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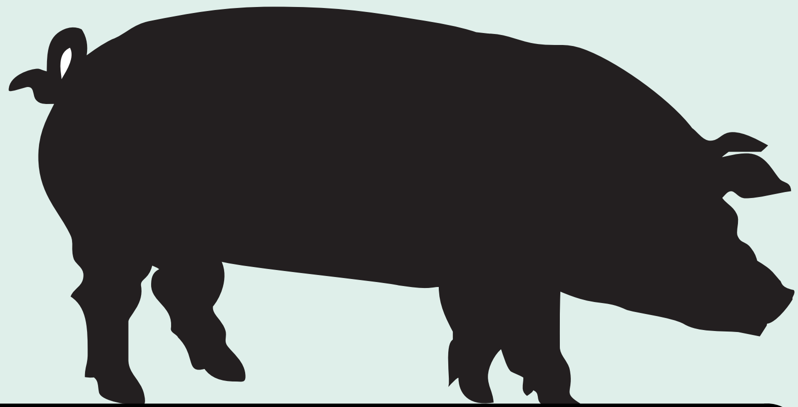

CENTRALIA SWINE RESEARCH UPDATE

January 26th, 2005

CENTRALIA SWINE RESEARCH UPDATE
Kirkton-Woodham Community Centre
January 26, 2005

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E. coli in Weaned Pigs

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Two types of pathogenic *E. coli* have been implicated in diarrheal disease in weaned pigs. One of these is called enteropathogenic *E. coli* (EPEC) and is not frequently associated with disease. However, the importance of this type of *E. coli* in post-weaning diarrhea (PWD) in pigs may be under-estimated as most laboratories do not attempt to detect them. EPEC attach intimately to the intestine by means of a protein on the surface of the bacterium and a recepto,r which is injected by the bacterium into the host cell and becomes integrated into the enterocyte apical membrane. Diarrhea develops because of destruction of absorptive microvilli, inflammation, and increased enterocyte secretion.

The second type of *E. coli* that causes PWD is enterotoxigenic *E. coli* (ETEC) and accounts for most cases of PWD. These bacteria adhere to intestinal epithelial cells by means of hair-like projections from the bacterial surface, called pili or fimbriae. Two types of fimbriae, named K88 (F4) and F18, are found on ETEC from PWD. The K88 fimbriae exist as K88ab, K88ac, and K88ad antigenic variants, but the K88ac variant is by far the most common. The fimbriae are needed for attaching the ETEC to the intestinal epithelium, thereby preventing the bacteria from being flushed through the intestine. Recently, another fimbria called AIDA (antigen involved in diffuse adherence), which has been associated with human pathogenic *E. coli,* has been shown to mediate colonization of the intestine of weaned pigs (3). Some AIDA-positive strains produce enterotoxins. Diarrhea is the result of the action of toxins called enterotoxins. There are three major enterotoxins, namely, heat-labile enterotoxin (LT), heat-stable enterotoxin a (STa), and heat-stable enetrotoxin b (STb). A single ETEC may possess one or more of the enterotoxins. The enterotoxins bind to receptors on the surface of the enterocytes and interact with host systems that regulate secretion of ions and water from the enterocyte. The effect is hypersecretion of fluid into the lumen of the intestine. A fourth enterotoxin, called EAST-I (enteroaggregative heat-stable enterotoxin I), is related to STa has been detected in many ETEC, as well as many other types of *E. coli*. Recent evidence suggests that LT may also play a role in colonization of the intestine of the pig (1).

Several serotypes have been identified as ETEC that cause PWD, but strains of one serogroup (O149) appear to be dominant worldwide (4). The genes for pili and enterotoxins are carried on plasmids and we have recently shown that genes for tetracycline resistance and STa are linked on a plasmid in certain O149 ETEC from PWD. Othere putative virulence genes are also present on this plasmid. Also, the genes for spectinomycin resistance in some O149 ETEC appear to move readily to plasmids that encode STa.

The importance of pili and enterotoxins in the virulence of ETEC has been well established. However, little is known about other bacterial products that may contribute to virulence and/or bacterial fitness. We are interested in obtaining a better understanding of virulence of O149 ETEC. In a recent study we demonstrated that recent O149 ETEC that were involved in severe outbreaks of diarrhea in weaned pigs had a delayed positive phenotype for utilization of urea – a phenomenon that had been reported in 1976 for certain Danish strains of O149 ETEC that lacked the K88 fimbriae but were associated with PWD (2). Our research is seeking to characterize the urease operon, to generate random mutations that affect expression of the urease operon, to create a urease-negative deletion mutant, and to assess whether production of urease affects virulence of the O149 ETEC in pig infection studies.

Random transposon mutagenesis was carried out and colonies that were urease-negative or were rapidly urease-positive were sought. Urease-negative transposon mutants were examined to identify the sites of insertion of the transposon. Mutants in which the urease operon was not the site of insertion were subjected to sequencing of the regions flanking the transposon. Several mutants that were examined all had the transposon inserted in the *guaA* gene, a gene that is required for synthesis of GTP, which is needed for transport of urea into the bacterium. One mutant which was rapidly urease-positive had a transposon inserted in a gene of unknown function immediately upstream of the urease operon. The insertion may have been in a regulatory area for the operon, or the unknown open reading frame could be an inhibitor of the urease operon. The delayed expression of the urease operon in the wild type O149 ETEC may be due to the presence of an inhibitor. When we cloned the seven genes of the operon into a plasmid that was introduced into *E. coli* K12, the K12 organism expressed urease without the delay seen in the O149 ETEC. However, when the upstream region as well as the entire operon was cloned and transferred to *E. coli* K12, there was no inhibition of expression of urease, indicating that the upstream gene was not encoding a repressor. Other mutants are being examined.

A urease deletion mutant has been created and will be used in comparisons with the wild type to assess whether urease affects virulence. The urease enzyme encoded by the operon converts urea to ammonia and carbon-di-oxide. The ammonia that is released may be directly toxic to cells, may reduce acidity, or may be a source of nitrogen for the bacteria. These properties could contribute to fitness and survival of the bacteria in the host intestine. Alternatively, they could be important in survival of the organisms in the environment of the pig.

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Genetics: Combining Molecular Information with Traditional EBV Information

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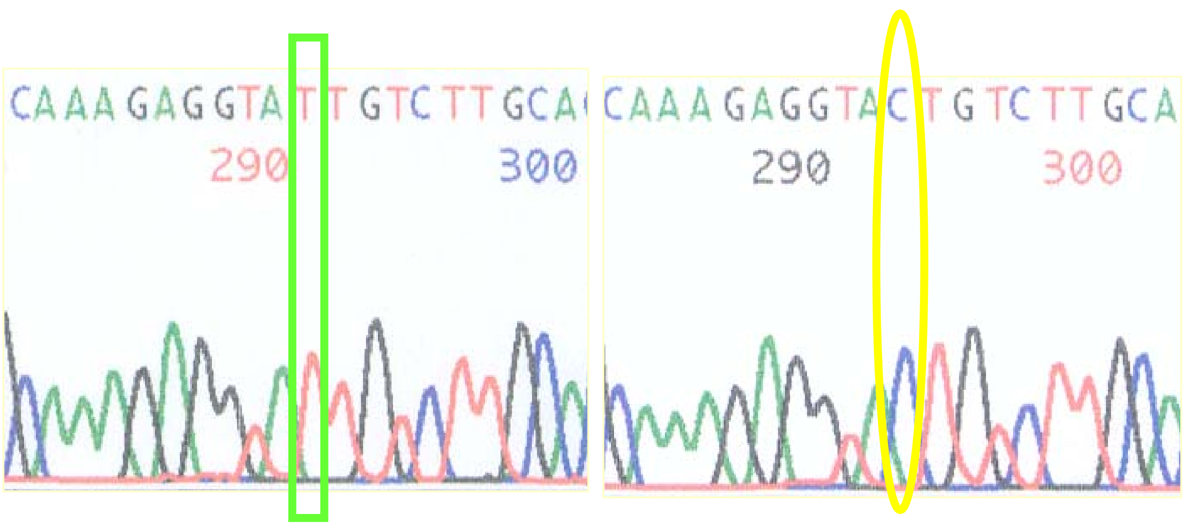
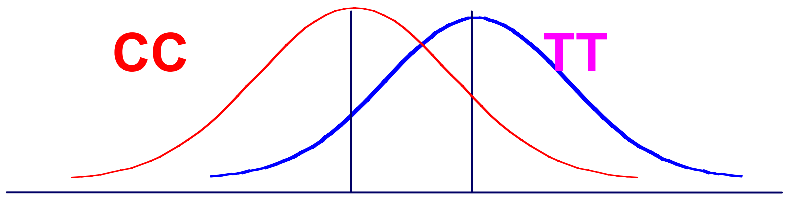
Traditional genetic improvement has achieved a lot of success through the time-tested methods of measuring the performance of pigs for specific traits and doing a statistical analysis on this performance information along with all available pedigree information to calculate the genetic value (estimated breeding value or EBV) of potential breeding stock. When we calculate an EBV, we assume that many genes influence a trait but we don't know or need to know which ones are involved as long as the trait responds to selection. Breeders have used EBVs very successfully and the lean, fast growing genetics that are available now are a result of the effective use of EBVs for selection. However, there are many traits that we can't easily or cheaply measure; traits that require post-slaughter processing (like meat quality traits) or traits that are measured on only males or only females (like litter size). If we can't measure traits easily or for all animals, then we often have less information and need to take advantage of ways to get more and better information about the animals we may want to select. A source of information for these kind of traits are molecular genetic markers; a flag or signal that occurs in an animal's DNA.

The ability to detect molecular genetic (DNA) markers has been routinely available for over 30 years but progress has been huge in the last decade. The latest example of this technology is the single nucleotide polymorphism (or SNP pronounced "snip"). The DNA alphabet consists of 4 letters called nucleotides. Substitution of one letter for another is a SNP. An example is shown below with the DNA sequence of a specific gene in a Yorkshire pig on the right and the sequence of the same gene in a Meishan pig on the left. You'll notice that the sequence is the same for both pigs except for the SNP which is shown by the overlaid box and oval.



This SNP above and most of the SNPs that we use as markers do not contribute directly to the differences that we see between pigs. However, these markers are located within or very close to the gene we are interested in and serve as a handle for identifying and selecting the pigs with the good version of the gene. Using these SNPs as markers, we can develop simple lab techniques to identify the markers connected to the good versions of the genes we are interested in. Like the example shown below, we hope to find a difference in performance between the two different groups of animals with the different SNPs.



For example, suppose we are interested in finding markers for meat quality traits. We would do a detailed meat quality study on a manageable group of pigs. For all of the pigs, we study connections between the differences in these SNP markers and the pigs that have the best meat quality. Once we have established a connection between good quality pork and a specific SNP in that manageable group of pigs, we can use that SNP marker to test all other pigs to see which of them have the potential for superior quality pork. All that is required is a blood, ear notch, semen or tail dock sample and a molecular genetic lab test. These tests can be done on pigs at any age so we can cut down on the time it takes to make decisions or we can reduce the costs of further performance testing by only focusing on individuals that have the potential to be great. Since a tissue sample doesn't require sacrificing the animal, we can determine the potential for meat quality and still have a pig that can be used for breeding. The test for the PSS or "halothane gene" is an example of such a test.

Research is proceeding to develop a large number of these SNPs so we can rapidly navigate our way to identifying many markers we can use for selecting pigs. Several groups internationally are working on sequencing the pig genome, much like the process to sequence the human and bovine genomes. Even though the pig genome sequence is not getting the same level of funding or profile, we can borrow a lot of information from the human and bovine genomes to help with our pig research. With this information, we can locate even more genes and their corresponding SNPs to increase our understanding of what makes a better pig.

Environmental Implications of On-Farm Deadstock Cremation

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Introduction

The disposal of normal on-farm mortalities, or deadstock, in the Canadian agricultural community is undergoing a period of uncertainty. While rendering facilities, in conjunction with licensed deadstock collectors, have traditionally received the larger on-farm mortalities, fear of prion-related diseases has dramatically reduced the market for meat and bone meal products. This has resulted in rendering facilities charging a fee for the disposal of carcasses where at one time the farm operators were paid for the benefit the by-products would bring. In addition, rendering facilities in Ontario no longer accept carcasses or parts of carcasses from certain animal species or carcasses that cannot be guaranteed to be free of sulpha-based drugs.

Farm operators are beginning to explore alternative disposal methods for on-farm mortalities, especially in the larger and more intensive farm operations where bio-security is more critical. Two methods that are gaining popularity are composting, and thermal incineration or cremation. Under the current regulation in Ontario, cremation is not a recognized disposal method for sheep, goats, swine, cattle, or horses. As part of current regulatory review, however, cremation may be included as an accepted disposal method for all livestock, provided that it does not have an adverse effect on the environment. To obtain an indication of the emissions of contaminants and their variability, two commercially available cremation units were tested using poultry and swine as feedstock, with triplicate runs conducted for each species in each units.

Experimental Design and Methods

Testing of two cremation units, the Eco Waste Solutions CleanAire cremator system (EW) (Eco Waste Solutions, Burlington, Ontario) and the Burn-Easy Model 37-1 (BE) (R&K Incinerator, Indiana), was conducted at the Arkell Research Station of the University of Guelph, Ontario. Both units came equipped with primary and secondary burners, used low sulphur diesel, and were rated at a nominal loading capacity of 250 kg.

The tests were performed in the second half of 2003. Each unit was run 3 times for both poultry and swine cremation, with poultry tests being conducted first, followed by swine. Prior to the swine testing, a load of swine was run through the cremation units, to condition the units before sampling occurred. Each sample was analyzed for selected compounds including particulate mater (PM), acid gases, metals, oxides of nitrogen (NO_x), sulphur dioxide (SO_2), and carbon monoxide (CO). In addition, analysis for dioxins and furans (PCDDs/PCDFs), co-planar polychlorinated biphenyls (co-planar PCBs), chlorobenzenes (CBs), pentachlorophenol (PCP), polycyclic aromatic hydrocarbons (PAHs), and other volatile organic compounds was conducted. Details of the test methods can be found in Environment Canada (2004a and 2004b).

Results and Discussions

Concentrations of NO_x (reported as NO_2), SO_2, and CO for the EW and BE units are given in Figure for the poultry and the swine runs separately. Each symbol is an average of 24 integrated half-hour samples (3 runs with 8 samples each). In all cases, NO_x, SO_2, and CO concentration were slightly higher for the BE unit than for the EW unit. However, both units performed better than similar UK units reported in AEA (2002) probably due to the BE and EW units being brand new while some of the tested UK units had seen up to 5 years of service.

Table 1 summarizes the measured concentrations of particulate matter, hydrochloric acid (HCl), and the more prevalent metals found in the exhaust stream. On average, the EW unit had less PM and HCL but higher metal emissions than the BE unit.

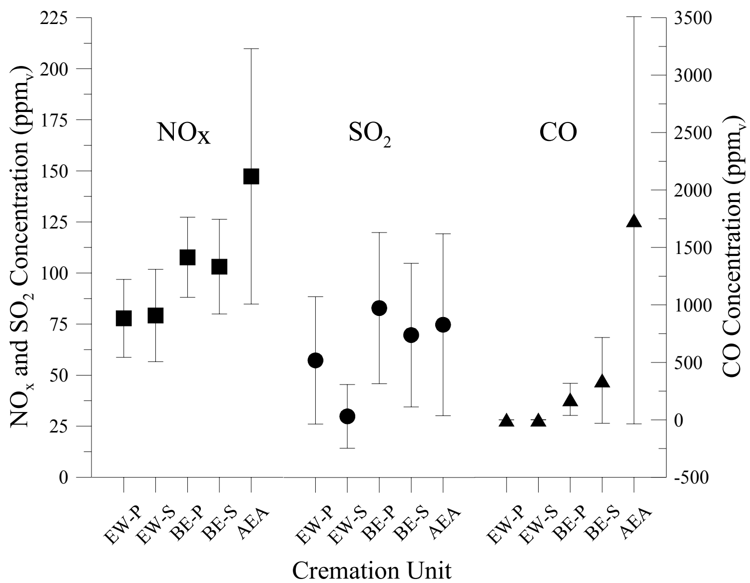

Figure 1: Concentrations of NO_x, SO_2, and CO adjusted to 11 % O_2. Symbols give the average concentration while the whiskers represent ± one standard deviation. (P - Poultry; S - Swine; AEA: average of data from 11 units tested by AEA) (2002)

Table 1: Summary of Particulate Matter, Hydrochloric Acid, and Metals

Pollutant	Units	EcoWaste CleanAire				Burn Easy Model 37-1			
		Poultry	Stdv	Swine	Stdv	Poultry	Stdv	Swine	Stdv
Particulate	mg/m^3	20.57	4.25	15.24	2.35	26.19	2.54	34.14	9.60
HCl	mg/m^3	41.70	8.33	41.70	7.31	49.50	14.55	58.10	25.03
Antimony	ug/m^3	31.57	20.64	4.42	0.49	0.18	0.07	0.17	0.08
Cadmium	ug/m^3	1.45	0.17	0.61	0.44	0.43	0.12	0.46	0.12
Chromium	ug/m^3	12.64	3.17	12.27	0.40	4.54	0.22	5.47	1.51
Copper	ug/m^3	202.00	39.93	129.21	33.48	13.66	2.87	16.21	6.99
Lead	ug/m^3	71.74	22.32	14.51	2.97	5.30	4.23	3.43	2.23
Manganese	ug/m^3	2.74	0.46	8.39	10.56	2.87	0.46	3.56	0.78
Selenium	ug/m^3	10.90	2.03	6.46	0.87	9.23	3.55	11.30	1.21
Zinc	ug/m^3	158.45	37.55	88.31	31.94	69.62	38.69	67.12	46.87

Values are expressed on a dry basis refernced to 25° C and 101.325 kPa

Values are an average of 3 runs and corrected to 11% oxygen

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How Different Systems Address Welfare Issues for Gestating Sows

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Introduction

The housing for gestating sows is one of the most controversial issues in farm animal welfare and swine production. The welfare status of animals in the various systems available is widely debated among swine producers, consumer and animal interest groups, and scientists. The approaches taken by different jurisdictions to implement changes in commercial production practices also differ widely and sometimes confuse the primary issue of ensuring animal welfare. In this presentation I will outline what I perceive to be the key welfare issues concerning sow gestation housing, and my experiences with various alternatives to conventional stalls.

Key Welfare Issues

Although freedom of movement is generally cited as the key welfare issue for gestating sows, this freedom is open to some interpretation itself, and several other welfare issues must also be considered in recommending a housing system.

Freedom of Movement: The Brambell Report (Command Paper 2836, 1965) stated the committee's opinion that 'An animal should at least have sufficient freedom of movement to be able without difficulty, to turn round, groom itself, get up, lie down and stretch its limbs.' This statement refers to what is often termed 'dynamic' space, or that space necessary to change postures and perform certain behaviours in place. Although this statement is made in the context of a discussion on natural behaviour, the emphasis arising from this listing of 'freedoms' is that of postural changes.

The Farm Animal Welfare Council (Webster, 1993) later expanded on this concept of space by stating that an animal should have the 'Freedom to express normal behaviour by providing sufficient space, proper facilities, and company of the animal's own kind.' It is important to note the shift from postural change to a more comprehensive expression of behaviour. I have suggested that the importance of freedom of movement arises from three needs of the animal: a sense of control over the environment; the opportunity to select the most comfortable micro-environment; and, benefits arising from increased exercise (Gonyou, 1996). Marchant and Broom (1996) demonstrated the later by examining specific muscles and bones in sow housed for several parities in either stalls and group housing. The muscles of sows kept in stalls were smaller, and their bone breaking strength weaker, than for those in group housing that provided for freedom of movement.

Freedom from Aggression: Non-stall systems generally require animals to live in groups and to be re-grouped with unfamiliar pigs several times during their lifetime. Aggression among sows arises for three major reasons. The first is the aggression associated with re-grouping. Pigs, to a greater degree than other farmed animals, will fight with unfamiliar animals in an attempt to either exclude them from the social group or to establish dominance over them. The second form of aggression is competition over limited resources, specifically feed. Sows are restricted to a limited amount of feed each day and competition can be severe. There is also a continuing low level of aggression within a group as animals maintain social order within the pen.

The aggression associated with re-grouping and feed competition is a major concern to producers. To a large degree the industry adopted gestation stalls to eliminate these types of aggression. Sows are frequently injured, usually in the form of scratches, during this aggression, but the damage is short-lived. Studies typically demonstrate a high level of scratches in group-systems for several days or weeks after re-grouping, but these heal by mid-gestation. Aggression associated with competition for feed will result in mild injuries throughout the gestation period, but more importantly will affect access to feed.

Control Over Individual Feed Intake: Over the past few decades we have amassed a considerable amount of knowledge on how to best feed sows. To achieve both high productivity and longevity it is necessary to limit the amount of feed that sows consume and maintain a certain level of body condition. Both fat and thin sows create problems. To achieve the desired level of body condition, typically expressed in terms of back-fat thickness, animals are periodically assessed and levels of energy and protein intake adjusted (Young et al., 2004).

To avoid the aggression associated with feeding, and to achieve control over individual feed intake in sows, the industry moved to first feeding, and then gestation, stalls. Producers remain committed to the importance of controlling feed intake, perhaps even more so with the high levels of productivity expected on today's farms. Overly thin sows are recognized as a welfare problem. To be acceptable, a housing system must ensure that timid animals are able to access sufficient feed.

Environmental Enrichment: The European Union has issued a directive that pigs should have access to manipulable material (Council Directive 2001/88/EC). In most cases this is straw. There are many benefits to providing straw or other forms of bedding to pigs, including thermoregulation, reducing hunger, protection from the floor, and increased activity. Had the EU not already required an end to stall housing, the need to provide environmental enrichment would have shifted their industry in that direction as well.

Much of North American pig industry exists in regions with little straw. Corn is the most common feed grain in North America and its stover is a poor bedding substrate. As a result the industry has moved to liquid manure systems, precluding the use of significant amounts of bedding. To incorporate environmental enrichment into sow housing, in the form of bedding, involves both supply issues and a change in manure handling.

Static Space: The Food Marketing Institute and National Council of Chain Restaurants have re-introduced the concept of static space as a welfare requirement (FMI-NCCR, 2002). Although they advocate freedom of movement as outlined earlier, they also state requirements in terms of space to lie comfortably and safely. Specifically, they indicate that sows in stalls should be able to lie on their sides without their udder extending into the adjacent stall.

During their productive life, sows may double in body weight. They also increase in size as their pregnancy progresses. Narrower stalls may be sufficient to meet the static space requirements suggested during a sow's early parities, or the first part of each gestation, but be unable to do so as she increases in size.

Alternative Housing Systems

Suggesting that we can classify housing systems as stall vs group is overly simplistic. Various housing systems have been developed to address the issues described above. Stalls are able to meet the needs of controlling aggression and feed intake, but fail in terms of space for natural behaviours. All group housing systems are challenged by their inability to completely eliminate aggression, but some types will accommodate the need to control intake and provide enrichment. My discussion will be focused on four systems that differ in how feed is presented to the sows. If you include management options such as floor type (slatted, partial slatted, and bedded), social grouping strategy (static vs dynamic groups), and the timing of re-grouping (weaning, pre-, and post-implantation) there are 72 combinations to consider. These should not be lumped together as 'group' systems in an analysis of sow housing options.

Floor Feeding: Many producers assume that group housing means floor feeding as this was the system they remember from before stalls. The group of animals is fed by spreading their feed on the floor or outside lot. This is a very competitive situation, with dominant sows able to monopolize the feed and subordinate animals encountering both social and nutritional stress. Control over individual feed intake is never very good, but some management options can be used to improve the situation. Forming groups of similar sized animals will result in more even competition for and distribution of feed. It is therefore important that all animals have similar feed requirements as well. To achieve these conditions, it is necessary to allocate animals into several groups, and the resulting group size is small. Floor feeding groups are generally managed on a static basis (animals are not added to already existing groups). Providing more space in the feeding area, and ensuring that the feed is widely spread, will make it more difficult for sows to claim a disproportionate amount of the feed. However, this additional space increases the cost of the system, and low cost is the greatest advantage of floor feeding.

A recent article in National Hog Farmer described a floor feeding system used on a large commercial farm (Miller, 2004). Some of the key components were that the sows were stalled for about 5 weeks before entering the group pens. This ensured that embryonic implantation was complete before re-grouping, and allowed the manager to feed the animals individually for several weeks. The animals were penned in groups of 5 animals sorted by size and parity to minimize the negative aspects of feed associated aggression.

The competition involved in feeding can be intense, and 10-15% of the sows may need to be pulled from such a system. European legislation is already suggesting that highly competitive systems will not be acceptable (Council Directive 2001/88/EC). Our industry has embraced the importance of good sow nutrition, and this can only be achieved when control over individual feed intake is possible. If we are required to adopt group housing, then floor feeding will be used by producers who are concerned about capital costs in the transition. But in the long run, systems that provide better control over feed intake will be necessary in order to achieve the productivity that we have come to expect on modern farms.

<u>Short Feeding Stalls or Trickle Feeding:</u> In the trickle system, sows are fed in partial stalls, providing protection to their head and shoulders, but not extending further into the pen area. This arrangement conserves space compared to feeding stall systems, yet still attempts to achieve uniform distribution of feed among sows within a pen. In each feeding space, feed in metered in at a set rate, representing the eating speed of the animals in the pen. Because feed is distributed at the same rate that the sow can eat it, no feed accumulates and it does not benefit a sow to move from space to space attempting to steal from other animals. The system may be operated with a single drop of feed, in which case it is called a short-stall system. Animals must be sorted by eating rate (sows eat much faster than gilts) and by feed requirement. The result is a number of small, uniform groups. Trickle feeding depends on social management of the animals. It has not been used extensively on large farms. Although popular for a time in the U.K., it is not widely used within the rest of Europe. Conventional stall barns have been renovated to incorporate an inexpensive, modified trickle feeding system. It is not clear that such modified systems can adjust the rate of feed drop in different groups, and the importance of this to the system has yet to be determined.

<u>Individual Feed Stalls:</u> Before our industry adopted gestation stalls, many farms used feeding stalls as a means to control individual feed intake. Although housed in a loafing area for most of the day, animals are moved into stalls for feeding. The system can easily achieve uniform intake among all members of a group, and sows requiring additional feed can be topped up by hand. Traditionally, sows have been housed in relatively small groups and the feeding stalls have been located within each pen. Larger groups are feasible, although provision must then be made for individual supplementary feeding. The greatest drawback to within pen feeding stalls is the requirement for both stall and loafing space. In our indoor systems, this added expense is substantial.

The feeding stall system can be made more efficient in terms of space and capital costs by 'time-sharing' the feeding stalls among several groups of sows. Each pen of sows is released from their loafing area in rotation and has access to the feeding stalls once a day. Although some mechanization of sow movement is possible, essentially you trade space and capital cost for labour. Sharing of feeding stalls in this way allows stockpersons to observe each group of animals as they go to eat, and various procedures, from treatment to pregnancy-checking or breeding can be accomplished easily while the sows are confined. Large herds can be managed in this way, using static social groups. However, sow movement to the feeding stalls resembles a stampede and facilities must be design for both animal and stockperson safety. Preliminary results from a study using large social groups and time-shared feeding stalls indicates that sows in groups had less lameness and fewer abrasions than did sows in conventional stalls, but had more scratches (Karlan et al., 2003, 2004). It is not clear if the reduction in lameness was due to the daily movement to the feeding area, or to the bedded loafing area for the sows in groups.

Electronic Sow Feeder: Electronic sow feeders provide the greatest control over individual feed intake of all group-housing systems. Each pen of animals has one or more feeding stations which animals cycle through and obtain their specific daily allowance. Each animal can be fed a different amount of feed, and may even be fed different diets or a blended ration of two basal diets. Daily feed allowances can be programmed to change as an animal progresses through pregnancy. Theoretically, all size and body condition combinations can be housed together as each can have a separate feeding program.

The electronic sow feeding system is a technically complex one, involving computer programming, electronic identification, and the mechanics of station gates and feeders. Early systems had many problems but most companies have now developed reliable equipment and support services. Nevertheless, a producer who is not adept at computer records should recognize that they would have to develop those skills to operate such a system effectively.

The relative cost of an electronic sow feeding system is highly dependent upon the number of sows fed from a station. The larger the number of sows, the lower the cost per sow. It is recommended that the entire group of animals be able to complete feeding in 14-18 hours. For mature sows, this limits the number of animals per station to 55-65. Gilts eat more slowly than sows, and the number of animals may have to be reduced if a group contains a large number of gilts. Increasing the number of sows beyond this point may result in increased competition and aggression at the feeder entrance, and more animals will miss a feeding. Attention must be paid to training animals to use the system, and to the daily checking of feed records to detect animals going off feed.

We operate an ESF system on partially slatted floors, without bedding. We are comparing static and dynamic (new animals added to existing group every 5 weeks) groups. We also add animals to the pens either pre- (within a week of breeding) or post- (6 weeks after breeding) embryonic implantation. We have found few differences between the static and dynamic social management options. It should be noted that dynamic groups do not have new animals added weekly, as some commercial operations would, but rather at 5 week intervals to reduce the frequency of re-grouping prior to implantation.

The pre-implantation treatment has reduced farrowing rates (by about 5%) compared to the post-implantation animals (Table 1). Overall productivity, combining farrowing rate and litter size, is reduced in pre-implantation animals, but does not differ among animals in stalls and those grouped after implantation (Tables 2 and 3). We attribute the reduction in farrowing rate to the stress of aggression following regrouping, and that this occurs during a sensitive period prior to embryonic implantation. There has not been any interaction of these main factors with the parity of the sow, indicating that young animals are not at a disadvantage in the ESF system.

Wider Stalls: Conventional gestation stalls are criticized for denying freedom of movement to sows. Although it may seem obvious that stalls will never provide freedom of movement as defined by some welfare advocates, as an industry we have done little to avoid criticism. When a 'turn-around' stall was developed in the 1980's (McFarlane et al., 1988), the industry failed to adopt it. Yet this stall did allow animals to 'without difficulty, turn around'. Also, even though mature sow size has increased over the years, until recently we have narrowed gestation stalls rather than widened them.

The Canadian Code of Practice suggests that sows should be housed in wider stalls as they increase in size with each parity (AAFC, 1993). Few producers manage their sows in this way. I suspect that many studies involving stalls have looked at animals only as gilts and young sows. Are we confident that productivity in older sows is not limited by stall size?

We are studying the relationship between sow and stall size and sow behaviour, and have initiated a long-term project looking at stall size and productivity this past summer. In our initial study we observed females from gilts to mature sows in stalls from 55-70 cm (22-28in) in width. Using the criteria suggested by the Food Marketing institute and National Council of Chain Restaurants, that sows should be able to lie on their sides without their udder extending into the adjoining stall (FMI-NCCR, 2002), we assessed the posture of sows during the 14th week of gestation.

We found that sows spent 50-60% of the time lying laterally, that is, on one side. The proportion of that time that their udder protruded into the adjoining stall was dependent upon both sow size and stall width (Figure 1). No definitive guideline has been given on the criteria for ‘protruding into the adjoining stall’. If we used a value of 50% of lateral lying time then a 70 cm stall would be sufficient for all animals, but a 65 cm stall would only be sufficient for the gilts and small (1st parity) sows. Whatever percentage is used as a criteria of acceptability, it is clear that this guideline would require wider stalls for larger sows.

Our studies will continue to look at productivity, behaviour and stress levels of sows in different widths of stall, but the industry should consider what they must do if they want to retain gestation stalls in a high welfare environment. Increasing the width of stalls, particularly for larger sows, would seem to be an appropriate action.

Table 1. Farrowing rate (% of bred sows that farrow) of gilts and sows in Stalls and various management programs within an Electronic Sow Feeder system[1].

		Pre-implant		Post-implant	
	Stalls	**Static**	**Dynamic**	**Static**	**Dynamic**
Gilt	81.8	71.4	71.7	74.1	75.5
1st parity	84.7	81.7	85.6	87.6	86.7
2nd parity	83.8	81.4	81.7	80.0	89.2
Mature	87.8	83.7	79.5	86.1	88.3
Adjusted[2]	85.0	79.8	79.1	82.3	84.9
Adjusted sows[3]	86.0	82.6	81.7	85.1	88.1

[1]Results of five reproductive cycles with new gilts added each cycle.
[2]Based on a theoretical herd demographic of 25% gilts, 20% 1st parity, 18% 2nd parity and 37% mature (approximates a 15% culling rate per cycle to a maximum 6th parity).
[3]Based on a theoretical sow herd run without gilts, as we have done for 3 cycles, with 27% 1st parity, 23% 2nd parity and 50% mature (approximates a 15% culling rate to a maximum of 6 parities).

Table 2. Litter size (liveborn piglets) of gilts and sows in Stalls and various management programs within an Electronic Sow Feeder system[1].

		Pre-implant		Post-implant	
	Stalls	**Static**	**Dynamic**	**Static**	**Dynamic**
Gilt	9.7	9.5	9.5	9.9	10.1
1st parity	10.6	10.7	10.1	10.6	10.5
2nd parity	11.0	10.8	11.7	11.2	11.3
Mature	10.8	10.7	11.2	11.4	11.1
Adjusted[2]	10.5	10.4	10.6	10.8	10.8
Adjusted sows[3]	10.8	10.7	11.0	11.1	11.0

[1]Results of five reproductive cycles with new gilts added each cycle.
[2]Based on a theoretical herd demographic of 25% gilts, 20% 1st parity, 18% 2nd parity and 37% mature (approximates a 15% culling rate per cycle to a maximum 6th parity).
[3]Based on a theoretical sow herd run without gilts, as we have done for 3 cycles, with 27% 1st parity, 23% 2nd parity and 50% mature (approximates a 15% culling rate to a maximum of 6 parities).

Table 3. Liveborn piglets per 100 sows bred for gilts and sows in Stalls and various management programs within an Electronic Sow Feeder system[1].

		Pre-implant		Post-implant	
	Stalls	**Static**	**Dynamic**	**Static**	**Dynamic**
Gilt	793	678	681	734	763
1st parity	898	874	865	929	910
2nd parity	922	879	956	896	1008
Mature	948	896	896	982	980
Adjusted[2]	895	834	845	894	917
Adjusted sows[3]	929	886	898	948	968

[1]Results of five reproductive cycles with new gilts added each cycle.
[2]Based on a theoretical herd demographic of 25% gilts, 20% 1st parity, 18% 2nd parity and 37% mature (approximates a 15% culling rate per cycle to a maximum 6th parity).
[3]Based on a theoretical sow herd run without gilts, as we have done for 3 cycles, with 27% 1st parity, 23% 2nd parity and 50% mature (approximates a 15% culling rate to a maximum of 6 parities).

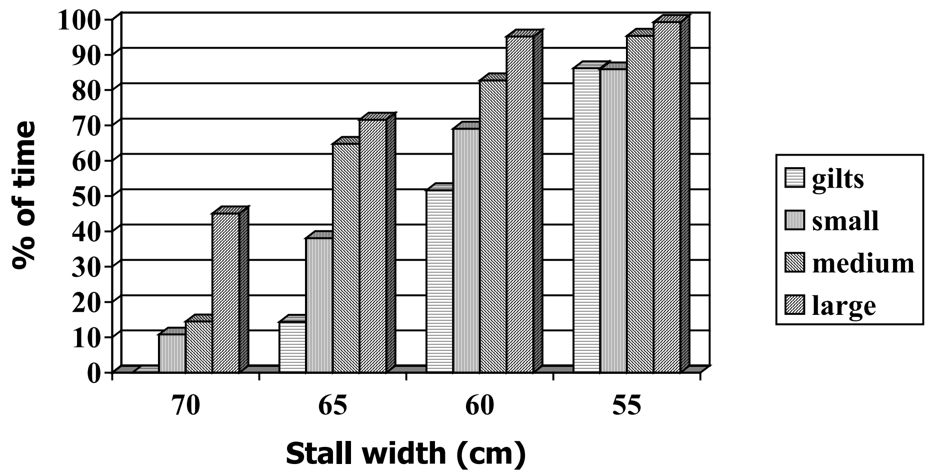

Figure 1: Proportion of time, of that spent lying laterally, during which teats extended into an adjacent stall for different sized sows in stalls of various widths in the 14th week of gestation.

Importance of Management

We experienced a number of management problems within our ESF system. Our sows were going lame at an unacceptable rate. We identified the problem as being slippery floors. We made some changes to the penning that shifted the dunging patterns off of the solid area, and installed sprinklers to facilitate cleaning of the slats. The problem was not one of the electronic feeding system, but of our management of the partially slatted floor.

We also encountered problems getting our gilts adequately trained prior to breeding. Our solution, taking into account the pig flow within our unit, was to wait until after implantation had occurred in our gilts before training them to the ESF system. These two experiences demonstrate that implementing a new system is often accompanied by other problems. Problems need to be analyzed and the appropriate changes made. The problems are often not with the group system per se, but with some peripheral component of the system.

Systems and Issues

None of the systems outlined completely address all of the issues identified. If 'freedom of movement' is consider essential, 'trumping' all other concerns, then a non-stall system would be required. Similarly, if 'freedom from aggression' were considered to 'trump' other issues, then stalls would be the only satisfactory solution. Basing the selection of a gestation housing system on a single welfare issue may lead to significant reduction in welfare according to other issues. Some 37 characteristics of housing systems have been identified that relate to sow welfare, and weighting factors for these have been proposed to allow comparison of different systems (Bracke et al., 2002). However, these weighting factors are very dependent upon the values of the scientists and experts setting them, and there will be considerable disagreement. Some modifications within a system may be appropriate to better address critical issues for that system; eg. wider stalls to allow greater freedom of movement, or low aggression social management for ESF systems.

The Future

Concern about the welfare of farm animals will ebb and flow with other societal issues. But it will not disappear. It would be prudent to thoroughly investigate alternatives and remain open to new systems that prove themselves both economical and welfare-friendly. A consensus among interested parties (producers, animal advocate groups, consumers) will be needed. Not all group housing systems are equal, and the industry should be careful not to accept single issue solutions.

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Salmonella in Swine Production: The Problems and Opportunities

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Each year, an estimated 1.4 million persons in North America are infected with *Salmonella spp*. (Arbeit 1995, Bean 1996), with greater severity of illness often observed in children (Stutman 1994), the elderly and those with compromised immune systems (Blaser 1981, Celum 1987). Therefore, *Salmonellae* are well established as a universal pathogen. Additionally, as a result of their ubiquity and zoonotic nature, they are also potentially important reservoirs of genetic material (Ausubel 1993). Pigs are an important reservoir of *Salmonella* for naïve pig populations as well as humans (Bush 1995, Gray 2002). There have been a wide range of prevalence statistics identified for swine herds ranging from 3% to 35% and from pork products and carcass contamination at 17.5% in Canada (Lammerding 1988).

Recently, *Salmonella* isolates that are resistant to one or more antimicrobials have presented treatment difficulties (Seyfarth 1997). Most notably, *Salmonella typhimurium* phage type DT104 has been described as both clinically important and multiply drug resistant (Threlfall 1993, 1999). Some recent reports have described multiple drug resistance in other *Salmonella* as an important event (Dunne 2000, Fey 2000). Additionally, emergence of *Salmonella* isolates that are resistant to cephamycins and extended-spectrum cephalosporins has been reported in the United States (Dunne 2000, Fey 2000) and swine in Canada (Allen 2002). These isolates carry a plasmid mediated AmpC-like beta-lactamase that hydrolyzes cephalosporins (Livermore 1995). This cephalomycinase (CMY) is encoded by the blaCMY gene (Bauernfeind 1996) of which at least 11 variants are known. An identical CMY-2 gene has been identified in isolates from both humans and animals (Fey 2000). *Salmonella* carrying the CMY-2 gene have been isolated from bovine, porcine, human, and foodstuff sources (Fey 2000, Winokur 2000, Zhoa 2001).

Swine production is the result of diverse management practices where each system or component can have specific antimicrobial uses (Friendship 2000). Bacterial resistance to therapeutics is neither a surprising nor a new issue. Infections caused by resistant bacteria may fail to respond to treatment, resulting in prolonged illness and greater risk of death (Gustafson 1997, Shryock 2000). For the swine production industry antimicrobial resistance can have even broader impact. When one considers where antimicrobials are used in swine production, what they are used for, the economic importance of antimicrobials, their impact on animal well being and their impact on food safety and quality, the importance of this issue becomes evident (Friendship 2000, Gustafson 1997, Shryock 2000).

Consumers are concerned about the safety or their pork and pork products and the prevalence of *Salmonella* in pork products ranks high on the list of concern. Consumers have now become concerned about production industries contributing to antimicrobial resistance (Corpet 1996, Falkow 2001, Isaacson 2002). While these concerns can be sensationalized, they do deserve some attention. It has been hypothesized that when a resistant *Salmonella* is introduced to a swine population that is receiving antimicrobials it will spread more rapidly and replicate to higher levels than if the antimicrobial was not present. This phenomenon would create an important direct, amplified food safety and environmental risk from the combined presence of *Salmonella* and antimicrobials than either factor would alone. Because of the common use of antimicrobials in the swine industry and the ubiquity of *Salmonella* in swine, this could have a significant negative impact on swine industry over time. However;

- Recent research in our laboratory indicates that multiple antimicrobial resistance in Salmonella isolates does not necessarily lead to increased transmissibility regardless of antimicrobial selective pressure. Additionally, a sensitive salmonella strain can survive and transmit efficiently between animals even with antimicrobial selective pressure at MIC levels.

The swine industry has some opportunities associated with concerns over *Salmonella*. The development of reliable and appropriate detection technology for *Salmonella* along with new testing and implementation of food safety control and mitigation strategies is an important approach. This approach will provide the Ontario Pork industry with tools it needs to move forward with Salmonella control without drastic alterations in management. Additionally, Ontario now has state of the art research on antimicrobial selective pressure and *Salmonella* in swine. This topic is driving consumer concerns worldwide yet there is little or no data supporting or refuting the concepts and how producers can manage the problem. Our goal is to provide producers with these management tools.

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Swine Influenza Virus – Pigs to Humans

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Swine influenza was first recognized as a new disease entity in the United States in 1918. At this time (1918-1919) the Spanish flu pandemic was wreaking havoc in the world claiming an estimated 40 to 50 million human lives. It was observed that the clinical signs exhibited by pigs were very similar to the signs presented by people affected by the human influenza virus.

Swine influenza virus (SIV) has been endemic in the US swine population since 1918, however in Ontario it wasn't until 1981 that the first classic swine influenza outbreak was recorded. Since 1981 sporadic outbreaks of swine influenza have occurred in Ontario typically in the fall and winter. These outbreaks are characterized by high morbidity but low mortality and clinical signs such as a barking cough, fever, lack of appetite and lethargy. As quickly as the virus enters a herd it leaves and thus pigs recover within two weeks of the initial outbreak.

Recently an endemic form of swine influenza has been recognized in Canadian swine herds. This form results in chronic, low grade respiratory disease in nurseries and / or grow-finish barns and may occur year-round as opposed to the more seasonal acute outbreaks. The endemic form of SIV may be mild in nature but the severity of the respiratory disease can increase dramatically in the presence of the more common PRDC pathogens i.e. *Mycoplasma hyopneumoniae* and PRRS virus. The reasons for why the clinical presentation of SIV has changed during the past few years is unknown, but it's likely that larger farms, pig flow and population dynamics within barns have each played a role.

In addition to being an economically important cause of respiratory disease in swine, SIV is a human public health risk. Influenza viruses can be transmitted directly from pigs to people, and vice versa, from people to pigs. There have been approximately two dozen documented cases of zoonotic transmission of swine influenza viruses to people. However, it is highly likely that numerous people associated with swine production have contracted swine influenza virus from pigs. The clinical signs of influenza in pigs and people are very similar thus a swine influenza infection in a human would probably be diagnosed as human influenza by a physician. Evidence of transmission of human influenza virus to pigs has been confirmed by the presence of human genes in some swine influenza isolates.

As well as being susceptible to infections with human influenza viruses, pigs are susceptible to infections with avian influenza viruses. This is because cells in the swine respiratory tract express receptors for both human and avian influenza viruses. Pigs are believed to serve as the "mixing vessels" in which avian and human influenza viruses can exchange genetic material (i.e. reassortment). In general, avian influenza viruses do not readily infect humans, although there have been exceptions such as the current situation in Asia where at least 32 people have died from H5N1 avian influenza. Fortunately it appears that human to human transmission of this deadly avian virus has not occurred thus far. A major concern, however is that this virus may co-infect swine harbouring human influenza viruses and undergo genetic reassortment to produce a novel influenza virus readily transmitted between people that may initiate the next global influenza pandemic. There is speculation that the Spanish flu pandemic of 1918-1919 mentioned previously was the result of an avian virus undergoing reassortment with a human virus possibly via swine.

The monitoring and minimizing of interspecies transmission of influenza viruses is in the best interests of both human public health and animal health.

Potential for Large Groups and Auto-Sorting of Grow/Finish Pigs

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Introduction

Conventional management of grow-finish pigs has been in groups of 30 or fewer pigs in a pen. Group size has often been determined after selecting a feeder type, and thus groups of 24-28 for a two-space wet/dry feeder have been common in the past decade. However, larger operations have resulted in hundreds of animals being weaned simultaneously and moved into nursery and eventually grow-finish facilities. Even after sorting these animals by sex, it is possible on many farms to have several hundred males and females available for placement at one time. Keeping animals in groups of 100 or more has the potential of reducing housing, specifically penning, costs and giving producers more flexibility in building design and management.

In the past, professional judgment would have urged caution in adopting large group management. Concerns were expressed about growth performance, variability, morbidity and vices (English et al., 1988). Because these opinions were formed when large groups meant that pigs from several farms and weeks were mixed together, we should now question the advice to keep groups small. In addition to being assured that good productivity is possible, we must also learn how best to manage pigs in large groups. As the industry moves toward this change in systems, we have encountered challenges, but also great potential in new management approaches.

Productivity

Two recent reviews of studies on large groups for wean-finish pigs (Wolter and Ellis, 2002; Turner et al., 2003), as well as analysis of our own data from the Prairie Swine Centre (Samarakone and Gonyou, 2003; Street et al., 2005), have reached similar conclusions concerning the effect of large groups on productivity. Managing pigs in large groups of 100 or more will result in a reduction in average daily gain of 1-2%. In general the reduction occurs during the nursery or grower phase. Our own data suggest that the reduction takes place during the first 2-4 weeks after the group is formed (generally the nursery or grower phase) and that gain is equivalent in large and small groups thereafter. Greater emphasis on the management immediately after group formation is needed and may reduce this problem.

Other aspects of productivity show little or no response to large group sizes. The variability of weights within a weekly weaning group is similar at the time of marketing in both large and small groups. The proportion of pigs removed for health reasons has also been reported to be similar in the studies reported. In fact, several studies and reports from producers suggest that morbidity may be reduced by up to one half in large groups. Outbreaks of behavioural vices, such as tail biting, have been anticipated, but not forthcoming as researchers and producers adopt large group management.

In short, any loss in productivity in large groups appears to be small, and is likely offset by advantages in facility costs and flexibility of management. We need to improve our care of the animals at the time of regrouping, hoping to reduce the temporary reduction in growth rate. But there are other aspects of management that we recognize need to be addressed.

Social Management

We have studied the level of aggression when large groups are formed. It is not any greater than in small groups, and many pigs are able to escape fighting altogether. Pigs in large groups also develop a ‘tolerant’ attitude to strangers. New pigs can be added to the group with little ensuing aggression. This is true both within the large pens, and also in separate pens similar to temporary holding facilities. I have seen market weight pigs from two large groups combined in holding pens prior to loading with no evidence of aggressive behaviour. The use of large groups may have significant positive implications for the social management of animals going to market or remaining behind on the farm. It may also be the case that animals from large grow-finish groups will better adapt to group housing systems for the breeding herd.

Facility Design

Managers of very large groups (over 500 pigs) have reported that lying and dunging patterns are very consistent. Pigs lie against the wall or pen dividers, and dung in the centre of the pen. It is tempting to suggest that a partial slat system could be used in barn design. However, experience with remodeling existing partial-slat facilities suggests caution is necessary. One feature of large groups is that space utilization can change considerably as pigs grow to fill the pen. My experience has been that it would be unwise to attempt to renovate partial-slat facilities from small to large group pens. Poor dunging patterns may become established early, resulting in unacceptably high levels of ammonia and increased labour costs for cleaning.

It has been suggested that large groups of pigs will require less space/pig as animals have more free space to share. A recent study at PSC confirmed that both large group size (>100) and crowding (k<0.035, where k=$m^2/BW^{.667}$) reduced gain by about 4%, but there was no interaction (Street et al., 2005). That is, pigs in large groups required as much space/pig as did those in small (18 pigs).

Day-to-Day Management

One of the biggest changes to management is that of health and feeder checks. Whereas many technicians will inspect small pens from the centre alley (even when encouraged to enter the pen), this is impossible with large groups. Entering the pen is necessary to inspect both the pigs and the feeders. Typically the technician will enter the pen and follow a circuit that takes them by each feeder and into most areas of the pen. In Fact, a thorough inspection of animals and feeders takes less time in large group pens than an inspection of a similar number of pigs in small pens. However, the technician must be prepared to fend off a large number of pigs that crowd around during this inspection. Whenever possible, two or more technicians should work together to ensure safety.

Treatment of animals in large groups would, on first impression, be problematic. How does one catch and inject an animal requiring treatment? However, pigs in large groups are generally approachable, and particularly so when ill or lame. Animals may be herded out of the pen and retained elsewhere for repeated treatment. Others have reported that pigs requiring treatment are easy to find as they generally seek out protected areas of the pen, such as in a corner out of the traffic flow.

Sorting and Handling

Handling large groups can be difficult, particularly if facilities are not adequately planned. In order to gain the advantage of reduced capital cost, including less penning, producers may have gone too far. It is important to have sufficient penning, strategically placed, that pigs can be controlled for weighing and sorting. If pigs remain in their large groups when moved to a scale or shipping area, then hallways should be wider than in conventional small-group barns. Doorways should be wider as well. Otherwise pigs will bunch up and you are better off moving small sub-groups. When moving any group of pigs it is important to balance driving from the rear with letting them move on their own into an attractive space ahead of them. In the case of large groups, driving from the rear should be restricted to closing off return access to the pen. Working the front of the group will usually be the better method. Working within the pen, it will be harder to prevent animals from coming back past you as you cannot control the entire width of the pen. However, by providing properly sized hallways and holding pens, it is possible to greatly improve handling of large groups.

Having recognized that handling can be a problem, the question of sorting becomes very important. Most of our systems require frequent and precise sorts, meaning that animals must go across a scale. If a manual sort is done, that is pigs are driven across a scale, the facilities must be very well planned. The use of a circular 'tub' with crowding gates to move animals into a short single file chute into a scale would be well worth the investment in terms of saved time.

The development of intensive large group management has led to use of electronic sorting technology. In this case an electronic scale and sorting device is positioned such that pigs will voluntarily pass through it during their daily activity, or may be herded through during a 'forced' sort. The market weight animals are diverted to a separate pen where they remain until shipping.

The most automated forms of this system sort pigs continuously, maintaining a group of market pigs at all times. Combining auto-sorting with multiple marketings a week can result in a very high percentage of pigs within core. Typically the sorter provides a print-out of the weight distribution of all pigs passing through it, allowing the manager to schedule future marketings with a great deal of accuracy.

Large Group/Auto-Sorting

Combining large group management with auto-sorting technology is becoming a popular system as it allows continuous sorting of animals and efficient use of relatively expensive equipment. The most common system at present is to manage pigs in large groups throughout the wean-to-finish or grow/finish production phase. This works well with operations that typically fill barns with 500-1000 pigs.

In long-term large group systems the sorter is typically placed at a key access point. Most manufacturers recommend using a 'food-court' that pigs must enter whenever they want to eat and then return to the lying area. In this case pigs pass through the sorter to enter the food-court. Pigs in small groups typically have 10-15 meals/day. With sorters and food courts, pigs typically pass through the sorter three times a day (for 500 pigs/pen there will be 1500 'hits'). Once inside they may have two or more meals with a short break between each. If 'hits/pig' is less than 3, the system should be monitored closely as this would normally indicate inadequate feeding activity.

There are two methods advocated to 'train' pigs to pass through the sorter. In the first case, the only access to the food court is through the sorter. Pigs must be herded through this point for the first few days in the system in order to learn the task. It is important that this training be taken seriously, as pigs that do not learn the system will refuse to enter the food-court on their own, loose weight, and have to be removed. However, training should not consist of driving pigs through the sorter, but rather gradually crowding them towards the entrance and letting them enter voluntarily. Extensive use of gates within the pen is needed. The advantage of this approach is that pigs are using the sorter from the beginning. Sorting pigs by weight for access to different feeds is possible. Numerous producers in the U.S. use this method to provide Paylean to a specific weight range of pig within a larger group.

The second method of training is to have numerous access points to the food court and gradually close them off until they can only use the sorter. Only 1-2 gates are closed per week, and pigs need not pass through the sorter until they are nearly at market weight. In this system the pigs 'train themselves', and starve-outs are few. The sorter can also be set open, avoiding wear and tear, for several weeks into the finishing period. The disadvantage of the system is that you cannot sort animals for nutritional management until training is complete.

Farrow-to-finish operations, typically producing fewer pigs per week, are expressing interest in forming large groups late in the finishing phase. For the most part these producers want to use auto-sort technology without having to purchase a sorter for each weekly cohort. Regrouping pigs late in finishing in conventional small groups results in a slowing of growth for about two weeks. The net set-back is 2-4 days. We have little data from large groups. A key to any such regrouping is that pigs have ready access to feed and water. The increased space and group size itself will likely reduce the effects of aggression.

Producers with conventional small pen systems are reluctant to tear out their penning and use large groups throughout. Interest has been expressed in providing a large-group sorting pen that pigs would enter as they approach market weight. The pen would be operated on a dynamic basis, with animals added and removed each week. As pigs would only be in the large group for a few weeks, and would need to have ready access to feed throughout, training to the point of pigs using the auto-sort on their own is unlikely. In this case, it would be best to provide multiple access points to the food court, and sort once a week. Sorting would consist of closing off all access except the sorter and gradually crowding pigs to the entrance over the day. Numerous gates would be required to gradually crowd pigs to the entrance. The final few pigs would have to be forced through or sorted by hand. A diagram of such a system is presented in Figure 1.

An alternative developed by one sorter manufacturer is to retain the small pens within the room but allow pigs to flow through the system through a series of one-way gates and the sorter. The sorter is placed in the alleyway and can direct pigs to a pen on either side. All pens would have one-way gates that would prevent them from returning to a pen once they pass through. They would gradually be directed towards the sorter. On sort days, pigs would gradually be driven through the one-way gates and crowded towards the sorter. A diagram of such a system is presented in Figure 2.

Conclusions

Large groups of grow-finish pigs represent a new development in swine management. Productivity can be maintained at a high level, and any decrease is probably offset by reduced costs. The key to good management is to understand how to handle large groups and to design appropriate gating and penning arrangements. The use of electronic sorters is likely to become standard for very large groups. Training the animals to use the sorters is critical, but once accomplished, the sorters can be used to incorporate new management possibilities such as phase feeding and grid sensitive marketing.

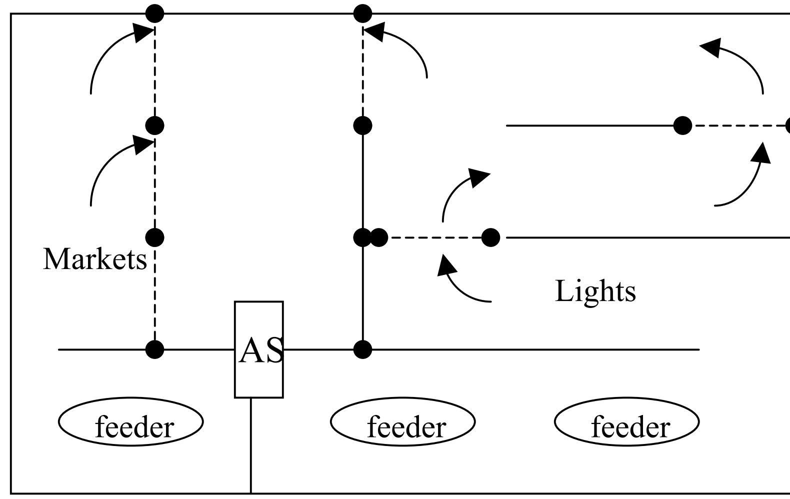

Figure 1. Large group pen set up to direct pigs through auto-sorting device. Dotted lines are swinging gates used to gradually crowd pigs. AS is the auto-sorting device. Market pigs sorted to left, and light pigs to right.

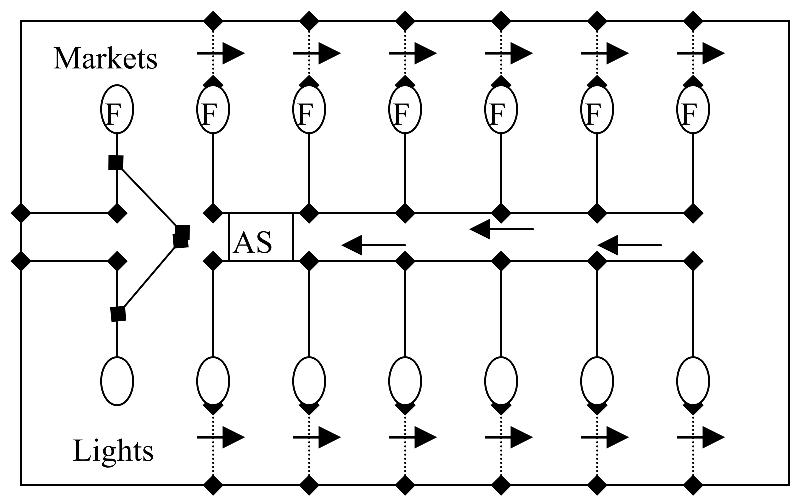

Figure 2. A 'small' pen room equipped to auto-sort. One-way gates are gradually closed off on the 'market' side, and pigs are herded through the 'light' side to achieve a sort. F-feeder. AS=auto-sort. (Adapted from Farmweld).

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Transporting Finisher Pigs in the Ideal World

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Ideally all pigs that reach market weight and remain healthy will be transported from the farm to the packing plant and from the holding pens in the packing plant to the processing area in a healthy state. In 2001 in Ontario 0.17% or 17 of every 10,000 pigs died some time between leaving the farm and arriving at the processing area in the packing plant. This represented 7,969 pigs out of the 4.7 million that were marketed. Of these, 1212 were classified as subject which means that they were not normal at the farm or sometime during transport or arrival at the plant.

Producers who ship less than 2,000 pigs have higher losses than those shipping more pigs. Approximately 65% of producers shipped less than 500 pigs. Most producers (75%) who lost a pig in-transit lost fewer than 6 pigs during the year.

During 2001 dry temperatures seldom went above 30º C in the summer months of June, July, and August, and the maximum temperature was in June (33º C). Humidity in the summer averaged 64.1%. Death and subject classification were greater in the summer months with the highest levels again in August. A pigindex can be calculated that functions for pigs something like the humidex does for people. This measures what the temperature "feels like" taking both the temperature and the humidity into account. Based on the pigindex calculations, August 2001 was the most uncomfortable month (Hahn et. al 2003). In that month, 1,617 pigs died and 195 of those were classified as subject. A temperature of 27^{o}C at a very low humidity < 15%, will have the same impact as a temperature of 23^{o}C with a humidity of > 75%. Pigs transported under these conditions will have a incidence ratio of in-transit deaths that is 4 times higher than if pigs are transported at low humidity with a temperature of 20-23^{o}C or high humidity with a temperature of 17 - 19^{o}C.

Approximately 74% of all shipments to packers involved a distance greater than 200 km. Distance alone did have an effect on deaths or subject classification. The in-transit loss ratio was 23 times higher for loads with a subject pig than in loads without a subject pig.

Approximately 56% of pigs that die in-transit are found dead on the truck. This might lead people to believe that the transporter was responsible for a large portion of the in-transit losses. However, by looked at the random variation due to producer, transporter and packer, we can determine which level explains most of the extremes of the in-transit losses. The random error variance was 0.99. The highest level of variance based on the clustering of pigs was at the producer level (estimate= 0.47). This was slightly lower at the packer level (estimate= 0.32) and lower still within the transporting company level (estimate= 0.15).

Other research suggests that producers can reduce in-transit losses by taking pigs off feed for a few hours before loading them onto the truck, getting pigs used to people by walking the pens, teaching pigs to move through gates and hallways by moving them during the grower-finisher phase, and setting up the load out facility to reduce stress. Some important concepts to keep in mind are to keep the alley and halls very well lit, have pigs move from a darker area to a lighter area, allow pigs to move together rather than in single file and ensure that the ramp is not slippery and is at an angle of less than 30 degrees.

Take Home Message

- Pigs are affected by both temperature and humidity
- Reductions in density of pigs on trucks must take both heat and humidity into account
- Farm of origin accounts for more variation due to in-transit loss than does transport company or packing plant
- Producers must implement changes in genetics or handling or feeding practices to reduce in-transit losses
- Pigs travelling large distances did not experience higher in-transit losses than those travelling shorter distances

Acknowledgements

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Campylobactor AMR Pattern - Sentinel Herd Project

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What is "Campylobacter"?

The word may be familiar to many older pork producers because we used to believe that bacteria called Campylobacter were the cause of porcine prohiferative enteropathy (PPE) or ileitis, a disease that can cause diarrhea and slow growth rate in grower-finisher pigs. We now know that PPE is caused by another bacteria "*Lawsonia intracellularis"*.

Campylobacter sp can be found in the pig intestine and isolated from pig manure but these bacteria do not appear to cause disease in pigs. So why are they important? The most frequently diagnosed food-borne bacterium causing human illness is Campylobacter. Symptoms of campylobacteriosis usually occur within two to 10 days of ingesting the bacteria. The most common symptoms include mild to severe diarrhea, fever, nausea, vomiting, and abdominal pain. Most people infected with Campylobacter can get well on their own without treatment, but antibiotics may be necessary for severe cases.

The purpose of our research

We set out to find how widespread Campylobacter is in the Ontario pig population and to determine which species of Campylobacter are present. In addition we were interested in determining what the antibiotic resistance pattern of Campylobacter was because there is a great deal of concern that fluoroquinolone antibiotics used in human medicine to treat cases of campylobacteriosis are becoming ineffective due to the development of resistance by Campylobacter.

Our research findings

Eighty farms were selected to represent the wide variety of pig farms in Ontario. The farms were visited between January and June 2004. Fecal samples were taken directly from the rectum of 10 finisher hogs close to market weight and five samples were collected from the pen floors. These 1200 samples were submitted to Veterinary Laboratory Services, University of Guelph for culture and testing of antimicrobial resistance.

Campylobacter sp were cultured from over 99% of the samples, and almost all isolates were identified as *Campylobacter coli*, with only a single isolate classified as *Campylobacter jejuni*. Interestingly most of the Campylobacter isolated from poultry and from human cases are identified as *Campylobacter jejuni.*

The percentage of isolates resistant to various antibiotics are listed in Table 1. We found very little resistance to fluoroquinolones represented in this table by ciprofloxacin. This is in contrast to European countries where isolates of Campylobacter from pigs are often resistant to fluoroquinolones. A recent study from Spain suggests almost 100% of the isolates are resistant.

Table 1. Antimicrobial resistance (%) for Campylobacter isolated from Ontario Finisher hogs.

Antimicrobial	Resistance (%)
Ampicillin	30
Azithromycin	94
Chloramphenicol	0.5
Ciprofloxacin	3
Clindamycin	84
Erythromycin	84
Gentamicin	0.2
Nalidixic acid	26
Streptomycin	68
Tetracycline	44
Sulfamethoxazole	61

Significance of the Research

This work suggests that pork is not likely an important source of human campylobacteriosis because the predominant species in pigs is different than the species that most commonly causes illness in humans and the antimicrobial resistance pattern of the pig Campylobacter is different than the Campylobacter most commonly isolated from human disease.

Acknowledgements

The Laboratory Services staff who performed the culture and antimicrobial resistance work including Dr Joseph Odumeru, the lab director, Dr Susan Lee, and Carolyn Larkin and others, were instrumental in the success of this project. Financial assistance was primarily from the Ontario Ministry of Agriculture and Food. We wish to thank the 80 Ontario pork producers who cooperated in this study and Bryan Bloomfield, Arturo Ruiz and the others who helped collect the samples.

Condemnations at Slaughter; Preliminary Analysis of Ontario Data

Kathy Zurbigg, Surveillance Analyst, Ontario Ministry of Agriculture & Food

The relationship between packers and producers has historically had an "us versus them" theme. Producers complain that although they ship perfectly healthy market hogs, the packers either trim or fully condemn a percentage of the carcasses. However, at slaughter the packer finds a percentage of poor hogs, which slows down the processing line and increases production costs. The majority of the trims and condemns of carcasses are done more to preserve the wholesome image of Canadian pork rather than for food safety reasons.

The objective of this study was to investigate the condemnation rate and the reasons for condemnation of Ontario hogs, and to determine if problem areas could be targeted and solutions provided to reduce carcass condemnations.

After analysis of 2003 market hog data, the overall condemnation rate for Ontario was 0.25-0.30% or 2.5-3.0 hogs per thousand slaughtered. A 1996 study done in Ireland stated that country's market hog condemnation rate at 0.7% of all carcasses slaughtered that year. (1) The Ontario data were then broken down to examine the reason for condemnation. The top four reasons for condemnation at slaughter in Ontario were abscesses (40%), peritonitis or inflammation of the lining of the abdomen (15%), arthritis (13%), bruising (5%), pneumonia (4%), with all other reasons for condemnation totaling 23%. Studies done at slaughter in both the United Kingdom and the United States state that abscesses are also the most common reason for full and partial condemnations. (2,3) Numerous studies have been completed which investigate the location of abscesses that resulted in partial or full condemnation at slaughter. The order of the predominant locations of the abscesses varied somewhat depending on the study but the top two locations were the same, either superficial (eg neck, sides or legs) or in the spine and pelvic region. (1,4,5,6) In general all studies indicated that most superficial abscesses develop from injections or injuries sustained during fighting or sharp edges on gates or feeders. Tail biting or unhygienic tail docking or castration practices leading to infection were commonly listed as the cause of abscesses in the spine or pelvic region. Correspondence and discussion with CFIA veterinary inspectors confirms that this is also the situation with market hogs in Ontario.

The condemnation data for 2003 Ontario market hogs were then broken down by farm and categorized as those that were under the provincial condemnation average, those that were at the condemnation average and those farms that were above the condemnation average (Table 1).

Table 1. 2003 Ontario Market Hog Data by Comparison to Provincial Condemnation Rate

Comparison to provincial condemnation rate	% of Ontario pork producers	% of Ontario pigs shipped	% of condemns	Farm size (based on number of hogs shipped in 2003)
below average (<0.2)	66	54	19	1-21,000
Average (0.2-0.3)	9	16	16	300-23,000
higher than average (>0.3)	25	29	65	4-28,900

As presented in Table 1, the farm size was not a factor in predicting where the majority of condemnations are coming from. Farm size ranged from very small to large in all of the categories. Interestingly, 80% of those farms with either 0% condemned or over 1% condemned were small farms that shipped under 500 pigs during 2003.

Twenty farms with high condemnation rates, were then selected to be visited in an attempt to discover if there was a common link or problem amongst these farms. On contacting farms to arrange visits, it was discovered that many of these farms had significant health problems as well as a high condemnation rate and had taken steps to correct the problem. This involved changing the source of their pigs, closing out problem barns and changing herd health strategies. Visits to the remaining farms produced several common threads including a high rate of treatment for various diseases during early growth stages and the pigs were regrouped many times after weaning due to space restrictions in pens. Overall finishing pigs on these farms looked healthy and in good body condition. However it seems possible that the more pigs that recover after being sick and receiving treatment, the more condemnations that occur at slaughter.

Two packing plants in Ontario were also visited. Market hogs can be broken down into four categories: carcasses with no defects, carcasses with defects that are trimmed out with no demerits to the producer, carcasses that are trimmed or partially condemned that result in demerits to the producer and carcasses that cannot be salvaged and are completely condemned with no payment to the producer. Carcasses in the last three categories cause slower processing line speeds as they must be derailed and moved into the held area for special trimming. Lost time is lost money and ultimately the packer does not want these carcasses on the line. However, once they have come through the processing system to the point of the veterinary inspector, the plant already has money invested in the carcass which causes them to try hard to condemn the least amount of meat possible. Producers would be surprised to see how often pigs are derailed and trimmed without any losses occurring to them.

Summary

- Majority of pigs that are condemned look healthy to the producer and the packer before slaughter.
- It seems plausible that the more sick pigs on the farm the higher the condemnation rate.
- The possible key to condemnation reduction is prevention of disease rather than treatment of problems after they occur. Work with your veterinarian on other disease prevention strategies.
- Infections of wounds from fighting, tail biting or unhygienic tail docking or castration have been demonstrated to cause abscesses in the spine and pelvic region. Reducing the number of these abscesses could reduce condemnations. Storing tail docking and castration tools in disinfectant rather than on a dirty shelf could aid in this reduction.
- Losses due to condemnations should be included in the cost of treatment when comparing the total cost of treating sick pigs versus the cost of prevention of disease.

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Saving Piglets to Make Money

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Piglet mortality can be a frustrating problem, but small changes in farrowing/nursing practices can help improve the situation.

Many factors lead to preweaning mortality, such as trauma, chilling, starvation, scours as well as unpredictable events. Over 60% of preweaning deaths occur in the first 4 days of life (Cutler et al., 1999). Thus, good supervision during this early nursing period is very important for improving the profitability of pork producing operations. Piglet viability is directly related to litter size, liveweight and the duration of uterine contractions the piglet is exposed to, which decreases gas exchange across the placenta (Zaleski and Hacker, 1993).

Piglet viability is also highly related to ambient temperature and the piglets' capacity to withstand chilling via its ability to consume colostrum and the sows ability to deliver the colostrums. Poor nutrition and cold stress are considered the primary causes for piglet mortality (LeDividich et al., 1998).

In order to address these challenges, trials were undertaken with additional heat at birth, oxygen, supplemental energy and immunoglobulin products.

Animals and Housing

The trials were carried out utilizing Yorkshire and Hay Bay sows at the Arkell Research Station and on a commercial farm, respectively. All sows were farrowed in farrowing crates with slotted floors. Sows were moved to the farrowing crates by day 109 of gestation and fed twice a day with a corn and soybean meal diet. The farrowing room temperatures were maintained at 18 to 22ºC and the creep area at 28 to 35ºC with supplemental heat lamps.

Treatments, Products and Analysis

The products and treatments tested were:

- Cream (6 ml, 10% Half and half cream) (C)
- Porcine IgG concentrate (P)
- Heat in the farrowing zone (H)

During the farrowing period, the floor temperature behind the sow was maintained at 25 to 30ºC. Within 12 hours after farrowing, the litter was processed and weight recorded. The four smallest piglets from each litter were syringe-fed four different treatments as follows: 1) Control; 2) Cream; 3) Cream plus 120 mg/ml IgG; and 4) Cream plus 210 mg/ml IgG.

The data was analyzed using SAS with group effects tested using ANOVA. Mortality to 3 and 7 days were analysed using PROC LOGISTIC.

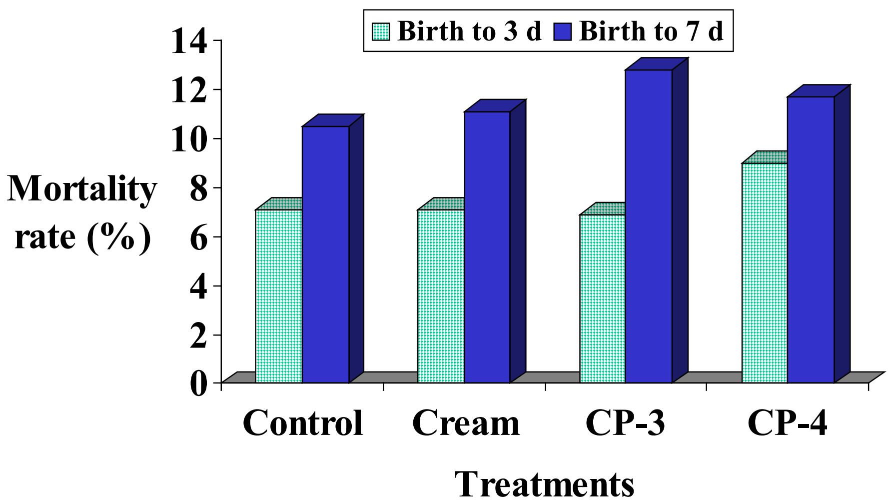
Results and Discussion

Results showed that additional heat in the farrowing zone did not significantly reduce the number of stillborn pigs. However, heat did appear to make live born piglets move readily to the sows udder. Furthermore, there was no difference between heat and the no-heat group for the time sows spent lying, sitting or standing. Additional heat did not significantly reduce piglet delivery interval (16.9 vs 17.2 min). However, it did reduce position change frequency which reduces the risk of piglets being crushed by the sow.

There was not a significant effect on the 3 or 7 day piglet mortality associated with supplementation of energy (cream) or IgG to small newborn piglets in this study (Fig. 1). However, when porcine immunolgobins were fed for at least a 5 to 10 day period after birth, survival was improved (Drew and Owen, 1988). Apparently, passive immunity is only conferred when immunoglobulins are fed for an extended period after birth. In addition, this study did not utilize unsuckled newborn piglets as in previous research believing that the results may be more practical when applied to pork producing enterprises.

In conclusions, it can be stated that heat in the farrowing zone increased IgG concentration in 7-day piglet blood, yet failed to significantly improve survival. Supplementation of cream and porcine IgG also failed to significantly reduce small piglet mortality at 3 or 7 days of life.

Fig. 1. Cumulative mortality rate for treatment



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Prevalence and significance of *Actinobacillus pleuropneumoniae* and *Actinobacillus suis* in Ontario

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Introduction

In the summer of 2004, I witnessed an outbreak of pleuropneumonia caused by *Actinobacillus pleuropneumoniae* (APP)(this was once referred to as “hemophilus”) in a finishing herd in southwestern Ontario during my veterinary externship. The attending veterinarian commented that he had dealt with several similar but unrelated outbreaks recently. Until those recent cases, he had been of the opinion that APP was disappearing and in its place *Actinobacillus suis* (*A. suis*) was becoming a common swine pathogen causing lesions of pleuropneumonia. He cautioned that APP and *A. suis* infections could be hard to distinguish from each other based on clinical signs and gross post-mortem lesions and recommended that samples should be routinely sent to diagnostic laboratories to confirm the presence of APP or *A. suis*. After this experience, I wanted to investigate the prevalence and importance of both APP and *A. suis* in Ontario’s swine industry, and discuss the importance of these diseases with the regional swine practitioners.

The objectives of this study were to investigate the prevalence of APP and *A. suis* in Ontario swine herds and to investigate the attitudes of practitioners as to whether pleuropneumonia was an important disease and how they attempt to control outbreaks.

Materials and methods

Three approaches were used to characterize the prevalence and importance of APP and *A. suis* in Ontario’s swine industry.

<u>Veterinary survey:</u>
A survey of 21 of the regional swine veterinarians was conducted. Each veterinarian was contacted individually and the survey was carried out over the telephone. The survey consisted of questions related to the prevalence and importance of APP and *A. suis* cases and outbreaks within the individual’s practice over the past year. Practitioners were asked to comment on number of cases, number of outbreaks, morbidity and mortality, presentation of disease, post mortem lesions, laboratory diagnostics performed, management of the disease, and their impressions regarding the importance of each disease within the province.

<u>Animal Health Laboratory review:</u>
Records from the University of Guelph’s Animal Health Laboratory (AHL) were obtained from 1997 to 2004 to examine whether or not there was an increase in submissions or prevalence of APP and *A. suis*.

<u>Farm level testing:</u>
Serological testing of 77 finisher herds for antibodies to APP serotypes 1 and 5 was done. These herds consisted of a representative sample of herds in the province chosen at random, and at the time of testing, none of the herds were experiencing clinical evidence of pleuropneumonia or reported a history of the disease. Within each herd, 30 pigs were randomly selected from the group of hogs that was closest to market age. Blood samples were collected from the infra-orbital sinus. Upon return to the laboratory, these samples

were centrifuged and serum was separated. Ten of these serum samples were randomly selected and sent to the University of Montreal's veterinary diagnostic laboratory for testing using an enzyme-linked immunosorbent assay (ELISA). Farms were classified as APP positive if one of the 10 samples submitted was found to be positive for serotype 1 or 5a or 5b APP using the following interpretation: O.D.<0.29 = negative, O.D. between 0.30 and 0.39 = suspect, and O.D. >0.40 = positive. In addition, tonisillar swabs were obtained from 7-week-old nursery pigs. Ten pigs from this age group were selected at random from 50 of the 77 farms visited. Swabs of the palatine tonsils were collected using a mouth gag and immediately placed into transport medium. These swabs were plated on selective media and tested for *A. suis* and APP by PCR (Department of Pathobiology).

Results

Veterinary survey:
Eighteen out of 21 (86%) of veterinarians surveyed reported that they had diagnosed APP over the last year and 12 out of these 18 (67%) had diagnosed these cases as serious herd outbreaks. The average morbidity during an outbreak was 30% (range 5 to 90%) and the average mortality was 7% (range <1 to 30%). Most outbreaks presented as classical pleuropneumonia with sudden death in finishing hogs, (a frothy blood-tinged nasal discharge was often noted) and respiratory disease observed among survivors; however, there were a few outbreaks that did not fit the typical presentation for an infection of *A.pleuropneumoniae.*

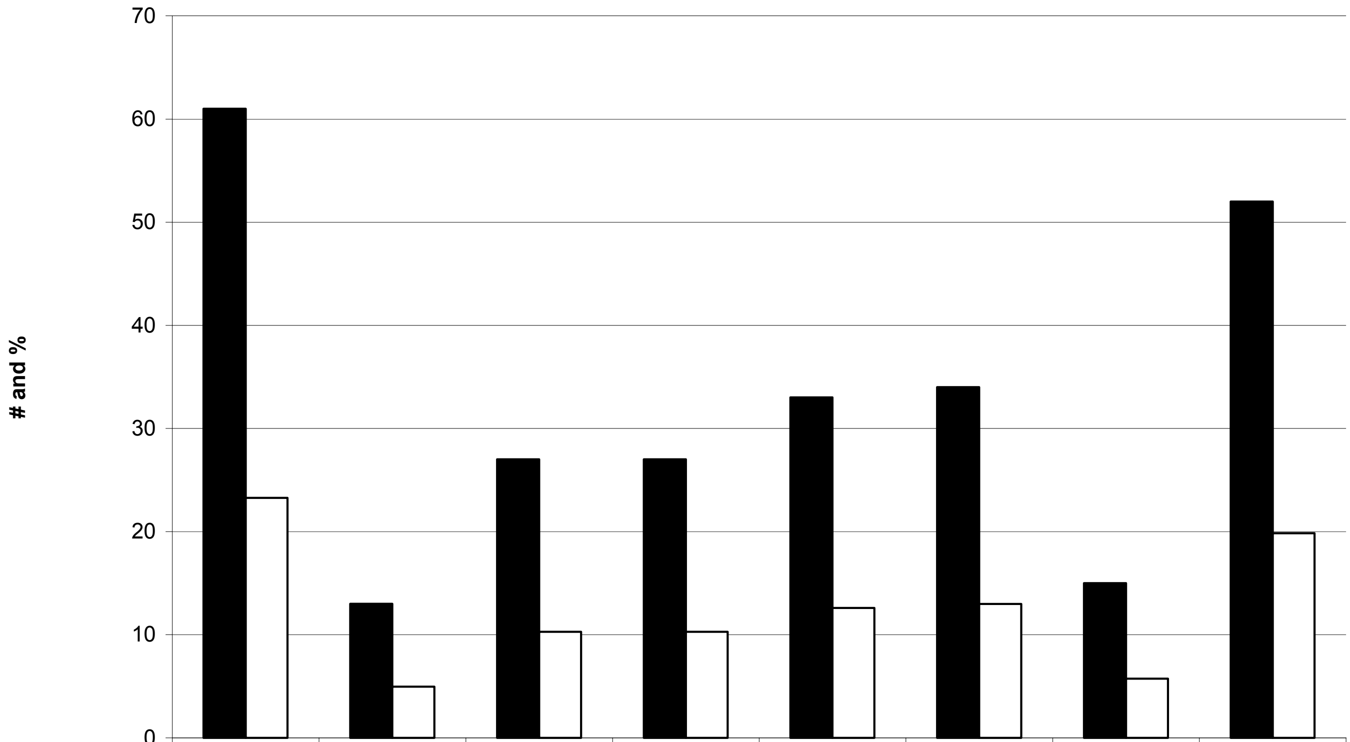
Twelve out of 21 (57%) of veterinarians surveyed had diagnosed *A. suis* over the last year, but on average these practitioners had each seen 5 or more cases of *A. suis* (range 1 to 24 cases). Eight of the 12 (67%) practitioners had their cases of *A. suis* confirmed by a diagnostic laboratory. The clinical presentations exhibited in the cases of *A. suis* seen by Ontario practitioners in order of most to least common included sudden death, dyspnea/pneumonia, poor-doing pigs, skin lesions, and septicemia.

Animal Health Laboratory review:
The AHL data had been collected and compiled for APP since 1997 and for *A. suis* since 1999. The data received had been condensed such that multiple test positive cases from the same herd were reported only as a single test positive case. Thus, the reported positives are at the farm level not at the individual animal level. The APP levels were analyzed and the results are reported in figure 1. The highest numbers of positive farms were documented in 1997 followed by 2004. The most common serotypes were types 5, 1 and 7. The highest numbers of positive farms for *A. suis* were documented in 2000 followed by 2004. Something that is immediately apparent is that the data provided by the AHL appears to roughly mimic trends in the hog markets in Ontario. In 1998, there was a large dip in hog prices and consequently the number of positive cases of APP was at the lowest level (13 cases). However, when hog markets were good, as in 1997, the levels of APP were at their highest. Similarly, the hog prices in 2004 have been good and there is an increase in submissions overall and an increase in cases of APP and *A. suis* reported by the AHL this year.

Farm level testing:
In the surveillance study of the 77 farms, only eight (10.4%) were positive for APP antibodies on serology. Additionally, 3 of the 77 (3.9%) farms were considered suspect for APP antibodies on serology. Two of the 8 samples were positive for serotype 1. The remaining 6 samples were positive for serotype 5. Interestingly, 24 of the 50 (48.0%) farms

that had tonsillar swabs taken tested positive for APP by PCR. Two of the 3 suspect farms had tonsil swabs taken and both of those farms were positive for APP on PCR. Of the 50 farms that had tonsillar swabs analyzed only 2 farms were found to be negative for both *A.suis* and APP.

Figure 1: Number of APP Positive Farm Cases Received by AHL by Year



	1997	1998	1999	2000	2001	2002	2003	2004*
■ # APP	61	13	27	27	33	34	15	52
□ % of Total	23.28	4.96	10.31	10.31	12.60	12.98	5.73	19.85

Year
(2004*-estimated using cases received to date)

Implications

- Practitioners need to be vigilant in asserting the importance of biosecurity and health monitoring even in the face of poor pork market conditions to prevent outbreaks of "controllable" diseases like APP.
- Diagnostic laboratory records may not be an accurate reflection of disease prevalence in diseases that present with obvious lesions such as in the case of pleuropneumonia because practitioners tend to base their diagnosis on gross post-mortem examination in the field and clinical presentation.
- APP is still relatively widespread in the Ontario swine population and stressful factors may precipitate an outbreak.
- *A. suis* is a highly prevalent swine pathogen in the province of Ontario and is likely under-diagnosed due to its similarity in clinical signs and post-mortem lesions to APP.

Acknowledgements

I would like to acknowledge the work and contributions from Dr. Gaylan Josephson who compiled the diagnostic laboratory results, and Dr. Don Atkinson and the Kirkton Veterinary Clinic who hosted my veterinary externship. Ontario Pork and the Ontario Ministry of Agriculture and Food provided funding for this project. This project would not have been possible without the participation from the Ontario swine producers and veterinarians. I would also like to acknowledge the hard work from the summer students and technicians who helped me with data collection.

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Swine Liquid Feeding:
Feeding Value Of Corn Condensed Distillers' Solubles

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Objectives

Studies were conducted to evaluate the feeding value of corn condensed distillers' solubles (CDS) for growing pigs. Controlled fermentation studies and pig performance studies were performed to enhance and evaluate the feeding value of CDS for pigs.

Introduction

Currently about 20% of grower-finisher pigs in Ontario are raised using computerized liquid feeding systems. As the extent of swine liquid feeding and the use of co-products from the food and fuel industry in swine feeds are likely to increase, more information on swine liquid feeding practices in Ontario is needed. For this reason the swine liquid feeding association has been formed and a state-of-the art swine liquid feeding system has been installed at the University of Guelph (www.slfa.ca).

A feed ingredient that has received considerable attention in swine liquid feeding is corn condensed distillers' solubles (CDS), a co-product of the alcohol industry. Due to the demand for alcohol as a fuel, the supply of CDS will continue to increase. Typically, CDS is quite acidic (pH of about 3.5), contains about 28% dry matter, and – on a dry matter basis - 24% protein, 21% fat and 9% ash. Based on on-farm observations it has been suggested that the feeding value of CDS can be enhanced by addition of microbes and fermentation.

Using a micro-fermentation unit, the impact of varying fermentation conditions on the nutritional value of CDS and the presence of potentially beneficial microbes was evaluated. A series of pig performance studies was conducted to determine palatability of CDS containing diets, as well as feed efficiency and carcass quality.

Results

In the fermentation studies, increasing the initial pH to 6 - by adding sodium hydroxide - and inoculation with a combination of *Lactobacillus acidophilus* (L) and *Bacillus subtilis* (B), resulted in the most effective fermentation of CDS. This is based on decline of pH, appearance of lactic acid (up to about 2% of the liquid fraction) and volatile fatty acids, as well as on microbial evaluation of the fermented material. Lactic acid is of special interest, because this organic acid has been known to stimulate digestive function in pigs and plays an important role in the control of pathogens in feed and the pig's digestive tract.

In the palatability study, pigs were fed diets containing either 7.5, 15.0 or 22.5% fermented CDS or 15% non-fermented CDS on a dry matter basis. Feed intake was reduced only when feeding the 22.5% fermented CDS containing diet.

In a pig performance study, using the Big Dutchman Hydrojet liquid feeding system, good growth performance was achieved for each of the dietary treatments (Table 1). However, feeding non-fermented CDS reduced growth rates ($P<0.05$) as compared to the control. Pigs fed fermented CDS had intermediate growth performance. Only pigs fed the control diet and the non-fermented CDS were raised all the way up to slaughter weight. Feeding CDS did not impact routine carcass measurements.

Table 1. Growth performance and carcass quality of pigs fed a corn and soybean meal based control diet, or corn and soybean meal based diets with either non-fermented or fermented CDS at 15% of diet dry matter. All diets were fed in a liquid form.

		CDS		
	control	**Non-fermented**	**Fermented**	**SEM**
		Growth performance		
Number of pens (pigs)	6 (59)	6 (59)	6 (59)	
Initial body weight, kg	23.5	23.3	23.4	1.6
Final body weight, kg	50.1 a	47.5 b	48.6 ab	0.6
Average daily gain, g/d	952 a	858 b	898 ab	22
Average daily feed intake, g/d [1]	1.62 a	1.49 b	1.61 a	0.03
Feed: gain [1]	1.70	1.73	1.80	0.03
		Carcass quality		
Final body weight, kg	106.54	107.01		0.79
Carcass dressing, %	82.13	82.60		0.31
Probe back fat, mm	16.60	17.10		0.39
Probe muscle depth, mm	54.31	53.73		0.86
Carcass lean yield, kg	61.15	60.85		0.19

[1] Dry matter basis; a,b values within rows followed by different superscripts differ ($P<0.05$).

Summary and implications

Liquid feeding of swine is gaining in popularity in Ontario as it represents a means to improve various aspects of pork production, and to reduce pork production costs in particular. Current studies indicate that corn condensed distillers' solubles (CDS) can be an effective pig feed ingredient and that its feeding value can be enhanced by controlled fermentation. When feeding non-fermented CDS slight reductions in pig growth performance were observed. It did not influence routibe carcass measurement and value.

Acknowledgments

This research was initiated in close collaboration with the swine liquid feeding association (www.slfa.ca) and is supported by a number of organizations. A full listing of references is available upon request.

Labour Management on Ontario Hog Farms

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Background

As Ontario swine farms have grown in size labour requirements have often exceeded what can be provided by family members. These farms have come to rely on hired labour to fill their human resource needs. Many farms report that it is a challenge to attract, keep and motivate employees who have many employment opportunities to choose from. Added to this is the perception that agriculture is low-paying, requires long hours of work and the working conditions may not be ideal (i.e. smell, dust, physically demanding, and etc.). A survey of swine farm employers and employees was undertaken to better understand the issues of human resource management in the industry.

Results

Results from the employer survey showed that swine farm employees worked about 45 hours per week. For general labour this is about 3 hours/week more than for jobs in other industries that require similar skills, for example construction trades helpers (source Statistics Canada). Not surprisingly, with respect to pay swine farm employees receive lower compensation than some other industries. General and skilled swine farm labour in particular received wages up to $6/hr less than, for example, full-time truck drivers and construction trades helpers (source Statistics Canada). Cash wages ranged from $10.93/hour for general swine farm labour to $18.65/hour for supervisors/managers. The biggest complaint heard from employees in the survey was regarding wages.

Table 1. Hours Worked/Week and Compensation for Swine Farm Labour

	General Labour	**Skilled Labour**	**Supervisor/Manager**
Average hours worked/wk	44.8	47.0	48.2
Cash wage $/hr	10.93	15.00	18.65
Additional benefits $/hr	0.80	1.92	2.85
Total compensation $/hr	11.73	16.92	21.50

Swine farm employers indicated that they provide a wide range of additional benefits. These benefits included medical or dental coverage, housing, paid utilities, use of farm vehicle, the provision of pork and so on. These benefits increased the value of the compensation package by $0.80/hour for general labour up to $2.85/hour for supervisors and managers.

An attempt was made to analyse why employee turnover was low on some farms and high on others. Swine farm survey participants were divided into low (i.e. no employee turnover in last two years) and high employee turnover (70% or greater employee turnover in last 2 years) groups. It was found that employees on low turnover farms work slightly fewer hours and receive higher wages than similar employees on high turnover farms. This is summarized in Table 2. Employees on low turnover farms also receive more weekends off each month and more paid vacation days.

Table 2. Comparison of Hours Worked and Wages Between Low and High Employee Turnover Farms

		Low Turnover Farms	High Turnover Farms
General Labour	Average hours/wk	45.7	44.7
	Wages $/hr	10.10	10.08
Skilled Labour	Average hours/wk	44.8	51.6
	Wages $/hr	15.21	14.61
Supervisor/Manager	Average hours/wk	47.0	49.3
	Wages $/hr	18.25	16.75

Staff turnover can be costly. Survey participants assisted in determining a value for turnover. Costs related to the time for an exit interview for a departing employee and record-keeping associated with their leaving was estimated to be $252. Replacement costs totaling $1,138 included advertising and the salaries of individuals who discuss and interview candidates. Training costs involve manuals provided to new employees, training workshops, the salary of another employee who works with and trains the new employee and the salary of the new employee until they are fully productive. Training costs totaled $7,018. In summary, the average total cost of turnover is $8,408 each time an employee leaves the business. It was also reported that the average beginning salary and benefits of a new employee is $26,653 depending on the job and it takes about 52 days for a new employee to become fully productive.

Recommendations

Many of the following recommendations are not unique to the swine industry. Most employees simply want to feel valued and respected for their skills and for their time working.

1. Hours of work – Indicate at time of hire what the typical hours of work are and if flexible hours are offered.
2. Compensation – Compensation should be fair for the work done. Offering benefits such as dental and health insurance, housing, providing pork, and etc. increase the total value of the compensation package.
3. Employee interaction – Let employees know when they are doing a job well and when improvements can be made. Interaction amongst employees may prove beneficial.
4. Statutory holidays and weekends – Trying to establish a mutually agreeable and acceptable schedule ahead of time shows consideration for employees. The provision of additional money or time off on another day may be incentive to work holidays/weekends.
5. Vacation time – Providing paid vacation time off is a way to reward employees for the work they have done.

Special thanks to Ontario Pork for providing funding for this study. Recognition and appreciation is extended to the employers and employees that participated in the survey.

Porcine Circovirus Type 2 Update

Gaylan Josephson, Veterinary Pathologist, Exeter, Ontario

First identified in Western Canada in 1995, porcine circovirus type 2 (PCV2) is the primary causative agent of

- postweaning multisystemic syndrome (PMWS)
- porcine dermatitis nephropathy syndrome (PDNS)

and has been associated with other syndromes such as

- abortion and reproductive failure in newly started herds
- congenital tremors (Type A2).

The disease in North America, and particularly here in Ontario has not been as devastating to the swine industry as it has been in Europe. EU has estimated annual costs of E600 million ($960 million Can) due to PCV2-associated disease and has established a budget of E3.45 million to study epidemiology, early pathogenesis and control of diseases associated with this virus.

Over the past several months, the Animal Health Laboratory, University of Guelph, has seen a marked increase in the number of submissions from which PCV2 has been identified as a primary agent. This is in contrast to the occurrence of the disease in Western Canada, where the incidence of PCV2 associated disease is on the decline. In Ontario, we have noted an increase in the severity of the clinical disease, and in the number of syndromes that have been seen. Immunohistochemistry staining (IHC) of suspect tissues has also allowed the laboratory to associate the presence of the organism with the actual microscopic lesions produced by the virus.

Respiratory system

Significant losses have been experienced in grow finisher operations, with the culprit being identified as PCV2. Losses have been attributed to increased deaths (many of which were rather unexpected), a decrease in growth parameters, an increase in cull pigs, as well as an increase in medication costs. The major clinical sign has been pneumonia, with some of the affected pigs exhibiting a "barking cough", similar to that produced by swine influenza. However, neither this nor other pathogens were identified in some of these submissions. In one operation, death losses in a 1000 head grow-finish barn approached 8%. Pigs were sourced from 2 sow herds of similar health status, and from 2 nurseries. Almost all of the losses originated in piglets from 1 of the nurseries, making the death losses close to 15% in that group of pigs. PCV2 was the only organism identified from a total of 13 pigs that were examined by AHL personnel.

Research has identified that infection with *Mycoplasma hyopneumoniae* increases the severity and duration of PCV2 associated disease. In addition, piglet vaccination within 2 weeks of exposure to PCV2 contributes to the severity of PCV2 associated disease. Specific vaccines have not been incriminated, although those containing oil-in-water adjuvants may created more severe disease. However, the effects of not vaccinating the herd may be much greater than those produced by PCV2 in a small number of pigs.

Enteric system

An ileitis and colitis, with or without necrosis, as well as a hemorrhagic enteritis were observed in pigs that were positive only to PCV2. Clinical signs included diarrhea, unthriftiness as well as increased death losses. Affected pigs were identified in a high health status nucleus breeding operation that supplied replacement gilts, as well as in more conventional f-f operations. On post-mortem examination, gross appearance of the small intestine was strongly suggestive of a *Lawsonia intracellularis* infection, but microscopic findings were not suggestive of this infection. In other submissions associated with the identification of PCV2, a granulomatous enteritis was observed. Other lesions consistent with PMWS were not seen in these pigs.

Jensen TK, et al, presented a report at the 18th IPVS Congress, Hamburg, Germany, in 2004 of a study involving 76 pigs, 2-4 months old, with diarrhea, unthriftiness and increased mortality. They looked specifically at *Lawsonia intracellularis* and PCV2, with the following results.

Lawsonia intracellularis positive	- 45%
PCV2 positive	- 43%
LI and PCV2 positive	- 8%
LI and PCV2 negative	- 25%

Central nervous system

In several submissions to the AHL, PCV2 was identified in sections of brain, from pigs of all ages, that experienced nervous signs that were identified by the owner as being somewhat distinct from those due to *Streptococcus suis*. Again, these pigs were observed in conventional f-f operations, as well as in high health, 3-site operations. Losses were not high in these operations.

Reproductive system

Although PCV2 has been identified in tissues from aborted piglets via PCR, significant histological findings were not described in these fetuses. In June of 2004, 13 of 100 sows aborted their piglets between 31-100 days of gestation. Microscopic examination revealed a lymphoid depletion in lymph nodes in one of the fetuses. Numerous inclusion bodies were seen in these tissues, and IHC staining was strongly positive for PCV2. Other causes of abortion were not identified. Similar findings were reported recently from South Korea, where 13.1% of 350 aborted fetuses and stillborn piglets were positive for PCV2 by PCR, and the antigen was detected in aborted fetuses by IHC.

Reasons for increase in PCV2-associated disease

The reason for this increase in PCV2 submissions and diagnosis is not known.

The virus is ubiquitous in distribution. In fact, in studies done elsewhere, it was difficult to find herds that were negative to PCV2, and we have no reason to suspect differently here in Ontario

The virus is very stable, and there is no evidence of an increase in virulence of the virus. Fenaux et al, serial passaged a PCV2 isolate 120 times through cell cultures. The complete genomic sequence was identified at viral passages 0, 30, 60, 90 and 120. After 120 passages, there were only 2 nucleotide mutations in the entire genome. In addition, the clinical disease produced by the virus was actually more severe at passage 21 than that at passage 120.

Initially, PCV2-associated disease was reproduced when pigs were co-infected with porcine parvovirus, suggesting that PCV2 is not a primary pathogen, but produced disease only when associated with other pathogens. However, disease has since been produced by PCV2 alone, although there are some who believe that another agent (unknown at this time) must be involved before clinical disease becomes evident.

Management factors do play a significant role in PCV2 associated disease however, so efforts to reduce stress on the pigs need to be followed. The three main rules to reduce the impact of PCV2 infection still remain

- limit pig-to-pig contact
- reduce “stress”
- practice good hygiene and maintain biosecurity measures.

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University of Guelph / OMAF Partnership Pork Research Program Projects

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

The University of Guelph/OMAF Pork Research Program currently supports 43 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 OMAF website (www.uoguelph.ca/research/omaf/animals/pork.shtml) or contact the lead researcher.

OBJECTIVE 1: STRATEGIES TO ADDRESS ENVIRONMENTAL ISSUES

Goal 1.1. Manure handling, including deadstock disposal

025613 – Chemical Agents for the Selective Capture of Heavy Metals from Swine Manure – A. Schwan, Department of Chemistry and Biochemistry

025983 - Characterizing Air Emissions and Ash Residues from the Cremation of Deadstock from Small On-Farm Commercial Cremation Units – B. Van Heyst, School of Engineering

Goal 1.2. Reduction of nitrogen and phosphorus excretion

025720 - Quantitative Effects of Non-Protein Feed Constituents on Utilization of Dietary Amino Acids for Lean Tissue Growth in the Pig – C. de Lange, Department of Animal and Poultry Science

026015 - The Enviropig: From the Research Lab to the Market Place - J. Phillips, Department of Molecular Biology and Genetics

026082 - Modulation of Intestinal Fermentation and Nutrient Utilization for Reducing Detrimental Effects on the Environment from Swine Production – M. Fan, Department of Animal and Poultry Science

Goal 1.3. Reducing Odour

026001 - Biofiltration as a Means of Odour and Dust Control in Animal Housing Facilities – M. Dixon, Department of Environmental Biology

026177 - Development of a Pork Farm Odour Expert System and Studying the Feed Effects on Odour – S. Yang - School of Engineering

Goal 1.4. To investigate ways of improving the health and safety of pigs and people with respect to the barn environment

025783 - Characterization of E. coli O157:H7 from Pigs in Ontario – C. Gyles, Department of Pathobiology

OBJECTIVE 2: PORK QUALITY AND SAFETY

Goal 2.1. Food safety

025611 - Monitoring the Prevalence of Diseases of Economic Significance and Public Health Interests – R. Friendship, Department of Population Medicine

026021 - Validation of HACCP in Pork Production and Processing – K. Warriner, Department of Food Science

026207 - The Natural Transmission of Salmonella typhimurium in Swine With and Without Antimicrobial Selective Pressure – J. Gray, Department of Pathobiology

Goal 2.2 Reducing antibiotic use

025588 - Porcine Ficolins and Related Lectins as Indicators of Resistance to Bacterial Disease – A. Hayes, Department of Pathobiology

025992 - Molecular Epidemiology of Antimicrobial Resistance in E.coli from Pigs in Ontario – P. Boerlin, Department of Pathobiology

026180 - Molecular analysis of important bacterial pathogens of swine – J. MacInnes, Department of Pathobiology

026083 - Efficacy of Alternative Growth Promoters for Weanling Piglets as Assessed by Visceral Organ Protein Turnover Rate – M. Fan, Department of Animal and Poultry Science

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

026038 - Grow-Finish Pigs - Improving Carcass Quality through Barn-Level Parameters Analyses – C. Dewey, Department of Population Medicine

026059 - Quantitative and Molecular Genetic Improvement of Swine – A. Robinson, Department of Animal and Poultry Science

025981 - The effects of feeding high protein corn to pigs based on performance and carcass quality - P.L. McEwen, Ridgetown College

026174 - Development of Genetic Markers for Boar Taint – J. Squires, Department of Animal and Poultry Science

026176 - Development of Nutritional Strategies to Improve the Processing and Eating Quality of Pork – I. Mandell, Department of Animal and Poultry Science

OBJECTIVE 3: TO IMPROVE PRODUCTION EFFICIENCY

Goal 3.1. Feeds, feeding and mycotoxins

025622 - Alternative Feeds and Management Strategies to Improve Growth Performance, Manure Composition and Carcass Characteristics and to Minimize Environmental Impact of Pigs – G. Ablett, Ridgetown College

025900 - Effect of Feeding Blends of Grains Naturally-Contaminated with Fusarium Mycotoxins on Growth and Reproductive Performance of Pigs – T. Smith, Department of Animal and Poultry Science

025997 - Liquid feeding of swine: gut health, food safety, environmental impact and growth performance - C. de Lange, Department of Animal and Poultry Science

026171 - The use of byproducts from dry mill ethanol production as a feed ingredient in swine diets – P.L. McEwen, Ridgetown College

026173 - Dietary means to enhance gut health and function in newly weaned pigs - C. de Lange, Department of Animal and Poultry Science

Goal 3.2. Improving pig health

026005 - Enteric Disease Control in Post-Weaned Pigs – R. Friendship, Department of Population Medicine

026037 - Understanding the Spread and Control of Respiratory Disease in Nursery Pigs - C. Dewey, Department of Population Medicine

026170 - Phenotypic Immunological Imprinting by the Neonatal Environment in Pigs - B. Wilkie, Department of Pathobiology

026175 - Tetracycline use and selection of virulent enterotoxigenic Escherichia coli (ETEC) – P. Boerlin, Department of Pathobiology

026068 - Modulation of Host Cell Responses by Porcine Reproductive and Respiratory Syndrome (PRRS) Virus – D. Yoo, Department of Pathobiology

Goal 3.3. Improving reproductive performance

025670 - PRRS Virus: The Implications for the Breeding Herd – C. Dewey, Department of Population Medicine

025726 - Improving Reproductive Performance in Swine – R. Friendship, Department of Population Medicine

025973 - Summer Heat and Boar Semen Quality – M. Buhr, Department of Animal and Poultry Science

026013 - A study of oxytocin-producing reproductive centres in the hypothalamus of the pig brain – G. Partlow, Department of Biomedical Sciences

026179 - Analysis of transient lymphocyte functions in implantation sites during early pregnancy – A. Croy, Department of Biomedical Sciences

Goal 3.4. Transgenics

025620 - Establishment of a Gene-Manipulation System in Porcine Somatic Cells – J. Li, Department of Animal and Poultry Science

025619 - Production of transgenic pigs that are more resistant to diseases – J. Li, Department of Animal and Poultry Science

026036 - Artificial Insemination Mediated Modification of Pig Genome – S. Golovan, Department of Animal and Poultry Science

OBJECTIVE 4: TO IMPROVE ANIMAL WELL-BEING

025743 - Critical Points for Losses in the Transport and Handling of Hogs in Ontario - T. Widowski, Department of Animal and Poultry Science

026069 - Meeting the Needs of Ill Swine to Improve Well-Being and Decrease Reliance on Antimicrobials – S. Millman, Department of Population Medicine

026081 - Developing a Comprehensive Framework to Assess Farm Animal Welfare - S. Henson, Department of Agriculture Economics & Business

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

Ontario Pork's Research Investment

Jean Howden, Research Coordinator, Ontario Pork

Research serves as the fundamental building block for the advancement of our industry and is the cornerstone of the industry's success. In recent years, Ontario Pork has focused and supported research on herd health, food safety, nutrition, reproduction, animal welfare, and the environment. The resulting knowledge and improvements have advanced the Ontario industry. The projects range from building a baseline of herd data for food safety confidence to increasing the knowledge and treatment of swine illnesses and diseases. Enhanced detection methods have been funded to minimize the effect of illness and diseases on animals and herds. Research into feeding and nutrition has lead to improved feed and growth efficiencies; and manure and dead stock disposal effects on the environment have been and continue to be studied for continual improved. It is critical that the industry continue to more forward and this requires a strong research base.

In 2004, Ontario Pork invested over one million dollars directly into research and development projects. These projects are not funded by Ontario Pork alone. Both federal and provincial government, producers and industry alike have <u>significantly</u> contributed funding. Ontario Pork's one million dollars has been enhancing at least three times with some researchers excelling far above this level.

The adoption of research outcomes, into practical application also result in cost efficiencies. These are very difficult to measure. Estimates have put the benefit of each public dollar spent on agri-food research as high as 27.5:1, and for hogs at 9.5:1 (Brinkman, G. L., 2004. "Strategic Policy Issues for Agricultural Research in Canada". *Current Agriculture, Food and Resource Issues).*

Our continual contribution to research is imperative for the industry to grow and prosper. The research committee of Ontario Pork continually strives to fund research projects that will benefit this industry and all producers involved, as detailed in the following list of projects.

Researcher: Robert Friendship
Title: Control of Salmonella on Ontario Pig Farms
<u>Synopsis:</u> The objectives of the research are to reduce the prevalence of Salmonella-carrier animals arriving at Ontario packing plants and to determine if lower levels on-farm translates to less contamination at slaughter. The project will evaluate and develop rapid and reliable testing. An experimental infection model will be developed. The on farm testing of the model is projected as a second year to the project and funding for the second year will be evaluated at the completion of model.

Researcher: Tina Widowski
Title: The effects of different amounts of regular human-animal interaction on response to handling of market hogs
<u>Synopsis:</u> The overall objective is to improve the behaviour and welfare of pigs during handling and transport at slaughter. Specifically, we will determine the optimum frequency of regular human interaction to reduce fear responses and improve handling during loading and unloading of market hogs at commercial farms and a packing plant. The data will be summarized in a report targeted for producers who may be interested in adopting practical methods to prepare market pigs for the stress associated with the handling and transport of pigs to slaughter.

Researcher: Cate Dewey
Title: Defining the impact of transportation and handling practices used for Ontario Market pigs
<u>Synopsis:</u> Objectives of the Research Proposal: To further understand the conditions on the farm that account for variations in in-transit losses experienced by pigs transported to market in

Ontario, this project will examine the farm facets of the marketing process utilizing a case-control farm study. This project is associated with Dr. Tina Widowski's project 04/03 involving the effects of different amounts of regular human interaction-animal interaction on response to handling of market pigs.

Researcher: Harold Gonyou
Title: Gestation Housing for Sows: Studies on Electonic Sow Feeders and Stalls
Synopsis: The four studies will examine questions critical to the management of pregnant sows in both group housing and stalls. These questions are directed at reducing social stress in groups, and issues of crowding in stalled sows.

Researcher: Carlton Gyles
Title: The Role of Urease in 0149 E. coli that cause Post-weaning Diarrhea in Pigs
Synopsis: Objectives of Research Proposal: 1. Clone and sequence the urease genes in an O149 ETEC. 2. Identify other genes associated with the urease genes. 3. Determine whether urease genes are present in other ETEC and in normal flora E.Coli from pigs. 4. Determine whether elimination of urease production reduces virulence of O149 ETEC in experimentally infected pigs.

Researcher: Patrick Boerlin
Title: Tetracycline use and selection of virulent enterotoxigenic Esherichia coli
Synopsis: Objectives of Research Proposal: 1. Develop molecular methods for the identification and detection of a new virulent E. coli variant causing post weaning diarrhea in pigs in Ontario. 2. Assess if tetracycline use increases the persistence and spread of this E. coli variant in animals. 3. Assess if the combined resistance-virulence plasmid found in this variant is a cause of increased virulence.

Researcher: Philip Willson
Title: Practical needle-free immunization to enhance herd health and pork product quality
Synopsis: Objectives of the Research Proposal: The objectives are to take needle-free immunization of swine to the next step as see if 1) there is an effect on early growth rate for pigs immunized at a young age, 2) we can get as good or better immunity with a reduced dose of vaccine and 3) if the volume of vaccine is reduced is the potential for adverse effects on meat also reduced.

Researcher: Mario Jacques
Title: Canadian Research Network on Bacterial Pathogens of Swine
Synopsis: Objectives of the Research: To identify and characterize virulence factors of prevalent bacterial pathogens of swine; to use these to develop new diagnostic tools' to develop vaccine and vaccination methods and to use this information to prevent and treat bacterial diseases of swine.

Researcher: Dongwan Yoo
Title: Interference of PRRS virus replication by gene silencing
Synopsis: Objectives of the Research: To investigate whether RNA interference can block PRRS virus multiplication in cell. The long term objective is to control PRRS virus infection in pigs and improve the health status of pigs.

Researcher: Ming Fan
Title: Determination of an Optimal True Digestible Phosphorus to Calcium Ratio in Post-Weaned Pigs for Minimizing Phosphorus Excretion.
Synopsis: Objectives of the Research: The major objective is to determine true digestible CA to P ratio value and the effect of changing Ca and P ratio on manure Ca and P excretion in the post-weaned pig. A related objective is to compare and examine the effect of changing Ca to P ratio on manure P leaching and mobility in soil under laboratory conditions.

Researcher: C.F.M. de Lange
Title: Dietary means to enhance gut health, growth performance and well-being of newly weaned pigs
Synopsis: Objectives of the Research: To determine the effect of feeding GMOS plus a specific herbal extract product to newly and early weaned pigs on gut health and growth performance.

Researcher: Robert Friendship
Title: Effect of addition of seminal plasma to thawed semen on sow fertility
Synopsis: The objective of the research is to improve sow fertility to insemination of frozen sperm.

Researcher: B. Anne Croy
Title: Evaluation of Pig Uterine Lymphocytes and their Association with Enhancement of Blood Flow to the Developing Placenta
Synopsis: The overall objective is to understand the functions of lymphocytes recruited to the pig uterus early during normal pregnancy. Specifically, to identify which angiogenic message detected in porcine uterine lymphocytes are translated into protein and how this process is regulated

Researcher: Ira Mandell
Title: Enhancing the Pork Meat Quality Value Chain
Synopsis: Objectives of the Research: The proposed research project will measure variability in Ontario pork and take a value-chain approach to examine how genetics, on-farm management, packing plant management, and nutrition interact to affect the main mechanisms determining pork meat quality and what these quality variations cost the industry.

Researcher: Cathy Aker
Title: Determination of optimum levels of intramuscular fat based on taste panel assessments and its relation to intramuscular fat levels determined via live-animal ultrasound
Synopsis: The project will determine optimum intramuscular fat levels based on consumer and trained taste panel assessments and relate this to comparable live-animal measurements determined by real-time ultrasound. The results will be used to implement strategies (i.e. an on-farm program) for optimization of intramuscular fat content in commercial market hogs.

Researcher: Ron Fleming
Title: A "Sloped Belt" Manure Handling System for Feeder Pigs
Synopsis: The objective is to compare the performance of a sloped belt manure system to a partially slatted floor system in a swine feeder operation. A belt will be installed under the slats in a partial slatted floor barn. Feces stay in place and are removed regularly. Urine runs off immediately and is stored separately.

Researcher: Wayne Caldwell
Title: Finding the Balance: Evolving Provincial and Municipal Governance of Nutrient Management
Synopsis: Objectives of Research: This research relates to the changing nature of Provincial and Municipal Governance of Nutrient Management. It has two key objectives: the identification of on-going issues between the province and municipalities (including the monitoring of municipal acceptance or rejection of provincial authority) and the development of policy options and recommendations to improve the municipal/provincial relationship.

Researcher: Bill Van Heyst
Title: Environmental Characterization of Selected Dead Animal Disposal Methods
Synopsis: Objectives of Research:·To assess the environmental impact of commercial on-farm cremation units·To assess the air emissions from dead animal compost piles·To determine the fate of sulpha-drugs during the composting process

Researcher: George Lazarovits
Title: Evaluation of Pasteurization of Liquid Swine Manure for Use as a soil-borne Plant Disease Control Product of High-Value Crops
Synopsis: Objectives of Research: To test the efficiency of a continuous batch composter for eradication of all potentially harmful microorganism in manure under barn conditions: to develop formulations of LSM from the liquid compost obtained after thermophylic treatment that controls diverse soilborne pathogens: To demonstrate in large scale trials that formulated LSM derivatives can provide significant financial returns to producers of high value crops such as potatoes.

Researcher: Bonnie Ball-Coelho
Title: Zone-injection: New Conservation Till Manure Delivery System
Synopsis: Objectives of the Research: To develop a system where manure is applied

during zone tillage in one operation and evaluate in terms of corn yield and environmental impact.

Researcher: Jim Dalrymple
Title: To conduct a study of a Century of Achievement by the Agricultural Industry
Synopsis: Objectives of the ResearchTo create greater agricultural research investment by the public and to increase confidence in pork production

Researcher: Jim Vidoczy
Title: New Product Strategy for Pork Products in the Food Service Industry
Synopsis: Objectives of the Research: The intent of the research is to identify pork products for the food service industry where the outcome will increase pork meal opportunities as well as allowing food service operators a number of menu offering from strategically manufactured pork products.

Researcher: Peter Pauls
Title: Fusarium Resistance and Genetic Improvements in Ontario Corn through Biotechnology
Synopsis: Research Objectives and Anticipated Deliverables: I - Genetic Modification of Corn for Improved Fusarium Resistance. II - Development and Application of Molecular Markers for marker-assisted selection of fusarium-resistant corn.

Researcher: Jeffery Gray
Title: Detection of Foodborne Pathogens and Control of Antimicrobial
Synopsis: Objective of the Research: This proposal is targeted at Development of reliable and appropriate detection technology for Salmonella along with some key experiments in step 3 (Testing and implementation of food safety control and mitigation strategies). This approach and proposal will provide the Ontario Pork industry with tools it needs to move forward with Salmonella control. Additionally, the proposal includes some key experiments regarding antimicrobial selective pressure in swine (ie. Antimicrobial use selecting for more Salmonella and more resistant Salmonella). This topic is driving consumer concerns yet there is little or no data supporting or refuting the concept and how producers can manage the problem.

Researcher: Nigel Bunce
Title: Pilot scale electrolyses for amelioration of liquid hog manure odour
Synopsis: Objective: To follow up laboratory-scale experiments that showed proof of concept, to determine whether an on-farm pilot electrolyzer is capable of removing odour components of hog manure, while retaining fertilizer value

Researcher: Cate Dewey
Title: Identifying the best treatment for haematomas in swine
Synopsis: Objective: To determine whether ear haematomas in swine resolve more rapidly if treated using one of two treatment techniques or if left untreated.

Researcher: Paul Luimes
Title: Improving piglet survival by development of hormone model of lactation
Synopsis: To gain a fundamental understanding of amino acid-hormone interactions that effect lactation such that they can be manipulated in order to improve piglet survival.

Researcher: Scott McEwen
Title: Evaluating effectiveness of interventions against Salmonella in swine: Can Salmonella be controlled at the farm level
Synopsis: This project will generate a ranked list of potential 'farm-to-slaughter' interventions against Salmonella in swine and their estimated impact on Salmonella reduction in swine.It will develop a quantitative risk assessment of interventions within the Ontario swine pork production system; and provide recommendations to the Ontario pork industry regarding the optimal combination of control measures to deliver the most effective and feasible approach. Finally it will identify future research needs and implementation strategies.

Researcher: Bruce Thompson
Title: Literature Review Regarding Cooking Temperature of Pork
Synopsis: Evaluation of research regarding the cooking temperature of pork.

2004 OPC Carcass Evaluation Program Provides Insight Into Consumer Preferences

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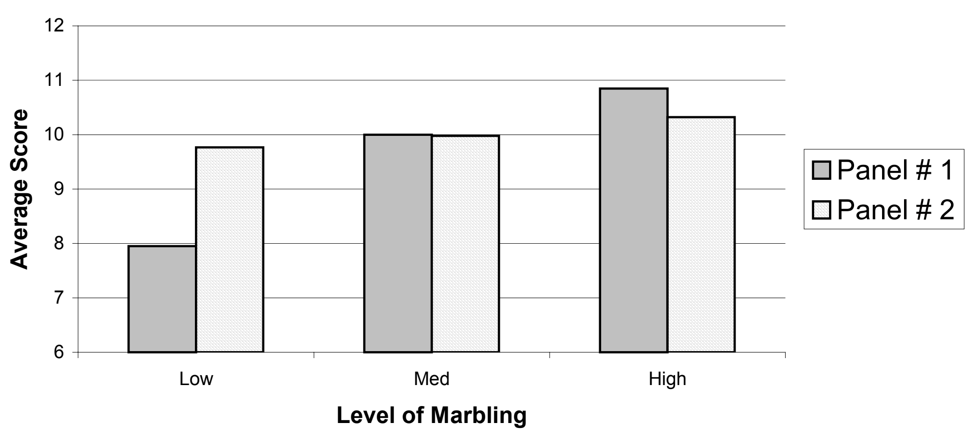
At an industry level, pork quality has been evaluated almost exclusively for the last ten years on the basis of color. Excessively pale pork has been discriminated against because of its' association with PSE (pale, soft, exudative) pork. PSE pork is not well accepted by consumers because of its' tendency to dry out when cooked. Today, the industry is starting to focus more on another important pork quality characteristic – marbling or intramuscular fat. The beef industry has fully exploited the benefits of intramuscular fat for years, but the pork industry has been slow to realize the value of this trait. However, all that is changing now – marbling is now rated as having medium to high importance for the Japanese, U.S. and domestic fresh pork markets and many fresh pork processors are more focused on marbling than they have been in the past.

The 2004 OPC Carcass Evaluation Program provided the opportunity to evaluate the influence of marbling on the eating quality of pork. Taste panel assessments are the ultimate test of a products' acceptability by the consumer. The carcass program provided two different opportunities to assess the flavour and tenderness of pork in relation to marbling score (based on the NPPC scoring system where 1 = scant levels of marbling and 6 = abundant levels of marbling). In the first test, loins were selected on the basis of low (marbling score of 1) medium (marbling score of 2) and high (marbling score of 4) levels of marbling. Loins were evaluated by 10 panellists consisting of chefs (instructors at Niagara College) and chefs-in-training. In the second test, the low, medium and high loins had marbling scores of 1, 2 and 5, respectively. These loins were assessed by 14 panellists including staff and directors of Ontario Pork. The combined results for flavour and texture (tenderness) are presented in Figures 1 and 2.

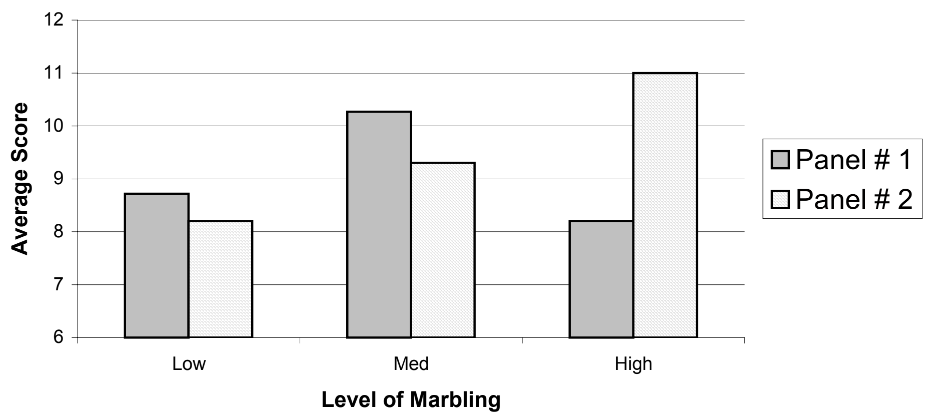
In the first panel, the higher levels of marbling (medium and high) were clearly preferred for flavour compared to the lowest level of marbling. Overall flavour scores (out of a possible 15 which is considered the highest possible score) were 7.95, 10.00 and 10.85 for low, medium and high, respectively. It was interesting, however, that panellists did not detect much difference in flavour between the medium (marbling score of 2) and high (marbling score of 4) samples. In the second panel, the results were not as conclusive as in the first test, although the trend was similar. Average flavour scores were 9.77, 9.98 and 10.32, respectively for low, medium and high marbling samples.

Figure 1 - Taste Panel Results for Flavour



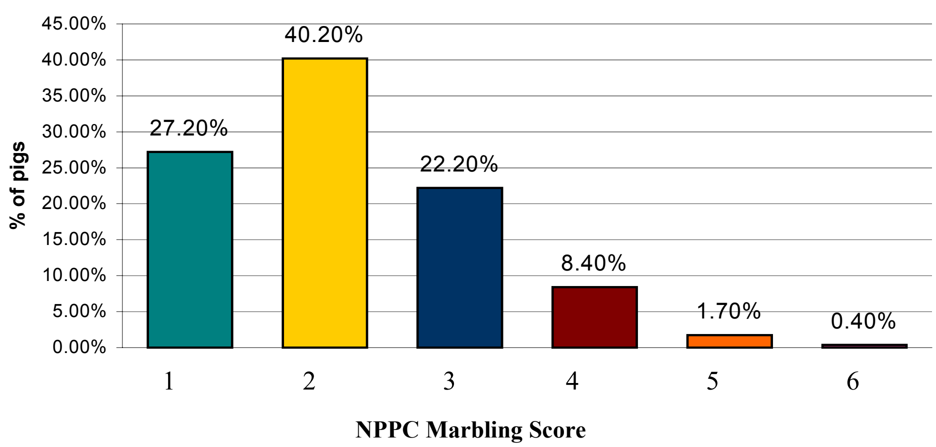
Results for texture were somewhat different than the results for flavour. In the first panel, average texture scores were highest for the loin with the medium amount of marbling with very little difference detected in texture between the low and high samples. The average scores were 10.27, 8.72 and 8.20 for medium, low and high samples, respectively. In the second test, panellists clearly preferred the highest level of marbling with an average texture score of 11.00 versus 9.30 and 8.20 for medium and low samples.

Figure 2 - Taste Panel Results for Texture



Although there was some variability in the taste panel results, the general trend was that the low samples were least desirable which would indicate that a marbling level of 1 does not produce acceptable eating quality. Conclusions on the medium versus high samples are not as clear but would indicate that a minimum marbling score of 2 (and possibly higher) would be required for acceptable eating quality. The project also provided an opportunity to determine how marbling scores are distributed in a typical population of market hogs. Marbling scores were plotted for 237 crossbred (three and four-way cross) market hogs and are presented in Figure 3.

Figure 3 - Distribution of Marbling Scores From 237 Commercial Pigs



The results were encouraging with more than 70 % of the pigs receiving a marbling score of at least 2 which appeared to be the minimum required to produce acceptable eating quality. This data would suggest that approximately one in every four market hogs has too little marbling and as a result, may produce pork with reduced eating quality. On the flip side, three out of every four market hogs is producing pork that should be providing a positive eating experience.

A full report on the project is yet to be released but will be available by March 2005. Thanks to Ontario Pork and Ontario Pork Congress for their financial support for this project as well as Agriculture Ultrasound, Conestoga Meat Packers and s.e.c. Repro for their valuable assistance with the project. Participating farms are also gratefully acknowledged for their cooperation.

Carcass Quality and Phosphorus Utilization by the Cassie Line of EnviropigTM

Ajakaiye, A., R.G. Meidinger, M.Z. Fan, D.A. Murray, J.P. Phillips, S.P. Golovan, R.R. Hacker, C.W. Forsberg and J.M. Kelly*. University of Guelph, Guelph, ON, Canada N1G 2W1

Introduction

The potential environmental problems created by the addition of inorganic sources of phosphorus (P) to the diets of pigs have been well documented. Many practical strategies and solutions have been developed to reduce the excretion of P by pigs. The feasibility of using Enviropigs^{TM} that carry the phytase gene and secrete phytase in the saliva has been reported by Golovan et al., 2001. Also the efficacy of P utilization by some lines of Enviropigs has been reported (Ajakaiye et al., 2003). However, it is unclear how well the Cassie line of the Enviropig can utilize phytate P in the diet in comparison with the conventional Yorkshire pig. Therefore the objectives of these experiments were: (i) to determine the effect of feeding phosphate supplemented, non supplemented and low crude protein diets on the performance of the Cassie line and to compare these values with the conventional Yorkshire pigs. (ii) to assess the carcass quality of the Cassie line in comparison with the conventional Yorkshire pigs.

Experiment 1

Six of each Cassie Enviropig and Yorkshire growing barrows, with average initial BW of 24 and 20 kg, respectively, were fed three diets according to a cross over design. There were 3 diets, 6 pigs, 3 periods with 2 pigs/diet/period for a total of 6 replicates/diet. The diets were formulated on the basis of available P with Ca:P maintained at 2:1. The diets consisted of Diet A, a control diet with supplemental PO_4^{3-}; Diet B, no supplemental PO_4^{3-}; and Diet C, no supplemental PO_4^{3-} and 2% lower CP. Each experimental period consisted of 14 d with 10-d adaptation and 4-d collection of urine and representative fecal samples. Data collected were subjected to analysis of covariance using a mixed models procedure with the initial BW as a covariate. Total fecal P was significantly reduced ($P <$ 0.05) in the Enviropigs as compared to the Yorkshire pigs. Fecal P values were reduced by up to 39% on diet A, 70 % on diet B, and 68% on diet C. Apparent P digestibility was significantly increased (P < 0.05) in the Enviropigs than the conventional Yorkshire pigs. Phosphorus digestibility was increased by up to 52% on diet A, 76% on diet B and 86% on diet C. There were no differences ($P <$ 0.05) in the urine P when the pigs were fed low-P and low-CP diets.

Experiment 2

Forty eight (24 Cassie Enviropig and 24 Yorkshire) comprised of 12 boars and 12 gilts of each breed with average initial and final BW of 25 kg and 100 kg respectively were individually housed in a temperature-controlled room maintained at 22^{o}C. The experimental design was 2 x 2 factorial combinations of breed and gender. All the pigs were fed at a percentage of their BW with weekly adjustments using the NRC (1998) model. The experimental diets were formulated based on the available P with the Ca:P maintained at 2:1 at both the growing and finishing phases. Data collected were subjected to analysis of variance using the general linear model of SAS (2000). There were no differences ($P >$ 0.05) in the initial and final BW of the pigs (Table 1). The empty carcass weight and organ weights were not different ($P >$ 0.05) between the Enviropigs and the conventional Yorkshire pigs (Table 1). The carcass drip loss and pH were similar between the Enviropigs and the conventional Yorkshire pigs.

Conclusion

Even though they consumed equivalent available P, the total P excretion was reduced when the Enviropigs were fed the diets with low P and low CP compared with the Yorkshire pigs. Enviropigs do not require supplemental feed inorganic P, are friendly to nutrient management program requirements and are more environmentally sustainable than conventional Yorkshire pigs.

The quality of the measured carcass traits was similar between the Enviropig and the conventional Yorkshire pigs. Additional analyses are in progress to further assess the substantial equivalence of the Enviropigs and conventional Yorkshire pigs.

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Table 1. Carcass quality of the Cassie line of the Enviropig compared to Yorkshire Pigs.

Items	Transgenic	Conventional	SEM
Initial BW (kg)	24.7	25.6	0.4
Final BW (kg)	100.5	102.5	0.6
Empty carcass wt (kg)	83.1	85.0	0.5
Carcass length (cm)	82.2	81.9	0.2
Heart (kg)	0.4	0.4	00
Liver (kg)	1.5	1.6	0.0
Kidneys (kg)	0.3	0.3	0.0
Lungs (kg)	0.7	0.7	0.0
Drip loss-ham (%)	10.4	10.5	0.2
Drip loss-loin (%)	9.7	10.9	0.3
pH – ham	5.8	5.8	0.0
pH – loin	5.8	5.7	0.0

[a,b]Means within the same row followed by different superscripts letters are different ($P < 0.05$)

Drinking Water Separated From Liquid Manure

Jim Morris, Ron Fleming, Malcolm MacAlpine,
Ridgetown College, University of Guelph.

The efficacy of separated clean water from liquid swine manure as a source of drinking water for pigs was evaluated in a trial at Ridgetown College, University of Guelph using New Logic's VSEP (Vibratory Shear Enhanced Process). The VSEP employs the use of oscillating vibration which controls the effectsthe "diffusion polarization" that limites permeation of conventional crossflow membrane systems. Studies have shown that the VSEP is capable of 5-15 times the permeate flux per unit of area when compared to conventional static membrane crossflow systems. The use of vibration to control membrane blinding (fouling) by suspended solids has increased the number of applications of membrane filtration. Many liquid/solid separation are now possible that were not previously using membrane technology. This includes liquid/solid separation of liquid swine manure.

The objective of the Ridgetown study was to evaluate the impact of separated clean water from liquid swine manure using the VSEP as a source of drinking water for pigs on:

- Quality of water
- The growth performance of starter pigs
- The health status of starter pigs.

Water was recovered from liquid manure using the Vibratory Shearing Enhanced Processing (VSEP) unit. The VSEP was fitted with an reverse osmosis (RO) filter pack. The quality of the recovered water (permeate) was assessed and provided for drinking water to young pigs.

The study involved 3 water treatments (regular barn water, half barn water and VSEP permeate, and VSEP permeate). A total of 54 pigs were allocated to 9 pens of 6 pigs each. All pens were balanced for sex with 3 barrows and 3 gilts being allocated to each pen. The data collected included initial and weekly body weights, daily feed consumption and feed consumption on a pen basis. Mortalities and their causes were recorded. Morbidity of the pigs were assessed in several ways including their growth performance, frequency of treatment and the levels of feed and water consumption.

Results:

Results showed that the VSEP unit produced permeate (separated water) from liquid manure at a quality level acceptable to pigs. The data revealed that no performance (Table 1) or health effects resulted from providing the recovered water from liquid manure to yong weaner pigs (12 - 26 kg livewight). The pigs drank as much of the permeate from the VSEP as the normal barn water supplied to the pigs. It can be assumed that if young pigs will accept this water with no seemingly ill effects, then the water should be quite acceptable to older pigs.

Experimental pigs enjoying a drink of permeate which was separated from liquid manure.

Table 1. The growth performance of the pigs subjected to the various water treatments.

Parameter	Barn water	50% barn /50% permeate	Permeate	SE	Probability
Initial Wt. (Kg)	12.4	12.4	12.6	0.666	0.982
Week 1 Wt. (Kg)	15.0	14.9	15.3	0.659	0.884
Week 2 Wt. (Kg)	17.8	17.8	18.3	0.591	0.771
Week 3 Wt. (Kg)	21.8	22.1	22.7	0.640	0.650
Final Wt. (Kg)	26.6	26.9	26.9	0.640	0.913
ADFI (Kg)	1.20	1.18	1.23	0.040	0.755
ADG (Kg)	0.50	0.52	0.51	0.009	0.579
F/G	2.38	2.28	2.40	0.095	0.671

ADFI - average daily feed intake; ADG - average daily gain; F/G - Kg feed per Kg gain.

Conclusions:

- This study showed that clear and potable water for pigs can be recovered from liquid swine manure using a Vibratory, Shearing, Enhanced Processing (VSEP) machine fitted with reverse osmosis membranes.
- There were no apparent health problems for any of the pigs on trial.
- There was no effect of water treatment on overall water consumption. There appeared to be a higher daily consumption of water per pig ($P < 0.05$) during the latter period of the study for those pigs on the separated water treatment.
- No statistical differences associated with water treatment were observed for any of the body weight measurements, average daily feed intake, average daily gain and feed conversion throughout the trial.
- The separated water (permeate) recovered from liquid manure was quite acceptable as a water source for pigs under the conditions of this experiment.

Benefit of Research to the Pork Industry:

The ability to separate clean water and reuse it in the barn is important for water conservation considerations in livestock systems. The ability to extract water clean enough without the presence of pathogens potentially will produce a water quality good enough for drinking water for pigs. Such a capability would offer a tremendous benefit in reducing the amount of liquid spreading and to reduce the amount of outside water used in swine units resulting in a substantial conservation of fresh ground water on the farm.

For further information visit the Ridgetown College Website at **www.ridgetownc.uoguelph.ca**

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Acknowledgments:

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Survival of Bacteria in Manure Storages

Ron Fleming
Ridgetown College, University of Guelph

This study set out to measure die-off rates of bacteria in liquid manure storages on swine farms and to establish which criteria, if any, have the biggest impact on these die-off rates. Between July, 2003 and July 2004, liquid manure samples were collected from 28 swine farms in southwestern Ontario. Four samples per storage were collected, over the 12-month period. The samples were analyzed for levels of manure nutrients and for *E. coli* and *Salmonella*. All of the storages served barns with a recent history of *Salmonella* presence (at least in individual animals or pens), so the prevalence of *Salmonella* was expected to be high. At each site, measurements were made of manure depth in storage, temperature of manure, and the approximate age of manure in the storage. Eleven of the storages were covered and 17 were uncovered (including 15 concrete tanks and two earthen storages).

The main findings of the study:

- Even though the farms were selected based on a high probability of finding *Salmonella*, only 40.9% of the samples tested positive for the presence of *Salmonella*.
- Numbers of *Salmonella* present were rather low. For the 45 samples testing positive, the geometric mean density was 1.36 organisms per mL (using the Most Probable Number analysis). The highest count was 427 MPN/mL. (In contrast, *E. coli* is often present in the millions of organisms per mL.)
- There was no significant difference in *Salmonella* counts between the four visits to the farms - roughly representing different seasons of the year – shown in Fig. 1.
- Despite the fact that there were differences in manure temperatures and dry matter levels, there was no significant difference in *Salmonella* numbers (log transformed) between covered and uncovered storages.
- There was no significant relationship between *Salmonella* numbers (log transformed) and either manure depth or manure age.
- There was a relationship between *Salmonella* detected in animals in the barn (from pen manure and from individual animals' fecal or blood samples) and *Salmonella* in the manure storage.
- High levels of *E. coli* in the stored manure did not prove to be a good predictor of the presence or density of *Salmonella*.
- Concentrations of any of the commonly-measured manure nutrients bore no relation to the density of *Salmonella* organisms in the manure.
- There was a significant difference in *E. coli* densities between farms and between visits, but not between storage types.
- There was no statistically significant relationship between the log density of *E. coli* and any of the following: manure depth, manure age, dry matter, NH_4, TKN, K, P, or manure temperature.

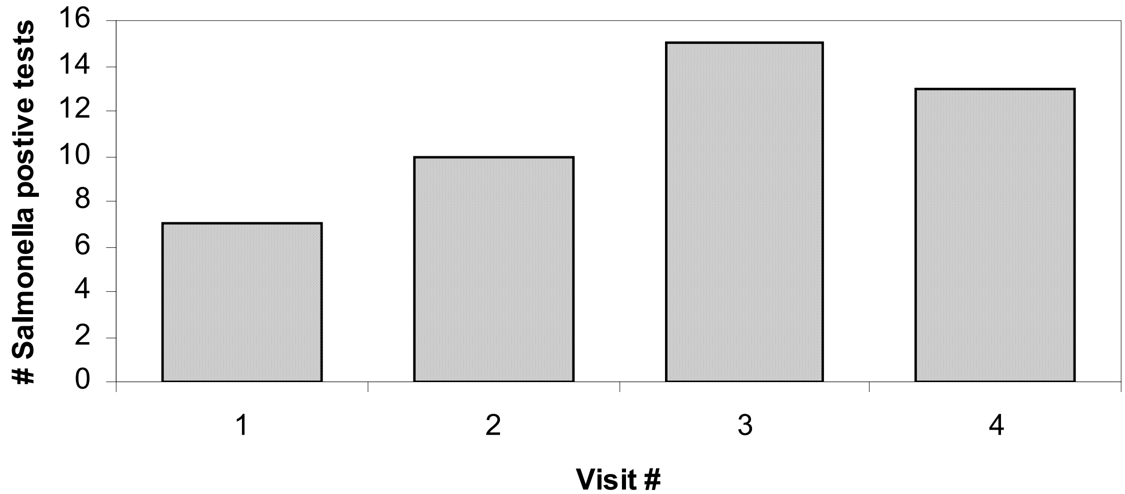

Figure 1. Number of manure samples (out of 28 maximum) testing positive for Salmonella for each of the 4 farm visits between Fall 2003 and summer 2004.

This study was not able to establish the rate of die-off of *Salmonella* or *E. coli* in manure storages. The most likely reason for this was that fresh manure was added regularly to all of the storages in the study. However, it did establish that in those manure storages where *Salmonella* was present, the counts were very low.

Download the complete report from:
http://www.ridgetownc.com/research/research_fleming.cfm

Funding for this study was provided by Ontario Pork and the Ontario Ministry of Agriculture and Food.

CPC Traceability Initiatives Update

Francois Bedard, CPC analyst, Dennis McKerracher, CPC traceability chair,
Clare Schlegel, CPC president

CPC – National Swine Traceability Pilot Project

The pilot project set out to determine and analyze the performance of various identification means as well as the performances of traceability systems. This report will highlight the most effective way to acquire knowledge of the location and description of all premises where hogs can be raised, quarantined, auctioned and slaughtered; analysis identifiers and the collection, transfer and reconciliation of animal movement data. It evaluates identification scenarios using non-automated means (ear tags, etc.), permanent automated means (radio frequency identification), and identification and traceability of pigs in groups. It measures elements as equipment costs, potential impacts on human resources, data capture and transfer and tracing for zoning. The final report is due in January 2005, and will form the basis of the national traceability program.

This work is leading to the Canadian Swine Traceability System. A decision on a recommended system will be made in January by the CPC traceability committee with a consultation process that involves all provinces in March/April of 2005.

CPC – National Tattoo Identification

National tattoo standardization was completed in late November 2004. The study ascertained the tattoo numbers being used and maintained throughout Canada. The CPC along with all provinces are working together in order to develop a national tattoo numbering scheme.

Canadian Livestock Identification Agency (CLIA)

CPC has also been actively involvement with CFIA and AAFC, and other national livestock organizations in creation of the CLIA. The CLIA is a multi species agency to determine the shape, scope and implementation of a national livestock identification scheme for all livestock in the food chain. They will provide animal tracking and tracing services to Canada's primary producer associations. The strategy for the incorporation and the launch of the CLIA is presently in progress.

Various working groups have been established with representation from the pork industry. These working groups are developing industry standards in terms of system compliance and integrity, national performances, lot identification and premises identification

Can-Trace

The Electronic Commerce Council of Canada (ECCC)'s through an initiative called Can-Trace are committed to the development of traceability standards for all food products grown, manufactured and sold in Canada. The standards represent minimum information requirements to establish whole-chain traceability. They have initiated a Pork Pilot Project to test the standards beginning with beef, pork, fruit and vegetables. They have recognized that the result of the CPC pilot study will have a significant impact on what traceability looks like from the farm to the abattoir. Their focus is the abattoir to the consumer. Can-Trace will focus on developing change management procedures, data communication protocols as well as standards for multi-ingredient products.

Zoning

The West Hawk Zoning Plan to effectively zone Canada at the Manitoba and Ontario border has been studied by the Canadian Animal Health Coalition in order to control animal movement and strengthen the economic implications of a Foreign Animal Disease outbreak. A zoning control point would allow the control of a disease within the country, to isolate the disease to one country, with the tracking of animal movement between regions to isolate suspect FAD carriers. For industry, there is benefit for the disease free zone, to resume be able to resume trading. The eventual release of zoning plan will show the need for a Canadian industry governance model for the development of future zones.

The status of this initiative is unknown at the present time.

CQA® Program

Christine Ritter, Ontario Pork

Since its launch in 1998, the National CQA® program has undergone a complete revision. These changes are reflected in the 2004 version of the CQA® program materials that was launched December 1st, 2004 for Ontario Pork producers.

Over the years, selected changes have been made to the text of the program materials to address changes in the industry and to clarify areas that were found to present challenges. This new version is a result of a complete internal review by the CQA® Technical Working Group as well as an external review through the Canadian Food Inspection Agency's (CFIA) on-farm food safety program technical review process, which formally recognized the CQA® program in July 2004.

One such change to the manual is the removal of Sulfamethazine testing of finisher rations. Other changes include new emphasis on "verification procedures", which is the act of having someone review a specific on-farm activity to ensure that it is being performed properly and that records are being kept accurately. The new material also has new manual sections and all chapters have been expanded and modified.

Currently, the program requires that any farm supplying stock to a CQA® recognized farm must be enrolled under the program, which includes purchasing a CQA® binder from Ontario Pork. As of October 2005, this requirement will be increased from "enrolled" to "recognized" as outlined in question 2b of the On-Farm Assessment Form. Producers who have a non-market hog barn should begin making arrangements to complete their CQA® in order to meet this future requirement.

The national CQA® program also launched its new website at www.cqa-aqc.ca. This informative and useful site contains all necessary resources for producers, industry partners, and veterinarians, and includes the revised 2004 Producer Manual along with an interactive component. Ontario-specific CQA® news can still be found on the Ontario Pork website at www.ontariopork.on.ca/cqa/cqa.htm.

Today, there are over 10,000 farms enrolled in the CQA® program across Canada, which represents 82% of hogs. Over 6,400 farms are CQA®-recognized, representing about 70% of hogs raised in Canada. In Ontario, CQA® Recognized farms represent over 82% of market hogs shipped, above the National average. If you have any questions about the CQA® program, please contact Ontario Pork's CQA® Coordinator, Christine Ritter at 1-877-668-7675 or email at christine.ritter@ontariopork.on.ca.

Sentinel Herd Project Update

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In 2001, we selected 100 farms from across Ontario representing the provincial pig industry and we have since visited these farms on an annual basis. Fecal samples and blood samples have been routinely collected and processed. Various bacteria have been cultured and serology for antibodies to a variety of diseases has been conducted. Information regarding management including drug use has been obtained.

A major objective of the study was to establish a baseline for the prevalence of zoonotic disease pathogens in Ontario pig herds. We have established that *Campylobacter coli* are present in almost all fecal samples, whereas *E. coli* O157:H7 are very rare but can be isolated from pig manure. *Salmonella sp* and *Yersinia enterocolitica* are likely the two most important organisms from a public health standpoint and were found on almost half of the farms. *Salmonella* Typhimurium was the most common serovar isolated and multiple drug resistant strains were identified. Antimicrobial resistance was further investigated using commensal *E.coli*. Over the 4 years studied we did not identify an increase or marked change in resistance patterns and generally resistance to the important drugs such as fluoroquinilones and 3rd generation cephalosporins was not found.

We also examined blood samples for antibodies to both diseases of economic importance and public health significance. Diseases that were investigated included; salmonellosis, porcine proliferative enteropathy, swine influenza, toxoplasmosis, pleuropneumonia, and porcine parvovirus. Diseases that are quite important and are very common often appear in a subclinical form. For example, many herds were found to have antibodies to *Lawsonia intracellularis*, *Salmonella sp* and swine influenza virus H1N1 but often the herdsmen were unaware that these organisms were present. Therefore good diagnostic tests are important in determining the status of a herd or an individual animal. We used duplicate sera to test agreement between serological tests for the three diseases mentioned above and found poor correlation at the individual animal level in all three cases. In the case of *L. intracellularis* an IPM assay conducted at the University of Minnesota was compared to an IFA test performed at the University of Montreal and the tests agreed on only 25% of the individual samples despite reports in the literature that these tests strongly agreed based on sera from experimentally infected pigs.

We also used nasal swabs and tonsil swabs to look for disease agents that commonly live in these areas such as Strep suis and *Hemphilus parasuis* (the cause of Glasser's disease). These organisms are found very commonly and the prevalence of disease due to these agents seems to be on the increase. Likewise we isolated K88+*E. coli* from weanling pigs with diarrhoea on about 35% of the farms tested, illustrating that post-weaning *E. coli* diarrhoea is quite common. On the other hand we found that some diseases that were once very important are disappearing, including swine dysentery and atrophic rhinitis.

Management factors were identified which were associated with the prevalence of disease. For example, in the case of *L. intracellularis* there was a greater likelihood of finding positive pigs if the finisher barn was operated in a continuous flow manner and antibiotics were not included in the feed compared to a farm that used medication and emptied and cleaned the barn between batches. *Salmonella sp* were more likely to be found on a farm using dry feeding compared to a farm using liquid feeding.

Some Highlights of Results

1. *E. coli* O157:H7 can be isolated from pigs but it is rare.
2. *Salmonella* prevalence appears to be associated with feeding and that liquid feeding can reduce the presence of *Salmonella*.
3. Swine influenza is widespread in Ontario but newer strains that are common in the U.S. don't appear to be endemic here.
4. Diseases that used to be common are disappearing but other diseases are increasing in importance.

Significance of this research

We have established benchmarks for the presence of a large number of disease organisms in the Ontario pig population. Based on the results of this study future work in the area of disease monitoring or control strategies will be able to use this information to make decisions about sample sizes, test procedures and costs associated with surveillance.

Acknowledgements

This work has received financial support from the Ontario Ministry of Agriculture and Food, Ontario Pork, Health Canada, Pfizer Animal Health, Elanco, Schering-Plough and the University of Guelph-OMAF Animal Research Program.
Most importantly we wish to thank the pork producers who have participated in this project.

The Effects of Gender, Grain Source and Feeding Method on Pig Growth Performance and Carcass Composition.

Phil McEwen and Jim Morris, Ridgetown College - University of Guelph

Introduction

The pork industry is seeking a faster growing, leaner pig with acceptable meat quality parameters. The industry is also seeking efficient performance with strict operating and fixed cost control. Previous research at Ridgetown College (RCAT Animal Research Report, 1986/87) indicated that a controlled feeding program could reduce feed intake (per pig) and cost, increase net return while reducing daily gain. However, the current swine population has an increased genetic potential for growth and leanness. Therefore the historic economic advantage associated with a controlled (restricted) feeding program may have dissipated due to an improved feed efficiency by present day genetics.

Objective

The objective was to evaluate the effects of gender, grain source and feeding strategy on pig growth performance, feed intake and carcass merit.

Experimental Procedures:

Ninety-six feeder pigs (61.9 $\pm$ 1.6) were randomly assigned to pens by gender. Each pen of six gilts or barrows was then assigned to either barley (BG) or corn (CG) based diets. Pens were fed a grower diet (0.9% lysine) until 75 kg followed by a 0.7% lysine finisher diet. Eight pens were full fed (FF) until market while the remaining groups were restricted (RF) to 2.6 kg of daily feed per pig after achieving a 75 kg average body weight (BW). Feed allocations were recorded daily with weighbacks measured weekly. The pigs were weighed weekly and pens were marketed after achieving a 110 kg average BW. Backfat and loin eye depth (ultrasound) were also taken on each pig before they were slaughtered and carcass graded.

Results and Discussion:

Daily gains (kg) were similar (Table 1) for gilts and barrows while CG fed pigs grew at an increased rate. Gains were also increased for full (FF) versus restrictive (RF) feeding (1.07 vs. 0.92 kg). Total feed intake was greater for barrows versus gilts (957.0 vs.884.8 kg) resulting in an increased daily intake for barrows (3.11 vs. 2.87 kg). BG versus CG fed pigs consumed more total feed (975.2 vs. 884.6 kg) while daily feed intake was similar. FF feeding increased total (952.8 vs. 889.0 kg) and daily (3.33 vs. 2.65 kg) feed intake versus RF. Feed to gain (F/G) was similar for FF versus RF (3.06 vs. 2.93) while F/G was reduced for RF pigs during the finishing period (3.41 vs. 3.20). F/G was also less for CG versus BG feeding (2.87 vs. 3.12). While feed to gain estimates were similar for both sexes a significant improvement in F/G was observed when barrows were limit fed (3.19 vs. 2.93).

After correcting for final weight, carcass weight (kg) was increased for barrows versus gilts (90.4 vs. 89.3) and RF versus FF pigs (90.3 vs. 89.4). Lean yield (%) was increased for gilts versus barrows (61.9 vs. 60.6) and RF versus FF pigs (61.7 vs. 60.8). Therefore gender, grain source and feeding method significantly affected many growth, feed intake and carcass parameters.

Table 1. Effects of gender, grain source and feeding method on pig growth performance, feed intake and carcass composition.

	Gender		Grain Source		Feeding Method	
	Gilt	**Barrow**	**Barley**	**Corn**	**Full**	**Restricted**
Growth Performance and Feed Intake						
Ave. Final Wt. (kg)	114.9	112.3	112.5	113.9	113.6	112.8
Days to Market	52.1	52.2	54.6[c]	49.6[d]	47.9[e]	56.3[f]
Average Daily Gain (kg)	0.98	1.02	0.96[c]	1.04[d]	1.07[e]	0.92[f]
Total Feed Intake (kg)	884.8[a]	957.0[b]	957.2[c]	884.6[d]	952.8[e]	889.0[f]
Feed Intake (kg/d)	2.87[a]	3.11[b]	2.98	2.99	3.33[e]	2.65[f]
Feed to Gain (F/G)	2.93	3.06	3.12[c]	2.87[d]	3.06	2.93
F/G – Finishing Period	3.16[a]	3.45[b]	3.48[c]	3.13[d]	3.41[e]	3.20[f]
Carcass Characteristics						
Carcass Weight (kg)	89.3[a]	90.4[b]	89.7	90.0	89.4[e]	90.3[f]
Lean Yield (%)	61.9[a]	60.6[b]	61.7	60.8	60.8[e]	61.7[f]
Fat Depth (mm)	16.5	17.9	17.5	17.0	17.7	16.8
Meat Depth (mm)	61.0	60.5	59.7	61.8	60.1	61.4

[a,b] LS means within row for gender that do not share a common superscript differ ($p < 0.05$).
[c,d] LS means within row for grain source that do not share a common superscript differ ($p < 0.05$).
[e,f] LS means within row for feeding method that do not share a common superscript differ ($p < 0.05$).

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Acknowledgments

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Community Perceptions of Livestock Production

Wayne Caldwell[1], Melanie Williams[1] and Sarah Thomson
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Many farmers and decision makers in rural Ontario have faced acrimonious public meetings related to the construction of new or expanded livestock facilities. The challenge for local politicians is to sift through this public debate to develop an objective and informed opinion on what are real concerns versus what is a NIMBY response (Not In My Back Yard). The following provides the summary of a research project that attempted to evaluate how neighbours have reacted to existing large livestock facilities.

The research surveyed 50 owners of large livestock operations and 180 of their nearby neighbours. The farms had 150 or more livestock units and had been in operation for at least five years at the current site. The farms were scattered across Ontario from Windsor to the Quebec border. The selected neighbours lived beside the operation both before and/or after its construction.

The aim of the research *Agricultural & Livestock Intensification: Community Perceptions of Environmental, Economic and Social Impacts as an Impediment to Agricultural Production*[*], was to examine the real and perceived concerns associated with livestock intensification by surveying neighbours in the area where livestock production has intensified.

In total 21 hog, 10 dairy, 11 beef and 8 poultry farms were studied. There were a larger number of hog operations studied because of the prevalence of more intensification in the hog industry. In total there are more beef cattle across the province but they are dispersed in smaller operations of less than 150 livestock units.

Four hundred landowners were contacted to fill out surveys regarding the nearby livestock operation and asked for their opinions about how the neighbouring livestock operation has impacted them.

A total of 180 (45%) neighbours responded to the survey. In general farmers received approval from their neighbours: 81 per cent agreed that farm operators make good neighbours, 69 per cent see farmers as good stewards of the land and 70 per cent felt farm operators were good at caring for their animals. Moreover, 81 per cent of neighbours located near a large livestock operation have “never expressed a concern” about the nearby farming operation.

More than half, 58 per cent of the neighbours said they had not changed their normal activities due to the nearby livestock operation. Many of the changes neighbours had made where in conjunction with the manure-spreading schedule of the farm operation (usually twice a year). During this time 36 per cent kept their windows closed; 13 per cent stopped having outdoor functions and 24 per cent stopped hanging laundry outdoors.

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[*] *Agricultural & Livestock Intensification: Community Perceptions of Environmental, Economic and Social Impacts as an Impediment to Agricultural Production* was co-authored by Dr. Wayne Caldwell and Melanie Williams, School of Environmental Design and Rural Development, University of Guelph and funded by the Ontario Ministry of Agriculture and Food.

Farmers said they had made changes to their farming operation since construction or expansion, to accommodate the concerns of neighbours 28 per cent of the time; the biggest change was 86 per cent of farm operators said they had changed their manure handling and application techniques to work the manure into the soil to decrease odours. A further 29 per cent changed their hours of operation to exclude evening and some weekends.

Neighbours noted that expansion of the farm operation often led to investments that were an improvement over the pre-expansion operation. These improvements included improved manure storage and handling, retention of runoff from manure storage, reduced flies and related aesthetic improvements.

The better than expected results should not be taken to mean that all is well. Pronounced environmental concerns voiced at the time of construction continue to be prevalent in some cases. Although concerns tended to lessen after initial construction a significant number of neighbours still have concerns over odour (40%) and water quality (25%). These concerns can be the foundation for on-going conflict that taints neighbourly relations and complicates a farmer's ability to adopt new management practices in the face of changing economics.

The research provides insight into the long-term relationship between rural residents and intensive livestock operations. This information can be used by planners, councillors, farmers and other rural residents to improve understanding and develop more informed opinions. It provides a response to Not in My Backyard thinking and promotes practices that foster good neighbour relations between large livestock operations and rural residents. This information can assist provincial and local authorities with the development of policy and land use planning practices. The research can also be used as a medium to understand and resolve conflict.

The project proposal and final report are available on line at www.waynecaldwell.ca/livestock.htm.

Author Bio notes

Wayne Caldwell, MCIP, RPP holds a joint appointment between the University of Guelph and the County of Huron. He was the Director of this research project. Melanie Williams, is a graduate of the Masters program in rural planning at the University of Guelph. She is currently employed with the Toronto and Region Conservation Authority. Sarah Thomson is a journalist who specializes in issues that affect Rural Ontario.

Evaluation Of Alternative Nutrient Management Regulatory Standards And Producer Compliance Options – Swine Case Studies

Executive Summary

Cher Brethour and Kate Stiefelmeyer, George Morris Centre
Chris Attema, Water Quality Specialist

Compliance with the nutrient management regulations and the cost of implementation will be variable and unique to individual site conditions, producer circumstances and objectives. Due to the site-specific nature of compliance, it is less meaningful to producers to understand the 'average' cost of compliance than to identify individual and site-specific costs with the 267/03 regulations.

The purpose of this project was to develop a database of information pertaining to the costs of implementing the proposed nutrient management regulations and to identify the cost savings of producer suggested compliance alternatives and modifications to the regulations.

The specific objectives of the project were:

- To briefly review and summarize the current Nutrient Management Regulations (267/03).
- To develop case study selection criteria for various farm operations.
- To develop a standard survey instrument to collect information that is relevant to the regulations and all operations.
- To estimate the cost of compliance using a case-by-case approach of the nutrient management regulations for livestock production in Ontario.
- To assess how modifications to the regulations and compliance alternatives might change the cost scenario for each case and commodity.

For each individual Ontario Pork case study, specific site condition information and farm management practices information was required from the producers. Questionnaires were designed to collect this information, as well as to identify any anticipated cost of compliance for the proposed regulations that the producer may have already invested, for example, developing a nutrient management plan. The site visit consisted of confirming information on the survey questionnaire, and assessing requirements for producer compliance with the regulations (267/03, December 2003). Where site assessments were more complex, OMAF technical staff participated in the on-farm interviews. In addition, the interviewers identified any contentious issues on the farm that could result in problems with compliance in the future.

Using the information collected from the survey, site visits and the database of producer compliance costs, the compliance cost of the proposed regulations was estimated for each case. This process was a challenging one, as it was the first time the regulations had been implemented in real-life cases. This required extensive feedback from both OMAF and MOE staff for interpretation and clarification.

In total, 10 swine operation case studies were conducted, consisting of 11 individual site assessments. Table 1 illustrates the size and type of each operation, as well as the lowest compliance cost option for each of the cases (some cases had more than one compliance cost estimate due to various compliance options available, for example, storage construction). Of the ten cases, five were 300 NU or greater and will be required to comply with the regulations by July 2005. The other cases will not be required to comply by July 2005; however it was assumed that at some point in the future, all farms would be required to comply.

Table 1: Description and results of Swine Case Studies

Case #	Size of Operation	Type of Operation	High Compliance Costs	Estimated Cost of Compliance	
				Low	High
1	157 NU	Farrow - Wean	• NMS/P	$6,506	$13,592
2	300 NU	Farrow - Wean	• VFS and land replacement	$11,803	$28,348
3	207 NU	Farrow - Finish	• VFS and land replacement	$9,570	$19,928
4	213 NU	Farrow - Finish	• NMS/P	$5,735	$10,395
5	233 NU	Farrow - Finish	• VFS and land replacement	$18,100	$38,841
6	343 NU	Farrow - Finish	• storage	$51,161	$81,777
7	455 NU	Farrow - Finish	• municipal well within field	$33,036	$88,161
8	350 NU	SEW	• storage	$76,129	$90,439
9	476 NU	SEW	• VFS and land replacement	$6,700	$14,925
10	736 NU	SEW	• VFS and land replacement	$18,736	$47,303

Overall, the estimated costs of compliance ranged from just under $6,000 to just over $90,000 per farm. It is interesting to note that the highest costs of compliance do not necessarily relate to the size of the operation, which reiterates the fact that these compliance costs will be site specific, and depend on the existing infrastructure and management practices.

As shown in Table 1, the greatest impacts from compliance are expected to be with:

- Storage capacity and storage assessment
- Buffer strips and setback (N & P indices)
  - Value of land, establishment of buffer, lost crop production & fertilizer
- Operating costs

In addition to producers having difficulty understanding and implementing the regulatory requirements, an issue that will make compliance difficult for many producers will be incomplete information with respect to understanding their property, for example location of wells.

As a direct result of this case study assessment, numerous recommendations have been made to OMAF regarding the modification and/or clarification to the regulations. September 2004 marked the conclusion of the research with a final report presentation and recommendations to the Provincial Nutrient Management Advisory Committee made in October. In December 2004, Chris Attema and Cher Brethour also participated in Producer Information Sessions titled "*Will the Nutrient Management Act Affect Your Business*?" across Ontario hosted by Ontario Pork and Ontario Cattlemen's Association in which they presented the results of this research.

The Development of an Enhanced Electronic Nose to Reliably Measure Odours in and around Swine Facilities

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Abstract
We designed and implemented the first prototype robotic electronic nose for pork odours. Preliminary version of software for signal acquisition, signal processing, and user interface were developed. Some testing experiments were conducted using artificial odorant gas in research laboratory and also natural odorant gas at several livestock farms. The circuit and noise of the odorant gas sensors in our robotic nose were analyzed. In addition, we developed both statistic and neural network approaches for modeling and analysis of pork odours using several single-component datasets and a multiple-component dataset. Future work includes refinement of the hardware design, development of an integrated systems modeling framework for the pork farm odours, and creation of a user-friendly software suite.

Prototype Design of the Robotic Nose for Odours
The design of the robotic nose includes the selection of sensors especially to measure the odour compounds in and around the pork farms, the design of electrical circuits and corresponding software for signal amplifying, regulation buffer and sampling that acquires all the sensor signals to a laptop computer. The developed robotic nose includes (1) fourteen gas sensors as well as the temperature and humidity sensors; (2) the gas chamber with a pump; (3) the signal amplifier and regulation buffer, and the analog/digital (A/D) conversion and interface; and (4) the software for sensor data acquisition, signal processing and user interface. A photo of the prototype robotic nose and its user interface are shown in Figures 1 and 2, respectively.

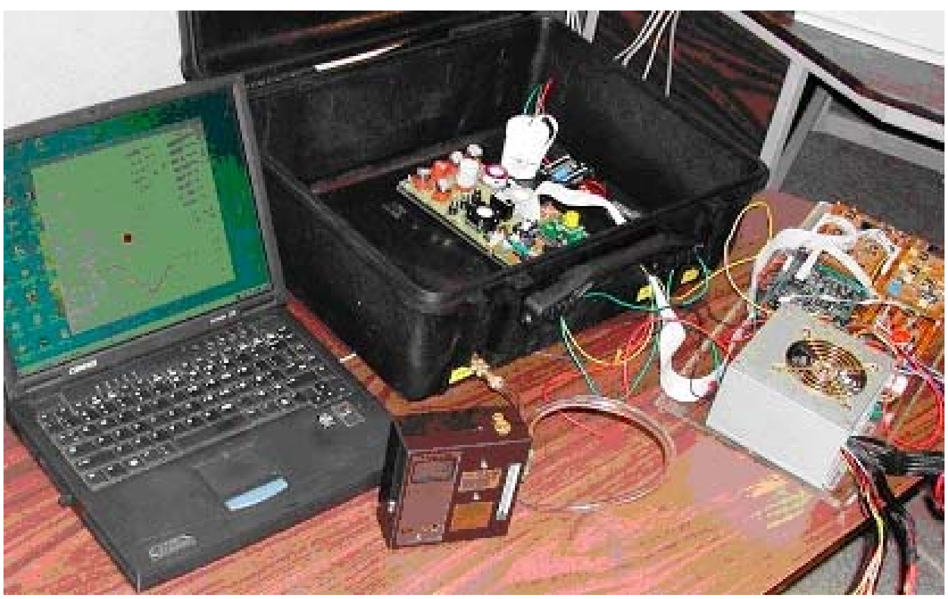

Figure 1: The prototype robotic nose with connection to a laptop computer.

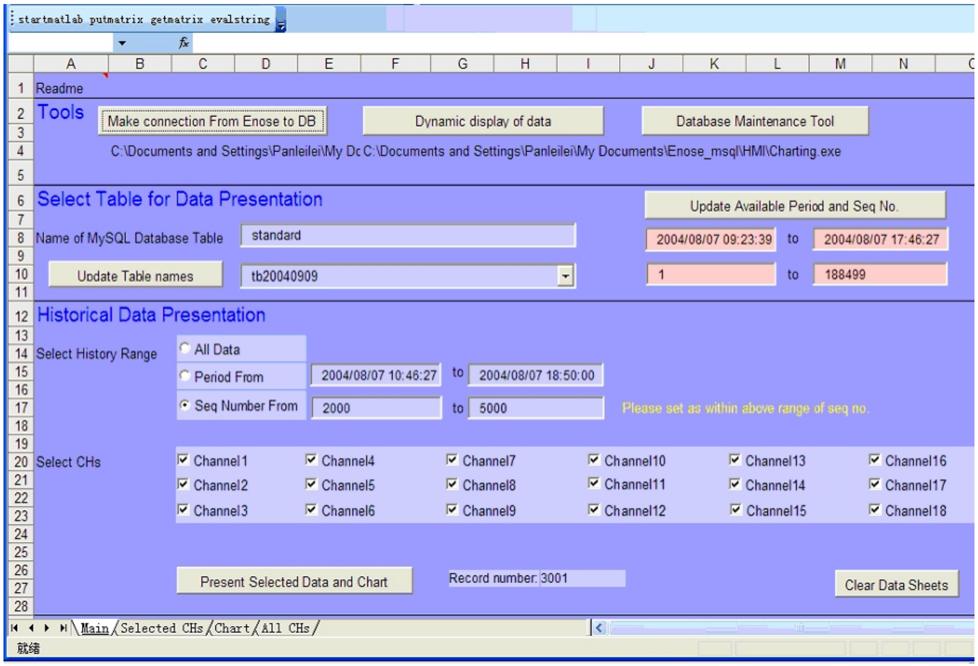

Figure 2: A user interface for data acquisition, dynamic display and data management.

Systems Modeling and Analysis of Odours Pork Farm Odours

In addition to the hardware and software development, we conducted extensive analysis on our robotic e-nose and also the complex odour problem. The circuit and noise or the odorant sensors in our robotic nose were analysed [4,5]. Statistic and neural network approaches to modeling and analysis of pork farm odours were developed [1,2]. Relative contribution of odour components and factors were investigated [3].

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Detoxification of Vomitoxin with Bio-transforming Microorganisms

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Background and Objective

It has been known for some time that vomitoxin (DON) can be transformed into a much (several hundred times) less toxic compound de-epoxy vomitoxin (DOM-1). Previous research indicated that the large intestinal contents from chickens were able to achieve this transformation, while contents from the remaining regions of chicken gut showed only slight activity. The research also demonstrated that the transformation resulted from microorganisms in the chicken gut. Our specific objective for year 2004 was to pinpoint microorganisms capable of transforming DON to DOM-1.

Experimental Procedures

Digesta were collected from crop, small intestine and large intestine of Leghorn hens raised with feeds mixed with clean and contaminated wheat containing 0 or 10 ppm DON, respectively. The digesta were added either directly or after being autoclaved, to a medium amended with purified DON. The resulting mixtures were incubated for 0, 24 and 72 hours and subcultured for six generations at 37 ^{0}C before being processed for chemical analysis. The extent of transformation of DON to DOM-1 was determined by using a LC-MS.

Results and Discussion

Data presented in Figure 1 showed that, compared to the non-DON control, digesta of the large intestine from chickens fed with contaminated wheat were more effective in transforming DON. This may have resulted from increased population and/or improved efficacy of the active microorganisms in the chicken gut. The data also indicated that gut microorganisms acted rather quickly and could transform all DON to DOM within 24 hours.

When digesta of large intestine were cultured in an artificial medium, their effectiveness of DON transformation was still high after the 2nd subculture, but significantly declined at the third subculture (Figure 2). Other media should be tested for their ability to maintain the transforming activity in subsequent subcultures.

Two out of four samples of small intestine gave 100% DON transformation although not all samples had activity. Since microflora of the small intestine is much less complex than that of the large intestine (Figure 3), selection of active microorganisms from the small intestine should be relatively easier. Only one out of four samples from chicken crop had some (26%) activity in DON transformation.

Conclusions and Take Home Messages

The efficacy of DON transformation by microorganisms of chicken gut can be improved through an *in vivo* enrichment.

Microorganisms capable of transforming DON to DOM-1 also exist in the small intestine and could be effective.

The DON transforming microorganisms are cultivable.

Our next objective is to identify the microorganisms effective in transforming DON to DOM-1. This will be done with the aid of antibiotics, selected medium and molecular finger printing technology.

Acknowledgments
We are deeply grateful to Ontario Pork Producers Marketing Board and Agriculture and Agri-Food Canada for funding this research project.

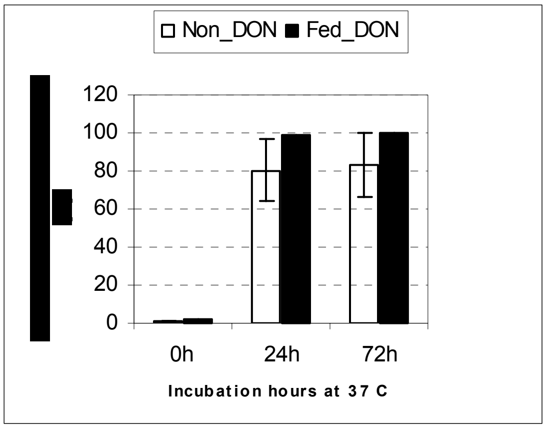

Figure 1. Transformation of DON to DOM by large intestinal contents of chickens fed with and without vomitoxin.

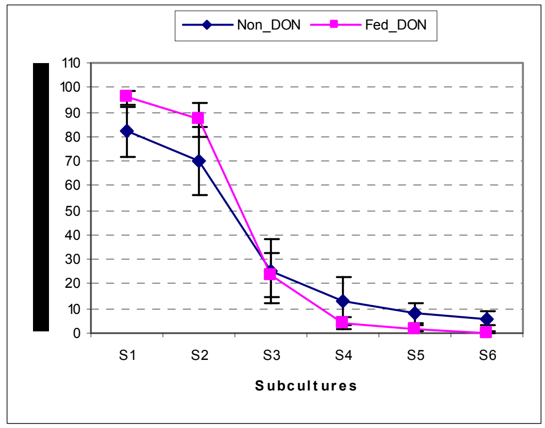

Figure 2. Transformation of DON to DOM by subcultures of large intestinal contents of chickens fed with and without vomitoxin.

Figure 3. DNA finger prints of microorganisms from small intestine (left) and large intestine (right) of Leghorn hens. Each band represents a microorganism species. The figure indicates that the number of microorganisms of small intestine is much less than that of large intestine.

Frozen Semen: Myth or Reality?

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Will the average swine producer ever be able to count on frozen semen like the dairy farmer does? Frozen boar semen has been promised for so long that you would be completely justified in laughing at anyone who continues to say "It will come". Despite that, I do believe that the day will arrive - - I've just given up predicting when!

Why do I think that this will become reality? Firstly, because the need and potential is so great. An international market for semen from boars of outstanding genetics would be an economic gold mine for countries such as Canada with excellent swine genetics. But an international market absolutely requires that semen can be stored for a long time, because the world's increasing concern for biosecurity means that any biological product, including semen, will have to undergo an ever-increasing number of tests to prove that it's safe before an importing country will allow it in. These tests take time, and liquid semen deteriorates too quickly. Thus we have a potentially huge market that would buy Canadian swine genetics, but to create or tap into that market we must be able to store semen for a long time, and freezing is the most likely long-term storage method, so researchers will continue to try to meet that need. The second reason I think we'll be able to freeze semen is because I know the scientists who are working on the problem, and they are some of the best and most dedicated (read: stubborn!) people I know. These scientists recognise that many types of animals, including many endangered species, also have hard-to-freeze semen, and pigs are much more readily available and easier to work with than, say, elephants or komodo dragons. So whatever we learn from boar semen research has the potential to help feed a hungry world more efficiently, and protect species at risk. These scientists work at universities and boar semen centres and for companies that supply the AI centres - - so there's a lot of talent and a lot of different approaches being taken, and I believe one or more will succeed.

The Present Situation

But what is the current status? How do we freeze semen now, how good (or how bad) is it and what's being done immediately to improve it? When we freeze boar semen now, the entire process takes 6-8 hours. Very briefly, fresh semen of good quality is cooled at a carefully controlled rate, the seminal plasma (fluid that the sperm are in) is removed and an extender is added, which is a buffer with sugar, salts, egg yolk and antifreeze. The semen is packaged, either as pellets or in straws of varying sizes, and stored in liquid nitrogen (-196°C) until it is needed. For insemination, thawed semen is diluted with a buffer and the female is inseminated with at least twice the normal dose of sperm, very close to the time she ovulates. If the semen was good quality to start with, frozen and thawed properly and the sow is inseminated carefully, pregnancy rates will be around 50% with about 10 pigs total per litter. The process requires much specialised equipment, a professional lab technician and lots of time, so very few commercial semen centres do it and it is very expensive. The difficulty and cost, coupled with the low pregnancy rates and small litters, means only producers with special needs who are determined to use, or save, particular genetics will use frozen semen.

Coming Soon

Research that is underway right now is looking at almost every step as a possible point to improve the quality of frozen-thawed semen. The speed at which the semen is cooled has been carefully examined, and Canadian scientists are involved in evaluating and designing new freezing equipment. Japanese scientists in 2004 confirmed that removing seminal plasma does improve the quality of frozen-thawed semen, although it doesn't harm fresh sperm. Spanish scientists, also in 2004, found that the way you remove the seminal plasma is really important – and incidentally, the way we've been doing isn't very good. Indeed, one of the AI equipment suppliers has produced a new chemical that is said to protect the sperm during removal of seminal plasma. Other scientists (in Britain, Europe, Korea, Canada, USA, and elsewhere) have been testing new additives to extenders, and new types of anti-freeze. A replacement for egg yolk is being sought, because biosecurity concerns might mean that, in the future, a country might forbid importation of semen that is processed in egg yolk in case the chickens had a virus – or indeed, just on the general principal that mixing egg yolk and semen is un-natural and might permit some kind of disease transference, as with bovine BSE and human CJD.

Conclusion

Frozen boar semen is not a myth. Boar semen can be frozen, preserving the genetics of particular males and resulting in successful pregnancies. The current processes are inefficient and costly and impractical for most producers. Scientists, industries and producers need to continue to work together, and in the future I believe that we will see methods to freeze boar semen that are practical at least for an export market, where purchasers are ready to pay a bit more for a reliable product that brings great genetic benefit to their herd. Frozen boar semen will be a practical reality for the swine producer of the future.

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The Incidence of *Clostridium difficile* in Scouring Ontario piglets

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Clostridium difficile is a Gram-positive, spore-forming anaerobic bacillus that is distributed widely in soil, water and the intestinal tracts of various animals, birds and reptiles. It is an established cause of antibiotic-associated diarrhea and colitis in humans since the late 1970s. *Clostridium difficile* can lead to severe complications and is currently the most common cause of nosocomial diarrhea in humans. It is also responsible for enterocolitis in foals, diarrhea and typhilocolitis in adult horses, and typhilitis in adult hamsters. Colonization occurs by the fecal-oral route; the spores are ingested, and in most cases they produce no symptoms following germination in the intestine. However, in young animals that do not have an established resident population of bacteria, or in those that have been treated with antibiotics, *C. difficile* produces toxins that cause damage to the colonic mucosa. Antibiotics most frequently associated with the infection are clindamycin, ampicillin and/or amoxicillin, and cephalosporins, but all antibiotics may predispose to *C. difficile* infection. Changes in diet may also potentiate the infection, and several swine cases have been identified in "high health" herds. Interestingly, human infants and young children commonly harbor *C. difficile* but have no symptoms related to production of toxin as they do not have receptors sites for the toxin. In humans, the number of carriers quickly declines for unclear reasons as children age.

In October, 2004, researchers reported that 7,000 people had been infected with *C. difficile* while hospitalized in Montreal, with at least 600 deaths. Other hospitals reported periodic outbreaks, but of much lower magnitude. Ribotyping of strains of *C. difficile* that had been isolated from various species has identified that the isolates in humans are different from those in pigs. This organism might be in emergence.

Typically, affected piglets are between 1 and 7 days of age, with a pasty to watery, yellowish diarrhea starting shortly after birth. Morbidity and death losses vary tremendously, ranging upwards to 90% (morbidity) and up to 50% (mortality) of affected piglets, but are usually much lower than these numbers. There is however, a loss of condition, with stunting of survivors. Respiratory distress is often evident. Post-mortem examination of affected piglets may reveal fluid in body cavities, and almost invariably, there is edema of the mesocolon . This edema is due to tissue damage caused by the toxins that are produced by *C. difficile*. Microscopic examination revealed a severe edema of the mesocolon (tissue surrounding the spiral colon), often accompanied by accumulations of neutrophils. The mucosal surface was segmentally eroded, and when accompanied by a fibrin and neutrophil exudation, resulted in a "volcano-like" lesion.

This infection is difficult to deal with, as there are no approved antimicrobials or vaccines and the use of these products has generally produced unsatisfactory results. Anecdotal evidence suggests that bacitracin methylene disalicylate (BMD) may have some beneficial effect, if given to sows prior to and after farrowing. Prefarrowing disinfection of the farrowing rooms, with products such as bleach, is recommended.

Diagnostic laboratories in the USA have identified the presence of *C. difficile* in more than 30% of neonatal piglet enteritis submissions. As a result, the Animal Health Laboratory obtained funding from Ontario Pork to determine the incidence of *C. difficile* in neonatal piglet diarrheas in Ontario. Samples were taken from piglets under 1 week of age, that had been submitted to the Animal Health Laboratory, University of Guelph, with a history of diarrhea. In addition to the routine diagnostic samples, sections of large intestine (colon) were put in formalin for microscopic examination, and colon contents were submitted for detection of the toxin produced by *C. difficile*.

Over a 3 year period (Jan 2002 to Dec 2004), 163 samples from 65 submissions were tested for the presence of *Clostridium difficile* toxins A and B, by using a commercially available enzyme-linked immunosorbent assay (ELISA) kit, TOX A/B II test, TechLab, Blacksburg, Virginia, as per instructions from the manufacturer. Piglets from all types of operations were tested, including large and small herds, those with variable health status and maintaining varying degrees of biosecurity practices.

There were 8 submissions with positive animals, and they can be broken down as follow: 4 sow herds within one system, each with 2,500 sows (one herd was positive on 2 occasions), one herd that was positive on 2 occasions, one herd that was positive on one occasion. Overall, 10 positive piglets were detected. Interestingly, the positive herds were all large operations, having 2,500 to 3,200 sows at each site. All operated the farrowing rooms in an all-in all-out system with weaning ages of 17-20 days, with farrowing rooms being washed and disinfected between usages.

Mesocolonic edema, a hallmark of *C. difficile* infection, was identified in piglets from 18 submissions, including the 8 from which *C difficile* toxin was found. More than one agent is often identified in neonatal piglet diarrheas, and this was often the case in this study. Although identified by itself on several occasions, enterotoxigenic *E. coli*, rotavirus and/or *Salmonella* sp. organisms were also found in some of the *C. difficile* positive piglets.

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Shoulder Sores in Sows – Solve Tomorrow's Problem Today

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Introduction and Objectives

Shoulder sores in sows were defined as a welfare problem by the Danish National Committee for Pig Production in 2003 (1). In the Danish pig industry this disease has sparked a controversy because of the negative public image of the industry that it projects. These sores are called decubital ulcers and occur when tissue is exposed to increased pressure for a prolonged period; the pressure prevents blood flow and in turn causes death of the tissue (2). A sow spends more time in recumbence and moves less often in the lactation period than other times in her cycle (3). During this time, she is exposed to an increased pressure over the shoulder area (2). The shoulder is prone to development of decubital ulcers in sows because of the shallow tissue depth over the ridge of the shoulder blade. The large muscles of the shoulder attach above and below the ridge of the shoulder blade leaving only fat and skin to protect the area. The cause of decubital ulcers in sows has not been greatly studied. The objectives of this study were to identify and evaluate risk factors for the development of decubital ulcers of the shoulder in sows and to determine the on farm prevalence of the disease in the study herds.

Materials and Methods

Eighteen farms, ranging in size from 190 to 650 sows, were chosen for the study based on their willingness to participate in the project. At each farm visit a survey about the farm production type and management was collected. A prevalence investigation and a case-control study were also completed. The prevalence investigation was done by randomly selecting approximately 200 sows. Each sow was observed for the presence of decubital ulcer on the left and right shoulder. Ulcers were given a score of 1 to 3 and barn location and farrowing or weaning date were also recorded. The case-control study was completed by selecting all or the first 25 cases in each farm. Parity, farrowing/wean date, barn location, number of piglets, height of piglet bar, width of farrowing crate, nurse sow status, body condition score, lameness, size of ulcer, injury to legs and treatments were also recorded for each case and control sow.

Results and Discussion

Decubital ulcers were found in 306 / 3797 (8%) sows sampled in the prevalence evaluation. The on-farm prevalence ranged from 1% to 22%, and the farrowing room prevalence ranged from 2% to 36%. The farm level prevalence of score 3 decubital ulcers ranged from 0% to 10.3%, where those with the highest prevalence of decubital ulcers were also the farms with the highest prevalence of score 3 decubital ulcers and vice versa.

Results from the case-control study showed that the three most important risk factors for presence of decubital ulcers are Body Condition Score (BCS), Parity, and Lameness. The model with these three variables and adjusting for within farm correlation was significant ($p<0.05$).

BCS was collapsed into three categories for analysis, because of the very low prevalence of BCS 1 and 5 sows. Those sows with a BCS of 1 or 2 had an Odds Ratio (OR) of 4.96 ($p<0.0001$) to have a decubital lesion compared to those with BCS 3. Those sows with BCS 4 or 5 had a 0.12 ($p<0.0001$) OR with BCS 3 as the reference group. This trend was also shown by Davies et al. (2), even though the distribution of body condition scores in their study tended toward fatter sows. Case sows with lower BCS were also observed to have more severe decubital ulcers then those with satisfactory or above BCS. These thin sows were also more likely to have bilateral shoulder lesions then the sows with better BCS.

Parity is a significant risk factor for the presence of decubital ulcers in sows. A significant quadratic relationship was found between parity and the disease. This shows that there is an increasing risk of decubital ulcer from parity 0 to parity 6 after which the risk starts to fall. The OR for parity 6 is 4.94. Older case sows were also observed to have a higher prevalence of score 3 lesions then younger sows. There are several possible explanations for the fall in OR after parity 6. It may be that if a sow is predisposed by other factors to develop a decubital ulcer then she will develop it before parity 6. If she has not developed the disease by parity 6 then she never will. Another part of it could be due to culling of sows. A farmer may not be willing to cull a young, reproductively fit sow just because of a decubital ulcer. As the sow gets older and does not perform as well, the farmer is willing to cull based on two factors, the reproductive performance and the decubital ulcer.

A sow with lameness is at a much higher risk of having a decubital ulcer then those without lameness. Lameness has an OR of 16.78 ($p<0.0001$). Those sows with lameness probably spend a greater amount of time in lateral recumbence and therefore expose the scapula to pressure for an increased time. It is however possible that the causal direction is opposite, that the lameness comes from the decubital ulcer. This study cannot show which is the cause and which is the effect.

Analysis of data from the prevalence study show that 3 important risk factors for decubital ulcers are location in the barn, flooring type in the farrowing room, and parity measured as gilt or sow. The model with farm as a random effect was significant to $p<0.05$.

Those sows located in the farrowing rooms had an OR of 3.28 ($p<0.0001$) compared to the gestation barn. Those sows in the breeding room had an OR of 2.57 ($p<0.0001$) compared to those in the gestation barn. However the highest prevalence of severe decubital lesions was found in the breeding room. This may be explained because although the sows are weaned into the breeding room with the disease, the less severe lesions heal very quickly. This leaves severe ulcers behind to be counted. The disease may heal before the sow is moved into the gestation barn or early in the gestation period.

Three of the 18 farms had slatted metal floors in the farrowing rooms; the rest had solid concrete. All the herds had only one type of farrowing room flooring throughout the barn. Slatted metal flooring had an OR of 3.13 ($p=0.0026$) with solid floor as the reference group. Slatted metal flooring is made up of less solid area to distribute the pressure and offers less grip for the sow. A slippery floor can make it difficult for the sow to stand up which would increase exposure time to pressure or may increase leg injuries.

Parity was not measured on all animals in the prevalence investigation, only the gilts were recorded as being parity 0. Not surprisingly, a sow had an OR of 69.08 ($p=0.0001$) of having a decubital ulcer with gilts as the reference group.

More lesions were found on the right than on the left: 4.7% of sows had lesions on the right, 3.3% on the left and 2.4% of sows had bilateral decubital lesions. Three of the 18 farms however showed a greater number of lesions on the left then on the right. It is generally accepted that decubital shoulder ulcers develop more often on the right then on the left side due to a sow's preference for right side down recumbence (2). The fact that some farms show the opposite relationship suggests that the higher prevalence of ulcers on the right side may be due to a highly prevalent farm level risk factor.

Other measured factors such as the number of days a sow has been in the farrowing crate, the size of the farrowing crate, number of piglets in the litter and type of gestation housing were not significant. Many factors seem to play a role in the development of decubital ulcers in sows. The combination of exposures to the various factors on a farm can lead to a problem with this disease. In addition, risk factors that seem very important on one farm can be negligible on another farm because of overshadowing of important farm level factors such as fully slatted floors in the farrowing room. Genetics of the sow and occurrence of other diseases may also be other important risk factors for this disease that were not measured in this study. The use of treatments and preventative measures for the disease were not evaluated in this study and may be important. Some of the more common are use of rubber mats in the farrowing rooms, use of a disinfectant spray, use of moisturising cream and use of a cushioning bandage on the sow.

Take Home Message

1. Thin sows are at a high risk of shoulder sores; make sure sows are in good body condition at farrowing and have a high energy feed during lactation.
2. Lame sows are at a high risk of shoulder sores; severely lame sows should be culled and moderately lame sows should be monitored and moved to straw bedding for recovery.
3. Older parity sows at a high risk of shoulder sores; sows that have had severe shoulder ulcers in previous lactations should be culled.
4. Fully slatted flooring is a risk factor; new construction should be built with the at least the front 1/3 of the farrowing crate in solid concrete and metal mesh floors should be avoided.

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Effect of Social Group Size on Aggressive Behaviour of Grower-Finisher Pigs in Fully-Slatted Floor Rearing System

For more information on this project please contact
Dr. Harold Gonoyu at the Prairie Swine Centre (306) 373-9922.

Introduction

Most studies into social behaviour in pigs have been limited to relatively small group sizes (<40 pigs/group) compared to those that are now used in some commercial practices. The social strategy adopted by pigs in large social groups is not well understood, but it could be expected that the pigs in larger groups to adopt different social strategies than those exhibited by pigs in small social groups. Any changes in the social behaviour of pigs in larger groups could directly affect the overall welfare and productivity of animals. The objective of the present study was to determine the effect of large social groups on aggressive behaviour of grower-finisher pigs.

Results and Discussion

There was no difference in the percentage of time spent fighting observed between the two group sizes up to 48hr following grouping (Figure 1). When pigs with large social group experience were mixed into an established large social group (LL), a significant reduction in time spent in aggressive behaviours was observed between the intruder and the resident pigs ($P<0.05$) than when pigs with LG experience were introduced to SG (LS), or SG experience were introduced to LG (SL) or SG (SS) (Figure 2). Upon re-grouping at week eight, pigs derived from two SG showed an increased level of aggression towards unfamiliar pigs compared to those that were derived from two LG. When pigs derived from SG and LG were combined an intermediate level of aggression was observed (Figure 3). This indicates reduction in aggressive behaviour by pigs living in large social groups.

Conclusion

Large group size did not cause higher aggression following group formation. Pigs formed into large social groups appear to modify their social organization by adopting a non-aggressive, tolerant social strategy, which is indicated by the reduction in aggressive behaviours. This may provide potential benefits for welfare of pigs under commercial production situations.

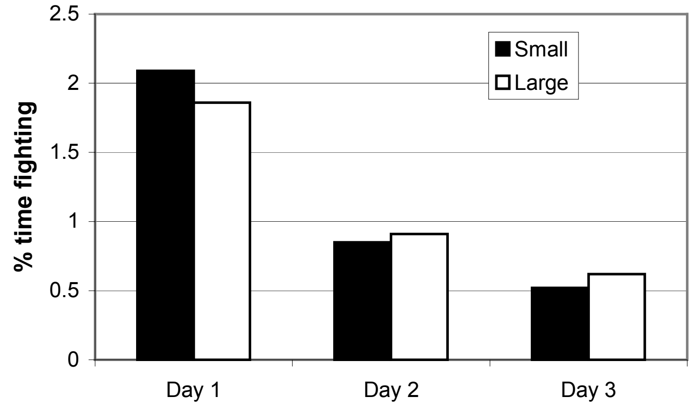


Figure 1. Percentage of time fighting observed at 0, 24 hrs and 48 hrs following formation of groups.

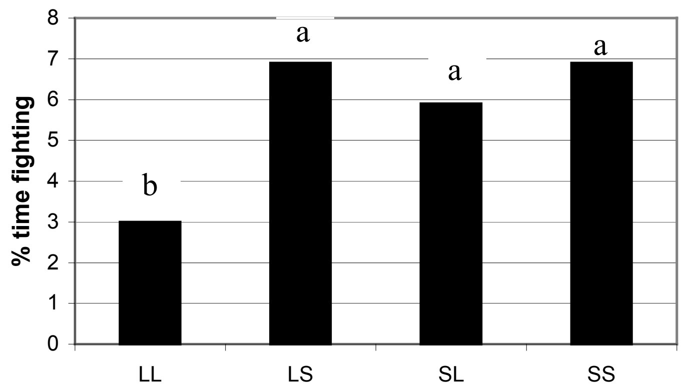


Figure 2. Percentage time spent on aggression (P<0.05) upon mixing of pigs. (Test combinations; 2 pigs transferred from, LG to a LG (**LL**), LG to a SG (**LS**), SG to a LG (**SL**) and SG to a SG (**SS**)).

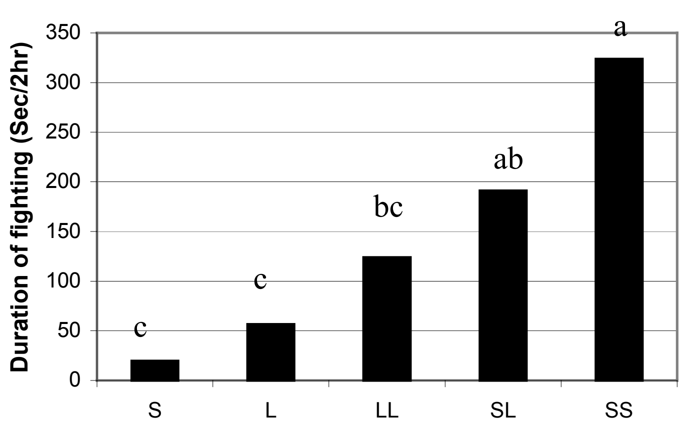


Figure 3. Mean duration of fighting observed in five different pig combinations tested (P<0.05). (Test combinations: Four pigs from the same SG (**S**), same LG (**L**), 2 pigs each from 2 different SG (**SS**), 2 different LG (**LL**) and 2 pigs from a SG and 2 pigs from a LG (**SL**)).

Design of a Manure Handling System for an Air Quality Laboratory in a Swine Barn

For more information on this project please contact
Ms Karen Stewart at the Prairie Swine Centre (306) 373-9922.

Introduction

There have always been concerns about air quality in intensive swine operations, and these concerns are growing as more people and animals are exposed to the atmosphere in livestock buildings. There is no firm understanding of where the components in the air contamination originate. In an effort to understand the source of the air contamination in an intensive swine operation, this study separates the factors (feed, manure, and the animals themselves), and attempts to obtain zero effect of each factor on air quality. Once the effect of each of the factors can be reduced to zero, the factors can be varied individually to find out their effect on air quality. The first focus of the study is the manure handling system. Two methods of removing the manure will be tested, one is a washing gutter, using nozzles and pressurized water to clean the dunging area, and the other is a washed, inclined conveyer belt. The objective is to have zero contamination from the manure in the room using these manure handling systems.

Experimental Procedure

An air quality laboratory has been built by Prairie Swine Centre Inc. The laboratory consists of two rooms, and each room is lined with stainless steel to reduce absorption of contaminants by the room surface. The washing gutter is installed in one room, and the inclined conveyor belt is installed in the second room. Testing of the manure handling systems will focus on the frequency of cleaning the dunging areas. Three different frequencies will be tested - every half hour, every hour and every two hours. Groups of 10 female pigs weighing about 30 kg will be used in each room, and data will be collected for one week in each trial. Three trials will be run at each frequency for a total of nine trials in each room. Ammonia levels will be used to measure the effectiveness of the systems, as ammonia comes only from the manure, and is measured at the inlet and outlet of each room over a period of a week.

Implications

When the manure handling systems have been optimized to produce minimum contaminants from the manure, further testing will be done on the air contamination in a swine barn, particularly from the pig and the feed, and ultimately the effects of the various air contaminants on both pigs and people will be studied.

The Dose Response to Phytase Inclusion in Diets for Growing Swine

For more information on this project please contact
Dr. Denise Beaulieu at the Prairie Swine Centre (306) 373-9922

Introduction

Most of the phosphorus (P) in grains and oilseeds used in swine diets is in the form of phytic acid which is unavailable to the pig and thus excreted into the manure. Inorganic P is usually added to swine diets to meet the animals' requirements, thus increasing diet cost. The phytase enzyme releases the P from the phytic acid allowing the formulation of diets with less total P. Because the enzyme increases the amount of available P, the Ca concentration in the diet may need to be re-examined, since the Ca:P ratio is critical to the utilization of these minerals. Currently, we do not know the optimum Ca:P ratio to use in the presence of phytase.

This experiment was designed to:
1.Define the growth response of growing pigs to 4 levels of a unique, new, phytase enzyme.
2. Determine how critical the Ca:available P ratio is to optimizing the utilization of the phytase enzyme in practical swine diets.

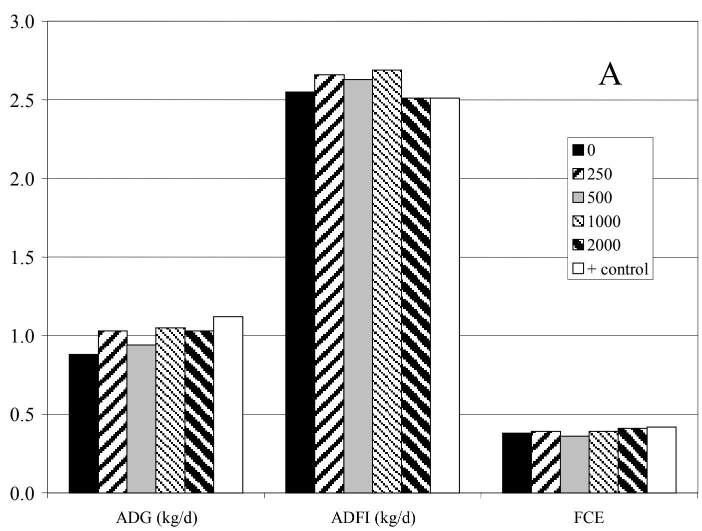
Results and Discussion

Neither performance (ADG, ADFI, feed conversion) nor P digestibility was affected by the Ca concentration in the diet ($P>0.1$; data not shown). This was surprising and will be investigated in future studies.

Although the inclusion of the phytase enzyme in the diet improved ADG, ADFI and feed efficiency ($P<0.05$); this improvement plateaued at about the 250 U/kg inclusion level (Figure 1A). Conversely P digestibility was improved linearly ($P<0.001$) with each increment of supplemental phytase (Figure 1B). This implies that each incremental increase in phytase addition improved P availability, however, beyond the 250 U/kg level, the pigs did not require or utilize this additional P.

Conclusions and Implications

The inclusion of 250 U/kg phytase into diets for growing swine allows the formulation of diets containing less total P without sacrificing performance. This results in less total P excreted into the manure. For example increasing the P digestibility of a diet form 18% (without phytase) to 54% (with phytase) would reduce P excretion in the manure from 7,4 g/d to 4 g/d. Moreover, reducing the P content of the manure also improves its N:P ratio, resulting in a manure that is a more balanced fertilizer relative to the needs of crops grown in Western Canada.



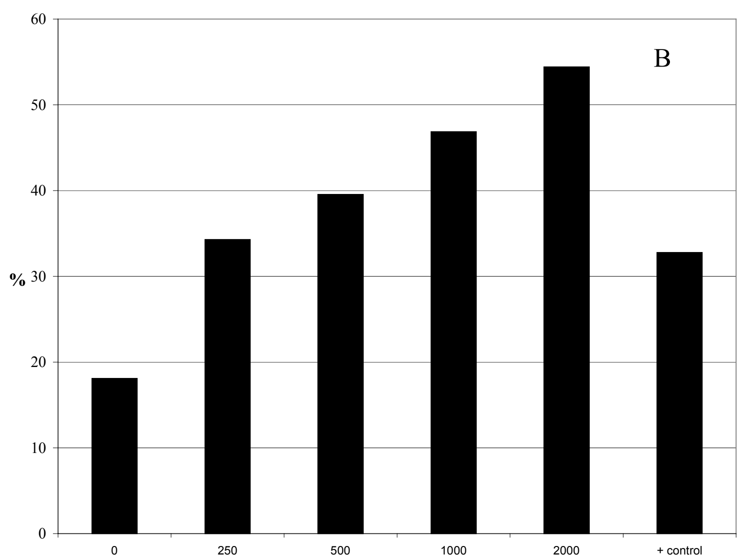


Figure 1. The effect of supplementing corn-soybean diets with phytase on growth, feed intake, feed efficiency (A) and P digestibility (B). The positive control was supplemented with dicalcium phosphate.

Simulating Ammonia Emissions from Slurry Pits

For more information on this project please contact
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Introduction

The slurry pit and urine puddles on the slatted and solid floor have been identified as the main sources of ammonia in a pig-housing unit. Decreased protein in the diet will result in decreased nitrogen in the excreta. Increased fermentable carbohydrates, such as sugar-beet pulp, will increase the amount of nitrogen excreted in the feces compared to the urine. Nitrogen that is excreted in the feces is more stable and takes longer to decompose, whereas nitrogen in the urine is in the form of urea, which readily converts to nitrogen. The objective of this experiment was to measure the ammonia emission from slurry samples produced by pigs fed different diet compositions, and compare the measured results to model calculations. Two models will be compared and one will be chosen to represent the slurry emission in the future overall room emission model.

Results and Discussion

In this experiment, lowering the crude protein content and adding sugar beet pulp to the diets did not result in lower ammonia emissions. Both models showed the fluctuation in ammonia levels over the sampling period (Fig. 1). However, neither model simulated the level of concentration very well (Fig. 2). Model 2 calculations were chosen to represent the slurry pit emission process in the overall room model because Model 2 considers the pit concentration and previous concentration levels. Additional work is required to adjust the level of ammonia concentration predicted by Model 2.

Based on a sensitivity analysis, slurry pH is the most influential factor in model calculations. A 1.0 unit decrease in pH will decrease ammonia emissions by 90%, but a 1.0 unit increase in pH will increase emissions by 833%.

Implications

The ammonia emission from the slurry pit is a major contributor to the ammonia concentration in a pig-housing unit and the ammonia emission to the environment. By validating model equations to simulate ammonia emission from slurry, we are better able to simulate the overall ammonia emission from a pig building.

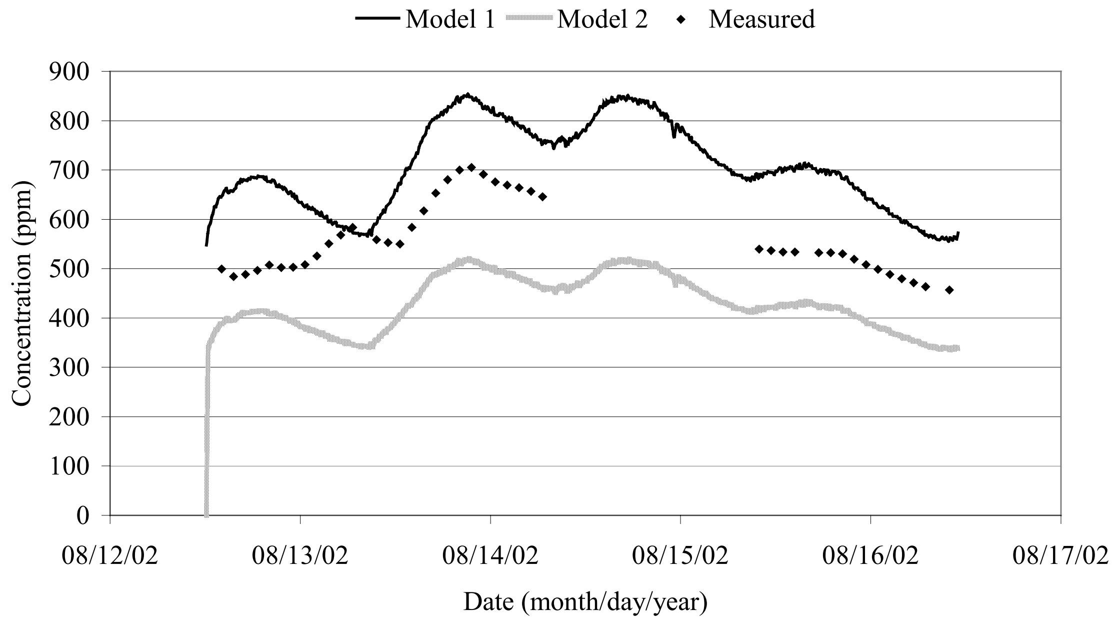

Figure 1. Measured and simulated ammonia concentration in an emission box containing slurry from a finisher pig fed a high protein, sugar-beet pulp added diet.

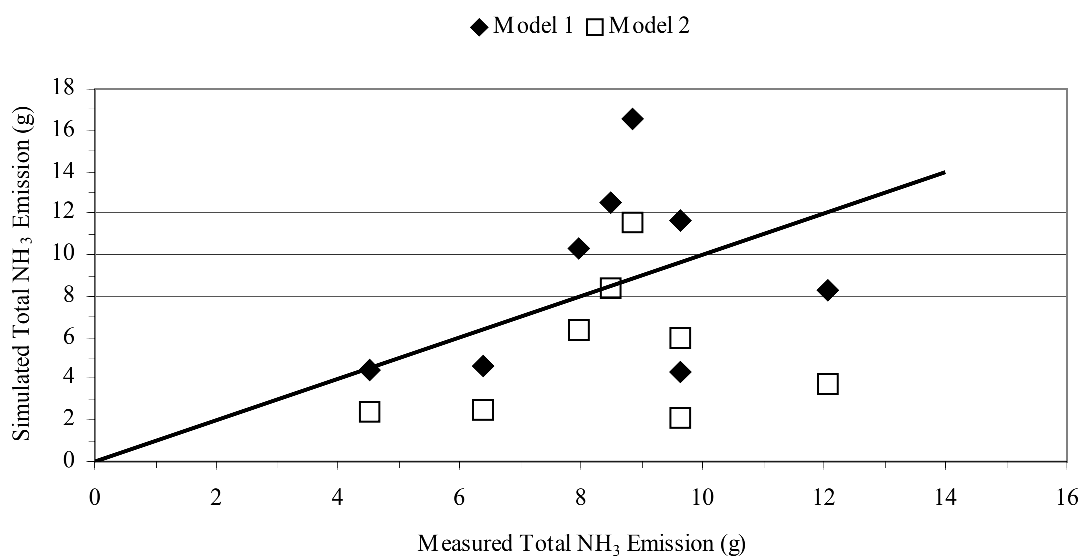

Figure 2. Comparison of the total simulated ammonia emission by both models to the total measured emission for all slurry samples in the second trial. This illustrates how the level of ammonia was not accurately predicted using either model.

Pre-planned segregation: The effect of grouping by weight at weaning on variability in body weight at nursery exit

For more information on this project please contact
Dr. Denise Beaulieu at the Prairie Swine Centre (306) 373-9922.

Introduction

Variability in pig growth is emerging as a critical issue for pork producers. It has been estimated that variability costs Saskatchewan pork producers $3.41 per pig at market due to sort losses and an additional $1.25 per pig sold due to reduced barn utilization.

One option for managing variability is called "pre-planned segregation" or PPS. PPS is the separation of the total population of pigs into sub-groups expected to differ in performance. Under current operating methods, room throughput is dictated by the slower growing pigs. Segregating a heavier group allows the rooms housing these animals a faster turnover which will improve overall barn utilization is overall variability remains unaffected.

Objectives

1.To determine if PPS improves the uniformity of growth of the total population compared to contemporary pigs that remain in random weight groups.
2.To determine if the segregation of pigs by weaning weight will result in the faster growth of .heavier pigs compared to contemporary pigs that remain in intact groups.
3.To determine if the segregation of pigs by weaning weight will result in the faster growth of lighter pigs compared to contemporary pigs that remain in intact groups.

Results

The initial and final bodyweights of the light and heavy subsets of each sorting treatment are shown in Table 1. The differences between the light and heavy groups were maintained through to day 50. The CV at day 50 was similar between sorting regimes. Moreover, the CV of the 12th or the 50th percentile at day 50 was similar regardless of whether 0 (unsorted), 12% or 50% of the pigs had been removed at weaning (Table 2).

Implications

Segregating pigs by weight at weaning into light and heavy subsets will have no effect on the variability of the entire group at day 50 postweaning. By segregating pigs into rooms based on expected performance, the rooms housing faster growing pigs will turn over more quickly. The rooms housing the slower growing pigs will not turn over any slower than rooms housing non-segregated pigs. The results is an improvement in overall barn utilization.

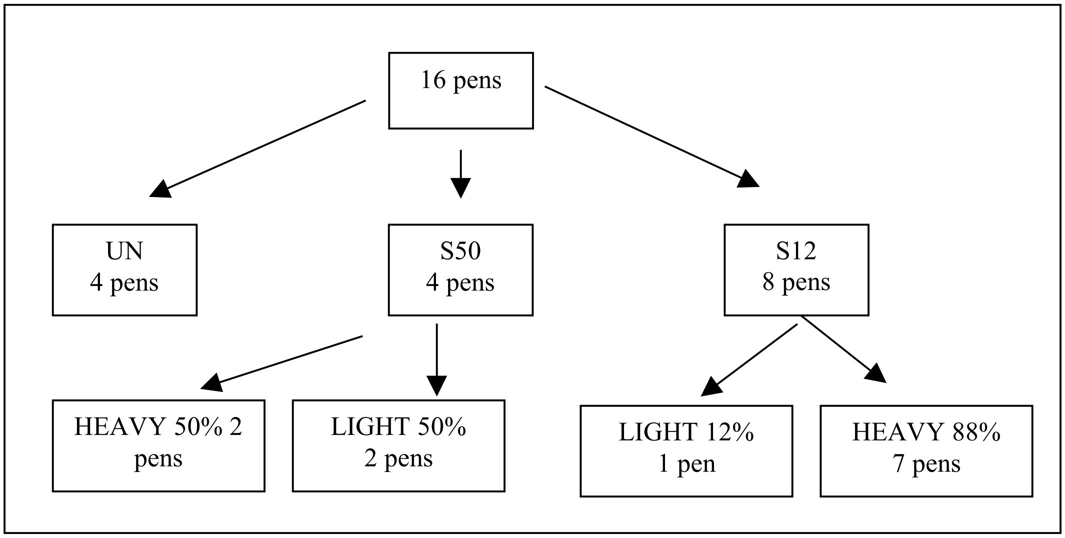

Figure 1. Treatment allocation for one room. The number of pigs per pen varied between weeks (15 to 18) but was constant within a week.

Table 1. Initial and final (d50) body weights of the light and heavy subsets of the treatment groups.

	UN	S50 HV	S50 LT	S12 HV	S12 LT
day 0 (kg)	5.82	6.86	4.93	6.31	4.16
day 50 (kg)	31.17	33.55	29.15	32.35	26.77

Table 2. The effect of pre-planned segregation on bodyweight and CV for the entire data set, and the 12th and 50th lightest percentiles of each sorting regime.

	Bodyweight (kg)		CV (%)	
	d0	d50	d0	d50
100th percentile				
UN	5.82	31.17	19.56	14.25
S12	6.04	31.70	19.96	14.15
S50	5.77	31.14	20.31	13.45
P value	*0.25*	*0.57*	*0.78*	*0.53*
12th percentile light				
UN	4.15	26.76	8.40	11.93
S12	4.16	26.77	7.63	12.49
S50	4.08	26.54	7.45	10.88
P value	*0.77*	*0.91*	*0.80*	*0.68*
50th percentile light				
UN	4.90	28.90	11.30	13.32
S12	5.07	29.17	12.35	12.54
S50	4.93	29.06	12.03	11.90
P value	*0.23*	*0.85*	*0.68*	*0.35*

The Effect of Starter Feeding Regimen on Variability in Bodyweight and Performance in the Nursery

For more information on this project please contact
Dr. Denise Beaulieu at the Prairie Swine Centre (306) 373-9922.

Introduction

Variability in growth and performance is a concern to pork producers due to the associated negative impact on revenues and expenditures. The challenge of reducing the impact of variability on pork production is a serious one and two options are available. The first is to reduce variability and the second is to manage it. If variability is considered to be excessive the implementation of management practices to reduce it will be a reasonable approach.

The starter program has the potential to influence the relative growth of individual pigs within a group by allowing the smaller and/or younger pigs to excel relative to the older and/or larger contemporaries. Variability will be reduced if the feeding regimen allows the smaller pigs to "catch-up" or meet the performance of the larger animals in their cohort. It is recognized that the subject of nursery diet impact on variability is complex; determining whether a feeding program can reduce the impact of variability was considered a first step.

Results and Discussion

Starter program had a modest effect on performance (Table 1). However, when examined within specific phases (data not shown), no specific program outperformed the others. There were no starter program by weight group interactions, meaning that a starter program did not elicit an improvement within specific weight groups. Feed cost per pig or per kg of gain did differ between feeding program. Feed costs were based on information provided by the collaborating feed companies and was intended to reflect the price charged to a customer for this program.

As mentioned above, the objective of this experiment was to determine if differences exist among commercial starter programs in terms of their impact on variability at nursery exit (not to determine the "best" commercial starter program, nor examine specific nutrients which impact pig growth during the nursery phase). Although weight group had an effect on CV at nursery exit, starter program had no effect on uniformity. Moreover, there were no interactions of starter program by weight group, implying that within a specific weight group, no starter program consistently improved uniformity.

Implications

Within every weaning group there are some very lightweight pigs. Uniformity at nursery exit will be improved if we can specifically increase the growth rate of these pigs. The effect of starter program was not specific for any weight group, and therefore will not affect overall variability.

Table 1. The effect of starter program on the performance of nursery pigs. The data were indexed to diet A which was arbitrarily assigned a value of 100.

	Treatment					
	A	B	C	D	Mean[a]	SEM[a]
Initial weight, kg	100.00	100.00	100.00	100.00	6.26	0.018
Final weight[b], kg	100.00	100.31	104.37	101.92	32.36	0.341
ADG, kg/d	100.00	100.00	103.15	102.95	0.52	0.008
ADFI[b], kg/d	100.00	99.31	105.82	105.13	0.74	0.009
FCE[b]	100.00	100.57	97.30	99.29	0.70	0.004
Feed cost/kg gain[b]	100.00	104.92	109.84	101.64	0.64	0.006
Feed cost/pig[b]	100.00	104.74	113.89	105.39	16.34	0.193

[a]Calculated from untransformed data.
[b]Significant effect due to treatment ($P<0.05$).

Table 2. The effect of grouping by weaning weight on the performance of nursery pigs.

	Weight Group				
	Lightest	Light	Heavy	Heaviest	SEM
Initial weight, kg	4.93	5.80	6.55	7.76	0.018
Final weight, kg	29.19	31.74	32.94	35.55	0.341
ADG, kg/d	0.479	0.519	0.521	0.545	0.008
ADFI, kg/d	0.665	0.730	0.756	0.800	0.009
FCE[a]	0.719	0.711	0.689	0.681	0.004
Feed cost/kg gain	0.64	0.63	0.64	0.64	0.006
Feed cost/pig[a]	15.29	16.24	16.49	17.33	0.193

[a]Significant effect of weight group ($P<0.05$).

Table 3. The effect of starter program on the coefficient of variation (CV, %) calculated from body weight[a] within pens. Pigs had been blocked by weight at weaning. The data were indexed to diet A which was arbitrarily assigned a value of 100.

	Treatment					
Phase	A	B	C	D	Mean[b]	SEM[b]
d 4	100.00	98.77	101.97	95.08	8.05	0.42
d 7	100.00	89.81	97.98	92.04	8.94	0.65
d 20	100.00	91.37	94.34	95.21	13.13	1.16
d 34	100.00	104.43	83.14	97.59	12.39	0.84
d 50	100.00	94.13	85.43	99.36	10.33	0.68

[a]Calculated from pen data, averaged for each treatment. The overall CV for each nursery room averaged 17.8% at d 0 and 12.6% at d 50.
[b]Calculated from untransformed data.

Table 4. The effect of grouping by weaning weight on the coefficient of variation (CV, %) calculated from body weight[a].

	Weight Group				
Phase	Lightest	Light	Heavy	Heaviest	SEM
d 4[b]	8.13	8.03	8.29	7.73	0.42
d 7	9.42	8.46	9.23	8.67	0.65
d 20	13.79	12.60	13.01	13.13	1.16
d 34[b]	12.87	13.44	10.70	12.56	0.84
d 50[b]	10.91	10.27	9.32	10.84	0.68

[a]Calculated from pen data, averaged for each weight group. The overall CV for each nursery room averaged 17.8% at d 0 and 12.6% at d 50.
[b]Significant effect due to weight group ($P<0.05$).