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PRAIRIE SWINE CENTRE

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Swine welfare a hot topic in cold Banff

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Just prior to the start of the Banff Pork Seminar, on January 9, while it was quickly becoming frigidly cold outside, discussions were taking place around animal welfare in modern pork production systems.

More than 40 pork producers, industry representatives and researchers came together for a research forum to hear the results generated from the Natural Sciences Engineering Research Council (NSERC) Industrial Research Chair (IRC) in Swine Welfare research program. The program is located at the University of Saskatchewan, led by Yolande Seddon. The forum was hosted by Prairie Swine Centre, which played a key role in the establishment of the research Chair.

Seddon kicked off the meeting with an overview of the factors at play driving the conversation forward on animal welfare, including emerging regulatory changes. This includes the switch to group sow housing by 2029, as mandated by the National Farm Animal Care Council's (NFACC) Code of Practice for the Care and Handling of Pigs, along with changes to the Health of Animals Regulations under the Health of Animals Act.

Transport regulation changes have come under fire from the industry, as changes are considered to be not fully informed by science, due to a lack of research in the area of swine transport.

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The NSERC IRC in Swine Welfare program was on full display during a forum in advance of the Banff Pork Seminar.

Program created to address industry challenges

With the onset of regulatory changes for animal welfare, in 2015, the industry recognized the need to proactively respond, which prompted 14 partners in the Canadian pork value chain to come together with a vision to enhance collective understanding of welfare considerations.

The solution was the creation of a research Chair in swine welfare, providing resources to address current and future challenges. The University of Saskatchewan agreed to create a position at the Western College of Veterinary Medicine (WCVM) in Saskatoon, and following a competitive application process, including an international scientific review, NSERC matched industry funding to create the five-year program, which started in 2018 and is now wrapping up.

From the beginning, the objective was to conduct research to support sustainable pork production systems, with a focus on improving welfare in fully slatted reared pigs, including tools to measure and monitor welfare. Along with improving welfare of pigs on-farm, the program provides an opportunity to communicate progress on animal welfare within and outside of the industry.

This objective was split into four goals: 1) the impact of early life influences on sociability and resilience to stress of growing pigs; 2) the ability for play to induce positive emotions and immune response; 3) the identification of biological markers to indicate welfare; 4) and the examination of carcasses at processing to measure welfare.

During the forum in Banff, three PhD students and one postdoctoral fellow presented their research results tied to the respective program goals.

GOAL 1 - Early life management leads to long-term success

Siba Khalife looked at how early life management of pigs influences their long-term welfare in fully slatted systems. Pigs were provided enhanced management consisting of chewable materials to support normal foraging behaviour, intermittent positive human contact to reduce their fear of humans and additional space to support social skill development either in the farrowing room, nursery or both stages until 12-weeks-old, before returning to 'standard' production conditions and followed to slaughter.

Pigs provided with enhanced management in both the farrowing and nursery stage had higher lifetime weight gain thanks to improved growth in the nursery period, and better handleability scores at the end of the nursery period, suggesting that modifications in early life management can have long-term positive effects.

GOAL 2 - Play provides benefits beyond enjoyment

Understanding the role of play as it relates to disease resiliency and quality of life provides production benefits for producers and increases public trust for the entire industry.

Karolína Steinerová explored whether play behaviour can be used as a tool to enhance positive welfare and quality of life for pigs, while also supporting benefits for production.

When pigs play, they're happier and healthier, which support their wellbeing and those who work with them in the barn.

Research showed it's possible to stimulate play in pigs in a commercial environment beyond the age it naturally occurs – between two- to six-weeks-old – demonstrating the potential for the industry to promote this behaviour, characterized by spontaneous excitement with arousal. The research also collected data supporting the assumption that play is a positive experience for pigs, therefore increasing the evidence that play can be used as an approach to support positive welfare in commercial settings.

Since positive emotional wellbeing is associated with improved health and resilience in humans, an important aim of the research was to evaluate whether the same benefits can be realized by pigs, through play. Exciting findings reveal that when challenged with a Porcine Reproductive and Respiratory Syndrome (PRRS) infection, pigs reared with play opportunities had a more moderated immune response than control pigs – those reared without play – suggesting a lower inflammatory response.

Pigs reared with play and control pigs both fended off the PRRS virus at the same rate, but pigs reared with play gained more weight. Pigs reared with play also experienced lower respiratory distress and for less time, suggesting enhanced disease resilience. For producers, this demonstrates the potential to incorporate play strategies into production to better manage disease threats. Improved approaches to animal care routines can promote positive welfare, enhancing pigs' quality of life and resilience to production stressors. Positive welfare can also be incorporated in on-farm assessment programs as a measure of animal care. The next steps are to test play promotion on commercial farms to develop practical adoption strategies.

GOAL 3 - Physical indicators speak volumes

Whether looking at live pigs or carcasses, biological markers and other physical indicators can paint a picture of welfare that is now better understood. By tying this understanding to farm- and processing-level assessments, decisions around pig care can be evidence-based.

Darian Pollock presented her work on using hormone levels in swine hair to measure welfare and discussed the applicability of this technique for genetic selection for stress resilience. Hair collection is a non-invasive, low-cost method of sample collection, and a section of hair can provide information on the hormone activity over time, corresponding to the hair growth, helping to reduce the frequency of sample collection and providing a chronic measure.

One of the significant advantages of the NSERC IRC in Swine Welfare program is the opportunity for additional collaborations with industry researchers across North America. Darian Pollock presented work on a collaboration between the WCVM Swine Welfare team, Iowa State University and PigGen Canada to analyze hair from pigs with a variety of genetic backgrounds, taking a closer look at using hormone levels for genetic selection of stress resilience.

This work showed a correlation between cortisol levels in hair and the number of struggles and vocalization intensity of

Physical indicators provide a wealth of information on pig welfare, but monitoring at the processing plant level demands automation to support integration.

piglets during a standardized handling test – the backtest – that evaluates behavioural stress response. Hair cortisol levels are also considered 'moderately heritable,' meaning they are somewhat able to be passed from sows or boars to piglets, suggesting the potential application of hair hormones for genetic selection for stress resilience.

When evaluating whether hair hormones were influenced by rearing system modifications that could support improved welfare, Pollock found that hair hormone levels were not influenced by providing straw to pigs, nor by the enhanced early life management practices described by Khalife. However, there was a lot of individual variation in hormone levels, and piglets with lameness pre-weaning did have a higher ratio of cortisol-to-DHEA – a steroid hormone precursor – suggesting hair hormone ratios can potentially be used as a biomarker of individual pig welfare.

GOAL 4 - Assessing on farm welfare at the packing plant

Martyna Lagoda looked at whether physical indicators on pig carcasses could be used to automatically monitor welfare in plants. The research team assessed on-farm welfare indicators all the way from breeding to slaughter. Indicators on carcasses were evaluated using a camera installed opposite the production line after scalding and dehairing had taken place.
Analysis is evaluating if the appearance of skin lesions, tail length and hernias can shed light on the conditions under which pigs were raised. Initial results show a relationship between the proportion and severity of tail-biting on-farm and observable lesions on carcasses, demonstrating how monitoring carcass lesions could be used as a herd diagnostic tool for welfare on-farm and during pre-slaughter handling.

For processors, using these indicators to determine welfare requires seamless integration with existing plant procedures. The research team collaborated with Seok-Bum Ko from the College of Electrical & Computer Engineering at the University of Saskatchewan to develop a software model using artificial intelligence to recognize and track individual pig carcasses and identify different body parts for assessment. The next steps are to train the model to measure skin lesions, tail length and hernias while organizing the data collected for analysis.

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Impact of dietary Calcium and Phosphorus on sow reproduction and bone development in piglets

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Take home messages:

- The recommended level of dietary Ca and P as prescribed by NRC 2012 is adequate for high-producing sows of modern genetics, whether housed in stalls or groups.
- The current recommended levels of dietary Ca and P for gestating sows are adequate for fetal skeletal development.
- Group housing does not negatively affect the sow reproductive performance and in fact, may be advantageous, when using a non-competitive feeding system

Why look at Ca and P levels in gestating sows?

The current nutrient requirements for sows found in NRC (2012) were based on older and limited research for stall-housed sows. Canadian pork producers are committed to transitioning to group housing for gestating sows. As of 2023, more than half of the sows in the country are estimated to live in groups. Group housing offers more opportunities for movement compared to stalls, and it has been proposed that movement is required to maintain bone strength and integrity. Questions have been raised on whether the current recommended levels of Ca and P will be sufficient for animals housed in groups, with the potential for increased mobility.

Improvements in sow productivity have also raised the question whether current dietary mineral recommendations are adequate. The increase in anatomical and physiological demands of the skeletal system has led the feed industry to routinely recommend higher dietary levels of minerals including calcium (Ca) and phosphorus (P). There has been very limited research examining the Ca requirement of the modern, highly prolific sow. It is not known if the Ca requirements to accommodate milk requirements of the larger litters are met by the current dietary inclusion levels or require excessive Ca mobilization from bones. Previous research showed more lameness in sows with low Ca and P intake (Nimmo et al., 1981; Giesemann et al., 1998). Increased Ca demands could be a potential cause of reduced longevity for our sow herd. Currently, Canadian producers are faced with extremely high feed and housing costs, and reduction in sow longevity leads to increased costs associated with raising replacement gilts.

Two experiments were conducted to determine the influence of dietary Ca and P levels in the gestation and lactation diets of high producing sows on Ca and P balance, productivity, bone turnover, and bone development in piglets. The objective of the first study was to determine if the recommended levels of dietary Ca and P are adequate for sows housed in groups that have potential for increased mobility. The second study was conducted to determine the influence of Ca and P intake by young, gestating sows on the growth and skeletal development of their developing piglets and if smaller birth-weight piglets are at greater risk from mineral insufficiency during gestation.

Table 1. Analyzed dietary Ca and P levels used in treatment diets

	-15% Ca and P	Control	+15% Ca and P
Trial 1			
Gestation			
Ca, %	0.67	0.70	0.76
Total P, %	0.54	0.59	0.63
Lactation			
Ca, %	0.64	0.78	0.89
Total P, %	0.58	0.67	0.79
Trial 2			
Gestation			
Ca, %	0.64	0.75	0.89
Total P, %	0.54	0.59	0.67

Trial design

First trial: The experiment was designed using a 3 x 2 factorial arrangement of treatments with dietary Ca:P level and housing strategy as main effects. A total of 180 sows were randomly assigned to one of the 6 treatments. Three dietary levels of Ca and P were fed (Table 1). The control diet followed NRC (2012) recommendations. The other treatment diets were formulated with Ca and P levels 15 % lower and 15 % higher than the control, primarily by increasing limestone and monocalcium P content. The ratio of Ca and P was maintained across diets within each phase. Two different housing strategies were used; individual stalls and group (modified free access housing). Free access housing ("walk-in lock-in" stalls) allows sows access to feed in a non-competitive environment, however they can leave the stall when desired. To accommodate the experiment, these sows were locked in for individual, controlled feeding and then forced out of their stalls into a group pen for the remainder of the day. Treatment groups were balanced across parities.

Second trial: A total of 30 young sows (gilts and parity 1) were randomly assigned to 3 treatment groups, consisting of similar Ca:P levels in their gestation diets as described for the first trial (-15%, control, and +15%; Table 1). All sows were housed in individual stalls during gestation. A standard lactation diet was available ad libitum to all sows on study during lactation. In each litter, the smallest or second smallest piglet (SMALL, average birth weight 0.86 kg) and a piglet representing the heaviest 20% of the piglets (NORM, average birth weight 1.36 kg) were selected and birth weight recorded.

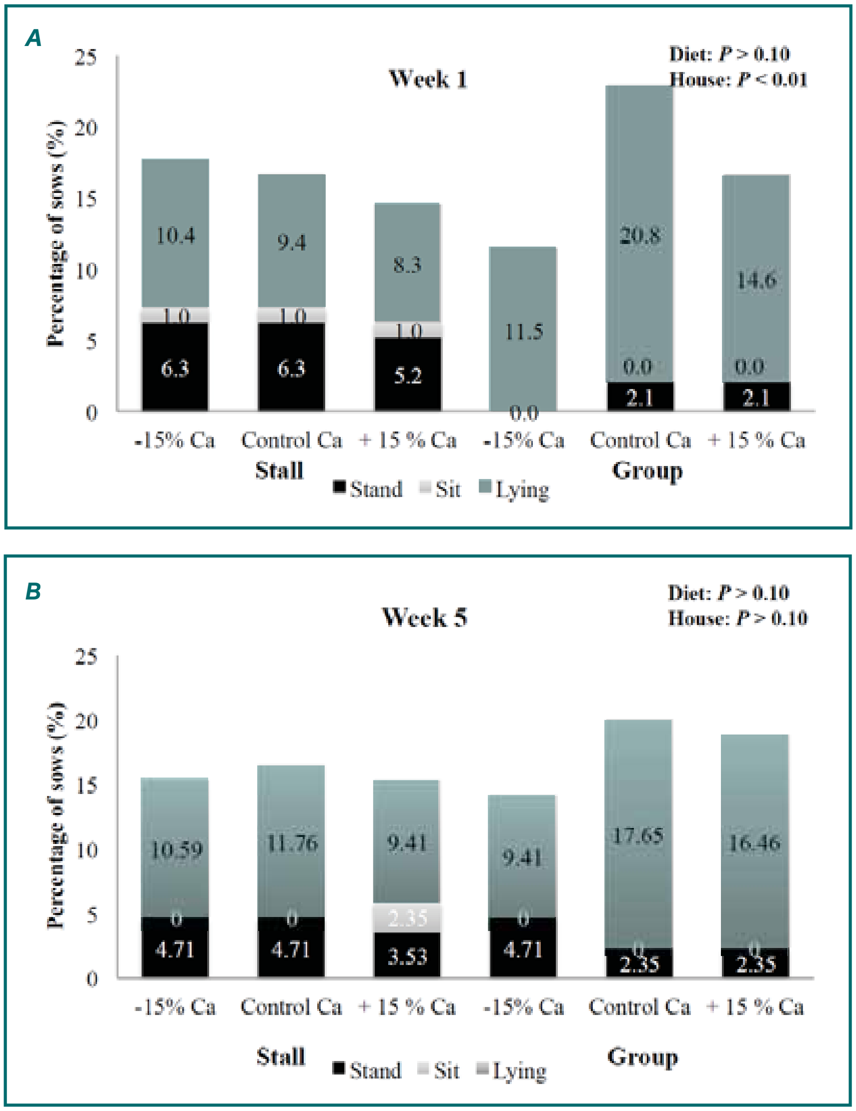

Figure 1. Video observation of sows, % by treatment and posture in wk 1 (A) and wk 5 (B) on trial. Data presented as number of sows per total number of sows observed (n = 81 for stalls, n = 81 for group).

For both trials, gestation feeding began when sows were moved to the gestation room from breeding (approximately d 28 of gestation). Sows were fed 2.3 kg/d until 2 wk prior to farrowing, when this allotment was increased to 3.0 kg/d. Sows were moved to the farrowing room 1 wk prior to the anticipated farrowing date and kept in farrowing crates. Piglets were cross-fostered within the first 24 h of birth but only within the dietary treatment assigned during gestation.

What we found

Effect of Ca and P level:

Reproductive performance: The first trial showed no effect of Ca and P level on sow weight on d 28 and 107 of gestation and at weaning, or sow feed intake during lactation. Both trials showed no effect of Ca and P level on total number of piglets born, the number of liveborn piglets, piglet birth weight, piglet weight gain, or weaning weight (Table 2).

Sow and piglet serum constituents: In the first trial, group-housed sows fed the -15 % diet had reduced serum Ca in late gestation (diet × housing interaction; P = 0.02) and the greatest reduction (between d 28 to d 100 gestation) in serum P level (diet × housing interaction; P = 0.04). In the second trial, serum Ca was not affected by diet in late gestation, but prior to weaning sows fed the -15% diet had the highest level of serum Ca while sows fed the high Ca and P diet had serum Ca levels comparable to the control.

Osteocalcin (OC) and pyridinoline (PYD), markers of bone formation and resorption, respectively, were unaffected by Ca and P level in both sow and piglet serum.

In the second trial, the highest piglet serum Ca level at birth was seen in the small piglets from sows fed a high Ca diet (diet × size interaction; P = 0.04) however, at weaning, this value had the smallest deviation from the initial value (diet × size interaction; P = 0.02).

Other parameters: An effect of diet was observed for fecal Ca excretion during both stages of reproduction as the amount of Ca excreted in the feces increased as the levels of dietary Ca increased (P < 0.05).

(Impact of dietary Calcium ... cont'd on page 10)

Evaluation of a Pilot-Scale Electro-nanospray System for Decontaminating Pig Barns

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Exposure to bioaerosols, noxious gases, and high dust concentrations in confined livestock facilities have been linked to human and animal health hazards, with consequent adverse economic implications. Having a safe and secure workplace is essential for hog operations, and necessitates the need for enhanced strategies to address the concerns due to air contaminants in production facilities. In this study, an electro-nanospray system was developed for pig barn decontamination. This technology generates engineered water nanostructures (EWNS) through electrospraying and ionization of reverse osmosis (RO) water. The highly charged nano-scale water droplets encapsulate reactive oxygen species (ROS), which are responsible for bacterial inactivation and for capturing particulate matter through electrostatic forces.

The size of generated EWNS is dependent on the liquid electrical pH and conductivity, liquid flow rate, applied voltage, distance between needle tip and counter electrode, and needle diameter. These nanodroplets are highly mobile and can remain suspended in the air for hours colliding with particulate matter in the air, effectively removing dust from the air through Coulomb interactions. The oppositely charged dust and water droplets attract each other, resulting in the deposition to surfaces through gravitational force. Due to the highly reactive oxygen species (ROS) encapsulated in the EWNS, it can deodorize compounds through various chemical reactions, while ROS such as hydroxyl radicals, superoxide, and hydrogen peroxide cause oxidative stress, damage cell membranes and lipoproteins through lipid peroxidation, resulting in microbial deactivation. Aside from the previously mentioned advantages, electrospray is environmentally benign and safe due to the absence of chemical residues.

Studies on the application of electrosprays in decontaminating animal facilities are limited and not fully established. Recently, laboratory scale studies optimizing the operating parameters of the electro-nanospray system for the inactivation of surface and air contaminants relevant to livestock operations showed the importance of design parameters such as increasing the distance of the capillary needle, liquid flow rate, pH, and conductivity could increase the electrospray area. However, other operating conditions in livestock stock facilities require further examination, including the number of EWNS generators, higher ventilation rate, relative humidity (RH), dust and bioaerosol concentrations, and effect on diverse contaminants.

Project motivation and knowledge gap

Existing electrospray technology developed by various researchers provided a clearer understanding of its mechanism and applications on surface and air decontamination. However, the effects of the electrospray system generating nano-scale water droplets in inactivating airborne bacteria, reducing dust and noxious gases, and decontaminating surfaces in actual livestock barns are not yet tested. Therefore, this project aimed to further refine and evaluate the performance of an electro-nanospray system in improving air quality and decontaminating surfaces in a swine barn, specifically looking at variations in ventilation rate, the number of needles, higher relative humidity, higher dust and bioaerosol concentrations, and different contaminants.

> "The electro-nanospray system effectively reduces levels of bacteria, gases and dust."

The objective of the work was to design and investigate the effectiveness of the electro-nanospray system in decontaminating a small pig room. Specifically, this study aimed to:

1. Determine the decontamination performance under a broad range of operating parameters such as airflow rate and number of spray injectors in laboratory-scale chamber;
2. Evaluate the performance of the electro-nanospray system in inactivating airborne bacteria, reducing gases and dust levels in small-scale pig rooms; and
3. Evaluate the performance of an electro-nanospray system in decontaminating barn surfaces.

Laboratory-scale evaluation

Prior to testing the nanospray under actual swine barn environment, laboratory-scale experiments on bioaerosol deactivation were conducted using an acrylic chamber in which the electro-nanospray system was installed. A series of experiments were conducted wherein Escherichia coli was dispersed as test bioaerosol pathogen inside the chamber and the resulting E.coli deactivation efficacies were determined at varying number of EWNS needle spray injectors and bioaerosol concentrations. The test chamber was also used to conduct experiments to determine the effect of the nanospray on decontamination of various types of surfaces commonly found in hog production facilities such as plastic, metal, wood, and concrete.

In-barn assessment

In this study, an electro-nanospray system generating engineered water nanostructures (EWNS) was designed and tested to reduce microorganisms in air and on surfaces and airborne particulate matter in a swine barn room. The electro-nanospray system was enclosed in an acrylic treatment chamber and installed in one of the two pilot-scale rooms (Control vs. Treatment) at Prairie Swine Centre, with four grower/finisher pigs per room. Over the 8-week trial, air samples were collected to evaluate the impact of the electro-nanospray system on levels of airborne dust and bacteria, gases (i.e., ammonia, hydrogen sulphide, carbon dioxide, ozone) and microbial population on various types of surfaces, including concrete, wood, polycarbonate plastic and stainless-steel metal. Three replicate trials were conducted.

Operating conditions were optimized in the previously conducted laboratory-scale study. All other design and operating parameters are the same as those determined from the laboratory scale experiment. In the treatment room, the contaminated air from the room was drawn into treatment chamber and subjected to the EWNS generated by the electro-nanospray system installed in the chamber, and the treated air was recirculated back to the room airspace. Thus, the continuous flow of room air into the electro-nanospray treatment chamber resulted in continuous partial cleaning of the air in the overall room airspace through recirculation of treated air to mix with the bulk air in the room airspace.

Monitoring was initiated during the first two weeks of the trial to collect baseline data, after which treatment was applied by turning on the electro-nanospray treatment system from 3rd to 7th week, at which time the electro-nanospray system was turned off. Then, monitoring was continued for another week to determine any residual effect of the treatment on room air quality. Air samples were collected 0.6 m away from the exhaust at 1 m above the pigs.

Results

Theoretical calculations done as part of the laboratory assessment revealed that the optimum air flow rate was 10 ACH, resulting in 49% microbial reduction using E. coli as test pathogen. Considering this deactivation efficiency, the optimum number of spray injectors for the volume of 0.25 m3 treatment chamber used is 16. Furthermore, it was observed that higher reduction efficiency could be achieved at higher bioaerosol concentrations, wherein 1.3 x 105 colony forming units (CFU) per m3 achieved the highest reduction efficiency at 61% after an hour of treatment using the optimized operating conditions. Surface decontamination tests using laboratory-scale set-up to apply the EWNS nanopsray on various surfaces such as stainless-steel metal, polycarbonate plastic, slab wood, and concrete showed 71%, 64%, 59%, and 51% microbial reduction, respectively.

The optimized and designed electro-nanospray system was installed in a small pig room at PSC with four grower/finisher pigs. One electro-nanospray system was installed during the preliminary trial, and two units were installed in pilot-scale trials. Results from the preliminary trial with one electro-nanospray system showed no measurable impact on culturable bacteria, and hydrogen sulphide; however, an average reduction of 28% and 80% was observed for dust and ammonia concentrations. Various in-barn surfaces such as concrete, stainless-steel metal, polycarbonate plastic, and wood slab resulted in surface microbial reduction of 32%, 26%, 22%, and 19%, respectively. Pilot-scale experiments with two electro-nanospray systems installed showed better results on culturable bacteria and dust concentrations with 31% and 42% reduction efficiency, respectively. Moreover, surface decontamination revealed 46%, 36%, 31%, and 29% microbial reduction on concrete, stainless-steel metal, slab wood, and polycarbonate plastic surfaces, respectively. On average, a reduction of 40% in ammonia concentrations was observed, which was relatively lower than the preliminary trial results, mainly due to differences in environmental conditions when the trials were performed (summer vs. winter conditions). Only 6% reduction in hydrogen sulphide was observed. Pig performance showed no significant difference between the Control and Treatment rooms.

Conclusions

Overall, the electro-nanospray system can provide an innovative approach to mitigating air quality as it can reduce levels of bacteria, dust, and gases. In addition, no chemical residues remain; thus, it can be a sustainable and environment-friendly treatment technology for barn air and surface decontamination.

Results from this study effectively reduced microorganisms in the air and on surfaces. Although EWNS can potentially deactivate gram-negative bacteria such as E. coli, further investigation of other susceptible microorganisms in the barn that can be deactivated by this technology should be identified, and the performance in deactivating infectious, transmissible pathogens of concern to the swine industry, such as PRRSV should be investigated in future work.

The effects of the electro-nanospray technology when applied in larger-scale swine rooms over a longer period should be evaluated. To assess the overall health impact, we need to analyze the effects on lung function and respiratory system of pigs after exposure to EWNS. After which, a feasibility analysis for implementation of this treatment technology in commercial livestock facilities should be conducted.

A Survey of Best Management Practices of Swine Farms Across Canada

Ken Engele, BSA. P.Ag.
Prairie Swine Centre

The past three years have been one for the record books. Starting in 2021 widespread dryness seen throughout western Canada, not seen on this level since 2002, resulted in record high feed costs for many producers. Overall 2021 resulted in a crop that was 40-50 percent of average. As any livestock producer knows, feed costs are always the single biggest factor representing 60-70 percent of the total cost of production. Residual effects of these high grain prices carried throughout 2022 and well into 2023. Grain prices increased significantly with wheat and barley prices close to doubling the values seen in the fall of 2020.

The past three years have experienced inflationary pressures not seen since the 1970s, increasing the financial burden producers have faced over this period. In 2022, for the first time ever many producers achieved an average hog price that exceeded $200/ckg for the entire year. While this is a good news story, the challenge was, at the same time cost of production increased up to $60/ckg for some producers over this same period. Many producers break evens ranged between $220-240/ckg. This change in price relationships meant many producers still struggled with positive margins throughout 2022.

A new year brought a set of new challenges. The positive, a drop in feed cost throughout 2023, between $25-30/pig in many cases, provided producers optimism of an improved financial position throughout the year. The negative, an unresponsive hog price resulted in positive margins, for less than expected number of weeks throughout the summer, largely remaining negative for a majority of the year. While feed cost garner most of attention and rightly so, we should not lose focus on those things that we do on-farm on a daily basis to ensure we are optimizing each phase of our farms. Day-to-day activities can be lost in all the noise of everything going on in the barn. Ensuring we are do all the little things right everyday add up to bigger savings than you might think possible?

> “By focusing on 6-8 daily tasks we can effectively improve our returns by $6-8/hog”

How are we doing as an industry?

Two projects funded by Swine Innovation Porc and carried out by Prairie Swine Centre (PSC) and Centre de développement du porc du Québec (CDPQ) examined the adoption of best management practices on farms throughout Canada. The first project audited 24 farms across Canada (2018), with a minimum of two farms in each province, consisting of a questionnaire and an on-site visit. The second project focused on a survey (2023) of pork producers, throughout Canada, of various best management practices implemented in their operations.

Each project had good representation of size and type of operations across the industry. Size of operations ranged from 300 to 6,000 sows, while farrow-to-finish and farrow-to-wean

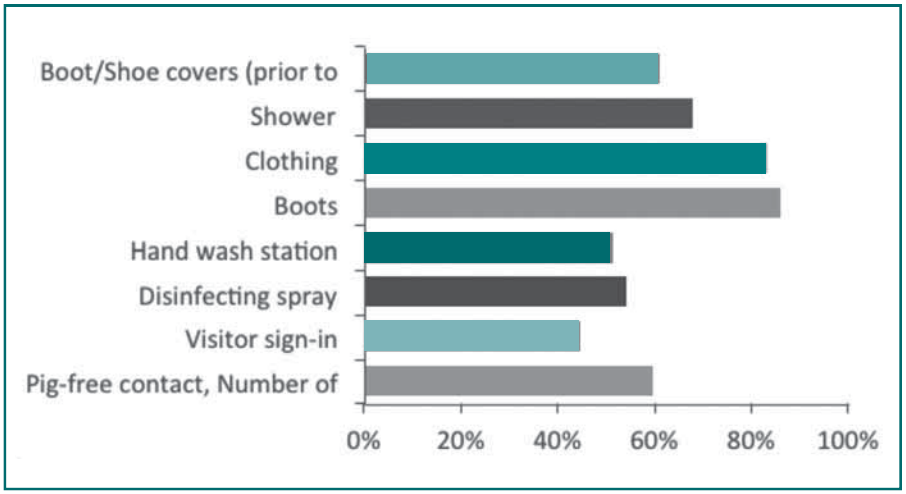

Figure 1. Biosecurity measures implemented on-farm.

operations represented approximately 80% of respondents, with the balance being wean-to-finish operations. Focus of each project was similar. Each focused on best management practices looking at biosecurity/herd health, feed/feeder management, and personal protection, water use/management, in addition to each phase of production (breeding, gestation, farrowing, nursery, and grower-finisher). We analyzed the results from each project, measuring the change in the adoption of best management practices across projects.

Biosecurity Measures

Overall, the industry seems to be doing a good job at implementing various biosecurity measures in their operations. Individual farms need to calculate their individual risk reward ratio when it comes to biosecurity procedures, as not all farms face the same level of risk. Some things to take into consideration is the disease status of your herd or your neighbours herd, proximity to neighbours, pig density in the surrounding area, diseases circulating in the area (PEDv, PRRS), value of your herd (multiplier), and the ability for you to weather some magnitude of a disease break. These things all change over time, as a result discuss biosecurity measure with your employees, management team, and herd health veterinarian on a regularly scheduled basis to ensure you are doing everything possible to keep your herd healthy as possible.

Biosecurity is often one of those things that we take or granted, that is, until something goes wrong. Like insurance, biosecurity is an integral part of your day-to-day operations, but essential in avoiding a major business interruption. Figure 1 displays the eight common biosecurity steps implemented on farms throughout Canada. You should take the opportunity to speak with your veterinarian, on your next herd health visit, to reassess policies and procedures that are right for your operation.

Enrichment

Enrichment seems to be one of those things that can be easily over looked. The National Farm Animal Care Council's 2014 update to the Canadian Code of Practice for the Care and Handling of Pigs states that all pigs must have "multiple forms of enrichment that aim to improve the welfare of the animals through the enhancement of their physical and social environments." While implementing enrichment on-farm is simple in nature, the proper selection, installation and maintenance of enrichments can have a positive impact to the bottom line of your operation. The lack of enrichment is known to result in more problematic behaviours such as tail-biting and belly-nosing and there is a need for practical and cost-effective solutions that producers can implement.

Based on information presented in Figure 2 enrichment is an area that require additional attention from producers. As seen in Figure 2, just over 50% and 60% of farms incorporate enrichment into nursery and finisher respectively. According to the Code of Practice for the Care and Handling of Pigs (NFACC, 2014) pigs must be provided with multiple forms of enrichment that aim to improve the welfare of the animals through the enhancement of their physical and social environments. The incorporation of enrichment into individual facilities is unique to each operation. Support tools regarding enrichment materials are available in Appendix H of the Code, with different types of enrichment grouped into categories along with the advantages and disadvantages of each type.

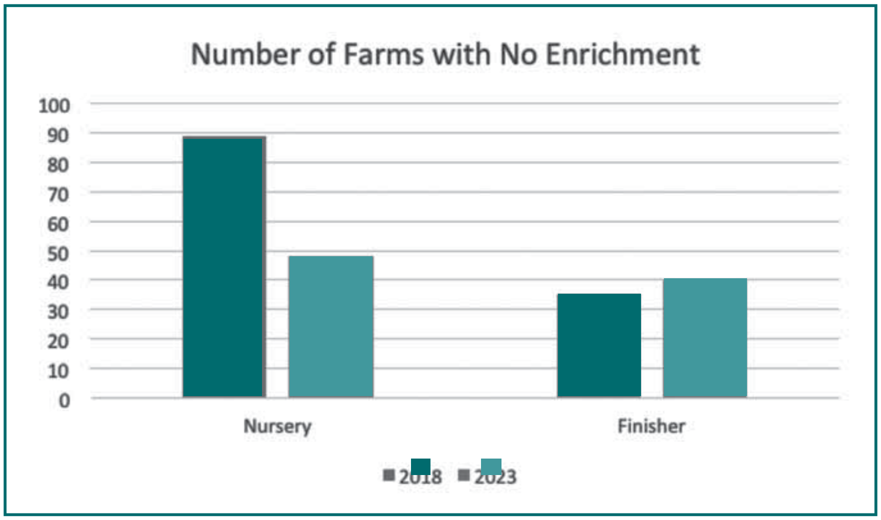

Figure 2. Number of farms surveyed with no enrichment 2018-2023.

As outlined in Appendix H (page 54) of the Code of Practice there are six criteria to consider when choosing enrichment for your operation. Considerations could include the follows aspects: SIMPLE, SAFE, SANITARY, SITE, SOFT, & SUSPENDED.

(A Survey of Best Management Practices ... cont'd on page 11)

(Impact of dietary Calcium ... cont'd from page 5)

Femurs of piglets from sows fed the low Ca and P diet had the highest cortical density (P = 0.03), as measured using peripheral quantitative computed tomography (pQCT). Bone ash %, ash Ca %, ash P %, were unaffected by dietary Ca and P levels.

Effect of sow housing:
Sows housed in groups were heavier at day 100 of gestation than those in stalls, despite no difference in feed intake ($P < 0.05$). Housing (groups vs. stalls) had no effect on total number of piglets born, piglet weight gain from birth to weaning, or weaning weight. The number of liveborn piglets and birth weight was greater in sows housed in groups relative to stalls ($P < 0.05$; Table 2).

In the first week, ~57% of sows housed in stalls were observed to be lying down vs. ~90% of group-housed sows (Figure 1a). In week 5, whether measured using accelerometers or behavioural analysis, there was no difference in number of steps taken by the sows due to housing (Figure 1b).

What it means

Ca and P level: Our study showed that varying dietary Ca and P for gestating sows did not negatively influence the serum Ca and P or bone marker levels in newborn piglets, even those born to younger sows. Our results also showed that the blood Ca of newborn piglets is maintained regardless of the maternal blood Ca level, suggesting that maternal skeletal Ca reserves, as a source of Ca for the piglets during developmental stage, may be mobilized should a deficiency in dietary Ca occur in sows during gestation.

The consistent percentage of bone ash, ash Ca and ash P observed in our study, regardless of treatment, suggests that the current recommended levels of dietary Ca and P for gestating sows are adequate for fetal skeletal development. This conclusion is supported by the estimations of cortical density and bone strength obtained from pQCT bone analyses.

Results from these studies suggest that the recommended level of dietary Ca and P as prescribed by NRC 2012 is adequate for high-producing sows of modern genetics, whether housed in stalls or groups. Moderate changes in Ca and P intake by young, gestating sows, does not negatively affect the growth or skeletal development of their piglets.

Table 1. Analyzed dietary Ca and P levels used in treatment diets

	-15% Ca and P	Control	+15% Ca and P
Trial 1			
Gestation			
Ca, %	0.67	0.70	0.76
Total P, %	0.54	0.59	0.63
Lactation			
Ca, %	0.64	0.78	0.89
Total P, %	0.58	0.67	0.79
Trial 2			
Gestation			
Ca, %	0.64	0.75	0.89
Total P, %	0.54	0.59	0.67

Sow housing: The improvement in reproductive performance of sows housed in groups compared to stalls suggests that group housing does not negatively affect the sow reproductive performance and in fact, may be advantageous. However, a few factors, such as the feeding system, and the number of parities evaluated in these studies require consideration. In the current study, sows that were assigned to stalls or groups were manually fed in their individual feeders without the need to compete for feed. Extrapolating this data to systems that utilize a competitive feeding system in group housing requires caution.

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Table 2. Effects of dietary Ca and P level and housing on sow reproductive performance in the first trial

	Diet			SEM	Housing		SEM	P-value		
	-15%	Control	+15%		Stall	Group		Diet	Housing	Diet × Housing
Sows, n	51	54	57	-	81	81	-	-	-	-
Live born piglets, n	14.2	14.3	14.7	0.43	13.9	14.9	0.36	0.60	0.03	0.54
Litter size, n	15.2	15.6	16.1	0.55	15.2	16.1	0.38	0.38	0.07	0.46
Birth wt, kg	1.56	1.51	1.49	0.03	1.49	1.55	0.03	0.26	0.04	0.87
Weaning wt, kg	6.67	6.58	6.72	0.14	6.59	6.73	0.12	0.76	0.39	0.86
Weight gain, kg/piglet·d^{-1}	0.23	0.23	0.23	0.01	0.23	0.23	0.01	0.99	0.41	0.21

(A Survey of Best Management Practices ... cont'd from page 9

Water Use and Management

Among nutrients, water is required in the greatest amount but quite often receives the least attention. Water intake of finisher pigs is approximately two to three times feed intake, depending on body weight and feed intake. However, most 'water intake' reported is in the form of water disappearance from drinkers, including water wastage, rather than water actually consumed by pigs. Previous work has shown finishing pigs can waste 25% of water from well-managed nipple drinkers; therefore, opportunities exist to reduce wastage by adjusting flow rates on a regular basis.

We measured on-farm water flow rates and nipple drinker heights on 24 farms across Canada, representing each phase of production from gestation to finishing. Table 1 outlines water flow parameters showing ranges measured for low, target, high, and very high values. Recommended flow rates should range between 1.0 to 2.0 L/min and 0.5 to 1.0 L/min for farrowing and all other phases of production respectively.

Overall water management within audited farms varies across phase of production (Table 2). Generally, producers do a better job in managing flow rates within Gestation (pens) and Nursery, where approximately 60% of the nipple drinkers measured met the target flow rate. The challenge is in Finishing, where approximately two-thirds of nipple drinkers provide flow rates in excess of pig's requirement, with 11% of nipple drinkers being rated very high (>2.5 L/min). Assuming the cost of manure disposal is $0.015/gallon, the additional water wastage would cost producers, on average, $2.20-$2.60/hog.

Table 1. Water flow recommendations

	Low (l/min)	Target (l/min)	High (l/min)	Very High (l/min)
Gilt pen	<0.5	0.5-1.5	1.5-2.5	>2.5
Gestation	<0.5	0.5-1.5	1.5-2.5	>2.5
Farrowing	<1.0	1.0-2.0	2.0-3.0	>3.0
Nursery	<0.5	0.5-1.5	1.5-2.5	>2.5
Finishing	<0.5	0.5-1.5	1.5-2.5	>2.5

Table 2. Measured water flow rates of selected farms across Canada (%)

	Low (l/min)	Target (l/min)	High (l/min)	Very High (l/min)
Gilt pen	5.1	33.33	56.4	5.1
Gestation	0	59.4	21.9	18.8
Farrowing	15.3	38.9	29.3	16.6
Nursery	15.2	56.8	19.0	8.9
Finishing	5.4	29.3	54.3	10.9

Conclusion

Based on the survey results we can see that little changes can make a big impact on the overall profitability of your operation. While most producers are aware of individual best management practices throughout their barns, day-to-day activities and emergencies sometimes get in the way. Currently there seems to be a margin for improvement as we incorporate approximately 50% of measured and surveyed best management practices. I do not think it is possible to complete 100% of tasks 100% of the time, however if we can move that needle incrementally from 50% to 55% then to 60% can save producers substantial dollars over the long run.

(Swine welfare a hot topic in cold Banff... cont'd from page 3)

Research supports pigs and people

Given the success of the projects under the NSERC IRC Swine Welfare research program, the group is looking to continue its efforts on behalf of the Canadian pork industry. The commitment of NSERC and producer organizations to date has made it possible to build a strong research team that is also able to look at other welfare priorities outside of the research Chair focus, providing opportunities to up-and-coming professionals aiming to make their careers here in Canada. Carmen Cole, who first joined the swine welfare research group to do her undergraduate research thesis, then continued as a research technician, is now a Master's student with the group. She had the opportunity during the forum to present on her work developing and validating a one-step electrocution technique for on-farm euthanasia. As her research continues, the program holds value not only for the students engaged in the work and the pigs whose quality of life is improved, but also for those who reap its benefits in pork production and processing. Seddon ended the research forum with a call to action: as the program will end in June 2024, she encouraged stakeholders to consider renewing their commitments to the program, both financially and in principle. Sustaining a research Chair in swine welfare maintains key research infrastructure for the industry and demonstrates a strong working partnership. She also encouraged producers to think about how they can incorporate results of this work into their own operations.

The NSERC IRC in Swine Welfare program wraps up this year, but researchers are looking for continued support.

This certainly gives everyone enough to think about while we're waiting for warmer temperatures outside!

Personal Profile

Nolan Matuba, BEng.

Nolan graduated from Sorsogon State University in the Philippines and holds a Bachelor's Degree in Electrical Engineering. He worked for 9 years in the construction industry in the Philippines as a quantity surveyor and cost control estimator in electrical for industrial, mid to high-rise residential, and commercial buildings. He was given an opportunity to study at the University of Saskatchewan as a Master's student in Biological Engineering and is working under the supervision of Dr. Bernardo Predicala. His research will be focusing on determining the optimum environmental temperature requirements of sows and grower-finisher pigs that will reduce energy costs and environmental carbon footprint while maintaining the overall productivity and performance of the pigs.

Coming Events

Saskatchewan Livestock Expo
February 22, 2024
Swift Current, Saskatchewan

London Swine Conference
March 5-6, 2024
London, Ontario

Alberta Pork Congress
June 12-13, 2024
Red Deer, Alberta

Ontario Pork Congress
June 19-20, 2024
Stratford, Ontario

The NSERC Industrial Research Chair in Swine Welfare website is here!

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