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Finding the Opportunity in Change

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As I prepare this article the 'winds of change' have reached gale force proportions. A mere nine months have passed since significant and sustained profitability came upon the industry. After nearly a decade of decline and doing with less, producers and the sector that services them welcome this return to prosperity. The USDA numbers were released this week. The industry is growing again. About 2% more sows in the US breeding herd; that is the true measure of industry optimism – reinvestment. The general sense is we are being more cautious in Canada. The number of new projects can be counted on the fingers of one hand, plus a few barn conversions. Most of these projects are located in eastern Canada and most are sow spaces actually replacing sow gestation spaces with group housing resulting in only a slight increase in sow numbers.

Industry growth is a blunt tool to measure progress but it is definitive. Builders have reported they are 'fully booked' for the year. That is encouraging, but in the peak of the growth period these same builders had multiple crews available. The pork industry has seen a remarkable turn around in profits for the past year. However the time it takes producers to re-build equity over the past eight years depends on individual cost structures and risk management strategies. In a nutshell, the typical Canadian herd has 18 more months of profitability to replace the equity lost in those many months of operating losses.

Attitudes can and do change more quickly than balance sheets, and rightfully so. Balance sheets reflect good decisions made previously, ahead of the current trends. So in celebration of making good decisions ahead of the trend let us first replace our 'slash and burn' vocabulary with one of optimism and faith in the future. I like the following 'story' as a metaphor for our current mindset:

A Eulogy to I Can't

Author-appears in various forms on the web

"Friends, we gather here today to honor the memory of 'I Can't.' While he was with us here on earth, he touched the lives of everyone, some more than others. His name, unfortunately, has been spoken in every public building -- schools, city halls, national capitols, and yes, even in our house."

"We have provided 'I Can't' with a final resting place and a headstone that contained his epitaph. He is survived by his brothers and sisters, 'I Can', 'I Will', and 'I'm Going to Right Away'. They are not as well-known as their famous relative and are certainly not as strong and powerful, yet. Perhaps someday, with your help, they will make an even bigger mark on the world."

"May 'I Can't' rest in peace and may everyone present pick up their lives and move forward in his absence. Amen."

May you enjoy and prosper in these times we are in. Take full advantage of this moment and do not waste this opportunity for change. Just as our successful farms did not waste the opportunity to cut costs and change when fortunes were poor, we will measure future success by our ability to grasp this moment and reignite our passion to do it better this time.

Publication # 40010021

Returning to Profitability

Ken Engele, BSA.

Lee Whittington, B.Sc., MBA.

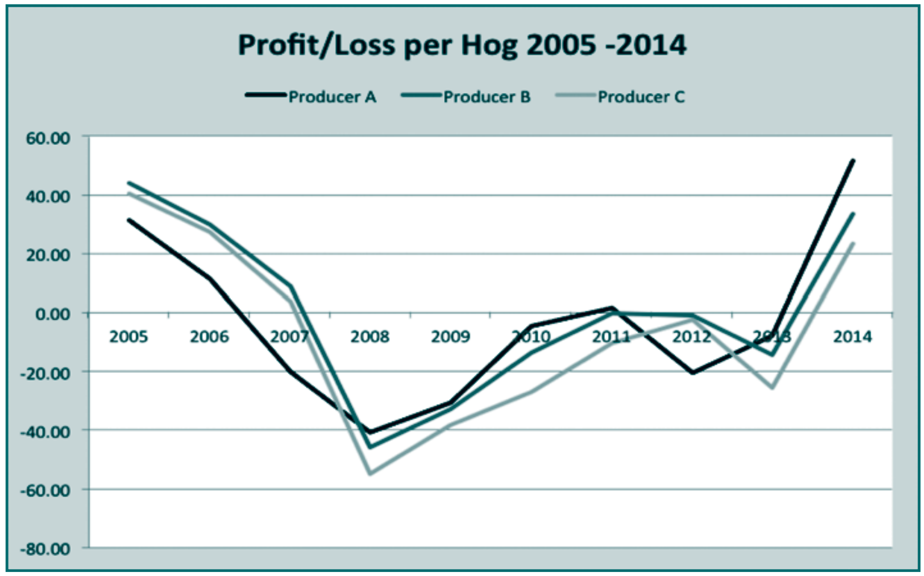

Figure 1. Average profit/loss per hog 2005-2014

This past June at Alberta Pork Congress Rick Dehod (AARD) was speaking to the topic of "Managing Financial Risk on the Hog Farm" and addressed the financial stability within the pork industry. At the end of the presentation the inevitable question was asked. "How long before financial institutions start looking favourably at the pork industry?" The answer at that time that was a minimum of another 12 months of profit would need to be realized before bankers would give serious consideration to the pork industry. Producers have a good handle on what their individual financial situation looks like today, and based on expected future returns, how many additional months will be required to backfill the equity loss since 2007. However the same statement can't be broadly applied to financial agencies, governments or perhaps service providing industries. How is it, an industry can go from record losses to record profits within a few short years.

The past twenty years in the Canadian hog industry has been a wild ride. 1995 was the beginning of roughly ten years of unprecedented growth where we saw sow numbers increase close to 50%. Sure, there was the price adjustment of late 1998 – early 1999 that dampened some enthusiasm, but low grain prices throughout this period kept producers aware of the long term opportunity within the pork industry. What transpired next I don't believe anyone could have possibly imagined: Circo virus, avian/swine influenza, exchange rate, country of original labelling, ethanol policy, drought, and record feed costs. A once strong and vibrant industry was hit with ten years of meeting new challenges, ones that resulted in 25% decline in sow numbers since 2005 and left the producers still in the industry wondering if the light at the end of the tunnel would ever arrive.

The first glimmer of hope was seen in 2011. Hog prices started showing some recovery, and that along with moderate feed prices created something some producers hadn't seen since 2006; PROFIT. While not large it created a sense of cautious optimism within the industry. According to the USDA-ERS about 80% of agricultural land experienced drought in 2012, making it more extensive than any drought since the 1950's. The resulting drought saw feed prices increase by 30-50% in a mere two months, once again pulling all the profit out of the industry. What a difference a year can make! In late 2013 the stars appeared to be aligning for the pork industry. A record (large) harvest met with production losses associated with PEDv, and strong product demand saw profits once again return to the industry; profits at levels which many producers have never experienced.

Any industry that achieves record profits soon expands; basic economics. While the latest USA Pigs and Hogs Report shows a 2% increase in the U.S. breeding herd, the general sense in Canada is we are being more cautious. While profits are nice, everyone realizes the Canadian pork industry has dug itself a huge equity hole since 2007. So the question in the industry in September 2014 becomes; "How many more months of profitability does the industry need to replace the lost equity?"

In short, an average producer needs 12 more months of profitability to fill in that hole.

12 MONTHS

While we knew the 2007-2013 period wasn't kind to the pork industry we were never sure how big a hole we had dug for ourselves. Figure 1 compares the net profit/loss for three hypothetical producers, with Producer A being low-cost; Producer B industry average-cost; and Producer C being a high-cost producer. We can see the overall trend of profitability is the same for all producers. Somewhere over an 18 month period starting in late 2006 margins turned negative. The point to which margins are impacted is dependent on many producer specific conditions including productivity, cash position, risk management preferences and leverage to name a few. The interesting fact Figure 1 points out, is while the overall trend is the same, the severity and length of loss is vastly different across each operation. For example, Producer A experienced a slight profit overall for 2011, Producer B achieved a breakeven position, and Producer C's losses are still in excess of $10/pig. In fact, Producer C does not realize profitability until 2014, a six year time-frame of no profits. It's important to remember the numbers are being averaged for the calendar year, so it's not to say Producer C didn't achieve profitability during some months, or in the last half of 2013.

What happens if we extend the information presented in Figure 1 to a 600 sow farrow-to-finish operation producing 12,500 pigs on an annual basis? Figure 2, presents the cumulative profit/loss for each operation for the 2005-2014 timeframe. One of the most important take home messages from Figure 2 is the importance of the cash position of each operation heading into 2007. Based on these examples, the cash positions ranged from $277,000 to $1.02m in cash reserves, meaning Producer A's cash reserves were used up by the end of 2008 while it took until 2009 and 2010 for Producer C and Producer B respectively. Profits throughout the 2014 time frame ranged from $25 to more than $50/hog for all producers. Profit is largely dependent on individual producer cost structures cost structures in addition to positions taken with future hog contract prices. Throughout 2014 some producers have not seen the full value seen in the cash hog market as they may have been heavily hedged. According to the data in Figure 2 we can see that Producer B would have covered all losses since 2007 with 2014 profitability. What about the other 2 producers?

> "Many lower-cost producers have re-built the equity lost throughout the 2007-2013 period"

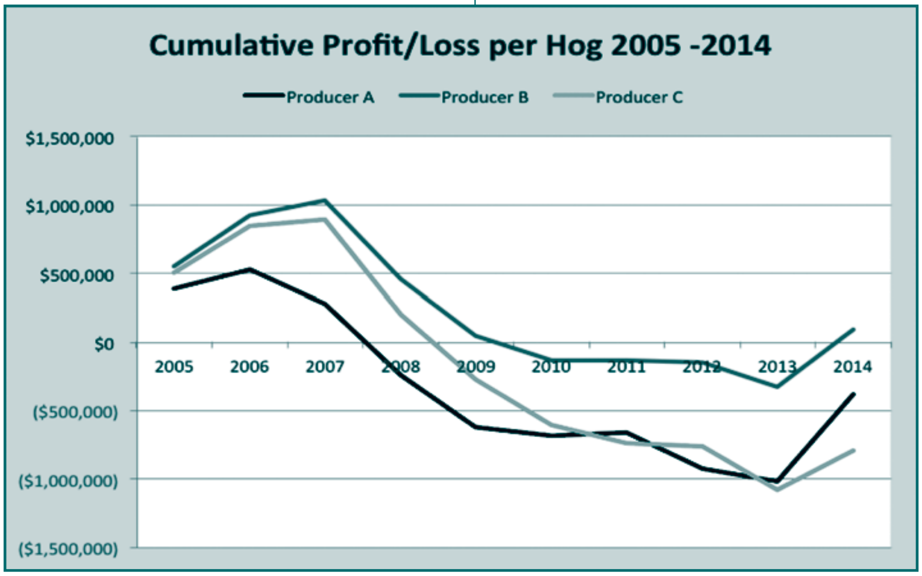

Figure 2. Cumulative profit/loss 2005-2014.

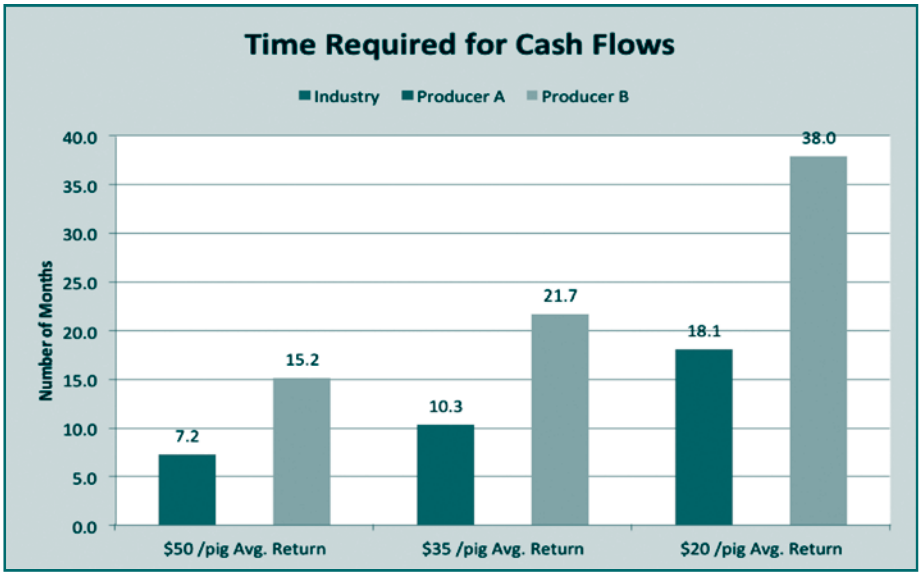

Figure 3. Time required to fill equity gap

Figure 3 assumes three different long term profit scenarios (in 2014, and going forward); $50, $35, and $20/hog profit. Based on the data presented in Figure 3 we can see that Producer A would require somewhere between 7 and 18 months of profit before all cumulative losses would be covered. Producer C is a completely different story. Due to management decisions over this time period; Producer C would still require a minimum of 15 months and as long as three years into the future to return to profitability.

Even though some producers have seen record profits in 2014; there is still a long way to go to fill the void created over six unforgiving years.

Dietary omega 6 to omega 3 ratio impacts nursery pigs more than omega 3 intake alone


Laura Eastwood, Ph.D. Denise Beaulieu, Ph.D

Introduction:

Weaning is a stressful time in a piglet's life. They undergo social, environmental and nutritional stressors at a time when their immune system is not fully developed. This can precipitate the 'post-weaning growth lag', which is characterized by animals going off feed, reduced or negative growth rates and increased susceptibility to pathogens. These stresses can trigger an inflammatory reaction in some piglets. Although a certain degree of an inflammatory response is beneficial, an over-production of inflammatory cells may become detrimental to the animals, leading to reduced muscle synthesis or even muscle degradation, characteristic of the post-weaning growth lag.

Over the years, there has been a high degree of interest in nutritional modulation aimed at helping piglets cope during this time period. Omega (ω)-3 fatty acids (FA) have many potential health benefits, including anti-inflammatory properties. Previous research however, has shown conflicting data in terms of inflammatory responses and animal performance when ω-3's are fed. We hypothesize that different concentrations of ω-6 fatty acids in the diet among the different studies may explain some of these contradictions. In fact, it has been suggested that it may be more beneficial to reduce the dietary ω-6 to ω-3 FA ratio when feeding pigs, than to simply increase the ω-3 amount, in order to see benefits.

This project was designed to determine if whether altering the dietary ω-3 to ω-6 ratio or changing the absolute intake amount of ω-3 FA's was more important for impacting nursery pig health and performance. To achieve this, we conducted two experiments. First, our aim was to characterize how the FA ratio and intake would affect the growth and performance of nursery pigs, including whole body FA and protein deposition. Secondly, we wanted to look specifically at how the ω-3 ratio and intake amounts affect the piglets' ability to mount an acute inflammatory response post-weaning.

Materials and Methods:

A total of five dietary treatments were used for each trial. Diets consisted of a control (Con; 10:1 ω-6:ω-3 , 3.5% total fat, tallow based), three diets with 3.5% fat (plant based) and ω-6:ω-3 ratios of 10:1, 5:1 or 1:1 (3.5/10, 3.5/5 and 3.5/1 respectively), and a 10:1 ratio diet with 5% total fat (5/10). This design allowed the comparison of increasing ω-3 intake at a constant ratio (10:1 ratio, 3.5% vs 5% fat) and decreasing ratio at a constant ω-3 intake (3.5% fat, 10:1, 5:1 and 1:1 ratios).

Experiment 1: Nursery Pig Performance

Newly weaned pigs (n = 300; 26 ± 2 days of age) were housed in groups of 5/pen. Pens were assigned to one of the five diets described above. Pigs and feeders were weighed weekly for four weeks. Additionally, six pigs were slaughtered on d 0 (initial slaughter group, ISG) and 6 pigs/diet were slaughtered on d 28, allowing the calculation of whole body protein, fat and water deposition rates throughout the course of the four week trial.

Experiment 2: Inflammatory Challenge

Individually housed, newly weaned pigs (26 ± 2 days of age; n = 100) were assigned to one of the five diets and one of two inflammatory challenge groups arranged as a 5 x 2 factorial with repeated measures. Challenge groups consisted of a saline or LPS (15 µg/kg BW E. Coli lipopolysaccharide) injection. Pigs were fed their assigned diets for 22 d prior to the 24 h inflammatory challenge on d 23. Rectal temperatures were measured hourly for the first 6 h, then at 12 and 24 h post-injection. Blood samples were collected at 0, 2, 6 and 12 h post-injection for analysis of certain inflammatory proteins (interleukin (IL)-1ω, IL-6, IL-8 and tumor necrosis factor (TNF)-ω) as well as blood urea nitrogen (BUN) as an indicator of muscle catabolism.

Results and Discussion:

During the nursery performance study (Table 1), increasing ω-3 amount (constant 10:1 ratio), did not affect average daily feed intake (ADFI) or average daily gain (ADG); but when the ω-6:ω-3 ratio decreased (constant total fat) from 10:1 to 1:1, ADFI improved (0.93 vs 1.13 g/d, $P = 0.02$) during d 21 to 28 post-weaning. Pigs consuming the 3.5/5 diet tended to have increased protein (82.5 vs 71.1 vs 74.2 g/d, $P = 0.07$) and water (342.1 vs 301.0 vs 313.0 g/d, $P = 0.06$) deposition rates relative to those consuming the 3.5/10 or 3.5/1 diets. Lipid deposition was unaffected by treatment ($P > 0.10$). These results indicate that altering the ω-6:ω-3 ratio is more beneficial than altering the intake amount of ω-3's in terms of eliciting positive responses such as increased feed intake and protein deposition in nursery pigs when using plant based ω-3 FA's.

In the inflammatory challenge experiment, ADG and ADFI from d 0 to 22 or just during the challenge period were unaffected by diet ($P > 0.05$). During the challenge, LPS pigs had lower ($P < 0.01$) ADFI (0.93 vs 0.40 kg, saline vs LPS) and ADG (+0.44 kg vs -0.52 kg, saline vs LPS). Rectal temp, BUN, IL-1ω, IL-6 and TNFω were unaffected by diet ($P > 0.05$), but were increased by LPS ($P < 0.01$). Serum IL-8 concentration was reduced with decreasing ω-6:ω-3 ratio (16.79 vs 11.14 pg/ml; 10:1 vs 1:1; $P = 0.03$) but was unaffected by dietary ω-3 amount at a constant ratio ($P > 0.05$). Pigs consuming the

Table 1: Effects of altering the dietary omega-3 fatty acid amount or ratio on nursery pig performance and carcass composition

	Dietary Treatment[1] A	B	C	D	E	Effect of Ratio[2] (Diet B vs. D vs. E)	
n6:n3 Ratio	10:1s	10:1	10:1	5:1	1:1		
% Fat	3.5%	3.5%	5%	3.5%	3.5%	SEM	P Value
ADFI (kg/d)							
d 21-28	0.97a	0.95a	0.93a	0.97a	1.13b	0.042	0.02
d 7- 28	0.68	0.67	0.66	0.69	0.78	0.031	0.08
d 0-28	0.56	0.55	0.54	0.56	0.63	0.025	0.11
ADG (kg/d)							
d 21-28	0.97	0.97	0.95	0.94	1.01	0.031	0.59
d 7- 28	0.48	0.49	0.48	0.49	0.51	0.016	0.65
d 0-28	0.39	0.40	0.39	0.40	0.42	0.015	0.58
G:F							
d 21-28	1.00	1.02	1.03	0.98	0.92	0.032	0.18
d 7- 28	0.71	0.73	0.75	0.72	0.68	0.023	0.38
d 0-28	0.70	0.73	0.74	0.71	0.69	0.024	0.64
Deposition Rate (g/d)							
Protein	78.45ab	71.07bc	69.27c	82.45a	74.24abc	3.241	0.07
Lipid	35.62	31.88	34.03	31.37	30.29	2.800	0.92
Water	328.72ab	300.95bc	298.61c	342.05a	313.01bc	11.520	0.06

[1]10:1s diet contains a saturated fat source whereas all other diets contain unsaturated fat sources
[2]Effect of altering the ω-3 amount (diet B vs. C) was non-significant for all parameters

3.5/1 diet had lower IL-8 responses relative to those consuming the 3.5/10 and 3.5/5 diets (diet ω challenge P = 0.03). Additionally, the IL-8 response of pigs fed the 1:1 diet and challenged with LPS was similar to the saline injected pigs fed the 10:1, 5:1 or 1:1 diets (P = 0.09, Figure 1), indicating that reducing the dietary ω-6:ω-3 ratio impacts a piglets inflammatory response post-weaning.

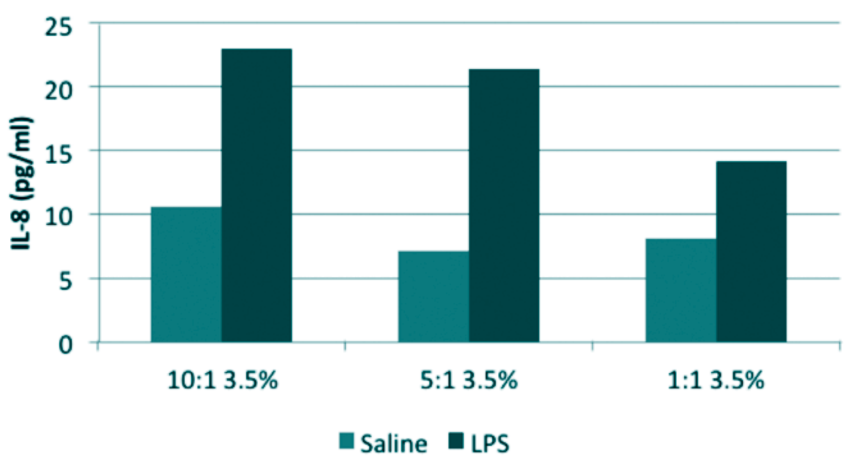

Figure 1: Diet by challenge interaction for pigs fed decreasing ω-6 to ω-3 fatty acid ratios during an inflammatory challenge (SEM = 2.02, P = 0.09)

Summary and Conclusion:

During the inflammatory challenge, we observed a significant reduction in interleukin (IL)-8 (an inflammatory cytokine) as the dietary ω-6:ω-3 ratio decreased, but there was no effect on IL-8 when just the ω-3 amount was altered. In addition to this, during the challenge, pigs consuming the 1:1 diet had an IL-8 response level similar to the non-challenged pigs on any diet. During the performance study, increasing the amount of dietary ω-3 fatty acids while keeping the ω-6:ω-3 ratio constant did not affect piglet growth, feed intake or carcass composition; however, when total fat was held constant, a 5:1 ratio led to improved feed intake in older nursery pigs, as well as increased protein deposition without altering lipid deposition. It is possible that this reduction in inflammatory response at weaning may help explain why pigs consuming the lower ratio diets had increased feed intakes and improved protein deposition rates, as they did not require as much protein to mount an inflammatory response.

The Bottom Line

Results from these experiments indicate that altering the ω-6 to ω-3 ratio can improve nursery pig performance, and protein deposition, potentially by diverting nutrients away from an unnecessary inflammatory response. Additionally, we found no effects on piglet performance or health by altering the amount of ω-3's without changing the FA ratio. Results from this project indicate that in order to observe benefits of feeding ω-3 FA's to nursery pigs, it is more important to ensure the ratio of ω-3's relative to ω-6's are altered as opposed to simply increasing the amount without changing the ratio.

Feeding mycotoxin contaminated grain to swine

Laura Eastwood, Ph.D. Denise Beaulieu, Ph.D

Take Home Message

- Mycotoxins, which are produced from moulds, can contaminate all grains and grain-by-products commonly fed to swine in Western Canada.
- Personnel working with grains should avoid inhaling the dust and wear a mask.
- Dilution is (only partially) the solution.

Mycotoxins are chemicals (secondary metabolites) produced by moulds or fungi infecting grains. There are over 400 known mycotoxins; however only a small number of these probably affect pig performance on a regular basis. It is important to note that the presence of the mould or fungi does not guarantee the presence of mycotoxins; conversely, mycotoxins can be present in a sample with no obvious mould contamination. The mycotoxins of major concern in Canada are listed in Table 1. Several factors contribute to the production of mycotoxins in grain, including humidity and temperature during the growing and harvest periods, oxygen availability during growth, harvest, transport or storage and insect or bird damage. Multiple mycotoxins may be present at the same time and mycotoxins may be "masked". These are mycotoxins bound to another molecule which may make them undetectable by routine assays. They will however, break down in the gut, and cause problems.

Pigs are more susceptible to the effects of most mycotoxins than other species, especially ruminants. The age of the animal and production status are important considerations. Table 1 outlines the mycotoxins of major concern, and their impact on animal performance.

"Determining the optimal feeding strategy is dependant on which mycotoxins are presence and their concentration"

In order to determine optimal feeding strategies, it is critical to know which mycotoxins are present and the approximate concentration. Many commercial laboratories can analyze for the common mycotoxins. The difficulty is obtaining a sample which is representative of the entire lot. When sampling grains or feeds, subsamples from 12-20 locations should be collected, composited and mixed thoroughly (Whitlow et al., 2014). Once a sample is collected, it is also important to store it in a dry, cool area to impede further mycotoxin development before the analysis. Mycotoxins are often distributed unevenly throughout the load, and very small quantities can cause problems (1 part per million (ppm) is equal to 1 contaminated grain in 1 million non-contaminated grains). The more subsamples collected, the better the likelihood of obtaining a laboratory analysis which really represents what is in the feed.

The CFIA has regulatory guidelines for the feeding of mycotoxins to livestock. This document reminds us that mycotoxin contamination is typically higher in the lighter fractions (grain dust, screenings, shrivelled kernels, etc.), and that while removing these fractions from the parent stock may help to reduce overall contamination, it also means that these fractions are typically heavily contaminated. Because mycotoxins and mould spores can concentrate in grain dust it is very important that inhalation is avoided and dust masks are worn when handling, as they will affect human health also. Soaking, dehulling, cleaning and/or roasting may be beneficial in some cases, as are some dietary additives.

The Canadian regulatory guidelines for feeding mycotoxins are summarized in Table 2 (see page 9). Diets must not contain more than what is listed in these guidelines. If mycotoxin contamination is suspected; dilution can mitigate the problem, but because of the issues discussed with sampling, even when diluted, the grain should be fed to the least susceptible group (for example, keep ergot and ZEN out of your breeding herd).

Table 1: Major effects of mycotoxins on swine performance

Mycotoxin	Primary Effect	Stage Affected	Clinical Signs
Deoxynivalenol (DON, vomitoxin)	Affects serotonin receptors and cytokine production	All stages (younger pigs may be more susceptible)	- Reduced ADFI and ADG[1,2] - Vomiting[2] - Diarrhea (soft or watery feces)[3] - Reduced immune function[3] - Mild changes to kidney, thyroid, blood[4]
Aflatoxins	Mutagenic and carcinogenic	All stages	- Reduced ADFI and ADG[5] - Reduced milk production[5] - Lethargy[6] - Ataxia (lack of coordination)[6] - Rough hair coat[6] - Hemorrhage[6] - Fatty liver[6]
Zearalenone	Estrogenic	Pre-pubertal gilts, sows and pre-pubertal boars	- Swelling and reddening of the vulva[7] - Vaginal and/or rectal prolapse[7] - Anestrus[8] - Reduced litter size[8] - Fetal resorption[8] - Implantation failure[8] - Decreased libido and testosterone[9] - Feminization[9]
Ochratoxin A	Disrupts phenylalanine (an amino acid) metabolism	All stages	- Kidney damage[10] - Decreased ADFI and ADG[11] - Immunosuppression, increased risk of infection[12]
Fumonisins	Disrupts lipid metabolism	All stages, especially young pigs	- Unthriftiness[6] - Low ADFI and ADG[6] - Reproductive failure[6] - Gastric upset (diarrhea)[6] - Cellular necrosis[6] - Immunosuppression [6]
T-2 and HT-2 Toxins	Inhibits protein synthesis	All stages	- Pulmonary edema[3] - Reduced immunity[3] - Decreased ADFI and ADG[13] - Shortness of breath[3] - Weakness[3] - Cyanosis (blue/purple colour of skin/membranes)
Ergot Alkaloids	Neurological	All stages, especially the reproductive herd	- Lameness[14] - Gangrene[14] - Decreased ADG[14] - Abortion[14] - Agalactia (absence of milk production)[14] - Ataxia[14]

[1] Decreased ADFI and feed refusals have been shown at levels as low as 0.5-1 ppm (Smith et al., 2005)

[2] > 2-5 ppm is for decreased ADFI and ADG, vomiting and complete feed refusal at > 20 ppm (Haschek et al., 2002)

[3] Pierce and Diaz, 2014

[4] JECFA, 2001

[5] Nibbelink, 1986

[6] Whitlow et al., 2014

[7] Friend et al., 1990

[8] Smith et al., 2005

[9] Osweiller, 1986

[10] Kidney damage occurs at levels as low as 0.5 ppm (Lippold et al., 1992)

[11] Performance is affected at levels of 2 ppm or greater (Lippold et al., 1992; Stoev et al., 2000)

[12] Can occur when levels > 2 ppm are fed for longer periods of time (Harvey et al., 1992)

[13] ADG reduced by 11% when 10 ppm fumonisin B1 was fed to starter pigs for 8 weeks (Rotter et al., 1996)

[14] Strickland et al., 2011

(Feeding Mycotoxin...Continued on page 9)

Stimulating exploratory behaviour in piglets: Effects on pre-weaning creep consumption.

Yolande Seddon, Ph.D; Sara Fairbrother; B.Sc; Krista Davies; Megan Bouvier, B.Sc.; and Jennifer Brown, Ph.D

Background

Stress at weaning results from the abrupt change from a liquid to a solid diet, and a change in the environment and pig grouping, and leads to a reduced feed intake for two days following weaning, and the potential for increased disease susceptibility and mortality. Familiarising pigs with a solid diet prior to weaning through provision of creep aims to help piglets transition to solid feed, to decrease the time spent non-eating, and prevent weight loss in the period post weaning. In addition, the provision of creep can help to familiarise the gut with solid food gradually. However, observations have shown less than 50% of piglets in a litter will actually consume the creep. In the wild, piglets learn to consume appropriate feedstuffs while foraging in groups, imitating the behaviour of the dam and the littermates. In contrast, the intensive environment is relatively barren and uniform, and combined with the restriction of the sow in a crate, provides little opportunity for sow piglet interaction or exploration. However, if the pigs' natural exploratory drive could be stimulated in the farrowing pen, this may stimulate interest and exploration of the creep feed between the littermates, and help them more readily accept solid feed post weaning. This study investigated whether providing environmental enrichment, or increasing the opportunity for social feeding, could stimulate exploratory behaviour and result in greater creep consumption and improved growth performance before and after weaning. The research questions were:

- Can stimulating exploratory behaviour increase pre-weaning creep feed consumption in piglets?
- Is exploratory behaviour best stimulated by provision of: a) pen enrichment (E: suspended ropes); or b) a shallow tray feeder that facilitates synchronized feeding, stimulating group foraging?
- Does this result in increased growth performance before or after weaning?

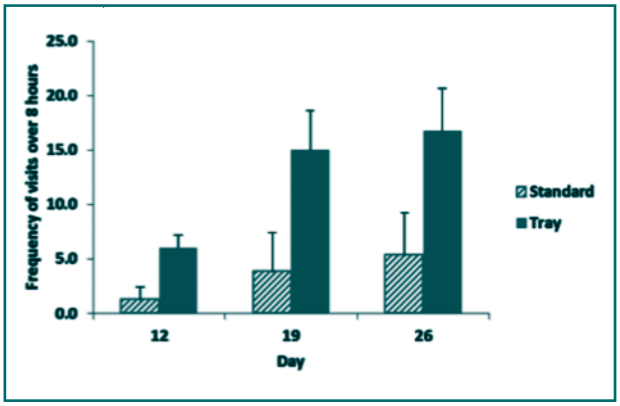

Figure 2: Frequency of piglet visits to standard and tray feeders.

Figure 1: The four treatment types a) T1: Standard Feeder (SF), b) T2: Standard feeder with enrichment (SF&E), c) T3: Tray feeder (TF), d) T4: Tray feeder with enrichment (TF&E).

Study Design

Twenty-eight litters were studied over four treatments (seven litters per treatment), with creep feed provided to all litters from 10 to 28 days of age (weaning). Treatments consisted of creep offered in one of two feeder designs (a standard commercial feeder, or a low edge baking tray), with or without enrichment provision, as follows: T1) creep provided in a standard feeder (SF), T2) creep provided in a standard feeder with enrichment (SF&E), T3) creep provided in a tray feeder (TF), and T4) creep provided in a tray feeder with enrichment (TF&E) (Figure 1). Enrichment treatments received strips of cotton rope suspended in the pen from day 5 until weaning. Piglet weights and creep consumption were recorded weekly, from birth up until six weeks of age, including an additional weight at day 1 post weaning. Piglet behaviour was recorded from 8am – 4pm, on days 12, 19, and 26 of age, and on days 1, 7 and 14 post-weaning. Footage was scanned at five minute intervals to determine the number of piglets interacting with the feeder (head in feeder), and the number of piglets interacting with the enrichment.

The Bottom Line

Provision of a large tray feeder encouraged social feeding and foraging by piglets and was more effective at attracting piglets to the creep than a standard feeder, or the provision of rope enrichment. This may be because the tray feeder provided a greater opportunity for group foraging and rooting behaviour. Provision of the tray feeder before weaning led to a positive effect on piglet growth immediately after weaning. These growth benefits may have arisen from piglets more readily taking to solid feed post weaning, having had increased exploration of solid feed pre-weaning. The greater feed disappearance from the tray feeder may have been due to increased feed wastage. However, if increasing the foraging behaviour is enough to encourage feed intake immediately post-weaning then providing expensive creep feed in the tray may not be necessary – and rather any material that the piglets can forage and ingest would do, such as beet pulp. This is an area for further research. Analysis of the post-weaning data is ongoing, and results will help determine if the effects of the tray feeder pre-weaning has lasting positive effects post weaning.

(Feeding Mycotoxin...Continued from 7)

Table 2. Legislated maximums, regulatory guidelines and recommended maximums for different mycotoxins into swine diets (adapted from Charmley and Trenholm, 2012)*

Mycotoxin	Commodity	Levels
Deoxynivalenol[1]	Diets for swine	1 ppm
Aflatoxins[2]	Animal feeding stuffs	20 ppb
T-2 toxin[3]	Swine diets	< 1 ppm
Zearalenone[3]	Gilt diets	< 1-3 ppm
Swine diets	< 0.25-5 ppm	
Ochratoxin A[3]	Swine diets (kidney damage)	0.2 ppm
	Swine diets (reduced weight gain)	2 ppm
Ergot Alkaloids[3]	Swine diets	4-6 ppm
Fumonisins[3]	Swine diets	10 ppm

**ppm is parts per million (mg/kg) and ppb is parts per billion.*

[1] Regulatory guidelines (Worldwide regulations for mycotoxins. FAO Food and Nutrition Paper 64, 1997)

[2] Legislated maximum tolerated level (Worldwide regulations for mycotoxins. FAO Food and Nutrition Paper 64, 1997)

[3] Recommended tolerance levels in Canada and the United States

For Further Information:

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Assessing daily exposure risk of pig barn workers to airborne contaminants


Alvin Alvarado, M.Sc. Bernardo Predicala, Ph.D.

Extended exposure of pig barn workers to airborne contaminants, particularly dust and gases (ammonia and hydrogen sulphide) is primarily associated with increased risk of developing respiratory symptoms and other health problems (Senthilselvan et al., 2007; Dosman et al., 2004). Various researchers have comprehensively investigated the work environment in pig barns and the associated effects on the health of barn workers. However, most of these studies focused on documenting the health symptoms and rarely involved characterization of occupational exposure environments in intensive livestock operation. Hence, to protect the health and safety of barn workers, there is a need to gain more understanding of the work environment in barns and the associated worker exposure risks.

The goals of this study were to assess the occupational exposure risk of barn workers to dust and gases while performing their assigned daily tasks in the barn, and to identify specific activities in the barn that pose high occupational exposure risk to workers.

This study was conducted in swine grow-finish rooms at the PSCI barn. The rooms included typical types of production rooms with different floor types (partially and fully-slatted floor), pen sizes (from 5-10 animals per pen), and room sizes (from 72-144 animals per room). A total of 18 monitoring days spanning winter and summer months over a one-year period were conducted to account for variations in seasonal conditions and to ensure a scientifically-valid evaluation of the collected data. Every monitoring day, the occupational exposure of a barn worker to respirable dust, ammonia (NH_3) and hydrogen sulphide (H_2S) was assessed by outfitting the barn worker with personal dust samplers and gas monitors over the course of the work shift (Figure 1). A regular working day of the barn worker involved carrying out various combinations of different tasks in the grow-finish rooms which may have included daily health check, feeding, pen floor scraping, pressure washing of rooms, loading out market pigs, weighing, among others. The worker was instructed to make sure that the personal monitoring equipment was continuously running while performing the regular assigned tasks, and to record in a logbook the time, location and the corresponding tasks performed while wearing the personal monitoring equipment.

Figure 1. Gas monitors and respirable dust sampling gear worn by the worker while performing specific tasks during personal sampling.

The results shown in Table 1 indicated that the time-weighted average (TWA) exposure levels for all the monitored parameters were below their respective exposure limits. The barn worker had a combined average respirable dust exposure of 0.98 mg/m^3, with the mean values ranging from 0.42 to 2.50 mg/m^3. Although the average respirable dust exposure levels were below the 3.0 mg/m^3 threshold limit set by the American Conference of Governmental Industrial Hygienists (ACGIH), it is important to consider that respirable dust levels exceeding 0.23 mg/m^3 were found to be associated with higher health risks in swine confinement workers (Donham, 1995).

The average NH^3 exposure for the barn worker was found to be 11.1 ppm and ranged from 1.3 to 21.4 ppm. On the other hand, mean H_2S exposure for the barn worker was about 1.3 ppm and ranged from 0 to 11.4 ppm. Further examination of the real-time data showed certain peaks were recorded for both gases during certain periods while the worker was performing daily assigned barn tasks. Notably, a number of these peaks exceeded the corresponding short-term exposure limits (STEL) and TWA for these gases. For ammonia, 11 out of 18 monitoring days had

Table 1. Occupational exposure of barn worker to respirable dust, gases and noise and their corresponding exposure limits.

	Respirable dust, mg/m³	*Ammonia, ppm*	*Hydrogen sulphide, ppm*
Mean	*0.98*	*11.1*	*1.3*
SD	*0.54*	*6.2*	*2.8*
Range	*0.42 - 2.50*	*1.3 - 21.4*	*0.0 - 11.4*
Exposure limit	*3 (TWA)[1]*	*25 (TWA); 35 (STEL)[1,2]*	*10 (TWA); 15 (STEL); 100 (IDLH)[2]*

[1]ACGIH (American Conference of Governmental Industrial Hygienists)
[2]NIOSH (National Institute for Occupational Safety and Health)
TWA – Time Weighted average
STEL – Short Term Exposure limit
IDLH – Immediate Danger to Life or Health

exposure values higher than the exposure limit of 25 ppm NH_3. These values were observed during feeding and weighing pigs as well as draining manure pits inside the room. High levels of H_2S (as high as 202 ppm) were also recorded when performing manure handling activities particularly draining manure pits in the room.

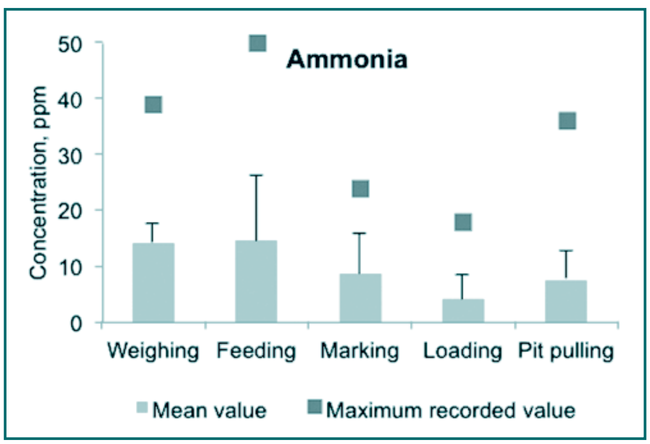
After benchmarking the occupational exposure to airborne contaminants, five specific tasks that posed greater exposure risk to workers in swine barns were identified. These included weighing, feeding, marking, and loading pigs for market, as well as draining manure pits inside the room. A task-based assessment of potential occupational exposure risk for each of the identified specific tasks was done over another year and results are shown in Figure 2.

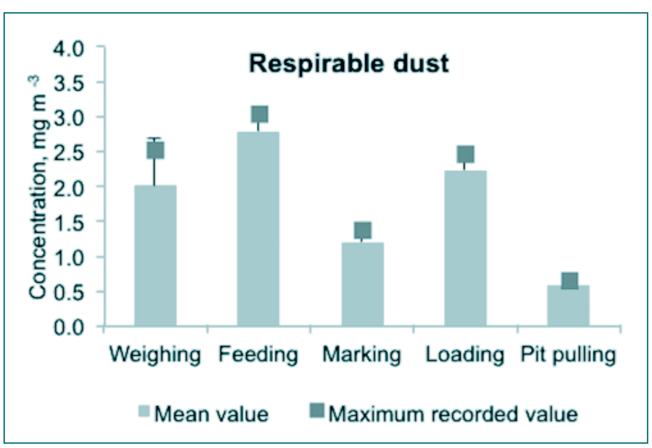
On average, all five tasks yielded NH_3 levels below the 25 ppm TWA exposure limit (Figure 2a). However, exposure to NH_3 levels exceeded the 35 ppm STEL at certain times while feeding, weighing pigs, and draining manure pits. Feeding pigs recorded a maximum NH_3 concentration of 50 ppm while weighing pigs and draining pits had peak NH_3 levels of 39 ppm and 36 ppm, respectively. Similarly, the average H_2S exposure for all five tasks was found to be below the 10 ppm (TWA) and 15 ppm (STEL) threshold limit values (Figure 2b). Levels of H_2S when draining manure pits were significantly higher ($p<0.05$) than the levels recorded when performing the other four tasks. This can be attributed to several observed spikes in H_2S levels while the worker was draining manure pits inside the room; these peaks (maximum of 220 ppm) exceeded the 100 ppm mark which is considered immediately dangerous to life or health (IDLH) according to the NIOSH guidelines. During these instances, the worker's H_2S gas monitor emitted an alarm, which compelled the worker to immediately leave the area according to established safety protocol.

Feeding pigs resulted in the highest respirable dust exposure among the five tasks (Figure 2c), with a maximum recorded value of 3.04 mg/m³. The other selected tasks had levels below the 3.0 mg/m³ threshold limit value established by ACGIH for airborne respirable particulates in the workplace. On average, respirable dust levels during feeding was significantly higher ($p<0.05$) than the levels during weighing and marking pigs as well as during manure pit clearing in the room. This can be attributed to the way feeding was done in this study which involved filling feed carts from the bin and distributing them into individual feeders inside the room.

The Bottom Line

The occupational exposure of barn workers to respirable dust, ammonia and hydrogen sulphide while performing their assigned daily tasks in the barn was generally below the respective time-weighted average (TWA) exposure limits for each parameter (3 mg/m³ for respirable dust, 25 ppm for NH_3 and 10 ppm for H_2S). The variation in the time-weighted average of the airborne contaminants was dependent on the tasks the workers performed during any specific workday. Activities like feeding, weighing pigs, and draining manure pits, have a higher likelihood to result in exposures that exceed the 15-min threshold limit value and thus, pose greater occupational exposure risk to barn workers.





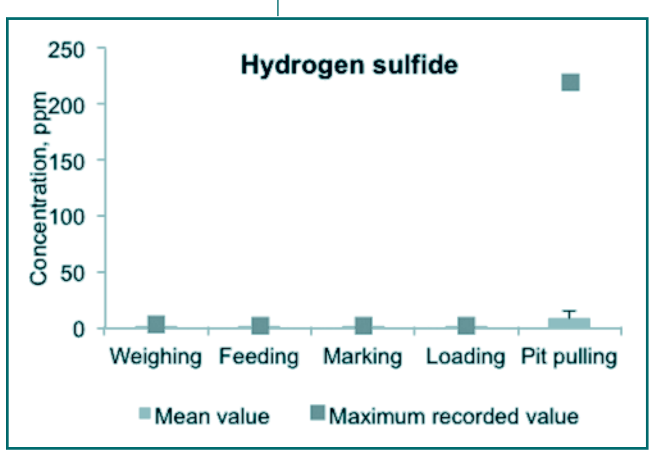


Figure 2. Exposure levels of barn worker to ammonia (a), hydrogen sulfide (b), and respirable dust (c) for each of the monitored tasks. Dashed horizontal line represents the time-weighted average (TWA) exposure limit for each hazard.

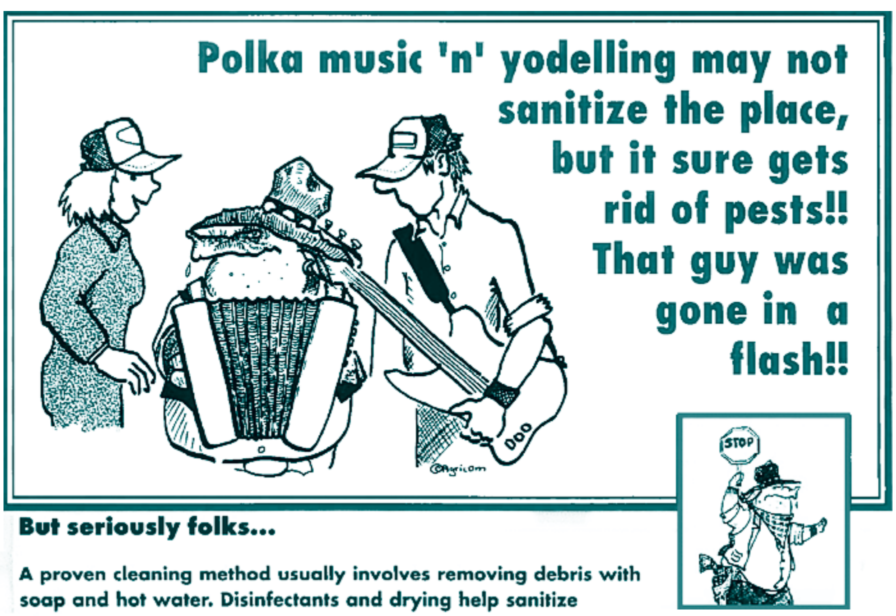
Dr. Laura Eastwood

Dr. Laura Eastwood completed her Ph.D. program in 2013 at the University of Saskatchewan, in conjunction with the Prairie Swine Centre, under the supervision of Dr. Denise Beaulieu. Laura first joined PSCI in September 2006 as a Masters student, and remains a part of our Nutrition research team, as a Research Assistant.

Throughout her graduate studies, Laura focused on feeding flaxseed meal to swine. Originally her program focused on ingredient evaluation, including digestibility and animal performance trials. Following this, Laura became interested in the unique fatty acid properties of flaxseed and its related products (meal, oil), and began to study the effects of feeding plant based omega-3 fatty acids to sows on reproductive performance and piglet health. Her program has been focused on determining an optimal omega-3 to omega-6 fatty acid ratio, in order to improve sow and piglet performance.

As a Research Assistant in Nutrition, Laura's program continues to focus on the use of omega-3 fatty acids to improve piglet health post-weaning. She has several trials looking at the effects on the inflammatory responses of piglets fed different omega-3 to omega-6 ratios. She is also focused on using maternal feeding to alter the inflammatory responses of the offspring at weaning and in the nursery, and is looking at the use of plant based omega-3 fatty acids as an antibiotic replacement in newly weaned piglet diets.

Additionally, Laura is interested in nursery pig nutrition in general. She seeks to improve the transition of piglets from the farrowing room to the nursery, and has been involved in trials aimed at reducing negative effects of mycotoxins, and trials aimed at improving feed intake within the first 24 hours post-weaning.



Coming Events

Prairie Livestock Expo
December 10, 2014
Victoria Inn Hotel & Convention Centre
Winnipeg, MB

Banff Pork Seminar
January 20-22, 2015
Banff Centre
Banff, Alberta

Manitoba Swine Seminar
February 4-5, 2015
Victoria Inn and Conference Centre
Winnipeg, Manitoba

Cramer Livestock Expo
February 19, 2015
Kinetic Park
Swift Current, Saskatchewan

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