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Phytase improves P bioavailability in swine diets

Denise Beaulieu, Ph.D. and
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The phosphorus (P) in most common plant-based feed ingredients is tightly bound to phytic acid and largely unavailable to the pig. As shown in Table 1, the bioavailability of phosphorus in commonly used dietary ingredients varies from only 14% in corn to almost 100% in dicalcium phosphate (DiCal).

The phosphorus that is not available (ie. almost 90% of the P in corn) is excreted into the manure. This of course means that not only are diets over-formulated for total P, a costly and wasteful exercise, but the excess P may contribute to ground-water pollution and limit the application of that manure to the soil. Phytase is an enzyme or organic catalyst aiding the release of the P bound to the phytic acid molecule. The supplementation of swine diets in North America with phytase is rapidly increasing. However, despite research dating back 40 years documenting the efficacy of this enzyme questions still exist and we are unable to fully exploit the potential of phytase. Responses are not predictable and may be affected by processing of the diet, particle size of ingredients, and the presence of other minerals. Additionally, some feeds (ie. wheat) contain endogenous phytase. The amount of this varies, depending on variety and growing conditions.

Several companies world-wide produce and market phytase. It is a product of a microbial fermentation, which varies between manufacturers, and thus the enzymes produced are not identical with regards to their efficacy or conditions for optimal activity. To provide some standardization, phytase activity is expressed as "phytase units" per unit of feed (FTU). This refers to the amount of P that is released from a standard solution, when incubated with the enzyme under

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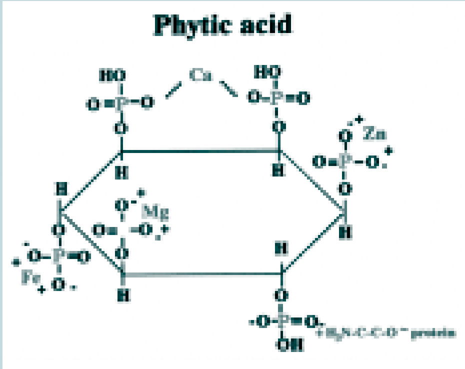

What is phytic acid?

Phytic acid, or phytate is the is the storage form of phosphate or phosphorus (P) in the seeds of cereals and legumes. Phytate bound P is not available for use by monogastriacs and will be excreted.

What is phytase?

Phytase is an enzyme able to catalyze the release of P from phytate allowing it to be used by the animal. The phytase available commercially has been produced from microbial fermentation. Some grains (ie. wheat) contain phytase.

Does phytase only work on P?

Although less studied, some research indicates that phytic acid may also complex some proteins and minerals other than P. Phytase may also increase the availability of other these nutrients.

Wheat and Barley Quality

Emma J. Clowes Ph.D.
and Ruurd T. Zijlstra, Ph.D.

The nutritional quality of barley and wheat can vary substantially. For example, the digestible energy (DE) content of each grain may vary by up to 600 kcal/kg (approximately 14%). Ignoring this variation may cause lower finished feed quality and thereby impact the producer economically through reduced growth performance.

Variation in feed grain quality is managed by measuring the nutrients with the greatest impact on diet cost or animal performance. For barley and wheat this is DE. If the DE-variation is not monitored, growth performance may not be predictable and/or net income may be reduced. For example:

1. ***A reduction in grain DE content will reduce the grain's economic value***
   The economic impact of a 5% change in wheat DE content was calculated for grower pigs based on the following assumptions: (a) mean wheat DE content was 3,425 kcal/kg, and (b) canola oil (8,800 kcal DE/kg; $0.89/kg) was the purified DE source. A 5% difference in DE content is 171 kcal DE in a kg of wheat. The economic value of this 171 kcal difference in DE content is **$17.29 per tonne of wheat.**
2. ***Ignoring variations in DE content may affect pig performance***
   An unaccounted reduction in dietary DE content and thus DE intake may (a) reduce growth performance if feed intake is not increased, or (b) reduce feed efficiency if feed intake is increased to maintain the DE intake. From an energy intake study, a 7% reduction in DE intake may:
   • cause a 70 g/d reduction in growth. Pigs may be 8 kg lighter at slaughter after 16 weeks in the grower-finisher barn. The lower body weight at marketing would result in a **loss of $10.56/pig sold**, assuming a market price of $1.50/kg and an average index of 110.
   • cause a 7% increase in feed intake. To compensate for the reduced dietary DE content, feed conversion may increase by 0.2 kg feed/kg gain, **increasing feed costs by $2.95 per pig sold.**

Prediction of grain DE content

Grain DE content cannot be directly measured in commercial labs, but can be calculated fairly accurately using prediction equations based on the grain's chemical characteristics. These grain characteristics can be measured in commercial labs within five days. Wheat DE content is predicted from the grain's fibre (neutral detergent fibre; NDF) and protein (CP) content (Equation 1). Barley DE content is predicted from the grain's fibre (acid detergent fibre; ADF) content (Equation 2).

Equation 1: Wheat DE = 3,584 + 38.3 x CP – 16.0 x NDF

Equation 2: Barley DE = 3,918 – 92.8 x ADF

These equations and the practice of analyzing grain samples in commercial laboratories to predict nutritional quality are presently under review.

Due to the severe drought conditions recently experienced on the Prairies, the quality of grain from the 2002-harvest proved a challenge to the swine industry because of low yield and poor quality. Analysis of 21 barley samples and 20 wheat samples from the 2002-harvest, collected from farms throughout Saskatchewan, showed a wide range of physical and chemical characteristics. These included characteristics related to grain DE content (fibre and protein) and commonly measured physical characteristics such as density (Table 1).

Table 1. Characteristics of barley and wheat from the 2002 harvest

	Barley (n = 21)		Wheat (n = 20)	
	Mean	Range	Mean	Range
Moisture, %	11.8	8.8 to 14.1	12.9	10.8 to 19.3
Density, kg/hL	56.1	35.1 to 66.8	70.2	56.0 to 77.3
On a dry matter basis				
CP, %	13.7	10.0 to 16.4	18.6	13.0 to 21.4
Lysine, %	0.52	0.38 to 0.57	0.52	0.37 to 0.64
ADF, %	6.8	4.5 to 11.1	3.8	2.2 to 6.0
NDF, %	26.2	21.9 to 35.1	30.3	24.2 to 35.7
Predicted DE, Mcal/kg DM*	3.39	2.86 to 3.50	3.81	3.69 to 3.98

** Predicted using Equations 1 and 2*

The Bottom Line

To attain predictable animal performance, the actual DE content of the finished diet should be similar to the diet's calculated DE content. Thus, when grain quality declines diet formulation must be adjusted to ensure that the actual dietary DE content is met.

Low quality grain can be effectively used in swine diets once identified. However, the grain's DE content must be predicted, using Equations 1 and 2, after the grain's chemical characteristics (fibre and protein) have been measured. Once the DE content of the grain is know it is possible to:

1. *reduce the safety margins* that guarantee the minimum dietary nutrient levels in least-cost diet formulation are met
2. *re-formulate the diet* to meet the dietary DE content required for predictable performance. For example, if the predicted DE content of barley is lower than its average book value (3,430 kcal/kg DM), additional energy, in the form of canola oil or tallow, should be added to the diet to ensure that the desired dietary DE content is achieved. Only then can the grower-finisher pig achieve the energy intake required to maintain protein deposition.

Value-added processing, such as increasing the fineness of grind of the grain and the addition of suitable enzymes to the diet, can be used to increase the DE content of low quality grains. These processes are presently being tested at research institutes such as Prairie Swine Centre.

[1] Dr. Emma J. Clowes is Swine Systems Specialist at AAFRD in Edmonton. Dr. Clowes was a Visiting Scholar at PSC in early 2003.

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standard conditions. Typical inclusion rates of phytase in swine diets are 250 FTU/kg in finishing diets, and 500 FTU/kg in starter and grower diets.

Whenever studies of P are undertaken, the issue of the calcium:phosphorus (Ca:P) ratio arises. The pig industry has traditionally expressed its requirements on the basis of total P, and ratios shown as Ca:tP (calcium:total phosphorous). Moreover, diets were typically formulated with both these nutrients in excess of the requirement, a situation that puts little pressure on the ratio between the two. It is well known that as the animal's intake drops to a level providing only the requirement for P or below, the Ca:P ratio becomes extremely important in terms of maximizing the utilization of the P. Moreover, when phytase is added to the diet, excess dietary Ca, especially relative to the level of P, decreases the efficacy of the enzyme. As the industry moves to diets with little or no excess P, and the use of phytase increases, there is a need to clarify the Ca:P ratio.

We recently conducted an experiment to examine some of these questions regarding inclusion levels of phytase and the importance of the Ca: tP ratio to the response to phytase.

A group of barrows weighing about 35 kg were fed one of 21 diets for a 28 day experimental period. These pigs were also used to estimate digestibility of P at 65 kg and then again at 100 kg. The dietary treatments were 4 levels of a novel phytase enzyme, compared to the recommended level of a commercially available enzyme, a negative control with no phytase added and a positive control which contained supplemental inorganic P. The positive control was included to confirm whether the effects seen with phytase are indeed due to increased P availability. Except for the positive control, the barley based diets were purposely formulated to be limiting in available P before the addition of phytase. When we formulated the diets we worked with the assumption that 100 FTU of phytase would increase the available P content of the diet by 0.01 %. Using this calculation, diets containing 500 to 1000 FTU/kg would be adequate in available P. The diets were fed in mash form. Similar to other proteins, the phytase enzyme is not heat stable, and thus its activity would be destroyed by pelleting, an issue the manufacturers of the enzyme are presently addressing.

Table 1. Phosphorus content of feeds.[1]

Ingredient	Total Phosphorus (%)	Bioavailability of P (%)	Available P (%)
Wheat	0.36	50	0.18
Barley	0.36	30	0.11
Corn	0.28	14	0.04
Canola meal	1.01	21	0.21
Soybean meal	0.65	31	0.20
Dicalcium Phosphorus	18.5	95 to 100	18.0

[1] National Research Council. 1998.

Table 2. The effect of phytase addition on performance during a 28-day trial [1]

FTU/kg	ADG[2], kg/d	ADFI[2], kg/d	FCE[2]
0[3]	0.88	2.48	0.35
250	1.03	2.66	0.39
500	0.94	2.63	0.36
1000	1.05	2.69	0.39
2000	1.03	2.50	0.41
+control (added Dical)	1.06	2.64	0.41

[1] Barrows weighed 35 kg at the start of the experiment.

[2] Phytase addition improved ADG, ADFI, and FCE when compared to the 0 addition level ($P<0.05$). There was no difference ($P>0.05$) between the diets with added phytase and the positive control.

[3] The basal diet was formulated to contain 0.36 % total P and 0.09 % available phosphorous (a P). The NRC (1998) suggests that pigs of this size require 0.50 % t P and 0.23 % a P.

The addition of the phytase enzyme to the diet improved the performance of the barrows when averaged over the 28-day growth experiment (Table 2). However, contrary to what we had hypothesized, there was no further improvement after the initial phytase supplementation of 250 FTU/kg. This was surprising since we had expected the diets with 0 and 250 FTU/kg to be limiting in available P. However, the performance of the barrows on any diet that contained added phytase was comparable to the positive control with the supplemental DiCal. Performance was similar regardless of the Ca:P ratio, when averaged over the different phytase treatments. We had hypothesized that the excess Ca would interfere with the activity of the phytase, and/or the utilization of the available P.

Contrary to what we observed with the performance results, P digestibility continued to improve, and showed no evidence of a plateau, even at the 2000 FTU/kg level of addition. The digestibility of P was determined in pigs at the end of the growth study when the pigs weighed 65 kg, and again when these pigs reached 100 kg. The results were very similar. This indicates that even at these high levels of phytase inclusion, P continued to be released from the phytate molecule and made available to the pig. As indicated by the growth study, this P did not result in improved performance, however, the output of P into the manure would have been reduced at all levels of phytase inclusion. For example, a pig consuming 2.50 kg/day of a diet containing 0.36 % total P would consume 9.0 g of P/day. If the digestibility was only 20% then 7.2 g P /day would be excreted into the feces from each pig. If digestibility improved to 55 % then 4.0 g P/pig/day would be excreted in the feces. It must be noted these are only fecal excretions. Total excretion needs to account for urinary excretion. In experiments conducted at PSC recently it was shown that the proportion of P excreted into the urine relative to fecal excretion increased at high levels of inorganic P intake. Future experiments at PSC will investigate this further.

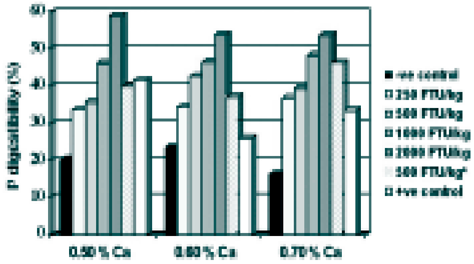

Figure 1. The effect of phytase on P digestibility. The average P digestibility calculated in 65 kg and 100 kg pigs is shown. ** indicates a commercially available enzyme which was compared to a novel phytase enzyme.*

The Bottom Line

The addition of 250 FTU/kg of phytase to diets fed to growing pigs maintained performance compared to a positive control supplemented with inorganic P (DiCal). Phytase decreased the amount of P excreted into the feces (increased P digestibility) even at the highest increment of phytase used in our study (2000 FTU/kg). The phytase enzyme is a tool that allows producers to formulate diets with less total P. Phosphorus output in the manure can be minimized without sacrificing performance. New technologies for the production of phytase are being developed, providing the producer with increased flexibility and selection.

Determining the Cost of Variation

Ken Engele, BSA, P.Ag.

Results compiled from Saskatchewan marketing data for 2002, indicate 53.4% of all hogs marketed provincially were marketed within the "ideal" marketing core of 85-94.99 kgs (dressed). This number of hogs marketed within core increases to 67.9% when the "ideal" weight range is expanded to 85-99.99 kgs.

Based on the above percentages and an average Saskatchewan pool price of $125.00/ckg, and finished feed price of $175/mt (average values for 2002), this results in a potential opportunity loss of $2.11 - $72.51 for all hogs not marketed in the "ideal" weight range of 85-99.99 kgs. Provincially, based on 2 million marketings per year, this sort loss results in an opportunity loss in revenue to the industry of approximately $7.5 million for 2002. This of course, assuming all hogs could be marketed in the "ideal" weight range.

How Do We Calculate Sort Loss?

First we need to collect marketing data for individual weight categories, based on the weight classes directly corresponding to the packers grading grid that you are marketing into. Table 1 provides the average values of lean yield, dressed weight, index, premiums, and feed conversion for individual weight classes. In addition the table also displays the total number of hogs marketed in each weight class.

The results in Table 1 demonstrate average index and premiums increase directly with weight class, achieving a maximum value at the 85-94.99 kgs. Beyond this range, both index and premiums fall with every subsequent increase in weight class. Based on the relationship of weight class with the relative change in index and premiums, the 85-94.99 kg weight class seems the most logical to define as the "ideal" marketing core.

Table 1. Breakdown of Carcass Distribution by Weight Class (Saskatchewan 2002)

Weight Class (kgs)	Feed Conversion	Lean Yield	Weight	Index	Premium		Hogs	Percent
					Weight	Loin		
69.99	3.4	61.01	66.40	50.00	$0.00	$1.58	10,000	0.5%
74.99	3.5	60.64	72.80	92.27	$0.00	$1.58	30,000	1.5%
79.99	3.6	60.42	77.80	103.38	$0.00	$1.75	110,000	5.5%
84.99	3.6	60.07	83.00	109.29	$0.00	$1.94	310,000	15.5%
94.99	3.6	59.59	89.90	111.31	$3.00	$2.00	1,068,000	53.4%
99.99	3.7	59.17	97.00	110.84	$2.98	$2.00	290,000	14.5%
104.99	3.8	58.69	102.20	106.05	$0.00	$1.75	118,000	5.9%
109.99	3.8	58.40	107.40	103.00	$0.00	$1.65	42,000	2.1%
117.99	3.9	58.26	113.50	97.38	$0.00	$0.00	22,000	1.1%

While we can arbitrarily define the 85-94.99 kg weight class as the "ideal" marketing core, pricing situations may exist where the revenue generated from increased carcass weight more than offsets the potential reduction in index and premiums associated with the heavier carcass. This situation occurs in extended periods of high cash hog prices, usually when prices exceed $160.00 ckg.

Margin Over Feed Costs

Table 2 demonstrates the cumulative impact on hog revenue over variable market hog prices, and a fixed finished feed price of $170/mt. When pool prices are $70.00/ckg or lower, producers would maximize their potential revenue by marketing all their production in the 85-94.99 kg weight class. For example, producers would realize an opportunity loss of $7.93/hog if the pool price was $60/ckg and the hogs were marketed in the 100-104.99 kg weight class. Likewise producers would experience an opportunity loss of $5.72/hog for all hogs marketed between 75-79.99 kgs with a $60/ckg pool price.

Provincially, this would represent the potential opportunity loss of $935,000 ($7.93/hog x 118,000 hogs) and $629,000 ($5.72/hog x 110,000 hogs) respectively for each weight class if the pool price had averaged $60/ckg for 2002.

However, when pool prices range between $80-$150/ckg producers would now maximize their revenue by targeting the 85-99.99 kg weight category, in particular the 95-99.99 kg range. In other words, at a pool price of $150/ckg and

Table 2. Change in Revenue Associated with a Variable Hog Price and Fixed Feed Price

	0	70	75	80	85	95	100	105	110
price/ckg	69.99	74.99	79.99	84.99	94.99	99.99	104.99	109.99	117.99
60	-25.71	-10.04	-5.72	-3.36	Core	-1.06	-7.93	-10.91	-17.65
70	-32.39	-13.33	-7.68	-4.30	Core	-0.32	-7.10	-9.86	-16.61
80	-39.08	-16.62	-9.65	-5.23	Core	0.43	-6.27	-8.80	-15.56
90	-45.77	-19.91	-11.61	-6.17	Core	1.17	-5.44	-7.75	-14.51
100	-52.45	-23.20	-13.57	-7.11	Core	1.92	-4.60	-6.69	-13.47
110	-59.14	-26.49	-15.54	-8.04	Core	2.66	-3.77	-5.64	-12.42
120	-65.83	-29.78	-17.50	-8.98	Core	3.41	-2.94	-4.58	-11.38
130	-72.51	-33.07	-19.46	-9.91	Core	4.15	-2.11	-3.52	-10.33
140	-79.20	-36.36	-21.43	-10.85	Core	4.90	-1.28	-2.47	-9.29
150	-85.89	-39.65	-23.39	-11.78	Core	5.64	-0.45	-1.41	-8.24
160	-92.57	-42.94	-25.36	-12.72	Core	6.39	0.38	-0.36	-7.19
170	-99.26	-46.22	-27.32	-13.66	Core	7.13	1.22	0.70	-6.15
180	-105.95	-49.51	-29.28	-14.59	Core	7.88	2.05	1.75	-5.10

finished feed price of $170/mt, producers could generate an additional $5.64/hog by shipping between 95-99.99 kgs, rather than 85-94.99 kg weight class.

In general, as pool prices increase, so to does the revenue that can be generated by increasing market weight; when we use the "ideal" marketing range (85-94.99 kgs) as the base for the comparison. For example, if we use a pool price of $180 ckg, and a finished feed price of $170/mt we can generate additional revenue of $7.88/hog, $2.05/hog, and $1.75/ hog for the 95-99.9 kg, 100-104.9 kg, and 105-109.9 kg weight classes respectively.

This also demonstrates the maximum amount of revenue generated occurs in the 95.99 kg category ($7.88). While the 100-104.9 kg weight category will generate an additional $2.05/hog relative to the "ideal marketing range" (85-94.99 kg), however it generates $5.83/hog less revenue than the 95-99.9 kg weight category. In other words, as long as the pool price exceeds $80/ckg the "ideal marketing range" should be 95-99.9 kgs, and NOT 85-94.99 kgs.

Table 3. Change in Revenue Across Weight Class

Price/Ckg	5 kg (80-94.99 less 100-104.99)	10 kg (75-79.99 less 105-109.99)
60	4.57	5.19
70	2.80	2.18
80	1.04	-0.85
90	-0.73	-3.86
100	-2.51	-6.88
110	-4.27	-9.90
120	-6.04	-12.92
130	-7.80	-15.94
140	-9.57	-18.96
150	-11.33	-21.98
160	-13.10	-25.00
170	-14.88	-28.02
180	-16.64	-31.03

Impact of Weight on Sort Loss

So far the discussion has focused around the opportunity loss of not marketing in the "ideal" marketing range. However, due to challenges like genetic potential, feeding programs, and space constraints within operations, marketing all hogs within the "ideal" marketing range may not be possible. If we have to market hogs, and they don't fall into the core, where can we get the best value for these hogs?

In order to answer this question, Table 3 compares the net impact of marketing hogs 5 and 10 kg light against 5 and 10 kg heavy relative to the core (assuming in this case the core is 85-99.99 kgs). In other words, we are comparing the difference in net revenue generated in 80-84.99 kg against 100-104.99 kg and 75-79.99 against 105-109.99 kg weight class respectively. For example, at $80/ckg, marketing hogs 5 kg lighter, would generate an additional $1.04/hog, over marketing 5 kg heavier relative to the core (-$5.23 less -$6.27, from Table 2). If we compare marketing 10 kg outside the core, marketing hogs heavier, in this case, would generate an additional $.85/hog revenue, compared to marketing lighter (-$9.65 less -$8.80, from Table 2).

The important point to note, based on the information in Tables 2 and 3, is the potential opportunity loss associated with not marketing in the core. Such that a producer's loss will be much smaller if hogs are marketed heavier rather than lighter when compared against the core. As hog prices increase, this relationship becomes much more predominant, as seen by the shaded areas in Table 3. When the pool price is $150/ckg, and hogs are marketed 10kg outside the core, either lighter or heavier, heavier hogs would generate an additional $21.98/hog in revenue compared to the lighter hogs.

The Bottom Line

Not marketing hogs in the ideal marketing core can result in potential lost revenue in excess of $70/hog marketed (at a pool price of $130/ckg).

For hogs not marketed within core, the opportunity (revenue) loss associated with light hogs (<85 kg) is far greater than associated with heavier hogs (>100 kg). Up to 10 times greater.

A producer's ideal marketing window constantly changes corresponding to different combinations of hog and feed prices.

Greenhouse Gases and Odour Control

Lee Whittington, BSc., MBA,
Stéphane Lemay, Ph.D., P.Eng.

Animal production units and manure storage structures are fixed, permanent sources of various gas emissions. Since animal digestive processes are incomplete, and because microorganisms are present in the feces, there is a substantial amount of organic matter contained in the manure, the decomposition of which can result in a number of gaseous by-products including acidifying gases such as ammonia (NH3), greenhouse gases (GHG), including carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), toxic gases such as hydrogen sulphide (H2S), and offensive odours. Management and storage of manures inevitably contributes to the increase in GHG concentrations of animal origin resulting from agriculture, primarily in the industrialized countries where a large proportion of livestock production is intensive. It has been estimated that production buildings are responsible for 50% of the total GHG emissions of intensive livestock operations, with the storage of liquid manure and its land application each accounting for 25% of total emissions (Zhang and Gaakeer, 1998).

The contribution of the pork industry to the odour, gas and particulate composition of air around pig barns can be debated at length. The role of science in these debates is the subject of an increasing amount of research at Prairie Swine Centre. Not only does this new information provide 'real' numbers and potential remedies, it also serves as an example of the industry's responsiveness to external concerns when the information is more readily accessible to a broad group of industry stakeholders.

The Greenhouse Gas Mitigation Program for Canadian Agriculture combines best management practices with demonstration and communication programs aimed at introducing developing technologies to the industry. Prairie Swine Centre and the Pork Industry Interpretive Centre were recently confirmed as one of the sites in Canada that will be demonstrating these new technologies. The approach includes a three year program to demonstrate the following technologies; 1) synthetic covers for earthen manure storages (EMS), 2) reduction of Green House Gases through diet manipulation, 3) installation and monitoring of shelter belt influence on air quality, and 4) make the findings available via a combination of on-site demonstration, written and electronic communication with pork producers and other visitors to the Interpretive Centre.

> Low protein diets may reduce GHG production up to 25% compared to conventional diets.

Manure Storage Covers

The first step in achieving a better understanding of the contribution of the earthen manure storage is already underway. In July, a floating cover was installed on the two-cell 4.9 million gallon EMS at the Elstow Research Farm. This plastic cover weighs approximately 8,000 kg (17,600 lbs.) and is buried around the perimeter of the cells to form an airtight seal. The installation of 6, 0.25 kw (1/3 horsepower) fans provides a vacuum under the cover, sealing the plastic against the liquid and preventing contact between the liquid and the air passing over the EMS, thus reducing the opportunity for odours or other gases to escape. It has been estimated that 50-60% of the nitrogen stored in the EMS is lost each year as ammonia. These losses represent a significant decrease in manure value as a fertilizer, while decreasing the manure N:P ratio, making manure phosphorous management more challenging. In addition, the covers eliminate rain water from entering the EMS, thus reducing hauling and injection costs.

Diet Manipulation

Excess nutrients in the diet of the growing-finishing hog is a source of emissions. These nutrients, and their associated costs, can be reduced through incorporating current information on diet management. For instance, substitution of protein sources like soybean meal with synthetic amino acids reduces the available nitrogen in the urine and feces. Low protein diets (16.0%) may reduce GHG production by finishing pigs by at least 25%, compared to the conventional diets (19.3% protein) (Atakora et al., 2003). Reducing the N excretion by the pig may reduce nitrous oxide (N2O) emissions from the manure (Misselbrook et al., 1998).

Recent work completed at Prairie Swine Centre shows that Phytase, used to make better use of the phosphorous in grains, also has a beneficial effect on protein digestion and thus potentially reducing nitrogen excretion. In years 2 and 3 of the demonstration project, two rooms at the Elstow Research Farm will be used to demonstrate the effect of low protein diets on gaseous emissions. Approximately three production cycles will be completed, providing a continuous display to any visitor.

Shelter Belt Development

An irrigation system and shelterbelt will be constructed at the Elstow Farm in year 2 of the project (summer 2004). The equivalent of one kilometer of trees and shrubs will be planted in the first year, with provisions for more planting in future years. This shelterbelt will provide long-term carbon sequestration on the site, and will provide barriers to wind movement, which can impact on energy usage on the site and disrupt air patterns and assist in odour dispersion from site.

Demonstration and Visitor Education

Demonstration of reduced GHG room emissions will supplement a major GHG display in the interpretative centre. This display will include general information on GHG production and mitigation techniques, presented in a fashion similar to the other displays. It is envisioned that the display may include continuous measurements of the CO_2 using a gas analyzer, with a display booth designed and installed in the viewing gallery to demonstrate the instantaneous differences in the gases from the two low-protein diet rooms. The display booth may include meters showing the instantaneous values of CO_2 in the two rooms, or light sources with different intensities, which are representative of the level of the gases present in the rooms. The display will draw its inputs from the gas analyser but will have an easy to read interface. Further, it is proposed to have the display capable of presenting real-time GHG (CO_2, CH_4) data from the covered EMS.

The Bottom Line

The role of pork production in odour and GHG emissions is becoming better understood. Projects like this one will allow pork producers easy access to determine the technologies which show promise as well as gaining valuable information on the cost and challenges of operating these best management practices.

Atakora, J.K., S. Mohn and R.O. Ball. 2003. Low protein diets maintain performance and reduce greenhouse gas production in finisher pigs. In: Advances in Pork Production. Vol. 14, Abstract #17.

Zhang and Gaakeer. 1998. An inflatable cover for a concrete manure storage in a swine facility. Applied Engineering in Agriculture. 14(5); 557-561

Grand Opening of the Pork Interpretive Gallery, October 15, 2003

Lee Whittington, B.Sc., MBA

The cool temperatures did not chill the spirits of the over 200 people attending the Grand Opening Celebrations of the Centre located near Elstow, SK (45 minutes east of Saskatoon on #16 highway). Pork producers, financial contributors, neighbours and a busload of Grade 4 students gathered to see the culmination of 2 years of fundraising and almost one year of construction.

"The project came directly from the pork industry asking for the Centre to provide the general public with an opportunity to see into modern pork production" notes John Patience, President of Prairie Swine Centre. The Centre's mandate is to provide new and practical information for pork producers. Extension of information to the general public is the mandate of the various pork boards across Canada, however the development of a new research barn gave Prairie Swine Centre the opportunity to provide a site that could act as a permanent open house to describe the science and facts of pork production. This facility will become a major part of the communications strategy with the public, says Sask Pork General Manager Neil Ketilson.

"Modern hog operations now limit access to the public because of potential diseases that may be brought into the barn", notes Ketilson. This facility with its biosecure hallway allows that access with minimal risk to the farm and with the signage, interactive displays and tour guides, the visitor has lots of access to the facts.

Windows looking over the farm site allow full view of the earthen manure storage. Signage at the window points to three important points: 1) the size of the EMS is 4.9 million gallons, over 400 days storage, 2) The earthworks are engineered to prevent seepage, "not just a hole in the ground", 3) The EMS is covered by either a straw cover or negative pressure cover for odour control. The signage is colourful, and includes photographs and drawings that explain the technology. The first reaction from non-farming public is that the EMS is much smaller than they had imagined. Similar reactions of surprise or contradiction to previous beliefs surface as the tour continues.

In the farrowing room, visitors are surprised just how large a mature sow is. "The image of 'Babe' the movie may be the closest they have come to a live pig. Seeing a sow weighing 150-250 kilograms, and finding out she is 100 times larger than the piglet is a defining moment when the visitor is discovering real life agriculture." Notes Lee Whittington, Manager of Information Services for Prairie Swine Centre. For many visitors this is the first farm they have been on. The reaction to pork production as it really is has been very positive. "Visitors are very supportive of modern production practices is our experience with groups to date", Whittington adds that they have had many tours since the Centre opened its doors for tours in late March. "We have toured over 900 people through the Centre, with groups as diverse as Kindergarten, grades 4 and 5, a seniors group from Saskatoon, and numerous families at the Family Fun Day in June." The comments and evaluation forms filled in by the visitors is helping the Centre to continually improve the tour experience.

Tours are provided for groups of 12 or more, Monday through Saturday, and are free of charge. Tours can be booked by contacting Cindy Jelinski, Manager Pork Interpretive Gallery at 1-866-PIG TOUR (1-866-744-8687).

Personal Profiles

Dr. Denise Beaulieu

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Dr. Denise Beaulieu joined the Prairie Swine Centre staff two years ago as a Research Assistant in the nutrition group working with Dr. John Patience. Denise received her undergraduate and M.Sc. degrees from the University of Saskatchewan and her Ph.D. from The Ohio State University. Her Ph.D. dissertation work utilized a novel cell culture system to examine protein and lipid synthesis by bovine mammary cells. She moved to the University of Illinois for post-doctoral training and switched to monogastrics; investigating energy utilization by intestinal cells. She remained at the University of Illinois for 3 additional years as a Visiting Assistant Professor, working in the area of ruminant lipid metabolism and milk fat synthesis.

At the Prairie Swine Centre Denise assists in experimental design, protocol development, data analysis and the preparation of reports and articles for publication. The nutrition group is presently involved in projects which focus on energy and the net energy system, reducing and managing variability in the swine barn, and nutrient management through the use of exogenous enzymes.

Thusith Samarakone

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Thusith Samarakone was born in Colombo, Sri Lanka, one of the smallest of the South Asian nations, 29 km south-east of India in the Indian Ocean. He completed his B.Sc. in Agriculture in October 1993 at the University of Peradeniya, Sri Lanka, with a specialisation in Animal Science. After working at the Department of Animal Science, University of Peradeniya, for four years, he continued his studies in Japan and earned his M.Sc. at the Obihiro University of Agriculture and Veterinary Medicine, Hokkaido in March 2001, studying management, behaviour and welfare aspects of dairy cattle on deep bedded free barn systems. In May 2001, Thusith joined the Prairie Swine Centre to begin his Ph.D. program at the University of Saskatchewan under the direction of Dr. Harold W. Gonyou. For his Ph.D. research Thusith's focus is to study the effects of managing grower-finisher pigs in large groups on social behaviour and productivity.

Traditional practice in North America is to house pigs in groups of 10-40 animals. Over the past few years the concept of 'large groups' has become more common, with group sizes of 100 or more pigs/pen, as a management strategy to increase overall profitability. However, how pigs in large groups adapt to the new social environment and whether there are any detrimental effects on pig productivity by forming large groups is not clear. The objectives of his research are to assess the effects of group size on social behaviour following mixing, particularly aggressive and feeding behaviours and resulting pig productivity. Two social group sizes, 108 (large) vs. 18 (small) pigs/pen, are used in his experiment.

The Bottom Line

The level of aggression up to 2 days post-mixing was similar in large and small groups. Furthermore a significant reduction in the expression of aggression was found in pigs living in large groups whenever they were introduced to foreign pigs, indicating a "tolerant social strategy". For the entire grower-finisher period, a slight reduction in growth rate was observed for the pigs in larger groups, but mortality, morbidity and the final variability in body weights were not affected by large group management.

Coming Events

Pork Industry Interpretive Centre Grand Opening
PSC Elstow Research Farm, Elstow, SK
October 15, 2003

Saskatchewan Pork Industry Symposium
Saskatoon Inn, Saskatoon, SK
November 18-20, 2003

Sask Pork Annual Meeting
Saskatoon Inn, Saskatoon, SK
November 20, 2003

Pork Industry Occupation and Health Committee Training
Rural Service Centre, Saskatoon, SK
Level II – November 4-5, 2003

Canadian Western Agribition
Regina Exhibition Park, Regina, SK
November 24-29, 2003

Banff Pork Seminar
Banff Centre, Banff, Alberta
January 20-23, 2004

Alberta Pork Annual General Meeting
Coast Terrace Inn, Edmonton, Alberta
December 10-11, 2003

Brandon Hog Days
Keystone Centre, Brandon, MB
December 3-4, 2003

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