular tests for use in the field. The test is performed by adding a sample to a tube containing RT-qPCR hydrogel and running the reaction on a quantitative qPCR instrument. This takes approximately two hours to perform.

These results describe the first steps in creating a highly sensitive test for PED that can be implemented at swine production facilities. The next short-term phase would be to conduct a proof of concept demonstration in a challenge facility.

Collaborator

Volker Gerdts

VIDO-InterVac



The Accutast™ on-farm testing instrument is about the size of a regular household toaster.
Source: Aquila Diagnostic Systems.

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

- ▶ Geneviève Berthiaume, Centre de développement du porc du Québec
- ▶ Ken Engele, Prairie Swine Centre

A number of videos, articles and factsheets are now available to provide the swine industry with practical information on a number of subjects, including:

- Enrichment strategies
- Improving laying areas for gestating sows
- Phase feeding for gestating sows
- Water conservation
- Monitoring trailer cleanness

In addition, videos, presentations and articles from events on transitioning to group sow housing are also available along with articles on best management practices audited on 24 farms across Canada.

Visit our website for links to the videos, articles and factsheets related to each of these subjects at www.swineinnovationporc.ca/resource-for-producers.php.

Why was this work done?

This project aimed at increasing the speed of adoption of new technologies and management strategies arising from research projects. To reach this goal, CDPQ and PSC partnered with a number of pork producer and related organizations throughout Canada to carry out on-farm demonstrations, audits of best practices, as well as to hold nation-wide workshops.



Sows playing with enrichment object at Hog-Tied Farms. Source: Doug Richards, Prairie Swine Centre

What was done and what was the outcome?

On-farm demonstration

Environmental enrichment for gestating sows

The use of environmental enrichment, such as hanging chains or pieces of wood in pens, was implemented on six farms in Alberta, Saskatchewan, Ontario and Québec.

Participating farms have indicated that the experience was positive for them and the sows seemed to enjoy playing with the enrichment objects. Even once the project was completed, all of the demonstration sites continued to use the installed enrichment objects and most of them set up additional ones.

Activity outcomes: Videos of interviews with participant producers (1 English & 1 French)

Strategies to improve laying areas for gestating sows

Gap covers for slatted flooring (see photo) were installed on three farms in Saskatchewan, Ontario and Québec. These covers can be a solution to converting fully slatted flooring to partially slatted without having to undergo major construction. At the end of the demonstration project, all sites decided to leave them in place.

Activity outcomes: Videos of interviews with participant producers (1 English & 1 French)



On-farm demonstration of installing slat gaps Amberley Bacon Company. Source: Doug Richards, Prairie Swine Centre

Water bowl and water usage meter.
Source: CDPQ



Water management strategies

For this demonstration activity, two different water conservation strategies were installed: nipple drinkers with side panels were installed on a finishing operation in Saskatchewan and water bowls replaced nipple drinkers in a nursery facility in Quebec. Both projects had the overall goal of reducing water wastage and both sites successfully achieved this goal.

In the Saskatchewan finishing operation, results indicated that the side panel with water trough setup effectively reduced water wastage by 20%. In the Quebec nursery barn, the results showed an average reduction in water consumption of almost 33% when using water-saving bowls compared to conventional nipple drinkers. Both demonstration sites have indicated they will continue to use the new drinker systems.

Activity outcome: Articles about both on-farm demonstrations (2 English & 2 French)

Parity-segregated phase feeding for pregnant sows

Phase feeding for older pregnant sows was implemented on one farm in Ontario.

For this activity, third parity (or higher) sows were given feed containing less protein (0.39% SID lysine) at the beginning of gestation until day 85. They were then given standard feed (0.55% SID lysine) at the end of gestation to better meet their nutrient requirements. For younger sows, standard feed was provided throughout the entire gestation period.

This feeding strategy required the installation of a second feed line and was tested over 10 months. Based on 2017 feed prices, it reduced feed costs by around \$5/sow per year.

Activity outcomes: Articles about on-farm demonstration (1 English & 1 French)



Trailer used in demonstration of cleanliness assessment.
Source : CDPQ



ATP bioluminescence meter.
Source: CDPQ

Rapid assessment of trailer cleanliness

Using an ATP bioluminescence meter has been shown in previous studies to be a rapid and efficient method to assess the cleanliness of swine transport trailers. Cleanliness is evaluated by taking swabs of surfaces and then using the ATP meter to obtain a reading on contamination.

Two different wash facilities, one in Saskatchewan and one in Québec, participated as demonstration sites for this technology. Both facilities followed similar protocols of cleaning, washing, disinfecting and drying. The drying took place in heating bays in the winter, while the vehicles were left outside to dry in the summer. In addition, a minimum of two swabs were taken on sampled trailers, ensuring an accurate representation of trailer cleanliness.

During the demonstration, both sites experienced variances in meter readings related to potential environmental contamination. This variance resulted in one demonstration site not continuing to use ATP bioluminescence. However, the second site adjusted certain techniques and has continued to use it.

Activity outcomes: Articles about both demonstrations (1 English & 1 French)

Auditing on-farm best management practices

A total of 24 farms were audited regarding a number of management practices related to:

- On-farm biosecurity
- Personal protection and training
- Washing procedures
- Gestation housing systems
- Farrowing systems
- Nursery facilities
- Finishing facilities and
- Managing water intake

Individual reports were provided to each farm detailing their barn's performance, comparing performance to the participating farms and suggesting improvements.

The data gathered from these audits allowed a number of fact sheets to be produced to give producers an idea about certain everyday practices that may be improved.

Participating farms were located in Prince Edward Island, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia (minimum two farms per province).

Activity outcomes: Fact sheets
(10 English & 10 French)

Workshops: Transitioning gestating sows to group housing systems

Three events were held in the fall of 2017: one in Alberta, one in Manitoba and one in Quebec. In Alberta¹ and Manitoba, events featured five speakers who focused on several topics, including: renovation/construction costs, an overview of group sow housing across Canada, producer's experiences and testimonials, group-housed sow behavior, nutrition and others.

In Quebec, the focus of the workshop was primarily around a panel of four producers, each having experience with using different feeding systems. The audience was invited to ask producers directly about transitioning to group sow housing, the challenges and benefits of each feeding system and their general appreciation of these systems.

Links to videos, presentations and articles related to these events and all of the above activities are all available on our website at www.swineinnovationporc.ca/resource-for-producers.php.

To view the French versions of this material, please visit our website at www.innovationporc.ca/ressources-pour-les-producteurs.php.

¹ The event in Alberta was made possible through collaboration with the Swine Cluster 2 project 'National sow housing conversion project' led by Jennifer Brown.

Group sow housing workshop held in Winnipeg, Manitoba in 2017.
Source: Swine Innovation Porc



Communication & Collaboration



Swine Cluster 2 | 2013 ▶ 2018



16 NETWORKING MEETINGS HELD INVOLVING 329 PARTICIPANTS



+340 FARMSCAPE ONLINE REPORTS



+255 MEDIA REPORTS AND ARTICLES PUBLISHED



+70 PEER-REVIEWED PUBLICATIONS



Networking meeting held in Banff in January 2015 for the project on piglet and growing/finishing nutrition.
Source: Swine Innovation Porc



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

Researchers and invitees of the networking meeting held in Montreal in February 2015 for the novel technologies project.
Source: Swine Innovation Porc



Swine Cluster 2 | 2013 ▶ 2018



+255 PRESENTATIONS GIVEN AT REGIONAL, NATIONAL AND INTERNATIONAL EVENTS



29 NATIONAL EVENTS AND CONFERENCES ATTENDED REACHING +7400 PARTICIPANTS OVER 5 YEARS

Including:

- Banff Pork Seminar (Alberta)
- Swine Health Event: *PED and pig health: where do we go from here?* (Alberta)
- London Swine Conference (Ontario)
- Porc Show (Quebec)
- Red Deer Technology Workshop (Alberta)
- Sask Pork Symposium (Saskatchewan)
- Manitoba Swine Seminar (Manitoba)
- Group Sow Housing Seminars (Quebec, Ontario, Manitoba and Alberta)
- Prairie Swine Centre Spring Producer Meetings (Saskatchewan & Alberta)



On-farm demonstration of enrichment objects at Ferme porcine L.V. in Quebec (2018). Source: CDPQ



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



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



Kiosk at the 2018 Banff Pork Seminar. Source: Swine Innovation Porc.



Swine Cluster 2 researcher presenting at Banff Pork Seminar in 2018. Source: Swine Innovation Porc

Swine Innovation Porc in a few numbers

RESEARCH & DEVELOPMENT (2010 - 2018)

- ▶ **\$31.7** million investment from government and industry in R&D and KT programs
- ▶ **35** projects completed
- ▶ **+50** industry partners
- ▶ **+100** researchers
- ▶ **+135** masters and PhD candidates involved

COMMUNICATIONS (2010 - 2018)

- ▶ **14** workshops hosted by Swine Innovation Porc
 - **+1000** participants
- ▶ **+1000** communication activities related to Swine Innovation Porc (4 per week), including:
 - Ebulletins
 - Conferences and events
 - R&D featured articles
 - Farmscape interviews
 - Media reports
 - Presentations given by researchers on cluster projects
- ▶ **+260** peer-reviewed scientific papers

ON-FARM DEMONSTRATION (2010 - 2018)

- ▶ **39** end users who participated in Knowledge Transfer Programs
- ▶ **6** technologies and strategies demonstrated on various sites, related to welfare, water wastage, feeding and health.



Group sow housing workshop in Winnipeg, Manitoba in 2017.
Source: Swine Innovation Porc

Presenter at Swine Innovation Porc's health session held in Banff in 2018: *PED & pig health: where do we go from here?*
This event featured five experts who gave presentations on current health challenges facing the swine sector.
Source: Swine Innovation Porc



Panel of producers at group sow housing seminar held in Drummondville, Quebec in 2017.
Source: CDPQ

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:

Andrew Van Kessel

SAB Chair
Professor & Department Head
University of Saskatchewan

Patrick Charagu

Senior Geneticist
Hypor

Neil Ferguson

Swine Nutrition
Research Manager
Trouw Nutrition

Sylvain Fournaise

Vice President
Food Safety
& Technical Services
Olymel

Alain Giguère

Acting RDT Director
Agriculture and
Agri-food Canada
Sherbrooke & Quebec
Research & Development
Centres

Dan Hurnik

Chair; Professor
Swine Health Management
Atlantic Veterinary College
University of PEI

Nathalie Trottier

Professor
Michigan State
University

Management Team

Abida Ouyed

Acting General Manager

Marie Vachon

Research Coordinator

Leslie Walsh

Executive Assistant

Pierre-Dominique Munger

Assistant Accountant



Partners in Research

Canadian Partners

- Alberta Agriculture and Forestry
- Alliance Genetics Canada
- Aquila Diagnostic Systems
- Batista & Asociados
- Biovet
- 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 Groenestage Construction Ltd
- Gowans Feed Consulting
- Group Cérès
- 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 Swine Centre
- Prairie Agricultural Machinery Institute
- Saint Hyacinthe Research and Development Centre, AAFC
- Sherbrooke Research and Development Centre, AAFC
- University of Alberta
- University of Calgary
- University of Guelph
- University of Manitoba
- University of Montreal
- University of Saskatchewan
- University of Sherbrooke
- VIDO-InterVac
- Zinpro

International Partners

- Institut national de la recherche agronomique (INRA), (France)
- Iowa State University (USA)
- Leibniz Institute for Farm Animal Biology, Research Unit Muscle Biology and Growth (Germany)
- Newcastle University (United Kingdom)
- Universidade Estadual Paulista (Brazil)
- Universidade Federal do Rio Grande do Sul (Brazil)

Financial Partners



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada

Canada

Growing Forward 2 | Cultivons l'avenir 2

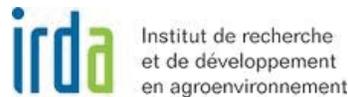


ONTARIO PORK



Canadian Pork Council
Conseil canadien du porc

Financial Partners





Financial Partners

Organizations Collaborating in Certain Projects

- Blue Water Wash
- Bureau vétérinaire Dr Jean Brochu
- Bureau vétérinaire Vaillancourt
 - Capital Wash
- Crystal Spring Hog Equipment
 - Conestoga Meat Packers
- Demeter Services vétérinaires
 - Gowans Feed Consulting
 - Hylife
 - Luckhart Transport Ltd.
 - Dr Martin Choinière
- Dre Marie-Claude Germain, Shur-Gain
 - Dre Julie Ménard, F. Ménard
- Dr Jacques Miclette, Agri-Marché inc.
 - Dr Alain Ricard, Isoporc inc.
- Services vétérinaires St-Bernard
- Services vétérinaires Triple-V inc.
- Western Canada Swine Health Alliance



The background is a solid orange color with a subtle texture. In the lower right quadrant, there is a complex, abstract geometric pattern composed of various overlapping shapes. These shapes include triangles, quadrilaterals, and polygons in shades of blue (from light to dark), white, and light orange. Some of these shapes have fine white or yellow lines running through them, creating a layered, architectural effect.

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