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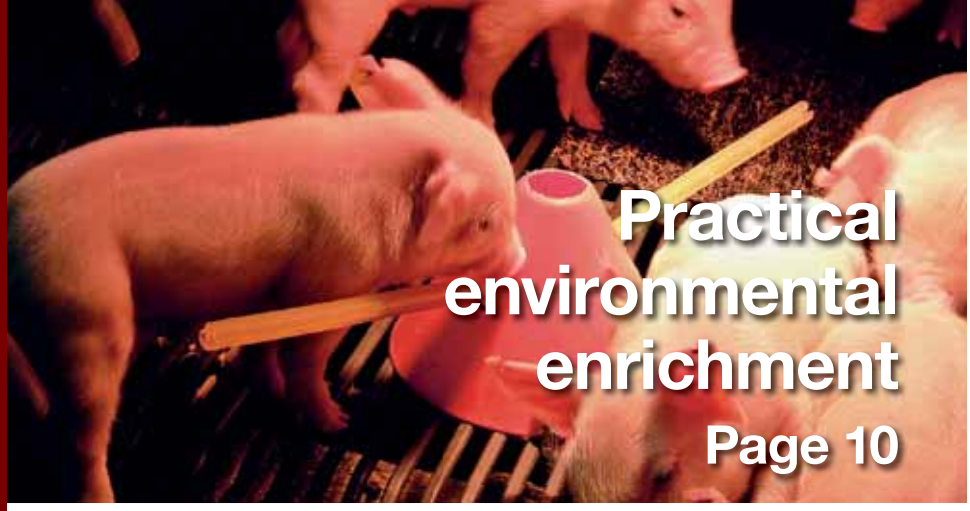

Practical environmental enrichment

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Canadian Hog Journal Message from the editor

Welcome to our annual tradition of celebrating science and research in our summer edition!

It has been really gratifying over the years to build relationships with Canada's leading swine scientists, and I think they look forward to this issue as much as I do.

Science, especially in the U.S. over the last decade, has really been attacked by certain political factions, which makes it even more important to allow the general public to peer into the labs and the ongoing fieldwork that happens in our industry. I have always been impressed by the pork industry's commitment to innovation, and its willingness to invest into improving efficiency and quality of life – for farmers, consumers and of course, the animals at the heart of the business.

As I was finishing this magazine, the news broke that China had banned all meat products coming from Canada. I'm not going lie – my stomach rolled when I saw the headlines. I remember BSE like it was yesterday, and this affects ALL meat sectors. It's hard to even wrap my head around.

It's going to take some time to sort out. I don't doubt Canada's commitment to food safety, transparency and adherence to the rules established by our trading partners. I do know China has a record of being flippant with its trading partners, and for leveraging its immense power in trade to accomplish other political goals.

Some believe this is all related to the December 1 arrest of Meng Wanzhou, a high-up executive with a Chinese tech firm. U.S. authorities had requested the detainment on suspicion of fraud, and the day after suspending all meat imports, China renewed its calls for her release.

If this is, in fact, the real cause of the ban, it leaves Canada in a very tough spot, stuck in a feud between its two largest trading partners. The U.S. is still the destination for 75 per cent of our exports, and China is nearing five per cent, according to World Stop Exports. Nonetheless, China is incredibly important to Canada's meat and livestock sector and we're feeling it.

We will take a much deeper look at this in our fall edition.

Stay tuned, and stay strong. ■

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S Monk.

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What is the long-term production and economic impact of feeding deoxynivalenol-contaminated feed to finisher pigs?

Submitted by Dan Columbus, PhD, Research Scientist, Prairie Swine Centre, Inc., and Michael Bosompem, BSc, MSc Student, Department of Animal and Poultry Science, University of Saskatchewan

Mycotoxins a continuous concern for agriculture

Mycotoxin-contaminated grains are commonly downgraded for use in livestock feed. While the best strategy for livestock producers is to avoid feeding mycotoxin-contaminated grain altogether, with the increased incidence and level of contamination this is no longer a viable option. The mycotoxin, deoxynivalenol (DON), is of significant importance to agriculture since it commonly contaminates corn, wheat, oats, and barley and is one of the most prevalent mycotoxins worldwide. Therefore, strategies which allow the use of mycotoxin-contaminated grains in livestock feed are necessary.

The majority of studies examining the effects of mycotoxins in swine are performed in young (e.g., weaned) animals with the assumption that the effects of consuming mycotoxin-contaminated feed is highest in the young animal. Moreover, previous studies have examined the impact of mycotoxins over a relatively short period of time. It is possible that due to the higher feed intake in grower-finisher pigs and longer possible exposure time that the effects of mycotoxins may be greater in this stage of production. However, it has also been suggested that the effect of mycotoxin intake is reduced in grower-finisher pigs and that older pigs may have the capacity to adapt to DON-contaminated feed, with feed intake and growth performance recovering after a period of exposure. We wanted to examine the impact of long-term feeding of graded levels of DON in finisher pigs to determine whether pigs have the ability to adapt to DON-contaminated feed and the economics of reduced growth performance.

What we did

A total of 200 pigs (initial BW of 76.6±3.9 kg) were housed in groups of 5 pigs/pen and randomly assigned to 1 of 4 dietary

CONTINUED ON PAGE 8

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treatments over 2 blocks (n=10/trt). Dietary treatments consisted of a control diet with no DON contamination (CON), or 1 of 3 DON-contaminated diets containing 1, 3, or 5 ppm DON (DON1, DON3, DON5). DON contaminated diets were achieved by the addition of an appropriate amount of naturally-contaminated wheat and wheat screenings at the expense of clean wheat. All diets were formulated to be isonitrogenous and isoenergetic and to meet or exceed nutrient requirements (NRC, 2012) and both feed and water were provided *ad libitum*. Body weight and feed intake were measured on a weekly basis for 6 weeks for determination of average daily gain, average daily feed intake, and feed efficiency (gain:feed).

What we found

Compared to CON fed pigs, body weight was reduced in pigs fed the DON3 and DON5 diet from week one to the end of the study. Average daily gain was reduced on the DON3 and DON5 diets for the first three weeks of the study, but recovered by week four for DON3 and week five for DON5. Average daily feed intake was reduced only in week one for pigs fed DON3 and DON5 diets and only in DON5 fed pigs up to week four, whereas afterwards ADFI was the

Growth performance of finisher pigs fed diets containing graded levels of DON for 6 weeks

	CON	DON1	DON3	DON5	SEM	P-value
Body weight (kg)						
Day 0	76.9	77.0	76.3	76.0	1.18	0.917
Day 7	85.4^{a}	84.8^{a}	83.0^{b}	80.8^{c}	0.34	<.0001
Day 14	95.3^{a}	95.3^{a}	92.4^{b}	88.7^{c}	0.42	<.0001
Day 21	103.4^{a}	103.8^{a}	99.8^{b}	95.7^{c}	0.50	<.0001
Day 28	112.1^{a}	111.9^{a}	107.8^{b}	103.0^{c}	0.53	<.0001
Day 35	119.7^{a}	119.8^{a}	114.9^{b}	110.4^{c}	0.63	<.0001
Day 42	126.7^{a}	126.9^{a}	123.6^{b}	118.5^{c}	0.80	<.0001
Average daily gain (kg/d)						
Week 1	1.27^{a}	1.18^{a}	0.93^{b}	0.60^{c}	0.05	<.0001
Week 2	1.40^{ab}	1.49^{a}	1.33^{b}	1.13^{c}	0.04	<.0001
Week 3	1.17^{ab}	1.21^{a}	1.06^{b}	1.01^{c}	0.04	0.004
Week 4	1.24^{a}	1.17^{ab}	1.15^{ab}	1.04^{b}	0.04	0.033
Week 5	1.08	1.12	1.01	1.06	0.04	0.392
Week 6	1.06	1.00	1.20	1.14	0.06	0.116
Overall	1.19^{a}	1.20^{a}	1.12^{b}	1.00^{c}	0.02	<.0001
Average daily feed intake (kg/d)						
Week 1	2.59^{a}	2.59^{a}	2.22^{b}	1.70^{c}	0.06	<.0001
Week 2	2.98^{a}	3.07^{a}	2.89^{a}	2.55^{b}	0.07	<.0001
Week 3	3.03^{a}	3.03^{a}	2.88^{a}	2.56^{b}	0.05	<.0001
Week 4	3.25^{a}	3.19^{a}	3.13^{a}	2.85^{b}	0.05	<.0001
Week 5	3.22	3.20	3.19	3.04	0.06	0.222
Week 6	3.19	3.11	3.36	3.05	0.08	0.079
Overall	2.99^{a}	3.06^{a}	2.94^{a}	2.60^{b}	0.05	<.0001
Gain:Feed (kg/kg)						
Week 1	0.49^{a}	0.46^{a}	0.41^{a}	0.34^{b}	0.02	<.0001
Week 2	0.47	0.49	0.47	0.44	0.01	0.136
Week 3	0.38	0.40	0.37	0.40	0.01	0.518
Week 4	0.38	0.36	0.37	0.36	0.02	0.738
Week 5	0.33	0.35	0.32	0.35	0.01	0.211
Week 6	0.33	0.32	0.36	0.37	0.01	0.083
Overall	0.40	0.39	0.38	0.38	0.01	0.073

^{a,b,c,d} Means within a row without a common superscript differ significantly *($P < 0.05$)*

same across diets. Feed efficiency was only reduced for DON5 fed pigs in week one. There was no difference between CON and DON1 fed pigs for any measures.

What does this mean?

While it has been suggested that deoxynivalenol can have a significant impact on animal physiology, with negative effects on gut health, protein synthesis (lean gain), and organ function, the results observed in the present study suggest that the reduction in performance is mostly related to the reduction in feed intake observed immediately after introduction of the experimental diets. Indeed, while feed intake was reduced for up to five weeks in DON-fed pigs compared to control fed pigs, feed efficiency was only reduced in week one, suggesting that the capacity for growth is not affected in these pigs but feed intake is insufficient to support maximum growth. While there was an immediate reduction in feed intake, growth performance, and feed efficiency, these parameters had recovered by week four, for DON3-fed pigs, and week five, for DON5-fed pigs. Based on these results, it would appear that pigs have the ability to adapt to DON-contaminated diets. While feed intake and growth performance had recovered to the level of CON-fed pigs, body weight never recovered.

Economics

Initial results indicate margin over feed costs may not differ between 1, 3, and 5ppm DON contaminated diets. While feeding diets containing 3 and 5 ppm DON resulted in a lighter hog at market resulting in lost revenue up to $20/hog – feed consumption was also reduced by approximately $20/hog resulting in little change when comparing margin over feed cost. It is important to note individual grading grids may have a significant impact on the change relative to margin over feed cost.

Take Home Message

Overall, it may be possible to feed diets containing higher levels of DON than currently recommended, however, adjustments may be needed to account for reduced performance.

Acknowledgements

Funding for this research was provided by Saskatchewan Ministry of Agriculture and the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement, Biomin Holding GmbH, Saskatchewan Barley Development Commission, and Mitacs. General program funding provided to Prairie Swine Centre by Saskatchewan Pork Development Board, Alberta Pork, Manitoba Pork, Ontario Pork, and the Government of Saskatchewan. ■

Practical environmental enrichment strategies for piglets

Submitted by Hayley Bowling, Western College of Veterinary Medicine, and Jennifer Brown, Prairie Swine Centre

During the summer of 2018, undergraduate student Hayley Bowling carried out a research project at the Prairie Swine Centre that examined effective and practical ways of enriching piglets in farrowing and nursery. Recent interest in environmental enrichment stems from the National Farm Animal Care Council's 2014 update to the *Canadian Code of Practice for the Care and Handling of Pigs* which 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."

Results showed that piglets given enrichment before weaning showed less pen-mate manipulation (tail-biting, ear-biting, belly-nosing, etc.) and tended to fight less at weaning than the other pigs.

Pens in commercial barns severely restrict pigs' innate foraging behaviours. The lack of enrichment can lead to problematic behaviours such as tail-biting and belly-nosing and there is a need for practical and cost-effective solutions that producers can implement.

Pigs are intelligent and curious from birth, and the lactation and nursery periods are critical for their mental and physical development. Despite this, research on suitable enrichments for piglets is lacking. Research that has been done found that piglets given enrichment had increased play and exploratory behaviours and decreased aggression, tail-biting, and belly-nosing. There is also some evidence of improved growth and meat quality when pigs are given enrichment, so there is potential for enrichment to benefit production as well as welfare.

Unfortunately, most previous research on enrichment for pigs has been done using substrates such as straw. While straw is effective and attractive to pigs, it isn't feasible for most Canadian barns because of biosecurity risks and slatted flooring systems. The project therefore looked at enrichment alternatives such as commercially available pig toys hung from chains, segments of PVC pipe, hanging knotted cotton rope, rubber mats, and hay cubes. To help maintain pigs' interest, three or four objects were provided at once, and the set of enrichments was rotated twice per week.

Thirty litters were used for the experiment – 10 litters received enrichment only in the nursery (from four-eight weeks

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of age), 10 received enrichment both pre-weaning and in the nursery, and 10 received no enrichment. All piglets were weighed shortly after birth, at weaning (approximately 28 days of age), and at eight weeks. Video cameras were used to record piglet behaviour in their nursery pens at weaning, two weeks post-weaning, and four weeks post-weaning. Skin lesions were recorded before weaning, 24 hours post-weaning, and four weeks post-weaning. Finally, the pigs' fear of humans was assessed by measuring their latency to approach and contact a human.

No difference in growth between the groups was found, however previous research indicates that the effects of early enrichment on growth are be greater later in the pigs' lives.

Results showed that piglets given enrichment before weaning showed less pen-mate manipulation (tail-biting, ear-biting, belly-nosing, etc.) and tended to fight less at weaning than the other pigs. This is important because weaning is stressful for piglets, so anything that can help to reduce weaning stress has the potential to benefit their health, welfare, and productivity throughout the nursery and beyond. Similarly, piglets that were given enrichment only in the nursery had fewer head and shoulder lesions at four weeks post-weaning than the other groups, indicating that they fought less towards the end of the nursery phase.

Additionally, pigs with enrichment spent more time exploring their pens at three weeks post-weaning, indicating that they were more engaged with their surroundings. Pigs enriched post-weaning also showed reduced fear of humans, which has implications for both welfare and ease of handling.

No difference in growth between the groups was found, however previous research indicates that the effects of early enrichment on growth are be greater later in the pigs' lives. Pigs in this trial were not followed after eight weeks of age. Therefore, more research should be carried out regarding the

long-term growth and welfare effects of enrichment.

Of the objects used, the hanging knotted cotton rope was the most popular. Pigs are known to prefer malleable objects that they can chew and destroy because these qualities allow them to express their instinctive rooting and foraging behaviours. The attractiveness of the rope and its low cost make it a viable alternative to substrates such as straw. However, the drawback of destructible enrichments such as rope is the fact that they need to be replaced regularly, which may make them more labour intensive than something that can be used for a longer period of time. If a more durable option is desired, commercial pig toys hanging from chains were also attractive to the piglets and required significantly less labour, however they involve a higher initial cost. Both the rope and the pig toys had the advantage of being suspended off the ground and were not soiled by feces, unlike the rubber mat and PVC pipe which were placed on the floor of the pen.

This study indicated that for producers looking to implement physical enrichment in their barns, a rotation of several inexpensive objects can be effective to increase exploration and reduce manipulation of pen-mates among piglets. Environmental enrichment for piglets is an exciting area of research because it also has potential to improve pig health, productivity, and public perception of the swine industry as a whole. ■

This research project was funded by an NSERC Undergraduate Student Research Award and by Prairie Swine Centre.

Photos courtesy of Prairie Swine Centre

On-farm demonstration of parity-segregated phase feeding in group-housed sows

This demonstration was part of the Canadian-wide project entitled "From Innovation to Adoption: On-Farm demonstrations of swine research," led by Swine Innovation Porc. It aimed to increase the pace of adoption of new technologies and management strategies. To achieve this goal, we have partnered with several hog producers and organizations operating in the sector across Canada. These producers and organizations have agreed to implement new technologies and management strategies, and thus become demonstration sites for these innovations. We regularly collect information to better understand the process and challenges of adopting and using new technologies and strategies on these demonstration sites," says Geneviève Berthiaume, Senior manager in Economics and Management at the Centre de développement du porc du Québec (CDPQ).

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By 2024, hog producers will have to renovate or build new barns to accommodate group sow housing.[1] Making these improvements presents a real opportunity for producers to evaluate which equipment and technology can be implemented that will have a positive economic impact on their operations and ensure long-term sustainability. For example, can a phase feeding program be considered for your gestating sows? To learn more about phase feeding, read below about the results of a recent on-farm demonstration project that evaluated the concept of parity-segregated phase feeding in group-housed sows.

Based on research conducted by Dr. Ron Ball (retired researcher at the University of Alberta), parity-segregated phase feeding would more precisely meet the amino acids and energy requirements of the gestating sow.[2] Possible benefits include: reduced feed costs, improved sow body condition at farrowing, better rebreeding success and prolonged productive life of sows. The savings in feed costs depend on price relationships, but in general, are greater for older sows when wide price gaps between corn and soybean meal exist.

What is parity-segregated phase feeding in group-housed sows?

Typically, gestating sows are fed a single diet, where the nutritional composition is constant for the entire gestation period. Parity-segregated phase feeding involves the use of two

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different diets to meet the needs of sows at different stages of gestation and parity. The objective of this on-farm demonstration project was to evaluate the effect of parity-segregated phase feeding in gestating sows on feed costs.

More specifically, the following feeding strategies were compared:

Conventional feeding which involved the use of a single diet (Diet A) for the entire gestation period, for all sows;

Parity-segregated phase feeding which consisted of using two diets for parity three sows and above. From Day 0 to 85 (day 0 being the first day of gestation), a diet with lower SID lysine content (standardized ileal digestibility) was given to sows (Diet B). Then, from day 86 to the end of gestation, sows were fed Diet A (same as conventional feed). Meanwhile parity one and two sows were fed Diet A throughout their entire gestation period.

In short, it was the diet of parity three sows and above during their first 85 days of gestation that differed from the conventional feeding strategy. Parities one and two received the same diet in both strategies. This demonstration is therefore a simplified application of parity-segregated phase feeding.

Table 1: Cost reductions of using parity-segregated phase feeding when compared to conventional feeding for the gestation period.

Criteria on a yearly basis		Conventional	Phase feeding	Difference
Average feed price (2017)	$/mt	302.70	293.60	-9.10
Feeding cost	$/sow	188.73	183.04	-5.69

Using phase feeding for gestating sows housed in groups typically involves the use of an ESF (Electronic Sow feeder) or a Free-access ESF system with two feed lines, allowing for two diets to be fed simultaneously. The period of application of this feeding strategy covers the gestation period, from day zero, when the sows are inseminated, to the transfer of the sows to the farrowing unit (around the 115th day of gestation).

Impact on feeding costs

Combining both diets (A and B) for parity three sows and above allows the parity segregated phase feeding strategy to achieve a lower feed cost than a conventional feeding strategy (see Table 1). Using 2017 average (Quebec) feed prices, utilizing a parity segregated phase-feeding strategy would result in a savings of $5.69 /sow /year compared to a conventional feeding program.

Price Fluctuations?

As feed prices fluctuate over time, a sensitivity analysis was conducted to assess the variation related to corn and soybean meal prices. Considering the minimum and maximum (Quebec) prices ($/ton) observed between January 2013 and December 2017, the parity-segregated phase feeding strategy has an economic advantage over conventional feeding, with annual savings ranging from $ 1.66 to $ 10.06 per sow (Table 2).

Producers' comments

This project was demonstrated with the assistance of Hog Tied Farms (Thedford, Ontario) owned and operated by John

Table 2. Difference ($) between the feeding cost of the parity-segregated phase feeding strategy and conventional feeding under different combinations of corn and soybean meal prices

		Soybean meal prices ($/ton)							
		350	400	450	500	550	600	650	700
Corn prices ($/ton)	175	-$3,53	-$4,46	-$5,40	-$6,33	-$7,26	-$8,20	-$9,13	**-$10,06**
	200	-$3,30	-$4,23	-$5,16	-$6,10	-$7,03	-$7,96	-$8,90	-$9,83
	225	-$3,06	-$4,00	-$4,93	-$5,86	-$6,80	-$7,73	-$8,66	-$9,60
	250	-$2,83	-$3,76	-$4,70	-$5,63	-$6,56	-$7,50	-$8,43	-$9,36
	275	-$2,60	-$3,53	-$4,46	-$5,40	-$6,33	-$7,26	-$8,20	-$9,13
	300	-$2,36	-$3,30	-$4,23	-$5,16	-$6,10	-$7,03	-$7,96	-$8,90
	325	-$2,13	-$3,06	-$4,00	-$4,93	-$5,86	-$6,80	-$7,73	-$8,66
	350	-$1,90	-$2,83	-$3,76	-$4,70	-$5,63	-$6,56	-$7,50	-$8,43
	375	**-$1,66**	-$2,60	-$3,53	-$4,46	-$5,40	-$6,33	-$7,26	-$8,20

**Using 2017 grain prices, parity-segregated phase feeding would result in annual savings of $ 5.69/sow compared to conventional feeding programs. Savings could vary from $ 1.66 to $ 10.06/sow depending on the feed price scenario (2013-2017). **

Van Engelen. "I already had the intention of installing a second feeding line further down the road, but this project has made that happen faster than expected. I did not observe any nutritional deficiencies in my sows while applying the parity-segregated phase feeding strategy. However, the demonstration only took place over a short period of time (10 months). I do not think the test was long enough to observe changes in sow body condition and performance," John commented.

In addition, the producer also mentioned wanting to learn more about phase feeding strategies and even precision feeding to decide on the best program for his herd. Overall, Mr. Van Engelen had a positive experience and reduced his diet cost.

Two feeding lines allowing the use of two different feeds simultaneously, installed in Hog Tied Farms.

Conclusion

Parity-segregated phase feeding in gestating sows would minimize overfeeding while adequately meeting sow requirements. This reduction in the excess nutrients results in a reduction in feed cost of around $ 5/sow per year.

Partners

This project was funded by Swine Innovation Porc within the Swine Cluster 2: Driving Results Through Innovation research program. Funding was provided by Agriculture and Agri-Food Canada through the AgriInnovation Program, provincial producer organizations and industry partners.

We would also like to thank the producer who participated in the project: Mr. John Van Engelen from Hog Tied Farms in Ontario, as well as Mr. Doug Richards from the Prairie Swine Centre for his support in implementing and following up on the on-farm demonstrations. ■

For Further Reading

[1]Code of Practice for the Care and Handling of Pigs
http://www.nfacc.ca/pdfs/codes/pig_code_of_practice.pdf

[2]Feeding Sows More Efficiently
http://www.prairieswine.com/wp-content/uploads/2012/11/Volume-1-Issue-4-Gestation-Nutrition.pdf

Swine research, education and outreach at the University of Alberta

Submitted by Ruurd T. Zijlstra

At the University of Alberta in the Department of Agricultural, Food and Nutritional Science (AFNS), research with swine is conducted mostly in partnership with internal or external partners. Swine education includes the teaching of undergraduate students in the Agriculture program (Animal Science major) and Animal Health program. Graduate students in their MSc or PhD programs together with their professors drive innovation using an array of facilities and collaborations. Swine outreach is conducted via a range of routes including the Banff Pork Seminar that is organized together with an Advisory Committee including representatives from industry.

Overall, research is conducted to enhance key value attributes for the pork industry and value chain. Our research is focused on enhancing animal health and welfare, reproduction, pork quality, nutrient efficiency and reducing feed cost, together thereby enhancing the sustainability of the pork industry. The pig is also used as a model for biomedical research.

Swine health and immunity is studied by Dan Barreda and Richard Uwiera. Such research is tied to genomics as described below, to create robust pigs that rely less on antibiotics in research programs led by Michael Dyck. Research conducted by Ben Willing and Michael Gaenzle links gut microbiology and the effect of bacterial communities and microbial metabolites on swine health. As support, equipment was recently acquired to perform germ-free piglet experiments.

Pork quality and animal welfare are becoming increasingly important for the pork industry. Pork quality is tied to important genomic, nutrition, husbandry and slaughter variables as studied by Heather Bruce. Animal welfare in particular is related to group-housed pigs. Clover Bench studies automated behavior and welfare assessment technology platforms.

Livestock Gentec CEO Graham Plastow together with Leluo Guan and Paul Stothard apply genomic-based tools to support the livestock industry. For porcine genomics, scientists study

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mechanisms in pigs that make them genetically less susceptible to disease or more efficient in the use of nutrients, provide important new diagnostic tools for breeders, and expand our understanding of disease control mechanisms. Other projects in collaboration with the team include pork quality and pig welfare (see below). Such Genome projects include our colleague Ellen Goddard from the Department of Resource Economics and Environmental Sociology who provides the GE^{3}LS component linking Genomics with its Ethical, Environmental, Economic, Legal, and Social Aspects.

Alberta Agriculture and Forestry Scientist Eduardo Beltranena and Ruurd Zijlstra conduct feedstuff evaluation research. Such research includes new commodity ingredients but also novel feedstuffs that are created using dry or wet fractionation technologies.

For biomedical research, the pig model is used by AFNS Human Nutrition professor Spencer Proctor who studies heart disease risk, diabetes and the complications of low birth weight swine. Moreover, Pediatrics Associate Professor Justine Turner studies severe intestinal malfunction in young piglets and has been testing pharmacological solutions to this problem that could translate to life-saving therapies for human babies.

Facilities are an important component of research and education. AFNS operates the Swine Research and Technology Centre (SRTC) on South Campus that is managed by Jay Willis. Professors collaborate with scientists from other organizations to provide access to SRTC or gain access to pigs elsewhere to reach better research outcomes and training opportunities. On North Campus, researchers use central laboratories for Genomics and Proteomics, Chromatography, and Proximate analyses. Genomics and associated research is organized under the umbrella of Livestock Gentec. On South Campus, novel feeds or feedstuffs are created at Agri-Food Discovery Place.

The SRTC provides a full range of support for activities including research programs for graduate students, teaching programs for undergraduate students, and training in swine handling. The SRTC has a sow herd providing research animals and animal facilities for researchers in AFNS and biomedical researchers in other departments. Sows are housed in gestation and farrowing rooms. Weaned pigs are housed in nursery rooms until reaching 25 kg body weight, and some pigs can reach slaughter weight in a growout facility. Pigs can be modified using surgery and subsequently be housed individually in the metabolism wing of SRTC.

To enable the described research in the facilities, strong industry and government partners are essential and appreciated. Furthermore, strong ties exist among the researchers mentioned and their external collaborators. The description of the research provides the entry-point information to contact scientists working with swine among several disciplines in our department. ■

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Nutrient digestibility of canola co-products in grower pigs

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Take Home Message

- **Oil extraction methods affect energy value and amino acids digestibility of canola co-products.**
- ***Brassica (B.) juncea* canola meal had greater energy digestibility and greater calculated net energy value than *B. napus* canola meal.**
- ***B. napus* canola expeller had greater energy and amino acids digestibility than *B. napus* canola meal.**
- ***B. napus* canola press-cake had lower protein content and lower protein digestibility than *B. napus* canola meal.**
- **Due to greater residual oil content, *B. napus* canola press-cake had greater calculated net energy value than *B. napus* canola expeller, but either *B. napus* canola press-cake or expeller had greater net energy value than *B. napus* canola meal.**

Canola co-products and pork production

Canola is a major oilseed crop in Canada. The co-products after oil extraction from canola seeds can be included in swine feeds to manage costs of pork production. A commonly used canola co-product in swine feed is solvent-extracted canola meal. However, other canola co-products, e.g. canola expeller, canola press-cake, are also used in pork production. These co-products are all yielded from canola seeds but differ in oil extraction methods and their parent canola seed varieties. One may question whether they have similar nutrient composition, and same energy and protein digestibility. The nutritive value of feed ingredients is essential to accurately formulate swine diets. However, information on the nutritional value, and energy and nutrient digestibility

CONTINUED ON PAGE 22

of these canola co-products for pigs is minimal and scattered. Characterisation of nutritive value of these canola co-products in a trial on the same pigs is sparse. Thus, we decided to run a trial to measure nutritive value of four commonly used canola co-products in growing pigs: *Brassica (B.) napus* canola meal, *B. napus* canola expeller, B. napus canola press-cake and *B. juncea* canola meal.

The canola co-products for test

Dark-seeded canola, *B. napus*, is the most common crop in western Canada, but a novel species, yellow-seeded canola, *B. juncea*, grows well in southern prairies that receive less rain. It is well known that *B. juncea* canola contains more glucosinolates than *B. napus*, but it has a merit of containing less fibre. Therefore, the solvent-extracted meal from the two canola cultivars were selected for test. Pressing canola seed without following step of solvent extraction will leave much oil in the co-product, press-cake. In some practices to enhance oil extraction, conditioning the seed using steam prior to expelling will generate co-product of canola expeller, which contains less oil than press-cake but still more oil than the meal. So, we also selected canola expeller and canola press-cake for test.

Figure 1. Nutrient composition of canola co-products (%, as is)

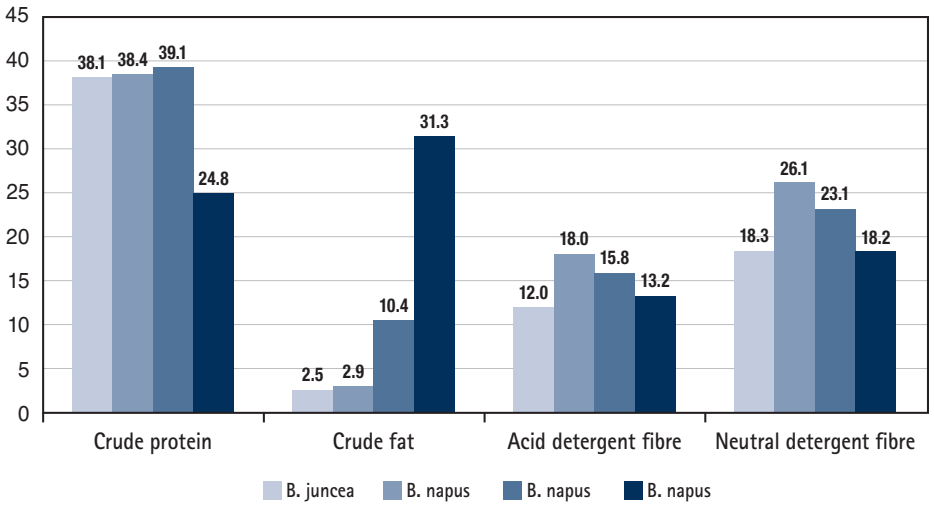
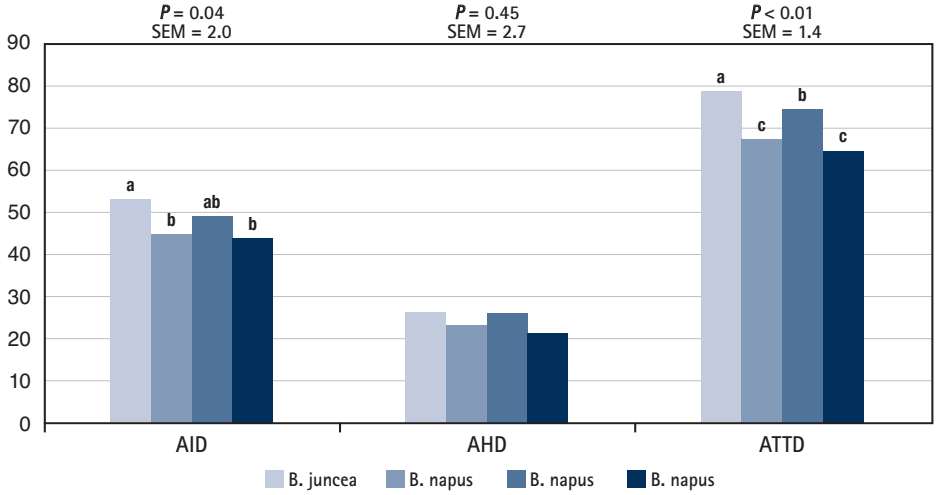


Figure 2. Apparent ileal digestibility (AID), apparent hindgut fermentability (AHD), and apparent total tract digestibility (ATTD) of gross energy of canola co-products in growing pigs (%)



The pig trial

We conducted this trial at the Swine Research and Technology Centre, University of Alberta (Edmonton, AB). We used 5 crossbred barrows (initial body weight, 65.7 kg; Duroc × Large White/Landrace F1; Genex Hybrid, Hypor, Regina, SK, Canada) to measure nutrients and energy digestibility of *B. juncea* canola meal, and *B. napus* canola meal, expeller, and press-cake. These pigs were surgically fitted with a T-cannula at the distal ileum and housed individually in metabolism pens (1.2 × 1.2 m) that allowed freedom of movement in a temperature-controlled room. We prepared diets by mixing 50 per cent canola co-products as a sole source of protein with a basal diet based on corn starch. Each pig was fed a test diet at three times maintenance energy requirement according to their body weights in a nine-day period ¬– the first five days for adaptation, followed by two days of faecal collection and subsequently two days of ileal digesta collection. We arranged five periods so that each pig ate a different diet in each period to account for the variations from the pigs and periods. To measure digestibility, diets contained 0.5 per cent chromium oxide as an indigestible marker. However, protein and amino acids (AA) in digesta were not only from

CONTINUED ON PAGE 24

undigested canola co-products, but also from secreted enzymes, sloughed gut cells, and microbials etc., that would under-estimate protein and AA digestibility. Therefore, we formulated a diet mainly composed of corn starch without including any protein ingredients to quantify the basal endogenous losses of protein and AA. This allows us to get standardized ileal digestibility (SID) of protein and AA of canola co-products, a more accurate measurement of digestibility of these nutrients.

What we found

Regardless of variety difference, the *B. juncea* and *B. napus* canola meal had similar protein (Figure 1) and AA content. However, due to a thinner seed coat, *B. juncea* canola meal contained one-third less fibre than *B. napus* canola meal. Because of less efficient oil extraction, the *B. napus* canola press-cake contained the most fat (31 per cent) among the tested co-products, but had one-third less protein and fibre than the meal due to dilution effect of residual oil. The *B. napus* canola expeller contained 10 per cent fat, but less than the press-cake.

Fibre is poorly digested in small intestine of pigs and lignification reduces fibre fermentation by gastrointestinal microorganisms. With less fibre and less lignin, the *B. juncea* canola meal had greater apparent total tract digestibility (ATTD) of gross energy (GE) than *B. napus* canola meal (Figure 2), which was resulted from greater apparent ileal digestibility (AID) of GE and greater apparent hindgut fermentability (AHD) of GE of undigested residue entering hindgut. The meal and press-cake of *B. napus* canola had similar AID and ATTD of GE, but lower than that of the expeller. The test diet of press-cake contained 18% crude fat, which might have challenged the pigs to digest the oil. Unsaturated fatty acids that form bulk of canola oil reduce fermentability by gastrointestinal microorganisms, which is reflected by the lowest AHD of GE in digesta in the present study. However, canola co-products did not differ in AHD of GE as proportion of GE in feedstuff.

With greatest oil content, *B. napus* canola press-cake had the greatest calculated net energy (NE) value among the canola co-products despite with the lowest ATTD of GE. The *B. napus* canola

Figure 3. Digestible energy (DE) and calculated net energy (NE) of canola co-products in growing pigs (kcal/kg as fed)

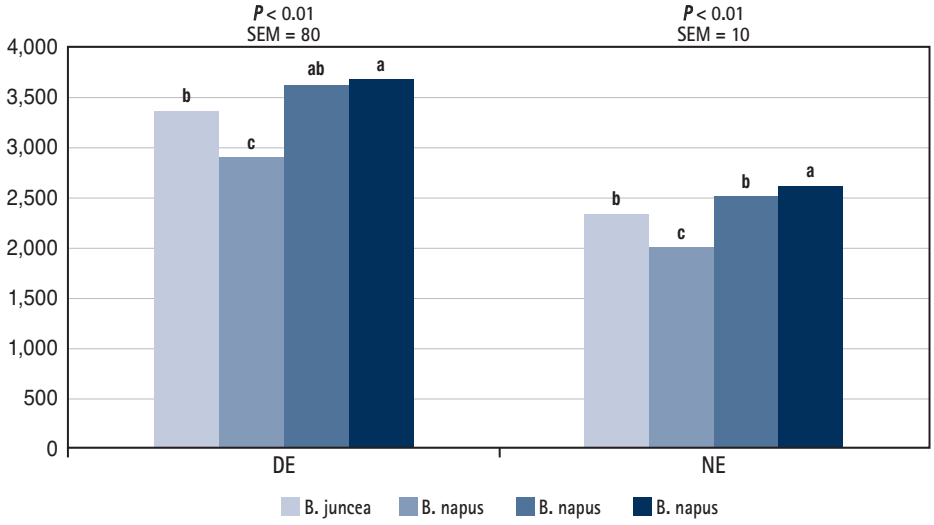
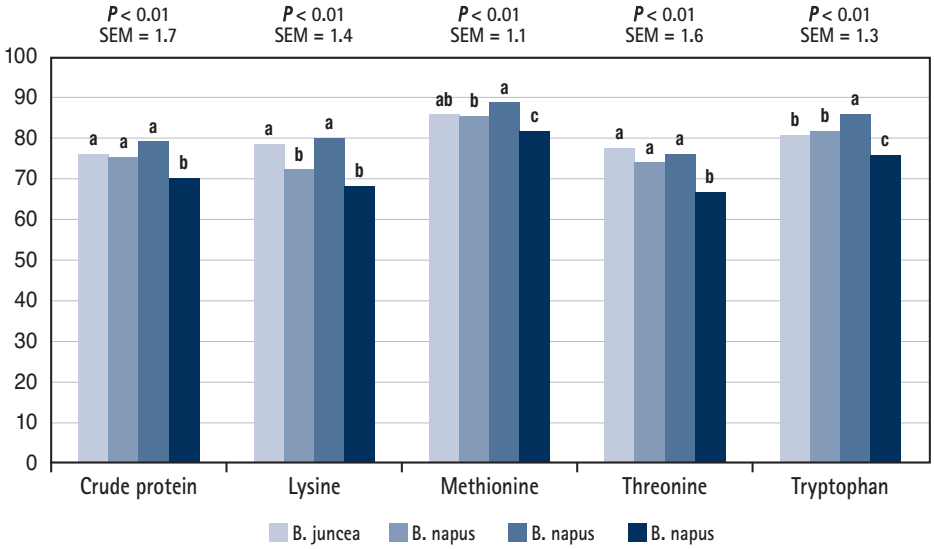


Figure 4. Standardized ileal digestibility (SID) of crude protein and amino acids of canola co-products in growing pigs (%)



meal had the lowest NE because of the lowest digestible energy (DE), greatest fibre and low fat content. However, even with greater fat content, *B. napus* canola expeller did not differ in DE or NE values with B. juncea canola meal. Too much fat content in diets of canola co-products seemed to depress the AID and ATTD of GE, and affected hindgut fermentation of energy-yielding nutrients. However, this relationship is not conclusive and needs more studies to confirm.

Nowadays, diet formulation is not based on protein, rather based on digestible AA. Thus, AA content and their digestibility are important criteria. The SID of lysine, histidine, isoleucine and valine was greater for *B. juncea* canola meal than *B. napus* canola meal (Figure 4), likely due to the less fibre content in *B. juncea* canola meal. The *B. juncea* canola meal and *B. napus* canola meal did not differ in SID of arginine, leucine, methionine, phenylalanine, threonine and tryptophan. The SID of methionine, threonine and tryptophan was greater for *B. napus* canola meal than *B. napus* canola press-cake, but *B. napus* canola meal and *B. napus* canola press-cake did not differ in SID of the other indispensable AA. However, the SID of all indispensable AA (except threonine) was greater for *B. napus* canola expeller than *B. napus* canola meal, because desolventisation and toasting after oil extraction of canola meal may reduce AA availability due to heat damage. The SID of all indispensable AA was greater for *B. napus* canola expeller than *B. napus* canola press-cake. Steam conditioning prior to oil extraction may help to disrupt cell walls and denature protein, leading to increased availability of AA and other nutrients within cells for digestion and absorption. Without correction for basal endogenous losses of protein and AA, the AID of protein and AA was about five per cent lower than the SID, but they had similar pattern to the SID.

Conclusions and implications

B. juncea canola meal can contribute more dietary digestible AA and energy to the pig than *B. napus* canola meal. Methods of oil extraction from canola seed affect energy and AA availability in canola co-products. Protein, oil and fibre content determines nutritive value of canola co-products, whereas glucosinolates content affects the feeding value. It should be mentioned that the residual oil content of canola expeller or press-cake is highly variable depending on pressing parameters; thus, their energy values may vary. ■

Acknowledgments

Consejo Nacional de Ciencia y Tecnología (CONACYT, México, D.F. 03940, México) provided a scholarship to J. E. Sánchez. Research funding provided by Agriculture & Agri-Food Canada and Canola Council of Canada through the Growing Forward is acknowledged. We appreciate Bunge Canada (Altona, MB, Canada), Bunge Canada (Fort Saskatchewan, AB, Canada), Viterra Canola Processing (Ste. Agathe, MB, Canada) and Cansource Biofuels (Mayerthorpe, AB, Canada) for providing test canola co-products.

Pre-farrowing enrichment reduces number of stillborns

Mark Fynn[1], Dr. Laurie Connor[2] and Dr. Gary Crow[2] [1]Manitoba Pork; [2]Department of Animal Science, University of Manitoba

The release of the updated *Code of Practice for the Care and Handling of Pigs* in March 2014 made enrichment a requirement in all swine farms across Canada. While this practice could be seen as additional aggravation in a hog farmer's already-busy schedule, can it actually be used as a production tool with a positive return-on-investment (ROI)?

Manitoba Pork set out to investigate one specific kind of enrichment that may benefit pigs in a very real way and translate to more dollars and cents in a farmer's pocket. Manitoba Pork partnered with the University of Manitoba and a Manitoba isowean producer, Derik Bergmann of Oak Hollow Pork, part of ProVista Agriculture, to research the impact that a burlap (jute) farrowing crate enrichment might have on sows and their litters.

As they approach farrowing time, pregnant gilts and sows have a strong, innate motivation to build "nests" for their upcoming litters. They restlessly attempt to find materials for their nests and may root at the crate floor and chew on the metal bars. Without appropriate materials to manipulate, the sows are unable to fulfill their nesting instincts, which might leave them less settled as they farrow. Traditional nest-building materials cannot be provided in most modern farrowing facilities due to biosecurity concerns and the risk of clogging the manure management systems. However, MS Schippers has developed a product – irradiated burlap sheets (not currently available in Canada) – that can be anchored into farrowing crates and does not pose these issues.

The research questions we proposed were:
1. Will burlap sheets satisfy a sow's nest-building motivation prior to farrowing?
2. Will this result in a more relaxed farrowing experience that is apparent from the litter's performance?

Research Methods

The research was conducted between October 2018 and January 2019, on a 1,500-sow, farrow-to-wean Manitoba farm using Genesus Inc. genetics. Burlap sheets were anchored into every second farrowing crate when sows entered farrowing and were only removed once the sow was weaned. Using a specifically designed metal bracket, the burlap was anchored onto the bars near the front of the crate around sow shoulder height, on the opposite side from the nipple drinker. The burlap was then draped over the top bar, touching the floor of the crate but not long enough to interfere with feeding or drinking. Sows and gilts entering these crates would be considered part of the burlap treatment group (BRL). The other half of the crates had no burlap; sows and gilts entering those crates were part of the control treatment group (CTL).

While 626 sows were included in the trial, only 554 sows' data were used for analyses due to some missing data and removal of outliers, with 277 sows in each treatment group. Each treatment group had a similar parity distribution and similar number of gilts and sows. Pig measurements and performance records were collected, including:

- sow weight and back-fat measurements taken at farrowing crate entry and at weaning;
- sow daily feed intake;
- routine litter information (total born, liveborn, stillborn, fostered, weaned, etc.);
- individual piglet birthweights;
- litter weights at three days of age and at weaning; and
- pre-weaning mortality.

Results

Burlap chewing by sows varied from none at all to removing more than 10 inches of the 64-inch-long burlap sheet by the post-farrowing measurement. Measurements between farrowing and weaning showed more but variable use of burlap (which included use by the piglets) ranging from two inches to more than 20 inches. Producer Derik Bergmann noted, "Some sows seem to use it a lot and others not as much, but they all interact with it one way or another."

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In terms of sow and litter performance:

- No significant difference was seen in total piglets born (see Table 1), but a trend to more born alive for BRL sows was noted (13.00 vs 12.54, BRL vs CTL, respectively).
- Sows with access to burlap had a significantly lower percentage of stillborn piglets (6.5% vs 8.3%, BRL vs CTL, respectively).
- No significant differences in pre-weaning mortality were observed.
- Measurements of sow and litter performance to the time of weaning were not significantly affected by the treatment.
- Number and weight of piglets weaned and sow weight and backfat changes were similar between the treatment groups.
- Piglets weaned per sow per treatment group were 11.6 for BRL and 11.5 for CTL. However, the weaning results were likely a consequence of cross-fostering management, which showed that BRL litters had a higher rate of fostering piglets out than CTL litters (8.4% vs 7.1%, respectively), likely due to more piglets being alive in the litter at the time of fostering.

Application

Regarding the use of the burlap product in the barn, Derik said, "The extra work to put the burlap into the farrowing crates is minimal and the sows seem to enjoy it. Taking the burlap out of the boxes, initially, can be a bit irritating though; there are some fine particles from the burlap that can make you a bit itchy." He also had some thoughts about how to use the burlap going forward: "If I could do it again, I might consider taking the burlap down after farrowing [after the sow uses it for "nest-building" pre-farrowing] and throwing it in the pen under the heat lamps. It seems to attract the piglets to it." All in all, the burlap was well-received by the farm and its pigs.

Table 1. The effects of burlap treatment on litter performance at birth and weaning.

	Treatment		Significance (P-value)
	BRL	CTL	
Number of Litters	277	277	-
Born Alive / Litter (# of piglets)	13.00	12.54	0.1131
Total Born[1]	13.95	13.74	0.4749
Mean Liveborn Birth Weight (kg)	1.38	1.38	0.8241
Stillborns / Total Born (%)	6.5[a]	8.3[b]	0.0043
Piglets Fostered In / Total Litter[2] (%)	5.8	7.7	0.0886
Piglets Fostered Out / Total Litter[2] (%)	8.4[a]	7.1[b]	0.0487
Total Piglet Deaths / Total Litter[2] (%)	12.0	12.1	0.8655
Total Weaned / Litter (# of piglets)	11.6	11.5	0.4613

[ab] Means in the same row for treatment which have different superscripts are considered significantly different with Tukey's comparison of means.
[1] Total Born = Born Alive + Stillborns
[2] Total Litter = Total Weaned + Total Piglet Deaths

As for the results applying to other farrowing units, admittedly there were some practices performed on this farm that differ from the swine sector norm, e.g., inducing all sows and gilts at 114 and 115 days of gestation, respectively, and possibly weaning a couple of piglets from the litter a few days earlier than the rest. Accepting that the research was conducted on this particular farm with certain genetics in this one time period (October 2018 – January 2019), the results suggest that providing burlap enrichment to sows and gilts in their farrowing crates pre-farrowing could result in 1 extra piglet produced for every 4 litters. Assuming that farrowing room management allows that piglet to live to weaning and a weaned pig value of $50, the ROI on this burlap enrichment is around 200%, i.e., for every $1 spent on it, isowean producers get $3 back in piglet value.

The researchers recognize that this is only one specific type of enrichment, but hope it opens our minds to the idea of enrichment not just being an extra requirement that producers must do for sow welfare, but also a useful production tool. ■

Acknowledgements

The research is indebted to Derik Bergmann for carrying out the trials on his farm and collecting the data. We would also like to thank Schippers Canada for generously donating their burlap enrichment product for the research, and Genesus Inc. for allowing us to access and use their database to manage and analyze the research data. Manitoba Pork would like to acknowledge Manitoba Agriculture and the Government of Canada for providing the financial assistance through the Ag Action Manitoba program which made this research possible.

Nutrien Kamskénow program has connected kids and scientists for 10 years

Submitted by the University of Saskatchewan

A unique University of Saskatchewan (USask) program that brings hands-on science and math activities to Saskatoon community schools celebrated its 10th anniversary this spring.

Nutrien Kamskénow, a science outreach program based in USask's College of Arts and Science, launched as a single-classroom project in 2009. It has since grown rapidly, reaching more than 8,400 students in 375 classrooms during the past 10 years.

"We have been overwhelmed by the success of the Nutrien Kamskénow program over the last decade. Thousands of community school students have had their view of science changed by their hands-on participation in the program, which has also provided invaluable experience in community outreach to our University of Saskatchewan students who teach in it," said Peta Bonham-Smith, dean of the College of Arts and Science.

Participants and partners in Nutrien Kamskénow celebrated the program's 10-year anniversary at an event at USask on May 24.

One of the main objectives of Nutrien Kamskénow is to encourage Indigenous students—a group underrepresented in scientific fields—to consider further education and careers in the sciences. The program is offered at no cost to Grade 4–11 community school classrooms in Saskatoon with a high proportion of Indigenous students.

"We are proud to partner with the university to support the Nutrien Kamskénow program, which is tremendously valuable to community school students in Saskatoon. By engaging youth and getting them excited about science and math, they are inspired to see themselves with a future in the sciences," said Lisa Mooney, global lead sustainability and strategic inclusion at Nutrien.

Unlike most science outreach programs that offer one-time visits, Nutrien Kamskénow is unique in providing the same students weekly instruction in their own classrooms over a period of 13 weeks.

"Our team consists of talented and energetic university science students who love science and want to share that passion

CONTINUED ON PAGE 30

with kids. When these inspiring students are placed in situations to be role models, amazing things can happen, especially over a 13-week period," said Lana Elias, director of science outreach in the College of Arts and Science.

For 90 minutes each week, Nutrien Kamskénow participants learn through activities such as building balloon rockets, programming robots, simulating earthquakes and growing crystals.

Saskatoon Public Schools and Greater Saskatoon Catholic Schools are both partners on the program.

"The Nutrien Kamskénow program has played an important role in developing our students' love of science and math. Through the hands-on activities and experiential learning offered in the program, our students have gained confidence and can see themselves as scientists and mathematicians," said Brent Hills, superintendent of education with Saskatoon Public Schools.

"We are proud to host and support the Nutrien Kamskénow program in some of our schools," said Gordon Martell, superintendent at Greater Saskatoon Catholic Schools. "Nutrien Kamskénow strives to increase the participation of First Nations, Métis and Inuit students in the sciences. The instructors from USask have been fantastic role models and a key component of the success of the program. We're thankful for Nutrien and all of the program's partners over the last 10 years, and we look forward to what the next 10 will bring."

Students and teachers have given strongly positive feedback about the program. After participating, more than 60 per cent of students consistently report that they are likely to choose a career that involves math or science, and the majority of teachers note improvements in student attendance.

"It's a huge compliment when teachers express that this is the best educational program they have experienced and it will impact how they teach science," said Elias. "The program is truly a win-win-win for our USask students and for community school students and their teachers. We're so fortunate to have great partners and sponsors supporting this."

Nutrien Kamskénow was delivered to almost 1,200 students in 47 classrooms last year, but demand remains about double what the program can accommodate. With the help of new funding announced this month by the Natural Sciences and Engineering Research Council of Canada (NSERC) PromoScience program, organizers hope to expand the program's reach to 65 classrooms over the next three years.

Numerous sponsors support Nutrien Kamskénow: the College of Arts and Science; USask; Nutrien; NSERC PromoScience; the Community Initiatives Fund; Komatsu; and the NSERC Chair for Women in Science and Engineering (Prairies). ■

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1. Goodreads:Temple Grandin Quotes. https://www.goodreads.com/quotes/422878-we-raise-them-for-us-that-means-we-owe-them. Accessed August 8, 2017.

Transport Genie, University of Saskatchewan research collaboration funded by Swine Innovation Porc

Field trials with Transport Genie smart sensors aim to improve biosecurity in swine transport industry

It was announced in May that a research collaboration involving agri-tech start-up Transport Genie Ltd. and a team led by Dr. Terry Fonstad of the University of Saskatchewan has been awarded funding from Swine Innovation Porc (SIP) through the Swine Cluster 3 program.

The funds will support the third phase of a multi-year research project aimed at improving biosecurity in the swine transport industry.

"We're proud to contribute to the vital work being done by Dr. Fonstad and his research partners across Canada to improve the health and welfare of farmed animals," said Joel Sotomayor, president and CEO of Transport Genie Ltd.

The long-term aim of the SIP project is to develop a livestock transportation system that maximizes animal welfare and uses trailers that can be cleaned and disinfected quickly, effectively and affordably. The researchers will work with industry partners to deploy Transport Genie smart sensors to monitor temperatures inside swine transport trailers during "baking" ¬– also called thermally assisted drying and disinfection (TADD).

"Our previous research demonstrated that dry heating (baking) to temperatures of 75°C for at least 15 minutes has the potential to eliminate pathogens of concern to the North American swine industry such as porcine epidemic diarrhea virus (PEDV) and porcine reproductive and respiratory syndrome virus (PRRSV)," said Fonstad, associate dean research and partnerships at the University of Saskatchewan. "This project expands on that work to verify whether the baking process can reliably destroy pathogens in real-world conditions, in a variety of trailer types and cleaning facilities, summer and winter."

Fonstad's team is also looking at ways to optimize trailer design and automate the cleaning and disinfection process, which is labour-intensive and uses large amounts of water and harsh detergents.

Biosecurity is increasingly important for the swine industry as it responds to the challenges posed by infectious diseases including PEDV and emerging threats such as African swine fever (ASF). Recent outbreaks in Asia and Europe have made containing ASF a top priority worldwide. The Canadian Food Inspection Agency (CFIA) hosted the African Swine Fever Forum in Ottawa April 30 – May 1 to help industry and government stakeholders develop strategies for containing ASF. While neither PEDV or ASF is a risk to human health or food safety, they are lethal to pigs and have cost the swine industry billions of dollars globally. Health regulations now require all vehicles used to transport animals to be cleaned and disinfected before they cross the Canada - U.S. border.

"The industry has already moved to implement baking trailers to 75°C for 15 minutes. But they haven't had the scientific data to develop clear biosecurity protocols for baking because until now, they've lacked reliable instruments to verify that the entire trailer is being heated to the correct temperature," said Fonstad. Additional research may determine that heating to a higher temperature for a shorter period, or lower temperature for longer periods, would also achieve satisfactory results. "It's exciting to be working on a project that could have huge economic and animal welfare benefits for the industry from something that's so simple to do."

Transport Genie sensors will capture the data Fonstad's team needs to map the temperature regime inside the trailers in order to verify and improve the baking process. In addition, Transport Genie can be used to control environmental systems like cooling fans and drinkers during transport, which, along with the system's GPS capabilities, will help improve animal welfare and traceability.

"This collaboration is a significant opportunity for us to demonstrate the value and utility of Transport Genie technology, and to advance our mission to improve the agricultural system by enabling smart decision making through capturing and sharing data all along the supply chain," Sotomayor said. ■

Can trailer design effectively reduce disease transmission?

Submitted by Bernardo Predicala, Ph.D. Research Scientist – Prairie Swine Centre

Addressing an Industry Need

In response to an industry need for a livestock vehicle that addresses both increased animal welfare and biosecurity during transport, a prototype air-filtered trailer was designed and assembled. The project set out to select the best possible option for a swine transport trailer which reduces or prevents the risk of airborne disease transmission and at the same time address issues commonly encountered on existing trailer designs such as animal welfare, ease of maintenance as well as trucker/worker well-being. An industry questionnaire gathered input on observed strengths and deficiencies of the conventional commercial swine transport trailers and was distributed to a number of stakeholders involved in pig transportation and researchers. Additionally, desired features and preferences for an improved swine transport trailer were gathered and formed the basis for the initial new trailer design. Multiple design configurations were narrowed down using computer simulation with the most promising trailer design being developed as a prototype.

Trailer Design

The final design featured a transport trailer with two separate compartments: front compartment that houses generator set, a bank of six air filters, ventilation controller, supplemental heater, and two axial fans. The livestock compartment (Figure 1) has solid walls, in contrast to conventional livestock trailers where side vents are present throughout the entire length of the trailer. It has two straight decks each divided by a gate into two compartments (front and rear). Both bottom and upper decks are 3'5" in height. The middle portion of the floor of the upper deck is hinged and can be lifted up to allow easier loading, unloading or other activities (i.e., trailer clean-

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Figure 1. Photos of the animal compartment showing (A) its lower and upper decks, (B) hinged roof, (C) gate that partitions each deck into two compartments, (D) air exhaust damper, (E) hydraulic loading platform, (F) hydraulic system showing motor, pump, controller and power supply, and (G) exterior of the assembled compartment.

ing, washing, inspection, etc.) in the bottom deck. Similarly, the middle portion of the trailer roof is hinged for the same purpose in the upper deck. Additionally, pneumatic cylinders are installed on these hinged panels of floor and roof for easier lifting and closing of these movable parts. To address animal handling and welfare issues arising from use of ramps in the conventional livestock trailer, a 1,000-kg capacity hydraulic loading platform was added in the prototype trailer.

Trailer Efficiency

Based on this design, the prototype trailer was assembled and evaluation of the effectiveness of the installed air filtration system (MERV-8 pre-filter and MERV-16 main filter) showed overall reduction of 96.9 per cent in concentration of aerosolized model virus (bacteriophage Phi X174) inside the animal compartment relative to upstream of the filter (Figure 2). In addition, over two monitoring trips with pigs loaded, the trailer showed the mechanical ventilation system was able to maintain the desired thermal conditions within the animal compartment. Supplemental heating unit helped to ensure that the temperature in the animal compartment did not go lower than 10°C during the trips under winter conditions. However, events during the trip (slowing down or full stops due to traffic stops) affected environmental conditions inside the trailer, although the desired conditions were quickly restored once the trip resumed – when the mechanical ventilation control system enabled compensation for relative humidity and carbon dioxide levels in the animal compartment in addition to the conventional temperature-based control.

Cost Analysis

Cost analysis of the air-filtered trailer (prototype) including equipment, installation, operational and filter maintenance costs, yielded a payback of 2.10 years assuming a $5 premium per pig for transporting pigs using an air-filtered trailer. From this first effort on design and development of this new transport trailer, various points for optimization of the prototype have been identified to facilitate continuing work to further improve the efficiency of the trailer and to bring the overall trailer design closer to commercialization.

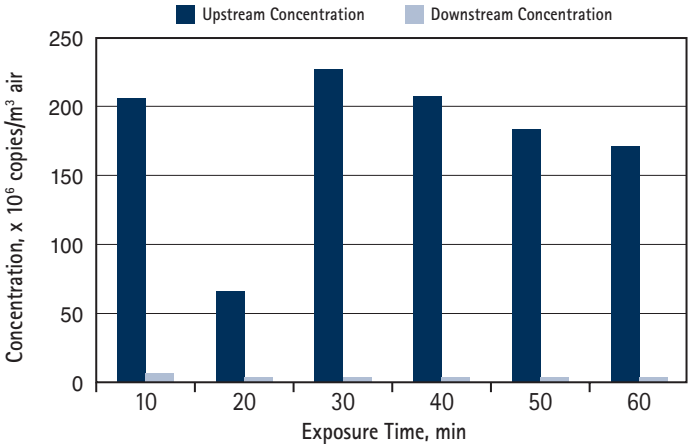


Figure 2. Total bacteriophage Phi X174 (in genome copies/m³ of air) detected by qPCR. Each bar represents average concentration of the surrogate virus in the air sampled using 37-mm cassettes loaded with polycarbonate filters from four replicate trials.

Next Steps

The next step is to fully gain the confidence of livestock producers to adopt and utilize this design, it is strongly recommended that the air-filtered trailer is ultimately tested against a disease challenge, wherein the performance of the trailer in protecting the animals being transported is assessed when the trailer is actually exposed to conditions known to certainly cause airborne transmission of disease. For more information on this project please visit prairieswine.com. ■

Acknowledgements

We would like to acknowledge the financial support for this research project from the Saskatchewan Ministry of Agriculture and the Canada-Saskatchewan Growing Forward 2 Bi-lateral Agreement and the Canadian Agrisafety Applied Research Program funded by Agriculture and Agri-Food Canada. The authors would also like to acknowledge the strategic program funding provided by Sask Pork, Alberta Pork, Ontario Pork, the Manitoba Pork Council and the Saskatchewan Agriculture Development Fund.

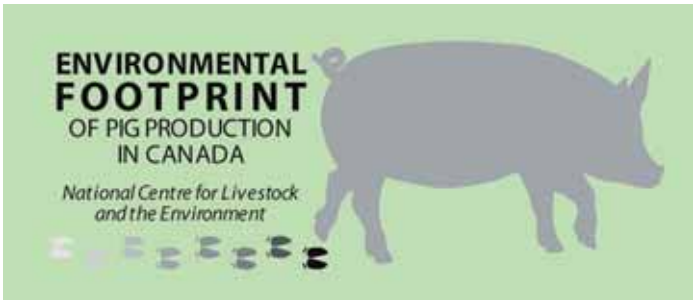
National pig production practices survey an essential piece of sector environmental footprint analyses

Submitted by Christine Rawluk, National Centre for Livestock and the Environment, University of Manitoba

Not all Canadian pig operations are the same, but all contribute to the environmental footprint of Canadian pork. It is the combination of feed, animal, barn environment and manure production, as well as characteristics of barn and manure storage structures that determine an individual operation's footprint.

New research led by Dr. Mario Tenuta at the University of Manitoba will build on foundational environmental footprinting done by some provincial pork boards and the Pork Value Chain Roundtable working with Groupe AGÉCO. This next generation of life-cycle assessment of Canadian pork will link production practices at the barn level to greenhouse gas emissions, water and energy impacts at regional and national scales. Data collected on pig production practices in each province will be used to determine the environmental footprint at these different scales and to identify the management practices and facility features associated with more favourable footprints.

This cross-Canada initiative involving researchers from British Columbia, Quebec and Manitoba is supported by the Canadian Pork Council with funding through Swine Innovation Porc and Manitoba Pork. This project will establish the current efficiency and environmental footprint of pig production in Canada, identify improvements in the environmental footprint compared with an earlier period (e.g. 30 years ago), and determine the key management practice changes driving past and future footprint changes.



A national survey to characterize today's pig barns

We anticipate considerable variation in the type, size, management practices, and environmental footprint of pig operations across Canada. As such, the first step is to survey current management practices and to provide information on the types of physical structures, storages as well as inflows and outflows of materials into and out of pig barns by province.

With input from experts across Canada, we are developing a comprehensive whole-farm survey of operations on feed, water, animal, housing and manure management practices as relating to environmental sustainability in the areas of water use, nutrients, energy use, and greenhouse gas emissions. The survey results will provide a current picture of common practices in the pig industry. Responses will also reflect changes in practices across the last decade and the possible reasons behind these changes on a per region basis.

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Save the Date

Alberta Pork 50th AGM

Nov. 21 in Calgary

Details to follow

Alberta Pork's 50th annual general meeting (AGM) and anniversary celebration will be held on Thursday, November 21, 2019 at the Calgary Airport Marriott In-Terminal Hotel, located at 2008 Airport Rd NE.

This year's event will be a special occasion to mark our half century of service on behalf of Alberta pork producers. Further details will follow later this summer. For now, please save the date, and get ready to help us celebrate the past, present and future of the Alberta pork industry.

Given the special nature of the event, there will be an attendance limit and cost to attend the celebratory banquet. Producers and partners will still be able to attend the business meeting at no charge.

We really hope you will be able to join us!

If you have any questions, please contact
Janice Brown, Administrative Support, Alberta Pork
by email at janice.brown@albertapork.com or by phone at 780-474-8288,
toll-free at 1-877-247-PORK (7675).

Alternatively, contact Charlotte Shipp,
Industry Programs Manager, Alberta Pork
by email at charlotte.shipp@albertapork.com or by phone at 780-491-3528.

ALBERTA PORK

What to expect

The online survey will be conducted by the professional market research firm Kynetec Canada (formally Ipsos Agriculture and Animal Health), which has been conducting market research with Canadian farmers, agricultural industry stakeholders, and consumers on agricultural issues since 1985. As a thank-you for your time, $50 will be sent to each person who completes the survey in its entirety. The survey will take about 40 minutes to complete and will be completely anonymous and confidential. There will be one question as to the general location of the operation (i.e. province, rural municipality) in order to categorize the responses based on ecoregion and province. Only Kynetec will have access to respondent's contact information, and they are bound by contractual obligation to the University of Manitoba not to use the information for any other purpose. As such, they will ensure that the survey response data files do not contain any personal identifiers and no-one outside of Kynetec will ever see this personal information and it will be destroyed once the study is complete. Kynetec will only contact survey respondents to arrange for payment and if clarification to a response is required.

How to take part

We are partnering with the Canadian Pork Council/Conseil canadien du porc to connect with provincial pork organizations, and through them, individual pork producers in each of the provinces to take part in the survey. It is important that the integrated production operations be included in the survey and footprinting to not bias results to small independent producers. To that end, our research team is requesting partnering with the integrated pig production companies to survey their production managers. If you would like to take part, contact Audrey Cameron (cameron@cpc-ccp.com), Director On-Farm Programs, Canadian Pork Council.

What is needed

The survey will be launched in late fall 2019. Our target is 500 complete surveys representing 500 distinct operations spanning all production types (e.g. farrowing, farrow-to-finish, grow-finish, etc.), operational structures (independent, integrated, cooperative, etc.), facility characteristics (small to large, old to new, etc.) and the full range of management practices found across Canada. This target number is needed to be considered statistically representative of pig production in Canada.

Project lead Mario Tenuta with students discusses greenhouse gas emissions from agriculture. Photo credit: Christine Rawluk

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Environmental footprint analyses

The life cycle assessment (LCA) will specifically examine the greenhouse gas emissions intensity of pig production, the water footprint of different feeding strategies that include both crop production and animal water use components, and will also include an economic analysis to calculate feed production costs and to estimate livestock economics. In addition to determining the current footprint, we will also use the assessment model to demonstrate footprint improvements over a specified time period and to establish a benchmark against which to measure the success of the implementation of new production strategies. The LCA tool, management practices survey data, and economic analysis will be used to estimate the potential for improving the pig production footprint by adopting a suite of beneficial management practices.

Why is this information needed?

Public scrutiny and regulatory action specific to the environmental risk associated with livestock production, including pigs, have been rising in recent years. Increasingly concerned about and interested in the environmental impact of their food choices, consumers are changing their purchasing behaviours, which is reflected in large retailer and restaurant chains making marketing and supply sourcing decisions, as well as in trade agreements. The detailed information on current and historical pig production management practices that this project will provide will help to clarify various environmental aspects of the pork industry and will provide Canada's pork industry with approaches for future improvements.

The study is to be completed in 2021. ■

For more information on the project, contact Mario Tenuta (Mario.tenuta@umanitoba.ca).

Project team

Agriculture and Agri-Food Canada - Shabtai Bittman (Agassiz), Bernard Goyette and Candido Pomar (Sherbrooke), Roland Kroebel and Aklilu Alemu (Lethbridge),

University of Manitoba – Mario Tenuta (PI) Laurie Connor and Martin Nyachoti, Qiang Zhang, Derek Brewin, and Christine Rawluk

Acknowledgement

This project is a collaborative initiative under the umbrella of the National Centre for Livestock and the Environment (NCLE: ncle.ca), Faculty of Agricultural and Food Sciences, University of Manitoba. Funding has been provided through Swine Cluster 3: Innovating for a Stronger Pork Sector research program, which is led by Swine Innovation Porc and funded by the Government of Canada under the Canadian Agricultural Partnership, provincial pork producer organizations and industry partners. Additional matching funding provided by Manitoba Pork.

Different zinc sources may affect the acid buffering capacity of weanling pig diets

Submitted by Natasha Brown, Yajing Wang, Chengbo Yang, Department of Animal Science, University of Manitoba*

Natasha Brown

Newly weaned pigs undergo considerable stress as their bodies adapt to a solids-based diet. The pork industry is looking for strategies to make this transition smoother. One challenge is that weanlings have a lower acid secretion compared to full-grown pigs, meaning that their stomach chemistry can become imbalanced, depending on what they are being fed. The ideal stomach environment is acidic, having a low pH. Insufficient acid secretion can result in elevated pH in the stomach, leading to reduced protein digestion and high incidences of diarrhea.

Additives or feedstuffs that help keep pH levels low and the stomach environment acidic are therefore ideal for including in new weanling diets. Two indicators of the potential for dietary ingredients to negatively affect digestion and cause diarrhea are the acid-binding capacity (ABC) and buffering capacity (BC). Additives that lower the ABC and that have a low BC are better suited for feeding to weanlings because they will help keep the stomach pH/acidity at the proper level.

Zinc is an essential trace element needed for many bodily functions including the metabolism of proteins, nucleic acids, carbohydrates and lipids. Dietary supplementation with high levels of zinc oxide (ZnO) (2000-3000 mg/kg) has been widely used as an effective approach to increase pig growth and reduce the incidences of post-weaning diarrhea. However, using a high dose of ZnO in weanling diets has been associated with a number of negative impacts including ZnO toxicity, post-weaning anemia, undesirable interactions with other feed ingredients, as well as zinc accumulation in the environment and antibiotic resistance. Therefore, there is a need to identify post-weaning feeding strategies that provide the optimal amount of zinc for anti-diarrheal and other health benefits but that mitigate the risk for negative impacts associated with high levels of dietary inclusion.

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This research project was undertaken to identify zinc compounds that would support a low pH stomach environment. The acid binding capacity and buffering capacity was determined for six zinc compounds: zinc chloride hydroxide monohydrate, zinc chloride, zinc glycinate, zinc sulfate monohydrate, nanonized ZnO and ZnO. The results show that zinc chloride, zinc sulfate monohydrate, zinc glycinate and nanonized zinc oxide are suitable candidates as dietary zinc sources as all have low ABC and BC (Figure 1). In this study, the lowest ABC and BC were measured for nanonized ZnO.

New cost-effective technologies such as organic minerals, nanotechnology, and microencapsulation can feasibly be used to improve the efficacy of ZnO application in pig production. Other studies with zinc glycinate have shown that this organic compound also demonstrates antimicrobial properties. Zinc oxide nanoparticles consist of a specially prepared mineral salt. Nanonized ZnO, ranging from one to 100 nm in size, has the ability to promote growth, act as an antibacterial agent, and modulate the immunity and reproduction of animals, although research assessing its potential as an antibiotic alternative is still at the early stages.

Figure 1. Comparison of buffering capacities (meq) of six zinc sources at pH 3 and pH 4. Acid-binding capacity at pH 3 and pH 4 followed similar trends. Compounds: zinc chloride hydroxide monohydrate (A), Zinc chloride (B), zinc glycinate (C), zinc sulfate monohydrate (D), nanonized ZnO (E) and ZnO (F).

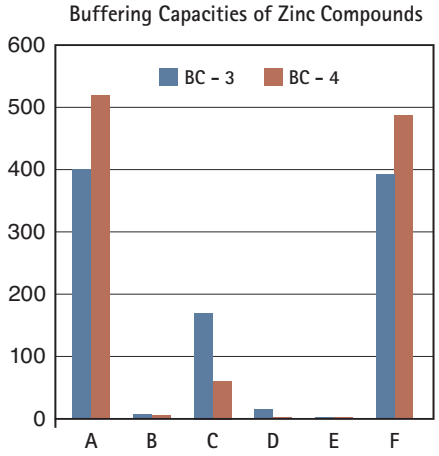

Table 1. Average acid binding capacity and buffering capacity means (meq) of four commercial zinc products, calculated to 1mol of the zinc ions.

	Commercially available protected zinc oxide products			
Acid-binding Capacity	# 1	# 2	# 3	# 4
pH 4	59.43	3785.32	1.91	0.01
pH 3	106.27	3872.62	7.69	0.61
Buffering Capacity				
pH 4	32.92	717.17	0.84	0.01
pH 3	37.82	616.82	2.38	0.15

Nanonized ZnO has been tested with multiple livestock species and shows promise as a candidate to replace conventional ZnO as a feed ingredient due to its bioavailability, although some studies have shown potential toxic effects associated with the production of reactive oxygen species and free radicals under controlled laboratory conditions. The toxicity of these particles is highly dependent on the concentration of the nanonized ZnO, with studies demonstrating that exposure to low levels yield very low toxicity results, whereas if given a high concentration, toxicity will be much more severe. Additional studies looking into the proper concentrations to include in animal feeds are needed.

There also seems to be the potential for a large range of variability in the quality of some commercially available coated zinc products. Select commercially available protected ZnO products were also examined for their ABC and BC, with the results showing a wide range of effectiveness from very low to very high, to the point where they could have a deleterious impact on health if fed as a starter diet to newly weaned pigs (Table 1).

Additional research on these and other zinc resources and products is required to determine the most effective products and delivery strategies for capturing maximal benefits with minimal negative side effects. It will continue to be very important to identify zinc sources to add to weanling diets that have both a low acid-binding and buffering capacity. ■

For more information on this research, contact Chengbo Yang, (Chengbo.yang@umanitoba.ca).

**Natasha Brown completed this research as an NSERC summer undergraduate student with Dr. Chengbo Yang, swine nutritionist, in the Department of Animal Science. This funding program provides students with the opportunity to explore science questions in a research setting.*

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