PRAIRIE SWINE CENTRE | 25 YEARS

Annual Report 2016 2017

Sask Pork · Alberta Pork · Manitoba Pork (Locally Grown. Globally Preferred.) · Ontario Pork · Saskatchewan Ministry of Agriculture · University of Saskatchewan

MISSION STATEMENT

"We provide solutions through knowledge, helping to build a profitable and sustainable pork industry"

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2016-2017 Report Highlights

Among all the design configurations tested, the horizontal flow ventilation system was the most effective in removing heat.	*10*
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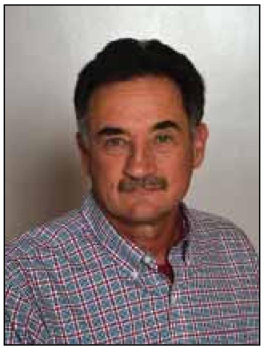
Chairman's Report

Creative Opportunities

JAMES RESSOR - Chairman of the Board



It has been an honour and privilege to serve the Board of the Prairie Swine Centre as Chair this past year. As well, I wish to especially thank the previous Board Chairs for their diligent, dedicated and professional leadership. The dedication of numerous past Board members are key factors enabling the PSC to become highly regarded within Canada and around the world. I also wish to sincerely thank retiring Board members and welcome the new members for 2018.

In 2017, the Centre is facing "Creative Opportunities". During the past year the Centre has continued examining how to sustainably operate a world class farrow-finish farm, research facility and knowledge transfer organization. The Centre continues to recognize opportunities, priorities and challenges resulting from a rapidly growing world pork industry. Of note, the past year has witnessed remarkable growth in the United States hog production and processing sectors. As well, Canadian processors have announced several expansions with resulting production growth opportunities across eastern and western Canada. This North American growth is largely driven by strong and growing world pork export opportunities.

The Centre has the opportunity to lead and assist the pork industry integrate numerous disciplines. As noted in my remarks last year, these disciplines include: traditional "on-farm" production measure research; environmental sustainability research that considers the wider "foot print" our industry leaves, including opportunities for integrating with crop production and livestock systems; food quality and safety research; and, social expectations regarding animal care and well-being. Overlapping all these areas are the need for designing and implementing economic systems that integrate these disciplines, enabling our industry to compete around the world. The PSC Board and Senior Staff continue to be very engaged and helpful in strategic discussions regarding these issues. The dedication, ability and willingness of the Board and PSC staff will continue enabling the Centre to deliver world class swine research and leadership.

During the coming year, the Board and Senior Staff will continue reviewing how to focus and integrate the valuable research the PSC is conducting. This will include continuing to cooperate with other swine research centres in Canada and around the world. As well, the PSC wants to reinforce the valuable relationship with the University of Saskatchewan and continue helping the University achieve its own research and teaching objectives.

The PSC deeply appreciates the very strong financial support received from the Province of Saskatchewan and the Alberta, Saskatchewan, Manitoba, Ontario and Quebec pork producer associations. The PSC is dedicated to continue earning this support and delivering valuable research and information back to the Canadian swine industry. As well, the PSC Board wishes to sincerely thank the dedicated efforts of the research farm production staff – while conducting world class research they are also are achieving world class sow, nursery and finisher production numbers, a difficult task for all research farms.

On behalf of the Board, I want to congratulate Lee Whittington and his highly skilled team on another successful swine research year. As this Annual Research report is reviewed, their passion and dedication becomes evident. The PSC Board looks forward to working with Lee and all the PSC staff during the coming year.

PRAIRIE SWINE CENTRE | 25 YEARS

President's Report

25 Years of Collaboration

LEE WHITTINGTON, B.Sc. (Agr.) - MBA - CEO/President

Once upon a time there was a brilliant scientist working for years alone in their lab in pursuit of …

This story has been interrupted by the reality of today's science, it is becoming more of a 'team sport'. The ability of science to disrupt the status quo in applied research requires the skill sets from many disciplines. For example, we started a project 7 years ago to address the looming challenge of fundamental changes in how the farm will manage its sows, moving from individual penned animals to groups. Many things would have to change from the space required, to floor type to how we deliver feed, water and fresh air. Perhaps the greatest change would be in attitudes around the care of our animals and who would be involved in this discussion beyond the farmer who's farm buildings and animals were the subject of discussion. The role we could see for research in this discussion was that we had already developed significant insight on the sow and how she interacted with her environment. The bold solution was to take what we knew and partner with other researchers, barn builders, equipment manufacturers and farmers to apply what we knew. Our goal was to have two touch point barns in every province that were to become the face of transformation. The plan included a collaboration of scientists and industry to achieve a simple goal – equal or better performance than the herd had prior to the renovation while applying what we knew about the sow. Today are now preparing the final report for this 'project' and although no two barns are alike, we have been able to use the collaboration between industry and science to achieve a good solution for each.

Scientists, in general, are very pragmatic and seek to have their efforts result in conclusions and recommendations that move the science or industry forward. Funding for these ideas has moved decidedly in the direction of collaboration. Today a successful scientist will be involved in multiple projects where they will play various roles, as leader and team mate. Collaboration allows progress to be made faster and under today's funding environment a project stands a much better chance of funding if it includes scientists from multiple disciplines, multiple institutions and a healthy dose of industry support. We collaborate because its more efficient to gather skills and expertise beyond your own staff and we collaborate because its good business. Those labs with good collaborations tend to be awarded large multi-year projects that seek multiple pathways to move major industry agendas forward such as improving feed efficiency, or maintaining animal health.

> *"The volunteer group of individuals has been, and continues to be, a guide, a sounding board and an inspiration for our dedicated staff."*

In our 25th year, the Centre itself is an example of collaboration. The original idea which has found favour in industry has been to have a Centre of world-class researchers reaching out all over the world to partner with like-minded scientists and industry innovators to 'move the needle' on key production and sustainability issues. This took special concessions from all the players. The University had to 'let go' to allow the Centre to become regional and then national in its scope to fulfill the mandate through a business model that included tremendous industry financial support and pursuit of a production system that was large enough to be approaching commercial, and flexible enough to serve the one-off needs of a research project. The Industry had to trust that the 'dream' and the plan for a multi-disciplinary team to manage the funds in pursuit of larger goals would become a preferred option to single grants for single projects – it has. The Prairie Swine Centre Board of Directors plays a pivotal role in keeping those relationships between industry, university and government functional and on task when it comes to how research resources can best be utilized for benefit to the pork industry in Canada. This volunteer group of individuals has been, and continues to be, a guide, a sounding board and an inspiration for our dedicated staff to collaborate broadly to take on the big issues and create new knowledge we can all benefit from.

Trust is at the very centre of collaborations. Those that work have at their core an unfailing trust between institutions and researchers that results in those teams repeating the formula again forming long-term teams that are both recognized for their good science and moving industry adoption of that research simultaneously.

Operation's Report

Fine Tuning to Achieve Optimal Production

TATJANA OMETLIC - Acting Manager, Operations

In reviewing rolling averages this fiscal year, the numbers not meeting our targets are pre-wean and post-wean mortality. Higher than expected pre-wean mortality rate is the result of multiple factors such as: multiple experiments in farrowing rooms during spring/summer months; piglets handled more than regular production practices; and not able to cross-foster between different treatment groups to even out litter sizes. Staff downsizing and training new employees made it difficult to have staff in the room at times of farrowing and to assist low viable piglets. However, we are still making it a priority to towel dry new born piglets, starch the heating mats to keep them dry, clip teeth, and assure colostrum intake. Now that experiments are close to wrapping up, we can go back to cross fostering within 24 hours and to minimizing litter interruption afterwards. This summer we had a spike in nursery mortality due to hot weather, a number of different experiments in the rooms, overcrowding of the pens, high humidity levels and high traffic in and out of the rooms. All of these factors contributed to higher than usual stress levels on the pigs, resulting in sudden deaths caused by general bacterial infections.

Table 1. Production targets for fiscal year 2017-2018

Category	Target/week	Rolling Average (July 1-Sept 23, 2017)
# Bred	15.0	16.4
# Sows farrowed	13.7	14.4
# Pigs born alive	178	204.0
Average born alive	13.0	14.2
# Piglets weaned	158.5	177.5
Pre-wean mortality	10.96%	12.59%
Post-wean mortality	2.0%	3.7%
Grow-finish mortality	4.0%	2.8%
# Sold/week	158.0	169.8

*last 16 weeks, ending June 30, 2016

Looking at the production performance, it is clear that the months of May and July are the highest in pre-wean and post-wean mortality rate.

Training new staff members and volunteers takes a lot of time and effort. Despite the recent downsizing in production, we still try to take on new volunteers and provide them with opportunities to learn all aspects of commercial/research swine production. Usually we commit to no more than two volunteers during the week and require them to commit to 20 full days of volunteering. This ensures that the appropriate amount of time is taken to properly train volunteers on all aspects of commercial swine production. Since January, we accommodated over seven volunteers who are trying to get into Veterinary Medicine.

Steffen Klenk, PIC Sales Representative, visited Prairie Swine Centre in August. He was very impressed with the barn's appearance and how well the animals are taken care of. He made a few suggestions on how we may further improve performance and barn efficiency. We took action and implemented some of the suggestions right away. Our herd has been over conditioned and after calibrating feeders and adjusting feed intake for sows in breeding and gestation, we are now looking at potential savings of $16,000 in feed per year. Our current L03 purebred female inventory is excessive and we are targeting to go down from 22% to 10-15%. Downsizing L03's would benefit herd efficiency. Our Cambourough Plus (cross-bred female) produce higher litter sizes, have better farrowing rates and will bring benefits to FCR and carcass value.

We put in place a new gilt schedule to be able to monitor and move them to the boar exposure in a timely manner at 24-26 weeks of age, so they reach puberty and are bred by the second heat (210th day). Our gilts are on maximized feed intake, to reach 135-145 kilograms body weight and bred on the second heat. This is a change from breeding gilts at the third heat. Research shows that gilts bred heavier than 320lbs (145 kg) increases the cost of production due to extra feed, facilities and equipment needed. Heavier gilts also have a larger maintenance feed cost during their life time, shorter productive life, are prone to have a dip in their second parity performance or have an extended wean to service interval.

We cut down the number of inseminations to 2-2.5 from four, saving us one day a week where we no longer have to do breeding. This in turn freed up some time for weekend staff and we were able to shift some of the work load around to make it easier on the days when we do not have enough staff.

We started our first load of RWA markets in May and have been shipping every two weeks to Brandon MLF. We managed to sell all of our NON-RWA pigs before market weight to local customers. Sales are 50 pigs per week on average including feeders and markets. Revenue is $190.00 a piece for these markets with no associated shipping charges. This takes care of our extra pigs and room density. Currently markets are shipped at 135kg and no lighter than 128kg. All of our non-productive gilts under 163kg are shipped to MLF as well, achieving premium price. This past summer and coming fall we did not see a lot of tail and side biting in the grow-finish area, due to enrichments installed in the grow finish rooms. The pigs definitely enjoy playing and using the enrichments.

This year has brought many new challenges for our production team and PSC as a whole. Despite all the challenges PSC faced due to some tough decisions that had to be made, staff morale, commitment and dedication to maintain high standards and productivity remain intact.

Table 2. Production parameters

	2014	2015	2016	Jan-Sept 2017
Number of sows farrowed:	701	739	750	558
Conception rate %:	87.4	92.8	92.5	92.7
Farrowing rate %:	86.8	93.1	92.2	90.9
Average born alive/litter:	13.6	14.0	14.2	14.3
Farrowing index:	2.47	2.46	2.49	2.47
Number weaned/sow:	12.6	12.8	12.6	12.4
Pre-wean mortality %:	11.0	11.4	11.2	12.0
Pigs weaned/sow/year:	28.5	28.7	29.5	29.6

Technology Transfer Report

Engaging the Industry

KEN ENGELE, BSA. - Manager, Information Services

2017 represented the 25th anniversary of Prairie Swine Centre being formed as a non-profit organization. A great deal of credit goes to the original advisory committee in realizing the importance of Technology Transfer in delivering a successful research program that continues to deliver practical, relevant, and timely information. As one of the original pillars of the Centre, the Technology Transfer program has seen many changes over these 25 years, while the three core areas of communication (personal, electronic, and print) remain the same, the level of importance dedicated to each method has changed significantly over time.

As the pork industry has changed so to has the Technology Transfer program adapted to the needs and economic pressures of the hog industry. Today approximately 40% of Canada's hog production is classified as vertically integrated, colonies represent approximately 30% of production with the balance of production being held in various sized operations. How we communicate with the industry is, and needs to be different than the way we communicated with the industry in the past.

A Ipsos-Reid survey of agricultural producers provides some valuable insight on the type and how producers collect information for their operation. The two most common sources of information were print (72%) and websites (50%), while social media ranked very low comparatively (2%). Do these numbers speak to an aging producer demographic? Or are tools like Twitter and Facebook seen more a personal network rather somewhere people look for credible information?

The survey also indicates the type of information producers are looking for is information on new technologies and products. On the surface this makes sense as we are in the commodity production business. By being one of the first adopters of a new technology we inherently maintain or increase our competitive advantage against our nearest competitor.

Where and how do producers gather information? A vast majority of producers (58%) get their information from aggregate news sites like Farms.com, ThePigSite, SwineWeb, MeatFYI or PorkInsight. According to the stats they access this information from desktops (70%), laptops (49%), and mobile devices (43%).

As we continue to assess how to best communicate with the pork industry we need to ensure there is a specific communication plan for each one of our target markets. The ultimate goal of Technology Transfer, is Technology Adoption. Ensuring the industry is implementing those recommendations that have been produced by the research programs at Prairie Swine Centre that improve profitability & competitiveness or address sustainability (welfare & environmental). The real trick becomes how do we measure implementation of recommendations, technologies, and products.

We are always assessing the most effective way in driving research results out to the industry. We always welcome feedback from the industry at any time. Over the course of the next 18 months you will see several new initiatives rolled out to engage the industry on a different level.

Corporate Objectives

Objective #1
To be a profitable organization operating in a marketplace that offers growth opportunities.

Objective #2
To meet the technology needs of the pork value chain better than any competitor. Using an industry-oriented and multidisciplinary approach that ensures timely adoption of knowledge by the stakeholder*.

Objective #3
To provide scientific leadership in our areas of expertise to industry, university and government.

Objective #4
To empower our people – that they should feel Valued, Challenged and Engaged in a safe work environment. Assisting them to find the breakthroughs to take us to the next level.

Objective #5
To enhance the Centre's effectiveness and sustainability, through successful collaborations, co-operative action and strategic alliances in our research, education and technology transfer roles.

* We define stakeholder as all beneficiaries in the pork value chain from cereal development to consumer acceptance of pork.

Research Objectives

Objective #1
To increase net income for pork producers by $1/pig/year through improved nutrition.

- **a)** This includes the development of feeding programs which emphasize economic efficiency, meat quality, and market value.
- **b)** Understanding feed and fibre sources and the modifications of these to meet the needs of the pig, and changing economic conditions.

Objective #2
To improve animal wellbeing by developing and modifying housing systems, animal management practices, and improving health of the pig.

Objective #3
To improve barn environment through the development of economical and practical techniques ensuring the health and safety of barn workers and animals.

Objective #4
To reduce the operating costs by $0.50/pig/year and reduce the environmental footprint of pork production through breakthroughs in the science of odour and gas emissions, nutrient and water management, utility and resource efficiency.

Objective #5
To address the needs of society by leveraging our knowledge of the pig. This includes for example, using the pig as a model for human health and nutrition.

OUR COMMITMENT

To meet or exceed the research data and scientific analysis expected by our clients, and demanded by regulatory guidelines.

Ventilation System Requirements for Conversion to Group Sow Housing

B. Predicala, A. Alvarado, R. Baah, J. Brown, J. Cabahug

Bernardo Predicala

Alvin Alvarado

SUMMARY

Computer simulation was utilized to assess the performance of different ventilation system configurations needed for a sow gestation barn newly-converted to group housing. Various configurations of the ventilation system involving varying capacities and locations of exhaust fans as well as size, design and location of air inlets, were examined based on indoor air quality (i.e., air temperature, humidity, and air speed at the animal level) and ventilation effectiveness (i.e., air distribution and airflow pattern, inlet air velocity, and room static pressure). Based on the computer simulation results, horizontal flow ventilation system with air inlets on one side and exhaust fans on the opposite side showed the best simulated performance among all ventilation design configurations tested. The horizontal flow ventilation configuration was then selected for further evaluation in a group sow housing facility, where energy use, temperature and air quality, and sow welfare and performance were assessed.

INTRODUCTION

Ventilation affects many aspects of the animal environment as well as barn operating costs, specifically energy costs. Retaining the existing ventilation system in a converted group-housed sow barn leads to over-ventilation during winter because the existing minimum ventilation fans are designed for higher animal density, thereby using extra heating fuel, and most likely causing chilling of the animals and affecting its performance. According to Harmon et al. (2010), if ventilation is continued at the pre-remodeling level (prior to conversion to group housing), the building would be over-ventilated by about 33% higher than required.

An estimate of energy use for an over-ventilated facility indicated that over-ventilating by 30% can raise heating energy consumption by 75%. During summer, the impacts are less pronounced but over-ventilation will use extra electricity which translates to higher electricity cost (Harmon, 2013). In addition, the transitioning of the ventilation system design from stalls to group housing is not simply reducing the ventilation rate but requires careful reconfiguration to ensure proper air distribution throughout the room to eliminate dead spots (unventilated areas) and unwanted drafts.

Air exchange is critical to providing a healthy environment that fosters efficient pig growth by reducing humidity and noxious gases like ammonia and carbon dioxide. Since under-ventilation creates an unhealthy environment and over-ventilation wastes valuable heating and electrical energy, finding the right balance is the key to a healthy environment for both animals and workers as well as to energy savings and efficiency (Harmon et al., 2010). This balance can only be achieved by careful re-design of the existing ventilation system of a converted gestation barn.

MATERIALS AND METHODS

Assessment of ventilation system design using computer simulation

In this project, numerical computer simulation technique which utilized computational fluid dynamics (CFD) principles to numerically simulate fluid flow, heat and mass transfer, and mechanical movement, was used as a tool to examine various design configurations and determine the most effective design of the ventilation system for a converted group sow housing facility.

The ventilation system design parameters investigated included: (1). capacity and location of exhaust fans, and (2). size and location of air inlets. These two parameters were configured in such a way that the resulting ventilation system design followed the principles of either an upward airflow, downward airflow, or horizontal flow ventilation.

Barn implementation of the most effective ventilation system design

Two group-housed gestation rooms were used: one room designated as the Treatment room was modified to incorporate the horizontal flow configuration, while the second room's ventilation system was similar to those in pre-converted (stall) gestation barns (Control room). Eight replicate trials (4 winter, 4 summer) were carried out.

Figure 1 shows the ventilation design configuration of the two experimental rooms. In the Treatment room, air inlets were located at one end of the room and exhaust fans at the opposite end allowing air to flow horizontally through the entire length of the room (Figure 1A). In the Control room, inlets were located on the ceiling while the fans were on one of the external walls; this configuration represented a downward air flow direction which is typical in commercial sow barns (Figure 1B). Each room had inside dimension of 23.1 ft (w) x 65 ft (l), two electronic sow feeders, and four nipple drinkers and housed 40 sows, on average, throughout the study. With the exception of the ventilation system design, the management of the two rooms was as identical as possible throughout the test.

RESULTS AND DISCUSSION

Computer models of the sow gestation rooms with different geometries were generated in the simulation work. The developed models were used in simulations under winter and summer conditions. In general, with the group housing layout and new ventilation design, heat removal effectiveness (HRE) values increased particularly when the air inlets were located on the opposite side of the exhaust fans following the principle of a horizontal flow ventilation system (HFVS). HFVS had the highest HRE values among all the design configurations investigated. Also, for this configuration, all nine

Figure 1. Photos of the control room with the existing (unmodified) ventilation system (A) and the treatment room with the air inlets on the opposite side (B) following the principle of a horizontal flow ventilation system. B – inset: wall air inlets installed in the treatment room.

monitoring points in the animal-occupied zone (AOZ) had HRE values greater than 1 which indicate that the air was homogeneously mixed. During winter period, in the model, all HRE values decreased which could be attributed mainly to the lower ventilation rates maintained in the rooms during the cold season. However, HFVS still had HRE values greater than 1 in all 9 monitoring points and the highest average HRE among all the designs tested for winter. Therefore, this ventilation system configuration (horizontal flow ventilation system) was selected for the subsequent in-barn evaluation.

Ventilation Effectiveness

Temperature and HRE

The set-point temperature in the rooms was 16.5°C which is the typical set-point temperature in gestation barns. During the summer trials, the average air temperatures in both the Control and Treatment rooms were uniformly distributed ranging from 20.4-21.0°C and 19.6-20.9°C, respectively. The inlet air temperatures were not much different between the rooms (Control; 16.0°C and Treatment; 16.1°C). However, a significant difference was observed at the exhaust with the average air temperature of 19.9°C and 20.4°C for the Control and Treatment rooms, respectively. This may imply that the ventilation system in the Treatment room was more effective in removing heat from the room.

The Control room had an average HRE value of 0.92 ± 0.05 (with only one point attaining 1.0) which generally implies that part of the fresh air coming from the inlets was directly removed from the room without mixing and without causing air displacement in the AOZ. This may result in accumulation of high contaminant levels in the AOZ because stale air is not being efficiently removed by the ventilation system. Conversely, the Treatment room had an average HRE value of 1.12 ± 0.15 indicating effective air displacement in the AOZ. Almost all the monitoring points in the treatment room had HRE values greater than one indicating that the fresh inlet air mixed well with the room air first before heading out to the exhaust.

Air Quality- CO_2

Carbon Dioxide (CO_2) levels are good indicators of air quality. In both the summer and winter trials the Treatment room had significantly lower concentrations of CO_2 than the Control room. In summer, the Treatment room had an average CO_2 concentration of 700.8 ppm compared to the average of 852.9 ppm, ranging from 806 ppm to 894 ppm in the Control room. In the winter trials the concentrations of CO_2 (Figure 2) in the Treatment room averaged 1904 ppm compared to 2158 ppm in the Control room. These levels indicate that the horizontal flow ventilation system in the Treatment room was better at removing contaminants from the room compared to the Control room which is consistent with the HRE values calculated in both rooms. Barn workers tending to the animals in these rooms during the trials also noted the much better air quality they experienced in the Treatment room compared to the control room.

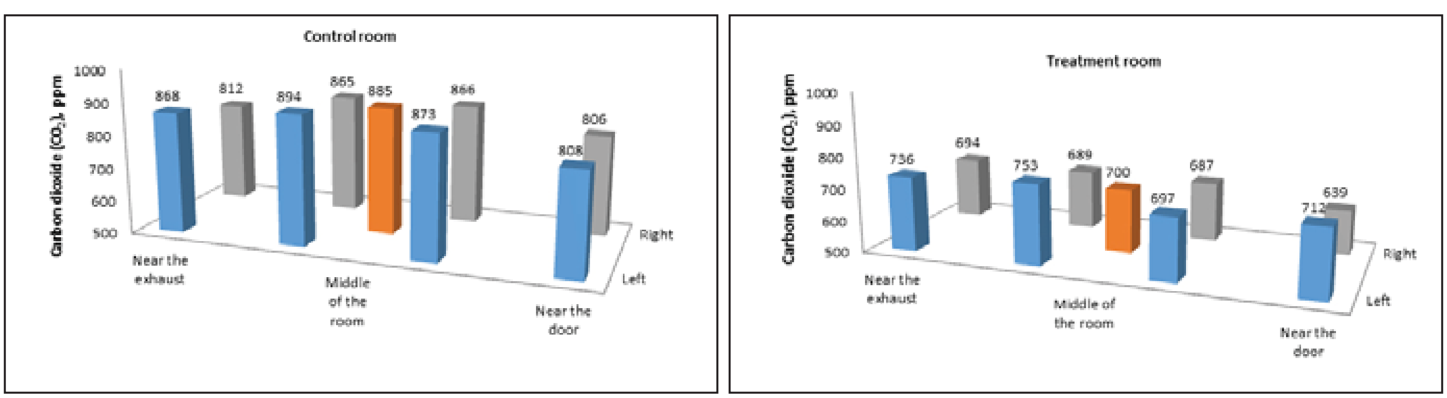


Figure 2. Average CO_2 concentrations measured at the animal-occupied zones in the Control and Treatment rooms in winter trials

Table 1. Percentage of sows in each posture.

Posture	Control room, %	Treatment room, %
Standing	13.78	14.75
Sitting	1.08	1.22
Lying ventrally	46.95	42.14
Lying laterally	38.28	41.92
Total Lying	85.23	84.06
Contacting*	74.87	68.08

*Percentage of sows lying and in contact with other sows.

Sow physiology, performance and condition

Monitoring of the performance of sows in terms of blood thyroxine levels, rectal temperature, average daily gain (ADG), backfat depth and condition score over four trials showed that there was little difference between the rooms with the only difference being higher blood thyroxine levels in sows in the Treatment room in the winter. This indicates that the sows in the Treatment room had higher metabolism in the winter compared to those in the Control room, but when taken together with the other performance indicators, this difference in metabolism level did not seem to lead to adverse impact on the performance of the sows.

Sow behaviour

Sow posture and location in the pen was monitored for 12 focal sows in each room on days 7, 14 and 28 of the trial using video recording. During that time, 85% of the sows were lying, 14% were standing and 1% were sitting (Table 1). A higher percentage of the sows in the Control room were observed lying in contact with other sows than in the Treatment room. The location of the sows in the room showed more sows in the Treatment room spending time in the enrichment area of the room implying that sow comfort was better in the Treatment room resulting in more exploratory behavior. In terms of sow aggression, sows in the Control room had more displacements (i.e., one sow forcing another sow at the feeder away) and attempted displacements at the feeder than the sows in the Treatment room.

Room and sow cleanliness

Dirtiness of sows as well as pens is a good measure of an effective ventilation system. Sow dirtiness was assessed weekly during each trial by following a 0 to 4 dirtiness score: 0 – completely clean to 4 – very dirty. Over the four summer trials, it was observed that sows in the Treatment room were relatively 'cleaner' than sows in the Control room. Sows in the Treatment room had an average dirtiness score of 2 which indicates that only their hooves and 20 % of their legs and body were soiled. On the other hand, sows in the Control room had an average dirtiness score of 3 which implies that their hooves and 50 % of their legs and body were soiled. Similar results were observed for the assessment of pen dirtiness. Consistently, the Treatment room had 25 to 50 % of its floor covered with manure while the Control room had about 50 to 75 % of its floor covered with faeces and urine. During winter, sows in both the Control and Treatment rooms had an average dirtiness score of 2 and both the Treatment and Control rooms had 25 to 50% of the floor covered with manure. These results imply that the horizontal air flow ventilation system in the Treatment room was relatively more effective than that in the Control room in the summer.

CONCLUSIONS

Results from the computer simulation work have confirmed the need to re-design the ventilation system of a newly-converted group sow housing facility. Among all the design configurations tested, horizontal flow ventilation system was the most effective in removing heat from the animal occupied zone (AOZ) in the room during both summer and winter seasons.

In-barn evaluation of the selected ventilation system design showed about 21% reduction in natural gas consumption during heating season and 14% reduction in electricity consumption in the room with the horizontal flow ventilation system relative to the control room with the unmodified ventilation system.

ACKNOWLEDGEMENTS

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Reducing Energy Use in Group Sow Housing Systems

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Bernardo Predicala

Alvin Alvarado

SUMMARY

In this study, controlled-chamber experiments were carried out to develop an operant mechanism that allowed the sows to demonstrate their preferred environmental temperature and to study the effects of fibre addition on growth performance and physiological response. Results showed that sows fed with high heat-increment diet were able to maintain significantly lower temperatures over the 24-hr period than those fed with standard gestation diet. Performance and physiological responses of sows fed with high heat-increment diet seemed to have not been affected by the exposure to colder temperatures. Subsequently, the developed operant mechanism and the use of high heat-increment diet were implemented in an actual gestation barn with group-housed sows and results showed that sows could tolerate temperature 8°C colder than the current set-point (16.5°C) maintained in most gestation barns without adversely affecting their growth performance and physiological response as well as their behaviour and welfare. Lower temperatures maintained in the Sow-controlled room resulted to about 59% reduction in energy cost for heating and ventilation.

INTRODUCTION

One advantage of group housing systems is that sows can better interact with and control their immediate environment, including thermal conditions. Sows housed in groups have the freedom to exhibit thermoregulatory behaviour such as huddling to maintain comfort even when the temperature in the barn is lowered. Barn temperatures currently maintained in barns with sows housed in individual stalls are based on the reported lower critical temperature (LCT) (Geuyen et al., 1984). Allowing the temperature to drop below LCT will require additional feed to maintain the sow body condition and weight gain over the gestation period. It has been estimated that sows housed in groups may have LCT values significantly lower than 15°C when given the ability to utilize thermoregulatory behaviour. Thus, if group-housed sows can maintain body condition and weight gain at temperatures lower than currently maintained in sow barns without the need for additional feed, the potential exists to significantly reduce energy costs for heating and ventilation.

However, some issues anticipated with group-housed sows include the potential for higher activity levels and aggression among sows. These problems are exacerbated when sows are put on a restricted feeding regime, which is a common practice for gestating sows to maintain optimal body condition. The sensation of feeling "full" is improved with high-fibre diets; these diets are also known to reduce the urge to feed continuously, as well as overall activity and repetitive behaviour in sows. Moreover, dietary fibre increases heat production in sows without increasing digestible energy. As such, adding fibre to the diet can be a means of reducing activity and limiting aggression in group-housed sows under reduced barn temperature.

"Preliminary results have shown that sows could tolerate temperature as low as 9°C."

MATERIALS AND METHODS

Phase 1 – Controlled environmental chamber tests

Two fully instrumented and controlled-environment chambers at Prairie Swine Centre (PSC) were used in developing the operant mechanism that allows the sows to control their own environmental temperature. The operant mechanism consisted of a manual control switch installed in the chamber along the penning at a location which the sows can access and manipulate, and a radiant heater. When a sow activates the switch, it operates the existing supplementary heating system for the entire room for a specified period, and with the radiant heater placed above the area of the switch as an immediate feedback reward. In addition to the functioning heat control switch, a 'dummy' switch that does not operate the radiant heater (i.e., unrewarded activity) was also installed close to the real switch to distinguish between deliberate behaviour by the sows to control the room temperature and random interaction with the mechanism. In addition two experimental diets were used, with sows in one chamber fed with the control diet (standard gestation diet) while sows in the other chamber were fed with the treatment diet (high heat-increment diet).

Phase 2 – Group-housed Sow Gestation Rooms

For the Phase 2 of the study, two rooms were used with one room was designated as "pre-set" with temperature maintained at 16.5°C (which is the typical set-point applied in sow barns) while the other room as "sow-controlled" with sows allowed to control their own environmental temperature using the operant mechanism developed in Phase 1.

With the exception of temperature, management of the two rooms was identical as much as possible. In the pre-set room, air temperature was set to 16.5^{0}C while the temperature in the sow-controlled room was set at a lower temperature of 8°C to prompt the sows to activate the heat control switch for supplemental heating. At 1 degree below the setpoint (i.e., 7°C), the supplemental room heater was set to run automatically without the need of switch press from the sows. This was done to protect the animals in the room from potentially being exposed to very cold temperatures. In addition a high-heat increment diet (treatment diet in Phase 1 trials) was fed to sows in both rooms at 2.3 kg per day per sow.

RESULTS AND DISCUSSIONS

Phase 1 - Controlled Environmental Chamber Tests

One major component needed to carry out the experiments in this research project was the design and assembly of the operant mechanism. The operant mechanism was configured to control the heating system of the chamber as well as a small radiant heater provided as an immediate feedback reward. When a sow activates the switch, it operates the existing supplementary heating system for the entire room for a specified duration as well as the small radiant heater above the location of the switch. One of the installed timers was configured to prevent sows from successively activating the heaters by deactivating the switch for a period of five minutes after its previous activation, i.e., any switch presses during this five-minute period will not operate the heaters. In order to encourage the sows to use the operant mechanism, the chambers were run at a set-point temperature of 8°C. To be able to do this, cold ambient air from outside the barn was directly drawn and streamed into the chambers.

Most of the time, sows fed with high heat-increment diet activated the operant mechanism at a relatively lower pig level temperature than sows fed with standard gestation diet. Over 3 trials, the average temperature when the operant mechanism was activated by sows fed with high heat-increment diet was 12.5 °C while that in the control chamber was higher at 13.4 °C. This suggests that sows fed with high heat-increment diet could tolerate lower temperature before calling for supplemental heat than sows fed with standard gestation diet.

Phase 2 – Group-housed Sow Gestation Rooms

Average air temperature. Air temperature in the Pre-set (control) room was uniformly distributed which ranged from 16.4 to 17.0 °C on average. Set-point temperature in this room was at 16.5 °C, which is the typical set-point for gestation rooms during heating (winter) season. Unlike in the Pre-set room, temperature in the Sow-controlled (treatment) room was relatively variable which ranged from 10.7 to 12.3 °C . On average, temperature in the Sow-controlled room was about 5 °C colder than the Pre-set room.

The actual temperatures at the instant when sows activated the operant mechanism were also recorded. Throughout the trial, majority of the temperature recorded was between 9 and 12 °C. Moreover, most switch presses were made during daytime and the corresponding average temperature recorded was 9.9 and 9.7 °C during the first and second weeks, respectively. In the succeeding weeks, switch presses occurred when the average temperature at the pig level was about 10.5 to 12 °C. This initial result suggests that the preferred environmental temperature of sows is between 9 and 12 °C, although this has to be confirmed in subsequent trials.

Natural gas and electricity consumption

The natural gas consumed for heating and the electricity consumed by the fans, room heater, and lights comprised the energy consumption of the room. Over six weeks, the Pre-set room consumed a total of 4,622.6 m^3 of natural gas for heating; this was about 78% higher than the Sow-controlled room which had a total of 1,011.1 m^3 natural gas consumed. Similarly, the total electricity consumption in the Pre-set room during this 6-week period was about 324.55 kWh while the Sow-controlled room used about 289.81 kWh of electricity to heat and ventilate the room during this period. The considerable difference in the total energy consumption (natural gas and electricity) between the two rooms was mainly due to the difference in temperatures maintained in the rooms during the trial.

Growth Performance

Table 1 shows the average daily gain (ADG), backfat depth and sow condition scores to evaluate the growth performance of sows. No significant difference ($p>0.05$) was observed in the ADG of sows in the Pre-set (0.25 ± 0.6 kg/day) and Sow-controlled (0.16 ± 0.12 kg/day) rooms over three trials, which translated to the same average backfat depth and sow condition score. On average, sows in the Sow-controlled room had an average backfat depth of 0.02 ± 0.02 mm while those sows in the Pre-set room had 0.01 ± 0.04 mm. Furthermore, using a scale of sow condition score of 1 to 5 with 1 – emaciated; 2 – thin; 3 – ideal; 4 – fat; and 5 – overly fat, an average sow condition score of 3 which is the ideal condition for gestating sows was observed in both rooms. With these results, it can be stated that sows in the Sow-controlled room were able to maintain their body condition and weight gain at relatively lower temperatures without the need for additional feed.

CONCLUSIONS

Based on the observations made in this study, the following conclusions can be made:

1. Experiments in controlled-environment chambers revealed that sows fed with high heat-increment diet tended to maintain relatively lower temperatures (11.9°C on average) in the chamber than those fed with standard gestation diet (12.7°C). Moreover, the exposure of sows fed with high heat-increment diet to relatively colder temperatures had no significant effect on their performance and physiological response.

2. Results of the implementation of the operant mechanism and high-heat increment diet in actual gestation room have shown that sows housed in groups could tolerate temperature as low as 8°C without adversely impacting their growth performance and physiological response.

3. Lower CO_2 levels were observed in the Sow-controlled room than in the Pre-set room during the heating season, which translates to the Sow-controlled room having relatively better air quality than the Pre-set room.

4. Allowing sows housed in groups to control their own environmental temperature resulted to about 75% reduction in natural gas consumption and 11% reduction in electricity consumption to heat and ventilate the room during the heating period relative to the Control room with temperature pre-set at 16.5°C.

5. No significant behavioral differences were observed between the sows in the Sow-controlled room and the Pre-set room, which implies that sow welfare was not adversely impacted by having the sows maintain relatively colder temperatures in the gestation room.

6. Using current cost estimates and application parameters, cost analysis indicated that the adoption of an operant mechanism to allow group-housed sows to control their own environmental temperature and feeding them with high heat-increment diet could lead to as much as 59% reduction in total heating and electricity cost, which can readily offset feed cost as well as the capital and operating costs for installing this system.

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Table 1. Average daily gain, backfat depth and condition score of sows in the Pre-set and Sow-controlled rooms, n=3.

Sow performance parameters	Pre-set room	Sow-controlled room
Average daily gain*, kg/day	0.25 ± 0.6	0.16 ± 0.12
Backfat depth**, mm	0.01 ± 0.04	0.02 ± 0.02
Sow condition score**	3	3

*ADG for each trial represents average from 40-42 sows per room.
**Backfat depth and condition score for each trial represents average from 12 focal sows per room. Sow condition score: 1 – emaciated; 2 – thin; 3 – ideal; 4 – fat; and 5 – overly fat

Spray Dried Bovine Plasma for DON Contaminated Nursery Diets

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SUMMARY

The mycotoxin, deoxynivalenol (DON) is a concern to swine producers as it causes reduced feed intake, growth and health problems. Spray-dried porcine plasma (SDPP) has been shown to mitigate the effects of DON. This study aimed to determine the effect of DON and spray-dried bovine plasma (SBBP) inclusion in the diet on feed intake, growth performance and gut health in newly-weaned pigs. Seventy-two nursery pigs were divided into six treatment (trt) groups :1) Diet A (no DON or SDBP), full-fed, 2) Diet B (with DON no SDBP), full-fed, 3) Diet A, limit-fed, 4) Diet C (no DON with SDBP), full-fed, 5) Diet D (with both DON and SDBP), full fed, and 6) Diet C, limit fed. No significant difference in average daily gain (ADG), body weight (BW) or feed efficiency (FI) were found between the control diet (treatment1) and DON (treatment2) or SDBP diet (treatment4), indicating that DON and SDBP had no detrimental or beneficial effect on performance of nursery pigs, respectively. Moreover, there was no significant difference among the treatment groups for gut morphology, indicating no harmful effects on gut health. However, there was a significant decrease in ADG and BW for treatment5 (DON and SDBP) when compared to treatment1 (no DON or SDBP). No differences were found between the full fed and the pair-fed (limit fed) group, indicating that the effects of DON and SDBP were not due to feed intake. Further research is needed to better understand the effect of DON and SDBP inclusion in diets on growth performance of pigs.

INTRODUCTION

Mycotoxins have become an increasingly growing concern among livestock and crop producers all over the world, including in Canada. Mycotoxins can induce a variety of detrimental effects in swine such as reduced average daily gain, feed intake, immunosuppression, negative effects on intestinal health and impairment of reproductive functions ultimately reducing animal performance and the livestock producer's profit. One of the major mycotoxins of concern in the swine industry is deoxynivalenol (DON) also known as vomitoxin. DON is the most prevalent mycotoxin worldwide in crops used for food and feed preparation and swine are the most sensitive species to DON when compared to other monogastric or ruminant animals. In a previous study at PSCI (see Annual Report 2007) reductions in ADG and ADFI in pigs were observed at 1.57ppm DON. Due to this sensitivity it is recommended that swine diets contain less than 1ppm DON.

The best way to avoid DON contamination in feed is to avoid the use of contaminated grains. However, this is not always realistically or financially possible as the levels of DON contaminated grain have increased and on some years clean grain can be difficult to obtain. Therefore, researchers have tried to find various strategies to mitigate or reduce mycotoxin contamination in livestock feed. One of the strategies used to mitigate the effects of mycotoxin contamination of feed is the addition of feed additives or ingredients to the feed. Spray-dried porcine plasma (SDPP) is one feed ingredient that has been shown to reduce the negative effects of DON. Spray-dried animal plasma (SDAP) is the generic term for an animal by-product that is obtained from slaughter houses from porcine or bovine sources and has been shown to improve feed intake and growth performance of nursery pigs. Plasma that is obtained from a single species may be identified as porcine (SDPP) or bovine (SDBP). Including SDAP in swine diets has been shown to increase feed efficiency, growth performance and improve health status and gut morphology. A study at PSCI (see Annual Report 2012) showed that including SDPP in diets of newly weaned pigs diets could mitigate the negative effects of DON by increasing the ADG and ADFI. However, the mechanism behind the mitigation of DON by the inclusion SDAP is not very well understood and it is not known if the improvement is due to appetite stimulation or the immunoglobulin content of the SDPP. Even though SDPP may be beneficial in mitigating the effects of DON, due to its association with porcine epidemic diarrhea virus many producers have stopped using SDPP in their diets. SDBP may be an ideal alternative as it doesn't have any association with porcine epidemic diarrhea.

"DON only modestly reduced feed intake and growth in this eperiment and there was no response to bovine plasma"

MATERIALS AND METHODS

Seventy-two newly weaned pigs (approx. 21 days of age and 6 kg body weight) were used in the trial. At weaning the pigs were housed in the production nursery for 3 days prior to selection for the trial. On day 4 post-weaning the selected pigs were moved to individual pens and switched to experimental diets. The experiment used 4 dietary treatments distributed among 6 treatment groups as described in Table 1. In order to evaluate the effect of the reduction in feed intake that is observed when pigs are fed diets containing DON, the pigs assigned to treatments 3 and 6 were feed restricted with their feed allowance based on the feed intake of the pigs fed the corresponding DON diet (pair-fed). The pair-fed pigs were one week younger and started the trial one week later than the full-fed pigs.

The pigs were weighed and feed disappearance measured on days 0, 7, 14, 21 and 25 of the trial. On day 25, a subset of pigs were euthanized to obtain tissue samples. Samples were obtained from the small intestine (jejunum and ileum) and sections stained for gut histology. The stained slides were analyzed for villus height (measured from tip of the villi to the base, excluding the crypt), villus width (measured halfway between the base and the tip) and crypt depth (measured from the transition between the crypt and the villi to the base of the crypt).

Table 1. Description of diets and feeding treatments

Treatment Number	Dietary Treatments	Full-fed/Pair-fed Group	Diet composition 1,2
1	A	Full-fed	No DON, No SDBP
2	B	Full-fed	DON, No SDBP
3	A	Pair-fed to treatment 2	No DON, No SDBP
4	C	Full-fed	No DON, SDBP
5	D	Full-fed	DON, SDBP
6	C	Pair-fed to treatment 5	No DON, SDBP

1 Target DON level: 4mg/kg (ppm), actual ranged from 3.1 to 3.8ppm over 3 dietary phases
2 SDBP inclusion level: 8%

RESULTS AND DISCUSSION

Effect of DON

In the current experiment, ADFI was reduced in pigs consuming DON (trt2) compared to the control diet (trt 1) but no significant difference was observed in any of the growth parameters such as ADG, BW or feed efficiency between the diet with DON (trt 2) or the control diet (trt 1).

Supporting the lack of treatment effect on growth in the current experiment it was found that there were no significant effects of treatment on gut morphology, suggesting that inclusion of DON in swine diets did not affect the gut morphology which is completely contradictory to the finding of previous studies, where pigs fed with DON-contaminated diets had decreased villus height in both jejunal and duodenal tissue samples and increased crypt depth in the jejunum.

Additionally, no significant difference was observed between the pair-fed and full-fed treatment groups for the growth parameters or gut morphology, suggesting that DON showed no detrimental effects when feed intake was not a confounding factor. However growth was variable and thus despite a 24% reduction in ADG when DON was included in the diet, this did not achieve statistical significance.

Effect of Spray Dried Bovine Plasma

In the current experiment no significant difference was observed between the control diet and the diet with SDBP, for growth parameters, suggesting that SDBP did not improve the growth parameters when included in the diet. Moreover, when the diet contained both SDBP and DON, the BW, feed intake, and ADG were decreased relative to Trt 1 (no DON, no SDBP). These results differ from a previous study conducted at PSCI, which showed that inclusion of SDPP in DON contaminated diets improved the growth parameters of pigs to performance equal to those without DON in their diet. However, in this current study we used SDBP instead of SDPP and the difference in effectivenss could be due to differences between SDBP and SDPP. For example, growth-related improvements observed with SDPP have been found to be associated with high immunoglobulin content of the ingredient and, therefore, SDBP may be less effective due to its lack of porcine specific antibodies. However, the results of other studies are inconsistent, with some finding that both SDBP and SDPP are equally effective while other research has found that SDBP in DON diets was unable to alleviate the negative effects of DON.

CONCLUSION

Overall, the results were found to be contrary to the previous experiments. The current experiment showed that DON did have a detrimental effect on ADFI and also showed some negative effects on ADG. Moreover, SDBP showed a beneficial effect on ADFI when present with DON in the diet but did not have a beneficial effect on ADG. Finally, DON and SDBP showed no detrimental or beneficial effects, respectively on pair-fed pigs compared to their corresponding full-fed pigs. Hence, the effects of DON and SDBP were not due to its effect on feed intake. Further research is needed in order to better understand the mechanism behind the effects of DON and SDBP in pigs and the ability of SDBP to mitigate the negative effects of DON in weaned pigs.

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Table 2. Body weight, average daily gain, average daily feed intake, average daily feed intake per body weight and feed efficiency of nursery pigs*

	Dietary Treatments						
	1	**2**	**3**	**4**	**5**	**6**	SEM
Diet	A	B	A	C	D	C	
Feeding strategy	Ad lib	Ad lib	To 2*	Ad lib	Ad lib	To 5*	
DON	No	Yes	No	No	Yes	No	
SDBP	No	No	No	Yes	Yes	yes	
BW, kg							
Day 3	5.84	5.8	5.99	5.87	5.91	5.95	0.24
Day 7	6.11	5.83	5.98	6.03	5.94	6.07	0.24
Day 14	7.45	6.96	6.86	7.35	6.77	7.07	0.24
Day 21	9.98a	9.3a	8.8b	9.66a	8.69b	8.88ab	0.24
Day 24	11.45a	10.4a	10.21b	11.16a	9.69b	10.22a	0.24
Overall	8.16a	7.66ab	7.57ab	8.01ab	7.4b	7.64ab	0.19
P Value, repeated measures: Treatment 0.02; Day <0.001; Treatment x Day <0.001							
ADG, kg/day							
Day 3-6	0.07	0.01	0.00	0.04	0.01	0.03	0.027
Day 7-13	0.19	0.16	0.13	0.19	0.12	0.14	0.027
Day 13-20	0.36	0.33	0.28	0.33	0.28	0.26	0.027
Day 21-24	0.37	0.28	0.35	0.37	0.25	0.34	0.027
Overall	0.25a	0.19ab	0.19ab	0.23a	0.16b	0.19ab	0.015
P Value, repeated measures: Treatment <0.01; Day <0.001; Treatment x Day 0.26							
ADFI, kg/day							
Day 3-6	0.14	0.09	0.09	0.09	0.10	0.09	0.02
Day 7-13	0.24	0.20	0.19	0.23	0.21	0.20	0.02
Day 13-20	0.52a	0.46a	0.38b	0.51a	0.45a	0.43ab	0.02
Day 21-24	0.70a	0.60ab	0.54b	0.68a	0.63ab	0.57b	0.02
Overall	0.4a	0.34b	0.3b	0.38a	0.35ab	0.32b	0.40
P Value, repeated measures: Treatment <0.001; Day <0.001; Treatment x Day 0.01							
Gain/Feed							
Day 3-6	0.21	0.01	-0.06	-1.63	-0.96	0.24	0.49
Day 7-13	0.81	0.76	0.65	0.81	0.50	0.70	0.49
Day 13-20	0.71	0.73	0.74	0.64	0.61	0.61	0.49
Day 21-24	0.52	0.47	0.66	0.55	0.38	0.59	0.49
Overall	0.56	0.49	0.5	0.09	0.13	0.53	0.25
P Value, repeated measures: Treatment 0.60; Day <0.001; Treatment x Day 0.88							

*pair fed to treatment 2 or treatment 5

Influence of Sow Lactation Feeding System on Sow and Piglet Performance

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SUMMARY

Electronic feeding systems are available commercially for delivery of feed to sows during lactation. These feeding systems have multiple advantages over manual feed delivery including collection of feed intake data, delivery of fresh feed, and reduced feed wastage. However, electronic feeding systems are costly to install and maintain. The objective of this study was to determine the impact of a modified feeding system on sow and piglet performance during lactation. The feeding systems were manual feeding (meal-fed by hand), a commercially available electronic sow feeder (delivery of small meals at sow request), and a modified system. The modified system consisted of a feed drop tube that extends to just above the base of the feeder. The tube was kept full of feed and required the sow to manipulate the tube to release feed.

Results indicate sow body weight, body condition score, and back fat did not differ across treatments ($P > 0.05$). Litter growth performance was reduced on the electronic feeder compared to manual fed sows in week 3 but did not result in any difference in overall litter weight. Sow feed intake was significantly higher with manual feeding compared to the electronic or modified feeding system in the first week post-farrowing but no difference was observed in week 3 ($P > 0.05$). All three feeding systems evaluated resulted in similar performance of the sow and litter, however, both the electronic sow feeding system and the modified feeding system resulted in lower feed usage than manual feeding. Based on current average feed prices this reduced feed usage would result in approximately $8.50 savings per lactation.

INTRODUCTION

Feed is the single largest cost associated with producing pork, ranging from 50-70% of the total cost of production. When looking to save money in their feeding programs, producers typically consider the finishing herd as it represents approximately two-thirds of the total feed cost. One area that can be easily overlooked is lactation feeding strategies and delivery.

Traditionally most producers feed lactating sows manually, feeding sows up to three times per day in order to maximize feed intake and optimize litter performance. However, providing large quantities of feed may result in increased feed wastage or spoilage and may also result in an oversupply of feed to sows resulting in negative effects on subsequent reproductive performance. One technology pork producers have utilized to maximize lactation performance is electronic feeding systems for sows during lactation. These systems have multiple advantages over manual feed delivery including ensuring there is always fresh feed available, reduction in labour costs and keeping detailed records of feed intake which allows for management changes on an individual sow or whole-herd basis. However, these feed systems can be costly to install and maintain.

"All three feeding systems resulted in similar sow and litter performance, however, the electronic and modified feeding system resulted in a significant reduction in feed wastage"

A simple feeding system was developed which consisted of a feed drop tube extending to approximately one inch above the base of the feeder, and required the sow to manipulate the tube to release small quantities of feed.

MATERIALS AND METHODS

A total of 45 sows (15 per treatment) were randomly assigned to 1 of 3 feed systems. The three feeding systems were: 1) manual meal feeding by hand, 2) electronic sow lactation feeder (Gestal, JYGA Technologies, Saint-Lambert-de-Lauzon, QC), and 3) a modified feeding system. The modified system consisted of a feed drop tube that extended to just above the bottom of the feeder. This tube was kept full of feed and required the sow to manipulate the tube in order to access feed. Sows were fed a standard lactation diet for the duration of the study.

Prior to be being moved into the farrowing room (approximately 7 days prior to their expected farrowing date), sow body weight, backfat thickness and body condition score (5-point scale) were measured. Upon farrowing, total pigs born alive was recorded. Within 24-h of farrowing, piglets were cross-fostered to equalize the number of piglets per sow. Number of piglets born alive, number of piglets after cross-fostering and initial litter weight was recorded. Sow feed intake was monitored daily and any wasted feed (e.g., due to spoilage) was removed from the feeder and weighed. Litter weight was recorded weekly on days 7, 14, and 21 and any mortalities recorded. At weaning (21 days), sow body weight, backfat thickness, and body condition score were again recorded as well as days to first estrus.

In order to compare the three feeding systems, an economic analysis based on estimates of costs associated with installation of the different feed systems and on sow feed intake and average feed costs were performed using the Prairie Swine Centre Enterprise Model.

Table 1: Sow characteristics and performance

	Feeder				
	MANUAL (n=15)	ELECTRONIC (n=15)	MODIFIED (n=14)	SEM	P-VALUE
Body weight (kg)					
Initial	286.7	272.9	288.3	10.3	0.49
Final	263.7	241.3	257.3	10.8	0.31
Change	23.0	31.6	31.0	4.2	0.26
Body condition score (1-5)					
Initial	3.1	3.3	3.2	0.12	0.71
Final	2.7	2.7	2.8	0.14	0.80
Change	0.47	0.53	0.44	0.17	0.92
Backfat (mm)					
Initial	16.8	17.0	16.9	0.39	0.90
Final	15.4	14.7	15.5	0.57	0.54
Change	1.39	2.33	2.05	0.54	0.41
Liveborn	14.8	13.0	13.3	0.8	0.21
Feed Disappearance (kg/d)					
Week 1	5.13a	3.46b	2.68b	0.32	<0.001
Week 2	6.80a	5.55b	5.12b	0.35	<0.01
Week 3	5.95	5.36	5.87	0.32	0.41
Total	5.69a	4.80b	4.49b	0.29	0.01

RESULTS AND DISCUSSION

Initial sow body weight, backfat thickness, body condition score, and total number of piglets born alive were similar across all treatment groups. The feeding system had no impact on the final body weight, backfat thickness, or body condition score, which all decreased during lactation. Sow feed intake (feed disappearance) was significantly higher with manual feeding compared to either the electronic or modified feeding system in week one and two of lactation and over the entire lactation period (d 0 -21) with the greatest difference in feed intake observed during the first week post-farrowing. There was no effect of feeding system on sow feed intake (feed disappearance).

Litter average daily gain was higher with manual feeding compared to electronic feeding during the third week post-farrowing. However, there was no impact of feeding system on total litter weight overall. Final litter weight was similar across treatments and there was no treatment effect on piglet mortality or number of piglets weaned per litter.

All three feeding systems evaluated resulted in similar performance of the sow and litter. Both the electronic sow feeding system and the modified feeding system resulted in lower fed intake (feed disappearance) during the first two weeks of lactation. This is most likely the result of decreased feed wastage as there was no difference in sow or litter performance. These results also suggest that feed intake measures with manual feeding may not be accurate or indicative of actual sow feed intake given the amount of feed wastage that occurs with this system.

Economic Analysis

Results from the project were analyzed using the Prairie Swine Centre Enterprise Model. On average the use of an electronic or modified feeding system reduced feed disappearance by 19.7%. This reduction was analyzed for an economic return to the producer. Results indicate producers who would adopt this technology would realize a net benefit of $.85/market hog or $8.45/sow lactation, not including the cost and maintenance of the system implemented. Ease of adoption was also assessed and indicated that the modified sow feeding system was ranked "easy" to adopt while the electronic system would be rated "moderate". The adoption scale considers three main components: cost involved, labour involved and time required to implement change. Easy to adopt projects are those projects that could be adopted between 0-6 months and require a minimal amount of capital and labour components.

CONCLUSION

All three feeding systems resulted in similar sow and litter performance, however, both the electronic and modified feeding system resulted in a significant reduction in feed wastage and, therefore, an estimated saving in feed costs of $8.50 per lactation compared to manual feeding. The modified feeding system is a viable option for feed delivery to sows during lactation but does not provide the additional benefits of automated feed intake collection and individual sow feed intake assessment. Pork producers should base their choice of feeding system on their individual needs and the value that additional data would provide.

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Cleaning Ease and Animal Welfare Implications of Trailer Design

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SUMMARY

The aim of this initial study was to develop an inventory list of trailers commonly used for the transportation of market hogs in Canada. Hog transport companies in Saskatchewan, Manitoba and Ontario were visited in order to document various trailer features specifically those influencing ease of cleaning and animal handling characteristics. Each trailer design was ranked according to cleaning ease, animal handling and welfare characteristics. In addition to a trailer inventory, a questionnaire was developed and transport companies were interviewed to gain further insight into trailer design and usage.

INTRODUCTION

The transport of market hogs occurs daily in Canada and around the world. As Canada and North America watched the spread of PEDv in the United States in the summer and winter of 2014, it became increasingly apparent that even when good on-farm biosecurity procedures are in place, there may be serious gaps in biosecurity, particularly related to transportation. Transport of pigs is a major vector for disease transmission, and work is now underway to reduce this risk by developing better processes to clean, sanitize and sample trucks and trailers. Problems have been identified related to the limited number of transport units, down time, and wash capacity of truck wash facilities. In addition, current trailer designs and the use of manual labour for cleaning have inherent problems for cleaning ease, consistency and cost.

MATERIALS AND METHODS

Multiple livestock trailer dealers and wash bays across Canada were interviewed by phone or location visit using a questionnaire, and information on trailers and photographs were collected.

From January to July, 2016, livestock transport companies and wash bays in Ontario, Manitoba and Saskatchewan were visited to characterize the make and design of trailers used for market hog transportation. The trailers were assessed based on cleaning ease and animal handling considerations. In addition, a survey questionnaire was used to inquire about the ease of cleaning and animal handling characteristics of trailers as well as cleaning protocols and preferences of truckers for trailer models and features.

RESULTS AND DISCUSSION

Trailer makes and designs

Trailers used by the Canadian swine industry for transporting market hogs are comprised mainly by manufacturers which include Wilson, Barrett, Merritt and Eby, all are based in the USA. However, one transporter, Luckheart Transport in Ontario, has recently begun importing Pezzaioli trailers from Italy. In western Canada, the majority of trailers used for market hog transport are dual purpose cattle and hog trailers with a tandem or triaxle spread.

The most commonly used trailer design is a double deck potbelly trailer with a belly rail installed between the pot and top deck. Removable flooring is inserted in the middle deck in order to convert the trailer from a double to triple deck design (two decks for transporting cattle, three decks for pigs). Inside these trailers, there are generally five ramps including: 1. access to the potbelly, 2. a pull out ramp to the top deck, 3. ramp to the lower level of the nose ,4. ramp to the upper level of the nose which is also used as a compartment barrier and 5. a ramp to the doghouse which is also used as a compartment barrier.

Other commonly used trailer designs include straight deck trailers for transporting market hogs and quad deck trailers which are used exclusively for transporting isowean piglets. In Ontario, Luckhart Transport Inc is working to introduce the Pezzaioli trailer which features flat hydraulic floors, no ramps or step-ups, active ventilation (fans), misters and heated drinkers (nipple drinkers for pigs and bowl drinkers for cattle). The Pezzaioli trailers are designed specifically to meet EU transport regulations which require the provision of food and water on all transports longer than 8 hours.

Trailer characteristics related to cleaning ease

Various aspects of livestock trailers impact the overall cleaning ease of trailers due to subtle changes in trailer design. Key factors that influence the ease of manual cleaning include:

i. Floor plan. Straight decks are simpler to clean than pot trailers which have multiple ramps and floor surfaces.
ii. Flooring type and pattern. Removable decking increases the flexibility of trailer use, but must be completely removed for proper cleaning. Smooth floors are easier to clean, but texture (eg checker plate) and cleats provide animals with more secure footing.
iii. Support beams. Some beams are encased, whereas others are open I-beams which collect dirt on side ledges.
iv. Deck height. Low ceilings make cleaning difficult, as cleaners need to bend over to access the compartment.
v. Design of fixtures. Sealed lights and tubing, angled gating, conveniently placed and easy to clean gate latches reduce buildup of organic matter and facilitate cleaning.
vi. Access doors and drains. Placement of doors and drains that are well placed and easily flushed.

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In general, straight deck trailers have been ranked as the overall easiest to clean due to presence of fewer complex floor surfaces and greater head room, while quad deck trailers are rated as the most difficult to clean. Another reason for this ranking is the increased removable decking used in quad deck trailers as compared to double deck trailers. As the amount of removable decking increases in a trailer the process of cleaning becomes more difficult and greatly increases the amount of labour required to clean the trailer. Part of the increased time spent cleaning is due to the time it takes to remove and wash individual pieces of decking.

In addition to the amount of removable decking, an increased number of ramps and enclosed spaces increase the difficulty of trailer cleaning. Trailers which feature open tubing on gates, compartment barriers and ramps are among the most difficult to clean. Open tubing within trailers can become packed with debris containing bacteria. It is difficult to clean inside the tubing, and is common practice for transport companies to weld the tubing closed to avoid it becoming filled with organic matter. Besides tubing, organic matter may also become lodged in protective light and electrical boxes, around nail heads, in hinges and any corners, and on support beams. In many designs the corners are reduced by welding extensions around ramps and in corners where debris is likely to become lodged.

Trailer characteristics related to animal handling

Stress associated with handling and transport can lead to heat stress, heart failure and high levels of stress. Particularly on hot summer days, heart failure can occur in pigs moving up ramps, or following strenuous exercise associated with mixing and handling. There are many trailer features which affect difficulty the loading and unloading of market hogs, as well as their comfort during travel and risk of injury due to trapping, pinching or impact with trailer components.

i. Ramp design. Number of ramps, ramp length, angle and surface (cleat height and spacing).
ii. Loading density.
iii. Head height. Handlers
iv. Protrusions. Sharp corners and edges, and ribbing on walls or floors can cause bruising.
v. Pen layout. Turns and distance travelled to each compartment.
vi. Flooring. Adequate ribbing to minimize slipping. Removable decks are typically smoother than permanent flooring.
vii. Gates and ramps. Crevices where feet or other body parts may be trapped. Temperature control. Hot or cold areas vary with season, ambient temperature, compartment (air flow/ventilation/boarding/bedding/contact with cold metal)
viii. Suspension and vibration. Previous research suggests that suspension in the rear of the trailer may cause greater bounce in these compartments. Pigs were more reluctant to lie, and spent more time standing in rear compartments.

One of the difficulties in ranking specific trailer models for animal handling and welfare is the ability to customize trailer design. Transporters have the option to customize trailers to their preference by pre- or post- market modifications. Two trailers from the same manufacturer and of the same design may have different features which impact animal handling within the trailer.

One of the main features which pose difficulty to hogs during loading and unloading is the number of ramps within a trailer. An increased number of ramps and angle of ramps makes loading hogs more difficult. The maximum recommended ramp angle for market hogs is 20° (Canadian Agri-Food Research Council, 2001). The design of the back ramp to the top deck either extends to the door, decreasing the severity of the slope, or leaves a few feet between the door and start of the ramp, allowing the handler loading hogs to create extra pressure which may make loading an easier process.

The number of floors in a trailer additionally decreases hog welfare at the time of transport. It requires extra time for the animals to be moved, leading to greater stress from handling and potential heat stress. By decreasing the number of floors in a trailer, it would decrease the amount to time required to load pigs and the number of ramps market hogs are required to traverse.

Additional trailer features which improve pig handling are wider doors and less loose equipment. Gate pins and hanging chains that make noise when moved are likely to startle pigs, making them more difficult to load. A feature favoured by drivers for improving animal welfare are misters installed inside of the trailers. Some trailers have misters installed in trailers which hook up to an outside water source when stopped. By utilizing misters within trailers heat stress, especially during the summer months, can be reduced upon loading, which may decrease overall death loss of hogs.

It should also be noted that animal handling and welfare issues during transport can be addressed by other means than trailer design. Handling can also be improved by measures taken on-farm, and by better training for animal handlers. Handling practices on different farms create the largest amount of variability when it comes to hogs willingness to load (likely in combination with other farm variables such as genetics, pen design and diet). Pigs from large group pen or autosort systems generally move better than those from small pen housing. Also, it is believed that handling difficulties due to ramps could be alleviated if pigs had some experience of ramps on farm, prior to shipment.

Trailer inspection protocols and checklists used by transporters

The SOPs and protocols for washing and disinfecting market hog trailers vary greatly between wash bays and the specific requirements of producers. Although washing and disinfecting protocols vary by location, there is some consistency between sites.

Across cleaning sites the general protocol is as follows:

1. Trucks are scraped out thoroughly prior to entry at wash bay
2. Personnel must wear sanitized boots for washing. Boots must be sanitized upon every reentry into the trailer.
3. Upon disinfecting, personnel must wear clean coveralls and sanitized boots.
4. Trailers are washed outside to inside, top to bottom, and back to front to avoid recontamination. If the trailer is frozen or especially dirty, run the hose inside trailer for approximately 20 minutes to loosen debris for cleaning ease.
5. Removable decking and winter kits (if assembled) must be removed from the trailer and washed.
6. After washing, trailer must be visibly clean with no remaining debris or it must be rewashed. Equipment within the trailer must be washed (paddles, sort boards, etc.)
7. Acceptable disinfectants include Virkon, Virocid, Synergize
8. Hoses and heads must be disinfected prior to entering the trailer
9. Trailers are disinfected in the same pattern as washing is performed (outside to inside, top to bottom, front to back). Any equipment within the trailer must be disinfected as well (paddles, sort boards, etc.)
10. No one enters the trailer once it is washed and disinfected
11. Trailer swabbing and inspection is performed at random by a 3rd party (veterinarian).

Retrofit opportunities to improve animal welfare and ease of cleaning

Retrofit opportunities will be evaluated in conjunction with engineers based on individual trailer design. Based on this report some initial factors for consideration are listed here.

Features to improve cleaning ease:

- Decrease the amount of removable decking
- Decrease the number of ramps
- Have fewer tight corners and enclosed spaces
- Avoid open ended tubing, I beams, ledges and fixtures that trap debris
- Have well placed and designed access doors and flush out openings

Features to improve animal handling and pig welfare:

- Decrease the number of ramps, and floor levels
- Reduce the amount of loose equipment (chains, pins, etc)
- Reduce sharp edges or protrusions and areas where body parts may be trapped or pinched
- Increase door width
- Decrease the slope of ramps and minimize step ups
- Handle pigs using behavioural principles (approach and retreat, use of flight zone) in a low stress manner (use prods only when needed)
- Have adequate ceiling heights during handling
- Forced ventilation in summer, and bedding/insulation in winter
- Use sprinklers at loading and unloading (temperatures ≥24°C)

Potential barriers or obstacles to automated cleaning

1. Each trailer has its own layout. There is not an industry standard for design. All trailers have different gate, floor and ramp setups.

2. Cleaning of removable floor decking, either on the trailer floor area or in storage is a problem.
3. Negotiating the different levels in the trailer and the need to open the gates, side doors and lower or move ramps would require sophisticated equipment.
4. The environment the units would need to work in is very harsh. Would the equipment stand up to these conditions, and could it become a potential source of contamination?

Certainly for initial development work, total automation is not the goal. Automated tools will be used by staff to assist them in the cleaning process. Navigating multiple floors and ramps poses a disadvantage to robotic trailer cleaning. The majority of market hog trailers contain 5 ramps, some of which include step-ups that must be navigated to access the ramp or compartment, and 3 floors, one of which is made of removable decking that must be removed from the trailer before cleaning can commence.

Outside of cleaning the floor, difficulties will extend to thoroughly cleaning gates, compartment barriers and inside hollow tubing. Equipment installed in the trailer such as gate latches and boxes enclosing electrical wires and lights require special care when cleaning to ensure all visible organic matter has been removed. In addition, when winter kits are used these must also be removed and washed resulting in some level of manual work and oversight to clean these components. However, if robotics can increase the speed and efficiency of this process it should increase biosecurity, reduce cleaning time and make the job less difficult.

CONCLUSION

Pot belly trailers remain the most commonly used trailer design in Canada. These trailers are highly versatile, have high load capacity and are relatively low weight. However, these trailers are also the most difficult to clean and have poorest animal handling characteristics. Alternative designs are available which are easier to clean and allow better ease of handling for animals, but these designs are less versatile, have reduced load capacity and/or are significantly heavier.

ACKNOWLEDGEMENTS

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Practical Alternatives for Managing Castration Pain in Piglets

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SUMMARY

The objective of this project was to identify which analgesics will provide optimal pain relief to piglets; at what age castration should be performed to minimize stress and production losses in piglets; determine if the timing of drug administration affects piglets' pain responses following castration and whether provision of oral sucrose prior to an analgesic can provide measureable benefits to pigs during the initial pain of castration. The first study evaluated the effectiveness of three non-steroidal anti-inflammatory drugs (NSAIDS) on post-castration pain. The second compared the influence of age at castration (3 days vs 10 days) on piglet welfare. Initial behavioural results from these two experiments found no significant differences in chute navigation times among the treatments studied. In study 2, the expected differences between sham handled and castrated piglets were not found, and no benefits of drug treatment were observed even though drugs were administered 15 minutes prior to testing.

INTRODUCTION

Castration is a common procedure performed on male piglets at an early age to prevent the development of boar taint, an unpleasant smell and odour in pork from entire males. Previous research has determined that piglets experience significant pain and stress from the procedure, and the pain may last for up to five days thereafter (Marchant-Forde et al. 2014). Subsequently, the Canadian Code of Practice for the Care and Handling of Pigs requires that as of July 1, 2016, castration performed at any age must be done with analgesics to help control post-procedure pain (National Farm Animal Care Council 2014). However, the Code does not provide specifics regarding the appropriate analgesics, or protocols for their administration.

MATERIALS AND METHODS

Study 1: *Comparing the effectiveness of three NSAIDs.*

Three approved analgesics were compared: meloxicam, ketoprofen, and paracetamol. Male piglets (n = 167) were randomly assigned to one of five treatments: 1) Castration with meloxicam (Metacam ® 0.4 mg/kg [0.3 ml/kg]) (CAM), 2) Castration with ketoprofen (Anafen ® 3 mg/kg [0.3 ml/kg]) (CAA), 3) Castration with acetaminophen (Pracetam ® 60 mg/kg [1.0 ml/kg]) (CAP), 4) Castration control (CA), and 5) Sham castration (SCA), with around 33 piglets per treatment. Immediately prior to castration, meloxicam and ketoprofen were given intramuscularly, while paracetamol was administered orally using a plastic transfer pipette.

Behavioural observations and physiological measures (involving blood collection) of stress were performed on separate litters of piglets to avoid the stress of blood collection influencing piglet behaviour. In total, one-hundred-six male piglets were studied for behaviour post castration, and blood samples were taken from 61 piglets. . In total eight piglets were removed from the study due to death or lameness. All piglets were weighed and individually marked at 2-3 days of age.

Study 2: *The effect of piglet age at castration on pain response and weight gain following castration.*

Male piglets (n= 117) were randomly assigned to six treatments: 1) Castration at 3 days of age with ketoprofen (YA), 2) Castration at 3 days of age (YC), 3) Sham castration at 3 days of age (YS), 4) Castration at 10 days of age with ketoprofen (OA), 5) Castration at 10 days of age (OC), and 6) Sham castration at 10 days of age (OS). For piglets that received ketoprofen (Anafen ® 3 mg/kg [0.3 ml/kg]), the drug was provided intramuscularly 30 min prior to castration.

Behaviour observations:

In both studies, behaviour observations were taken on piglets using a specially designed handling chute developed and validated as an objective behavioural measure of pain in castrated piglets. The duration of time piglets take to navigate the chute has been shown to take significantly longer in piglets castrated without pain control, compared to those handled but not castrated (Bilsborrow et al. 2016). The chute fit in place of the back gate of the farrowing pen and contained two hurdles, each 10cm in height. One day prior to treatment application, piglets were trained to navigate the chute.

On the day of treatment application, all piglets were first given a pre-treatment run at 30 min prior to the administration of treatment. Following treatment piglets were required to navigate the chute at 15, 30 45 and 120 minutes post-treatment. Piglets were given a total of two minutes to navigate the chute unaided. If a piglet laid down in the chute it was assigned a navigation time of two minutes and then gently pushed through the chute towards the farrowing pen.

Blood collection:

Study 1: Blood was collected from a total of 61 piglets at three time points. The first blood collection was taken at two days of age, to establish baseline cortisol levels. The second blood collection was taken at 45 minutes post treatment. A third blood collection was taken from 50% of piglets only, at one day post treatment.

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RESULTS AND DISCUSSION

The results of Study 1 suggest that there was a positive effect of the analgesic Ketoprofen as determined by the quicker navigation times of piglets in the CAA treatment, compared to the CA piglets. However, piglets in the CAM and CAP treatments were no different in navigation time as compared to CA and SCA piglets. The control group having a longer navigation time than other treatments suggests that results of this trial should be interpreted with caution, because the piglets may have experienced handling stress which influenced their navigation times.

The results of Study 2 showed no significant differences between treatments, even within piglet age group. Because castrated piglets showed similar navigation times to sham castrated piglets, it again suggests that there was an additional stressor affecting the navigation time of the piglets. This may be a result of handling stress, or an additional environmental stressor, which played a larger role than expected.

CONCLUSIONS

The behaviour results collected from studies 1 and 2 have not as yet revealed any clear differences among the treatments, particularly as the sham groups had navigation times that were no different from castrated groups. It is believed there must have been a confounding environmental influence affecting the piglets.

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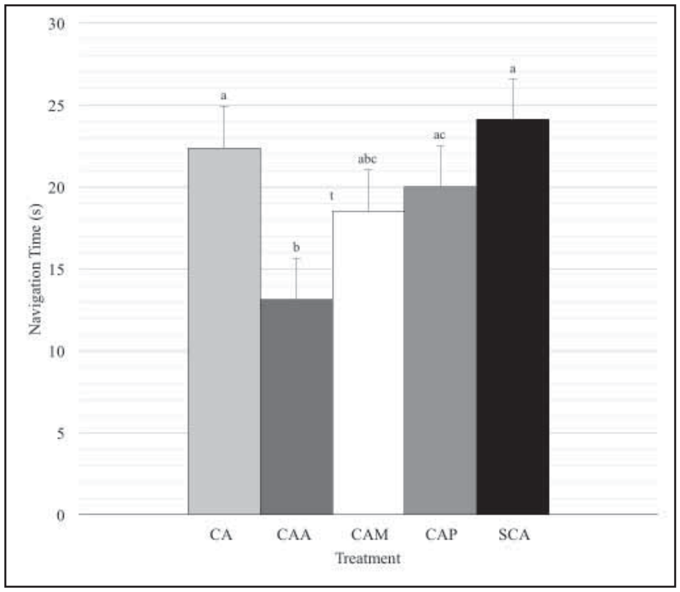

Figure 1. Overall navigation time (seconds, mean and SEM of navigation times recorded at 4 time points) between treatment groups post-treatment. Five treatments: castration control (CA), castration with ketoprofen (CAA), castration with meloxicam (CAM), castration with paracetamol (CAP), and sham castration (SCA). Significance shown at P > 0.05. Where superscripts differ, P<0.05. Trend = t.

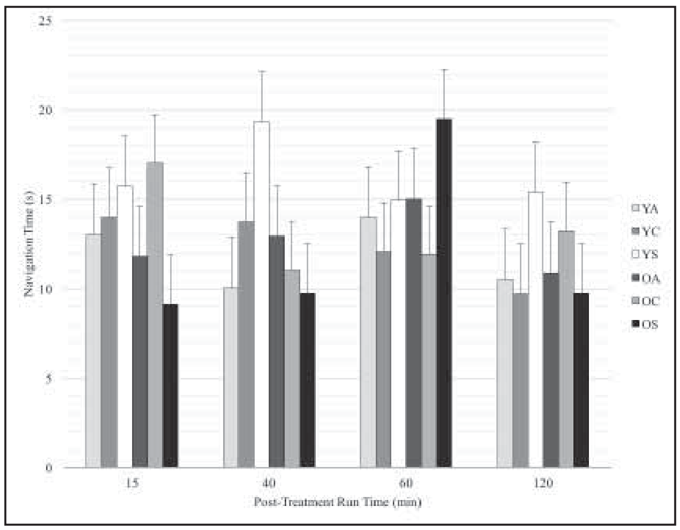

Figure 2. Mean chute navigation time (s, ±SEM) at four time points post-treatment. Six treatments: castration at 3 days of age with ketoprofen (YA), castration at 3 days of age (YC), sham castration at 3 days of age (YS), castration at 10 days of age with ketoprofen (OA), castration at 10 days of age (OC), and sham castration at 10 days of age (OS).

Determining Effective Enrichments for Group Housed Sows

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SUMMARY

Providing enrichment involves making changes to the environment that are intended to increase the range of normal behaviours and improve the biological functioning and well-being of animals. Enrichment in group housing systems has the potential to significantly improve animal welfare by reducing aggression and injuries, stimulating exercise and the expression of species specific behaviours. However, when one enrichment is used continuously, habituation results and the enrichment can become less effective.

Initial behavioural results indicate that regardless of the enrichment treatment provided, sows spent similar amounts of time in enriched areas of the pen. Sows spent more time contacting and near the enrichment when materials were rotated than constant. Sows in the ROTATE treatment spent the most time within 1 metre of the enrichments on day 10 when straw was provided..

INTRODUCTION

Although pigs are highly motivated to root and explore their environment, the modern production environment provides few outlets for these behaviours. Straw has been demonstrated to be one of the most effective forms of enrichment for pigs; however, straw provision is often not a viable option for producers operating bedding-free systems with liquid manure management. In Canada, the provision of enrichment is now required as part of the Code of Practice for the Care and Handling of Pigs, however, there is a distinct lack of effective environmental enrichment options for sows in slatted concrete pens.

The current project proposes to go beyond a simple examination of different objects and their use by sows. Methods were explored for maintaining novelty and increasing the value of enrichments by manipulating the way that enrichments are presented. The effectiveness of regular rotation of enrichments to maintain novelty were studied, as well as the delivery of new enrichments with an associated auditory stimulus, which is hypothesized to increase the value of enrichment. The use of enrichments by dominant and subordinate individuals will also be examined to determine differences based on social status within the group.

"When enrichment is rotated sows spent more time near and interacting with the enrichments."

MATERIALS AND METHODS

Sow housing

Eight groups of 28 ±2 multiparous sows and gilts were housed in a T-shaped free-access gestation pen at 5 to 6 weeks gestation (sows were mixed for a week or more before commencing the trial). Sows were allowed to freely enter or exit the feeding stalls during the study. Each treatment lasted 12 days, with four treatments rotated over a period of eight weeks (ending at 14 weeks gestation).

Treatments included:

1. Constant provision of a single enrichment- wood on chain 4 per pen (CONST),
2. Rotation of three enrichments- rope, straw, wood on chain, (ROTATE),
3. Rotation of three enrichments with an associative stimulus i.e. bell rung immediately before adding each enrichment (STIM),
4. No enrichment, acting as a Control group (CONTROL).

Sows at the Prairie Swine Centre interacting with the block of wood enrichment.

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Each treatment lasted 12 days, with the four treatments provided to each group in randomized order over a period of eight weeks. For ROTATE and STIM treatments new enrichments were provided 3x per week, including 1) cotton ropes 2) straw (300 g per sow), and 3) wooden block on chain. The same order of presentation in ROTATE and STIM treatments was kept throughout the study. Object durability was monitored throughout the study, and materials were replaced as needed.

RESULTS AND DISCUSSION

An initial analysis of the first two replicates showed that approximately 2% of sows use the enrichment at any one time, and the percentage of sows near enrichments was greatest in the Rotate and Stimulus treatments (Table 1). This suggests that these treatments were effective at increasing sow interest.

Enrichment use varied according to day of treatment with more sows remaining near enrichments on day 10 when straw was provided to Stimulus and Rotation groups (Figure 1). Straw was included in the Stimulus and Rotation treatments as a positive control, and had a clear effect on sows' interaction with enrichment.

Table 1. Mean percentage of sows near or in contact with the enriched area of the pen.

	Treatments				
Behavior	Rotation	Stimulus	Constant	SEM ±	P-Value
Contacting enrichment (%)	2.21	1.86	0.73	0.292	0.118
<1M from enrichment (%)	4.23 a	2.61 ab	0.65 b	0.301	0.043
>1M from enrichment (%)	10.58	9.97	12.09	0.262	0.06

Table 2. Effects of enrichment treatment on the postures of sows. Mean percentage of sows in each posture.

	Treatments					
Postures	Rotation	Stimulus	Constant	Control	SEM ±	P-Value
Laying	2.53	2.35	2.38	2.51	0.131	0.701
Sitting	1.85	1.09	1.02	1.49	0.159	0.118
Standing	1.37	1.23	0.8	0.9	0.153	0.071

There was no difference in the postures of sows among various treatments as seen in Table 2. However, standing behavior tended to be greater in the Rotate and Stimulus treatments compared to Constant and Control (P=0.071), suggesting that sows were more active when given the Rotate and Stimulus. The wood on chain enrichment showed greater durability than rope enrichment.

CONCLUSION

It was concluded that when enrichment was rotated (Rotation and Stimulus treatments) sows spent more time near enrichments and were more active than when Constant enrichment or Control treatments were provided. Based on this initial analysis the sound stimulus appeared to have no significant effect. Although the straw enrichment produced the greatest response, sows also made use of rope and wood on chain enrichments, and no adverse effects were found for sows or manure management indicating their suitability as enrichment materials for group-housed sows.

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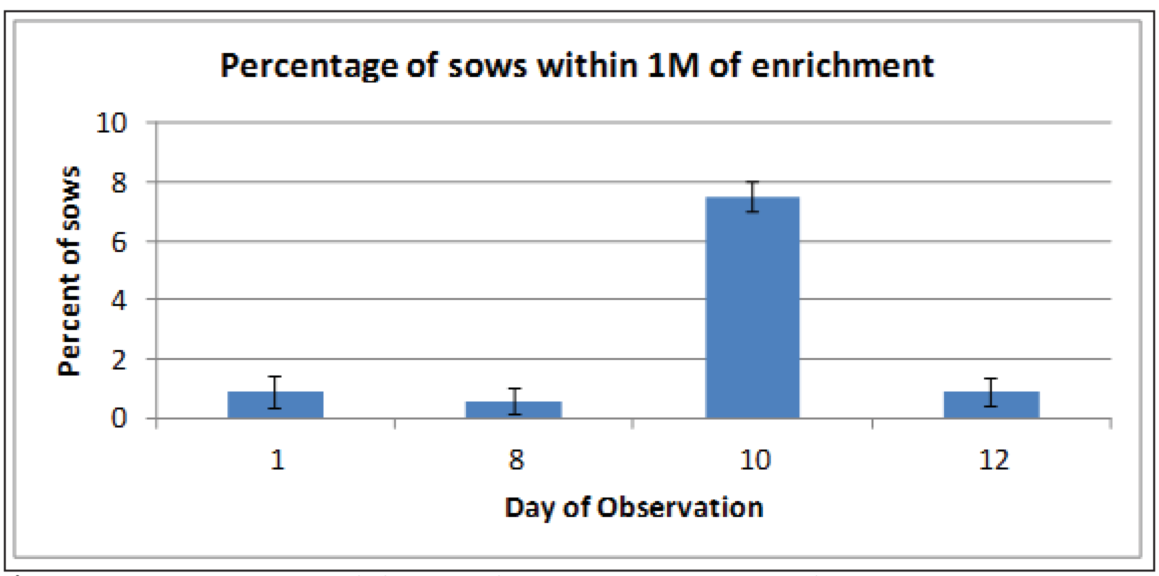

Figure 1. Mean percentage of sows within 1M of enrichment on each day of observation.

Determining the Optimum Stocking Density in Nursery Pigs

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SUMMARY

Significant effects of density were found for standing, sitting, feeding and lying recumbent (P <0.05). Both time spent feeding and percentage of pigs sitting was greatest with higher pig densities. Pigs spent more time overlying in week 1 than in weeks 3 or 5 , as well demonstrating more time standing and feeding in week 3 as compared to weeks 1 or 5. Initial results from Phase one indicate that temperatures were fairly consistent across seasons, and humidity was highest in the summer months. There were no consistent differences found in growth and immune responses were greater during the summer months

INTRODUCTION

Floor space allowance is a complex issue in swine production, and one that is critical for both economic and welfare reasons. There is currently a significant body of research on the effects of space allowances in grow-finish pigs The most widely accepted method to define floor space allowance (A) is to relate it to the size of pig by converting body weight (BW) into a two-dimensional concept yielding an expression of A = k * BW 0.667. Data from many studies on grow/finisher pigs was used to establish the critical k value at which crowding becomes detrimental to the growth of the pig. The critical k value established (by Gonyou et al., 2006) is used for the calculation of the current minimum required space allowance for nursery pigs in the Canadian Code of Practice for the care and handling of pigs (NFACC, 2014).

This study addresses concerns surrounding space allowance in nursery pigs to establish the critical cut-off points at which crowding occurs. To address the areas where uncertainty remains, this study examines average daily gain (ADG), pen group average daily feed intake (ADFI) and feed efficiency, health and pig behaviour at various space allowances, in both small and large groups, in controlled research and commercial settings across seasons. The resulting data will be entered into an economic model to determine the consequences of nursery space allowance on the cost of pig production and financial returns, and final conclusions regarding the optimum density for nursery pigs will combine welfare, economic and production outcomes.

MATERIALS AND METHODS

The study has been conducted in two phases, including: I) Controlled studies performed at the Prairie Swine Centre; and II) Commercial trials conducted at two sites (one in Saskatchewan and one in Manitoba).

Phase I Trial

Phase I trials took place at the Prairie Swine Centre's nursery barn. Pigs were housed in fully slatted pens, and fed ad-libitum via feed hoppers, with the availability of feeder space and drinkers (on a per pig basis) kept constant between treatments. Artificial lighting was provided to pigs from 07:30 - 16:00.

"Significant effects of density were found for standing, sitting, feeding and lying recumbent."

Treatments, animal care and data collection

A total of 1,200 newly weaned pigs were studied over six density treatments, tested in two group sizes (10 and 40 pigs per group), over four replicates, one replicate per season to control for seasonal variation in weaning weight and growth due to variation in temperature and air quality. Density was determined using the allometric equation Area = k BW 0.667(where A=space/ pig in m2, k = the constant under test and BW = body weight in kg), and the following k values tested: 0.0230, 0.0265, 0.0300, 0.0335, 0.0370 and 0.0390.

Phase II Trial

Farm selection and animal care

Two commercial operations with acceptable levels of nursery mortality levels (<3%, to minimize density changes) and with high heard health status were identified. One farm was selected in Manitoba and the second was selected in Saskatchewan. The same six density treatments from phase I were tested for a minimum of four replicates per farm over a span of two seasons (summer and winter). Unlike phase I, in which pen size is adjusted to ensure a specific nursery density, phase II pens remained static in size, and the number of pigs per pen was varied to achieve the required density based on the expected exit weight (25 kg - 30kg). Treatment groups were randomized and balanced for weaning weight and gender. Animals were fed and cared for following the standard management practices on each farm.

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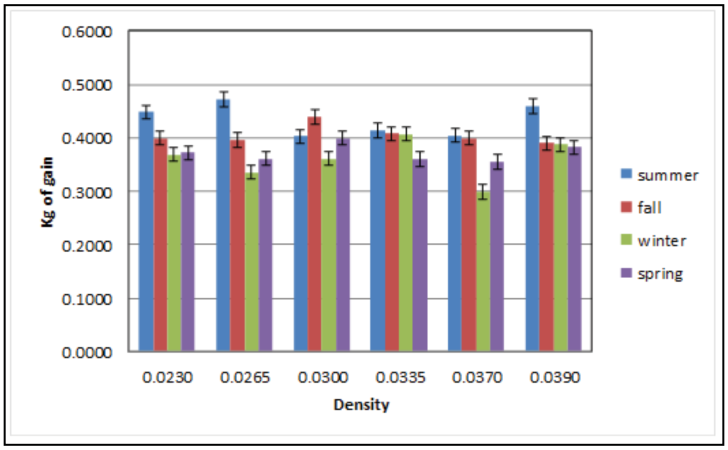

Figure 1. Average daily gain in Phase one trials.

Data collection

Information on pig diets, management protocols, pen and barn environment were collected for each facility. Information on temperature and humidity within the rooms and pens was collected using iButton data loggers. Both individual pig and group weights were collected at entry and exit, and group weights collected at mid-point in the nursery growth cycle to determine average daily gain. All feed inputs were recorded and feed returns taken on pig weigh days. Records of morbidity and mortality and any veterinary interventions were kept daily by barn staff. The date, weight and reason for removal of any pig removed from trial were also recorded.

Pig behaviour was recorded at three time points during the trial. On the second day after placement, the day before mid-point measurement of pig weights, and the day before nursery exit. Pig behaviour was recorded on cameras mounted above the pens to take pictures of pig behaviour.

RESULTS AND DISCUSSION

Phase I

Growth

Pigs on trial gained an average of 0.3924 Kg per day, with the best growth occurring during the summer months at densities 0.0265 and 0.0390 (Figure 1). There were no noticeable differences in ADG between densities, pigs given less space at a K value of 0.0230 did just as well on average as pigs given the most space (k=0.0390) however there were some seasonal interactions with density. Based on these descriptive statistics, there was no consistent pattern of improved or decreased performance.

Feed to gain ratios observed were fairly consistent across seasons and densities, with the summer months being the best for all densities. These preliminary results suggest that housing pigs at a tighter stocking density did not negatively affect the growth of animals.

Seasonal change in environment

There was very little change in temperature across the seasons. There was an increase in humidity levels during the summer months; likely due to the increased ambient humidity, while the rest of the seasons were fairly consistent.

Immune response

There was a seasonal effect on immune titers, with the highest titer values in summer. As this was only a minor immune challenge (inactivated m. hyopneumoniae vaccine) , it is possible that the increased titer, and best growth rates indicates the pigs were healthiest during the summer months, possibly partially due to the improved ventilation and air flow through the barn. The low titer levels and poor growth response during the cooler months may indicate that animals are facing other immune challenges at this time. There were no apparent effects of density treatment, indicating that the tighter densities did not affect immunity.

Behavioural Responses

There was a significant effects of density found for standing, sitting, feeding and lying recumbent ($P < 0.05$). When separated by density, there were significant differences in the percentage of pigs sitting and feeding. Pigs in the lower space allowances spent more time sitting and feeding when compared to the greater space allowance. All pigs demonstrated more time standing and feeding in week 3 as compared to weeks 1 or 5.

CONCLUSION

Initial results from Phase one indicate there were no consistent differences found in growth and immune responses were greater during the summer months. Significant effects of density were found for standing, sitting, feeding and lying recumbent ($P < 0.05$). The percentage of pigs sitting was greatest at lower space allowances (k= 0.023: 1.36 ±0.12 vs k= 0.039: 0.77 ±0.15% of time sitting, mean ±SEM). Similarly, pigs at lower space allowances spent more time feeding (k= 0.023: 1.91 ±0.07 vs k= 0.039: 1.74 ±0.07% of time feeding, mean ±SEM). Pigs spent more time overlying in week 1 than in weeks 3 or 5 ($P < 0.05$). Pigs also demonstrated more time standing and feeding in week 3 as compared to weeks 1 or 5. Further analysis including correlations with growth and physiological measures will help to interpret the importance of these changes for piglet health and welfare.

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National Sow Housing Conversion Project

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SUMMARY

The National Sow Housing Conversion Project (NSHCP) is a descriptive project intended to facilitate the successful conversion of Canada's sow barns to group housing. The project involves collaboration from industry participants and academic researchers across Canada working together on a comprehensive strategy involving demonstration farms and technology transfer materials and events to support Canadian pork producers. This report describes progress up to year 3 of this 4 year project. The project is a collaboration between the University of Manitoba, Manitoba Pork Council, CDPQ and the Prairie Swine Centre. The full project will collect detailed information on fourteen barn sites across the country that have implemented group sow housing. The information collected is in the form of questionnaires, interviews, photos, videos, barn layous and production and economic data. The results are being made available to producers through producer meetings and presentations, newsletters, and a comprehensive website: www.groupsowhousing.com.

INTRODUCTION

In 2007 the largest pork producers in the USA and Canada pledged to transition their sow housing to group systems over the next 10 years. The EU has banned sow gestation stalls in all member countries as of January 1st 2013. More recently, increasing numbers of food retailers, including Tim Hortons, Burger King and McDonalds, have pledged to source pork from producers who have plans for conversion to group housing, and the supermarket chains Safeway and Costco recently announced plans to develop a stall-free pork supply chain. Consequently, the Canadian pork industry is under great pressure to convert existing gestation stall housing for its approximately 1.3 million sows to group systems. With over 60% of Canadian pork going to export markets, the future strength of the industry depends on maintaining and increasing access to global markets.

However, there are major concerns within the industry surrounding the conversion from stalls to group housing. The process requires a large capital investment with little room for error, and selecting the 'right' system can be a daunting task. Within the Canadian industry there is relatively little knowledge or experience on the management of sows in group systems. A variety of group housing systems are available, most of which require more space, different management skills and require more labour inputs compared to stall housing. Without proper support and advice, there is the potential for substantial losses in herd productivity, a decline in sow welfare and an overall reduction in the Canadian herd size as producers struggle to make this change. The National Sow Housing Conversion Project (NSHCP) has brought together industry and scientific expertise to produce a comprehensive national strategy, involving demonstration farms and technology transfer, to support Canadian pork producers in this conversion.

"Results from the NSHCP will help producers transition to a group sow system in the most cost effective and manner possible."

MATERIALS AND METHODS

Primary barn sites

Five barn sites have been identified across Canada to document the conversion to group housing. The conversion process on these farms is being documented through questionnaires, interviews, farm visits, photos, and videos taken before, during, and after the transition. As well, producers are asked to provide production data and economic data. Videos and the project website will be used to give visitors a 'virtual tour' of each facility. Producers at the primary site barns will be aided by a barn evaluation by an experienced engineer, and ongoing support from the NSHCP working group.

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3.2 Secondary barn sites

In addition to the five primary barns, up to nine other barns that have already implemented group housing are being identified across Canada. Less intensive data will be collected from these sites, which will include questionnaires, interviews, photos, videos, and barn visits. These additional sites will be used to show producers a wider variety of feeding systems design choices, and to highlight the necessity of developing a plan that will work with their individual barn design, budget, and management style.

3.3 Communications

Communicating the results to other producers interested in converting to group housing remains one of the main goals of the NSHCP. Results are being presented through workshops and producer meetings, a bi-annual newsletter, and the development of the project website: www.groupsowhousing.com, which contains full documentation of the barn conversions, as well as general information on group housing options and contacts across the country for those seeking information and advice. A working group consisting or provincial pork organisation representatives from across the country will remain active and will conduct yearly meetings throughout the project.

Table 1: Existing group housing sites documented as part of the National Sow Housing Conversion Project

Barn location	Size (sow herd)	Barn Description	Group Housing System
New Brunswick	1,600	New build (2004), farrow-to-wean	ESF feeders (Schauer); one feeder per pen, 16 static pen groups of 60 sows
Quebec	850	Renovation (2012), farrow-to-wean	ESF feeders (Schauer); two feeders per pen, 4 static groups of 160 sows.
Ontario	1400	New build (2012), farrow-to-wean	Competitive feeding in trough; 48 static groups of 18 sows/pen
Ontario	650	Barn addition (2013), farrow–to-wean	ESF feeders (WEDA); five feeders in one dynamic pen of 260 sows
Saskatchewan	600	New build (2015), farrow to wean	ESF feeders (Nedap); four feeders per pen, two dynamic pens of 180 sows
Alberta	275	Renovation (2014), farrow-to- finish	ESF feeders (Nedap); three feeders in one dynamic pen of 168 sows

All barns are documented on the project website at www.groupsowhousing.com

RESULTS AND DISCUSSIONS

Primary barn sites

Five sites have been identified and are being documented, with three in Ontario, one in Quebec and one in Manitoba. The first site identified belongs to the van Engelen family, owners of Hog-Tied farms Ltd., a 250 sow farrow-to-finish operation located in Thedford, Ontario. Father and son, John and Mitch van Engelen operate the herd in a well-kept barn that includes multiple innovations, from a state-of-the-art ventilation system, hydraulic sow platforms in farrowing, a precision feeding area, and autosort feeders in grow-finish. The barn was originally built in 1983, and renovations for group-housing began in 2013. Doing most of the construction work themselves, the breeding and gestation room was converted from stalls in a three stage process. All sows were kept on-site, and while some minor reductions in herd size took place during the transition, the same numbers can be housed in the renovated barn as in the previous stall design. Sows in the group pens have roughly 20 sqft/sow, due to the efficient use of alley space around stalls and in the use of a large group dynamic ESF system. Doing the work in stages allowed the barn to remain in full operation, with little impact on the number of hogs shipped during the transition.

The second producer on the project is Adam Schlegel of Schlegelhome Farms, near Shakespeare, Ontario. The Schlegel sow barn accommodates 2000 sows, farrow to wean. The barn conversion involved gutting an existing farrowing area and converting it to two large dynamic group pens for 500 sows, with some sows remaining in gestation stalls A new farrowing wing was completed in 2014, and includes side-loading farrowing crates, in-floor heating and a robotic power washer. The new gestation area was completed in the spring of 2015. Sows in gestation are fed using four ESF feeders per pen, with a sorting alley. The ESF feeders are Sow Choice feeders, made by Ontario firm CanArm Ltd. The documentation of the both sites is ongoing, with periodic updates until December 2017.

Other sites include the farm of Luc Veilleux and sons in Quebec, Hylife's Rosco barn in Manitoba, and the farm of Ted Janmaat, a small organic producer located in Ontario. The Veilleux farm is located near Sainte-Marie-de-Beauce in Quebec. Their 600 sow farrow to wean operation was converted to group gestation in the spring of 2016, with Gestal ESF feeders installed in what were previously breeding and gestation rooms. Hylife's Rosco barn is a 3000 sow farrow to wean facility, which began renovations in the fall of 2016, also with Gestal ESF.

Ted Janmaat's facility is included as an example of organic production. The Janmaat barn is a 100 sow farrow to nursery site. The original barn was renovated in 2015 and an addition was built to accommodate farrowing and nursery pigs. All pigs are provided with straw, and sows in gestation have access to an outdoor run with sand footing.

As of January 2017, all of these barn sites can be viewed at www.groupsowhousing.com.

Secondary barn sites

There are currently six existing barns with group sow housing have been identified across the country, with site locations from the east coast (New Brunswick) to Alberta (Table 1). The herd examples range in size from 275 to 1600 sows, and include a variety of new builds, renovations and barn additions. In terms of renovation costs, smaller herds that have completed owner-built conversions indicate material costs as low as $300 per sow for basic conversion including existing manure pits and some floor improvements (new slats and/or solid bedroom areas).

Communications

The project website was launched in January 2016, and will be updated throughout the project as more resources are developed and as farms are added. Project information was presented at the 2014 Saskatchewan Pork Symposium, at PSC's 2015 spring meetings across western Canada, and at six workshops held in Quebec and Ontario. Numerous articles on the project and sow housing have been developed in collaboration with swine industry publications, for example, the National Hog Farmer produced a special 'Blueprint Issue' on group sow housing in collaboration with the project team.

Three issues of the project newsletter have been produced to help communicate the results of the project to producers. The newsletter also mentions the need for more participating barns, and may be able to help reach a wider audience. The working group remains active, and met during the Banff Pork Seminar in January 2017.

CONCLUSIONS

The NSHCP is designed to help Canada's swine production sector respond to the emerging issue of group sow housing. By compiling the best information available on group housing and working with producers on demonstration projects, the project will aid producers in meeting this challenge in an efficient manner. This four year project is being run in collaboration with the University of Manitoba and producer groups in Quebec and Manitoba. The information produced includes barn and pen designs, detailed costing and management strategies, and reviews of scientific literature. The information will be conveyed through demonstrations, factsheets, presentations at producer meetings, newsletters and the project website. The NSHCP will thus increase producer confidence surrounding this transition and provide clear support and guidance for producers wanting to convert from stalls to group housing. The project will therefore assist producers by providing the support needed to implement new housing technologies effectively. This will help producers to maintain productivity during the transition, and places the Canadian pork industry in a strong position with respect to meeting increasing animal welfare requirements within global markets.

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National Sow Housing Conversion Newsletter

October 2014 Vol. 1, Issue 1

NSHCP

SIP Swine Cluster 2 Funding Announcement

Final contracts for Swine Innovation Porc's Swine Cluster 2 program were signed in June, providing support for a four year project documenting barn conversions to group housing. The National Sow Housing Conversion Project (NSHCP) is directed by Dr. Jennifer Brown, a Research Scientist in Ethology at Prairie Swine Centre, and includes research partners from the University of Manitoba, Manitoba Pork and CDPQ. The goal of the project is to document barn conversions at four sites across Canada, including planning, construction, management decisions, staff training, changes to the sow herd and production levels both before and after.

"Barn conversions and new builds for group housing represent a huge cost to the pig industry", says Dr. Brown. "Our goal is to put together the best possible information, in terms of barn layout, sow management, and cost of construction, to help Canadian producers who are considering this investment." While countries in the EU have banned stall use except during breeding and early pregnancy (embryo implantation) as of January 2013, the new Canadian Code of Practice encourages the use of group housing systems, but does not totally ban stall use. The EU deadline resulted in reports of poor implementation in some countries, with last minute renovations resulting in lost production and poorer welfare in sows. By not having a deadline, Canadian producers can properly consider their options, and choose the right time for them depending on their situation and financial capability.

The project participants include leading researchers in the science of sow management, and will draw from barn design and management concepts developed in European countries over the past 20 years. "Due to poor market conditions, very little barn construction work has been done in North America over the last 10 years", says project participant and CEO of the Prairie Swine Centre, Lee Whittington. "By documenting top-notch barn conversions here in Canada, we will develop new expertise and can provide builders and producers with the information they need for successful conversion to group housing."

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In addition to funding from AAFC, the project is supported by provincial pork organizations, Alberta Pork, Sask Pork, Manitoba Pork and Ontario Pork. By taking a consistent and science-based approach on this issue, the Canadian pork industry demonstrates a pro-active approach to sow management that will have long-term benefits to sow welfare and production, while strengthening domestic and export markets.

CDPQ Centre de développement du porc du Québec inc.

University of Manitoba

Prairie Swine Centre

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Publications List

Alvarado, A. and **B. Predicala**. 2015. Assessing daily exposure risk of pig barn workers to airborne contaminants. Centred on Swine newsletter. Prairie Swine Centre. Saskatoon, SK. pp. 10-11.

Alvarado, A. and **B. Predicala**. 2016. Control of gas and odour levels in swine facilities using filters with zinc oxide nanoparticles. Prepared for submission to Applied Engineering in Agriculture.

Alvarado, A. and **B. Predicala**. 2016. Occupational exposure risk for swine workers in confined housing facilities. Prepared for Annals of Occupational Hygiene.

Bilsborrow, K., **Seddon, Y.M.**, **Brown, J.A.**, Waldner, C., Stookey, J.M., 2016. Validation of a novel behavioural test for assessing pain in piglets following castration, CJAS, In press. (Published on the web 1 April 2016, 10.1139/CJAS-2015-0109).

Brown, J.A., 2015. Piglet Health and Welfare in the Nursery. Centred on Swine, 21 (1), 2-3.

Brown, J.A., 2016. Applied ethology: what's the buzz? In Brown, J.A., Seddon, Y.M., Appleby, M.C., Eds. Animals and us: 50 years and more of applied ethology, Wageningen Academic Press, Wageningen, NL, pp. 81-96.

Brown, J.A., Whittington, L., and Richards, D. Who let the sows out? National Hog Farmer 2015 Blueprint Issue, October 2015.

Brown, J.A., **Seddon, Y.M.**, Appleby, M.C., Eds., 2016. Animals and us: 50 years and more of applied ethology, Wageningen Academic Press, Wageningen, NL, 336 pp.

Brown, J.A. Seddon, Y.M., Edwards, S.E., Beaulieu, A.D. and Boussieres, D., 2016. Determining the optimum stocking density in nursery pigs, PSC Annual Report 2015-2016.

Brown, J.A., **Seddon, Y.M.**, Li, Y, Bouvier, M.M., 2015. Mixing strategies for group-housed gestating sows: effects on production. Journal of Animal Science, 93 (Suppl. 2), pp 3.

Brown, J.A., **Seddon, Y.M.**, Rault, J.L., Doyle, R., Jensen, P., Marchant-Forde, J., Rodenberg, B., 2016. Animals and us: history, exciting developments, cross-pollination and new directions for applied ethology research. 50th Congress of the International Society for Applied Ethology, Edinburgh.

C**abahug, J., A. Alvarado** and **B.Z. Predicala**. 2016. Evaluation of ATP bioluminescence method for rapid assessment of cleanliness of commercial hog transport trailers. Prepared for Transactions of ASABE.

C**abahug, J., A. Alvarado** and **B.Z. Predicala** 2016. Rapid assessment of cleanliness of commercial hog transport trailers using ATP bioluminescence method. 2016 ASABE Annual International Meeting. Paper No. 2461774. Orlando, Florida.

C**abahug, J., A. Alvarado** and **B.Z. Predicala** 2016. Evaluation of ATP bioluminescence method for rapid assessment of cleanliness of commercial hog transport trailers. Presentation made at the Banff Pork Seminar. 12 January 2016. Banff, AB.

Columbus, D.A. (2016) Alternatives to antibiotic growth promotants. Prairie Swine Centre Producer Meetings. Lethbridge and Red Deer, AL, Swift Current, SK, and Niverville and Portage la Prairie, MB, April 2016.

Columbus, D.A. (2016) Molds and Mycotoxins: What is the impact and how can we minimize it? Prairie Swine Centre Producer Meetings. Lethbridge and Red Deer, AL, Swift Current, SK, and Niverville and Portage la Prairie, MB, April 2016.

Columbus, D.A. (2016) The pig as an agrimedical model. Symposium on Agrimedical Models in Research. University of Saskatchewan, January 2016.

Columbus, D.A. (2016) Use of a pig model in neonatal growth and metabolism research. Symposium on Agrimedical Models in Research. University of Saskatchewan, January 2016.

Columbus, D.A. (April 2016) Nutrition offers options for reducing dependence on antibiotics. Interview for FarmScape.

Columbus, D.A. (April 2016) Researchers explore methods to reduce effects of mycotoxin contamination. Interview for FarmScape.

Columbus, D.A. (May 2016) The importance of nitrogen for growth. Pages 5-6 In: Centred on Swine, Prairie Swine Centre, Saskatoon, SK.

Columbus, D.A. and **Whittington, D.L.** (2016). Research in Pigs Benefits Human Health. Centered on Swine, Vol 22, No 1, pgs 2-3

Columbus, D.A., and **Whittington, D.L.** (May 2016) Research in pigs benefits human health. Page 2 In: Centred on Swine, Prairie Swine Centre, Saskatoon, SK.

Columbus, D.A. and **Whittington, D.L.** (Spring 2016) Research in pigs benefits human health. Page 51-52 In: Western Hog Journal.

Columbus, D.A. and **Whittington, D.L.** (Spring 2016) Research in Pigs Benefits Human Health. Page 51-52 in: Western Hog Journal.

Columbus, D.A. Hernandez-Garcia AD, Naberhuis J, Suryawan A, Manjarin R, Nguyen HV, and Davis TA (2016) Impact of leucine on anabolic and degradative signaling and muscle protein turnover in the hind limb of neonatal pigs fed a protein and energy restricted diet. In preparation for J. Nutr.

Davis, K and **Seddon, Y.M.** (2015) Sugar: Solution for pain control in pigs? Pig Progress Magazine. Issue 7.

Fiorotto ML, **Columbus, D.A.**, Steinhoff-Wagner J, Suryawan A, Nguyen HV, and Davis TA (2016) Postnatal muscle growth is dependent on satellite cell proliferation which demonstrates a specific requirement for dietary protein. FASEB J. 30:1244.1

Hernandez-Garcia A, Suryawan A, Nguyen H, **Columbus D.A.**, Manjarin R, Orellana RA, and Davis TA (2016) Leucine ameliorates endotoxin-induced alterations in protein-protein interactions within mTORC1 complex in neonatal pigs. FASEB J. 30:915.20

Hernandez-Garcia AD, **Columbus D.A.**, Manjarin R, Suryawan A, Nguyen HV, Orellana RA, Davis TA (2016) Leucine supplementation stimulates muscle protein synthesis and reduces degradation signal activation in newborn pigs during acute endotoxemia. Am. J. Physiol. Endocrinol. Metab. Submitted June 6, 2016.

Kao M, **Columbus D.A.**, Suryawan A, Steinhoff-Wagner J, Hernandez-Garcia A, Nguyen HV, Fiorotto ML, Davis TA (2016) Enteral β-hydroxy-β-methylbutyrate supplementation increases protein synthesis in skeletal muscle of neonatal pigs. Am. J. Physiol. Endocrinol. Metab. In press.

Manjarin R*, **Columbus D.A.**, Fiorotto ML, Suryawan A, Nguyen HV, Hernandez-Garcia AD, Hoang NM, and Davis TA (2016) Leucine supplementation of a chronically restricted protein and energy diet enhances mTOR pathway activation but not muscle protein synthesis in neonatal pigs. Amino Acids. 48:257-267.

Manjarin R*, **Columbus D.A.**, Fiorotto ML, Suryawan A, Nguyen HV, Hernandez-Garcia AD, and Davis TA (2016) Short and long-term effect of leucine and BCAA inclusion in a reduced protein and energy diet on protein synthesis in neonatal pigs. *co-first author. In preparation for J. Nutr.

Manjarin R, **Columbus D.A.**, Solis J, Suryawan A, Hernandez-Garcia AD, Nguyen HV, Fiorotto ML, and Davis TA (2016) Long-term leucine and BCAA inclusion in a 30% protein and energy restricted diet increases mTORC1 signaling in skeletal muscle of neonatal pigs. FASEB J. 30:124.3

Martel, M., S. Lemay, **B.Z. Predicala**, M. Girard, M. Belzile, J. Feddes, R. Hogue, and S. Godbout. 2016. Identification of key odor components of swine facility air for biotrickling filter modeling studies. Prepared for Transactions of ASABE.

Moreno, L., M. Nemati and **B.Z. Predicala**. 2015. Biokinetic evaluation of fatty acids degradation in microbial fuel cell type bioreactors. Bioprocess Biosyst Eng. 38:25–38. DOI 10.1007/s00449-014-1240-3

Moreno, L., M. Nemati and **B.Z. Predicala**. 2016. Biodegradation of Phenol in Batch and Continuous Flow Microbial Fuel Cells with Rod and Granular Graphite Electrodes (WR-S-16-01925). Water Research, 10 May 2016.

Predicala, B.Z.. 2015. Engineering Research at Prairie Swine Centre: An Overview. Presentation made to OPP Group. Lleida, Spain. 14 September 2015.

Predicala, B.Z. 2015. Geothermal systems for heating in pork production. Centred on Swine newsletter. Prairie Swine Centre. Saskatoon, SK. pp. 2-3.

Predicala, B.Z. 2016. Animal housing environments: reducing pathogen distribution from animal transportation. Presentation made to Canadian Agrisafety Applied Research Program Annual Collaborative Meeting. Saskatoon, SK. 06 June 2016.

Predicala, B.Z. 2016. Technologies to improve the barn environment. 2016 Manitoba Producer Meeting. Niverville, MB. 06 April 2016.

Predicala, B.Z. 2016. Technologies to improve the barn environment. 2016 Manitoba Producer Meeting. Portage la Prairie, MB. 07 April 2016.

Predicala, B.Z. 2016. Technologies to improve the barn environment. 2016 Alberta Producer Meeting. Red Deer, AB. 19 April 2016.

Predicala, B.Z. 2016. Technologies to improve the barn environment. 2016 Alberta Producer Meeting. Lethbridge, AB. 20 April 2016.

Predicala, B.Z. 2016. Technologies to improve the barn environment. 2016 Saskatchewan Producer Meeting. Swift Current, SK. 28 April 2016.

Predicala, B.Z. 2016. Technology to improve swine transportation. 2016 Manitoba Producer Meeting. Niverville, MB. 06 April 2016.

Predicala, B.Z. 2016. Technology to improve swine transportation. 2016 Manitoba Producer Meeting. Portage la Prairie, MB. 07 April 2016.

Predicala, B.Z. 2016. Technology to improve swine transportation. 2016 Alberta Producer Meeting. Red Deer, AB. 19 April 2016.

Predicala, B.Z. 2016. Technology to improve swine transportation. 2016 Alberta Producer Meeting. Lethbridge, AB. 20 April 2016.

Predicala, B.Z. 2016. Technology to improve swine transportation. 2016 Saskatchewan Producer Meeting. Swift Current, SK. 28 April 2016.

Predicala, B. and **A. Alvarado**. 2015. Nanoparticles for controlling disease-causing microorganisms in barns. 2014-2015 Annual Research Report. Prairie Swine Centre. Saskatoon, SK. pp. 32-34.

Predicala, B. and **A. Alvarado**. Preferred environmental temperature of group-housed sows fed with high heat-increment diets. Proc. Int. Symp. on Animal Environ. & Welfare. Rongchang, Chongqing, China. 23-26 October 2015.

Predicala, B. and **A. Alvarado**. 2016. Computer Simulation and In-barn Evaluation of Modified Ventilation System in Sow Gestation Barn Converted to Group Housing. Paper No. CSBE16-54. 2016 CSBE/SCGAB Annual Conference. Halifax, NS.

Predicala, B., A. Alvarado and L. Dominguez. 2015. Geothermal systems for heating and cooling. 2014-2015 Annual Research Report. Prairie Swine Centre. Saskatoon, SK. pp. 30-31.

Predicala, B., A. Alvarado, D. Korber. 2015. Nanoparticles show promise in sanitation. National Hog Farmer. December 2015. pp. 24-25.

Predicala, B., A. Alvarado, J. Brown and D. Beaulieu. 2015. Determination of temperature requirements of group-housed sows fed high fiber diets to reduce energy costs. Paper No. 152190880. 2015 ASABE Annual International Meeting, New Orleans, LA. 28 July 2015.

Predicala, B., M. Nemati and L. Moreno. 2015. Treating swine and municipal wastewater with microbial fuel cell technology. 2014-2015 Annual Research Report. Prairie Swine Centre. Saskatoon, SK. pp. 35-36.

Rezaei, E., B. Schlageter, M. Nemati and **B.Z. Predicala**. 2016. Evaluation of Metal Oxide Nanoparticles Performance in Adsorption of GasPhase Ammonia (ADSO-S-16-00304). Adsorption Journal, 20 May 2016

Rioja-Lang, F.C., **Seddon, Y.M.** and **Brown, J.A.**, 2015. A review on the development, treatment and prevention of shoulder lesions in sows. In Proceedings of the 3rd International Meeting of Animal Welfare Researchers (Tercer Encuentro International de Investigadores en Bienestar Animal), UNAM, Mexico City, Mexico, 27th – 28th October.

Rioja-Lang, F.C., **Seddon, Y.M.**, and **Brown, J.A.**, 2016. Shoulder lesions in sows: a behavioural review and needs assessment for future research. 50th Congress of the International Society for Applied Ethology, Edinburgh.

Seddon, Y.M. and **Brown, J.A.** (2015) When to mix sows in groups. Pig Progress Magazine. Issue 9.

Seddon, Y.M. and **Brown, J.A.** (2016) Creep feed: Getting more piglets interested. Pig Progress Magazine. Issue 3.

Seddon, Y., Beaulieu, D., Brown, J.A., 2016. Getting More Piglets Interested in Creep Feed. Centred on Swine, 22 (1), 4-5.

Seddon, Y.M., **Brown, J.A.**, 2016. Managing Sows in Groups From Weaning: Are There Advantages? Centred on Swine, 21 (2), 6-7.

Seddon, Y.M., Brown, J., 2016. Using Exploratory Behaviour to Increase Pre-Weaning Creep Consumption. Centred on Swine, 21 (2), 8-9.

Seddon, Y.M., Davis, K., Bouvier, M., Stookey, J., Waldner, C., and Brown, J. 2016. Can oral sucrose solution alleviate castration pain in piglets? Results of an evaluation using a behavioural test. 50th Congress of the International Society for Applied Ethology, Edinburgh.

Seddon, Y.M., Brown, J., Whittington, L. and Richards, D. Options for managing group-housed sows. National Hog Farmer 2015 Blueprint Issue, October 2015.

Seddon, Y.M., Fynn, M. Xiang, C., Elliott, M., Connor, L., Whittington, L. and Brown, J.A., 2016. National Sow Housing Conversion Project, PSC Annual Report 2015-2016.

Stevens, B., Karlen, G.M., Morrison, R., **Gonyou, H.W.**, Butler, K.L., Kerswell, K.J. and Hemsworth, P.H. (2015). Effects of stage of gestation at mixing on aggression, injuries and stress in sows, Applied Animal Behaviour Science, 165: 40–46.

Tajallipour, M., B. Awume, M. Nemati and **B. Predicala**. 2015. Control of H2S emission at ambient temperatures using ZnO nanoparticles. Journal of Hazardous Materials. October 2015.

Vidovic, S., J. Elder, P. Medihala, J.R. Lawrence, **B. Predicala**, H.Zhang and D.R. Korber. 2015. ZnO nanoparticles impose a panmetabolic toxic effect along with strong necrosis, inducing activation of the envelope stress response in Salmonella enterica serovar Enteritidis. Antimicrob Agents Chemother 59:3317–3328. doi:10.1128/AAC.00363-15.

Whittington, D.L. and Murray Elliott (2015). Effectively Assessing Barn Renovations, Vol 21, No 1, pg 5-7

Whittington, D.L., (2015). Building Innovation Into What We Do – Everyday!, Vol 21, No 1, pg 1

Whittington, D.L., (2016). Optimization of Pork Production Facilities. Centered on Swine, Vol 22, No 1, pg 1

Whittington, D.L., (2016). What Does Being Sustainable Really Mean?, Vol 21, No 2, pg 1

Whittington, D.L., Beyond 30 Pigs Per Sow Per Year, Suinter8, Foz do Iguacu, Parana, Brazil

Whittington, D.L. 2015. Research in Swine Transportation. CCSI Genetics Technical Committee, St. Alexis des Monts, QC. May 22.

Whittington, D.L. 2015. The Future of Research – Industry University, Government Partnerships, CCSI AGM, London, ON, June 30.

Whittington, D.L. 2016. A Review of Transportation Research – 21st Century Pork Forum, Scotsdale, AZ, April, 2016

Whittington, D.L. The Future of Agricultural Research, Suinter8, Foz do Iguacu, Parana, Brazil, June 2015

Whittington, D.L., Many Innovations and Large Attendance at Eurotier 2014. Better Pork, June 2015, pgs 38-45.

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