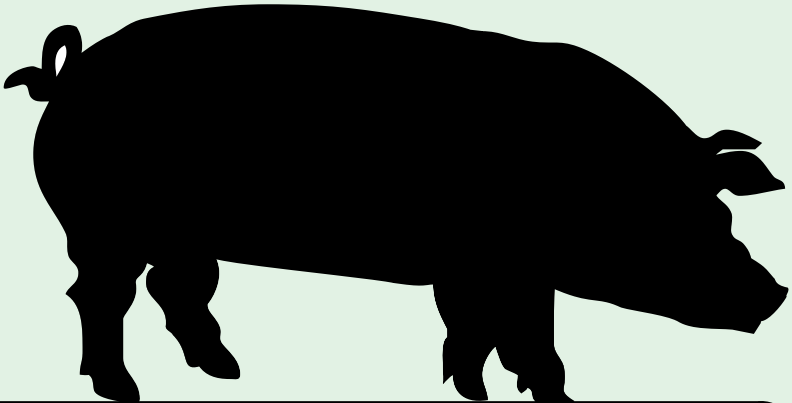
26th Annual



CENTRALIA SWINE RESEARCH UPDATE

January 31st, 2007

CentraliaSwineResearch.ca

CENTRALIA SWINE RESEARCH UPDATE
Kirkton-Woodham Community Centre
January 31, 2007

9:00 a.m. REGISTRATION and COFFEE
9:50 Opening Remarks

Adjourn

WRITTEN-ONLY TOPICS

Past Proceedings are available for download. Visit:

www.centraliaswineresearch.ca

Future Updates:

Wed. January 30, 2008

Wed. January 28, 2009

Centralia Swine Research Update
Box 37
Exeter, Ontario
N0M 1S6

ACKNOWLEDGMENT

Centralia Swine Research Update *wishes to* ***acknowledge*** *and* ***sincerely thank*** *the following Associations and Companies for their financial support as sponsors of this year's program:*

Ontario Pork
Huron County Pork Producers' Association
Middlesex County Pork Producers' Association
Oxford County Pork Producers' Association
Perth County Pork Producers' Association

BSC Animal Nutrition Inc.
(manufacturers of ***a complete line of swine premixes including BioNP™, Merit, GD, ISS, CAP, ORGANIC***)

Bio Agri Mix LP
(manufacturers of ***tiamulin 1.78% Premix***)

Floradale Feed Mill Ltd.

Grand Valley Fortifiers

Great Lakes Nutrition Inc.

Kenpal Farm Products Inc.
(manufacturers of ***vitamin/mineral premixes in a HACCP-certified facility, Amino Acid feeding program, DigestSTART ™ feed additive, & Lacta-Fat liquid feed fat, GreenStart, DigestStart, SowStart, BoarStart, FarrowStart, MicrobiStart, AcidiStart, HorseStart, YieldStart R, YieldStart S, DryStart*** ™, ***LitterStart***™)

Molesworth Farm Supply

Shur-Gain
(manufacturers of ***complete feeds, supplements & On Farm Macro Premix Programs***)

Alpharma Animal Health

(manufacturers of ***Aureomycin 220G - 110G, Aureo SP 250G, Aureomix 625G, BMD 110G, Albac 110P, 3-Nitro 20***)

Boehringer Ingelheim (Canada) Limited
- Vetmedica Division

(manufacturers of ***Ingelvac CircoFLEX & Enterisol Ileitis vaccines***)

Elanco Animal Health

(manufacturers of ***Apralan, Tylan Premix, Tylan Soluble, Monteban, Pulmotil, Paylean***)

Intervet Canada Limited

(manufacturers of ***PG 600, Depocillin, Myco Silencer vaccines, ProSystem vaccines, Sow Bac vaccines, Borgal***, ***Boroform, & SOA Spray***)

Merial Animal Health

(manufacturers of ***ANAFEN®, VIROCID®, IVOMEC®, STRESNIL® and TETRADURE®***)

Pfizer Animal Health

(manufacturers of ***RespiSure, RespiSure-ONE, FluSure, FarrowSurePlusB, LitterGuardLT, ERBac Plus, Excenel RTU, Draxxin, Lincomix, LS-20, Lutalyse, PreDef 2X, Dectomax***)

Phibro Animal Health Limited

(manufacturers of ***Posistac, Stafac, Terramycin, Neo-Terramycin, Pro-Banminth, Coxistac***)

Schering-Plough Animal Health

(manufacturers ***of M+Pac MaxiVac Excell, MaxiVac-FLU, MaxiVac-M+, ParaPac, Piliguard Coli-Swine, Planate, Pneu-Pac Injectable*** & ***Trivetrin***)

United Nutrients Corporation

(manufacturers of ***Protected Organic Acids, Degussa Amino Acids, Zinpro Performance Minerals, Nutrase Xylanase Enzyme, Jefo Liquids and Mistral***)

Vetoquinol Canada

(***Biosecurity Specialist - Virkon disinfectant, Biofoam-Biosolve heavy duty cleaners, Hombre/Ruse rodent control, Disvap insect control, Ferrofarte/Dexafer 200 double strength injectable iron, Suilence-Apaisine pheromones***)

Wyeth Animal Health

(manufacturers of ***Suvaxyn MH/HPS, Suvaxyn MH, Suvaxyn MH-One, Suvaxyn S.I.V., Sowvac Complet-E, Kolivax-5P, Kolibar-T***)

Pork Quality Research at the University of Guelph

I.B. Mandell
Department of Animal & Poultry Science, University of Guelph

Inferior pork quality affects profitability across the Canadian pork industry due to deleterious effects on product yields, appearance of the product in the meat case, and eating quality. Changes in production practices ranging from pig management to swine nutrition has the potential to decrease the amount of poor quality pork being produced, and increase demand for the product and returns for producers, packers, and processors in the Canadian pork industry. A multidisciplinary team at the University of Guelph is currently examining behavioural, nutritional and genetic interactions contributing to the variability in quality of pork being produced in Ontario. The goals of this project are to investigate basic mechanisms contributing to the variability in pork quality through proteomics, genomics and the biochemical conversion of muscle to meat, and ultimately identify management strategies to improve the quality of pork produced in Ontario. To date, data have been collected from approximately 700 pigs with on-farm and in-plant behavioural data collected for each pig, along with comprehensive carcass and meat quality analyses.

We have also examined the impact of nutrition on pork quality using two approaches. One approach has been aimed to decrease production costs for the producer with the goal to not affect or improve meat quality. Limit or restricted feeding of pigs during the growing phase was examined to decrease the amount of feed required to attain market weight. This approach is based on limit-fed pigs exhibiting compensatory growth (higher than normal gains) with lower feed to gain when the pigs are switched to full feeding of the finishing diet. In pigs limit-fed to 70 or 85% of feed intake by pigs on full feed during the growing period, the 70% limit-fed pigs outgained and had better feed efficiency (less feed required per kg gain) than pigs on full feed. There were no differences in days to market with limit versus full feeding. An added benefit with limit feeding was increased meat tenderness (lower Warner Bratzler shear force) in pork from limit-fed pigs versus pigs on full feed throughout the growing and finishing phases of production. The response to limit feeding may have significant ramifications to pork producers given current and future increases in feed grain costs due to the high demand of cereal grains for ethanol production. The added benefit of increased pork tenderness with limit feeding may help producers in the production of consistently tender pork. Current research is being conducted at the U of G to understand the mechanisms involved for improving pork tenderness with limit feeding.

Our second approach in examining nutritional effects on pork quality is to develop nutritional strategies to reduce stress in pigs going to slaughter. Elevated stress in pigs may impact pork quality such as the incidence of PSE and DFD which decreases returns to packers and processors and may result in pork of inferior eating quality for consumers. Studies were conducted examining the effects of adding the amino acid tryptophan to finishing diets in an attempt to reduce stress before slaughter. Since tryptophan is an expensive feed ingredient, the study examined amount and duration of feeding supplemental tryptophan on pork quality. Regardless of the amount or duration of feeding supplemental tryptophan, there were no effects on pork quality when examining subjective or objective measures of lean color and water holding capacity or pork tenderness. Trials were then conducted removing supplemental protein from the diets for one or 3 days prior to slaughter in an attempt to increase concentrations of specific amino acids in the brain at slaughter. Similar to the tryptophan work, protein withdrawal did not have any effects on pork quality. Work is continuing on nutritional programs to enhance pork quality with current trials examining the impact of feeding beet pulp and ractopamine (Paylean) on stress and meat quality in finishing pigs.

Genetic Defects – Innate Immunity

Tony Hayes
Department of Pathobiology, Ontario Veterinary College, University of Guelph

Background and Objectives

Recent studies in various laboratories indicate that genetic background can affect resistance of pigs to some infectious diseases. For example, the immune response varies among genetic lines (1), and illness associated with the PRRS virus or porcine circovirus varies among offspring of different breeds or sire lines (2,3). Our research group is looking for genetic defects that make pigs more likely to get sick or die when exposed to various common bacterial and viral infections. We have focused on innate immune proteins, especially mannan binding lectin (MBL), that provide a first line of defence against agents responsible for respiratory or systemic infections (4). In humans, lack of MBL increases susceptibility to various bacteria and viruses (see 4). MBL and similar lectins (e.g. ficolins and lung surfactant proteins) are innate immune proteins that can bind to sugar patterns on the surface of various bacteria and viruses (4).

Recent studies in our group have identified single-nucleotide polymorphisms (SNPs) that demonstrate there are genetic differences in porcine genes for pig MBLs, ficolins and lung surfactant proteins. SNPs that substantially impair function or supply of these lectins are considered to be genetic immune defects that might impair growth or health in some conditions. DNA tests for these SNPs have been developed and used to assess their role in susceptibility to disease.

Defects in porcine mannan binding lectin (MBL) genes

Pigs produce MBL-A and MBL-C mainly in the liver (5). Pig MBL-A in blood binds various bacteria that cause respiratory infections in pigs (5). One SNP in the MBL-A gene is in a location (MBL-A 271 G>T) that could disrupt the assembly of MBL-A. This SNP was found in various breeds and was more common in pigs that were culled with pneumonias and systemic infections (6). However, differences in SNP frequency between healthy and diseased pigs were not large enough to expect substantial improvements by avoiding breeders that carry it (8).

By comparison, a proportion of healthy pigs in all major commercial breeds produce very small amounts of MBL-C (6-8). We found that expression of the MBL-C gene was markedly reduced in pigs that were culled for post mortem diagnosis of various respiratory or systemic infections. Low production of MBL-C was associated with two unlinked SNPs located in the promoter region of the MBL-C gene (7). Pigs with one copy of the defect had several fold reduction in expression whereas pigs with two copies were more markedly deficient. One of these promoter SNPs, namely G(–1081)A, present in approx 25% of healthy pigs, was significantly more frequent in pigs that were culled for various common infectious diseases. A second MBL-C promoter SNP, namely C(–251)T, had a less pronounced impact on MBL-C expression, but the effect was additive with that of the G(–1081)A SNP. The C(–251)T defect was more common and found in the of over 60% of healthy pigs, but was more frequent in cull pigs with various infectious diseases. Promoter polymorphisms similar to those we have found in association with low MBL-C production and disease in pigs are are similar to some implicated in innate immunodeficiency and disease susceptibility in humans (4).

Conclusions

DNA-based tests for SNPs associated with impaired production of MBL-C and increased likelihood of disease in pigs have been developed. Such PCR tests are now being used to determine if these and other lectin gene SNPs are useful genetic markers for innate immune deficiency in pigs.

Those correlated with poor growth and ill health in pigs under commercial production conditions could be used to identify breeders that do not have the defects.

Acknowledgements

This work is supported by Ontario Pork, NSERC, OMAFRA, CIHR and the University of Guelph.

References

1. Wilkie B, Mallard B. Selection for high immune response: an alternative approach to animal health maintenance? Vet Immunol Immunopathol. 1999 72:231-235.
2. Vincent AL, et al. An investigation of susceptibility to porcine reproductive and respiratory syndrome virus between two genetically diverse commercial lines of pigs. J. Anim Sci 84:49-5, 2006.
3. Desrosiers R. Update on porcine circovirus related diseases Proceedings, North Carolina Healthy Hogs Seminar, Oct. 27, 2006. (see http://www.porknet.com)
4. Lillie BN, Brooks AS, Keirstead ND, Hayes MA. Comparative genetics and innate immune functions of collagenous lectins in animals. Vet Immunol Immunopathol. 2005 108:97-110.
5. Lillie BN, Hammermueller JD, Macinnes JI, Jacques M, Hayes MA (2006) Porcine mannan-binding lectin A binds to Actinobacillus suis and Haemophilus parasuis. Dev Comp Immunol 30:954-65.
6. Lillie BN, Keirstead ND, Squires EJ, Hayes MA (2006) Single-nucleotide polymorphisms in porcine mannan-binding lectin A. Immunogenetics 58:983-93
7. Lillie BN, Keirstead ND, Squires EJ, Hayes MA (2007) Gene polymorphisms associated with reduced hepatic expression of porcine mannan-binding lectin C. Dev Comp Immunol. In Press.
8. Lillie BN. Genetic polymorphisms and bacteria-binding function of porcine mannan-binding lectins. Ph.D, Thesis, University of Guelph, 2006.

North American PRRS Eradication Task Force

by George Charbonneau, DVM

Porcine Reproductive and Respiratory Syndrome (PRRS) continues to be a significant production-limiting disease in the North American swine industry. PRRS is estimated to cost the US industry approximately 560 million dollars per year. The cost of PRRS to the Canadian Swine Industry is estimated to be 100 million dollars per year.

The American Association of Swine Veterinarians (AASV) has presented a position statement with respect to the long-term plans for control of this devastating disease. Part of the AASV position statement says that "Control of the disease via traditional methods has not been effective in all cases; therefore, it is the position of the AASV that eradication of the disease from the North American swine industry is the long term goal."

At least initially, the idea of achieving North American PRRS eradication will probably seem like an overwhelming challenge to most of us. Over 30 years ago a small group of US pork producers first contemplated a Pseudorabies eradication program. At that time, they actually knew less about Pseudorabies than we currently know about PRRS. The existing information "gaps" did not deter this group from pursuing the possibility of establishing a US Pseudorabies eradication plan. Recently, the goal of Pseudorabies elimination from the US domestic herd was achieved. This national elimination program was the result of a dedicated team effort. The North American swine industry is now taking some of the initial steps towards investigating the potential of North American PRRS eradication. AS the Chinese proverb states, "Even the longest journey begins with a single step".

Dr. Scott Dee, as President of the AASV, has stated that PRRS eradication is a long-term goal requiring a careful, well-thought-out plan, and solid support from swine producers. To this end, the AASV has formed a North American PRRS Eradication Task Force (NAPETF). The members of the task force are veterinarians that are representative of regional eradication project groups and industry. An advisory panel of PRRS researchers has also been formed with the goal of supplying a direct link between the task force and the research community. The NAPETF includes veterinarians from the USA, Canada and Mexico.

There have been successes in eliminating the PRRS virus from individual herds and production systems. Several regional groups such as the Minnesota PRRS eradication task force and the OPIC Swine Health Advisory Board (OSHAB) are working on regional PRRS control and elimination. At a national level, Chile has made great progress with its national PRRS eradication program with only a few remaining sites that are PRRS virus positive.

PRRS elimination techniques are being fine-tuned to the point that the swine industry is increasingly confident that PRRS virus can be successfully eliminated at both the herd and system levels. The greatest challenge that we have is keeping the PRRS virus out of herds. Some progress has been made in the understanding the biosecurity required to control the spread of PRRS by people, aerosols, transport, insects and semen. One of the "weakest links" that has been identified in the management of PRRS is the actual assessment of PRRS risks at the farm level.

The NAPETF will be working with the AASV team lead by Dr. Derald Holtkamp at Iowa State University and Dr. Dale Polson, BI Vetmedica as they continue the development and implementation of the PRRS Risk Assessment Tool and the related PRRS Risk Benchmarking

Database. At the International Pig Veterinary Society (IPVS)[1], Polson et al. demonstrated the use of the PRA tool in benchmarking PRRS-related risks in breeding herds (PRA_{BH}). In a second study[2], Yeske et al. described how the PRA score influences the survival rate of PRRS virus naïve swine breeding herd sites. Survival rate is a term that is used to describe the ability of herds to remain PRRS naïve. This research demonstrates that much work needs to be done in the area of PRRS Biosecurity. One of the questions that the NAPETF will try to answer is how consistently we can eliminate PRRS from various types of production systems. An even greater question will be how consistently can we keep it out.

Currently the focus of the NAPETF is an assessment of producer and veterinary attitudes to PRRS eradication. A survey has been developed by the NAPETF. The goal of the survey is to provide a starting point or baseline with respect to producer and veterinary attitudes to PRRS eradication. The results will help in identifying the current knowledge gaps and help to prioritize research efforts. The survey will also help to provide direction with respect to industry education programs. The plan is to complete the US survey in the first quarter of 2007 with initial results to be presented at the AASV annual meeting in March 2007.

Having just completed the Pseudorabies eradication program, the US swine industry state and federal government is very aware of the systems required for an industry led disease elimination program. While this is familiar territory for the US participants in the NAPETF it is unfamiliar territory for the participants from Canada and Mexico. In Canada, we will need to identify the potential national and provincial players and establish a line of communication. The export of live pigs and pork to the USA is very important to the Canadian swine industry. Although PRRS is not currently a barrier to cross border trade, Canada can little afford to fall behind the US with respect to PRRS elimination.

It is entirely possible that the conclusion of the NAPETF will be that PRRS elimination is not possible given the nature of the disease and our current technology. If this is the case then we will need to focus on the control of PRRS until the appropriate technology becomes available that will facilitate elimination. If it were possible then it certainly would be a shame to have future generations look back at our inaction and say to themselves " What were they thinking?"

1. Polson, D, Holtkamp, D, Kjaer, J, Philips, R, Spiess, D Proc. 19th IPVS Congress
2. Polson, D, Yeske, P, Holtkamp, D, Philips, R Proc. 19th IPVS Congress

A Global Perspective on PCVAD

Andrew Jackson, PIC Canada

Since PCVAD was first identified, different strategies have been used to try to control the disease and its effects, with variable levels of success. The control strategies that have been used can be classified in different groups: Management, Nutritional, Genetic, Therapeutic, Immunological, Bio-security. The reason to choose one strategy or another varies, and nearly all control programs include a combination of strategies. So far no single management strategy could claim control by itself but combinations of strategies appeared to help. Recently the use of vaccines against PCVAD look to be giving very good results and perhaps some of the discipline around management may begin to slip. Rather than repeat a lot of what is already known I want to focus on the effectiveness of three strategies that in my experience <u>appear</u> to help productivity the most and that as a production manager I would not want to lose having fought so hard to implement.

20 Madec points: It has been demonstrated in France (Madec et al. 1999, 2001) that management strategies can have a positive impact in controlling PCVAD. In essence they are the basics of pig management fully applied. They are based in strictly applying all in–all out (AI-AO), limiting stress as much as possible, reduced stocking densities and strict hygiene. It is suggested that at least 16 of the 20 points must be carried out to show a significant response. The challenge is in having sufficient fortitude and discipline to apply all these points, especially in big units, notwithstanding the difficulties reduction in post weaning mortality has been observed from 19 to 3.7%, from 12 to 3%, from 21.4 to 10.2% and from 20.3 to 5.8% (Madec et al 1999,2001).
Individual measures have not been found to be successful by themselves. A Danish study (Hassing 2003a) found that AI/AO did not reduce mortality in a statistically significant way.
Limiting of cross-fostering of pigs to the first 24 hours, thereafter to a bare minimum and restrict to the same parity range has been difficult to implement. However, once done correctly the evidence in favour can be overwhelming. From my own experience I found weaning weights on a 50 000 sows operation increase by 2lb in 10 months with subsequent improvements in liveability and feed conversion rates in the nursery. Additionally benefits can be found in the more precise management of sows by parity in the farrowing room especially when considering intervention to reduce still births, feeding and ease of management for staff.

Batch farrowing: Changing to a batch farrowing practice every 2,3,4 or even 5 weeks has proved to be successful for some farmers. The main impact of this technique is to allow farms to undertake advantageous management techniques for PCVAD which they would not otherwise be able to do (e.g. AI/AO, terminal disinfection, age segregation etc.). This system has plenty of advantages, from improved health to faster growth but it also has its disadvantages (difficulties in achieving mating targets, boar use if not using AI, etc) and might be difficult to implement in herds over 500 sows. There is a report from a 380 sow herd where after changing to batch farrowing and implementing hygiene procedures the post weaning mortality decreased from 23.6% to 5.3% (Dennis 2002). There is a farm where mortality was reduced from 18-20% to 6-8% when the farm was moved to a 3 weekly batch (Waddilove 2003). However other work shows that variation can be observed between batches. A farm that was moved to 3 week batch production, had batches with 9.8%, 9.7%, 8.8% mortality and others batches in between with 1.3% and 1.2% mortality (Marco 2003a). From a management perspective the additional benefits around the batch farrowing that can be considered to outweigh the disadvantages would be the efficient use of labour and materials, specialisation of staff, staff motivation and the ability to more effectively manage fostering, over farrowing and parity control.

Wean to Finish: Initially implemented as a way to reduce the stress of nursery to finisher movements it soon became apparent that the incentives for doing this are larger. In particular labor savings (sorting and handling pigs plus power washing rooms), enhanced performance of pigs (since there is one less move and group sorting), and lower trucking costs. Some typical results from the USA suggest 5 – 11 days quicker to market and 7 – 20lb improvement in finished weight (Dritz et al. 1998). Another advantage is flow. In reality you generate more growing space if you are comfortable with working the buildings all in all out if not the site. This is because during the 1st weeks you only use the hot buildings on a site and the cold are empty, this gives the opportunity to hold pigs from the previous group in the cold buildings until they reach market weight and so have the opportunity to eliminate pre-market animals from the mix. Wean to finish offers a viable alternative to the traditional nursery – finish systems more common in the Americas. The key advantages come in the use of labor, improved growth rates and lower use of resources in moving animals and cleaning buildings. In a world of ever increasing costs of fuel, environmental control costs etc. these advantages may become larger over time as compared to the traditional systems.

Conclusions

Perhaps its common sense but if we give the pig the best start possible in the farrowing house and then provide a clean, stress free environment in which it can grow to its potential then we need do no more… perhaps! From experience if there is a silver lining to PCVD it is that it forces us to fully apply the basics of pig management.

References:

1- Dennis I. 2002. Experiences in the management of PMWS on a farm in East Anglia. The Pig Journal 49:103-109.
2- Hassing AG et al. 2003.Announcement from the National Committee for pig production, Danish Slaughterhouses.
3- Hassing AG et al. 2003a. Characterisation of the first cases of PMWS in Denmark. Proceedings of the 4th International Symposium on Emerging and Re-emerging pig diseases. Rome, Italy: 211-212.
4- Hassing AG et al. 2003b. Effect of sow on the mortality of pigs after weaning. Proceedings of the 4th International Symposium on Emerging and Re-emerging pig diseases. Rome, Italy: 193.
5- Madec F et al. 1999. La maladie de l'amaigrissament du porcelet (MAP) en France. 1999. Journees Rech. Porcine en France: 31, 347-354.
6- Madec F et al. 2001. PMWS: On-farm observations and preliminary analytic epidemiology. Proceedings of the Conference ssDNA viruses of plants, birds, pigs and primates – Saint Malo, France: 86-88.
7- Madec F, Waddilove J. 2002. Control PCV2 or control other factors? Several approaches to a complex problem. PMWS and PCV2 diseases: beyond the debate, Merial Symposium, Ames, IA, USA: 45-53.
8- Marco E. 2002a. PMWS – Field observations in Spanish herds. The Pig Journal 50: 135-142.
9- Marco E. 2002b. PMWS control – European style. Proceedings Tenth annual swine disease conference for swine practitioners: 83- 90.
10- Marco E. 2003a. Personal communication.
11- Marco E., Piñeiro C., 2003b. An update on mycoplasma vaccines. International Pig Topics, 2003, 18:3, 11-13.
12- Waddilove AEJ, Marco E. 2002. Assessing serotherapeutic control of PMWS in the field. Proceedings of the 17th IPVS Congress, Ames, Iowa, USA. I: 204.

The Impact of Litter Size on Pig Growth Performance and Variability

A.D. Beaulieu, J.F. Patience and P. Leterme
Prairie Swine Centre
Saskatoon, SK CANADA

Prior to the widespread adoption of all-in-all-out production systems, variation in growth was largely a "hidden" cost. Pigs were selected from pens when they reached market weight, and the fact that some pigs required 4 to 6 weeks longer than others to reach market went largely unnoticed, or at least ignored. Furthermore, in continuous-flow systems, downtime due to variable growth rates affects pen usage, while in all-in-all-out (AIAO) systems, it affects room or barn usage. The economic impact is therefore much greater in AIAO systems.

Additionally, sow productivity is rapidly increasing in Canada: Average litter size has increased from 10.4 to 11.2 piglets in the last 5 years. Increased litter size results in reduced average birth weight. Typical, a 1 pig increase in litter size reduces mean birth weight by 50 to 150 grams, and doubles the proportion of pigs with a birth weight below 800 grams. Whether this reduced birth weigh is accompanied by increased variation in growth is the current focus of research at the Prairie Swine Centre and Lacombe Research Centre.

Variation begins on the day piglets are born; a typical CV for birth weight is between 22% and 26%. When piglets from 52 sows were followed through eight consecutive parities, it was shown – not surprisingly - that the number of live-born piglets in a litter was negatively correlated with mean piglet birth weight and positively correlated with the CV of litter birth weight. The percent survival to weaning was highest in litters with fewer piglets born alive, high mean birth weight and a low birth weight CV.

After birth, additional factors contribute to variability. Heavier birth weight piglets consume about 30% more milk than their lighter littermates. In addition, heavier birth weight piglets, or at least those that win the most fights early in life, tend to suckle the anterior teats on the sow, which are known to deliver higher milk volumes. Lower milk intake is not only associated with slower growth, but whole-body protein synthesis is also reduced.

One of the most predictable contributors to variability in the post-weaning period is the variability in weaning weight. For example, the correlation (r) between weaning weight and nursery exit weight was found to be 0.73. Numerous researchers have related weaning weight to nursery exit weight by suggesting that for every 1 kg increase in weaning weight, nursery exit weights will increase by X kg. It is our experience that this relationship varies widely among farms; at PSC Elstow Research Farm, we have found that for every 1 kg increase in weaning weight, there is a concomitant 1.9 kg increase in nursery exit weight (~70 days of age) and a 4.2 kg increase in market weight.

While differences in birth weight are obvious, what is less clear is the relationship between birth weight and physiological "competency" at birth, or factors that may affect later growth rates. Low birth weight has been associated with a reduced number and height of intestinal villi, reduced lactase and lipase activity, reduced muscle respiratory enzyme activity, fewer muscle thyroid hormone receptors and lower IGF-1 levels in the blood. Additionally, increased litter size and associated smaller birth weights has been shown to lower the number of muscle fibres differentiating before birth. This could logically lead to changes in carcass composition and the eating quality of pork.

Because of the interest in this subject, an experiment is currently underway at the Prairie Swine Centre and Lacombe Research Centre whereby 98 litters were followed from farrowing through to market. Our objective is to study the impact of litter size and birth weight on growth performance, carcass composition and eating quality of pork. The experiment is still in progress, but the following information is now available.

Litters were arbitrarily assigned to "small" (3 to 10 born alive), "medium" (11to 13 born alive) and "large" (14 to 19 born alive) litters. Normal cross-fostering was allowed. Although, larger litters had the expected reduced average birth weight, the SD was similar between larger litters and litters with fewer piglets. A similar tendency was observed as the pigs grew. In fact, by nursery exit, and at 1st pull, the slight increase in CV observed at birth in the larger litters (a result of a reduced average body weight) was no longer observed.

Work on this project continues at Lacombe Research Centre to study the muscle composition and pork eating quality of pigs selected from each of 4 birth-weight categories within each of 25 litters. These data should be available in the near future.

Given that litter size is growing rapidly, and there is growing controversy surrounding the drive to increased sow productivity, much more data is required to determine the true impact of litter size and birth weights on ultimate pig performance and ultimate pork quality. Based on these preliminary results, the impact may not be as large as some people suggest.

Effect of litter size on growth and the variation in growth.

	Small litters (n=38)	Medium litters (n=39)	Large litters (n=21)	All litters (n=98)
	Total Born Alive			
n	318	472	324	1114
Mean	8.37	12.10	15.43	11.37
	Total Born			
n	350	521	329	1200
Mean	9.21	13.36	15.67	12.24
	Total Weaned			
n	277	402	274	949
Mean	7.29	10.31	12.86	9.68
	Birth Weights			
n	271	396	268	935
Mean (kg)	1.59	1.41	1.35	1.44
StDev (kg)	0.32	0.30	0.32	0.33
Min (kg)	0.80	0.75	0.75	0.75
Max (kg)	2.50	2.50	2.35	2.50
CV (%)	20.13	21.27	23.76	22.61
	Weaning weights (ave. 19 days of age			
n	271	396	268	935
Mean (kg)	6.78	6.43	6.47	6.55
StDev (kg)	1.59	1.33	1.45	1.45
Min (kg)	1.55	2.00	2.05	1.55
Max (kg)	10.70	9.75	10.10	10.70
CV (%)	23.45	20.67	22.39	22.11
	Body weights at nursery exit (ave. 68 days of age)			
n	271	396	268	935
Mean (kg)	32.57	31.67	32.88	32.28
StDev (kg)	5.00	4.28	4.63	4.62
Min (kg)	11.90	18.75	14.50	11.90
Max (kg)	44.40	43.85	44.90	44.90
CV (%)	15.36	13.50	14.10	14.33
	Body weights at 1st pull			
n	255	330	221	806
Mean (kg)	96.88	96.29	98.11	96.98
StDev (kg)	11.06	10.74	11.13	10.96
Min (kg)	59.90	49.00	51.20	49.00
Max (kg)	108.00	118.40	122.20	122.40
CV (%)	11.41	11.16	11.35	10.44

Pig Manure and Odour

Dorin Bejan and Nigel J. Bunce
Department of Chemistry, University of Guelph,
Guelph, Ontario N1G 2W1, Canada
e-mail: dbejan@uoguelph.ca/nbunce@uoguelph.ca

Offensive odours from large-scale hog operations are the subject of increasingly adverse public attention due to the land disposal of liquid manure. Odour components are formed by anaerobic bacteria reducing organo-nitrogen and –sulfur compounds in the anoxic environments of the porcine gut and liquid manure tank. Purging the liquid manure tank with air is insufficient to achieve and maintain oxygenated conditions because of the high bacterial load and biological oxygen demand. This research involves electrochemical oxidation in reactors with different anodes to "neutralize" the odour of hog manure immediately prior to land disposal.

Odour nuisance is poorly defined, both scientifically and in the regulatory framework. We defined the ***quality*** of smell as follows: **A** = extremely unpleasant (raw hog manure smell); **B** = moderately unpleasant; **C** = slightly unpleasant; **D** = neither pleasant nor unpleasant. The ***intensity*** of smell was defined in terms of "Threshold Odour Number" (TON), where TON = mL of odour-free water that must be added to 1 mL of sample so that the odour of the solution is just detectable.

Both odour intensity and TOC, along with a lightening of the color of the solution, fell progressively with the increased current and/or increased electrolysis time at Ti/SnO_2 and BDD in a plug-flow reactor operated in recirculation mode (Figure. 1). Odour removal proceeded more rapidly than loss of TOC, as a result of Kolbe decarboxylation of aliphatic carboxylic acids, yielding hydrocarbons.

Figure 2 (BDD anode) presents the progress of electrolysis when a plug-flow reactor was operated in simulated cascade mode. At all values of the applied current there was progressive loss of both TC/TOC and smell with a D quality after 3 passes.

The intensity of odour was determined following changes in TON values (Figure 3) using a plug-flow reactor in simulated cascade mode. These values fell faster using the BDD anode than at Ti/IrO_2. In chemical terms the difference between the two types of anode can be rationalized in terms of the oxidation mechanism. It is not possible to notice any change in colour during electrolysis of whole manure, due to the presence of solids, but electrolysis of centrifuged samples caused a progressive change in color that correlated with the decrease of odour. In an experiment at BDD at 600 mA, the initial dark green colour of the solution gradually faded, and became completely clear after three passes through the reactor.

Electrolysis also had a pronounced bactericidal effect, with anaerobic bacteria, in particular, reduced almost to zero after only one pass at both anodes (Figure 4), a result that is explicable by the evolution of molecular oxygen during electrolysis. The rationale for making this determination was our earlier observation that solutions electrolyzed to a near-odourless state could be stored for several weeks without redeveloping an off-odour, even though the solutions still contained a substantial residual TOC.

The foregoing results were reproduced with whole (uncentrifuged) manure on a larger scale using both the 1 L and 27 L reactors, the latter being used for an on-farm demonstration, in which the smell of freshly collected manure was **A** and the smell of treated manure was **C** in continuous operation.

This technology does not require ancillary chemicals and the resulting solutions could be stored without developing any off odor. Retention of total nitrogen in the solution showed that its nitrogen content is preserved. The research is presently being developed to a pilot plant scale.

Symbols used: TC-total carbon; TOC-total organic carbon; IC-inorganic carbon; TN-total nitrogen; BDD-boron doped diamond electrode.

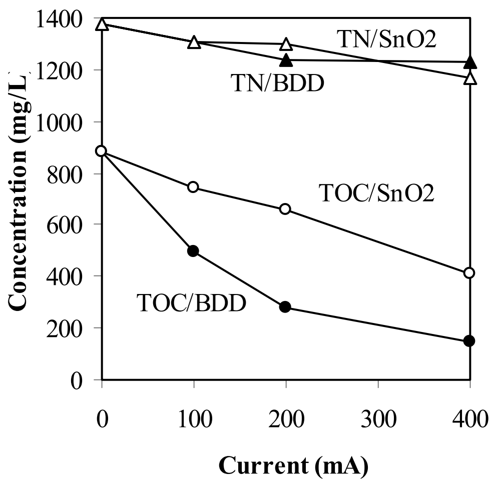


Fig. 1. Electrolysis of hog manure liquid in the plug flow reactor in recirculation mode (four equivalent passes).

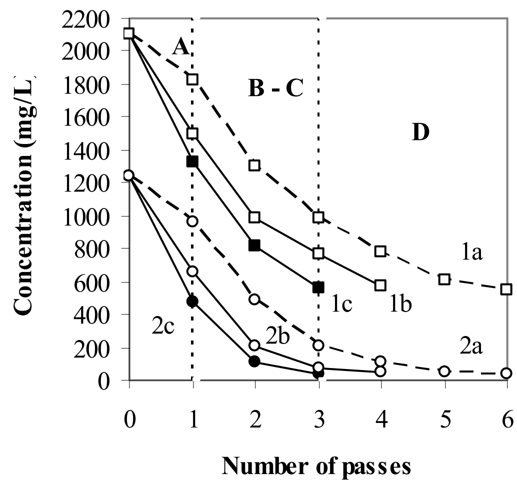


Fig. 2. Variation of TC (curves 1) and TOC (curves 2) at the BDD anode in a cascade of plug flow reactors; 400 mA (a), 600 mA (b) and 800 mA (c).

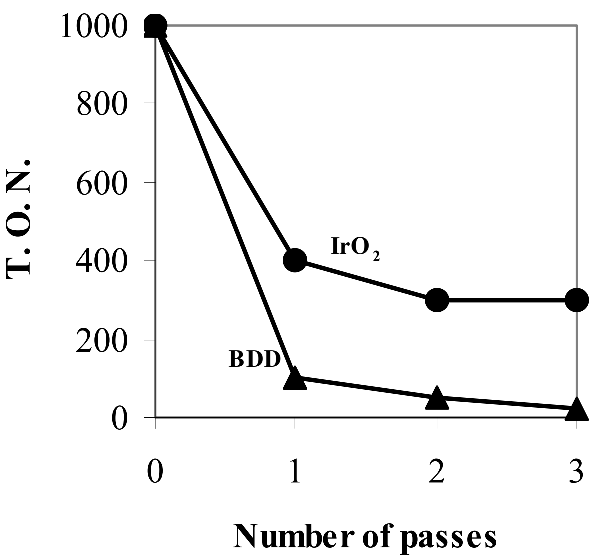


Fig. 3. Variation of TON using the plug flow reactor in simulated cascade mode at 600 mA.

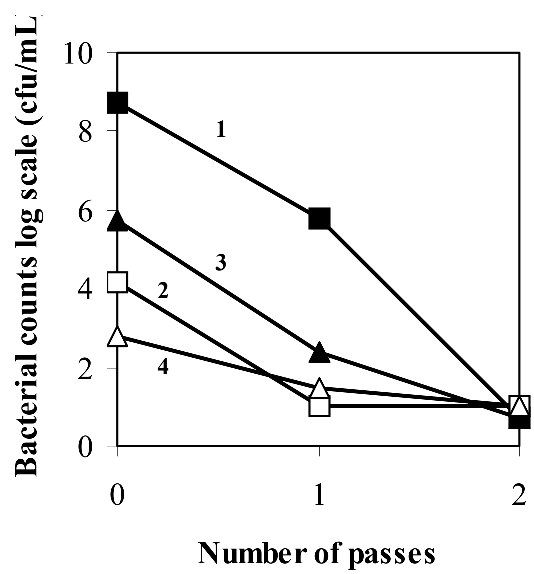


Fig. 4. Total Bacterial Count for Anaerobic (AN) and Aerobic bacteria (AER) for BDD and Ti/IrO_2 anodes, using the plug flow reactor in simulated cascade mode at 600 mA; 1 - BDD/AER; 2 - BDD/AN; 3 - IrO_2/AER; 4- IrO_2/AN.

Bio-Vator – Vessel Mortality Composter

Gilbert Vanden Heuvel
From the Hill Farms Ltd. Goderich, ON

Why did we get it?

As almost everyone did, we used to have dead stock picked by dead stock company. Worked ok but, as that business became less profitable they required us to do more. Such as : have pigs ready to dump into truck, only fresh mortality (strange words to have together), pick up times became a hassle and on top of that, rising pick up fees.

As this was all happening, we conducted a bio-security analysis of our farm. One of the risks we found was the dead stock truck. We decided to compost our own material to eliminate that risk.
We started composting with straw in piles. This worked fine. We buried all our dead stock in straw or sawdust and left it to compost. We let it sit for about a year and spread the dirt on our clay areas. Worked well, no remains of mortalities remained.
This method did have a few drawbacks:

- the piles leaked (environmental issue).
- the piles can be a lot of work in winter and wet periods of spring and fall. The area around the pile became very sloppy and hard to move around in. Too much time spent and too much wear on equipment was happening.
- we didn't have a tractor to use in the busy spring and fall cropping times. Bad news when a sow dies but even worse when you have to stop planting to bring it to the compost pile.
- the final straw was the constant visits from skunks, dogs and many other hungry animals that found this a good feeding area. The compost pile doesn't stink if the mortalities are buried but once you uncover them it's awful.

At this point NMP grants to farms bigger then 300 units was announced. We did the Environmental Farm Plan and applied to purchase the biovator with the grant money. This went through and we offset most of the $32,000 cost with grant $$.

It was easy to set up ourselves. An electrician was hired to bring 110 volts to the machine on a 20 amp breaker.

Basic principles

Micro-organisms feed on the carbon in the straw and consume the dead pig. Sounds easy.

These bugs are Aerobic so the exit end of the machine is left open to let air in.

Another critical issue for these bugs is moisture (need to move in liquid but too much will drown the aerobic bugs).

Carbon nitrogen ratio is very important. Rough rule of thumb is that you put equal amounts of straw or shavings to dead stock. But each carbon source is different so some experimenting will have to be done. We started with too little straw and the temperature never reached proper level.

Mixing is important to aerate the material and to move it along and out of the machine.

If temperature is high enough for long enough then product coming out is pathogen free.

How our works

Shed to hold chopped straw (better absorption when is short and dry). We are unable presently to put in our afterbirth since it is very wet. We end up with leakage which makes a smelly mess.

The machine is 32 feet long and 3 ¾ ' in diameter, insulated with two large fill doors and one smaller inspection door.

It ends up being a good height to unload from pickup truck.

Hoist to help with loading bigger animal, (no back injuries and one man operation).

Drum rotates a set number of times per day. (Simple mechanical timer to set when and how often). 12 rounds per day presently.

Product inside moves along some each time closer to outlet. When it reaches about 2/3 or the way it is mostly broke down already and drying happens after that point. Almost no bones are left, I've never even seen teeth coming out.

Aeration happens during each turn to feed aerobic micro organisms.

Temperature needs to maintain at least 25 degrees C. We've been staying about 30 C. 40 C is possible.

Ours is sized to take everything except sows. They are still composted in a static pile in field.

Would we do it again?

We had a rough start as we balanced our ratio of straw and dead stock but it's working well now.

It is expensive but:

- no tractor needed to move dead stock
- no seepage
- no dead stock trucks on yard
- one man operation with low daily time requirements

Evaluation of the Importance of Coccidia in Ontario Suckling Piglets

Andrew Peregrine,[1] Emma Webster,[1] Robert Friendship,[1] Cate Dewey,[1]
Kevin Vilaca,[2] and Andrea Aliaga-Leyton,[1]
[1]University of Guelph, Guelph, Ontario, [2]Maitland Swine Services, Listowel, Ontario

Introduction

Coccidia (*Isospora suis*) is a protozoan parasite that reproduces in cells lining the small intestine of pigs. In Europe, this parasite is recognized as a frequent and important cause of diarrhea and uneven weight gains in suckling piglets.[1-3] Unfortunately, current information on the importance of coccidiosis in Canadian pigs is not available – the last study was carried out in the late 1970s.[4] Furthermore, as the industry has moved away from concrete floors in the farrowing room and hygiene has improved, many people have assumed that coccidia has disappeared or diminished in importance. However, anecdotally, the parasite is a significant problem on some Ontario farms.

In most countries the only drug that has been licensed for prevention of coccidiosis in piglets is Baycox (toltrazuril) – administration of a single dose in the first week of life has significant economic benefits.[5,6] Although Baycox was never licensed for use in Canada it was commonly used under veterinary supervision with an emergency import permit. Unfortunately, in 2005, the use of the drug in pigs in Canada was banned because of concerns about human safety issues. As a result, Canadian swine producers are now without a drug with proven efficacy against coccidiosis. In order to maximize the chance of either the ban on Baycox being reversed or an alternative drug being approved for use in Canada, it would greatly help if information was obtained on the current importance of coccidia in suckling piglets. It would also help swine producers if management practices can be identified that reduce the risk of coccidia infections in piglets.

Objectives

(a) To determine the prevalence of coccidia infections in Ontario suckling piglets.
(b) To determine if coccidia infections are associated with diarrhea and/or reduced growth rates in suckling piglets.

Materials and methods

Fifty representative Ontario herds were selected for this study and visited between May and August 2006. Depending on herd size, up to 10 litters were selected on each farm in each of two age groups: 7-15 days of age and 16-21 days of age. Piglets aged 16-21 days were individually weighed and a fecal sample was collected from 3-5 piglets per litter. Fecal samples were similarly collected from litters of pigs that were 7-15 days of age. All weaning weights were standardized to 21 days of age and a survey was conducted on each farm to obtain information on the environment in which the piglets were housed and any treatments performed. All fecal samples were scored for consistency (to determine if piglets had diarrhea) and examined for coccidia oocysts. The number of oocysts was determined per gram of feces to evaluate the level of shedding in to the environment.

Results

Farms ranged in size from 30 to 1700 sows and had an average of 411 sows. Coccidia infections were detected on 70% of farms. Furthermore, the intensity of oocyst shedding in feces ranged from 1 oocyst to over 500 oocysts per gram of composite feces, i.e. very low to high levels. On farms with coccidia infections, the proportion of litters infected with coccidia ranged from 5% to 100% (average = 29%).

On 42 of the 50 farms (84%) at least one litter aged 7-21 days was found to be experiencing diarrhea. Furthermore, an average of 47% of litters experiencing diarrhea were positive for coccidia. By comparison, 24% of non-diarrheic litters in the same age range were positive for coccidia. These data indicated that litters that had coccidia were 4 times more likely to have diarrhea than non-infected litters.

On farms with coccidia infections the average standardized weaning weight was 6.3 kg, while the average standardized weaning weight on coccidia-negative farms was 6.7 kg.

Discussion

The proportion of coccidia-positive farms found in this study (70%) is comparable to the value obtained in a recent study on 324 farms in Germany, Austria and Switzerland (76%).[3] The average proportion of infected litters on coccidia-positive farms (29%) is also comparable to the European study.

Litters that were infected with coccidia were significantly more likely to experience diarrhea between 7 and 21 days of age than litters that were not infected with coccidia. Furthermore, coccidia were detected in 24% of the fecal samples from litters with no diarrhea (sometimes at high levels) – this is of concern as recent data have indicated that subclinical infections (i.e. infections without diarrhea) may have a significant negative impact on growth rates.[6]

In summary, this study has indicated that coccidia is commonly found on Ontario farms and is associated with both clinical and subclinical infections. Hopefully this will remind practitioners that coccidiosis is still a problem on many farms and should not be ignored. Future work will be carried out to determine the impact of coccidia on growth rates up to 8 weeks of age. In addition, a number of possible treatments for coccidia will be evaluated.

Acknowledgement

Ontario Pork is thanked for funding this study.

References

1. Eysker M, Boerdam GA, Hollanders W, Verheijden JHM. 1994. The prevalence of *Isospora suis* and *Strongyloides ransomi* in suckling piglets in the Netherlands. *Vet Q* 16:203-205.
2. Gualdi V, Vezzoli F, Luini M, Nisoli L. 2003. The role of *Isospora suis* in the etiology of diarrhoea in suckling piglets. *Parasitol Res* 90:S163-S165.
3. Mundt HC, Cohnen A, Daugschies A, Joachim A, Prosl H, Schmaschke R, Westphal B. 2005. Occurrence of *Isospora suis* in Germany, Switzerland and Austria. *J Vet Med* 52:93-97.
4. Sanford SE, Josephson GKA. 1981. Porcine neonatal coccidiosis. *Can Vet J* 22:282-285.
5. Mundt HC, Daugschies A. 2004. Piglet coccidiosis – update. In: *Proc 18th Cong Int Pig Vet Soc*, Hamburg, Germany, 824-825.
6. Maes D, Vyt P, Rabaeys P, Gevaert D. 2005. Effects of toltrazuril on the growth of piglets in herds without clinical isosporosis. *Vet J* - Epub ahead of print.

Effect of Paylean on Pig Performance and Carcass and Pork Quality

J.F. Patience[1], P. Shand[2], Z. Pietrasik[2], J. Merrill[3], D.A. Gillis[1], G. Vessie[3] and A.D. Beaulieu[1]
[1]Prairie Swine Centre, [2]University of Saskatchewan and [3] Elanco Animal Health

Ractopamine hydrochloride (RAC) has recently been registered for use in Canada under the brand name Paylean™. Initially, at least, the product is being recommended for use at a level that will supply 5 mg RAC per kg of feed for the last 28 days prior to marketing. Much of the earlier research on this product was undertaken at higher levels of inclusion, so information on the response of pigs to RAC at 5 mg/kg is less abundant. There is also limited information available on the impact of Paylean on the eating quality of pork, and the results available are equivocal. Consequently, an evaluation of the use of Paylean by the Canadian pig industry must consider the impact on growth performance, carcass traits, eating quality and economics. The objective of our study was to evaluate the effectiveness of 5 mg RAC per kg, fed for an average of 28 days, on growth performance, carcass characteristics, pork quality and economics

The experiment was conducted at PSC Elstow Research Farm, a 600-sow single-site commercial farrow-to-finish research facility. The experiment consisted of two dietary treatments: a control finishing diet or a similar diet supplemented with 0.025% Paylean® equivalent to 5 mg RAC/kg. The control diet was typical of that used by the commercial pig industry for pigs fed from 85 kg to market (Table 1). Based on previous research on Paylean, the treatment diet was formulated to contain 1.00% total lysine compared to 0.75% in the control to support the expected increase in lean gain. The minimum ratio of other essential amino acids to lysine was the same in both diets. The level of vitamin and trace mineral premix was increased by 12% and both calcium and total phosphorus were increased by 0.05 percentage points, to ensure that nutrient supply would not impair the pig's ability to respond to Paylean.

Pigs were marketed when they reached a minimum live weight of 116 kg or after the pigs were on test for 6 weeks, whichever occurred first. Pigs not reaching the minimum marketing weight at the end of the 6-week period were considered to be "tail-enders." On d 28 of the experiment, the two pigs within each pen whose bodyweight was closest to that pen's mean were selected for more intensive carcass and meat evaluation, as described below. The experimental started when the average initial weight of the pigs was 86 kg. On the day prior to shipping, pigs that weighed a minimum of 116 kg were identified and tattooed with a slap tattoo identifying the pen from which they came. The room was completely emptied on week 14 of the growout period, or on week 6 of the experiment, as per normal barn operation.

In each of two weeks, a total of 8 animals of each gender and each dietary treatment (ie. 2 pigs from each pen), for a total of 32 animals per week, were selected for detailed meat quality analysis. This provided 16 animals within each treatment within each gender, for an overall total of 64 animals. As the carcasses left the chiller in the packing plant, the carcasses were pulled off onto separate rails in the cooler and the 32 sides from each week were tagged for further testing.

The analysis of the experimental diets confirmed that the Paylean was added at the correct level to the treatment diet, and was absent from the control diet. Lysine was elevated as expected, although both the control and treatment diets contained slightly more lysine than formulated (0.84% and 1.09% compared to 0.75% and 1.00%, respectively).

The Paylean pigs were on test an average of 26.5 days, which was very close to the average of 28 days anticipated at the start of the experiment (Table 2). Average daily gain was 13% higher in the Paylean pigs as compared to the controls ($P < 0.001$); both genders responded in a similar manner ($P < 0.001$). Interestingly, there was no effect of treatment on feed intake ($P > 0.10$), so feed conversion also increased by 13% ($P < 0.01$) by Paylean (Table 3). Because the Paylean pigs grew more efficiently, they used 11.5 kg less feed per pig started than the control pigs.

One of the expectations of the use of Paylean is to reduce the variation in market weights, and more precisely, to reduce the number of tail-end pigs that would be shipped from an all-in-all-out production system. There were no Paylean barrows and only 2 Paylean gilts as tail-enders, but there were 2 control barrows and 18 control gilts that were tail-enders. Thus, Paylean reduced the number of tail-end pigs from 7.5% of the pigs shipped to 0.8%. The Canadian grading system heavily penalizes the marketing of lightweight pigs, so this is a noteworthy response.

Weekly growth rate, within treatment, was recorded. It can be seen that during the first week of the experiment, the response to Paylean was quite consistent, irrespective of the pig's shipping week; only the pigs shipped during week 5 appeared to not respond to Paylean during their first week on test (Table 4, Figure 1). However, those pigs responded to Paylean during their second week on test. It can be seen that for pigs marketed during their 5th and 6th week on test, the response to Paylean was diminished by week 3.

Dressed weight was the same for pigs on both treatments, so dressing percentage was also the same across treatments (Table 5). Overall, Paylean reduced backfat thickness by 1 mm from 18.1 to 17.1 mm; however gilts did not respond to Paylean while barrows did. Paylean increased loin thickness by 2.5 mm, from 68.3 to 70.8 mm; the response was the same in barrows as in gilts. Consequently, Paylean also increased estimated lean yield by 1 percentage point and tended to increase carcass index, from 110.0 to 110.6. Carcass premiums tended to be lower on the Paylean pigs; this anomaly was the result of a premium policy that reduces the loin premium from $3.50 when loins are less than 70 mm to $0.50 when loins exceed 70 mm. Overall value was similar between control and Paylean treated pigs.

Neither loin ultimate pH nor drip loss percentage was affected by the Paylean (Table 6). Paylean had no effect on CIE L* values, but it did lower a* and b* values of the loin chops, indicating less red and yellow intensiveness, respectively. No differences were observed for any subjective (color, marbling) quality measurements of pork loin samples nor were there any differences in marbling. There was no difference in cooking loss between loin chops from pigs fed the control or Paylean-fortified diet.

Interestingly, there was a significant gender x treatment interaction for Warner-Bratzler shear force (WBSF) of both enhanced and not enhanced chops (Table 7). Loin chops from gilts fed the Paylean-fortified diet had higher instrumental tenderness values when compared to chops from the control diet, whereas no difference was found in barrows. The presence of the interaction suggests the response to feeding Paylean may be gender dependent. No differences between dietary treatments were found for the amount of perceptible connective tissue, juiciness, pork flavour intensity and desirability or overall acceptability of enhanced or non-enhanced chops (Table 8).

The sole negative effect of Paylean in this experiment was observed in the number of animals lost during the marketing process. While no control pigs were condemned, 2 Paylean barrows were condemned at the packing plant and 3 gilts were dead on arrival. Past experience with the product suggests that Paylean pigs may be more susceptible to stress during shipping.

At the end of the day, the final decision on the use of Paylean will depend on relative economics and will vary substantially among farms. Considering typical farms, we might suggest a benefit in the range of $2 to $3 per pig sold. However, the range of benefits among farms could be substantial.

Furthermore, if losses in transit are not controlled, the economic advantage afforded by the use of Paylean will be lost.

In conclusion, the addition of RAC at the rate of 5 mg/kg to the diet of finishing pigs for an average of the last 26 days before marketing increased growth rate and feed conversion by about 13% each, to greatly reduce the number of tail-end pigs (from 7.5% to 0.75%), to reduce backfat by about 1 mm and to increase loin thickness by about 2.5 mm. The use of Paylean may increase DOAs, so producers using this product must apply greater care in the handling of pigs during loading, transport and unloading at the packing plant. While 5 mg RAC/ kg reduced tenderness slightly, as determined by both mechanical and taste panel evaluation, there was no impact on overall acceptability of the final pork product. The economic benefit accruing from the use of Paylean will depend on the circumstances of individual farms.

Table 1. Ingredient composition of experimental diets (% as fed) [1]

Ingredient	Control	Paylean
Wheat	50.000	48.000
Barley	33.725	31.120
Soybean Meal	12.893	16.623
Limestone	0.807	0.800
Dicalcium Phosphate	0.463	0.681
Salt	0.500	0.500
PSC Mineral Premix[2]	0.400	0.450
PSC Vitamin Premix[3]	0.400	0.450
Lysine HCl	0.075	0.236
dl-Methionine	-	0.053
l-Threonine	-	0.099
Canola oil	0.738	0.738
Paylean[4]	-	0.025
Nutrients, calculated		
DE, Kcal/kg	3,300	3,300
Nutrients, analyzed		
Lysine total, %	0.84	1.09
Ca, %	0.58	0.63
P, total %	0.48	0.51
Ractopamine, mg/kg	undetected	4.9

[1] Diets were formulated to be similar to typical commercial diets, except that the % total lysine was increased from 0.75 to 1.00 % in the Paylean diet to accommodate the expected increased lean growth. Other essential AA, formulated according to the ideal protein ratio with lysine, increased accordingly.

[2] Provided per kg of mixed feed: Zn, 80 mg as zinc sulphate; Fe, 64 mg as ferrous sulphate; Cu, 50 mg as copper sulphate; Mn, 20 mg as manganous sulphate; I, 0.40 mg as calcium iodate; Se, 0.08 mg as sodium selenite.

[3] Provided per kg of mixed feed; vitamin A, 6,600 IU; vitamin D_3, 660 IU; vitamin E, 32 IU; menadione sodium bisulfite complex, 3.2 mg; thiamine, 0.8 mg; riboflavin, 4 mg; d-pantothenic acid, 12 mg; niacin, 28 mg; vitamin B_{12}, 0.02 mg; d-biotin, 0.16 mg; folic acid, 1.6 mg.

[4] Provided per kg of mixed feed; ractopamine hydrochloride 5 mg.

Table 2. Effect of Paylean on animal numbers.

	Control	5 ppm Ractopamine	S.E.M.	P values Trt	Gender	Trt x gender
No. pigs started [1]						
Males	136	136				
Females	131	128				
Total	*267*	*264*				
No. pigs shipped [2]						
Males	135	135				
Females	130	126				
Total	*265*	*261*				
Days on test [3]						
Males	28.3	25.3				
Females	32.1	27.6				
Total	*30.1*	*26.5*	*1.78*	*0.001*	*.0001*	*0.23*
Tail-enders [4]						
Males	2	0				
Females	18	2				
Average	*20*	*2*				

[1] Started on test diets when the average weight of the room was 85 kg.
[2] All pigs were shipped after the 6 wks on test, difference between pigs started and shipped is pigs removed from test during the experimental period (described in results).
[3] Target was for pigs to be fed ractopamine for an average of 25 days.
[4] Number of pigs not reaching the minimum live shipping weight of 116 kg, within the available 6 week experimental period.

Table 3. The effect of Paylean on the overall growth performance

	Control	5 ppm Ractopamine	S.E.M.	P values [1] Trt	Gende r	Trt x gender
No. pigs started						
Males	136	136				
Females	131	128				
Average	*267*	*264*				
No. pigs shipped						
Males	135	135				
Females	130	126				
Average	*265*	*261*				
Initial wt., kg						
Males	86.7	85.7				
Females	85.6	86.3				
Average	*86.1*	*86.0*	*1.49*	*0.94*	*0.82*	*0.13*
Final wt., kg						
Males	118.9	118.5				
Females	117.9	117.8				
Average	*118.4*	*118.1*	*0.28*	*0.51*	*0.04*	*0.65*
Overall ADG, kg/d						
Males	1.14	1.30				
Females	1.01	1.15				
Average	1.08	1.22	*0.03*	*0.001*	*0.001*	*0.80*
Overall ADFI, kg/d						
Males	3.62	3.60				
Females	3.13	3.14				
Average	*3.37*	*3.36*	*0.05*	*0.98*	*0.001*	*0.87*
Overall FCE[3]						
Males	0.32	0.36				
Females	0.32	0.36				
Average	*0.32*	*0.36*	*0.01*	*0.001*	*0.33*	*0.89*
Kg feed/pig started						
Males	101.6	90.6				
Females	99.8	86.1				
Average	*100.7*	*89.2*				

1 Model included the effects of treatment, gender and the treatment by gender interaction. Room (n=2) was considered random. Pen (n=32) was the experimental unit.

2 Based on individual (not pen) data.

3 FCE: feed conversion efficiency (gain/feed).

Table 4. The effect of Paylean on average weekly growth rate according to the week of shipping

Week Shipped	Trt	n = [1]	Week on Test 1	2	3	4	5	6
1	C	3	1.43					
	T	4	1.68					
2	C	14	1.31	1.33				
	T	31	1.41	1.56				
3	C	52	1.22	1.14	1.13			
	T	64	1.34	1.43	1.25			
4	C	70	1.19	1.11	1.03	1.10		
	T	91	1.30	1.30	1.15	1.15		
5	C	84	1.17	1.05	1.07	0.99	1.12	
	T	62	1.08	1.32	1.08	0.99	1.03	
6	C	44	1.00	0.95	0.91	0.86	0.99	0.89
	T	9	1.15	1.12	0.93	0.81	0.91	1.07

[1] Number of pigs shipped within that week. For example in the second group of animals shipped, 14 pigs were shipped from the control group, they gain 1.33 kg/d the week before shipping, and 1.31 kg/d the first week on test.

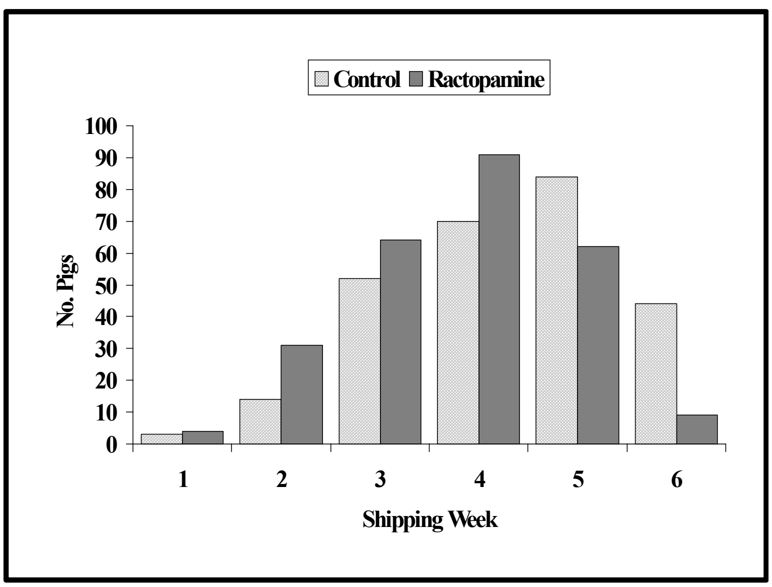


Figure 1. Effect of 5 mg ractopamine per kg on the number of pigs shipped by week

Table 5. The effect of Paylean on carcass quality.

	Control	5 ppm Ractopamine	S.E.M.	P values[1] Trt	Gender	Trt x Gender
Dressed wt., kg						
Males	94.22	94.06				
Females	94.46	94.74				
Total	*94.34*	*94.40*	*0.28*	*0.89*	*0.26*	*0.58*
Dressing percent, %						
Males	79.2	79.4				
Females	80.2	80.4				
Total	*79.7*	*79.9*	*0.15*	*0.29*	*0.001*	*0.81*
Backfat thickness, mm						
Males	20.32	18.48				
Females	15.83	15.64				
Average	*18.08*	*17.06*	*0.36*	*0.02*	*0.001*	*0.06*
Loin thickness, mm						
Males	67.06	69.74				
Females	69.45	71.83				
Average	*68.26*	*70.79*	*0.87*	*0.001*	*0.002*	*0.83*
Lean yield, %						
Males	59.23	61.07				
Females	62.27	62.47				
Average	*60.75*	*61.77*	*0.20*	*0.001*	*0.001*	*0.008*
Carcass index						
Males	108.57	110.15				
Females	111.34	110.99				
Total	*109.96*	*110.57*	*0.23*	*0.06*	*0.001*	*0.005*
Carcass premium, $						
Males	2.14	1.85				
Females	1.14	0.84				
Total	*1.64*	*1.34*	*0.26*	*0.06*	*0.001*	*0.96*
Carcass value, $						
Males	118.30	119.35				
Females	119.24	118.82				
Total	*118.77*	*119.08*	*2.71*	*0.76*	*0.84*	*0.48*

[1] Model included the effects of treatment, gender and the treatment by gender interaction. Room (n=2) was considered random. Pen (n=32) was the experimental unit.

Table 6. Least square means for loin quality characteristics.

	Treatment				Gender			
	Control	**RAC**	**SEM**	***p***	**F**	**M**	**SEM**	***p***
Probe pH	5.74	5.74	0.09	*0.93*	5.78	5.69	0.09	*0.08*
Purge loss								
24hrs	4.77	4.28	0.78	*0.35*	3.67	5.38	0.78	*0.00*
48hrs	6.73	6.21	0.80	*0.38*	5.56	7.38	0.80	*0.00*
CIE color								
L*	54.47	54.13	0.65	*0.62*	53.49	55.11	0.65	*0.03*
a*	8.19	7.43	0.23	*0.00*	7.43	8.19	0.24	*0.00*
b*	13.93	13.10	0.13	*0.00*	13.24	13.78	0.13	*0.01*
Visual color score								
Canadian[w]	2.7	2.7	0.17	*0.74*	2.7	2.7	0.17	*0.78*
USA[x]	2.9	3.0	0.08	*0.64*	3.0	2.9	0.08	*0.86*
Japanese[y]	2.8	2.8	0.09	*0.64*	2.8	2.8	0.09	*0.83*
Marbling[z]	1.8	1.8	0.13	*0.83*	1.6	2.0	0.13	*0.00*

[w]Scale of 1 to 5; 1=extremely pale, 5=extremely dark
[x]Scale of 1 to 6; 1=pale pinkish gray to white, 6=dark purplish red
[y]Scale of 1 to 6; 1=light, 6=dark
[z]Marbling scores correspond to estimated intramuscular lipid content.

Table 7. Effect of Paylean on Warner Bratzler Shear Force of non enhanced and enhanced loins.

	Not enhanced	**Enhanced**
Gender		
F	68.7	49.2
M	69.0	49.5
SEM	2.70	1.82
p	*0.83*	*0.91*
Treatment		
C	64.9	44.6
T	72.8	54.0
SEM	2.70	1.82
p	*0.00*	*0.00*

Table 8. Effect of Paylean on pork loin sensory attributes.

	Not enhanced loins							
	Treatment				**Gender**			
	C	T	SEM	*p*	F	M	SEM	*p*
Initial Tenderness[w]	5.6	5.2	0.16	*0.04*	5.3	5.6	0.16	*0.12*
Overall Tenderness	5.7	5.3	0.16	*0.05*	5.4	5.6	0.16	*0.16*
Percept. Connective Tissue[x]	5.8	5.7	0.23	*0.79*	5.6	5.9	0.23	*0.35*
Juiciness	5.2	5.2	0.17	*0.85*	5.2	5.3	0.17	*0.55*
Pork Flavour Intensity	5.2	4.9	0.13	*0.09*	4.9	5.1	0.13	*0.37*
Flavour Desirability	5.6	5.5	0.17	*0.67*	5.5	5.6	0.17	*0.57*
Overall Acceptability	5.6	5.3	0.16	*0.22*	5.4	5.6	0.16	*0.41*
	Enhanced loins							
	Treatment				**Gender**			
	C	T	SEM	*p*	F	M	SEM	*p*
Initial Tenderness	6.8	6.4	0.11	*0.04*	6.5	6.6	0.11	*0.56*
Overall Tenderness	6.8	6.5	0.10	*0.06*	6.6	6.7	0.10	*0.53*
Percept. Connective Tissue[x]	6.4	6.3	0.06	*0.20*	6.3	6.4	0.06	*0.32*
Juiciness	6.5	6.3	0.11	*0.33*	6.3	6.5	0.11	*0.18*
Pork Flavour Intensity	5.7	5.6	0.06	*0.43*	5.6	5.7	0.06	*0.23*
Flavour Desirability	6.2	6.2	0.07	*0.64*	6.2	6.2	0.07	*0.93*
Saltiness	5.3	5.2	0.14	*0.90*	5.2	5.3	0.14	*0.88*
Overall Acceptability	6.2	6.1	0.08	*0.29*	6.1	6.2	0.08	*0.54*

[w]Intensity of sensory attributes was evaluated based on an 8-point scale (8=extremely tender, juicy, intense, none, none; 1=extremely tough, dry, bland, abundant, and intense).
[x] Amount of perceptible connective tissue

Farrow to Finish Cost of Production

Ken McEwan
University of Guelph Ridgetown Campus
Ph: (519) 674-1531 Fax: (519) 674-1530
kmcewan@ridgetownc.uoguelph.ca

Background

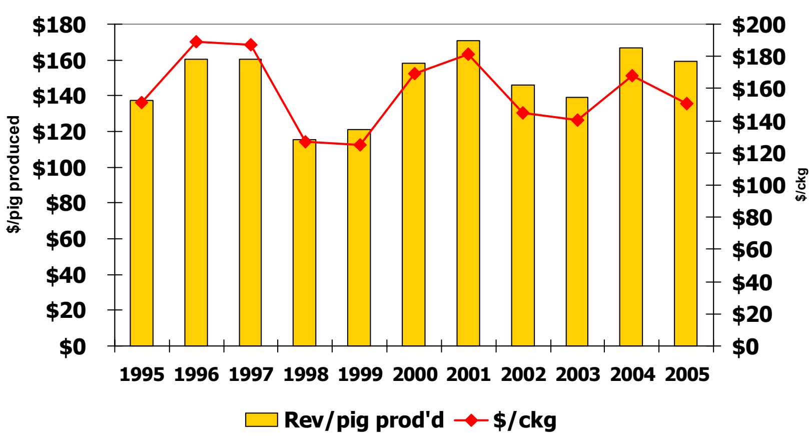
Cost of production is often touted as the most important factor in a region's competitiveness within the global pork market. The Ontario Data Analysis Project (ODAP) can be used to investigate Ontario's cost of production for raising market hogs[1]. This data set contains farm level financial and production information from a group of Ontario farrow-to-finish farms. The participants consider themselves to be full-time farmers and they report little, if any, off-farm income. Most of the farms rely on family labour to fill additional labour needs.

Results for the Swine Enterprise

This discussion focuses on the swine enterprise and does not take into account other farm activities (i.e. cash cropping). Family labour has not been included in the expenses. ODAP provides analysis on a per pig produced basis[2]. Some of these farms had SEW or weaner pig sales as well as market hog sales. The average number of pigs produced per farm in 2005 was 3,785. The average number of sows on these farms was 229.

Figure 1 shows average revenue per pig produced over time[3]. Also plotted on the graph is the average yearly market price ($/ckg). Revenue/pig has fluctuated with events such as the price crash in late 1998. The average revenue for this time period was $148.53.

Figure 1. Average Revenue Per Pig Produced



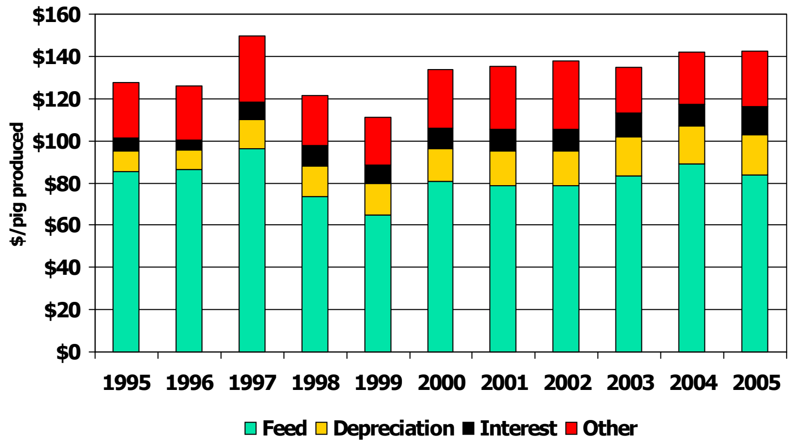
Expenses per pig produced as shown in Figure 2 have been fairly consistent averaging $132.94 over the 11 years. Feed makes up approximately 62% of total expenses each year. Depreciation expense has grown steadily from $9.61 to $19.20 during the years depicted. This is due to increased building and equipment investment that has

---

[1] Participation in ODAP varies each year. Results are for discussion purposes and are not assumed to represent an Ontario average. 2005 results are preliminary.
[2] This is a calculated number that converts all pigs produced and sold to market hog equivalents taking into account all production and inventory changes. Weaner pigs are converted to market hog equivalents using a factor of forty percent and SEW pigs are given a factor of twenty-five percent.
[3] Revenue accounts for premiums/discounts, cull pig sales, and changes in accounts receivable and inventory

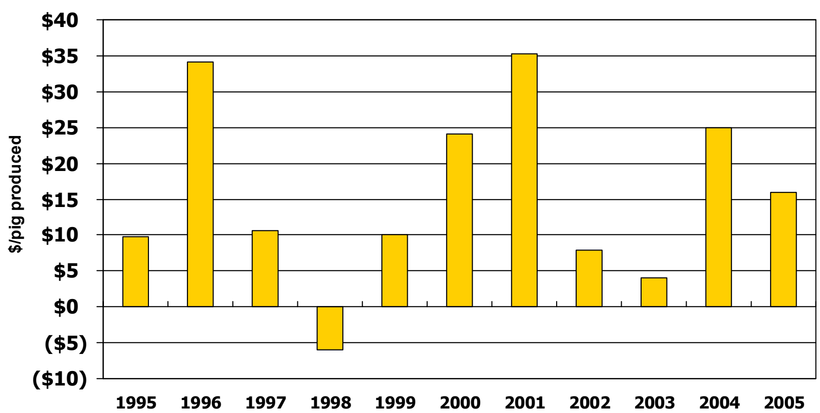
occurred with expansion and/or renovation of these farms over time. Average interest costs were $9.33/pig during the 11 years and "other" expenses were generally in the $26/pig range each year. "Other" expenses reflect health costs, building and equipment repairs, hired labour and any other expenses associated with the swine enterprise.

Figure 2. Expenses Per Pig Produced



The resulting profit per year is shown in Figure 3 below and the average over this time period is $15.52 per pig produced. This graph shows a trend of 3 years of increasing profits followed by a year of small to negative profits. Year to year profits are very volatile due to fluctuating market prices and rising input costs.

Figure 3. Average Profit Per Pig Produced



The Balance Sheet

Table 1 shows the balance sheet for the group of participants between 1995 and 2005 and takes into account all aspects of the farm operation. The average assets has grown to $2.5 million in 2005 indicating that these farms have invested significantly in their farm businesses. Some of the growth in farm assets is due to increases in livestock and building values but much of it is due to rising land prices. In 2005, the average total assets per sow per farm were $11,117 and the average amount of debt per sow was $4,258.

Table 1. Average Ending Balance Sheet

		1995	2000	2005
Assets	Market Livestock	$81,734	$129,868	$169,246
	Breeding Livestock	43,204	75,550	71,215
	Buildings	218,799	514,684	595,833
	Land	297,956	695,642	969,042
	Total Assets	**$1,032,498**	**$1,999,019**	**$2,545,745**
Liabilities	Operating Loan	56,138	88,253	101,584
	Mortgage	200,760	417,651	732,272
	Total Liabilities	**$379,609**	**$661,139**	**$975,155**
	Equity	**$652,889**	**$1,337,880**	**$1,570,591**

Conclusions

In summary, the average cost of production for the 11 years examined was $132.94 per hog produced not including family labour. Feed makes up about 62% of total expenses and depreciation has doubled reflecting investments in facilities and equipment. Average profits are highly volatile and will be even more so at the individual farm level.

Thanks and appreciation is extended to Agriculture and Agri-Food Canada for their generous financial support of this research and to the farm participants for sharing their time and information.

Integrated Model Of Pork Production

C. F.M. de Lange[1], G. vanderVoort[1], P.C.H. Morel[1] and A. Visser[1,2]
[1]Dep. of Animal and Poultry Science; University of Guelph
[2] Institute of Food, Nutrition and Human Health, Massey University, New Zealand
cdelange@uoguelph.ca

Abstract
Mathematical models are powerful tools for estimating the economic and environmental impacts of alternative management strategies for grower-finisher pig units, by integrating cumulative knowledge of nutrient utilization for growth and animal-environment interactions into one system. Models used in commercial pork production should be carefully tested, based on solid scientific principles and be flexible. Some illustrative examples of the commercial application of a pig growth model are provided and show the substantial benefit of applying such models in practice. Relatively user-friendly models are now available for use in commercial pork production in Ontario.

Introduction and background

An optimum feeding or management strategy for individual growing-finishing pig units is difficult to determine, as it is affected by many factors, including pig performance potentials, physical farm layout, feed intake, environmental conditions, available feed ingredients, feed processing, potential use of repartitioning agents such as Paylean™, phytase, and payment systems. Furthermore, it is becoming increasingly important to quantify the impact of pig production on the environment, i.e. nitrogen (N) and phosphorus (P) excretion, and the production of ammonia and green house gasses. Finally, the optimum strategy may change over time as environmental or economic conditions change. Financial losses and reductions in nutrient utilization can be substantial if management strategies are not optimized.

Mathematical models can integrate our vast amount of knowledge of nutrient utilization for growth and animal-environment interactions into one system. Such models can be used to explore in a quantitative manner the complex interactive effects of pig type, feeding level, diet nutrient content, the use of repartitioning agents and enzymes on nutrient utilization, pig growth performance, carcass quality and profits. Models of this type have two important applications in commercial pork production. First, they can be used to answer general questions that may apply to many different pig production facilities, such as the value of feeding Paylean™, enzymes such as phytase, or alternative pig feed ingredients. Second, they can be used to identify the optimum strategy for individual grower-finisher pig units by simulating alternative management and feeding strategies and comparing the predicted outcomes. The latter requires that pigs units characterized reasonably accurately. This applies in particular to operational lean tissue growth potentials, levels of feed intake at the various stages of growth, payment systems and the alternative management strategies that may be considered, i.e phase or split-sex feeding or shipping strategy, etc.

In this short contribution, some examples are provides to illustrate the value of computerized pig growth models as an advisory tool in commercial pork production. All simulation results presented here were obtained with a model which was developed by the International Pig Growth Modelling Group (University of Guelph, Canada; Massey University, New Zealand; Wageningen Agricultural University, The Netherlands; Cargill Animal Nutrition, formerly Ralston Purina International; www.porkmaster.com).

General assessment of alternative management strategies for growing-finishing pigs

In Table 1, pig growth performance and the environmental impact of alternative management strategies for growing-finishing pigs are estimated. The data show that an increase in feed wastage from 5 to 10% increases N and P losses into the environment by close to 10%. The use of phytase can reduce P excretion by about 35% provided that the available P (and thus total P) levels are adjusted appropriately. Given today's prices of phytase, dicalcium phosphate and the observed slight improvement in feed efficiency, profits per pig are slightly improved when phytase is used. Finally, the data show that feeding Paylean™ will improve average daily gain, feed efficiency, carcass dressing percentage and lean yield. However, the cost of Paylean™ is substantial and additional (balanced) protein needs to be supplied in the diet so that pigs can express increases in lean growth when they are fed this product. The main value of this product is that it allows reductions in variability in carcass weight at slaughter (by increasing growth rate of the slowest pigs in the barn), increasing the proportion of pigs in the optimum carcass weight categories and thus increasing average carcass value.

Conclusions

Pig growth models can be valuable tools to assist producers in improving the efficiency of pork production. Important applications of models include demonstrating the basic principles of nutrient utilization and performance in pigs, setting realistic production targets, and developing general feeding and management recommendations that may apply to the various production facilities. When models are applied to individual production units, detailed observations should be made on these units.

Pig growth models can never be perfect in predicting performance of different groups of pigs under varying conditions, simply because our knowledge of growth in the pig can never be complete. This implies that model-generated results should be interpreted with care and that model users should have a solid understanding of the theory included in the models, including its limitations. As more scientific information becomes available and, together with optimization mathematics, is integrated in mathematical pig growth models, these models will become even more powerful and a critical tool in commercial pork production.

Table 1. *Estimated pig growth performance and environmental impact of alternative management strategies for growing finishing pigs*[1]

	Scenario					
	Base	*10% Feed wastage*	*Improved pig*	*+500 PTU phytase per kg feed*	*-5% Dietary protein*	*+5 ppm*[2] *Paylean™*
Pig potential [3]	*Medium*	*Medium*	*High*	*Medium*		*Medium*
Dietary levels of standardized ileal digestible lysine, % / apparent fecal digestible P, %						
Phase 1	*1.00/0.254*	*1.00/0.254*	*1.10/0.280*	*1.00/0.175*	*1.00/0.175*	*1.00/0.254*
Phase 2	*0.80/0.221*	*0.80/0.221*	*0.90/0.215*	*0.80/0.149*	*0.80/0.149*	*0.80/0.221*
Phase 3	*0.65/0.177*	*0.65/0.177*	*0.75/0.221*	*0.65/0.103*	*0.65/0.103*	*0.80/0.181*
Pig growth performance						
Final BW, kg	*110.3*	*110.3*	*110.6*	*110.3*	*110.2*	*109.4*
Gain, g/d	*813*	*813*	*883*	*812*	*820*	*836*
Feed:Gain	*2.78*	*2.94*	*2.55*	*2.77*	*2.76*	*2.65*
Dressing %, %[4]	*80.2*	*80.2*	*79.9*	*80.2*	*80.2*	*80.7*
Lean yield, %[4]	*60.2*	*60.2*	*61.6*	*60.2*	*60.2*	*60.7*
Environmental impact, excretion per pig						
Nitrogen, kg	*4.02*	*4.37*	*3.89*	*4.00*	*3.67*	*3.94*
Phosphorus, g	*840*	*909*	*764*	*562*	*830*	*799*
Organic matter, kg	*30.9*	*42.0*	*28.4*	*30.3*	*30.6*	*29.2*
Methane, l	*291*	*291*	*293*	*294*	*276*	*294*

[1] Initial body weight of pigs is 25 kg. For all scenario's pigs are fed according to a three phase feeding program using corn and soybean meal based diets with added lysine.HCl. Diets are switched at 45 and 80 kg body weight. Feeding levels are 90% of voluntary daily DE intake according to NRC (1998) and include, unless stated otherwise, 5% feed wastage.

[2] Paylean™ was fed during 28 days prior to slaughter, and reduced feed intake 2.33% during this period.

[3] Pig potential represents the operation lean growth potential for pigs and is best expressed in units of whole body protein depositionl; this value is assumed to be 140 g/d for 'medium' pigs and 170 g/d for 'high' pigs.

[4] Typical Ontario carcass grading scheme; the impact of feeding Paylean™ on carcass characteristics will vary considerably with grading scheme.

References

A complete listing of references is available upon request.

Water Usage in Young Pigs – Not All Drinkers Are Created Equal

Torrey, S.[1], Toth, E.L.M., Widowski, T.M.*
Department of Animal and Poultry Science, University of Guelph, Guelph, ON, Canada N1G 2W1

Introduction

Drinker management is a mostly overlooked aspect of pork production, even though water is the most important nutrient in a pig's diet. Newly weaned piglets often drink excessively, have trouble initiating independent feeding, and exhibit higher levels of behavioural problems, specifically belly-nosing. In our previous studies, we found that the presence of different drinker devices can result in different feed intake, water usage and levels of belly-nosing. We found that piglets given access to a push lever bowl drinker, rather than a nipple drinker, belly-nosed significantly less and consumed more food during the first two days post-weaning, a critical period for early-weaned piglets. Additionally, piglets with a nipple drinker used double the amount of water as those with a push-lever drinker. The excessive water usage might be because young piglets are filling their guts with water since consuming fluid is familiar to them. Drinkers that reduce excessive intake but still meet water requirements may be best for the younger piglet. To determine if drinker type has an effect on feed intake, water consumption, growth and behavioural problems, two experiments were undertaken:

Objectives

1. To determine the impact of the different drinker devices on overall performance, water intake and belly nosing (Experiment 1).
2. To determine the preferred drinker style for piglets weaned at two different ages and to identify the relationships between a piglets' drinker preference and their initiation of feeding (Experiment 2).

The Drinkers


1.


2.

3.

1. The standard nursery pig bite nipple drinker
2. The stainless steel nursery push-lever bowl drinker
3. The plastic automatic float bowl drinker

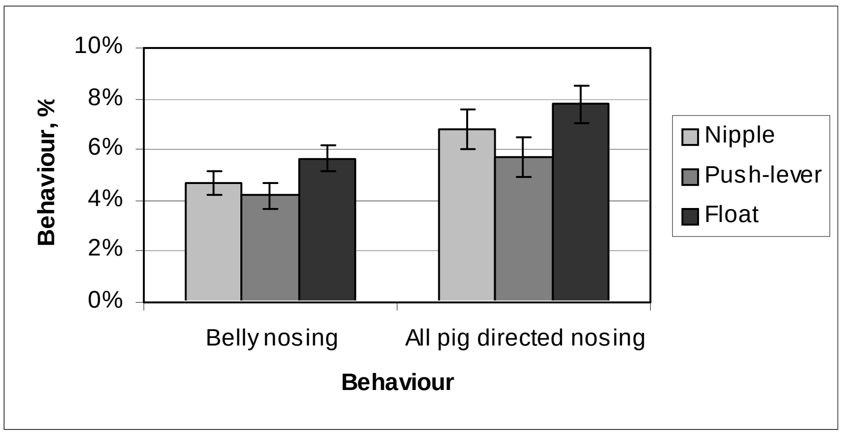
Experiment 1

In this experiment 6 replicates of 45 pigs were weaned at approximately 18 days of age into one of three treatments. Each treatment had one of the drinker types listed above. Feed intake was determined daily and water usage was measured using positive displacement water meters. Wasted water was also collected in order to calculate water consumption. The piglets were weighed at weaning and on days 7 and 14 thereafter. Pens were continuously video recorded for forty-eight hours on days 9 and 10. Behaviour was instantaneously scan sampled every 5 minutes from 0600-0800, 1200-1400 and 2000-2200 for lying, feeding, drinking, belly nosing, pen-mate directed nosing and other behaviour.

Results

- Piglets with nipple drinkers wasted significantly more water than those with the other types of drinkers (P<0.001; push-lever 0.16±0.05 L/pig/day; float bowl 0.36±0.07 L/pig/day; nipple 1.08±0.05 L/pig/day)
- Water intake was significantly lower for the float bowl drinkers than for the other drinkers (P < 0.01; push-lever 0.76 ± 0.05 L/pig/day; float bowl 0.46 ± 0.06 L/pig/day; nipple 0.86 ± 0.05 L/pig). Water intake was not different between the push-lever and nipple drinkers.
- Feed intake and weight were not affected by drinker type
- Piglets with the push-lever bowl exhibited the lowest levels of abnormal behaviour (Figure 1)

Figure 1. Effect of drinker type on the frequency of different behaviour patterns on days 9 and 10. Piglets with the push-lever bowl belly nosed less (P < 0.10) and performed less pig directed nosing (P < 0.05) than piglets with the float bowl.



Experiment 2

Over seven replicates, 104 piglets from 21 litters were split-weaned at either 20 or 28 days of age into pens of 8 piglets. Each pen contained each of the three drinker devices described in Experiment 1. Waste water was measured from collection troughs that were placed under the flooring below each drinker. The difference between the volumes of water dispensed and waste water collected was used to determine daily water intake and group preference for the different drinkers. The video recording system was the same as in Experiment 1. 22 piglets were observed for individual drinking behaviour at the three drinker devices through two days post-weaning.

Preliminary Results

- At the group level, piglets weaned at 28 days drank significantly more from the nipple while piglets weaned at 20 days drank the same amount from the nipple and the push lever (Figure 2, Figure 3).
- Younger piglets waste more from the nipple than older piglets (Figure 2, Figure 3).
- Individual piglets had different drinker preferences. When given three drinker devices, 11 piglets preferred the nipple drinker, 7 preferred the push-lever bowl, and 4 had no preference. No piglet preferred the float bowl drinker.

Figure 2. Water intake and waste at nipple and push-lever drinkers for piglets weaned at 20 d of age There was no difference in overall water intake between the nipple and the push-lever drinkers ($P = 0.52$); however, piglets wasted significantly more water from the nipple drinker ($P < 0.001$).

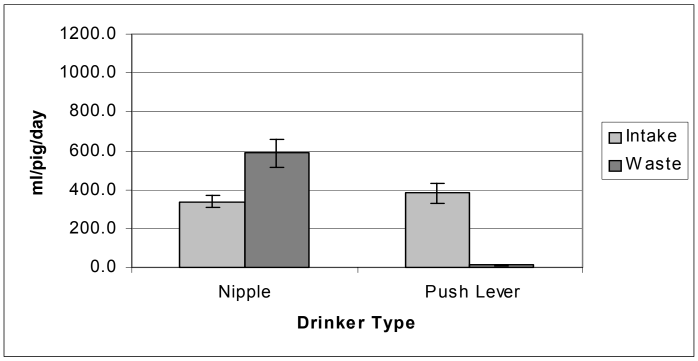
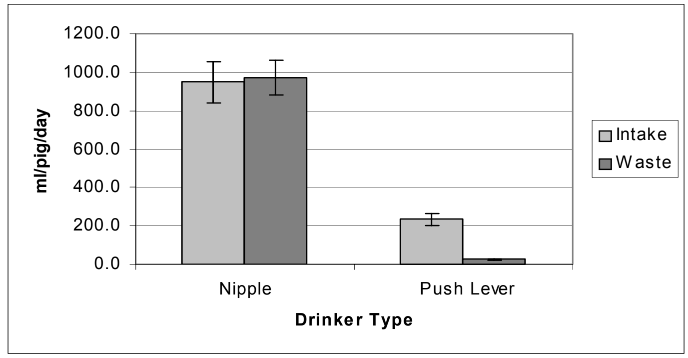


Figure 3. Water intake and waste at nipple and push-lever drinkers for piglets weaned at 28d of age. Overall, piglets consumed ($P < 0.0001$) and wasted ($P < 0.0001$) more water from the nipple drinker than from the push-lever drinker.



Conclusions

Drinker style affects multiple aspects of production and behaviour of the newly weaned piglet. Nipple drinkers contribute to high levels of water wastage, regardless of weaning age. Float bowl drinkers limit water consumption due to soiled water, and result in higher levels of behavioural problems such as belly nosing.

The push-lever drinker keeps water wastage in check while still ensuring that piglets consume adequate amounts of water. This style of drinker also appears to benefit younger weaned piglets through their initial feeding behaviour and overall growth.

Acknowledgements

This research is supported by the National Pork Board of the United States and by OMAFRA. The authors also wish to thank Bill Szkotnicki for his assistance with the data analyses and Meghan Mackenzie-Bell and Myriam Huot for their assistance with the behavioural analyses.

pork checkoff A Service of the National Pork Board

Ontario

Creating a Strong Infrastructure for Swine Producers

Tim Blackwell, OMAFRA

Infrastructures are critical to our day to day existence. When they work well, they are often taken for granted. From road maintenance to internet access, from barn builders to barristers, we are fortunate to live where we have access to the skills and services we require to function at a very productive level..

The large number of swine producers in southern Ontario has caused a strong swine production infrastructure to develop here. Swine producers have access to all the services and technology that are needed to successfully produce pork for the international marketplace. It is this access to services and expertise in housing, nutrition, health, meat science, marketing and more that allows Ontario hog producers to compete at the international level. We should be careful not to take this well-functioning infrastructure for granted. If the infrastructure weakens, so too will our industry.

Expertise in the feeding of pigs, in the diagnosis and treatment of swine diseases, in optimising manure management, in designing and operating efficient swine production facilities, and in processing and marketing pig meat is readily available to us in Ontario. The foundation of this strong infrastructure arises from the commitment of swine producers to improving all facets of swine production. One of the ways they accomplish this is through their generous and consistent support of swine research. The Centralia Swine Research Update is just one small example of the Ontario swine research infrastructure at work.

The commitment of Ontario swine producers to funding research has long reaching consequences. The Prairie Swine Centre data base, new diagnostic tests at the Animal Health Laboratory in Guelph, developments in liquid feeding systems for swine, economic comparisons of hog production costs and profits in various regions of North America, the value of market hogs to the packer, and many other projects and services are funded in part or in whole by Ontario producers. And the advantages to investing in swine research multiply.

Providing funding for swine research draws scientists from many disciplines to work with pigs. All researchers need funding to support their projects. Immunologists, virologists, bacteriologists, engineers, epidemiologists, agricultural economists, meat scientists and others are most often discipline-specific but not necessarily species-specific. These scientists will follow the money in order to keep their research programs moving forward. Interesting problems in muscle physiology, genetics, disease resistance, bacterial and viral metabolism, manure distribution and breakdown in soil, can be studied in a wide variety of animal species. The consistent commitment of swine producers to fund swine research has convinced a large number of these basic scientists to focus their studies on swine.

Active research programs catch the attention of other funding agencies and allow scientists to build on the foundations they created with their initial funding from pork producers. This was well demonstrated recently at the University of Guelph. The University encouraged scientists to collaborate on large multidisciplinary projects in an effort to increase the returns on University research projects. Two of the top three rated research projects selected by the University of Guelph for additional funding were swine-oriented. The scientists capitalized on the large amount of research they had done over recent years funded by Ontario Pork. They used this research work as a foundation to create large multidisciplinary research trials built on the projects originally funded by Ontario pork producers.

Ontario pork producers provide more money for swine research than any other province in Canada and more than most states in the U.S. This allows Ontario swine farmers to direct research towards issues that are Ontario-centric. Whether problems arise with water quality issues, a new production disease, food safety, odour complaints, specific housing requirements, transportation, meat quality, or other topics, Ontario pork producers are not forced to extrapolate from related research in other countries or wait and hope that someone in some other pork producing area will investigate the matter. Ontario Pork approaches researchers within as well as outside Ontario to provide answers to specific problems that are impacting production efficiency in Ontario today.

As the seed money from Ontario pork producers generates ever larger swine research capabilities at the University, more and more talented graduate students are drawn to where the active research programs exist. These energetic young swine researchers bring more expertise to the province and many stay in Ontario and take jobs with nutrition companies, diagnostic laboratories, meat processors, veterinary clinics, government, and engineering firms to continue to provide their expertise to Ontario swine producers and thus continue to strengthen the infrastructure in Ontario.

Ensuring that a newborn pig has a good start on the sow goes a long way towards ensuring a strong profitable market hog, Similarly, providing a strong basis for swine research in Ontario ensures a strong and functional research infrastructure in Ontario. This infrastructure allows Ontario hog producers to continue to compete successfully in the international pork market.

Most of us are only a phone call away from the information or services we need to successfully raise pigs. Much of this expertise has been created and sustained by the smart investment of producer funds in research into swine production. It is one investment that has paid off and continues to provide value to each of us.

Farm Animal Welfare Issues & Opportunities

Crystal Mackay
email: cmackay@ofac.org phone: 519-837-1326

About the Ontario Farm Animal Council:
The Voice of Animal Agriculture

- Non-profit education organization founded in 1988.
- 8 Founding Members including dairy, beef, turkey, chicken, egg, and pork.
- Core budget of $400,000
- Funded by memberships and donations: from $50 - $55,000
- Individuals, county, provincial, national, businesses, government
- Staff of 2 ½

What's new at OFAC?

- Shift to positive, proactive and professional
- Focus on our strengths: coordination and issue management
- Establish programs and resources where there's a need, without duplication.

Important basics to consider about the average Canadian when it comes to farm animal welfare issues:

- Less than 3% of Canadians farm. They don't know us or what we do.
- They don't get science or studies.
- They love animals.
- They are educated, but not informed.
- They demand safe food. They have never been hungry.
- They get their information from the media and the internet.
- They are concerned about food safety, animal welfare and the environment (in that order).
- They have never heard of Centralia.
- Common sense is not so common. **Perception IS Reality, so we better address some perceptions!**

Key Public Questions and Concerns about Pork Production

- Confinement – sow stalls, farrowing units
- Hormones & antibiotics
- Size of farms – factory farms, corporate control
- "Not natural"; Can't go outside
- Humane stunning and euthanasia
- Handling and transportation

Animal welfare is NOT animal rights.
Every person in the pork industry should be supportive of responsible farm animal welfare - this is the belief that animals can be used for human benefit, but must be treated with care and respect.
Animal rights is the belief that animals should not be used for human benefit, whether its for food, clothing or medical research.
It's very confusing, as groups such as PETA and the Humane Society of the United States and the Canadian Coalition for Farm Animals are really pushing an animal rights agenda, but use welfare arguments to make their case (and generate funds) from the public.

What are the answers to animal welfare issues?
Looking around the world, there seems to be only a few options to study:

- Banning?
- Legislation?
- Voluntary Codes?
- 3rd party auditing?
- Labeling

In North America, our customers are dictating animal welfare demands. We need to ensure our customers have the facts they need to make informed choices. We need to ensure we have the necessary investment in research to back up our facts.

What should we do?

1. If there's a problem – on your farm or in the industry:
   - Know about it.
   - Do something.
   - Do the right thing.
   - Do your chores early.
2. Continue to invest in research and solutions. Check out www.livestockwelfare.com to see a searchable database of welfare related articles and research.
3. Support existing efforts, like OFAC, to help make agriculture's voice louder.
4. Correct misinformation. Speak up for agriculture.
5. Don't accept anything on your farm or in the industry that you wouldn't want to see on the six o'clock news or on the front page.

What is OFAC up to? www.ofac.org
1. Public education: Virtual Farm Tours (www.farmissues.com), Faces of Farming Calendars, Real Dirt on Farming Booklets, "Oprah" the Spokesrobot, public events….and more.
2. Industry partnerships: Livestock Emergency Resources (transportation guide, who to call in case of emergency); information on compromised/unfit livestock, Farm Animal Care Helpline Service…and so much more.

Disease Update – 2006*

Gaylan Josephson
Swine Disease Consultant
Exeter, ON
gjosephs@lsd.uoguelph.ca

The Ontario swine industry was hit with three major viral respiratory diseases, starting in late 2004, resulting in the creation of the "perfect storm", in which losses from PRRS, PCVAD and swine influenza were high. In addition, secondary bacterial involvement further compounded the losses. Unfortunately for industry, this continued into 2006 as well. From a practitioner's point of view, the difficult task was to identify the disease producing agents involved and then to assess the importance of each agent in an effort to reduce their impact.

PRRSvirus
As expected, the numbers of new infections decreased during the summer months, but rose again in late fall. As far as the disease expression was concerned, there was little change from previous years. As in 2006, samples were forwarded to the PRRS sequencing project, sponsored by Ontario Pork, and carried out by Dr Cate Dewey.

Porcine Circovirus Associated Disease (PCVAD)
The American Association of Swine Veterinarians defined this syndrome, with the definition including the statement that the disease must be confirmed microscopically, with the following features being present

- a doubling of the historical mortality rate, with no introduction of new pathogens
- depletion of lymphoid cells
- granulomatous inflammation in tissues, and
- detection of PCV2 within lesions

PCVAD, along with PRRS, continued to have a devastating impact on the swine industry in 2006. Disease outbreaks commonly occurred at one of two times, those being in the nursery, or later in the grower phase. The nursery outbreaks often were detected in farrow-to-finish operations, and the grower outbreaks in 3-site production units.

PCVAD was diagnosed from 190 pathology-related submissions to AHL, from a total of 2,248 submissions (8.4% of total submissions). Of interest, the total for December dropped to 5.2% of the month's total submissions. This coincided with the introduction of porcine circovirus type 2 vaccines in late summer. It will be interesting to see if this downward trend continues in 2007.

In addition to its significance as a primary pathogen, the PCV2 virus was often identified with other disease-producing agents.

* data presented was obtained from the files of Animal Health Laboratory, Laboratory Services Division, University of Guelph

Agent	PCV2 #tested	PCV2 # positive	PRRSv # tested	PRRSv # positive
M. hyopneumoniae	14	13	10	6
A. pleuropneumoniae	8	5	7	3
H. parasuis	24	16	27	15
L. intracellularis	4	4	5	1

Swine Influenza
Swine have receptor sites for avain, human and swine strains of influenza, and are to be "mixing vessels" for influenza. Since genetic reassortment of the virus can occur during interspecies transfer, it is important to type all SIV isolates. In 2005, the H3N2 strain appeared as a major pathogen, and isolates of this strain were identified 32 times, vs 16 times for the H1N1 strain. In 2006, almost equal numbers of H1N1 and H3N2 strains were identified.

Mycoplasma hyopneumoniae
Two age groups were commonly affected, those being pigs from 5-9 weeks of age, and 14-20 weeks of age. There has been a marked decrease from 2005, in the number of diagnoses of Mycoplasma hyopneumoniae-induced pneumonia in swine - at least in the number of submissions in which the organism was positively identified. The reason is not known.

In summary, the devastating effects of the major respiratory swine diseases continued in 2006. With the release of at least 3 different circovirus vaccines in late 2006, and the apparent positive effect that vaccination has had, it is hoped that the impact of this virus will be diminished. It is also hoped that the educational efforts of the Ontario Pork Industry Council's Swine Health Advisory Board (OSHAB) will play a role in reducing the losses due to PRRS.

University of Guelph / OMAFRA Partnership Pork Research Program Projects

Kees de Lange, Pork Research Co-ordinator, University of Guelph

The University of Guelph/OMAFRA Pork Research Program currently supports 23 research projects. These projects are organized by objectives, which are established based on industry wide consultation and under the direction of the Agricultural Research Institute of Ontario (ARIO). New research proposals and research progress are reviewed annually. Current projects and lead researchers for each project are listed below.
For more information on individual projects visit the OMAFRA website http://www.uoguelph.ca/research/omafra/animals/pork.shtml or contact the lead researcher.

OBJECTIVE 1: STRATEGIES TO ADDRESS ENVIRONMENTAL ISSUES

026015 - The Enviropig: from the research lab to the market place
- J. Phillips, Department of Molecular Biology and Genetics.
026317 - Quantitative representation of nutrient utilization in the growing pig
– C. de Lange, Department of Animal and Poultry Science.
026319 - Determination of dietary true digestible calcium to phosphorus ratio and requirements in weanling piglets (10-20 kg) fed corn and soybean meal-based diets – M. Fan, Department of Animal and Poultry Science.

OBJECTIVE 2: PORK QUALITY AND SAFETY

Goal 2.1. Food safety

026273 - Evaluating effectiveness of interventions against Salmonella in swine using a novel evidence-based tool – S. McEwen, Department of Population Medicine.
026282 - Effect of bacteriophage on the population dynamics of Salmonella within Ontario pig herds – K.Warriner, Department of Food Science.
026301 - Investigating public health risks associated with pork production – B. Friendship, Department of Population Medicine.

Goal 2.2 Reducing antibiotic use

026282 - Effect of bacteriophage on the population dynamics of Salmonella within Ontario pig herds – K. Warriner, Department of Food Science.
026291 - Genetic markers of infectious disease resistance in Ontario swine - A. Brooks, Department of Pathobiology.
026301 - Investigating public health risks associated with pork production – B. Friendship, Department of Population Medicine.
026316 - Production of transgenic pigs that are more resistant to diseases - J. Li. Department of Animal and Poultry Science.

Goals 2.3 and 2.4. Improving pork quality and uniformity of carcass

026278 - The effects of gender and feeding strategy on pig growth performance and feed digestibility – P. McEwen, Ridgetown College.
026314 - On-farm management strategies to improve handling, reduce stress and enhance meat quality – T. Widowski, Department of Animal and Poultry Science.

OBJECTIVE 3: TO IMPROVE PRODUCTION EFFICIENCY

Goal 3.1. Feeds, feeding and mycotoxins

025997 - Liquid feeding of swine: gut health, food safety, environmental impact and growth performance – C. de Lange, Department of Animal and Poultry Science.
026278 - The effects of gender and feeding strategy on pig growth performance and feed digestibility - P. McEwen, Ridgetown College.
026317 - Quantitative representation of nutrient utilization in the growing pig - C. de Lange, Department of Animal and Poultry Science.
026323 - Effect of Fusarium mycotoxins on performance and metabolism of gestating and lactating sows – T. Smith, Department of Animal and Poultry Science.
026488 - Testing two mycotoxin detoxifiers for ability to make highly infected corn useable for swine – P. Luimes, Ridgetown Campus.

Goal 3.2. Improving pig health

026005 - Enteric disease control in post-weaned pigs – R. Friendship, Department of Population Medicine.
026068 - Modulation of host cell responses by porcine reproductive and respiratory syndrome (PRRS) virus – D. Yoo, Department of Pathobiology.
026291 - Genetic markers of infectious disease resistance in Ontario swine - A. Brooks, Department of Pathobiolgoy.
026316 - Production of transgenic pigs that are more resistant to diseases - J. Li, Department of Animal and Poultry Science.

Goal 3.3. Improving reproductive performance

026289 - Improving swine reproductive performance through improved semen quality and better methods of insemination – R. Friendship, Department of Population Medicine.
026294 - Use of soy liposomes for cryopreservation of boar semen – M. Buhr, Department of Animal and Poultry Science.
026318 - Sexing of boar sperm using single stranded DNA aptamers – S. Golovan, Department of Animal and Poultry Science.
026323 - Effect of Fusarium mycotoxins on performance and metabolism of gestating and lactating sows – T. Smith, Department of Animal and Poultry Science.

Goal 3.4. Transgenics

026036 - Artificial Insemination Mediated Modification of Pig Genome – S. Golovan, Department of Animal and Poultry Science.
026316 - Production of transgenic pigs that are more resistant to diseases - J. Li, Department of Animal and Poultry Science.

OBJECTIVE 4: TO IMPROVE ANIMAL WELL-BEING

026069 - Meeting the needs of ill swine to improve well-being and decrease reliance on antimicrobials - S. Millman, Department of Population Medicine.
026181 - Strategies for reducing aggression in loose housed sows – T. Widowski, Department of Animal and Poultry Science.
026182 - Management practices affecting the behaviour and welfare of piglets - T. Widowski, Department of Animal and Poultry Science.
026304 - Factors associated with transport losses in market weight finisher pigs - C. Dewey, Department of Population Medicine.

026305 - How to sample pig farms to be confident the results are correct when testing for toxoplasma, salmonella, influenza and yersinia – C. Dewey, Department of Population Medicine.

026314 - On-farm management strategies to improve handling, reduce stress and enhance meat quality – T. Widowski, Department of Animal and Poultry Science.

SUSTAINABLE PRODUCTION SYSTEMS RESEARCH PROGRAM

Under the research partnership agreement between The University of Guelph and OMAFRA, pork research will in the future be managed as part of the new Sustainable Production Systems Research Program. This program will primarily support large, multi-disciplinary and integrated research projects.

Based on an extensive review process two large swine and pork related research projects have been approved. In addition, swine reproduction research will be managed as part of a larger reproductive technology research project. Over time many of the individual research projects that are listed above will be integrated into these larger research themes.

The three approved projects are:

1. **Sustainable pork production: from gene expression to nutrient utilization efficiency and pork meat quality.** leader **K. de Lange** (Department of Animal and Poultry Science); team members: **S. Barbut** (meat science), **C. Dewey** (swine health management and epidemiology), **M. Fan** (swine nutrition and ecology), **C. Forsberg** (microbiology), **J. France** (mathematical modeling), **I. Mandell** (meat science), **P. McEwen** (pork production), **P. Purslow** (meat science), **A. Robinson** (genetics), **J. Squires** (biochemistry and gene expression), **A. Weersink** (Agriculture economy), **T. Widowski** (ethology)
2. **Sustainable pork production: Healthy pigs and safe pork.** Leader: **B. Friendship (** Department of Population Medicine); team members: **C. Dewey** (swine health management and epidemiology), **P. Boerlin** (bacteriologist), **C. Gyles** (bacteriologist), **S. McEwen** (public health), **K. Warriner** (meat scientist) **T. Widowski** (ethologist), **S. Millman** (ethologist) **A. Brooks** (pathologist) **B Wilkie** (immunologist) **J. MacInnes** (microbiologist) **K. deLange** (nutritionist) **T. Hayes** (pathologist) **J. Squires** (biochemistry and gene expression).
3. **Reproductive technologies – from test tubes to animals.** Leader **W.A. King** (Department of Biomedical Sciences); team members: **P. Bartlewski** (Reproductive imaging and endocrinology, **G. Bédécarrats** (Neuroendocrine control of reproduction), **D. Betts** (Gene expression, epigenetics and cloning), **M. Buhr** (Cryobiology, sperm technology), **A. Croy** (Reproductive immunology and uterine function), **A. Hahnel** (Spermatogenesis, spermatogonial transplantation), **W. Johnson** (Reproductive health and management), **J. LaMarre** (Gene expression and message stability, **J. Leatherland** (Fish brood stock health markers), **J. Li** (Gamete and Stem cell biology), **J. Petrik** (Ovarian biology).

Ontario Pork Research

Jean Howden, Ontario Pork

Ontario's pork producers invests 20 cents from each hog marketed into research equaling approximately one million dollars a year. The research committee is made up of producers, veterinarians and industry representatives that are active in our industry.

The committee reviews millions of dollars in research proposals each year. They recommend funding to only those proposals with merit to producers and the industry, while not duplicating other research initiatives.

Projects funded by Ontario's pork producers have improved our understanding of animal husbandry, the environment, nutrition, genetics and reproduction, as well as food safety and meat quality.

For the past three years, Ontario Pork has published a magazine called Pigs, Pork and Progress which highlights the research and results producers have funded. This has been mailed with Better Pork to all pork producers. Results are also available on the Ontario Pork website and in the Ontario Pork newsletter.

Research serves as the fundamental building block for the advancement of our industry and is the cornerstone of the industry's success.

A complete list of funded research is available at www.ontariopork.on.ca/issues/research/index.htm

Funded Projects

Primary Priority: Animal Welfare

Project No.06/02 Researcher: Harold Gonyou
Title: Effects of handling procedures at loading and of the transport vehicle design on the welfare of meat quality of pigs
Synopsis: This is a collaborative project involving multiple research groups in major pork producing provinces focusing on handling stress and transport conditions on trucks, their effects on animal welfare and pork quality. Alternative methods of handling and transport design will be developed and assessed.
Project No.: 06/01 **Researcher:** Kathy Zurbrigg
Title: Pressure lesions: The use of human pressure measurement systems to determine the type of farrowing crate flooring that promotes fewer sow shoulder lesions
Synopsis: Sows will be placed in the farrowing crate with a specific type of flooring (one of the following: solid cement, solid rubberized cement, cast iron, tri-bar slats) for one- 24 hour period and the pressures exerted on the bony prominence of the shoulder bone while lying laterally will be measured and recorded. On the second day a 2'x2' rubber mat (3/4" - 1" thick) will be installed over the flooring and another 24 hour period of pressure measuring will be recorded. A video camera will record the sow's resting behaviour during the 24 hour period. Pressures will be measured using a pressure mapping system that is used in human medicine for the prevention of pressure ulcers.
Project No.: 06/54 **Researcher:** Lee Whittington
Title: Livestock Issues Resource Centre
Synopsis: Bringing order and accessiblility to the large and growing body of information available on key issues facing the future of the pork industry. This is accomplished through summarizing of peer reviewed papers, conference proceedings and popular press articles, condensed into 250-500 word summaries and available on line through an easy to use searchable database.

Primary Priority: Environment
Project No.: 06/57 **Researcher:** David Rudolph
Title: Monitoring og Selected Hog Farms to Assess the Impacts of Iplemented BMPs Resulting from te Nutrient Management Act - Phase II
Synopsis: The objectives of the research is to evaluate the effectiveness of BMPs in reducing impacts on water quality with respect to land applications of swine manure. To instrument and investigate three selected farm sites to provide the baseline hydrogeological and water quality data necessary to evaluate recent and future changes in nitrate concentrations in the subsurvace soils and groundwater.The focus is on a farm where half of a field receiving manure has received only commercial fertilizer since the 1990's and so represents a unique opportunity to evaluate the side-by-side impacts of nitrate on a shallow aquifer used for a drinking water well.The Nutrient Management Act may require the use of BMP's for land application of manure to improve the environment but there is a lack of long-term field studies to evaluate how quickly and to what extent we can expect the improvements. This study will help answer those questions and provide a basis for better and more cost effective monitoring protocols and strategies by recommending the type of and frequency of monitioring
Project No.: 06/46 **Researcher:** TieQuan Zhang
Title: Agronomic and Environmental Evaluation of Nutrients in Low-Phosphorus Manures
Synopsis: Excessive excretion of phosphorus in pig manure is a leading nutrient management and environmental issue facing the Ontario pork industry. New technologies of diet supplemental phytase and phytase EnviropigTM offer unique approaches to enable pork farms to maintain and even increase the pig production without affecting or even with reducing the impacts of the industry

on environment and on the rural community. It is essential to characterize and evaluate the agronomic and environmental impacts of low-P manure nutrients from pigs treated with these new technologies for efficient use of manure nutrients with minimal pollution. Part of our studies conducted in the past indicate that EnviropigTM manure 1) reduces both immediate soil P loss after application and long-term soil P build-up; 2) is more suitable to meeting crop nutrient needs due to a better N:P ratio; 3) increases soil water use efficiency and enhances plant growth and dry matter production.

Project No.: 06/55 **Researcher:** Bill Van Heyst
Title: Environmental Characterization of Dead Animal Disposal Methods
Synopsis: This is the second year of a two year study to assess the environmental impact of on-farm cremation and deadstock composting. The fate of sulfa-based drugs during the composting process will be determined. The project will provide sound scientific results for the environmental impact of on-farm cremation and deadstock composting that can be used for policy decisions by stakeholders

Project No.: 06/52 **Researcher:** Bonnie Ball-Coelho
Title: Manure Application Systems for Corn
Synopsis: This project addresses Ontario Pork's research priority on improving handling of liquid manure to avoid possible contamination of the environment by evaluating, developing or improving techniques for applying manure. Specific objectives are:1. Compare the agronomic value, nitrogen use efficiency and environmental impact of liquid hog manure application systems (zone injection, surface application, surface application followed by incorporation, manure injection @ 75cm spacing, manure injection @ 37cm spacing, Aerway system, and side-dress injection) across differing soil types, and times of application (late summer, fall, and spring).2. Determine the influence of pre and post manure application tillage on the transport of E. coli, nitrogen and phosphorus in surface and ground water, and survival of pathogens in the soil, groundwater and tile drainage systems.

Project No.: 06/47 **Researcher:** Simon Yang
Title: Remote Monitoring and Analyzing Pork Farm Odour Using Wireless Sensors and an Odour Dispersion Model
Synopsis: This project will conduct both theoretical and practical investigation of odour monitoring and odour reduction for Ontario pork production, by developing a wireless sensor network, and developing an odour dispersion model based on farmstead factors and meteorological data of Ontario pork farms. A software will also be developed to give suggestions on possible odour control strategies, and predict the resulted odour impact area.

Primary Priority: Food Safety
Project No.: 06/07 **Researcher:** Robert Friendship
Title: Tetracycline residue in pig bones causing yellowing
Synopsis: The research is to determine: whether the yellow colour of bones is a predictor of the level of tetracycline present in bone or other tissues & further to determine the risk factors associated with the yellowing of bones.One experiment will involve providing pigs to a variety of tetracycline exposures, varying the drug, the dosage and the length of administration and then analyzing the tetracycline level in bones and tissue and the degree of yellowness of the bones. Samples will also be obtained from abattiors if animals with unacceptable bone discoloration are found. A survey of tetracycline use and risk factors will also be conducted

Project No.: 06/08 **Researcher:** Jerome del Castillo
Title: Effects of age, dose and treatment duration on the accumulation of chlortetracycline in bones of growing pigs
Synopsis: Objectives of the Research1. To compare bone accumulation of feed-administered chlortetracycline in growing pigs, as a function of age at the onset of the dosing regimen, dose, and dosing duration.2. To compare the time-course of chlortetracycline fluorescence in bone of pigs after cessation of drug therapy, as a function of age at the onset of the dosing regimen, dose, and dose duration.3. To develop imagery method for the non-invasive assessment of chlortetracycline accumulation and depletion in bone in growing pigs.Addressing the first two objectives of this project will help identify whether there exists a critical age, dose or treatment duration that increases significantly the risks of unacceptable bone stains. This new information will improve on short term the design of dosing regimens with in-feed tetracyclines, from which a majority of pork producers will benefit. The third objective of this study will provide a tool for repeated-measure assessments of tetracycline accumulation, which will enable on mid term the investigation of dietary or environment factors that affect the load of tetracyclines in the bone.

Project No.: 06/06 **Researcher:** Keith Warriner
Title: Bacteriophage based interventions to reduce the dissemination of Salmonella in pork production
Synopsis: To develop and evaluate the efficacy of bacteriophage based treatments to eliminate Salmonella from pig housing environments.Salmonella infecting bacteriophage will be isolated from Ontario pig farms. The host-range of isolated phages will be assessed in addition to the ability to replication and survival in the pig environment. The success of phage treatment will be assessed using pigs artificially infected with Salmonella.

Primary Priority: Herd Health
Project No.: 06/09 **Researcher:** Julang Li
Title: Production of epidermal growth factor expressing Lactococcus Lactis and its potential for enhancing early-weaned piglet growth
Synopsis: The objective of the project is to generate Lactococcus Lactis that secrete epidermal growth factor and to test their potential for enhancing early-weaned piglet growth.Diarrhea and the associated reductions in growth rates during the period immediately after weaning is one of the major problems in nursery pig management. Developing a diet to stimulate intestinal development of early weaned pigs may help to optimize their performance in this critical stage. Epidermal growth factor (EGF) is known to stimulate the development of intestine and its supplementation into

formulas was shown to facilitate the recovery of intestines in piglets from rotavirus infection. We hypothesized that locally deliver EGF to the GI tract using food-grade Lactococcus Lactis may be beneficial for improving early-weaned piglet performance. We will use a genetic engineering approach to generate Lactococcus Lactis that secrets epidermal growth factor and test if including these EGF delivering bacteria into feed enhances piglet intestinal development, and thus, early-weaned piglet performance.

Project No.: 06/11 **Researcher:** Tony Hayes
Title: Defects in innate disease resistance genes in Ontario swine
Synopsis: To identify defects in genes responsible for increased susceptibility of young pigs to various common economically important infectious diseasesThe researchers are developing genetic (DNA) tests for defects (mutations) in six innate resistance genes that normally help to protect young pigs from various important infections. These studies will determine if particular genotypes have better health and production due to lower frequency or severity of common respiratory, gut or systemic infections.

Project No.: 06/13 **Researcher:** Andrew Peregrine
Title: Evaluation of the prevalence of coccidia in Ontario suckling piglets and identification of a preventive treatment
Synopsis: The objectives of the research are:• To determine the proportion of suckling piglets that is infected with coccidia and the impact of coccidia on piglet health.• To identify an effective and practical preventive treatment for coccidia in piglets.The importance of coccidia will be determined on 20 farms with a diarrhea problem in suckling piglets at greater than 7 days of age by examining feces and monitoring growth rates of piglets. Swine veterinarians will be surveyed for the preventive treatment they recommend for coccidia. The most practical regimen will be evaluated in a clinical trial.

Project No.: 06/15 **Researcher:** Robert Friendship
Title: Case-Control Study of Porcine Circovirus Type 2 - associated disease outbreaks in Ontario
Synopsis: This project will be designed as a case-control observational study using 25 farms with a history of clinical Porcine Circovirus type 2 (PCV2) associated disease in the past year and 25 matched control farms without a diagnosis of PCV2 disease problems. A survey will be conducted to examine for risk factors and samples will be taken in order to test for concurrent diseases as well as to determine the PDR-RFLD type of circovirus present

Project No.: 06/16 **Researcher:** John Pasick
Title: Development of a rapid test for detecting serum antibodies to classical swine fever virus
Synopsis: Development of an antibody test for classical swine fever will be developed using recombinant DNA and monoclonal antibody technologies. The test will be validated using a library of serum samples collected from pigs experimentally infected with various classical swine fever viruses. If the test is successful it will be transferred to member laboratories of the Canadian Animal Health Surveillance Network.

Project No.: 06/17 **Researcher:** Hugh Cai
Title: Development of a microarray-based assay for rapid and simultaneous detection and molecular typing of multiple swine respiratory pathogens
Synopsis: Porcine respiratoury disease complex is a major concern for pork producers in Ontario and is caused by various combinations of porcine reproductive and respirotory disease syndrome virus (PRRSV), swine influenza virus (SIV), and Mycoplasma hyopneumoniae, and usually is complicated by type 2 circovirus (PCV2) and other bacteria. The current individual based tests (sulture, PCR, or IHC) are time consuming and labor intensive. The researchers propose to develop a microarray-based diagnostic assay for the detection of multiple swine respiratory viral pathogens simultaneously, which can be expanded to cover other respiratory bacterial pathogens in future projects

Project No.: 06/53 **Researcher:** Aiming Wang
Title: Development of a Plant-Based, Low Cost, Orally Administered Vaccine Against PRRSV
Synopsis: This is funding for the second year of a three year project to develop a plant-based, low-cost, orally admininistered vaccine against PRRS. The results of the three year study could provide the development of a novel, safe, low cost, convenient and uniform, editable vaccine for clinical use to protect Ontario pigs from PRRS. It could also be a model for the control of other animal infectious diseases.

Primary Priority: Nutrition

Project No.: 06/35 **Researcher:** Q Wang
Title: Essential oils as alternatives to dietary antibiotics: Microencapsulation for effectively delivering the oils to pig guts
Synopsis: Our previous studies have demonstrated the potential of some essential oils as a substitute for dietary antibiotics in controlling both human and swine bacterial pathogens and the requirement of effectively delivering these oils to pig guts to maximize their antimicrobial activity. The proposed research tests various encapsulation and emulsification techniques with regard to their efficiency in protection of oil antimicrobial activity and the cost feasibility for commercial or field application. The efficiency will first be assessed by in vitro assays.

Project No.: 06/37 **Researcher:** Paul Luimes
Title: Investigation into the metabolic status of sows during lactation
Synopsis: The health of the sow herd may be compromised by metabolic disease. This research will establish an understanding of the level of ketosis in sows during lactation. This disease is not an "on or off" disease. Missed diagnosis means missed potential. Thus, it is important to find out the degree to what this disease may be affecting sows.

Project No.: 06/41 **Researcher:** C.F.M. de Lange
Title: Impact of immune system stimulation on nutrient utilization and response to dietary methionine plus cysteine intake in growing pigs

Synopsis: Previous studies in our lab indicate that there are opportunities to manipulate the response of growing pigs during an immune challenge, in order to reduce the negative impact of sub-clinical levels of disease on pork production efficiencies. We hypothesize that the supply of dietary methionine plus cysteine is an important determinant of the pigs' immune and growth response to an immune challenge. Studies are proposed in which pigs are exposed to controlled levels of immune system stimulation (based on repeated injections of increasing doses of LPS) to evaluate its impact on nutrient digestibility, whole body protein growth and utilization of methionine and cysteine, especially as it relates to the production of glutathione.
Project No.: 06/43 **Researcher:** Peter Pauls
Title: Molecular Approaches Toward Improving Fusarium Resistance in Corn
Synopsis: The proposed work is based on previous successes in identifying regions of the corn genome that contain genes for resistance to Fusarium. In the proposed work, genes in these regions will be identified. The genes for resistance can be used as molecular markers in corn breeding programs or might be transferred to high yielding corn inbreds in the future
Project No.: 06/45 **Researcher:** Laima Kott
Title: Development of Fusarium resistant & high lysine corn genotypes for pork production
Synopsis: The protocol entails use of pollen grains that are induced to develop as embryos and plants. During this process pollen is exposed to a mutagen to produce minor genetic changes, and subsequently with in vitro selection novel corn genotypes are identified.

Primary Priority: Other
Project No.: 06/20 **Researcher:** Ken McEwan
Title: Cost of Production Benchmark for Ontario , Manitoba and Iowa
Synopsis: The project will investigate cost of production camparison between Ontario, Manitoba and Iowa for a 1,200 sow farrowing unit and 1,000 head finishing barn.

Primary Priority: Pork Product Quality
Project No.: 06/26 **Researcher:** C.F.M. de Lange
Title: Effective manipulation of fatty acid profiles in value-added pork products aimed at enhancing contrbution of pork to human health
Synopsis: To develop strategies for cost-effective production of value-added Ontario pork products that contain predictable and uniform levels of omega 3 fatty acids.To establish the impact of feeding saturated fat following a period of feeding unsaturated fat on the preferential incorporation and retention of omega 3 fatty acids in the various body fat pools (inter-, inter-and subsutaneous) in growing pigs.To enhance the functional food and value added attributes of Ontario pork that yields health benefits to the consumer without compromising carcass and meat quality.

Primary Priority: Reproduction
Project No.: 06/24 **Researcher:** Roy Kirkwood
Title: Influence of gonadotrophic stimulation on gilt estrus, cyclic responses and effect of pre-ovulatory LH surge magnitude on subsequent fertility
Synopsis: To determine the reason e for variable filt ovarian response to gonatrophins and to ezamine the relationship between size of the pre-ovulatory LH surge and fertility.
Project No.: 06/22 **Researcher:** Anne Croy
Title: Cellular and Molecular Evaluation of Mechanisms at the Maternal-Fetal Interface that Promote Porcine Fetal Survival
Synopsis: : Overall: To understand and manipulate the processes at the porcine maternal-fetal interface that control fetal survival. Specific: To quantify factors that regulate conceptus growth and development during known times of porcine embryonic/ fetal loss and to assess their alteration upon fertility-enhancing immune stimulation. The researchers will utilize laser capture microdissection of histological specimens followed by realtime PCR to quantify gene expression in maternal and fetal cells in the uterus. Previous work found lymphocyte-promoted angiogenesis differed between living and arresting implant sites from gestation day (gd)20. The study of individual littermates will move to earlier times and new genes to identify onset of dysregulation in the physiological/immunological signals that control fetal survival. With Bioniche Life Sciences, Belleville, gene usage in the same cell types dissected from gilts receiving a pre-conception drug that increase porcine litter size will be studied. This will address uterine actions of their immune stimulant.

Primary Priority: Environment
Project No.: 07/131 **Researcher:** David Rudolph
Title: Evaluating the spatial and temporal effects of tile drains on the partitioning of liquid swine manure constituents between surface-water and ground-water
Synopsis: The objective of this proposal is to provide information to improve Better Management Practices (BMP's) for land application of swine manure and minimize impacts to water quality. The main objective is to understand how macropores (i.e., mud cracks, worm holes and root holes) regenerate after tillage and how they act as preferential folw paths for liquid manure constituents to enter tile drains. A promary goal is to quantify seasonal and spatial varations in macropore generation,infiltration, and tile-water quality and the impact on overall water quality.
Project No.: 07/127 **Researcher:** Ann Huber
Title: Survival of pathogens during storage of livestock manures
Synopsis: The effect of a variety of on-farm manure storage conditions, including seasonal temperatures and static vs dynamic storage, on the survival of indicator organisms and pathogens will be determined; populations of pathogens at typical spreading times will be assessedThe results are expected to provide producers with management options based on cost-effective manure storage practices that reduce the load of pathogens prior to manure

application and thus reduce the risk of subsequent pathogen contamination of surface and ground waters; further, they are expected to provide science-based information to allow for improved flexibility in regulations and protocols. Schedules A,B,C are not applicable to this project

Project No.: 07/125 **Researcher:** Ron Fleming
Title: Possibilities for Anaerobic Digestion on Ontario Swine Farms
Synopsis: Objectives of Research Proposal: To digest liquid swine manure in 4 typical recipes (i.e. by itself and with 3 organic additions), measuring biogas production and digestate quality; to document logistical considerations for each recipe tested; to calculate gas yields and electrical power costs for the various recipes.

Project No.: 07/122 **Researcher:** Nigel Bunce
Title: Pilot Plant for Electrolytic Deodorization of Liquid Hog Manure
Synopsis: A pilot plant of approximately 1500 L will be constructed and equipped with commercially available electrodes and power supplies. Odour mitigation and bactericidal properties of the technique will be monitored in both short- and longer-term operationIf the technology can be successfully demonstrated at this scale, the way would be open for electrolytic remediation to be applied at full scale on working hog farms.

Primary Priority: Herd Health

Project No.: 07/111 **Researcher:** Douglas Hodgins
Title: Cloning and expression of porcine complement C3d for enhanced vaccines
Synopsis: Improved vaccine additives are needed, especially for use in vaccines for neonatal piglets. C3d, as a vaccine adjuvant, has potential to stimulate early (active) immune responses to maintain protection against pathogens as concentrations of maternal (passive) antibodies decline.Objectives of Research Proposal: a) To clone DNA coding for the porcine C3d protein, and b) express the recombinant protein in a form suitable for subsequent investigations of its enhancing effects in vaccines

Project No.: 07/110 **Researcher:** Tony Hayes
Title: Gene defects that impair resistance to infectious diseases of swine
Synopsis: We are developing tests for mutations in five genes that code for lectins involved in innate resistance to various bacterial and viral infections. Previously, we have identified two mutations that are more frequent in diseased pigs submitted for post mortem diagnosis. The work proposed will determine which tests are useful in identifying breeders whose progeny are less susceptible to health impacts of PRRS, PMWS, and other common infections. We will also determine if any of these defects are associated with reduced growth performance. The substantial impact of PRRS and/or PMWS on production could be more quickly reduced if we can eliminate breeders that carry mutations that increase their susceptibility to illness when exposed to the primary viral infections. Mutations that impair growth by increasing the impact of other infections will also benefit producers whose herds are not exposed to PRRS or PMWS. The development of a method to bank DNA samples from pigs with confirmed diagnoses will be a resource for future discovery of other mutations that predispose to disease.

Project No.: 07/108 **Researcher:** Scott Weese
Title: Evaluation of the prevalence of methicillin-resistant Staphylococcus aureus (MRSA) colonization in pigs and pig farmers in Ontario
Synopsis: MRSA is a of major concern in human medicine. MRSA is present in the pig population in certain countries and in such cases pig farmes and veterinarians are at high risk for MRSA colonization. It is necessary to know the status of MRSA in pigs and pig farmers in Ontario to determine the public health risks. Objective 1. To determine the prevalence of MRSA colonization in pigs in Ontario2. To compare the prealende of colonization from nasal and rectal screening sites3. To determine the prevalence of colonization of MRSA in pig farmersNasal and rectal swabs will be collected from 450 pigs from 30 farms in Ontario. Nasal swabs will be collected from volunteering farmers. MRSA culture and typing will be performed.

Project No.: 07/107 **Researcher:** Andrew Peregrine
Title: Control of Coccidiosis in pigs
Synopsis: This project will investigate control methods to reduce the effects of coccidiosis and to determine the impact of coccidiosis on post-weaning performance. Ten farms where coccidiosis has been previously diagnosed will be used in this study. They will examine pigs in the nursery to determine the prevalence of coccidiosis and its effect. Field trials will be conducted to evaluate preventative measures.As a result of this work Ontario pig farmers will have a much greater awareness of how important it is to control coccidiosis. Implementing preventive measures should result in increased weaning weights and improved post-weaning performance.

Project No.: 07/103 **Researcher:** Monte McCaw
Title: Are they REALLY PRRSv Negative??? Detection of Very low rates of Infection in Nursery Pig Groups
Synopsis: Objectives of Research Proposal:1) Evaluate the relative sensitivity and cost of pen-based hanging-chew-rope oral fluids sampling vs random blood sampling of 28 pigs per nursery by PRRSv RTPCR.2) Determine if there is sufficient virus concentration and quality in oral fluids collected by hanging chew-ropes for accurate PRRSv sequencing. Brief Description of the Project: This project is designed to compare the costs and ability to detect PRRSv infection (sensitivity) in nursery pigs of a novel sampling method (pen-chew-rope oral fluids collection) vs industry-standard random blood-sampling of 28 pigs (95% confidence of detecting > 10% infection rate). We will also evaluate whether these oral fluids samples can be used for accurate PRRSv ORF5 sequencing. The project will be performed in two 2400 sow genetic multiplier herds known to be weaning groups of pigs with < 5.0% infection rate (predictably seen by CoI Harms 8 to 12 weeks following whole-herd homologous wild-type PRRSv inoculation). Their weaned pigs will be sent to single-source single-weaning-group nurseries. Blood samples will be randomly collected from 374 pigs (95% confidence of detecting >

1.0% infection rate) at 4, 7, and 10 weeks of age. Oral fluids samples will also be collected at 4, 7, and 10 weeks of age by hanging cotton chew-ropes in each pen for 60 minutes. Serum and oral fluids will be tested by RTPCR to determine the exact number of PRRSv-infected samples. These data will then be used to compare the relative sensitivity of pen oral fluids sampling vs random bleeding and testing of 28-30 pigs per nursery group by computer modeling.If pen saliva sampling is able to detect infection rates as low as 1%, it will improve detection of nursery PRRSv infection by 10 fold for a per – group diagnostics cost of equal-up-to-double that for RTPCRs on 30 sera run in pools of 5. Several economically critical decisions for herd owners hinge upon the assumption they are producing PRRSv-free nursery pigs. These include: 1) determining initial success of gilt-acclimatization programs, 2) herd PRRSv-elimination attempts, 3) monitoring long-term success of gilt acclimatization (greater confidence weaned / feeder pig groups are PRRSv-free at entry into finisher), 4) PRRSv-elimination, 5) sow herd PRRSv vaccination programs, or 6) early detection of new PRRSv infection. Saliva sampling could also be used to easily monitor groups of developing boars and gilts in PRRSv-free seedstock herds.

Primary Priority: Nutrition
Project No.: 07/137 **Researcher:** C.F.M. de Lange
Title: A decision support tool to evaluate the impact of between animal variability and alternative management strategies
Synopsis: The aim of the project is to modify an existing and well-tested pig growth and nutrient utilization model, as well as simple decision support system, as user-friendly tools for optimization of profits and nutrient use on individual growing-finishing pig units in Ontario. The main refinements of the current versions of these computer programs will be to represent between animal variability and alternative shipping strategies.Two versions of the model will be made available for commercial use: (i) the full-scale biological and dynamic model and (ii) a simplified and very user-friendly decision support system. The latter will allow untrained model users to evaluate financial and environmental impacts of a large number of alternative and previously defined management strategies for individual growing-finishing pig units.
Project No.: 07/136 **Researcher:** C.F.M. de Lange
Title: Production of phytase expressing Lactococcus Lactis and its potential for enhancing swine productivity, gut health and reducing environmental loading
Synopsis: The aim of the project is to genetically modify a lactic acid bacteria, for the expression of the enzyme phytase. The resulting modified bacteria will be examined for phytate phosphorus release in swine liquid feed.
Project No.: 07/135 **Researcher:** C.F.M. de Lange
Title: Reducing the negative impact of high dietary potassium levels on growth performance and carcass characteristics of growing-finishing pigs fed large amounts of co-products.
Synopsis: The aim of the project is to (1) establish whether the negative impact of feeding high levels of co-product on growth performance and carcass characteristics of growing-finishing pigs can be attributed to high dietary potassium levels, and (2) reduce negative effects of high dietary potassium levels by increasing dietary chloride levels or adjusting the dietary electrolyte balance.

Primary Priority: Pork Product Quality
Project No.: 07/119 **Researcher:** Peter Purslow
Title: Enhancing the Pork Meat Quality Value Chain
Synopsis: Twenty commercial farms were identified and contacted with the cooperation of a major Ontario packing plant. To date, data have been collected on 23 occasions from 20 farms with a total of 672 pigs sampled. For each farm, genetic, management, nutrition and behaviour information were collected, and 24 pigs were identified and individually marked for tracking from farm through processing. At the plant, video records were used to quantify behaviour during handling, with blood samples collected for analyses of stress parameters. Temperature and pH were recorded over the first 48 hours in the ham and loin, and tissue samples were collected at 1.5 hours postmortem and stored at – 70 oC for analyses of gene expression and biochemistry. Loin and ham samples were also sent to U of G Meats Lab for subjective evaluation of meat quality (colour, marbling, firmness, wetness) and objective determination of colour (L* a* b* scale), pH, drip loss and Warner-Bratzler shear force (an instrumental measure of tenderness). Shear force measurements were conducted on cooked longissimus chops and smoked ham. From the first set of 312 samples statistical analyses were conducted to identify outliers based on drip loss and colour of the loins. Individual farm/day effects were accounted for in the model. Samples from the extremes have been extracted for microarray analysis to determine patterns of gene expression peri-mortem in pigs with differing meat quality parameters.
Project No.: 07/116 **Researcher:** Ira Mandell
Title: Mechanisms affecting pork meat quality in protein-restricted total feed-restricted dietary regimes
Synopsis: This initiative will investigate the potential mechanisms of improved meat quality (increased tenderness, decreased drip) that may be accessed by restricted protein versus restricted total energy dietary regimes, followed by high rates of compensatory growth.The pork industry is seeking a faster growing, leaner pig with good meat quality characteristics. Restricted feeding followed by compensatory growth can achieve target slaughter weights with high feed efficiency. The research aims to find efficient restriction diets that also improve meat quality.

Canadian Quality Assurance® Program

Christine Orton, Ontario Pork

There are 2 major changes to the Canadian Quality Assurance program for 2007. The first change is the mandatory use of Detectable Needles beginning January 1st, 2007. The Canadian Pork Council (CPC) Executive approved this new requirement for all CQA® Registered farms at their annual meeting this summer. While processing plants generally have metal detectors at one or more point on the line, the alloys found in commonly used disposable needles are often not identifiable by these machines, making it possible for needle fragments to slip through and into the food chain. Preventing broken needles remains the first priority. Producers are still required to have a protocol in place to avoid the needle breakage as well as a plan to follow in the event that a needle does break off and remain in a pig. Part of this plan must include reporting any pig with a suspected broken needle prior to shipping, regardless of the type of needle used.
It is important as an industry that we continue to reassure our customers that we are producing safe pork; food safety is very important to Canadian consumers as well as our customers abroad. The use of detectable needles is just one part of the efforts by the Canadian pork industry to control the hazard of broken needles.
The second change to the CQA® program for 2007 is regarding the CQA® Drug Use Policy. Phase 1 was implemented in October 2003 and required that all veterinary products used on CQA® Registered farms be approved for food producing animals in Canada. The allowable exception is for products obtained by a veterinarian under the emergency drug release program, through an investigational new drug certificate, or an active pharmaceutical ingredient (API). API's could be used but only when the same active ingredient could also be found in a product approved for food producing animals in Canada. The own-use provision of the Food and Drugs Act was also closed to CQA® producers through this policy during phase 1.

Phase 2 of the Drug Use Policy comes into effect January 1st, 2007 and will require that only compounded API's be used and only under the direction of a veterinarian. Producers are required to have a prescription for the API product and the prescribing veterinarian must ensure that the API has been identity tested according to guidelines proposed by the Canadian Association of Swine Veterinarians (CASV). In addition, only feed medications that have been approved for use in Canada and bear a Canadian drug identification number (DIN) may be used. All other requirements under Phase 1 remain the same for CQA Registered farms.

The National CQA® program can be found at www.cqa-aqc.comand includes further information, updates, blank record forms, and the manual. You can also contact Christine Orton, CQA® Coordinator for Ontario Pork, at 1-877-668-7675 or christine.orton@ontariopork.on.ca.

Animal Care Assessment Program

Christine Orton, Ontario Pork

Ontario Pork has begun offering the Animal Care Assessment program (ACA) on a voluntary basis. The ACA is a national program that provides an evaluation tool for Canadian pork producers to demonstrate that industry approved standards of animal care is being met on farm.

Keeping pace internationally with other countries such as the U.S., U.K., Denmark and Australia is important to maintain Canada's export markets. These countries currently have programs in place to meet consumer demand for assurances of humane conditions in the production of their food. Now Canadian pork producers have access to a program as well to help keep them competitive.

The ACA program allows producers to demonstrate that Canadian hog producers are providing excellent care to their pigs and that animal care is important to our industry. The ACA examines areas on farm that are critical to the well-being of the pigs, including stockmanship, feeding and watering, equipment, and housing.

Developed by a team of hog producers, producer organizations, animal care researchers, and government, the program has been reviewed and supported by the Canadian Federation of Humane Societies, the Canadian Meat Council, the Canadian Council of Grocery Distributors, and the Canadian Veterinary Medical Association. The program reflects an industry standard that incorporates all previous animal care standards, such as the existing Codes of Practice.

The ACA tool is similar in structure to the Canadian Quality Assurance® program (CQA®) and CQA® registration is a prerequisite for the ACA program. The ACA consists of a series of questions that producers use to evaluate and verify animal care practices on farm. Initial ACA registration will require a farm visit by a qualified ACA Validator, after which subsequent Partial and Full Validation anniversary dates for both CQA® and ACA will be merged.

ACA booklets, CD's and additional program information is available by contacting Christine Orton, CQA® Coordinator for Ontario Pork, at 1-877-668-7675 or by visiting Ontario Pork's website at www.ontariopork.on.ca.

OSHAB: PPRS Update
January 2007

Nadine Funk, OPIC Managing Director
Phone: 519–993–7585 Fax: 519-272-2215 nadineopic@hurontel.on.ca

OSHAB, the OPIC Swine Health Advisory Board, has a mandate to:
"To take a leadership role for major swine health issues in Ontario by:

- *Providing direction for primary research and resource allocation*
- *Advancing industry communication*
- *Fostering (encouraging) collaboration among sectors and jurisdictions."*

The goal of the original three year PRRS Project was to develop an understanding how PRRS is moving and changing among herds in Ontario, in order to develop effective control and elimination strategies.

The PRRS project is a comprehensive one and as such has a number of initiatives underway. The following is a brief update for some of the key PRRS related OSAHB initiatives.

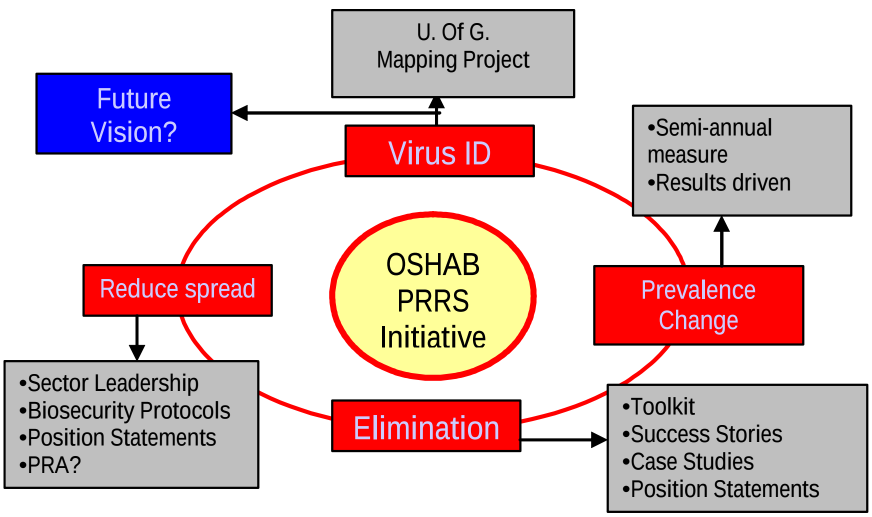


Figure 1: A Schematic Representation of the current PRRS Project Initiatives

Project One: U of G Mapping Project

Project one; involving PRRS sequencing and GPS mapping is underway. Maps identifying PRRS virus sequences relative to postal code are posted on a website accessible to veterinarians. Some preliminary data has been presented to industry.

Benchmarking:

OSHAB has initiated a benchmarking project to measure PRRS virus prevalence, success of elimination strategies and provide an objective basis for calculating economic impact of disease in Ontario. Changes in prevalence and impact will essentially serve as a score card for industry disease control/elimination initiatives. Prevalence data will measure PRRS virus, be reported semi-annually and will be classified according to barn flow (ex. Farrow-finish, farrow-wean, etc). Mortality data for finisher barns will be reported quarterly. A summary report from this first data collection period is presented below.

Table 1: PRRS Prevalence by Barn Type as at September 30th 2006 (# of Barns)

Type of Barn	Positive	Negative	Unknown
Sow	141	101	118
N-F	163	102	180
Total	304 38%	203 25%	298 37%

PRRSv Elimination Tool Kit:
Development of this tool for producers and industry to use to help with PRRSv elimination at the herd level is well underway. This tool kit will be a centralized "go to" source of information on PRRSv elimination strategies at the herd level which have been critically evaluated for scientific merit and will include sufficient detail to assist with effective decision making by producers.

Case Studies
Case studies which involve real-time reporting from specific Ontario farms are slated for publication in Better Pork starting in spring 2007. The concept behind these case studies is to show meaningful production/performance data in the context of success and failure for PRRS control/elimination strategies.

Risk Assessment
OSHAB is arranging a training session for veterinarians on the Risk Assessment program endorsed by the American Association of Swine Veterinarians (AASV) to occur in Ontario in early 2007. OSHAB is investigating hiring two students to help implement the PRRS Risk Assessment Tool in Ontario on a larger number of farms during the summer of 2007.

Sector Leadership:
OSHAB is actively working with specific sectors to develop biosecurity protocols and position statements which will be a key element for delivering PRRSv control and elimination strategies.

Three position statements and several concepts for position statements have been drafted by OSHAB and will form the basis for discussion at a series of sector meetings planned for the first quarter of 2007. The sector reviews and discussions will be used to finalize workable position statements for the Ontario industry to strive for. Identifying initial actions for an implementation plan will also be part of these sector meetings.

The following position statements have been drafted by OSHAB;

Industry Transport Biosecurity
Every pig transporter has documented protocols and audits for:

- washbay sanitation and usage criteria
- trailer/truck sanitation and usage criteria
- driver biosecurity measures
- load out sanitation and biosecurity measures

Barn Entrance
Every pig barn has a minimum of a Danish entrance.

Gilt Isolation
Sow herds must have a gilt isolation.
Concepts for having position statements regarding virus identification, vaccine usage and gilt/semen source have been raised and will also be discussed during sector meetings.

Watch for notice of upcoming sector meetings.

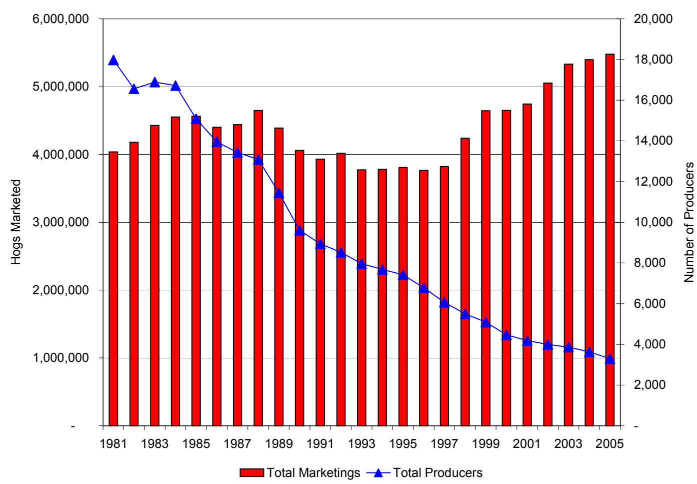
Benchmarking the Ontario Pig Industry

Ken McEwan and Lynn Marchand
University of Guelph, Ridgetown Campus
519-674-1531, kmcewan@ridgetownc.uoguelph.ca

Background

Ontario's swine farms have changed over time – both in terms of number of farms and size of farms. Figure 1 displays hog marketings and producer numbers over time and shows how hog marketings have grown despite the dramatic decrease in number of producers.

Figure 1 Ontario Hog Marketings and Producer Numbers Over Time



Source: Ontario Pork

As the swine production industry in Ontario changes it is important to identify trends that are occurring. This will assist in the development of policies that benefit not only the current producer base but also future generations of producers.

Objectives

The intent of this project was to contact all individuals that owned one or more pigs in Ontario at the time of the survey and to describe demographic, production, financial and future intentions of these people. More specifically, the objectives of the project were:

1) Develop a database of every producer that owns one or more pigs in the province of Ontario. Information to be captured would include producer demographics such as age, level of education, business structure, as well as other data including production type, pig inventory, age of facilities, future expansion or contraction plans, and etc..

2) Analyse producer information to benchmark changes in production type, farm size, marketing expertise and etc..

3) Quantify present and future rates of change occurring in producer numbers by farm size, geographic location, and business type.

A similar study completed in 1999 will serve as a benchmark.

Results

i) **Production Systems** – While much emphasis has been placed on unique production systems in the last ten years, farrow to finish is still the most common system with approximately 58% of respondents in this category in 1999 and 2006. Finishing systems (50lbs to market weight) represented 28% of respondents in 2006 up from 18% in 1999.

Table 1 Main Swine Production Systems

Production System	**% of Respondents – 2006**	**% of Respondents - 1999**
Farrow to Finish	58.5%	57.2%
Farrow to Early Wean (approx. 12lbs)	2.8%	4.0%
Farrow to Wean (approx. 50lbs)	5.6%	8.2%
Nursery	0.5%	0.3%
Wean to Finisher (12 – 25lbs to market)	4.7%	12.7%
Finisher (50lbs to market)	27.9%	17.6%

Response Rate: 1,737 in 2006, 3,333 in 1999

Table 2 shows that a large percentage of the respondents could still be considered small swine operations. For example, 40% of the farrow to finish farms have 50 sows or less and 46% of the finishing operations plan to market 500 hogs or less in 2006.

Table 2 Distribution of Farrow to Finish and Finishing Farms by Size

Farrow to Finish		Finishing	
# of Sows	% of Resp	# of Hogs to Market in 2006	% of Resp
1 – 25	22%	< 100	17%
26 – 50	18%	101 – 500	29%
51 – 100	23%	501 – 1,000	15%
101 – 200	16%	1,001 – 3,000	25%
201 – 500	14%	3,001 – 5,000	9%
501 – 1,000	4%	> 5,000	10%
> 1,000	3%		

N = 988 for Farrow to Finish and 464 for Finishing

ii) **Large vs Small Producers** – There is validation that there are fewer small producers and more large producers who are increasing the size of their operations. Table 3 shows the respondents categorized by their total farm sales and the amount of inventory they had on hand. In 1999 small farms with $100,000 or less in farm sales represented 37.7% of the respondents and 6.8% of the total inventory. By 2006 farms in this sales category represented 23.2% of respondents and only 1.9% of the inventory. On the other hand, large farms with more than $1 million in farm sales represented 4.8% of respondents and 37.2% of the inventory in 1999 but 12.7% of respondents and 63.4% of inventory by 2006.

Table 3 Farm Sales and Inventory

Total Farm Sales	2006 % of Resp	2006 Inventory	2006 % Inventory	1999 % of Resp	1999 Inventory	1999 % Inventory
< $50,000	11.3%	14,553	0.5%	20.2%	57,396	2.3%
$50,000 - $100,000	11.9%	37,801	1.4%	17.5%	114,042	4.5%
$100,001 - $250,000	25.8%	179,071	6.6%	30.6%	418,727	16.7%
$250,001 - $500,000	23.9%	327,403	12.0%	18.9%	553,200	22.0%
$500,001 - $1 million	14.3%	439,810	16.1%	8.0%	431,260	17.2%
> $1 million	12.7%	1,731,900	63.4%	4.8%	934,659	37.2%
		2,730,538			2,509,284	

Response Rate: 1,642 in 2006; 3,155 in 1999; Resp = Respondents

iii) **Business Organization** – As swine farms grow in size there is a tendency for them to adopt a more complex business arrangement as shown in Table 4. This may be done to reduce liability or for tax purposes. Sole proprietorships are most common on farms with less than 50 sows while family and business corporations are more prevalent on farms with more than 200 sows.

Table 4 Business Arrangement vs Sow Inventory

Business Arrangement	% of Resp	Sow Inventory < 50	50 - 100	101 - 200	201 - 500	501 – 1,000	> 1,000
Sole Prop	40.5%	57.2%	24.6%	10.7%	4.5%	1.5%	1.5%
Partner	29.7%	31.0%	31.3%	18.4%	14.6%	2.6%	2.0%
Fam Corp	25.1%	15.2%	11.4%	21.8%	27.3%	14.9%	9.3%
Bus Corp	4.7%	3.7%	13.0%	7.4%	29.6%	13.0%	33.3%

Response Rate: 1,152

iv) **Age of Main Decision Maker** – Table 5 shows the age of the survey respondents. It confirms that there are few young farmers compared to the number of older farmers. In fact, the percentage of farmers more than 55 years old has risen from 19.8% to 23% of respondents from 1999 to 2006. On a positive note, however, is that the younger farmers are optimistic and 20% of them plan to increase the size of their swine operations in the next 2 years.

Table 5 Age of Main Decision Maker

Age of Decision Maker	% of Respondents - 2006	% of Respondents - 1999
< 25 yrs old	2.5%	1.7%
25 – 30	5.8%	7.2%
31 – 35	7.1%	12.2%
36 - 40	11.1%	15.9%
41 – 45	19.2%	17.2%
46 – 50	17.2%	13.9%
51 – 55	14.1%	12.0%
> 55 yrs old	23.0%	19.8%

Response Rate: 1,740 in 2006; 3,330 in 1999

v) **Debt** – Overall, 51% of all survey respondents reported that they have low debt levels (i.e. < 33% debt). Part of this may be attributed to the large number of older farmers involved in the survey who have had time to pay down their debt. It does appear from Table 6 that lower levels of debt are more frequently observed on farms classified as sole proprietors where the farm is typically smaller. On the other hand, business corporations had the highest frequency of high debt farms. This is likely due to the size of these operations and the fact that many of them will have recently built new facilities and will have larger inventory levels.

Table 6 Business Type vs Farm Debt Level

Business Type	% of Resp	Farm Debt Level Low Debt	Medium Debt	High Debt
Sole Proprietor	43.3%	59.5%	29.9%	10.6%
Partnership	28.4%	50.4%	36.7%	12.9%
Family Corporation	23.6%	40.8%	45.3%	13.9%
Business Corporation	4.8%	33.8%	46.8%	19.5%

Response Rate: 1,613

vi) **Off-Farm Employment** – Of all survey respondents, 23.2% reported that they had off-farm employment income. Out of this group 56% reported off-farm employment income at less than $35,000/year while 44% had more than $35,000/year as shown in Table 7. Off-farm employment income is found on farms of all sizes and not just small farms as might be expected.

Table 7 Off-Farm Employment Income vs Farm Size

Off-Farm Employment Income	% of Resp	Total Farm Sales < $50,000	$50,000 - $100,000	$100,001 - $250,000	$250,001 - $500,000	$500,001 - $1 million	> $1 million
< $35,000	56.3%	19.3%	17.8%	32.7%	21.8%	5.9%	2.5%
> $35,000	43.7%	21.0%	12.1%	21.7%	15.3%	12.7%	17.2%

Response Rate: 359

Take Home Message

- Farrow to finish farms make up 58% of Ontario's swine industry
- Large farms are increasing in size and number of farms
- As farms increase in size they are likely to adopt a more complex organizational structure i.e. family or business corporation
- Older farmers leaving the industry outnumber the number of young farmers by almost 3 to 1
- Farm debt levels may be related to age of buildings, size of farm, age of farmer
- Off-farm employment income plays a role on farms of varying sizes

Special thanks to Ontario Pork for funding this project. Recognition and appreciation is extended to the farms that participated.

Development of *Fusarium* Resistant Corn Genotypes for Pork Production

Laima Kott
Department of Plant Agriculture, University of Guelph
Guelph, ON

Objectives:

This research work entails 2 distinct, yet interconnected technologies. **1)** The first, involves the **development of a laboratory protocol** to induce immature corn pollen grains plated and cultured in a nutritious liquid medium, to develop into plant embryos. These embryos then can be germinated when transferred onto a solid medium to develop into corn plants (Figure 1). This type of doubled haploid production is already being used for breeding of canola, barley, wheat and other crops worldwide. Secondly, **2)** once this enabling technology has been developed and streamlined for corn, the protocol will be further modified so that during the developmental process of the pollen cells, they will be exposed to UltraViolet light in order **to induce minor genetic changes** (point mutations). As the mutagenized embryos develop, we will be able to **select those embryos that are more tolerant of *Fusarium*** attack by chemical screening in the Petri dish. The selected resistant embryos will be germinated into corn plants for seed production and the next generation will be tested for disease resistance/tolerance in the field. This method is a non-GMO technology that has been developed in our lab and is working exceptionally well for selection of canola plants resistant to *Sclerotinia,* another fungal pathogen.

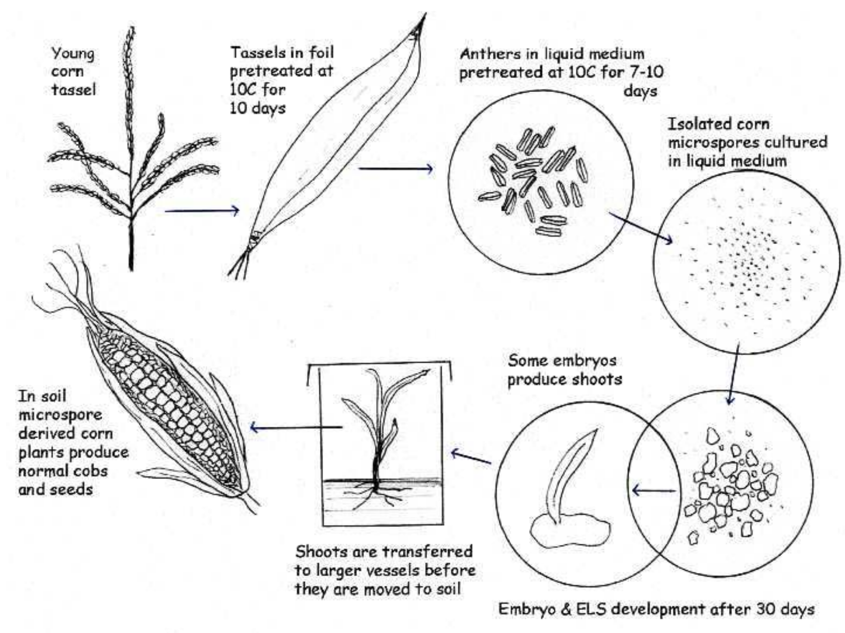


Figure 1: Pollen culture protocol for the development of corn doubled haploids

1) Methodology and protocol development:

Although some progress in pollen culture of corn has been reported in the literature, to date the methods have been unreliable and very labour and cost intensive. Our commitment is to generate a relatively simple, rapid technology for corn that works well with many different genotypes. Therefore, we are evaluating and streamlining all available existing methods from the literature, which involve a multitude of trials dealing with the pretreatment of corn tassels and anthers prior to culture, various media and media inclusions (eg. hormones, sugars), durations and timing of each treatment, temperature regimes of cultured plates etc., using 9 Thompson corn inbreds and one U of Guelph line. Examples of tests involved:

Tassel pre-tretament in cold: temperatures of 4, 10 or 28^{o}C
duration of exposure to temperatures for 4-7-10-12-14 days
tassels pretreated, anthers not pretreated and reverse
fresh tassels (not cold treated at all)

Culture of pollen grains in liquid medium: temperatures of 10, 28 or 32^{o}C
duration of temperatures 24hr to 10 days
Corn medium, Konzak medium, NLN medium
sucrose/maltose levels at 90, 130, 150 g/L

Plating methods: liquid medium (in 1mL, 2mL, 5mL, 10mL of medium)
Petri dish size (small, medium, large)
pollen suspension directly on solid medium
pollen suspension on filter paper on solid medium… etc.

To date we have eliminated or reduced the cold pretreatments, identified the best medium, carbon source and temperature regime for the rapid development of healthy embryos. We have so far produced 312 corn plants, many of which have now produced seed and will be grown out to make sure that no genetic anomalies are occurring. The development of the protocol is still ongoing as we still need to test all of the available genotypes against this system and show that this technique is repeatable under our protocol conditions.

2) Development of the *in vitro* selection system for *Fusarium* resistance:

Although we have worked with the mutagenesis/selection system for *in vitro* selection of various traits in canola (disease resistance, fatty acid alterations, cold tolerance etc), we have not tested this system in cereals. Since we have considerable expertise in the pollen culture of barley and wheat (which are considerably more like corn than canola), we propose to test the *in vitro* mutagenesis and chemical selection for *Fusarium* resistance in barley first. We have altered the barley system to allow for mutagenesis in the liquid phase and have already run the first mutagenesis trials. This is being done simultaneously while we are still developing the pollen culture system in corn, so that when this protocol has been adequately completed, we will be ready to screen for *Fusarium* resistance/tolerance immediately.

Financial support for this research is from: Ontario Pork, AAC/CORD IV, Thompsons, and applications for additional funding has been submitted also to NSERC Discovery Grants and OMAF New Directions.

Testing Sperm-Mediated Gene Transfer (SMGT) in Pigs

[1]Kang, J. H., [2]Ruiz, A., [1]Buhr, M., [2]Friendship, R., [1]*Golovan, S.P.
[1]Department of Animal and Poultry Science, [2]Department of Population Medicine
University of Guelph, Guelph, ON, Canada
* Correspondence author: (519) 824-4120, ext.56281; E-mail: sgolovan@uoguelph.ca

Introduction

A number of transgenic animals have been created for agricultural and biomedical purposes during last two decades. Several methods to create genetically modified animals have been developed such as: pronuclei microinjection, viral vectors, sperm-mediated gene transfer method, and gene targeting followed by nuclear transfer. However, there are still problems with application of these methods to livestock due to high cost and low efficiency. Sperm-mediated gene transfer (SMGT) has been proposed as cheap and efficient method which uses sperm as a natural vector to transfer transgene to the egg (Lavitrano et al., 1989; Lavitrano et al., 2002). Recent successes with production of transgenic pigs is very promising, as SMGT was used to produce transgenic pig with human decay accelerating factor construct (Lavitrano et al., 2002) and multi-transgenic pigs carrying up to three fluorescent proteins (Webster et al., 2005). Despite apparent simplicity of the method, many attempts to apply SMGT did not achieve the desired result, most notably Brinster et al. (1989) tested 1300 mouse offspring produced by SMGT but none of them was transgenic. Similarly, high efficiency of linker based SMGT (Chang et al., 2002) or restriction enzyme-mediated SMGT (Shemesh et al., 2000) have not been replicated to our knowledge in other laboratories. These data indicate that some important variables affecting SMGT have not been identified yet. The goal of current project was to provide independent confirmation for applicability of SMGT in pigs and better understand factors responsible for conflicting results. There is also fundamental question of how organisms protect their germline from invasion by DNA present in the environment. Such problem is especially acute in species with external fertilization, such as fish, but a similar problem also arise in mammals where sperm, oocyte, or embryo, might be exposed to microbial, viral, and endogenous cellular DNA in reproductive tract. It is possible that difficulty in reproducibility of SMGT is an indication of natural defences against exogenous DNA invasion functioning in sperm or embryo.

Results and Discussion

Despite indication of reliable protocol for SMGT in pigs finally established, we have not been able to reproduce it. No GFP positive transgenic embryos were detected after testing 105 fertilized ($\geq$2 cells) embryos produced by 9 sows inseminated with DNA treated sperm from 3 different boars and even a 20% higher fertilization rate in DNA treated sperm was elucidated (Figure 1). Based on previously published results around 50% of transgenic embryos were expected (Lavitrano et al., 2002). GFP is very sensitive reporter and injection of just 1-3 pEGFP plasmids directly into nucleus can produce GFP positive cells. Absence of pEGFP plasmid was also confirmed by WGA-PCR. That seems to indicate that no pEGFP plasmids were transferred to embryos by sperm in our experiments. It was important to confirm first that in our experiment porcine sperm bound and internalized sufficient amount of pEGFP plasmid. To compare our results with Lavitrano et al. (2003), actual copy number of plasmids bound per sperm was calculated. For SMGT, Lavitrano et al. (2003) used 400 mkg of 6.8 kb construct incubated with 10^9

spermatozoa. Boars were used with 58% and 67% rate of DNA uptake with around 20% of plasmid internalized in the sperm nucleus. According to our calculations this should lead to 1.2 -1.4 x 10^4 copies of plasmid per spermatozoa nucleus. In our experiment, similar estimation for boars used for SMGT resulted in 1.4 x 10^4 (boar ID 10) and 0.6 x 10^4 (boar ID 28) plasmids internalized in the nucleus. This is similar to Lavitrano et al. (2003) and 100 fold more then was found previously for pigs (3.8 x 10^2) (Horan et al., 1991).

Even if sperm internalized sufficient number of plasmids in the nucleus, but if it is unable to reach and fertilize oocyte, no transgenic animals will be produced. Our hypothesis was that DNA binding to sperm results in inability of DNA loaded sperm to participate in fertilization process. We did not detect any major negative effect from DNA treatment on sperm motility or viability. Significant decrease in motility seems to be associated with removal of seminal plasma and not the DNA treatment. It does not explain why DNA loaded sperm does not reach oocyte. DNA treatment did result in additional increase in DNA damage in boar spermatozoa (Figure 2). Number of researchers suggested that mature spermatozoa contain nucleases which are induced after sperm damage (Sotolongo et al., 2005). It was also shown that binding of exogenous DNA to sperm lead to activation of endogenous nuclease activity and degradation of both sperm endogenous chromosomal DNA and added transgene (Spadafora, 1998).

Based on our results and analysis of available data from other experiments it seems unlikely that selection against DNA loaded sperm happens at DNA/sperm interaction stage. Sperm seems to be able to internalize relatively large number of plasmids without any significant effects on sperm motility and viability *in vitro*. Similarly selection against exogenous DNA seems unlikely at the embryo level, both pronuclear microinjection and ICSI were used successfully to produce transgenic offspring. Yet, absence of transgenic progeny after SMGT seems to indicate that *in vivo* certain deficiencies of DNA loaded sperm become apparent and selected against *in vivo*. We suggest that either DNA degradation in DNA loaded sperm or even DNA binding to sperm might be recognized as fragmented/abnormal DNA and selected against *in vivo*. It has been shown that human cervical mucus can act as a selective sieve preventing progress of spermatozoa with fragmented DNA and chromatin structural abnormalities, and that through binding in tubal reservoirs, sperm with low DNA damage is selected. Attached exogenous DNA might also physically interfere with sperm interaction with oviductal cells, oocyte or with sperm movement through reproductive tract. In sperm autoimmunity, spermatozoa bound with antisperm antibodies are unable to penetrate human cervical mucus (Yanagimachi, 2003). It is possible that DNA bound to sperm membrane receptor might also create a physical drag on sperm progress in oviduct. This hypothesis is attractive, as it would explain selective elimination of DNA loaded sperm from fertilization process.

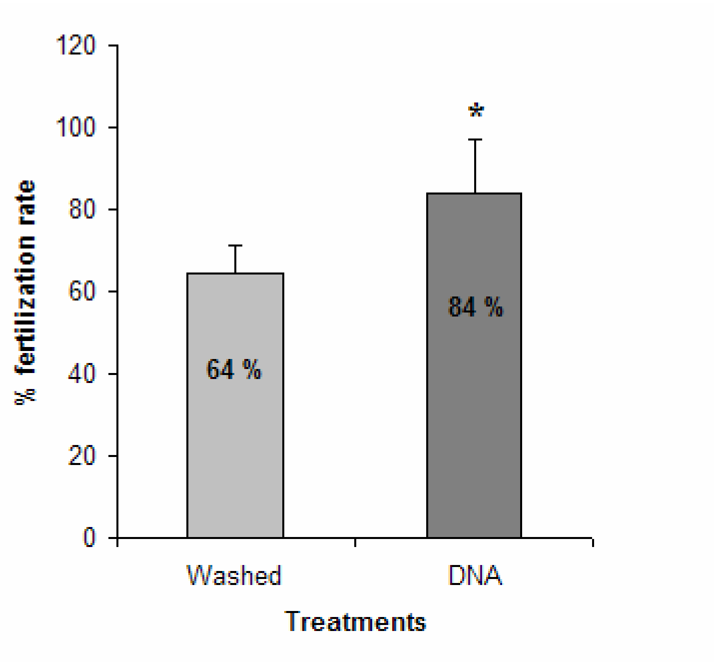


Figure 1. Fertilization rate.
Fertilization rate. Fertilization rate was calculated as the sum of embryos recovered vs total number of oocytes and embryos recovered (100%). Superscripts (*) indicate significant difference with negative control (ANOVA, proc glimmix model; $p < 0.05$).

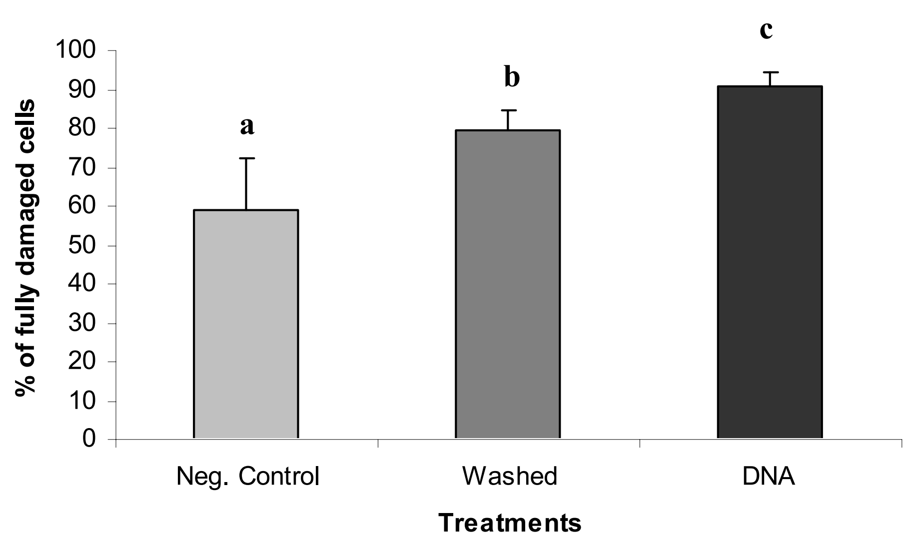


Figure 2. Effect of DNA treatments on sperm DNA damage (mean ± SD).
Neg. Control: diluted semen; washed: washed semen; and DNA: washed and DNA (pEGFP-N1) treated semen. All incubations were performed at 17°C for 24 hr; Different letters **(a, b)** indicate significant difference among treatments (tukey-test; $p < 0.05$).

References

Brinster, R. L., E. P. Sandgren, R. R. Behringer, and R. D. Palmiter. 1989. No simple solution for making transgenic mice. Cell 59:239-241.

Chang, K., J. Qian, M. Jiang, Y. H. Liu, M. C. Wu, C. D. Chen, C. K. Lai, H. L. Lo, C. T. Hsiao, L. Brown, J. Bolen, Jr., H. I. Huang, P. Y. Ho, P. Y. Shih, C. W. Yao, W. J. Lin, C. H. Chen, F. Y. Wu, Y. J. Lin, J. Xu, and K. Wang. 2002. Effective generation of transgenic pigs and mice by linker based sperm-mediated gene transfer. BMC. Biotechnol. 2:5.

Horan, R., R. Powell, S. McQuaid, F. Gannon, and J. A. Houghton. 1991. Association of foreign DNA with porcine spermatozoa. Arch. Androl 26:83-92.

Lavitrano, M., A. Camaioni, V. M. Fazio, S. Dolci, M. G. Farace, and C. Spadafora. 1989. Sperm cells as vectors for introducing foreign DNA into eggs: genetic transformation of mice. Cell 57:717-723.

Lavitrano, M., M. L. Bacci, M. Forni, D. Lazzereschi, C. Di Stefano, D. Fioretti, P. Giancotti, G. Marfe, L. Pucci, L. Renzi, H. Wang, A. Stoppacciaro, G. Stassi, M. Sargiacomo, P. Sinibaldi, V. Turchi, R. Giovannoni, C. G. Della, E. Seren, and G. Rossi. 2002. Efficient production by sperm-mediated gene transfer of human decay accelerating factor (hDAF) transgenic pigs for xenotransplantation. Proc. Natl. Acad. Sci. U. S. A 99:14230-14235.

Lavitrano, M., M. Forni, M. L. Bacci, C. Di Stefano, V. Varzi, H. Wang, and E. Seren. 2003. Sperm mediated gene transfer in pig: Selection of donor boars and optimization of DNA uptake. Mol. Reprod. Dev. 64:284-291.

Shemesh, M., M. Gurevich, E. Harel-Markowitz, L. Benvenisti, L. S. Shore, and Y. Stram. 2000. Gene integration into bovine sperm genome and its expression in transgenic offspring. Mol. Reprod. Dev. 56:306-308.

Sotolongo, B., T. T. Huang, E. Isenberger, and W. S. Ward. 2005. An endogenous nuclease in hamster, mouse, and human spermatozoa cleaves DNA into loop-sized fragments. J. Androl 26:272-280.

Spadafora, C. 1998. Sperm cells and foreign DNA: a controversial relation. Bioessays 20:955-964.

Webster, N. L., M. Forni, M. L. Bacci, R. Giovannoni, R. Razzini, P. Fantinati, A. Zannoni, L. Fusetti, L. Dalpra, M. R. Bianco, M. Papa, E. Seren, M. S. Sandrin, K. Mc, I, and M. Lavitrano. 2005. Multi-transgenic pigs expressing three fluorescent proteins produced with high efficiency by sperm mediated gene transfer. Mol. Reprod. Dev. 72:68-76.

Yanagimachi, R. 2003. Fertilization and development initiation in orthodox and unorthodox ways: from normal fertilization to cloning. Adv. Biophys. 37:49-89.

Investigating the Benefits of Inducing Sows to Farrow

Khanh Nguyen, Roy Kirkwood[1], Glen Cassar and Bob Friendship
Department of Population Medicine, University of Guelph
and Michigan State University[1]

Introduction

The importance of piglets receiving adequate amounts of good quality colostrum shortly after birth has been well known for a long time but recently has gained new importance as a result of the realization that serious diseases such as PRRS and PMWS are at least partly controlled on a herd basis by ensuring solid immunity among the suckling piglet population. The only way to make sure all piglets are born strong and receive colostrum in the first few hours of life is to supervise farrowings. Induction of sows to farrow during daytime can help ensure newborn piglets are assisted if necessary. The use of prostaglandin (PGF) for induction of farrowing is common practice in the swine industry. Advances have been made in induction protocols that allow for reduced drug dosage (vulva injection) and improved predictability (split-dose injection).

The main objectives of this study were; to determine if the predictable induction of farrowing and subsequent supervision at parturition reduces stillbirths and neonatal mortality and to determine if uniform levels of immunity in suckling piglets can be achieved through intensive care at farrowing.

Materials and Methods

The study was conducted on a commercial swine farm selected because of an older sow population and a relatively high stillbirth rate. A total of 140 sows were randomly assigned to a treatment (56 sows) or a control (84 sows) group. Treatment sows were induced to farrow using a split-dose vulval injection of 5 mg PGF (first injection at 8 am and second injection at 2 pm) and a subcutaneous injection of 8 mL calcium borogluconate administered at the time of the first PGF injection. Control sows were left to farrow naturally. Treatment sows were monitored during farrowing and assisted as needed. Piglets were dried, and kept warm and at the end of farrowing all piglets were allowed to suckle. If piglets appeared weak, or were splay-legged, they were tubed and provided with 10mL of colostrum. If there were too many piglets for the number of nipples the litter was split-suckled. Litters born to Control sows were handled using the farm protocol, which involved a minimum of intervention. All piglets, from Control and Treatment sows were weighed at about 48 hours and 21 days. At the time of weighing, blood samples were taken from the largest and the 2 smallest and the median weight pig in each litter. Mortality was recorded. Blood was tested for antibodies and immunoglobulin.

Results

Stillbirths were reduced in the Treatment litters. Timely intervention resulted in a 36% reduction in the likelihood of a stillbirth occurring in a litter from the Treatment group compared to the Control sows. Forty-nine percent of control litters had at least one stillborn piglet whereas only 27% of the Treatment sows recorded a stillbirth. There was no difference in the number of pigs weaned but piglets from Treatment litters were slightly heavier at weaning (270g at 21days). The prevalence of positive PRRS titres in this herd was less than 5% of sows and therefore serological results of PRRS titres among piglets could not be used to show the value of colostral supplementation. Sera are being tested for total immunoglobulin levels in order to prove the uniformity of immunity within litters.

Discussion

This induction protocol resulted in almost 100% of sows, which were induced, farrowing during the following day. The vulval injection technique results in very rapid uptake because of the good blood supply in the area and the few sows that do not respond from the first injection are caught with the second injection 6 hours later. Using a half dose each time reduces the likelihood of side-effects (restlessness, salivation, transient rise in temperature). This technique makes this an off-label use and therefore producers need to consult with their veterinarians regarding this procedure. There are reports in the literature of induction causing lightweight piglets and increased mortality as a result of piglets being born too early. Induction should occur so that pigs are born no sooner than 2 days before a natural birth. Because many herdsmen count gestation from the day of first breeding gestation is often about 117 days. In such herds a piglet born on gestation day 113 may be premature. In this study Control and Treatment piglets were of similar weight.

It is becoming clear that one of the best ways to prevent piglets from picking up an infectious disease like PRRS or PCVAD is to ensure piglets all receive adequate colostrum, particularly from their own mothers. Because of the variation in birth weights and variation piglet weights and viability at birth, uniform immunity can only be achieved by careful supervision and supplementation of colostrum when necessary. This protocol appears to make that easier.

Healthy Pigs and Safe Pork

Bob Friendship, Project Leader, University of Guelph

The University of Guelph / OMAFRA research partnership program has been reorganized. As a result the new research project tend to be larger in scope and involve groups of scientists in multiple disciplines. One of three swine related projects is in the area of pig health and food safety. An important justification for such an approach is that pig disease problems tend to be complex in nature being caused by interactions with more than one disease agent and affected by management, environment, nutrition and genetic factors. Therefore by creating a team of researchers with expertise in all of these different areas it may be possible to make exciting progress on important health issues.

The following are the primary objectives of the research project:

1. Explore interactions among pathogens, endogenous microflora, biosecurity, host animals and environment, both on-farm and in the laboratory, to identify key risk factors or contributing factors that cause increased persistence and disease expression with losses from mortality and reduced performance.
2. Explore a wide range of intervention strategies or methods that would reduce these losses due to disease including vaccination, bacteriophage therapy, genetic and environmental manipulation of the pigs' disease resistance, diet, or environmental conditions.
3. Use health management to reduce use of antibiotics, prevalence of human pathogens in pork products and improve animal welfare.

The original team of researchers includes faculty members of Animal and Poultry Science (Kees deLange, Tina Widowski, and Jim Squires), Food Science (Keith Warriner), Population Medicine (Suzanne Millman, Scott McEwen, Bob Friendship and Cate Dewey), and Pathobiology (Patrick Boerlin, Dongwan Yoo, Jeff Gray, Carlton Gyles, Jan MacInnes, Andrew Brooks, Tony Hayes and Bruce Wilkie). This team is composed of people with expertise in animal husbandry, and on-farm disease investigation, as well as nutrition and behaviour so that a portion of the work will involve field studies. There are also those with expertise in microbiology, immunology and molecular biology who will be working in the lab and involved in controlled animal experiments.

The researchers will study naturally occurring outbreaks of disease in an attempt to quantify risk factors and develop models to explain the clinical outcome. Biological material will be obtained from actual cases of disease outbreaks and examined using molecular techniques and isolates will be used in animal experiments. Controlled studies will be used to create infection models to investigate the interactions between hosts and pathogens as well as between multiple pathogens. It will also allow evaluation of preventative protocols particularly novel approaches such as bacteriophages, herbal extracts and vaccination, and behavioural components of the innate and adaptive immune response. Environmental and genetic regulators of variation in host resistance to infection and disease will also be investigated. Better methods of disease control will be created.. Specific goals include gaining an understanding of at least some of the complex interactions between host, environment and disease agents and using this knowledge to alleviate major losses associated with diseases like Porcine circovirus type 2 associated disease (PCVAD) and porcine reproductive and respiratory syndrome (PRRS). In addition, there will be continuous efforts to identify potential food safety pathogens and work to minimize the risk of zoonotic disease. Preliminary results of this team's work over the past few months includes the identification of gene defects associated with higher rates of sickness and culling, the identification of viruses that infect bacteria (bacteriophages) that are proving to be effective in reducing *Salmonella* and *E. coli* in controlled experimental studies, as well as advances in our understanding of PRRS.
This project is expected to continue for four years and provide a framework for other health and research initiatives sponsored by Ontario Pork and others.

Determining Sow Performance and Mineral Requirements With Phytase Supplementation of the Lactating Sow Ration – Preliminary Report

Paul Luimes University of Guelph Ridgetown Campus
pluimes@ridgetownc.uoguelph.ca; 519-674-1550

Introduction

Supplemental phytase offers interesting opportunities for farmers to reduce feed costs and lessen environmental pollution of minerals. Restrictions coming from Ontario's Nutrient Management Act may further increase interest about the use of supplemental phytase. In most cases the nutrient limiting quantity of hog manure that can be spread on land will likely be phosphorous. Farmers with limited land base or who wish to decrease manure transportation costs could consider phytase as a viable option to decrease phosphorous content of manure. In addition to binding up phosphorous, making it poorly available, phytate also renders calcium, iron, zinc, manganese and copper poorly available (Vohra et al. 1965). Much research has shown the effectiveness of adding phytase to hog rations to improve phosphorous availability (Ketaren et al. 1993; Young et al. 1993; Harper et al. 1997; Johnston et al. 2004; Omogbenigun et al. 2004). Recently, Shelton et al. (2004) sought to capitalize on the use of phytase to improve availability of calcium and the trace minerals as well. Shelton et al. (2004) observed no difference in growth performance and no negative response on carcass traits and pork quality when calcium and phosphorous were each reduced by 0.10% and the supplemental trace minerals were removed entirely.

Little has been done with respect to phytase with sows. Kemme et al. (1997b) observed that supplementation of phytase improved calcium, phosphorus and magnesium digestibility. They also observed that sows in different parities did not react differently to phytase supplementation in terms of mineral digestibility (Kemme et al. 1997b). Kemme et al. (1997a) and Nyachoti et al. (2004) observed an increase in calcium and phosphorus digestibility with phytase supplementation in lactating but not dry sow rations.

In lactating sows, no work has been done concerning the response due to phytase supplementation with respect to: 1) improved digestibility of trace minerals, 2) response of milk production and quality, and 3) piglet performance. Before farmers can safely incorporate such a product into their rations, these questions must be answered.

Objectives

The objectives of this project are threefold. The first is to determine whether phytase supplementation decreases the requirement for calcium, phosphorus and trace mineral supplementation for lactating sows similarly to growing-finishing hogs by determining the extent of improvement in mineral digestibility. Secondly, if there are going to be changes to the sow's nutrition, it must be determined what effect it will have on milk production and milk composition. Thirdly, and related to the previous point, any changes that occur in sow nutrition must occur for the improvement, or at least maintenance, of current piglet performance.

Experimental Procedures

After farrowing, sows were randomly assigned to one of four mineral-phytase treatments: A) calcium and phosphorus balanced at NRC levels and a trace mineral premix included with no phytase (control treatment), B) treatment A except with phytase (500 units/kg),

C) treatment A with calcium content reduced by 0.12 percentage units and phosphorus content reduced by 0.10 percentage units of NRC requirements (differential reductions set to maintain calcium to phosphorus ratio of diets across treatments) and no supplemental trace minerals with no phytase, and D) treatment C except with phytase (500 units/kg). Table 1 shows the ration content and predicted analysis of the diets.

Table 1. Diet content and predicted analysis.

	% in ration for each treatment			
Ration content	A	B	C	D
Corn	64.2	64.2	64.2	64.2
Soybean meal	29.2	29.2	29.2	29.2
Fat	3.0	3.0	3.0	3.0
Limestone	0.83	0.83	0.85	0.85
Dicalcium phosphate	1.50	1.50	0.95	0.95
Salt	0.45	0.45	0.45	0.45
Trace mineral premix	0.12	0.12	0	0
Vitamin premix	0.40	0.40	0.40	0.40
Chromic oxide	0.30	0.30	0.30	0.30
Inert filler	0.00	0.00	0.65	0.65
Phytase (units/kg)	*0*	*500*	*0*	*500*
Predicted nutrient supply				
True ileal digestible lysine (%)	0.92		0.92	
Metabolizable energy (kcal/kg)	3426		3426	
Calcium (%)	0.75		0.63	
Phosphorus, total (%)	0.66		0.56	
Phosphorus, available (%)	0.35		0.25	
Calcium to Phosphorus ratio	1.13		1.13	

Before entering the farrowing crate sow weight was recorded. All farrowing data (numbers of piglets born alive, mummified piglets and still born piglets; live born piglet weight and sex) was recorded. Piglets born within 12 h were cross-fostered to establish equal litter sizes on day 0. Pre-weaned piglet data (mortalities and weight gain) were recorded. Sow feed and water intake (individual water meters) was recorded daily. On days 14 and 28 of lactation the following samples were taken: 1) Feed and water samples were taken and frozen until further analysis. 2) During a milk let-down cycle, a milk sample was taken equally from 3 nipples (front-middle-hind). The sample was sent fresh for analysis. 3) A venous blood sample was taken from sows, centrifuged and frozen until analysis later. 4) A fecal grab sample was taken and frozen for later analysis.

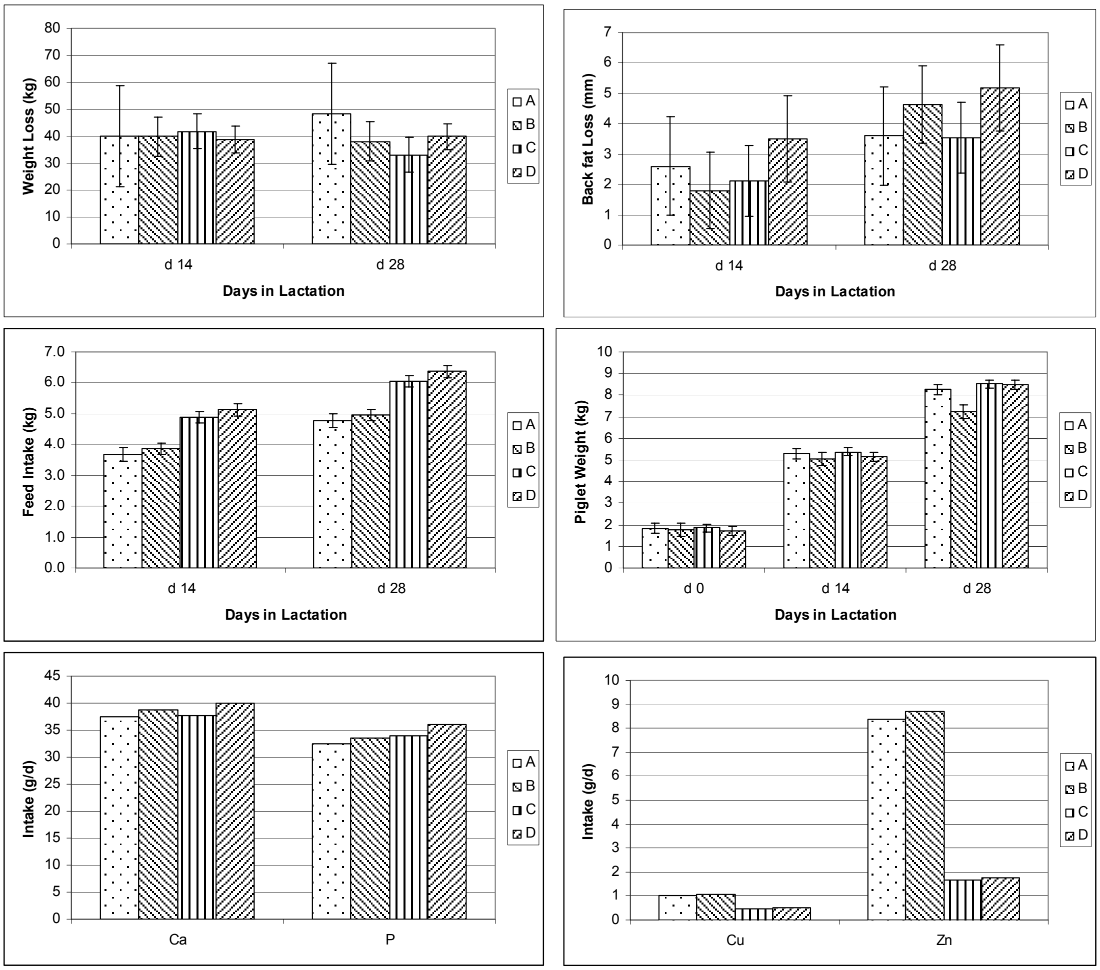
Feed, water, feces, milk and blood samples will be sent for analysis to reputable laboratories in Ontario for analysis of appropriate nutrients (including minerals). In addition, feed and feces samples will be analyzed for chromic oxide. Apparent digestibility of dry matter, crude protein, ME and minerals will be determined.

Preliminary data will be discussed for sow and piglet performance for 5 replicates of the experiment as the trial is incomplete and feed, water and fecal samples have not been analyzed.

Results to Date

Data presented in Figure 1 are raw means with standard errors. Copper (Cu) and zinc (Zn) are presented as examples of trace minerals. As the trial is incomplete and complete statistical analysis has not been done, results should be interpreted with some caution.

Figure 1. Results of trial to date.*



* Top left is sow weight loss at days 14 and 28 for the various treatments (see text). Top right is sow back fat loss at last rib at 14 and 28 for the various treatments. Middle left is average sow daily feed intake to days 14 and 28 for the various treatments. Middle right is the average piglet weights at birth, 14 days and 28 days for the various treatments. Bottom left is average sow intake of calcium (Ca) and phosphorus (P) based on actual feed intakes and table values of mineral concentrations in the component feeds for the various treatments. Bottom right is average sow intake of copper (Cu) and zinc (Zn) based on actual feed intakes and table values of mineral concentrations in the component feeds for the various treatments.

Discussion

So far, it appears even the sows on the treatment with restricted calcium, phosphorus and trace minerals and no phytase (C) perform (in terms of piglet weaning weight) as well as the sows on the control (A) treatment. Interestingly, sows consuming the two treatments receiving lower mineral supplementation (C & D) appear to have consumed more feed than those sows consuming full mineral supplementation (A & B). This increase in intake led to those sows consuming equal amounts of calcium (Ca) and phosphorus (P) (assuming book values for mineral concentrations in feed). The sows receiving trace mineral restriction treatments (C & D) did consume less trace minerals such as copper (Cu) and zinc (Zn) shown above – again assuming book values for concentration of minerals in the feed. Caution must be used in interpreting these data but, if these trends translate into statistical significance, it would suggest that trace mineral supplementation for sows is not required. As this trial only followed the sows for one parity, any effect possible depletion of trace minerals would have on subsequent parities and longevity has not been investigated. More substantial conclusions will be possible as total tract disappearance of the minerals is determined.

References

Harper, AF et al. J. Anim. Sci. 1997; 75(12):3174-86.
Johnston, SL et al. J. Anim. Sci. 2004; 82(3):705-14.
Kemme, PA et al. J. Anim. Sci. 1997a; 75:2129-38.
Kemme, PA et al. J. Anim. Sci. 1997b; 75:2147-53.
Ketaren, PP et al. Br. J. Nutr. 1993; 70(1):289-311.
Nyachoti, CM et al. Can. J. Anim. Sci. 2004; 83:145 (abstr.)
Omogbenigun, FO et al. J. Anim. Sci. 2004; 82(4):1053-61.
Shelton, JL et al. J. Anim. Sci. 2004; 82:2630-9.
Vohra, P et al. Proc. Soc. Exp. Biol. Med. 1965; 120:447-9.
Young, LG et al. J. Anim. Sci. 1993; 71(8):2147-50.

Microorganisms Isolated from Chicken Gut Can Effectively Detoxify DON and Other Trichothecene Mycotoxins

T. Zhou[1]*, J. Gong[1], J.C. Young[1], H. Yu[1], X.Z. Li[1], H. Zhu[1], A. Hill[1], R. Yang[1]
C.F.M. de Lange[2], W. Du[3], R. Cao[1]

[1]Food Research Program, Agriculture and Agri-Food Canada,
[2]Animal and Poultry Science, University of Guelph
[3]Ontario Ministry of Agriculture and Food
*zhout@agr.gc.ca

Background

Mycotoxin contamination of feed has been a serious threat to the swine and feed industries for a long time. The most significant contaminants in Canadian grains are the trichothecene mycotoxins produced by species of *Fusarium*. Despite a plethora of information regarding the biochemistry, toxicity, and modes of action of mycotoxins, there still remains no viable solution for either pre- or post- harvest control/eradication of these toxins. The industries are facing an even greater challenge in 2007 due to high incidence of Fusarium ear rot of corn harvested in 2006. Therefore, effective methods to detoxify mycotoxin-contaminated grains are urgently needed.

It has been known for some time that trichothecene mycotoxins can be degraded into much less toxic compounds (i.e. detoxified), such as vomitoxin or DON being degraded to DOM-1. Recently, our group has studied the potential of detoxifying trichothecene toxins by biological degradation, and confirmed that the degradation could be achieved by microorganisms from chicken guts (Gong *et al.* 2003; Zhou *et al.* 2005).

Objectives

1) To isolate microorganisms capable of degrading DON into its less toxic derivative;
2) To characterize the identified microorganisms.

Results

1) Several single microbial colonies with capability of degrading DON to DOM-1 were successfully isolated from microorganisms originated from chicken gut by a series of selections. The degradation efficacy of these isolates varied, however, at least one of the isolates converted DON to DOM-1 completely.

2) The active isolates were identified by using molecular techniques, and were found belonging to different bacterial genera/species. One of the active isolates was further characterized.

3) Effectiveness of the isolate: The selected isolate completely degraded DON into DOM-1 in a solution with initial DON concentration at 1000 μg/ml (ppm) after 24-hour incubation.

4) Consistency of the isolate: The isolate still showed full activity to degrade DON to DOM-1 after 10 consequent subcultures, proving that the degradation capability of the selected isolate is consistent.

5) Initial concentration required for complete degradation: the results from the test with 100 μg/ml DON and 24 hour incubation showed that the minimum initial concentration were 1 x 10^5 bacterial cells/ml.

6) Degradation of trichothecenes other than DON: The selected isolate also degraded **an**other eleven trichothecene mycotoxins tested, including 3-acetyldeoxynivalenol, 15-acetyldeoxynivalenol, 4-diacetoxyscirpenol, fusarenon X, HT-2 toxin, 15-monoacetoxyscirpenol, neosolaniol, nivalenol, T2 toxin, T-2 triol and verrucarol. The resulting degradation occurred either by deepoxidation and/or deacylation. The route depends upon the presence and position of acyl functionalities (Young *et al.,* 2006).

Conclusions and Take Home Messages

Bacterial isolates with capability of degrading trichothecene mycotoxins have been successfully isolated from chicken gut contains. One of the active isolates has been identified and characterized, and is effective in degrading various trichothecene toxins, especially DON. This microbial degradation technology shows promise in the detoxification of trichothecene-contaminated grains; studies to determine its potential applications in swine industry are underway.

Acknowledgements

This work was supported by Ontario Pork, Canada (Project No. 02/22) and by Agriculture & Agri-Food Canada through Matching Investment Initiatives.

References

Young, J.C., Zhou, T., Yu, H., Zhu, H., Gong, J., Degradation of Trichothecene Mycotoxins by Chicken Intestinal Microbes, Food and Chemical Toxicology (2007) 45: 136-143.

Zhou, T., Gong, J., Young, J.C., Yu, H., Zhu, H., Su, X.J., Li, X.Z., Yang, R. de Lange, C.F.M., Du, W. and Cao, R. 2005. Detoxification of vomitoxin with bio-transforming microorganisms. Proceeding of the 23rd Annual Centralia Swine Research Update, Kirkton, Ontario. February, 6, 2005. Pages II 28-30.

Gong, J., Zhou, T., Young, J.C., Cottrill, M., Yu, H., Zhu, H., de Lange, C.F.M., Du, W. and Cao, R. 2003. Gut microbes and mycotoxin: Can chicken gut microbes detoxify vomitoxin? Proceeding of the 22nd Annual Centralia Swine Research Update, Kirkton, Ontario. Pages I 30-31.

Feeding DDGS to Pigs

Phil McEwen, Ridgetown College - University of Guelph, and
Ron Lackey, OMAFRA, Feed Ingredients & Byproducts Feeding Specialist
519-674-1541, pmcewen@ridgetownc.uoguelph.ca

Introduction

An increased output of Dried Distillers Grains with Solubles (DDGS) is expected for North American livestock production. However, very little research has been completed in Ontario using product manufactured by GreenField Ethanol from their Chatham plant. Since variation in product quality can exist from one plant to the next, feeding trial initiatives were needed to quantify the economic ramifications of feeding DDGS (Chatham) to swine herds in Ontario.

Objective

The project evaluated the effects of feeding dried distillers grains with solubles (DDGS) to pigs based on measurements of growth, feed intake, economic returns and carcass quality. The following objectives were specifically addressed:

a) o determine the effects of feeding DDGS (Chatham plant) at a 10 and 20 percent dietary (as fed) inclusion rate based on pig growth rate, feed intake and efficiency.

b) To determine the economic benefits of feeding DDGS from the Chatham plant in pig growing and finishing diets.

Experimental Procedures:

After a three week adjustment period, ninety-six pigs (48.8 ± 5.2 kg) officially began the trial on February 14th, 2005. Each pen (3 barrows and 3 gilts) was randomly assigned to one of the four grower diets until they were 70 kilograms body weight (BW). They were then fed an assigned finisher diet until they were marketed (≥ 110 kg BW) by pen. The following dietary treatments were formulated and fed:

1. Grain corn, SBM (control diets) and premix. A grower diet [17% CP (0.8% lysine)] was fed until the pigs were 70 kg followed by a finisher diet [14% CP (0.6% lysine)] until they were marketed.
2. Similar diets and feeding strategy to control (above) group. However a 10 percent inclusion rate of DDGS + additional crystalline lysine was added to produce diets with similar lysine content.
3. Similar diets and feeding strategy to control group. However a 20 percent inclusion rate of DDGS + lysine was added to produce diets with similar lysine content.
4. Similar crude protein levels to control diets. However a 10% inclusion rate of DDGS was added with no additional lysine supplementation. Dietary lysine levels were therefore significantly reduced [0.7% (grower diet) & 0.5% (finisher diet)].

The pigs (pens) were fed *ad libitum* with a required feed refusal or weighback taken once weekly. Ultrasound measurements (backfat and loin eye depth) were taken at the start of the trial, five weeks later and before the pigs were marketed by pen. The pigs were weighed weekly and were marketed after achieving an average 110 kg BW per pen. All pigs were slaughtered at one location (Quality Meats) where carcasses were weighed and graded. The data was then entered and analyzed in an appropriate manner using SAS (2001) statistical procedures.

Results:

Table1. Effects of dietary treatment on pig growth rate, feed intake and carcass quality.

	Control Diet	10% DDGS + Lysine	20% DDGS + Lysine	10% DDGS no Lysine
Growth Performance				
Number of pigs	24	21	23	16
Days to Market (by pen)	56.6	56.7	55.2	56.6
Average Daily Gain (kg)	1.13	1.12	1.14	1.09
Feed Intake Measurements				
Total Feed Intake (kg)	174.7	170.6	171.3	170.9
Average feed intake (kg/d)	3.1	3.0	3.1	3.0
Feed efficiency (F/G)	2.8	2.7	2.7	2.6
Cost of gain ($/kg) - 2005	0.50	0.47	0.46	0.45
Carcass Measurements				
Dressing Percentage	79.6	79.8	79.4	79.5
Yield Index (%)	61.3	61.1	60.5	60.8
Grade Fat (mm)	17.1^{a}	17.8^{ab}	19.3^{b}	18.5^{ab}
Meat depth (mm)	62.0	62.6	61.3	64.0

^{a} and ^{b} LS means within row that do not share a common superscript differ significantly ($p < 0.05$).

Conclusions:

- Similar growth rate, feed intake and efficiency and gain costs were observed for each dietary treatment (0, 10 and 20 percent DDGS).
- Since feed efficiencies were similar, costs of gain were strongly related to ingredient costs. Therefore producers are advised to incorporate DDGS when this co-product is favorably priced relative to corn and soybean meal.

Acknowledgments:

The authors would like to thank the Innovation and Risk Management Branch (OMAFRA), GreenField Ethanol, and OMAFRA for their financial and technical assistance. Support and technical input from each research team member was also greatly appreciated.

The Effects of Compensatory Growth on Carcass Merit and Pork Quality

Phil McEwen, Dr. Ira Mandell and Dr. Peter Purslow - University of Guelph
519-674-1541, pmcewen@ridgetownc.uoguelph.ca

Introduction

Most on-farm feeding systems try to maximize feed intake during the growing and finishing phase. However, Therkildsen et al. (2002) observed improved feed efficiency, protein synthesis, meat quality and tenderness when pigs were limit fed during the growing period. This trial further investigated the performance, carcass and meat quality ramifications of limit feeding during the growing period.

Objectives:

The project is evaluating the effects of feeding strategy (full versus limit feeding) and gender (gilt versus barrow) on growth performance, feed intake, carcass and meat quality and economic returns.

Experimental Procedures (first experiment):

One hundred and eight feeder pigs (32.9 $\pm$ 3.3 kg) were randomly assigned to eighteen pens with six pigs per pen. A specific gender (gilt or barrow) and feeding strategy was assigned to each pen to provide three replications (pens) for each treatment combination. Corn, soybean meal (SBM) and a vitamin/mineral premix were used to formulate an 18% CP (0.9% lysine) diet which was fed to all pigs. The following feeding strategies were evaluated during the first experiment:

a) **Control Group:** - Pigs were fed *ad libitum* until the pigs (within pen) were marketed @ approximately 110 kg BW.

b) **Limit Fed Group (85% of control):** - feed allocation was limited to 85% of *ad libitum* feed intake consumed by the control group until the pigs weighed 60 kg (pen average weight).The pigs were then fed a*d libitum* until they were marketed at 110 kg BW.

c) **Limit Fed Group (70% of control):** - feed allocation was limited to 70% of *ad libitum* feed intake consumed by the control group until the pigs weighed 60 kg (pen average weight). The pigs were then fed *ad libitum* until they were marketed at 110 kg BW.

Hot carcass weights were recorded prior to overnight chilling at 1°C. The left-hand side of each carcass was probed prior to chilling between the third and fourth last ribs to estimate carcass lean content. After an overnight chill, carcass measurements (fat and muscle depth, loin eye area, were taken by an experienced evaluator.

A section of the loin was cut into chops for determination of drip loss, subjective evaluations (color, marbling, wetness, firmness), and pH. An objective measure of lean colour was determined using a Minolta Chroma Meter (Model CR 400). Lean color was measured at 2 locations for each chop with color data collected in the CIE, $L^* a^* b^*$ scale . A second chop was used to determine intramuscular fat content while the third and fourth chops were used for Warner-Bratzler shear force determinations to evaluate tenderness.

Results to date:

1) Compensatory gain (Table 1) was observed during the finishing period (> 60 kg) when limit feeding was practiced during the growing phase for R_{70} pigs (versus control) resulting in improved feed efficiency (F/G).

2) Control fed pigs (FF) had an increased yield index while muscle depth was increased for FF versus R_{70} (63.0 vs. 59.9 mm).

3) Loin colour, pH, and loin eye areas were similar for each dietary treatment with increased loin tenderness for pigs limit fed in the growing period [4.7 (FF), 4.2 (R_{85}) and 4.2 (R_{70})].

Table 1. Effects of feeding strategy and gender on pig performance, carcass and pork quality.

	Feeding Strategies			Genders	
	Control (FF)	85% of Control Intake (R_{85})	70% of Control Intake (R_{70})	Barrow	Gilt
Growth Performance					
Days to Market	73.0	74.2	72.4	70.9^{d}	75.5^{e}
Average Daily Gain (kg)	1.03	1.03	1.05	1.09^{d}	0.99^{e}
ADG – finishing period (kg)	1.02^{a}	1.06^{a}	1.16^{b}	1.16^{d}	1.00^{e}
Feed to gain (F/G) – over both periods	2.6^{a}	2.6^{a}	2.4^{b}	2.6	2.5
Carcass and Meat Quality					
Yield Index (%)	61.0^{a}	60.1^{b}	59.8^{b}	59.7^{c}	60.9^{d}
Grade Fat (mm)	18.1^{a}	19.5^{ab}	20.3^{b}	20.4^{c}	18.1^{d}
Muscle depth (mm)	63.0^{a}	60.2^{ab}	59.9^{b}	59.2^{c}	63.0^{d}
Loin colour L*	48.1	48.7	48.9	48.6	48.6
Shear Force (kg)	4.7^{a}	4.2^{b}	4.2^{b}	4.3	4.5

[a,b] LS means within row for feeding strategy that do not share a common superscript differ ($P<0.05$).
[c,d] LS means within row for gender that do not share a common superscript differ ($P<0.05$).

References

Therkildsen, M., B. Riis, A. Karlsson, P. Ertbjerg, P. P. Purslow, M. Dall Aaslyng, and N. Oksbjerg. 2002. Compensatory growth response in pigs, muscle protein turn-over and meat texture: effects of restriction/realimentation period. Anim. Sci. 75:367-377.

Acknowledgments

The authors would like to thank Ontario Pork and the Ontario Ministry of Agriculture and Food (OMAF) for their financial support. Data collection and animal care by staff in the Ridgetown Swine Research Facility was also very much appreciated.

Mapping PRRS in Ontario

Cate Dewey
Department of Population Medicine, University of Guelph, Guelph, ON N1G 2W1 519-824-4120 ext 54746 FAX 519-763-3117 cdewey@uoguelph.ca

Introduction

Swine producers and veterinarians have been successful in eliminating clinical PRRS problems from herds. However, the herd often becomes re-infected with the virus. The overall purpose of this project is to understand the spread of the PRRS virus in the Ontario Swine Industry.

Methods

Producers who have positive PRRS results from samples submitted to the Animal Health Laboratory are invited to participate in the study. We are including herds with samples submitted after August 2004. Producers with PRRS negative herds are also participating in the study as control herds. If a producer has a new break and is willing to participate in the study, the $200 cost of the gene sequencing of the virus will be paid for by the project.

Results

The swine producers and veterinarians in Ontario have been wonderfully cooperative with this project. To date we have 297 herds in the study with completed survey data, 51 of these herds are control herds. There are also 30 herds enrolled in the study pending completed survey data.

PRRS viruses are considered the "same" when 98% of the gene pattern from one virus is the same as the gene pattern from another virus. Five percent of the viruses from one farm were the same as a virus from at least one other farm. We know that viruses change over time as they replicate or multiply inside the pig's cells. Therefore, over time, a virus from one source might look almost the same as another virus. Eight percent of viruses in our study were had another virus that was 96% the same at itself.

We asked producers to describe the clinical problems they experienced in their herds during the clinical PRRS outbreak. Approximately half of the herds had problems with sows off feed, weak-born pigs, pre-weaning mortality and finisher barn mortality and respiratory problems. Close to 40% of herds had problems with abortion and increased numbers of stillborn pigs. Seventy percent of farms with nursery pigs had high mortality and respiratory problems in this age of pigs.

More than half of the herds (58%) in the study use PRRS vaccine in the breeding herd. Forty-four percent of herds use the vaccine in sows and forty percent use the vaccine in gilts. Only 3% of producers vaccinate their nursery pigs. Serum inoculation was used in only 6% of farms (to either gilts or sows or both). Feedback given to gilts was used in 22% of farms, whereas feedback was given to sows on only 15% of farms.

Acknowledgements: We thank Ontario Pork for the financial support for this project. We appreciate the participation of producers, veterinarians and the Animal Health Laboratory in this study.

Tips For Saving Water

Prepared by Lee Whittington, Prairie Swine Centre Inc.

Water is an essential nutrient in pork production. Research reveals how we can manage this resource for best results and minimal cost.

1. Do a water audit. Wasted water costs money to pump and to dispose of in slurry. The average usage is 78L per sow (farrow to finish farm), however actual usage has been reported as low as 65L/sow and as high as 120L/sow, a variation of as much as 50% from the mean! See water usage table in Pork Production Reference Guide 2000, pg 30.
2. Water requirements have been found to be 2.3L for every kilogram of feed consumed (grower and finisher pigs). Gonyou
3. Mounting water nipples correctly reduces wasted water. For nipples pointed straight out pigs should drink from shoulder height. For nipples mounted downward at 45^{o} the nipple should be 5cm (2 inches) above the back of the pig. Mounting lower will increase water wastage. Nipples should be set for the height of the smallest pig in the pen. Water Use and Drinker Management, Gonyou,
4. Check flow rates. Flow rates determine time spent at the nipple, water intake and water wastage. Too little is just as costly as too much when it comes to flow rates. Flow rates of 1,500 ml for lactating sows, 700 ml in grow-finish are recommended. Research on wastage found 23% at 2080ml/min versus 8.6% at 650 ml/min. Water use and Drinker Management, Gonyou
5. Adjust nipple height. Improved water nipple design by providing a step for smaller pigs resulted in a reduction of water waste of 13%, and reduced manure volume of 10% compared to conventional nipple drinkers. Well-managed nipple drinkers (including nipple height changed every two weeks and flow rate) gave similar results to the improved nipple designs. PSC Annual Report 2002, Li, pg 23.
6. Cup or bowl drinkers waste less water, reducing spillage by 10-15%. Energy Efficiency in Barns, Part I Winter/spring 2001.
7. Water wastage has been measured at 25% of total water disappearance in grower-finisher pigs at Prairie Swine Centre, this is lower than the 40-60% estimated on commercial farms. Proper flow rates and nipple height could contribute to reduced losses. PSC Annual Report 2002, LI, pg 23.
8. Use wet/dry feeders in grow-finish. Wet/dry feeders reduce water used by 34%, and slurry volume by 20-40% compared with dry feeders and a bowl. Wet/dry feeders also increase consumption of mash diets compared to dry feeders and a separate water nipple, resulting in a 5% improvement in average daily gain. PSC Annual Report 2002, Christianson, pg 24.
9. Avoid high mineral water sources. High levels of sulphate in water results in an osmotic diarrhea but has no effect on animal performance. PSC Annual Report 1997, Patience, pg 26.
10. Feeding a diet containing excessive protein and/or excessive mineral levels results in increased water usage. PSC Annual Report 2002, Shaw, pg 33.
11. Temperature impacts water requirements. For every 1^{o}C above 20^{o}C results in a sow drinking 0.2L more water each day. Energy Efficiency in Barns, part I, Winter/Spring 2001.
12. Wasted water results in increased slurry application costs. Assuming grow-finish pigs waste 40% of water delivered to the nipple, 396L will be wasted per market hog. This will result in increased manure slurry produced and cost an additional $0.60 per pig in manure application costs. Energy Efficiency in Barns, Part I, Winter/Spring 2001.