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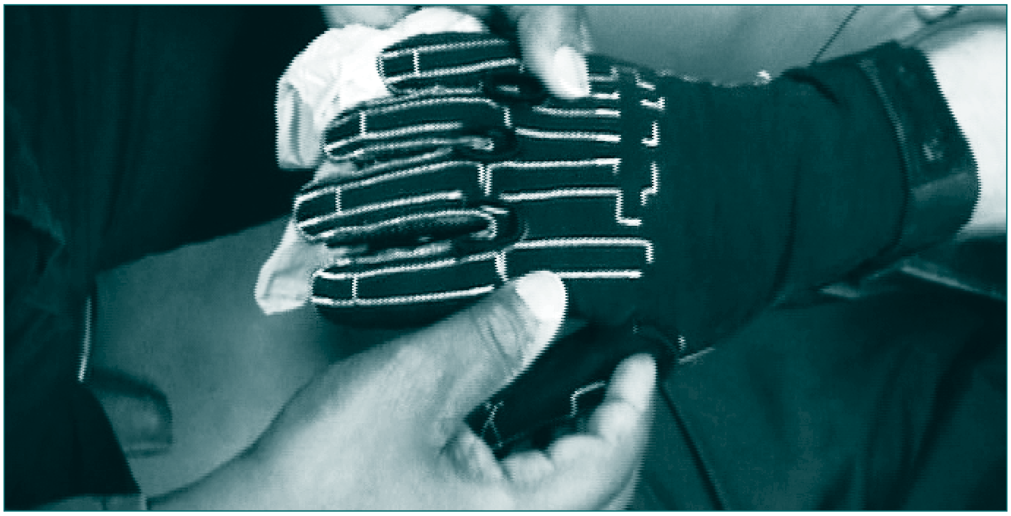
Bringing Precision Agriculture to the Pork Industry



Lee Whittington,
BSc(Agr), MBA, PAg
President/CEO,

Precision farming is now a commonly accepted term. In a decade, it has become the standard in pursuit of best management practice. Precision agriculture is a way of thinking about your farm and it is raising the bar for the whole industry on what is possible to measure and thus manage. When we think of precision farming we tend to think of various applications within the grain industry such as auto steering, sectional controls and yield mapping. Data coming out of this technology places resources such as fertilizer or herbicide in specific locations creating a database allowing analysis for impact of environmental (soil, moisture) conditions. In short, allocation of expensive resources linked to collection of yield data. I expect that nothing will push net income up quicker on well-managed farms, and thus reinforce to management the value of the technology.

But what to do with all that data? Observing, measuring, and responding cuts across all aspects of farming producing many different forms of data, and we will need a sophisticated decision support system, a whole farm system, to understand what it means to the enterprise. Precision agriculture is a natural partner to the whole farm concept that seeks to feed the world. A whole farm package may include

(Precision Agriculture... Cont'd on page 5)

Publication # 40010021

Fermented soybean meal for newly weaned piglets

A.D. Beaulieu, Ph.D. A. G. van Kessel, Ph.D. and P. Leterme, Ph.D. and D. Gillis, B.Sc.

Soybean meal contains a variety of anti-nutritional factors which limit its inclusion into the diets of young piglets. It has been shown that fermentation of soybean meal (fSBM) effectively removes trypsin inhibitors, oligosaccharides and phytic acid and improves digestibility of nutrients, including amino acids.

These improvements however, are not consistently observed, and work is required which determines the variability among fSBM produced from different plants. Results from this project indicate pigs receiving approximately 17% HP5010 fSBM in their diets had reduced body weight relative to the pigs receiving a comparable amount of a commercial SBM product, Hamlet 300.

There is some evidence that suggests improvements in feed efficiency when fSBM replaced SBM in the diet of nursery pigs. However, in many of these experiments the fSBM is used as only a partial replacement of the SBM, being used as an additive to a typical post-weaning diet. For example, various projects have observed an improvement in feed efficiency when either 3.75 or 7.5% fSBM or 5% fSBM was included in diets of post-weaning piglets . Results suggest that fSBM may be a suitable replacement for antibiotics.

Other research has also indicated that while the inclusion of fSBM in the diet of post-weaning piglets is "better" (based on performance and health indicators) than a diet with a high inclusion of SBM, piglets still do better when receiving a diet with reduced levels of soy proteins. This suggests that optimization of the fermentation procedure is required. This project set out to determine if differences exist in palatability and nutrient content of fSBM from different sources and if these differences can be attributed to specific processing methods.

This project examined five different fermented soybean meals (fSBM), standard 46% soybean meal (SBM), and two commercial products, Pepsoygen and Hamlet protein. Piglets were fed diets in 3 phases, where phases were 3, 18 and 14 days for phase 1, 2, 3 respectively and diets were formulated to meet all requirements of pigs in each weight range. The control diet contained the standard SBM and was formulated to contain 22% SBM in the finished diet. Individual fSBM's were substituted so that CP, NE and the lysine/NE ratio was comparable in all diets, and assumed the AA/CP ratio was constant in all the SBM ingredients.

RESULTS

On day 14 and 21, pigs receiving approximately 17% HP5010 fSBM in their diets had reduced body weight relative to the pigs receiving a comparable amount of a commercial SBM product, Hamlet 300. Average daily gain was consistently highest on the soybean meal diet (treatment 1), this achieved significance, relative to the HP5010 on days 10 to 14 ($P < 0.05$). Differences in feed intake followed a similar pattern. A significant treatment effect was only observed during the d 15 to 21 period when a difference between the soybean meal and HP5010 diet was observed. Piglets receiving the control diet had higher feed

> "Although only speculative some of these results may indicate reduced palatability with the fSBM product."

Table 1. Performance of post-weaning piglets receiving diets containing diets with fSBM replacing a standard SBM

				Experimental fSBM						
	SBM control	Pep	Hamlet	XHX	Bole	A50	CP200	HP5010	SEM	P-value
Body weight, kg										
d 0	6.37	6.45	6.45	6.38	6.39	6.42	6.5	6.46	0.05	0.39
d 3	6.15	6.2	6.27	6.25	6.07	6.11	6.23	6.13	0.07	0.27
d 9	6.56	6.64	6.79	6.69	6.51	6.53	6.64	6.51	0.10	0.33
d 14	7.70ab	7.54ab	8.17a	7.78ab	7.58ab	7.56ab	7.56ab	7.18b	0.21	0.07
d 21	10.20ab	9.75ab	10.60a	10.20ab	9.79ab	9.69ab	9.59ab	9.05b	0.29	0.02
d 28	13.40	13.10	13.60	13.40	12.70	12.80	12.40	12.10	0.43	0.12
d 35	17.90	18.00	18.30	18.20	17.30	17.20	17.30	16.50	0.61	0.42
Average daily gain, g/d										
d 0-3	-73.7	-82.8	-57.6	-42.8	-107.8	-104.1	-93.0	-111.8	19.30	0.098
d 4-21	232.2a	202.7ab	227.8a	218.1ab	203.3ab	192.3ab	186.0ab	168.1b	14.2	0.02
d 22-35	551.8	589.1	549.6	570.9	535.3	534.7	547.7	535.2	29.8	0.85
Average daily feed intake, g/d										
d 0-3	50.8	39.9	46.7	55.6	37.8	40.7	42.6	46.8	7.8	0.70
d 4-21	287.0	266.7	290.2	283.1	284.8	255.9	261.1	236.1	12.8	0.06
d 22-35	809.7	845.0	833.4	869.2	819.9	812.1	85.8	749.1	50.8	0.80
Feed conversion										
d 0-3	-2.46	-0.62	-1.91	-18.95	-5.31	51.6	4.69	-1.15	22.3	0.46
d 4-21	0.81a	0.76ab	0.78ab	0.77ab	0.71b	0.75ab	0.71b	0.71ab	0.02	0.02
d 22-35	0.69	0.70	0.67	0.66	0.66	0.68	0.70	0.74	0.03	0.41

intake relative to those receiving the HP5010 fSBM in their diet ($P < 0.05$). Although only speculative, since as there were no significant treatment effects, some of these results may indicate reduced palatability with the fSBM product. The number of piglets with evidence of diet consumption during the initial 48 hours post-weaning was numerically increased on the soybean meal diet, relative to the fSBM supplemented diet.

Conclusion

There was no evidence in this experiment that fSBM was superior to a standard SBM in improving growth or feed intake of the newly weaned pig. Further work is required to determine if palatability of the fSBM's was a factor.

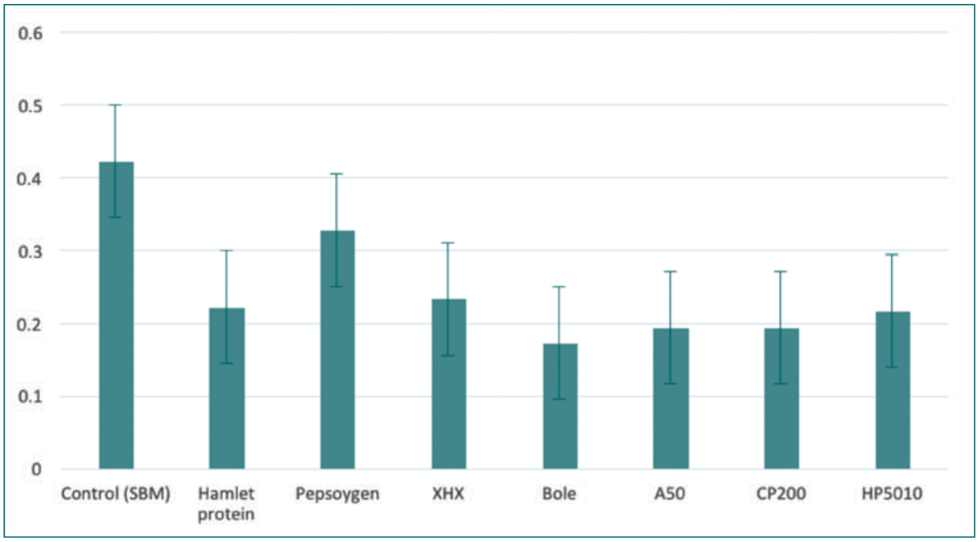


Figure 2. The proportion of piglets (mean ± SEM) exhibiting evidence of feed intake in the initial 46 hours post-weaning. Effect of treatment , P = 0.29.

How do you decide whether to adopt new technology?

Incorporating health and safety in the decision-making process

Catherine Trask, Canadian Centre for Health and Safety in Agriculture

Canadian pork production has been transitioning into large-scale high-production barns. This transition has spurred several process changes and technological advancements throughout the Pork Value Chain. So le's say you are presented with a new technology, tool, or method to help production. How do you decide if it is going to have a net benefit to your business?

There are a lot of things to consider: implementation and maintenance costs, productivity impacts, worker and manager preferences, food safety and animal handling regulations. Worker health and safety is another consideration that can impact the bottom line. For example, if a new tool increases risk factors for injury, injury and work loss may require overtime or recruiting and training replacement workers to

Fig 1 Research Study Team (L to R) Catherine Trask, Lee Whittington, Olugbenga Adebayo, Xiaoke Zeng, Bernardo Predicala

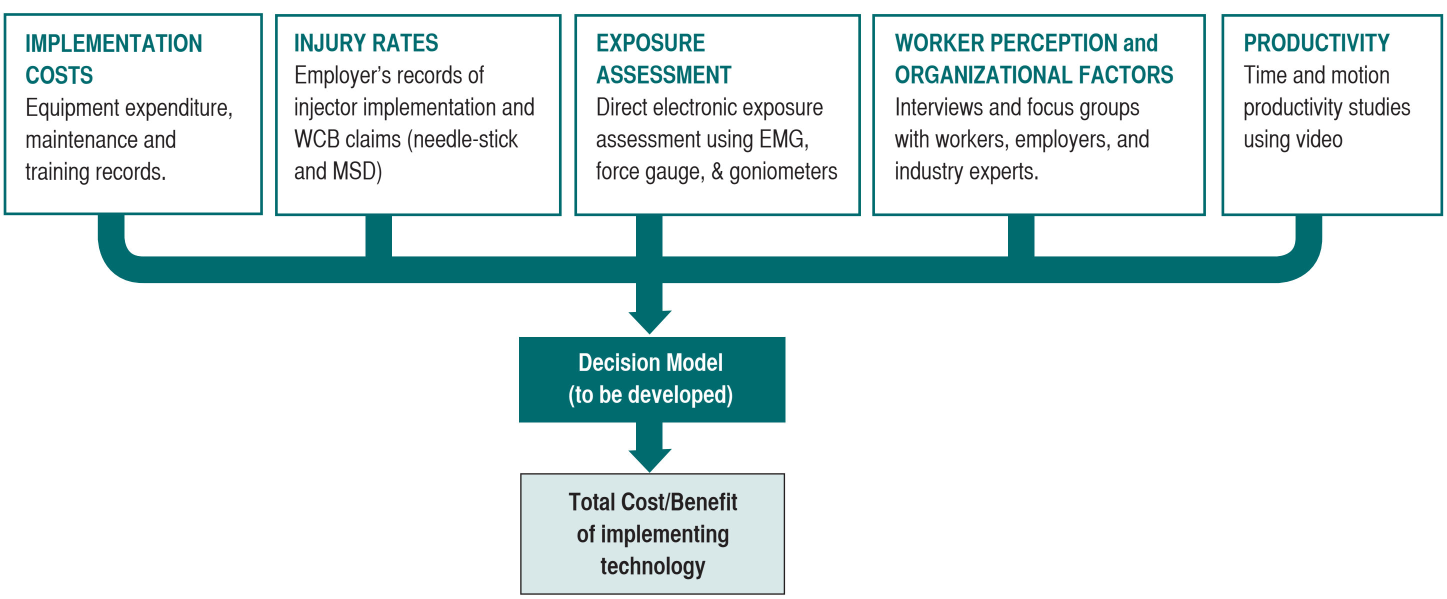


Fig 2 There are many aspects to consider when making a decision about adopting a new technology

Although innovations may have an impact on worker health and safety, they can be difficult to integrate with business decisions.

make up for absenteeism. Although technological innovations may have an impact on worker health and safety, these impacts (whether positive or negative) can be difficult to quantify and integrate with business decisions.

To address this, the Prairie Swine Centre is collaborating with the Canadian Centre for Health and Safety in Agriculture at the University of Saskatchewan to evaluate the health and safety effects of new technologies. This will help producers decide if they want to adopt a new technology. The goal of this project is to develop a suite of performance measures (a 'toolkit') which can be applied to decision-making about to new technologies. The specific technology we are investigating in this study is needle-less injectors, and we are comparing them with conventional needle injectors in a comprehensive evaluation that attempts to incorporate all the decision-making factors.

This last summer we conducted ergonomic evaluations at the Prairie Swine Centre during nursery pig injections and piglet processing. More than 650 injections were assessed using electromyography (EMG) to measure muscle activation and forces in the hand and wrist, as well as a posture sensor glove which records finger, hand, and wrist position during injection tasks. Processing is currently underway to determine muscle force and hand/wrist posture for each injection method. The study is still ongoing. This year we will conduct interviews on worker preferences, compare injury rates before and after the adoption of the needle-less injector, and evaluate the cost of each method.

For more information on this and other ergonomics studies, check out the Ergonomics Lab website of the Canadian Centre for Health and Safety in Agriculture : http://research-groups.usask.ca/ergolab/index.php

(Precision Agriculture...Cont'd from page 1)
water, utilities and nutrients used to produce a kilo of pork, and complete the story by accounting for the nutrients returned to the soil for future crops. Additionally, health and behaviour data are not far behind building a tool set for real-time management. But this approach also enhances transparency and tracebility, something that is growing in importance of branded products.

Grain and oilseed farming has been aided by GPS, and more recently, aerial monitoring equipment (drones) which make it possible to link a point on the field with a management practice to improve productivity and lower costs.

What is the pork industry equivalent technology to GPS and drones used in arable farming?

The number of devices to monitor farm activity is growing every month. I want to mention a few that I have seen, and we can begin to think of the potential these have to impact your business - in the near future.

I thought I would start with a few that are under investigation now as part of Prairie Swine Centre research or demonstration activities. Dr. Catherine Trask, Canada Research Chair in Ergonomics and Musculoskeletal Health at the University of Saskatchewan is featured in this issue. Her team is using microsensors measuring muscles in the hand and forearm to measure repetitive motion from common practices such as castration and tail docking to see differences in technique and equipment that may have an impact on reducing repetitive stress injury.

Feed ranks highest in cost of production, even in periods of low grain prices such as now. Two Canadian firms have their equipment installed in PSC to allow controlled gestation feeding. The JYGA G3 and Maximus gestation feeding systems monitor feed disappearance in our specialized gestation rooms, producing data for researchers. For the past three years the JYGA Gestal units have fed one of our five farrowing rooms. Recently we compared that 4x/day feeding program to a simple modified feed tube and hand feeding 3X/day. The results reinforce that even good hand feeding technique cannot compare to the efficiency of small amounts fed often, as seen in the other two systems. In fact feed cost was reduced by $9/farrowing in favour of the limit feeding systems, and additionally the JYGA Gestal allows continuous monitoring and provides alerts when the sow falls below the feed curve.

Be Seen Be Safe and Farm Health Monitor are in the late stages of development and will generate biosecurity data (specifically who comes and goes from your property) and allows the stockperson to contribute to real-time alerts on changes in disease presence on the farm. This technology represents not only new ways to capture data - through geofencing - but also is a good example of the democratization of data as multiple entry people and facilities can freely add data to a system thst deidentifies and shares the data for others to use in managing their herd health.

Speaking of herd health, this past week I was reminded of the 'Cough monitor'. A technology that has been used in health research in the UK. This was one of the examples cited by Caithrin Rintoul, CEO of the agtech platform Provender, in his presentation at the Ontario Pork annual general meeting. Mr. Rintoul's company philosophy was stated as "faster, more seamless technology into the hands of farmers".

Precision feeding of market hogs has been under investigation at Agriculture Canada that can alter the diet daily for each individual pig that enters the feeder. This captures data on feed disappearance, and growth rate today, and translating this into alterations to the diet tomorrow. The evidence suggests this technique can improve feeding costs by 8% (>$10/hog) and reduce Nitrogen excretion by 40%.

The use of infrared cameras in conjunction with water disappearance to investigate real-time monitoring of pig health through external body temperature readings, eventually even linking this to meat quality.

The Innovators Club meeting at Banff this past January was treated to a presentation by Dr. Ricardo Segundo of Optimal Pork Producers in Spain. Dr. Segundo demonstrated a new syringe with RFID capability that provides a perfect trail for all injectables, links the pig to the dose, date and even the lot code of the product used. Farms Mother is a custom software solution designed to capture the data from every device and animal on the farm and bring it to a single easy-to-read dashboard so that management, located anywhere in the world, can access the data for analysis and correlations between performance and environmental conditions or feed and water disappearance by pen in real-time.

Valerie, an EU initiative seeks to create a search process that links products and services to synthesize tech papers suited to the individual farm asking the question. Image having access to research and popular press, and perhaps even video that is resident on the web all searched and reported - just for you, right now.

None of this is science fiction – the technology exists today, not all of it applied to livestock agriculture, but with some effort it could.

WATER INTAKE

Recommended Flow Rate and Height of Nipple

Phase	Weight (kgs)	Intake (L/day)	Nipple Drinkers	
			Flow (L/min)	Height (cm, 450)
Gestation		Variable	0.5 to 1.0	90cm / 35in
Lactation		12-20	1.0 to 2.0	90cm / 35in
Piglets		Variable	0.5 to 0.7	15cm / 6in
Nursery	5	1.0 - 2.0	0.5 to 1.0	30 cm / 12in
	7	1.5 - 2.5	0.5 to 1.0	35cm / 14in
	15	2.5 - 3.	0.5 to 1.0	45cm / 18in
	20	3.0 - 4.0	0.5 to 1.0	50cm / 20in
Finishing	25	3.0 - 4.0	0.5 to 1.0	55cm / 22in
	50	5.0 - 7.0	0.5 to 1.0	65cm / 26in
	75	5.0 - 7.0	0.5 to 1.0	75cm / 30in
	>100	5.0 - 7.0	0.5 to 1.0	80 cm / 32in

This project 'From Innovation to Adoption: On-Farm Demonstration of Swine Research' is funded by Swine Innovation Porc within the Swine Cluster 2: Driving Results Through Innovation research program. Funding is provided by Agriculture and Agri-Food Canada through the AgriInnovation Program, provincial producer organizations and industry partners.

Drinkers

Height (cm, 900)
75 cm / 30”
75cm / 30in
10cm / 4in
25cm / 10in
30cm / 12in
35cm / 14in
40cm / 16in
45cm / 18in
55cm / 22in
65cm / 26in
70 cm / 28in

TIPS FOR SAVING WATER

- Nipple drinkers mounted at 900, nipples should be set at **SHOULDER HEIGHT** based on the height of the smallest pig in the pen.
- Nipple drinkers mounted downwards at 450, nipples should be set at 5cm or 2 inches **ABOVE** the back of the pig, based on the height of the smallest pig in the pen.
- Check fl ow rates. Flow rates determine the time spent at the nipple, water intake and water wastage.
- Repair or replace leaky drinkers and water lines.
- Individual water wastage increases with nipple flow rate.
- Water wastage of finisher pigs from a nipple drinker ranges between 25 - 40%.
- Recent preliminary audit results of water flow rates indicate approximately 65% of nipple drinkers provide water flow rates higher than required (‘From Innovation to Adoption: On-Farm Demonstration of Swine Research’)
- Drinking speed (actual intakes) of pigs was increased with nipple flow rate.

Managing Feeding To Reduce Feed Wastage In Lactation

Dan Columbus, Ph.D.

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

Traditionally most producers feed lactating sows manually, feeding sows up to three times per day in order to maximize feed intake and optimize litter performance. However, providing large quantities of feed may result in increased feed wastage or spoilage. One technology pork producers have utilized to maximize lactation performance is electronic feeding systems for sows during lactation. These systems have multiple advantages over manual feed delivery including collection of feed intake data, controlled delivery of fresh feed, reduced feed wastage, and lower labour costs, however, these feed systems can be costly to install and maintain.

A project at Prairie Swine Centre set out to develop a modified feeding system which provides the advantage of the delivery of fresh feed to the sow without the expense of the electronic feeding system. A simple feeding system was developed which consisted of a feed drop tube which extends to approximately one inch above the base of the feeder, requiring the sow to manipulate the tube to release small quantities of feed.

A total of 45 sows and litters were randomly assigned to 1 of 3 feeding systems, consisting of manual feeding, a commercially available electronic sow feeder, and the modified system. Sow body weight, back fat, and body condition score were recorded when moved into the farrowing room and at weaning, 21 days post-farrowing. Sow feed intake was recorded daily with any spoiled feed being removed, weighed, and feed intake adjusted. Litter growth performance was measured weekly over the 3 week lactation.

What did we find?

The type of feeding system used had no effect on sow body weight, body condition score, or back fat. There was a slight decrease in litter average daily gain in the third week post-farrowing on the electronic feeding system when compared to manual feeding, however, this did not result in a difference in overall litter weight. Sow feed intake was significantly higher with manual feeding when compared to the other two feeding systems in the first two weeks of lactation, but this difference was no longer evident in the third week.

Bottom Line

This study demonstrated that manual feeding of sows during lactation can result in higher feed usage with no corresponding increase in sow or litter productivity. At today's feed prices the reduction in feed intake associated with the electronic or modified feeding system would save producers an estimated $8.50 per lactation when compared to manual feeding. Therefore, the electronic and modified feeding should be considered to minimize feed wastage and maximize returns. While both systems would reduce feed usage and labour costs associated with feeding, higher costs associated with the electronic feeding system needs to be weighed against additional benefits, such as automatic recording of feed intake when considering which system to implement in their facility.

Looking Back

Prairie Swine Centre, 1991

Prairie Swine Centre, 2000

Prairie Swine Centre, Off-site facility 2016.

PSC Elstow Research Farm

Does the Inclusion of Lyso-Lecithin (Lecired) Improve the Growth of Newly Weaned Pigs?

A.D. Beaulieu P. Leterme

The inclusion of 10% (dietary fat) lyso-lecithin to high or low energy diets of weanling pigs had only modest effects on growth or feed conversion regardless of whether the diets contained 2, 4 or 6 % tallow.

Weaning is a stressful experience, one in which anewly weaned piglet is abruptly transferred from a liquid milk diet, containing about 8% fat to a dry diet with approximately 5% fat. In addition, fat digestibility of milk fat by the suckling pig approaches 95% while the digestion of dietary fat by the piglet shortly after weaning is only about 75%. Subsequently, supplementing dietary fat into diets of newly weaned piglets does not alleviate the deficit in energy intake experienced at this crucial time.

Previous studies have shown that the addition of lecithin to the diet of newly weaned piglets improved digestibility of long-chain fatty acids, however, it did not show an improved growth rate. Lecithin, which is primarily phosphatidylcholine, is commonly added to food, because it is an emulsifier. It is listed in CFIA, Schedule IV. One specific project at Prairie Swine Centre examined if Lyso-lecithin will improve digestibility of tallow, resulting in a performance response when the pigs are limiting in energy.

The experiment used 12 treatments, 10 pens of 4 pigs (weaned at 26 days of age, n = 480) per pen per treatment. Each room (considered a block) contained 24 pens (thus the experiment required 5 nursery rooms) with pigs being assigned to pen based on body weight.

Piglets received a commercial phase 1 diet for 7 days before switching to the phase 2 diet for the remaining 21 days. Diets were formulated to be a minimum of 5% different in NE content (approximately 120 calories) within 2 phases (average BW of weight group, 5 to 12 kg BW, and 12 to 25 kg BW). Except energy, all other nutrients met requirements for piglets of this age. In order

Table 1. Treatment designation.

Treatment #	1	2	3	4	5	6	7	8	9	10	11	12
Tallow, %	2	2	4	4	6	6	2	2	4	4	6	6
Lecithin	0	10%	0	10%	0	10%	0	10%	0	10%	0	10%
NE, kcal/kg	2400	2400	2400	2400	2400	2400	2280	2280	2280	2280	2280	2280
Actual lecithin inclusion, %												
Lyso lecithin	0	0.2	0	0.4	0	0.6	0	0.2 (0.4	0	0.4	0	0.6
(Lecired)		(0.4)		(0.8)		(1.2)				(0.8)		(1.2)

NOTE: Lecired is 48% lecithin.

to minimize variation among the diets, 4 batches (diets 1 to 6, 7 to 12, 13 to 18 and 19 to 24) were prepared. These were then divided into smaller batches and appropriate amounts of corn starch, cellulose and tallow added. Piglets and feeders were weighed on day 0, 3, 7, and weekly until day 42 (nursery exit). This allowed the determination of growth rate, feed intake and feed efficiency.

RESULTS AND DISCUSSIONS

Overall, there were minimal effects of treatment on performance of the piglets in this experiment. Because there were very few significant interactions of lecithin with either dietary tallow or energy, only the main effects of the lecithin are shown. Adding lecithin at 10% of dietary fat to the diet did improve growth and feed intake in the first 3 days of the experiment (Table 1. $P < 0.05$, d 7 to 10 post weaning).

However, despite a significant effect of the lecithin, there were no interactions with either dietary energy or tallow during this time period. We had hypothesized that lecithin would improve digestibility of the tallow, and effects would be more apparent in a low energy diet. However, as can be seen in Figure 1, the effect of lecithin was greater in the high energy diet ($P < 0.05$).

This experiment was designed to examine the effect of lecithin in the diet, because there is evidence that fat digestibility in the newly weaned pig is impaired because of a lack of lipase enzyme, and the observation that fat emulsification would improve fat digestibility and thus energy available to the piglet. For example, the addition of 0.02% lysolecithin improved growth performance and tended to improve fat digestibility when added to the diet of weanling pig (Jin et al. 1998). However, others (ie. Price et al. 1988) saw no effect of fat emulsification on the performance of newly weaned pigs. It was suggested that dietary energy was not limiting growth in these piglets. We included the energy treatment in our experiment to test this hypothesis.

> "Inclusion of lyso-lecithin (10% of dietary fat) into high or low energy diets fed to newly weaned pigs had no effect on growth or feed conversion."

Tallow was used as a fat source in our experiment because it has been shown that the digestibility of tallow a saturated fat) was improved more by the addition of dietary lysolecithin to the diet than when an unsaturated fat was used (Jin et al. 1988).

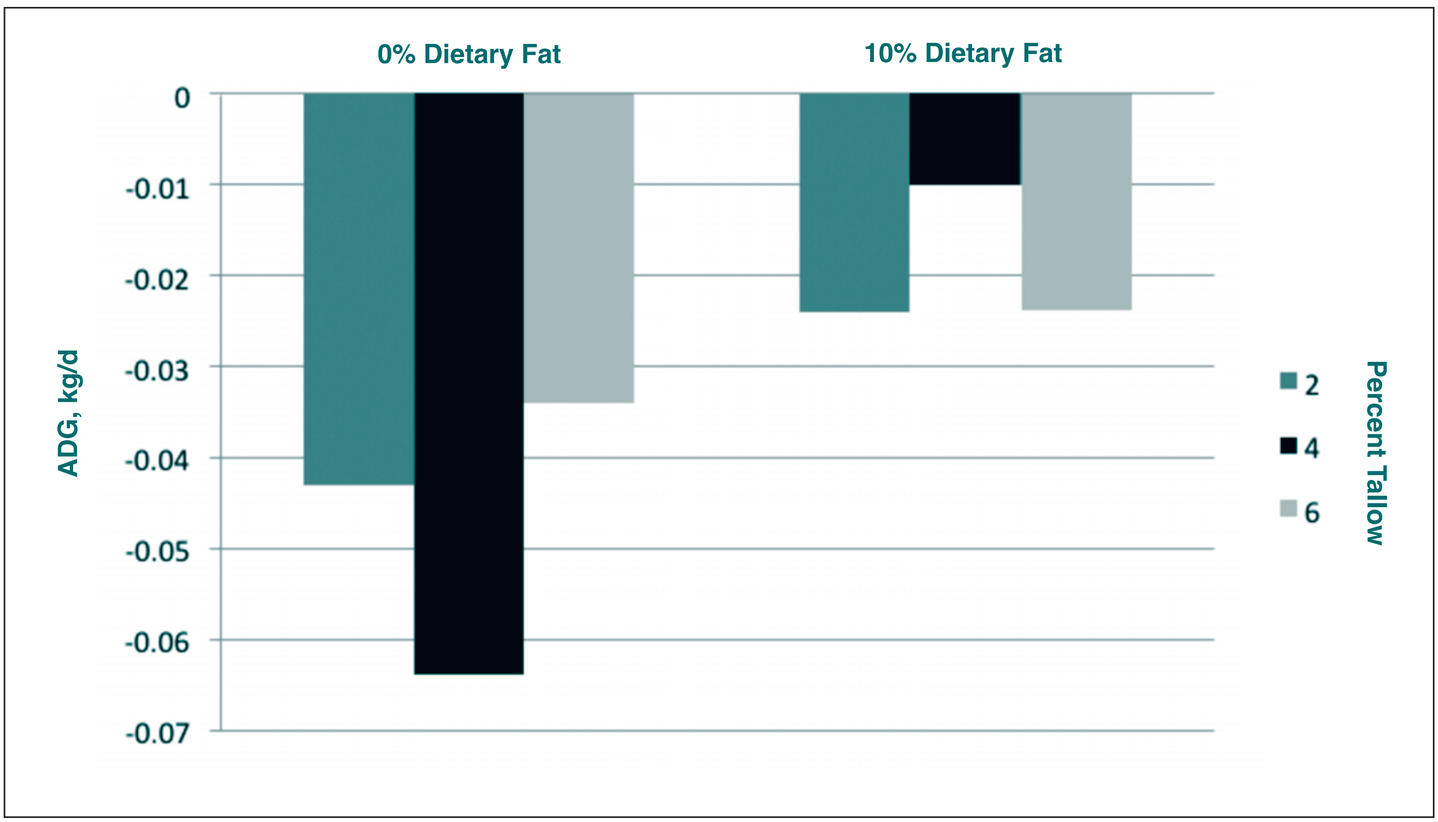


Figure 1. The interaction of lecithin (0 or 10 % of dietary fat) and tallow ($P < 0.05$) in the diet on the growth of weanling pigs, experimental d0 to 3 (d0 is d7 post- weaning)

Personal Profiles

Cyril Roy

Cyril Roy is a post-doctoral researcher who has joined the ethology team at Prairie Swine Centre in February 2017. He is working under the leadership of Dr. Jennifer Brown (Prairie Swine Centre) and also works in collaboration with Dr. Yolande (University of Saskatchewan) when necessary.

Three research projects that Cyril is currently working are

- Understanding the effects of mixing sows at different time points after weaning on production and aggressive behaviour
- Understanding the effects of different types of enrichment for gestation sows and their effect on health and behaviour, and
- Effect of different housing density in nursery pigs.

Another project Cyril will be associated shortly is "welfare issues associated with transport of young pigs." His other responsibility includes developing and implementing research protocols for behavioural studies, data analysis, and interpretation, preparation of final reports, articles for technical publication, scientific abstracts and papers, and grant applications.

Cyril worked for four years in the Canadian farm animal sector, three years managing dairy herds and one year as a manager in a hog production unit. While working with the Canadian swine sector, he was involved in the implementation of management practices such as conversion of farrowing crates to enriched pens, the introduction of pain management procedures for castration and group housing of sows at various stages of breeding management.

Cyril's doctoral research focused on welfare assessment of horses transported for commercial purposes in Canada, the USA, and Iceland. His research also focused on identifying risk factors to develop mitigation strategies for the identified welfare issues. Before doing his Ph.D., Cyril obtained a Master's degree in Applied Animal Behaviour and Animal Welfare. His bachelor degree was on Veterinary Sciences. Cyril's research interests revolve around finding practical solutions to improve farm animal welfare which can be backed up by evidence based research.

Coming Events

World Pork Expo
June 7-9, 2017
Des Moines, IA.

Alberta Pork Congress
June 14-15, 2017
Red Deer, AB.

Ontario Pork Congress
June 21-22, 2017
Stratford, ON

PRAIRIE SWINE CENTRE

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