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CENTRALIA SWINE RESEARCH UPDATE

January 29, 2003

CENTRALIA SWINE RESEARCH UPDATE
Kirkton-Woodham Community Centre
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WRITTEN-ONLY TOPICS

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New Initiatives and Commitments to Pork Safety and Quality Research

Dr Peter P. Purslow
Chair, Dept. of Food Science, University of Guelph

Safety and quality are key issues in the pork industry worldwide. Fundamental research programs in these two areas are the focus of internationally-competitive research at Guelph. The presentation gives an overview of existing interests and expertise and indicates strategic points of focus for developing research.

Canadian Research Institute for Food Safety

In the early 1990's researchers at Guelph involved in the microbiological safety of foods formed a consortium to promote collaboration and to encourage a multidisciplinary approach to research. Out of this group emerged the Canadian Research Institute for Food Safety (CRIFS). Presently, there are 53 research scientists from several disciplines involved in CRIFS, making it one of the largest centres of its kind in North America. Its goal is to assist all sectors of the Agri-Food industry in improving food safety and quality by providing sound scientific information, research and development and knowledge transfer.

The research focus of the institute can be divided into eight areas:

- Food diagnostics
- Epidemiology
- Food ecology
- Microbial physiology
- Pathogenesis
- Food safety engineering
- Food toxicology
- Risk analysis

Swine-Related Research – M.W. Griffiths

Detection of food-borne pathogens

The objective of this research is to develop assays detecting specific microorganisms present in low numbers in food that can provide rapid, reliable results in a time that has practical significance for the food industry. Several approaches are being examined. These include methods which rely on the innate specificity of bacteriophage towards their host. The use of bacteriophage also provides for a natural amplification of the detection signal due to the replication of the phage in the host cells. This process only takes 1 to 2 hours. Bioluminescence methods coupled with biosorbents to remove and concentrate target cells from suspension are also being explored. Dr Griffiths' research group is also developing molecular techniques, such as real-time PCR, and was the first to describe a magnetic capture hybridization-PCR method for the detection of *E. coli* O157:H7 in meat. A radically new approach is also being investigated which seeks to develop a biosensor for the detection of any pathogenic microorganism that may be present in food.

Microbial physiology and food ecology

To be able to improve the safety of foods it is imperative that food microbiologists gain a better understanding of the mechanisms by which microorganisms survive in foods and of the role that the interaction of microorganisms with the food matrix and other environments plays in their survival. We are using bioluminescence in a variety of ways to study how organisms respond to stress, how bacterial cells communicate and how microorganisms interact with their environment. This will allow us to devise more effective strategies for elimination of pathogenic microorganisms from food.

Food biotechnology

Microorganisms have been used for centuries in the manufacture of food but their genetic diversity has not been fully exploited. Dr Griffiths' research group is studying novel ways of utilizing microorganisms for the production of value added foods. For example, they are interested in producing novel starter cultures that produce bioactive molecules for use in the manufacture of fermented foods. They are also interested in using micro-organisms as agents to control food-borne pathogens.

Food Safety in Pork Production and Processing – K. Warriner

The contamination of pork poses a threat to consumer health and also has detrimental affects on domestic and export markets for which the industry depends on for sustained growth. Many processors (and producers), at great expense, have adopted Hazard Analysis of Critical Control Point (HACCP) system to reduce pathogen carriage on pork. However, there remains a knowledge gap on how effective such control measures are at controlling the spread of pathogens from the farm to fork. Dr Warriner is establishing a program of work at Guelph addressing these issues:

- Establish the routes by which pathogens such as *Salmonella* are introduced to pig herds.
- Evaluate on-farm strategies to minimize the initial contamination of pig herds prior to processing.
- Apply molecular approaches to identify procedures and processes that result in cross-contamination of pork carcasses.
- Develop effective HACCP schemes to minimize/prevent cross contamination events in pork production and processing.
- Develop and evaluate biosensors for monitoring identified critical control points in pork production and processing.
- Evaluate the efficacy of intervention strategies (for example, acid/hot water washes, steam pasteurization) in preventing carriage of pathogens on pork.
- Investigate how bacterial attachment and physiological factors impact on the efficacy of intervention methods applied in the slaughter process.

Mechanisms underlying pork quality and their control – P. Purslow

Research in this lab focuses on fundamental mechanisms of muscle growth, variability in waterholding and tenderness, and means of controlling and manipulating these. Nutraceutical benefits of pork meat have also been the subject of recent investigations. Areas of current and developing work include:

- Mechanisms of waterholding; the potential of NMR as a rapid near-line method to evaluate WHC.
- Influence of fiber type in the tenderness of pork muscles.
- Development of an early postmortem biosensor to predict tenderness.
- Strategic feeding to improve tenderness.
- Packaging strategies to reduce variability in tenderness and enhance waterholding capacity.
- Cell-matrix interactions as determinants of muscle growth and development.
- Identification of the components in pork meat which enhance iron uptake in the human diet.

An increasing emphasis in future will be placed on the use of genomics and proteomics to explain basic mechanisms behind variations in eating quality, with the object of controlling these by manipulation of gene expression.

Pig Variation – Genetic Conformity : Good or Bad

Cathy Aker, Technical Manager
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Let me start by saying that from a genetic perspective, at least, variation is a good thing. If all pigs were identical, then there would be no need for geneticists or selection programs. However, there would also be no opportunity for improvement whatsoever. That is not a good thing!

However, pig variation does cause commercial pork producers and pork processors a lot of grief. Variation increases costs of production and decreases efficiency.

Why does variability exist? Variability naturally occurs between pigs for the following reasons – *genetics, health status, facilities, diets and appetite, and interactions between all of these factors*. In addition, pigs react to challenges (i.e. disease, overcrowding, mycotoxins, etc.) to varying degrees.

Where does variability exist in pig operations? Variability exists in litter sizes, pig growth rates, feed intakes and conversion rates, market weights and carcass characteristics – in summary – at all stages of pig production.

It might be easy at this point to admit defeat and throw our hands up – after all, variability exists at all stages of production and it can occur as a result of all the key factors involved in raising pigs. However, variability can be managed if we keep the following points in mind:

1. **We need to try to "minimize and manage" variability but also understand that we cannot eliminate it.**

    It is impossible to eliminate variability between pigs but we can optimize our inputs so that variability is minimized as much as possible. Then manage (i.e. make the best of) whatever variability still exists.
2. **Additional value can be <u>captured</u> and also <u>created</u> by minimizing and managing variability.**

    Minimizing and managing variability can "capture" extra value in the production process – for example, extra value can be captured or realized by minimizing variability in growth rate, thereby decreasing cost of production (particularly in all-in / all-out operations). However, extra value can also be "created" – for example, minimizing variability in shipping weights can create extra value for the processor as carcasses are more uniform.
3. **Variable performance should be considered as a deviation from potential output.**

    We need to consider what the best 10 % of pigs in the barn (i.e. fastest-growing, leanest) are doing and then compare all other pigs to that group. Only then can we get a true picture of how much variability exists and what the cost of that variability truly is.
4. **We need to understand that it is much cheaper to reduce variability early in the production process rather than trying to manipulate non-conforming pigs very late in the production process.**

    "Non-conforming" (i.e. slow-growing) pigs are very costly to manage late in the production process because of higher feed consumption and higher overhead costs.

In addition, non-conforming pigs are often "cut off" after a certain period of time to allow refilling of barns and / or pens. These pigs are shipped at lighter weights and penalized heavily by processors. It is much less expensive to try to minimize variability earlier in the production process.

Variability in growth rate has the biggest impact economically. Not only do slow-growing pigs require more days on feed, they also tie up barn space and wreak havoc with the flow of all-in / all-out operations. At some point (when the barn must be emptied), slow-growing pigs can no longer be accommodated and they are marketed under-weight with serious penalties unless a "slush" barn is available. The following example shows that immense cost of variability in growth rate:

Table 1. Extra cost of keeping pigs beyond 160 days of age (approx. 23 weeks).

Week Shipped	% of Pigs Shipped*	Extra Cost ($)
Week 24	23.0 %	$ 6.29
Week 25	12.7 %	$15.49
Week 26	6.6 %	$26.16
Week 27	2.4 %	$37.68
Week 28	0.4 %	$44.21
Week 29	1.4 %	$59.34

* - 54 % of pigs were already shipped by 160 days of age

In this example, the average extra cost of pigs shipped after 160 days (based on 10,000 market hogs per year) was $7.05 per pig.

Dr. John Deen likes to say "consistency is the biggest marketing tool we have in animal agriculture". I have to agree. How do we achieve consistency? First of all, we need to take a positive perspective on things – instead of talking about variability and what we need to do to reduce it, we need to talk about striving for consistency in production. Then what? First of all, identify how much consistency (or lack of) you have – motivate yourself by doing a small, but representative growth or feed intake trial. Use dollar values to really motivate yourself. Second, chose one area or trait to focus on at a time – don't be overwhelmed by all the potential areas that could be targeted. Third, pay attention to the small details in your operation that allow variability to "creep in" – things like stocking density differences between pens, air flow patterns in different parts of the barn, feeders and drinkers that are not flowing properly – and make sure that all pigs have an equal opportunity to express their full potential.

Priorities in Meat Quality

Dan Cohoe, Quality Meat Packers Limited

I'm not a meat researcher so the illumination of the topic by me will not likely add much to your knowledge about meat research; however, I plan to discuss a priority meat quality issue flowing out of previous meat research efforts and to talk about some of the developments in commercial requirements of meat processing companies.

In the last section, "Delivering Product and Production Differentiation", I will focus on the long-term requirements and relationships characterizing successful production and marketing strategies to provide a sustainable future for our operations from the farm to the consumer.

Before proceeding I must state that my presentation here is concerned with specific issues related to my area of experience at Quality Meat Packers and may not be applicable to the strategy of others in the total pork supply chain.

Some Re-definition of Priorities in Meat Quality

New Technology Supplements Processing Choices
Over the past four or five years, the fresh meat marketplace has seen the entry of a range of products of the class known as "moisture enhanced". These products are taking increasing market share because of their desirable cooking characteristics and resultant serving and menu flexibility.
Previously, a good deal of research effort went into trying to adjust the genetic characteristics and sometimes the feed rations of pigs in an attempt to improve many of the same characteristics as are affected by moisture enhancement technology.

Built-in vs Added-on Sensory and Cooking Quality and Consumer Acceptance
Moisture-enhanced product is ramping up the consumer acceptance ladder for several reasons:
Allows less tender cuts to undergo partial tenderization
Works well with boneless packaging of semi-prepared case-ready cuts.
Presents well for HRI where stability during serving period is important.
Expands the possibilities for successful cooking strategies for "difficult" cuts. Benefit is "its more difficult to destroy in cooking".
Tender and moist product items can be consumed with very low fat intake.
Unusual flavour profiles are available to order offering novel taste choices.

The Battle for Market Share:

Niche markets
There will be some markets prepared to pay for non-moisture-enhanced product so long as it can provide some of the same cooking characteristics or better levels of flavour developed from higher internal fat content.
Moisture-enhancement has a negative connotation in some peoples minds. They want to "marinate" the product themselves.

The Mainstream
Moisture enhancement will likely continue to gain market acceptance and share.

Implications for Research and Production include:
Less emphasis on intra-muscular fat for much of hog production.
Water holding capacity and colour will continue to be critical for product and processing characteristics.
Differentiation will occur with different flavours and formulae for the enhancement process. Differentiation will be achieved in processing, not on farm.

Pork gains a more competitive position relative to other protein products based on versatility and flexibility for consumers.

Colour Improvement / Drip Loss Reduction Remains a Key Need
Production choices need to prioritize improvements in these characteristics.

Delivering Product & Production Differentiation

What am I Producing?
The first question any producer of goods or services must answer about their product concerns their product positioning strategy. The answer will likely fall into some combination of the following strategies:

focus on low cost production,
keep customer service cost low
standardize production
find a niche product which has a market
increase customer service
some combination of the above

What's a Commodity good?
Easily described,
May have very high quality standards and represent tremendous value to some customers,
Not differentiated from other production of its class,
Combined with low cost production, likely to be a successful strategy,

What's a Specialized Product for Specific Needs?
Needs are very subjective and may be specific to each customer.
Successful fulfillment of needs requires strong commitment from supplier.
Costs inevitably rise.
If costs rise faster than customer's view of fulfillment value, product will fail.

How will I choose my Production Orientation ?
Choice will be made based on a long-term view of the prospects and markets for each type of production.
Low cost commodity production emphasizes low-cost for continued success. Many of the cost factors are not under control of the supply chain so cannot be guaranteed for long periods.
Specialized production requires a supply chain that can deliver on meeting serial, demonstrated customer needs over a long time horizon.

Will it be easy?
No, because of the length of the time horizon from implementing potentially higher cost production systems to the delivery of return from these systems, the short-term noise from opportunities to jump out of the chosen supply chain and difficulties in assessing costs across the supply chain.

Difficult Questions for Customer-Centred Supply Solutions.
How does your production system match with the needs of your supply chain partners?
Are there production interruptions, bottlenecks or deviations that your customer or the rest of the supply chain can't deal with?
What is the mechanism to balance your need for production variations and low cost production with specific customer needs?
Will there be irresistible temptation to cherry-pick the best of each system.
How are prices established to pay for the inevitable higher costs of production from specialized rather than all-out standardized low-cost production systems.

Some Simple Illustrations to Close

Lawsonia intracellaris - The Cause of Ileitis

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Diseases caused by *Lawsonia intracellularis* are worldwide in distribution, and have not been eliminated by modern management changes.

The NAHMS project in the USA identified ileitis as the most common disease problem in grow/finish operations in the year 2000. A total of 36.9% of all sites surveyed reported outbreaks of ileitis within the last 12 months, while 75% of operations with inventories of 10,000 pigs or more had a diagnosis of ileitis made.

These proliferative enteric diseases are a group of both acute and chronic conditions which have a common underlying pathological change – that being a thickening of the wall of the terminal small intestine (the ileum) or the first part of the large intestine (the colon). Clinical signs in chronic cases include diarrhea and variation in growth rates in 6-20 week old pigs. On post-mortem examination, varying degrees of inflammatory or necrotic changes are apparent in the ileum or colon. Cases of acute, hemorrhagic proliferative enteropathy are most common in finishing or young replacement animals, 4-12 months old. In these animals, affected portions of intestine are thickened and have a corrugated appearance. Often a large blood clot is present within the intestine. In addition, an inapparent, subclinical form can occur, with poor performance and marked variation in growth rates being the only recognizable signs. A diagnosis is confirmed by identifying spirochetal bacteria (using special stains) in the cells of the proliferative crypts in affected areas of intestine.

It has been several years since I reviewed this topic at CSRU, at which time the major advancement had been the identification of the causative agent. Much research has been done since that time, and much remains to be done.

Recent studies have indicated that infected pigs shed organisms in the feces for several weeks (2-12), depending on the chronicity of the lesion. Serum antibodies can be detected from 3 weeks post infection up to 13 weeks post infection, and from 12-50% of susceptible pigs on affected farms may become infected.

As part of the Sentinel Herd Project, serum was collected from 30 sow and 30 finisher pigs from74 representative herds throughout Ontario. These samples were forwarded to either the University of Montreal or the University of Minnesota, to be tested for the presence of antibodies against *Lawsonia intracellularis*.

1968 serum samples from 66 finishing operations were tested in Minnesota, and 1018 samples were tested in Montreal. The latter originated from 30 finishing operations and 26 farrowing operations - of these 22 were farrow-to-finish operations, in which case serum was submitted from both sows and finishing pigs. Serum from 26 finishing sites was submitted for testing to both locations.

The University of Minnesota used the immunoperoxidase mononlayer assay test (IPMA) while the commercially available Ileitest, an immunofluorescent antibody test (IFA) was used in Quebec.

Using a value of a 1:30 dilution as the cutoff, the IPMA had a sensitivity of 88.9% and a specificity of 100%. With the same cutoff value, the sensitivity for the IFA test was between 90-92% and the specificity between 96-100%.

Initial analysis of results from the University of Montreal revealed that 22 of 22 farrow-finish operations, 6 of 8 grow/finish farms and 4 of 4 farrow-wean had at least 2 positive animals. The results are therefore from 26 breeding herds and 30 finishing operations.

All breeding herds were positive, with an overall prevalence of 91% within herds –ie- 91% (404 of 448) of all animals tested were positive. There was no significant difference between sows of varying parities. 58% of the finishing operations were positive, with farms having either a very small number, or a very high prevalence of positive animals. Of the 570 samples tested, 322 were positive, giving an individual animal prevalence of 56.4%.

Breaking it down into production units, 78% of finish operations from F-F farms were positive, whereas only 28% of strictly grow/finish operations were positive. In F-F operations, the herd size (number of sows) was not a factor in whether the finish operation was positive or not.

The results from the 66 finishing herds in which the sera was sent to the Univesity of Minnesota have not been fully analyzed as yet. However, 16 (24%) of the herds had no positive animals, and only 443 of the 1968 samples were positive, giving a seroprevalence of 23%.

In a separate study at the Animal Health Laboratory, University of Guelph, a PCR test for the identification of *Lawsonia intracellularis* from tissues and feces is being validated prior to implementation. Preliminary results indicate the test is highly sensitive and specific, using sections of affected intestine. Testing of feces from infected pigs is more challenging, due to the presence of unidentified inhibitory factors that are present in fecal material. Several attempts have been successful, suggesting that sensitivity values of up to the 70% that has been achieved in other laboratories is achievable.

We can conclude that the prevalence of *Lawsonia intracellularis* in Ontario Herds is high, but we now have the ability to detect exposure and infection in live animals. This is important in that we can now determine the exact time that infection takes place, and can implement control and preventative measures, whether they be pulse medication or vaccination.

Toxoplasmosis

Bob Friendship – Population Medicine, University of Guelph
John Wu – Alberta Agriculture
Zvonimir Poljak – Population Medicine, University of Guelph
Davor Ojkic – Animal Health Lab, University of Guelph

Background

Toxoplasmosis is caused by a parasitic protozoan, *Toxoplasma gondii*. Infection with Toxoplasma is common in the human population (about 500 million people infected). In addition birds and most mammals can be infected. Cats are the definitive host, meaning that the parasite can achieve completion of its complex life cycle in cats. Humans and animals other than cats are intermediate hosts. When a cat becomes infected the parasite can develop into an adult and excrete huge numbers of oocysts (eggs) that are past to the environment in the feces of the cat. When other animals (intermediate hosts) become infected the parasite passes through the intestinal wall and eventually becomes encysted as an immature form in various body tissues, but particularly brain, heart and skeletal muscle. The immune system limits the multiplication of these immature stages. However, they remain alive in this resting stage or cyst. Carnivores can become infected by eating muscle containing these cysts, for example when a cat eats a mouse. Animals can also become infected by consuming oocysts from cat feces that have contaminated feed or pasture or drinking water. A third way in which the parasite can be transmitted is across the placenta from mother to fetus. In humans this is a serious concern. If a mother has been previously exposed to Toxoplasma before pregnancy, there is little concern. However if there is no previous exposure and therefore no immunity, infection of the mother will result in about 45% of fetuses becoming infected. If fetuses are infected it is estimated that 9% will die and 30% will be seriously damaged (retardation and blindness).

Most human infections other than during pregnancy are of little consequence. However the parasite does remain in the body for many years and can become active and dangerous if the immune system is seriously weakened. Patients suffering from HIV/AIDS or receiving immune suppressing therapy for cancer or organ transplants are at serious risk.

Introduction

Toxoplasmosis is a serious zoonotic disease. Pork is considered a very important source of human infection (1,2). A common figure used in the literature is about 25% of human cases being related to pork consumption. This is possibly based on prevalence information that is no longer valid. Studies in North Carolina show dramatic decreases in the prevalence of pigs with antibody titres to Toxoplasmosis from the early 80's of about 23% to virtually zero today. A Canadian serological study was conducted in 1991 showing that Ontario had considerably higher levels of Toxoplasmosis in sows at slaughter than Western Canada or Quebec, (7.9%, 2% and 2.5%, respectively). The level of Toxoplasma positive market hogs in Ontario is not known.

The purpose of this study was to determine the prevalence of Toxoplasma on a herd basis in Ontario and to examine the risk factors such as the presence of cats.

Method and Materials

Ninety-five herds with grower-finisher hogs were visited in the summer of 2001. A survey was conducted including an assessment of cat accessibility to the pig barns. Sera was collected from 30 hogs close to market weight, (on 78 farms all 30 samples were analyzed and on the remaining 17 farms fewer samples were tested). Testing was performed by the Alberta Agriculture diagnostic laboratory in Edmonton using a commercial kit (Toxoplasma gondii Antibody Test Kit Microwell ELISA, Safe Path Laboratories, Carlsbad CA 92008, USA).

Results and Discussion

Only 35 samples were considered positive of the 2520 samples tested, based on the cut-off point recommended by the laboratory conducting the test. Four farms had more than a single positive reactor, and eight farms had just one animal test positive. The rest of the herds had no positive animals. Looking closely at the results it is tempting to think that of the eight herds with a single reactor, at least some of these animals may indicate a false positive. This is a common concern when any test is performed on a population that has a high proportion of negative animals. Overall, assuming all positives are true positives, the prevalence appears to be about 1.5%. We can conclude that toxoplasmosis is not very common in the general pig population but on certain farms the prevalence is quite high. On two farms almost half the animals tested were positive. It is suspected that when a cat is shedding oocyts the environment can become very contaminated and large numbers of pigs can become infected. Cats only shed large numbers of oocysts when they first become infected so kittens pose the biggest threat. The prevalence will vary a great deal depending on the time of the year with kittens generally born in the spring and fall. Sows are almost certainly to have a higher prevalence than finisher pigs because of their longer exposure period.

The most obvious means by which the prevalence of Toxoplasma can be reduced to almost zero is to ban cats from barns and to ensure feed and water sources cannot be contaminated by cat feces. Quality assurance programs in other countries (3) have incorporated the removal of cats from pig barns as part of their program to ensure safety.

Currently we are working with the Guelph Animal Health Laboratory to validate the ELISA test and verify what the proper cut-off for positive should be. AHL does offer a second test (Indirect hemagglutination) which should help confirm suspicious results. We hope to examine some of the farms to see how the prevalence varies over time and how the sow population compares to this finisher hog population.

Take Home Message

Toxoplsma is not commonly found in Ontario pigs but on farms where it is found the prevalence can be high. The major risk factor is the presence of cats. The decreased prevalence over the past twenty years in North America is likely attributed to the move to confinement rearing and improved biosecurity.

References

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2. Aspinall TV, et al. Int J Parasit 2002, 32: 1193-1199.
3. http://www.sardi.sa.gov.au/pages/livestock

Export Issues - Country of Origin Labelling (COOL)

Randy Duffy and Ken McEwan
Ridgetown College - University of Guelph

Country of Origin Labelling (COOL) was part of the 2002 U.S. Farm Bill and will become mandatory in September 2004. The impact this legislation will have on the Canadian pork industry is the topic of many conversations these days.

Presently, COOL is a voluntary program that retailers may choose to adopt. However, when the program becomes mandatory, all retailers, as defined in the law, will have to comply or face fines. A "retailer" is any person who buys or sells perishable agricultural products (i.e. fresh and frozen fruits and vegetables) solely for sale at retail with a cumulative invoice value in any calendar year of more than $230,000. This definition excludes butcher shops, fish markets, and small grocery stores that don't purchase the covered products at all or at a dollar volume level below the $230,000.

Covered commodities in the program include beef (including veal), lamb, pork, fish, perishable agricultural commodities (i.e. fresh and frozen fruits and vegetables), and peanuts.

Specifically relating to pork, covered commodity means muscle cuts of pork, and ground pork. But if the pork product has had an ingredient added or been cooked it becomes an exempt processed food item. Examples of pork products not included in the legislation are bacon, sausage, and high-end ham products.

A retailer of a covered commodity may designate the covered commodity as having a United States country of origin only if the covered commodity, in the case of pork, is exclusively from an animal that is exclusively born, raised, and slaughtered in the United States. Records will have to be maintained from birth to retail to verify that products are properly labelled. There is an exemption for food service establishments.

What are the implications for Canadian hogs and pork? COOL is definitely a trade barrier especially for live animal exports. However, it can't be challenged under W.T.O. rules until it is a mandatory program. Pork supply chain costs will increase due to the stricter labelling requirements. There is the potential for increased consumer costs, pork processor costs and lower producer hog prices. Pork processors will not absorb these extra costs on their own. What impact will this have on live feeder pig and market hog exports to the U.S.? Will no U.S. processors want Canadian animals? Will one or two of the major processors continue to take Canadian animals but only on specific days or shifts? There is also the potential for Canadian pork to gain an advantage in the U.S. market or U.S. export markets if the COOL system costs raise the price of all U.S. pork and make Canadian pork comparatively less cost. The only Canadian pork that will have to meet the COOL labelling requirements is that exported to the U.S. and which doesn't fall into an exempt category (as an ingredient in a processed food item, sold through food service establishments, etc.)

Table 1 shows a comparison of Canada and United States in terms of hog production and trade and pork production and trade for the year 2001. Canadian live pig exports to the U.S. are the equivalent of approximately 25.7% of Canadian hog slaughter and represents about 5.4% of U.S. hog slaughter. Canadian pork exports to the U.S. represent approximately 18.9% of Canadian pork production and is equivalent to approximately 3.8% of U.S. pork production. Canadian pork exports to the U.S. also represent approximately 73.9% of all U.S. pork imported.

Table 1. Comparison of Canada - United States Hog/Pork Statistics, 2001.

Variable	Canada	United States
Hog Slaughter ('000 head)	20,678	97,944
Live Hog Exports (head)	5,320,318	64,044
< 50 kg	3,168,770	N.A.
> 50 kg	2,151,548	N.A.
Live Hog Imports (head)	4,187	5,337,088
Pork Production (tonnes)	1,729,127	8,697,727
Pork Exports (tonnes)	809,975	671,666
To the U.S.	327,097	N.A.
To Canada	N.A.	69,903

Source: Statistics Canada, Agriculture and Agri-Food Canada, Canadian Food Inspection Agency, United States Department of Agriculture
Note: N.A. - not applicable

The United States Department of Agriculture has estimated that COOL will cost $2 billion to the U.S. processing industry. No estimate of costs at the retail level have been released. The impact of COOL at the different stages of the pork supply chain leaves many questions unanswered as no one is sure how this situation is going to unfold.

Advanced Manure Management Technologies For Ontario

Richard St. Jean, P.Eng., P. Ag.
AMMTO Project Manager, Geomatrix Consultants Ltd., Waterloo

Project Background

The Advanced Manure Management Technologies for Ontario Project (AMMTO) is a collaborative effort between private and government sectors to develop an information database of advanced manure management technologies suitable for use in Ontario. The project funding partners include Cold Springs Farm Ltd., Ontario Pork, Poultry Industry Council, Ontario Pork Industry Council, Premium Pork, Selves Farms, and Ontario Ministry of Agriculture and Food through the Healthy Futures Program.

The project has an executive group made up of representatives from each of the funding partners. In addition to the executive group, the project has an advisory group that provides technical input to the project. The advisory group is made up of representatives from government agencies, municipalities, educational institutions and the private sector, who have manure management expertise.

The project was initiated in January 2002 and project activities are scheduled to continue until July 2003 when a final report will be issued.

Summary of Project Activities

AMMTO hosted a public meeting early in the project to solicit input from private citizens, environmental groups, conservation authorities, municipalities, agricultural commodity groups and farmers to determine what issues needed to be addressed with new manure management technologies. A summary of the meeting discussions can be found on the AMMTO website which has it's home page on the Manurenet website. AMMTO used the discussion results from this meeting to develop a set of manure management objectives. The AMMTO manure management objectives were developed to provide a basis for evaluating the effectiveness of advanced manure management technologies, in addressing current manure management concerns.

An "Information Submission Form" was developed at the start of the project to solicit standardized information from all suppliers of manure management technologies. This information was used for evaluating the potential of the technologies to meet AMMTO Objectives. The form requests information regarding technical and economic aspects of the technologies, papers published on the technology, implementation status of the technology, details of operating systems, and government approvals obtained for the technologies. A copy of the submission form can be found on the AMMTO website. The submission form was forwarded to all manure management technology suppliers identified by AMMTO, requesting that the supplier provide a submission to AMMTO.

320 suppliers of manure management technologies have been identified by the project to date. Manure management technologies were identified through literature searches, presentations at agricultural meetings, website exposure, advertisements in the CSAE and ASAE publications, advertising in a Canadian Environmental magazine and an American Environmental magazine that receives global exposure, and exposure through the Ontario Water Pollution Control Equipment Manufacturers Association. Figure 1 shows a break down of the types of technologies identified and the number of suppliers offering each type of technology.

AMMTO received 52 completed manure management technology submission forms. The completeness of information provided by the technology providers varied greatly. Figure 2 shows a break down of the types of technologies for which submissions were received and the number of submissions received for each technology type. AMMTO is continuing to accept submissions for manure management technologies to add to the database and will continue to do so until the project is over.

Figure 1: Manure Treatment Technologies Identified

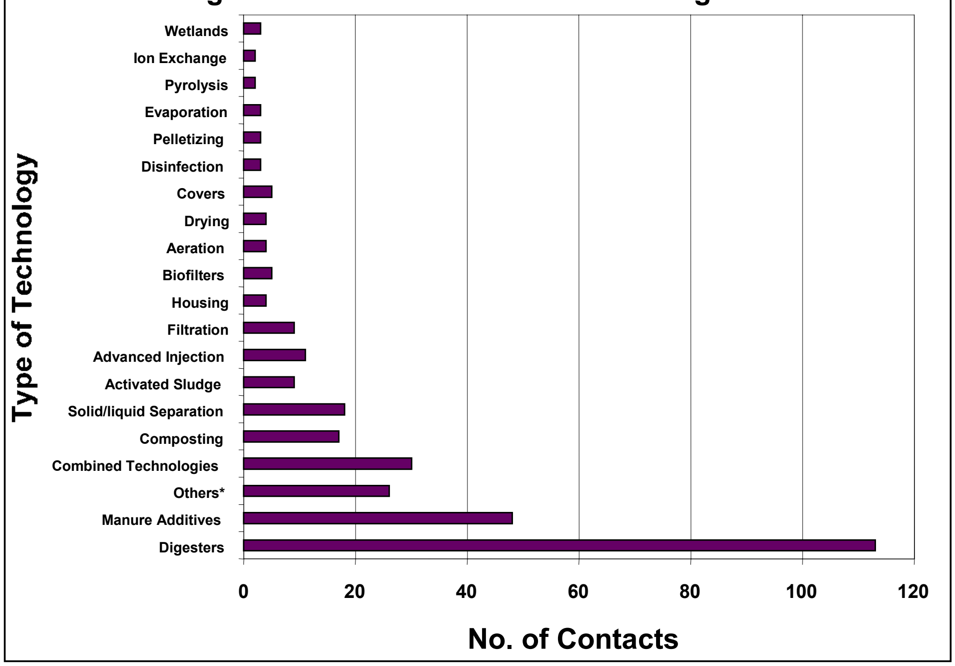
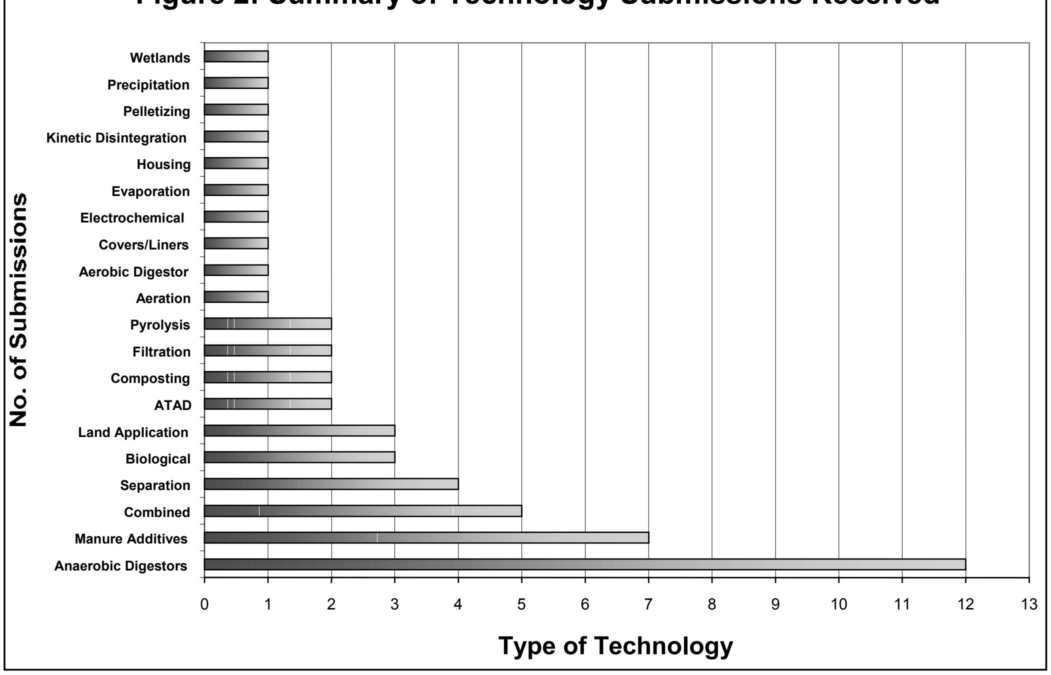


Figure 2: Summary of Technology Submissions Received



The technology submissions were reviewed by a committee of 9 people with a wide variety of agricultural backgrounds and expertise in different aspects of manure and waste management. The technologies were reviewed and ranked as to their ability to meet 9 objectives set by AMMTO. The 9 objectives used for ranking the performance of the technologies include:

1. Potential to reduce odour.
2. Potential to reduce greenhouse gas emissions.
3. Potential to reduce nitrogen loading to surface and ground water.
4. Potential to reduce phosphorus loading to surface water.
5. Potential to reduce dependency on local land base for manure application.
6. Ease of meeting government regulations.
7. Potential for degrading medicines and other by-pass substances found in manure.
8. Potential to reduce pathogen loading to soils from manure.
9. Potential to reduce manure volume and /or mass.

Each technology was given a technical ranking out of 10 for each of the 9 objectives, based on how well the technology was suited to addressing the objective. Each technology was also given a confidence ranking out of 10 for each objective, based on the confidence the reviewers had in the technology principles, technology performance claims, and the source and type of data provided by the technology suppliers.

All of the technology submissions received to date have been evaluated. The evaluation rankings will be included as part of the manure management technologies database, which will be released as part of the project deliverables. An interim report will be released in the early spring of 2003, which will include the technology database developed to date. The database will include a technology performance ranking out of 10 for each of the AMMTO objectives. The performance ranking will be the technical ranking out of 10, multiplied by a confidence factor between 0 and 1, calculated from the confidence ranking divided by 10. Each technology will also have an overall ranking out of 100, which will be based on the technical ranking, confidence ranking and importance weighting factors applied to each of the AMMTO objectives. The overall ranking will be a relative indication as to how well the technology addresses the AMMTO objectives. AMMTO is currently in the process of developing the overall ranking for each of the technologies.

AMMTO retained Ridgetown College to work with AMMTO on developing an economic model to evaluate manure management technologies. The model is intended to be used by AMMTO and farmers as a tool to evaluate current manure management practices against proposed technologies and to compare new technologies. The model takes into account capital, operating and maintenance cost including interest and taxes, salvage values of decommissioned manure systems, the impact on land requirements and allows the incorporation of a dollar value for environmental benefits (reduced compaction, reduced odour, reduced GHG emissions etc) that result from the use of new technology. AMMTO will be using the model to evaluate the top 3 or 4 performance ranking technologies, to determine which technologies merit performance monitoring as part of the AMMTO project, to verify performance claims. The economic model will be released with the final report in August of 2003.

AMMTO will be releasing an interim report early in the spring of 2003, outlining the project results to date. The final report will be released in August of 2003.

If you have any questions regarding the AMMTO project you can contact Richard St. Jean, the AMMTO project manager, by phone at 519-886-7500 ext. 225 or by email at rstjean@geomatrix.com.

Manure and Cropping

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Sidedressing Corn with Liquid Hog Manure

Where liquid manure is the primary nitrogen (N) source for corn, sidedressing can be optimum time for application. Advantages of sidedressing include: reduced movement of ammonium, phosphate and other contaminants to surface waters via tile drains (since tiles are less likely to be flowing then, and crop roots are actively absorbing nutrients); greater N-use efficiency; and the pre-sidedress nitrate test (PSNT), which is more reliable than the pre-plant nitrate test, can be used to fine-tune application rates. Good corn yields were achieved sidedressing with liquid hog manure over 4 years of testing. Just like fertilizer N yield response curves, corn grain yield increases with rate of sidedress injected manure, and then levels off as N supply exceeds crop demand. Sidedress injection rates for 95% maximum corn yields calculated from response curves were: 58,900 L/ha in 1999; 35,500 L/ha in 2000; 45,400 L/ha in 2001; and 54,700 L/ha in 2002. Optimum rates depended on grain yield potential (ranging 7,500 to 12,500 kg/ha), and manure N concentration (ranging 0.4 to 0.6% N). Corn grain N concentration increased with application rate, and was sometimes greater with injection than with topdressing. Method of sidedressing did not affect corn grain yields much when application was late (1999 and 2000 trials), but when corn was sidedressed earlier in dry growing seasons (2001 and 2002), injection out-yielded topdress (by up to 3100 kg/ha). The lower yield and grain protein content associated with surface broadcast can be caused by decreased root activity near the dry soil surface where the nutrients are placed, runoff losses, and N loss through volatilization if manure is topdressed when the canopy is small.

While injection reduces odour, runoff, and N volatilization compared to broadcasting, it can increase contaminant movement to tile drains. Worm holes are one way that manure moves directly to tiles, effectively by-passing the soil that could filter out the contaminants. Tools such as the Kongskilde Vibrashank with coulters, or the AAFC-Delhi Zone tiller (coulters + DMI shank + hillers), provide tillage and mix material around in the topsoil, which reduces the chance of large volumes of manure intersecting with worm holes and moving further down. For the sidedressing experiments, disc hillers were added to the coulter + Vibrashank injector (Nuhn-jector) to prevent preferential flow of rainwater down the injection slot and to allow shallower injection while still keeping manure covered. With this equipment, movement of manure to tile following application was greatest at injection rates above 56,000 L/ha, and dramatically reduced at lower rates. When sidedress injected, these rates supply sufficient nutrients for good corn grain yields if manure contains 0.4% N or more. Care should be taken not to apply manure in excess of crop N requirements even where there is a low risk of movement to tiles at the time of application, as residual nitrates left in the topsoil after corn harvest move to tile– or groundwater in the fall and the following spring.

Testing is ongoing to see if the PSNT, which has proven to be a useful tool for fine-tuning sidedress rates of N fertilizer, can similarly be used for predicting sidedress rates of liquid hog manure. In the on-farm strip trials, PSNT samples showed some residual N in plots where hog manure was sidedressed at rates above crop demand the previous year. The PSNT correctly indicated whether additional N was required in most cases. Flow control can be used for convenience of changing rates according to variability in soil nitrate tests, crop yield potential, field history or other factors. Coupled with GPS and appropriate software, the system provides records for nutrient management planning and demonstration of due diligence during application, with maps illustrating rates and any set-backs, such as from water courses.

Fall and Pre-plant Injection in Loamy Soil

Corn planted directly into the zone of 44,000 L/ha injected using the AAFC-Delhi Zone Tiller or the Nuhn-jector, responded equivalent to conventional fall plow with starter fertilizer, when manure was spring-applied. When manure was fall-applied, however, there was no growth response to planting into the injection zone (following wheat stubble, non-tiled loam). A PSNT test similarly indicated that fall-applied manure N was not available to the next season corn crop. Hillers on the tool bars used in this experiment prepare a raised berm, which allows the seedbed area to warm quickly in spring.

Pre-plant Injection in Sandy Soil

Manure management practices in sandy soils should be compatible with conservation tillage systems, which are favoured for reducing input costs and erosion without compromising yield. The Yetter Avenger injection system performs well in high residue situations such as no-till corn and cover crop residues, leaving the soil surface smooth enough for rotation into no-till beans. The Vibrashank is light and economical, but may leave a rougher surface.

In 3 years of testing, corn grain yields were similar whether N was supplied by inorganic fertilizer (primarily sidedressed UAN) or pre-plant manure injected at two rates. In a wet year (2000), corn yielded less at the low rate of manure application (56,000 L/ha - 153 kg total N/ha from manure + 40 kg N/ha starter fertilizer) than at the high rate (79,000 L/ha - 217 kg total N/ha from manure) or with fertilizer (40 kg N/ha starter fertilizer + 135 kg N/ha sidedress) due to N loss by leaching. In the other two years of the trial, yields were the same with fertilizer (150 to 175 kg N/ha) and manure (39,000 to 62,000 L/ha - 140 to 150 kg total N/ha). Nitrate concentrations in the top 30 cm of soil (pre-plant and pre-sidedress nitrate tests) were low pre-plant (shortly after manure application), increased with time as manure-N converted to nitrate (nitrification), and were highest just before sidedressing. Nitrogen release from pre-plant injected hog manure coincides fairly well with crop demand, with N availability similar to urea (converts to nitrate within a few weeks in warm weather). The 'late PSNT' (sampled a few days before sidedressing) correctly indicated that little additional N was required in manured plots. Pre-plant and 'early' pre-sidedress (sampled about 1 week prior to sidedressing) tests overestimated N requirements. Therefore, where liquid hog manure is the N source in sandy soil, PSNT samples should be collected as late as possible prior to sidedressing.

When producing corn on light-textured soils, extra caution is needed to avoid contaminating groundwater with nitrates. Most of the nitrate leaching from corn systems occurs after the growing season and into the following spring. This can be controlled in both manured and fertilized systems by overseeding a cereal rye cover crop into the standing corn. If the early part of the growing season is wet however (as occurred in 2000), manure nitrates can leach to groundwater - even with pre-plant injection, which couples N release fairly closely to crop demand for N. Otherwise (in dry years), nitrate movement to groundwater did not differ much whether the nutrient source was pre-plant injected manure or sidedressed fertilizer. In case of wet conditions in spring and early summer, ideal management for liquid manure in sandy soil is split-application between pre-plant and sidedress.

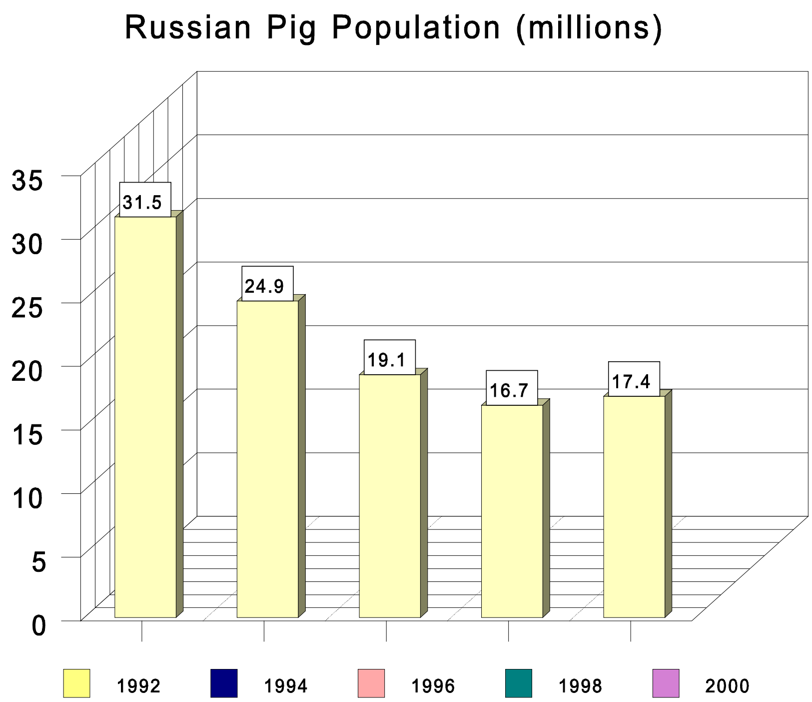
Acknowledgements: R.C. Roy, SCPFRC – Delhi; AAFC Technical staff and Delhi Farm Crew; Ontario Pork; Nuhn Industries; Green Lea Ag. Centre; A & L Laboratories; OMAF; DeKalb; Great Lakes New Holland; DaCosta Farms; Van Raay Farms; K. Otto; T. Groenestege; V. Hulsolf; L. Wight; P. Spriel.

New Ventures In Russia

Jim Donaldson
Donaldson International Livestock Ltd., Tavistock

The swine industry in North America has changed more in the last 5-7 years than in the last 20 years. These changes are just now starting to happen in other parts of the world, especially in China, Vietnam, Russia, the Ukraine and other Eastern European countries.

I visited Russia for the first time twelve years ago in 1990, but felt they just were not ready to purchase swine genetics at that time. From the chart, you can see that for most of the last ten years, they have had a steady decline in pig numbers and it has only been since 2000 that they show a slight expansion. Based on current statistics, Russia has around 17.4 million pigs, reflecting the recent gradual increase in numbers after many years of reduction.



At the time of my first visit, very few people in the Russian swine industry had ever travelled abroad and the political system had likely led them to believe they had the best. Many countries believe they are using the best genetics and technology in the world, until someone sends some pigs in and proves them wrong.

That was the case in the USA a few years ago, until the American slaughter-houses adopted a meat grading system and were able to compare truckloads of Canadian commercial pigs with the local truckloads. The difference blew them away. There were differences of 7-8% in lean yield and of course the Canadian pigs had a very uniform carcass.

Why?

Canada has 30 years of a national genetic selection program, concentrating on only four breeds. We also have had a national grading system for 30 years and our farmers get paid for quality.

At that time, the American genetic selection program was based on BS baffles brains. It was the show ring mentality, with no emphasis on performance traits.

Many of you here today do not realize that the best genetics in the world are right here in Canada, developed by private family farm breeders. The pigs are tested on the national testing program now run, at arm's length, by the Canadian Centre for Swine Improvement.

You do not have to go to Denmark, England or the USA or purchase from a multinational breeding company to get superior quality genetics. They are at a farm maybe right down the road from yours.

The commercial crossbreeding program in Canada is a simple program of breeding the best Canadian Yorkshire tested in the world with the strongest Landrace to produce the most prolific and durable F1 females, then crossing that F1 female with the best terminal boar proven worldwide, the Canadian Duroc.

In all the research and studies that I have seen to date, the Canadian Duroc will produce the best meat quality of any terminal boar in the world, and is likely one of the most rugged and durable. In some studies, the Duroc is shown to be more resistant to disease than other breeds.

Canada has eliminated the majority of Hampshire due to the RN gene and slow growth and we have never really used the Pietrain due again to vitality, poor meat quality, PSS and slow growth. In fact, in recent years, with our large "all in all out" nurseries, grower finisher barns and automatic slaughter house equipment, uniformity or consistency has become of major importance. The more genetics you throw into a breeding program, the wider the genetic variance, both in the barns and in the slaughterhouses. Russia, in the past, had followed the multinational breeding company policy of developing synthetic lines and have as many as 7-8 different breeds in their program. When you visit their farms, you see everything - short pigs, long pigs, fat pigs, lean pigs, big hams, small hams, anything but consistency.

Many of you have read of the project that Fred Groenestege and I have entered into with a Russian company. In 2002, we were approached by this company, which is the fourth largest meat processor in Moscow. They were dissatisfied with the supply of market pigs they were receiving from within the country and were not totally pleased with the carcasses from the pigs they had imported from Brazil. They wanted to ensure a constant supply of good quality, uniform pigs. They first visited us in April 2002 and spent a few days with Fred viewing modern, multi-site production facilities. They also visited Total Swine Genetics AI Unit to see what a modern AI Unit looks like, at the same time, seeing the best Duroc in North America. They also viewed the high health genetics at my nucleus herd, Topgen Swine.

In June, I did a follow up mission to Russia and took Gary Currie, Grand Valley Fortifiers, with me. Nutrition is a limiting factor in their system in Russia. Their feed mills are antiquated and their nutritional program is based on old formulations and old genetics and would not be adequate for the lean, fast growing genetics from Canada. We are sure some form of cooperation will be developed in areas of nutrition.
In September, Fred and I were invited to participate in an government agriculture mission to Russia with Minister of Agriculture Lyle Vanclief. We took this opportunity to visit the plant and the official signing of a contract took place.

Most of the farms in Russia were huge state farms built 30 years ago, based on the old system of farrow to finish in one site. Ventilation would be a major problem and a very big lack of good quality slats or flooring was noticed. Many of the barns were beyond renovation

As most of you know, most pig diseases are pig to pig. Every time you open the door and bring in new pigs, you risk disease. This project entails a closed system of 9000 sows made up of three commercial units of 2800 sows and a high health nucleus multiplier herd to supply these three sites with F1 females and the AI Unit with the top boars.

Fred is responsible for all preliminary drawings and final plans for the multi site facility. Fred has also been involved with me in establishing a customized training program for all sectors of the project. In November, a group of engineers and contractors were here for the first stage of the training program. They spent a week visiting new facilities built by Fred and then had detailed discussion on how to implement Fred's building technology into their Russian system.

Russia is the largest country in the world, with a population of 145,000,000 people to feed. It imports 600,000 tonnes a year of pork. It has a large land and feed base, but is in dire need of new investments from outside and modernization and legislative changes are the key to economic revival.

Training will be a way to ensure that our new ideas and technology are adopted successfully. We are hoping to have young people, who are sometimes more open to new ideas and change, involved in the project. Changing management thinking will be a large problem, but must be done if we want to have a successful project. Most of the management systems in Russia at the moment are handwritten, so computer programs would be of a great benefit.

We need to set new standards and this will mean a total revision of management guidelines. They must also now be aware that they have to put an economic value to what they do. In the past, many of these state farms were very inefficient and worked at a tremendous financial loss, but the system just kept paying. Now they must show a profit. There is a tremendous future in Russia for new products and equipment but to be successful, I believe it has to be accompanied with the appropriate technology and training.

We believe that by establishing this first swine unit properly and successfully, sales for other Canadian products and technology, such as feed, genetics, equipment, building design, consulting, will follow.

Thank you.

Global Pork Trade and the Design of Pens for Dry Sows

Tim Blackwell, Franklin Kains and Reid Wilson

Introduction

Canada possesses the enviable status of being the leading exporter of pork in the world. This is due both to the high quality of Canadian pork and because of Canada's low cost of production. However, investment capital and technology always seek optimal areas in which to locate. In the years ahead pork production as well as manufacturing may well relocate to countries in South America, Asia, or Eastern Europe. These countries could produce good quality pork at very low prices. To stay competitive, Canada will have to take a page from the Danish model of pork production.

Denmark is a country with few of the advantages that Canada has in terms of pork production. Land is scarce and prices are high. Denmark must import livestock feed and its environmental, food safety, and animal welfare regulations are considerably more restrictive than Canada's. And yet Denmark is second (and some might say first) in global pork exports. They use their restrictions to promote Danish pork in the marketplace and Denmark is a leader in new marketing initiatives. Denmark was one of the first countries to use a quality assurance program as a marketing tool. To compete, Canada was forced to institute its only quality assurance program. Denmark has strict environmental guidelines for pork producers and soon Ontario will be competitive at this level as well.

However, to remain a major player in international pork trade, Canada must also address animal welfare and food safety issues. In so doing we will position ourselves well in front of newcomers to pork production such as Brazil or Russia. New investments in pork production in these countries may result in a cost-competitive product, but such countries lack the infrastructure to compete in terms of environmental standards, food safety, or animal welfare. Canada's future is in producing a higher quality product while maintaining a competitive price. Canada therefore must follow the Danish example.

A major area of concern to both our domestic and international markets is that of animal welfare. The most widely criticized practice in modern swine production is the housing of gestating sows in confinement stalls. Gestation stalls ensure that sows receive adequate feed and water and that they are protected from aggression by their herdmates. However gestation stalls also restrict sows to simply standing up and lying down. Our customers at home and around the world believe in the simple philosophy, "fish gotta swim and birds gotta fly." An easy extension of this ethic is that "sows gotta stroll." Unfortunately it is not as simple as letting sows out of gestation stalls. The natural tendency of sows to establish dominance hierarchies through fighting causes injuries to individual sows when they are mixed into groups. Restricting feed to gestating sows leads to additional aggression at feeding time. If sows are to be taken out of gestation stalls to improve their welfare, the design of these group housing systems must ensure that fighting and subsequent injuries are minimized and that all sows have access to appropriate amounts of feed and water. Some major advances in achieving these goals have recently been accomplished.

To remain leaders in global pork production, Canada must combine its low cost of production with continued attention to the demands of its domestic and international customers. There is nothing to

be gained in trying to educate the public about modern animal agriculture in the hopes that they will change their minds about the welfare of sows in gestation stalls. To respond to the demands of our customers by attempting to convince them that change is not needed or possible is a sure sign of an industry in decline. Several Ontario pork producers have developed practical and innovative ways to satisfy consumer demands for welfare-friendly gestation housing. Ontario's continued progress in practical, cost-effective loose sow housing will ensure Canada's reputation as a cost-competitive, high quality and responsive pork producing country.
Recently, there has been a growing interest among Ontario swine farmers as to alternatives for housing dry sows. This is driven by the coming restrictions to the use of stalls on farms in European Community countries and the concerns expressed on this continent about the use of stalls by the fast food industry.

Group Housing of Dry Sows

Much of the talk in the past year or two has revolved around the reintroduction of electronic sow feeding. Less attention has been given to the more conventional option of housing sows in large pens and feeding them on the floor together as a group.

A decade ago a number of farrow to finish operations in Ontario were converted to SEW farrowing. On many of these farms, the operators chose to simply use the finishing pens to house the dry sows in late gestation and use the existing stalls for the sows up until they were checked pregnant. Renovations were often modest – adding drop feeders to the feed line or maybe taking out every second partition to expand the pens. Many of these have worked well but group pens for sows often do have challenges. Boss sows get fat, shy sows get thin and unlike stalls, fighting and aggression can be an issue.

Renovations at Arkell

In response to the growing interest in alternative housing, the University of Guelph changed one of their 4 dry sow stall rooms and chose group pens with drop feeding on the floor. To address the possible problems of fighting and uneven feed intake 4 modifications to the more conventional pen systems were employed:

- Number per pen: With the smaller herd sizes in the past, old barn plans showed group pens which would only hold a small number of sows, often as few as 6. If the area per sow is held constant, the flight distance available to a sow being harassed increases as the pen gets larger. Thus at Arkell the new pens were made large at approx. 40' x 20' and designed to hold at least 25 sows rather than the 6 to 12 or the past.

- Area: The existing sow rooms had a large area devoted to alleyways. With the renovations this area became available as pen space and as a consequence the pens provide up to 29 sq.ft. per sow. This compares with many group pen systems which allow 18 sq.ft. per sow, a density which is consistent with the Canadian Code of Practice for Swine.

- Privacy walls: Extending out from the side partitions and the end of the pen are short 5' long stub or "privacy" walls which add more wall length to the pens. They are intended to provide a greater sense of protection when the sows are lying down allowing the sows to form social groups within the pens.

- Feeding area: Whereas other barns have a single line with several dumps running across the pens, the Arkell barn has 2 lines which doubles the area of the floor on which feed is dropped. This is in an attempt to reduce the aggression at feeding time.

- Floor slope: The solid floors are sloped at 5% (5/8" per ft.) from front to back. It is believed that it is important to get any urine off the floor as quickly as possible as an encouragement to the sows to develop good dunging habits.

Wilson Barn

Following the renovations at Arkell, Reid Wilson of Milverton choose a layout similar to the Arkell renovations for his new addition to their sow barn. They choose to stay with the general principles of Arkell at 25 sows per pen, the privacy walls and 2 feed lines. They did cut back on the pen length to 32' which reduces the pen area per sow to about 25 sq.ft. per sow. The layout is shown below.

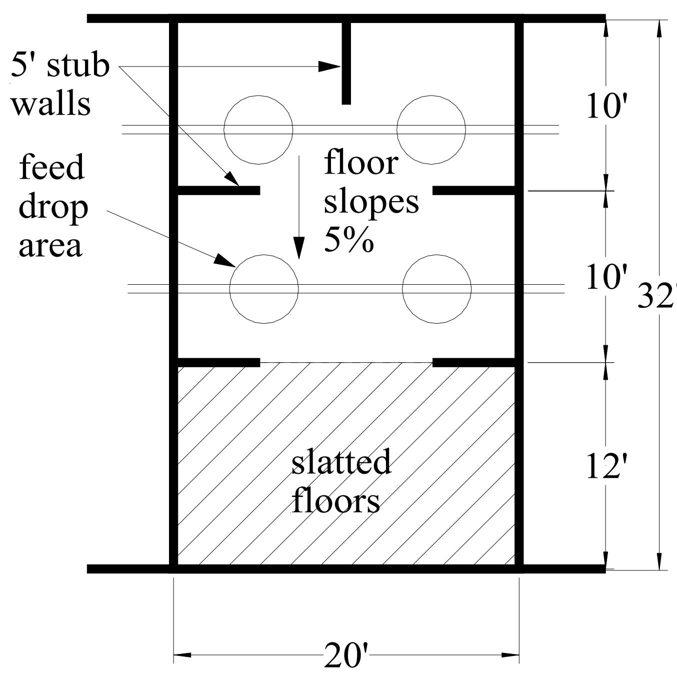


Figure 1: Dry sow pen layout

Cost

A recent cost comparison was completed by Fred Groenestege Construction of 3 styles of dry sow barns – a stall barn, a pen barn allowing sq.ft./sow and a pen barn allowing 26 sq.ft. per sow complete with an extra feeding line and privacy walls. The costs that follow did not include excavation, manure storage, electrical or plumbing.

Cost per sow place of 3 styles of dry sow barns

	100 sows	300 sows	1000 sows
Stall barn	971	800	713
Group pens @18 sq.ft., single feed line	660	527	500
Group pens @ 26 sq.ft., double feed line, privacy walls	904	733	686

Even at the generous allotment of 26 sq.ft. the pen barn was a lower cost alternative.

Summary

Both barns reviewed have been performing well and the operators have been delighted with their choice to date. The question remains as to how much the extra area per sow, the privacy walls and the large feeding area contribute to sow comfort, reduced aggression and more uniform sow conditioning. Tests are being done at Arkell under Dr. Tina Widowski to determine the performance and animal welfare aspects of their system to answer these questions.

Optimum Dietary P Levels for Grower-Finisher Pigs

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Background

Largely because of environmental concerns, but also because of feeding costs, it is critical that close attention is paid to the phosphors (P) levels in grower-finisher pig diets. For establishing the optimum diet P levels, both the availability of P in pig feed ingredients and the available P requirements of pigs should be estimated accurately. At the University of Guelph there is a considerable research effort to better understand P utilization in growing pigs.

P availability in Ontario corn and soybean meal samples

The major reason for the inefficiency of P utilization in monogastric animals is the poor digestibility/availability of P that is present in plant products (20 to 55%), largely because much of P in plant products is present in the phytate form. Normal pigs do not produce the enzyme phytase that is required to release P from phytate. However, some plant products, in particular wheat products, contain some natural phytases that can liberate P from phytates and contribute to improvements in P availability in these ingredients. Unfortunately, endogenous phytase contents in corn and soybean meal are very low and insignificant. To account for variability in P availability across ingredients, pig diets should be formulated on an available/digestible basis, rather than a total P basis.

In the scientific community there is still considerable debate on how to best measure the availability of P in pig feed ingredients. Based on Dr. Fan's research the so-called true fecal P digestibility assay should be used. Values of true fecal P digestibility of 60% and 50% have been observed for Ontario grown corn and soybean meal in growing-finishing pigs. However, until more information is available on true digestibility values, apparent digestibility values may be used, especially when a wide range of feed ingredients are included in the pig's diet. In the Guelph studies, the corresponding apparent fecal digestibility values (mean for the three highest diet P levels) were 27% and 40% for corn and soybean meal, respectively, which correspond reasonably well with the Dutch CVB (1999) feed table values (20 and 39%).

In ingredients of plant origin that contain no endogenous phytase there is reasonable agreement between P availability and the proportion of total P that is present in the phytate form. Recent studies at the University of Guelph indicate considerable variability in Ontario grown samples of corn and whole soybeans. In corn the proportion of P tied up in phosphorus varied between 49 and 90%; for whole soybeans it varied between 43 and 71%. This large variability within these two ingredients warrants some routine monitoring of total P and phytate content in swine feed ingredients. In the study, year effects on total P and phytate content were quite substantial, while growing location and variety were significant factors influencing total P and phytate content in soybeans and corn, respectively.

Use of exogenous phytase to enhance P digestibility

Microbially produced phytases are now routinely included in pig diets to enhance P digestibility. As a result the total P levels in the diet can be reduced, the efficiency with which P is retained in the animal is improved, and P excretion into the environment is reduced. Various points should be considered when including phytases in the pig diets:

- Different commercial products differ in the content of active phytase. Phytase units (PTU) may be used to compare different products using a standardized test.
- Phytases are quite unstable when exposed to heat. During pelleting the temperature of the feed should not exceed 65-70 ^{o}C when phytases are included pre-pelleting. Phytase activity should be checked in the complete, processed feed. In the very near future phytases with higher heat stability will become available.
- The marginal improvement in P digestibility declines with increasing added phytase level. The value of phytase is largest at low levels of added phytase. In corn and soybean meal based diets, adding 500 PTU per ton in the diet can replace 0.1% of added P from dicalcium phosphate in starter pig diets. In finisher diets 300 PTU per ton can replace 0.1% added P. This will reduce P excretion by about 25%, if diet P level is reduced from 0.6 to 0.5%. Given the above considerations and given today's prices of phytase and inorganic P sources, the use of phytase does not appear to increase feed cost by much. The cost of the product is largely offset by the reduced need for P (and Ca) in the feed.

Feed P closely to the pigs' requirements

Currently, NRC (1998) is used as an important guideline for dietary P requirements for pigs. However, the actual P (and other nutrient) levels in diets are often higher than NRC recommendations. These "safety" margins are sometimes very large. Reasons for these safety margins include:

- To account for potential errors in feed preparation and delivery. Feed preparation should be closely monitored.
- Only a few diets are used to meet the nutrient requirements of a wide range of pigs. To overcome this, apply phase and split-sex feeding, keep and manage breeding stock separate from market hogs.
- The Ca to P ratio in the diet is too high. It should be kept around 1.2. More accurately, the ratio between total calcium and apparent digestible phosphorus should be targeted at 2.8, with an acceptable range from 2.6 to 3.1.
- The perceived requirements of some groups of pigs, with high performance potentials, are higher than the actual requirements. This may be overcome by (factorially) estimating P requirements for specific groups of pigs. This requires that P retention in the pig's body be determined since this is the main determinant of dietary digestible P requirements. In fact, various studies have shown that the NRC requirements are adequate or more than adequate for pigs with average or unimproved (lean tissue) growth rates.

In a recent study at Ridgetown College we evaluated the P requirements in pigs with extremely high (lean tissue growth) potentials (Table 1). These data suggest that grower-finisher pigs can achieve excellent growth performance at diet P levels that are close to NRC requirements (treatment MLP). Actual NRC total P requirements for pigs fed corn and soybean meal based diets are 0.50 and 0.42% for grower and finisher pigs, respectively. This is equivalent to 0.20 and 0.16 apparent fecal digestible P contents, respectively. Interestingly, we found continued improvements in feed efficiency, and somewhat in growth rate, up to the highest P levels, which were about 30% higher than NRC (treatment HP).

Table 1: Growth performance and carcass characteristics of grower-finisher pigs fed diets with varying total phosphorus P levels.

	Treatment				Pooled	Treatment	Diet P Level
	LP	MLP	MHP	HP	SEM	effects	Linear effect
Diet P levels (analyzed) (%, grower/finisher)	.43/.32	.51/.37	.55/.44	.61/.49			
ADG (kg/day)	1.02[a]	1.06[ab]	1.07[b]	1.09[b]	0.014	P<.01	P<.001
Feed intake, kg/pig	200.2[a]	204.5[a]	194.3[ab]	186.2[b]	3.4	P<.01	P<.01
ADFI, kg/pig/d	2.56	2.62	2.59	2.59	0.04	NS	-
Feed:gain	2.50[c]	2.48[bc]	2.41[ab]	2.36[a]	0.028	P<.01	P<.001
Carcass weight (kg)	89.97[a]	93.43[b]	91.87[b]	88.86[ab]	6.89	P<.05	NS
Lean yield, %	59.87	59.58	59.27	60.45	1.49	NS	-

[a-c]means within column with differing superscripts are significantly different (P<.05).

Take home messages

- Pig diets should be formulated based on true digestible phosphorus contents in feed ingredients; until more data become available, apparent digestible phosphorus contents may be used.
- The P digestibility (true and apparent) will be quite variable between different samples of corn and soybean meal; phytate content may be measured in ingredient samples to estimate P digestibility.
- Phytase, if used properly, is an effective means to increase diet P availability, allowing a reduction in diet P content and thus reducing P excretion into the environment.
- Many grower-finisher pig diets are over-formulated for digestible P content. On most commercial pigs farms, growth performance and feed efficiency are poorer than what was achieved in a study at Ridgetown College at P levels recommended by NRC (1998): 0.50 and 0.42% total P for grower and finisher pigs, respectively. This is equivalent to 0.20 and 0.15 apparent fecal digestible P contents.

Acknowledgements

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Microbes and Gut Health: Pig Gut Flora Influenced by Dietary Antibiotics and Feed Additives

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Background

The large number and diverse types of microbes in the pig's gut influence animal health, well-being, and production efficiencies. Dietary antibiotics have long been used to prevent gut disease and digestive upsets, especially in newly weaned piglets. Because of the increased public concerns on the use of antibiotics in pig feeds, development of alternatives to dietary antibiotics is urgently required. The effect of dietary antibiotics and feed additives with anti-microbial activity on the development of gut flora, however, needs to be better understood.

Objectives

Our aims were to develop an advanced molecular technique (DNA profiling using PCR-DGGE) for quick global assessment of gut flora, and to investigate the effect of dietary antibiotics and feed additives with anti-microbial activity on the gut flora of post-weaning piglets.

Results and Discussion

Figure 1 shows the PCR-DGGE DNA profiles of bacteria collected from ileal (upper gut) and cecal (lower gut) digesta of 2- and 3-week post-weaning piglets fed medicated or non-medicated diets. Each DNA band in the flora profiles represents at least one bacterial species. Cecal bacteria were much more diverse than those in the ileum. Inclusion of carbadox (50 mg/kg) in the diets significantly influenced the early development of ileal flora (Panel A). In addition, the flora profiles in Panel B suggested that carbadox also had an impact on the development of cecal flora. Our PCR-DGGE data implied that the development of ileal and cecal flora was dynamic.

Figure 2 demonstrates the effects of some feed additives on the ileal flora of 2-week post-weaning piglets. The flora profile at Day 0 of weaning was significantly different from those at Day 14 with different treatments. Non-medicated diets resulted in a more complex profile of flora. Dietary inclusion of lincomycin (110 mg/kg), herb extracts (0.75%), acidifier 1 (1.4%), or acidifier 2 (2%) all appeared to inhibit the development of ileal flora. These ileal flora profiles with different treatments also exhibited a similar pattern although differences were detected. Treatment effects on gut flora coincided with changes in piglet growth rate and feed efficiency during the second week after weaning only. In week 2, acidifier 2 increased piglets growth rate by 30% as compared to the non-medicated control diet (158 vs 121 g/d) and brought it to a level similar to that of the medicated diet (161 g/d).

Conclusion and Take Home Messages

1. With PCR-DGGE DNA profiling techniques we were able to detect inhibitory effects of dietary antibiotics and feed additives with anti-microbial activity on the gut flora.
2. Dietary antibiotics, herb extracts, and acidifiers were able to influence the early development of gut flora, while one of the acidifiers increased growth performance in week 2 after weaning..
3. Gut bacteria influenced by dietary antibiotics, herb extracts or acidifiers are being identified.

Fig. 1. PCR-DGGE DNA profiles of bacteria collected from ileal and cecal digesta*

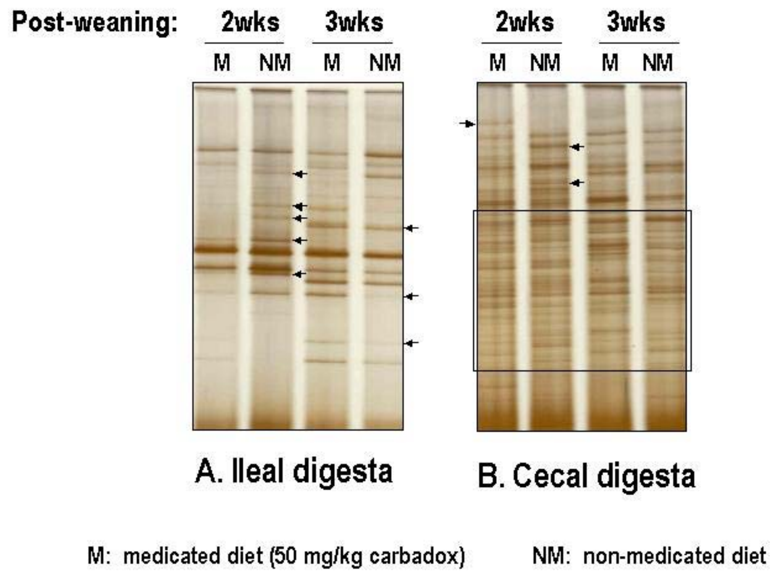
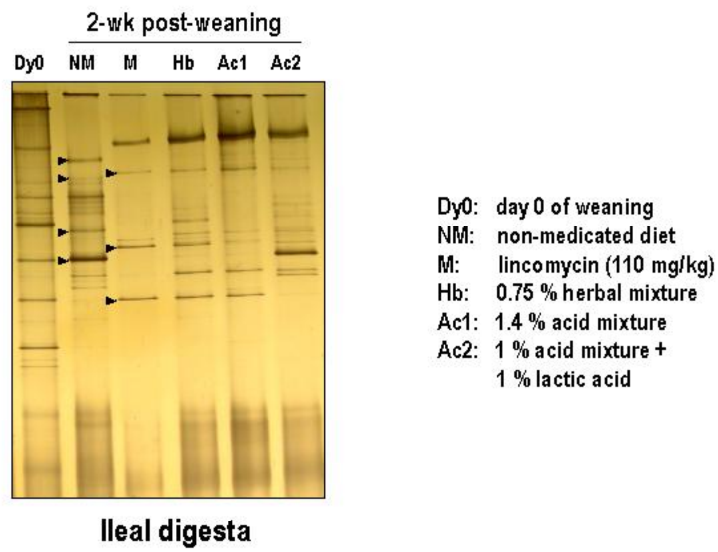


Fig. 2. Effects of some feed additives on the ileal flora*



*Significant DNA bands or differences in the flora profiles are indicated by arrows or included in an open squire.

This research is supported by Ontario Pork, Agriculture & Agri-Food Canada, and Ontario Ministry of Agriculture and Food.

Gut Microbes and Mycotoxin: Can Chicken Gut Microbes Detoxify Vomitoxin?

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Background

Mycotoxin contamination of feed continues to be a serious threat to swine and feed industries. Weight gains of pigs can be reduced by 5 to 10% with vomitoxin levels between 1 and 2 ppm and by up to 50% if toxin levels of the consumed feed reach 5 to 10 ppm. Although the adsorption and dilution are two commonly used methods by the swine industry, effective and economical detoxification methods are urgently needed. Bio-detoxification offers an opportunity besides its environmentally sound approach.

Objective

To determine if chicken gut microbes can detoxify vomitoxin.

Results

Vomitoxin (DON) can be transformed to a much (several hundred times) less toxic compound, de-epoxy vomitoxin (DOM-1) by microorganisms (Fig. 1). Our preliminary results have demonstrated that the large intestinal contents from chickens were able to detoxify vomitoxin by converting DON (either as a pure chemical or in contaminated grains) to DOM-1, while contents from the rest gut regions did not show the activity. Table 1 shows the capacity of individual chickens in converting DON to DAM-1. The White Leghorn hens were much more efficient in the conversion than the Isa Brown hens. The detoxification appeared to be biological since autoclaved large intestinal samples showed no activity of detoxification. Detoxification of vomitoxin in contaminated grains was also examined at different incubation temperatures. Although the conversion rate was slightly higher at 30^0C, incubation at both 30^0C and 37^0C was able to convert DON to DOM-1 in contaminated wheat and corn (Table 2).

Conclusion and Take Home Messages

4. Our data suggest that chicken gut microbes can detoxify vomitoxin (up to 84% of DON to DOM-1).
5. Different breeds of hens showed different capacity in detoxification of vomitoxin.
6. Further studies are warranted to use microbes (fermentation) to reduce vomitoxin levels in pig feed ingredients.

This research is supported by Ontario Pork and Agriculture & Agri-Food Canada.

Table 1. Effect of individual hen*

Breed	Hen	Conversion Rate (%)
Isa Brown	1	20
	2	18
White Leghorn	1	84
	2	51

* Incubation of the chicken large intestinal contents with DON (a pure chemical) in an anaerobic medium at 30^0C for 96 hr.

Table 2. Effects of the DON source and incubation temperature*

Temperature	Conversion Rate (%)	
	Wheat	Corn
30^0C	43	36
37^0C	33	31

* Incubation of the chicken large intestinal contents with DON (in contaminated grains) in an anaerobic medium for 96 hr.

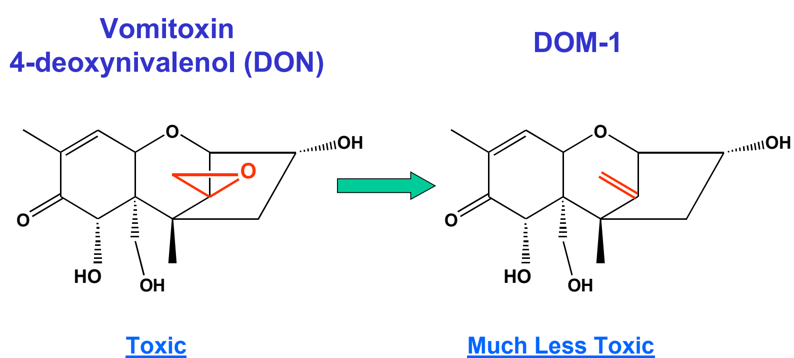

Fig. 1. Chemistry of bio-detoxification.

Report of Health Canada's Advisory Committee on Antimicrobial Use and Resistance in Animals

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Health Canada recently released the final report of its "Advisory Committee on Animal Uses on Antimicrobials and Impact on Resistance and Human Health". The committee reviewed the issues relating to antimicrobial resistance in Canada and made 38 recommendations to improve the ways Health Canada reviews, regulates and monitors antimicrobial use in animals. The executive summary and full 188-page report are available online along with Health Canada's interim response at http://www.hc-sc.gc.ca/vetdrugs-medsvet/amr/e_policy_dev.html .

Summary
In animals, resistance occurs whenever antimicrobials are used, whether for therapy, disease prophylaxis, or growth promotion. This is a problem when it reduces the effectiveness of drugs for treating infections in animals and when it leads to use of more expensive drugs of importance to human health. It is also a problem when resistant bacteria spread from animals to humans. Sound regulatory policy and prudent antimicrobial use are needed to reduce resistance risks. Research and surveillance are urgently needed to provide the scientific basis for policy and prudent use guidelines.

Top Recommendations

1. Make all antimicrobials used for disease treatment and control available by prescription only.

2. Develop an extra-label use policy, which ensures that this practice does not endanger human health. Such a policy should include the ability to prohibit the extra-label use of specific drugs of critical importance to human health.

3. Evaluate, register and assign a DIN to all antimicrobials used in food animals, whether manufactured domestically or imported. This includes antimicrobials imported in bulk (API), which should be allowed into Canada only under permit. The intent of this recommendation is to stop the direct use of APIs in food animals.

4. Stop the importation, sale and use of antimicrobials not evaluated and registered by Health Canada. The intent of this recommendation is to stop the "own use" loophole.

5. Evaluate antimicrobials for growth promotion or feed efficiency using sound risk analysis principles and rapidly phase out antimicrobial claims not fulfilling the following criteria: demonstrably effective; involving products rarely, if ever used in human therapy; and not likely to impair the efficacy of any other prescribed antimicrobial for human infections through the development of resistant strains.

6. In consultation with the provinces, other federal agencies and industry groups, design and implement an ongoing, permanent, national surveillance system for antimicrobial resistance arising from food-animal production. Surveillance should include indicator and pathogenic bacteria isolated from animals, foods, and imported animal products.

Profiling the Spread of PRRS and Mycoplasma in Nurseries

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Serological tests can be used to understand the spread of disease through a nursery barn. We measured the percent of pigs that had antibodies against PRRSV, mycoplasma and SIV to understand how the diseases spread through the barn. Swine Influenza Virus did not cause respiratory disease in these nursery pigs. Colostral immunity for SIV lasts a long time so the pigs still have some protection during the nursery phase of life.

Farm One
SIV Half of the sows (11 of 21) had positive SIV titres. Only 14% of the pigs had positive titres at 11 weeks of age. *PRRS* Only 24% (5/21) of sows were positive for PRRS (s/p ratio $\geq$ 0.4) and none of these had SP ratios greater than 2.5 (which would indicate active infection). Two nursing pigs had SP ratios greater than 2.5 and they were nursing the sow with the highest ratio. *Mycoplasma* Only 24% of sows (5/21) were positive for mycoplasma. One third of the pigs were positive at 7 weeks of age but by 11 weeks only 14% were positive. The cough in the nursery barn became most prominent at 5 to 6 weeks of age and then decreased at 7 weeks. Most nursery pigs with positive titres were between 11 and 12 weeks of age. It takes 14 days for the pigs to develop antibody titres after exposure to an agent. Vaccination protocol did not alter the number of pigs observed coughing, however only 15 coughing pigs were individually identified and vaccination groups were housed together. The cough observed at 5 weeks of age was likely due to mycoplasma that is matched by the rising titres at 7 weeks of age. This farm could use a pulse medication program at 4 to 5 weeks of age.

Farm Two
SIV All sows on farm two were positive for SIV. Most of the piglets were positive during the first week of life but none of the pigs were still positive at 11 weeks. Two of the pigs were still losing their colostral immunity at 9 weeks of age. *PRRS* More that half (13/21) of the sows were positive for PRRS with SP ratios between 0.4 and 2.4. More pigs were positive for PRRS at 18 days of life (86%) than at any other time. This represented some pigs with declining maternal immunity and other pigs with rising active antibody production. At 6 weeks of age, only 25% of the pigs were positive, at 9 weeks of age 8% were positive and then at 11 weeks of age it went up to 21% positive. *Mycoplasma* All 21 sows were positive for mycoplasma and only two pigs from the first and third week of life were negative. These pigs likely had poor colostrum intake. The proportion of positive pigs began to fall at 5 weeks of age and by 11 weeks of age, only 42% of the pigs were positive. No pigs had rising titres. There were only low levels of coughing in this barn until the pigs were 9 weeks old when the cough became moderate. Mycoplasma and SIV were not active in this nursery but PRRS was spreading through the group with a surge in newly weaned pigs and again late in the nursery.

By using serial bleeding serology results, we were able to establish which disease(s) were impacting the health and growth of the pigs in what time frame making it possible for us to suggest a pulse medication program which would address the disease problem but not leave the producer medicating all the time.

PRRS – New Methods of Transmission

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Dr Scott Dee and his grad student, Dr Satoshi Otake, University of Minnesota, have spent the last 1-2 years researching several novel methods whereby the PRRS virus could spread within and between herds. This presentation will focus primarily on results from those and other related studies.

People as Vectors
Dr Sandy Amass and her colleagues at Purdue University were unable to transmit the PRRS virus from PRRS-infected pigs to PRRS-naïve pigs, whether the persons handling the pigs showered or did not shower between the two groups of pigs in studies done 2-3 years ago (1). Their studies, however, left the door open for possible transmission when, via PCR, they found the PRRS virus in saliva and under the fingernails of two handlers immediately after handling the PRRS-infected pigs, before washing or showering. Furthermore, they identified PRRS virus in fingernail samples from one other handler, 5 hours after exposure and from a nasal swab of another handler 48 hours after exposure, in both cases, after showering.

Needles, Pins and "Pointy" Things
In addition to people as vectors, Drs Satoshi Otake and Scott Dee also investigated the possibility of transmission of the PRRS virus via needles and various fomites (2). They demonstrated successful transmission of PRRS virus to PRRS-naïve pigs after direct contact of PRRS-infected pigs with personnel and/ or fomites (boots, coveralls). They also demonstrated transmission of PRRS virus via injection needles (3). In their studies transmission to naïve pigs did not occur when handlers used any one of several of the available biosecurity measures ranging from simply changing boots and coveralls combined with washing hands ("Danish technique") to full shower-in/ shower-out protocols.

Mosquitoes, Flies and Snowballs from Hell
Drs Dee and Otake went on to investigate biting insects (4) and snowballs (5) as possible vectors for the spread of the PRRS virus.

PRRS Virus Transmission by Mosquitoes
They allowed about 300 mosquitoes to feed for 30-60 seconds on a PRRS-virus viremic pig, interrupted the feeding, manually transferred the mosquitoes in small plastic vials onto a PRRS-naïve recipient pig, then let the mosquitoes complete their feeding. PRRS virus was isolated from (i) a pool of the mosquitoes after interruption of their feeding and (ii) the recipient pig. Isolates from mosquitoes, donor and recipient pigs were compared genetically. Viruses from all 3 sources were identical.

Transmission by Flies
Using the same methodology as used for the mosquito study, PRRS virus was transmitted, by flies, from PRRS–virus infected pigs to PRRS-naïve pigs.

Snowballs
In the wake of the PRRS outbreaks in the mid-west USA a year ago Drs Dee and Otake got to work again this time investigating spread of the virus via snowballs.
They tracked a sequence of events that occurs daily on most swine farms to test the possibility of the virus moving from one herd to another in snowballs.

Sequence of Events

- The PRRS virus sticks to the exterior of a vehicle making a delivery or picking up pigs (eg. in a snowball under the wheelwell of a transport truck).
- The truck leaves the farm taking the PRRS virus contaminated snowball with it.
- Snowball falls off during truckwash and is picked up on the boot of the driver (or someone else).
- PRRS virus is tracked into the interior of the vehicle's cab.
- Truck drives (choose a distance) to another premises.
- Boot tracks virus into the entrance section of the second farm.
- Snowball, with PRRS virus, melts on the floor of the anteroom.
- Delivery parcel (Purolator package, semen container, tool kit, etc.) rested on the floor picks up the virus.
- Container passed through the access window into the "secure" section of the barn.
- Presto! The PRRS virus has entered the animal airspace of a PRRS-naïve herd.

And Mudballs
Scott's group has now extended their work to include mudballs. Using a sequence of events similar to the snowball sequence, they have demonstrated successful transmission of the PRRS virus via mudballs.

The Aerosol Debacle
Since the years of debate between Scott Dee and Robert Desrosiers in the pages of the Pigletter, Scott has run several experiments trying to demonstrate aerosol spread of PRRS virus. All have been failures to date. However, at the 17th International Pig Vet Society Congress (IPVS) held in Ames, Iowa, in June 2002, Dr Charlotte Sonne Kristensen, grad student of Dr Jens Peter Nielsen at the Royal Veterinary College in Copenhagen, presented results of aerosol transmission studies in Denmark. In her studies, aerosol spread of PRRS virus occurred between two trailers, 1 metre apart, connected by air tubes. By manipulating the air pressure in the two trailers, the amount of ventilation air transmitted from trailer A, housing recently PRRS-infected pigs, to trailer B, with PRRS-naïve pigs, was controlled and measured. PRRS virus was successfully transferred from pigs in trailer A to pigs in trailer B when the amount of ventilation air was 70%, 10% and even at 1%.

Conclusions and Take Home
Although pigs and semen are still at the top of the list as ways for spread of the PRRS virus, recent work has revealed a multitude of new ways that the virus can move around. Fomites (boots, coveralls), unwashed hands, biting insects (mosquitoes, flies), injection needles and snowballs have all now been shown capable of harbouring and transmitting the PRRS virus. Some of these ways were suspected previously, but never subjected to experimental proof. Through all this the message is that we will have to incorporate measures that will allow us, as best as we can, to counteract these new ways that we now know the PRRS virus can use to sneak into barns.

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Deadstock Services and Changing Times

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The deadstock recycling industry is a vital part of the livestock production business in Ontario. The industry not only provides an avenue for value added products, but it also has the potential to support greater environmental sustainability.

An estimated 300,000 dead animals are processed each year into valuable resources: hides, pet food, specialty foods for zoos and protein sources for non- ruminant animals, oils and a wide variety of other products used in our daily lives.

Although Canadian farmers are some of the best in the world in innovative technology, management skills, animal care and providers of Quality Assurance Programs, they can't escape the reality of mortalities. The occurrence of disease, accidental deaths, acts of nature, i.e. lightning, stress and naturally occurring deaths due to age, are all challenges that livestock operators face in their daily schedules. Despite gallant efforts, mortalities do occur and must be accepted as part of the normal production cycle.

The dead animal by-product industry in Ontario has a long history and once contained some 35-40 service providers. Presently the collection industry consists of 13 provincially licensed collectors serving on-farm collection services and four rendering firms. One rendering company supplies about 95% of the rendered product in Ontario.

For over a half century farmers have developed a working relationship with collectors for removal of their deadstock. In the last few years however, world and local events have begun to challenge that relationship.

Historically, for the most part, farmers in Ontario have had collectors knocking on their doors to provide deadstock removal twenty fours hours a day, seven days a week. Almost all species were once collected, and the market opportunities for products other than the rendered products were much greater. In fact during that era the financial structural of the industry permitted the collectors to actually pay farmers for their dead animals, a policy that does not exist in today's industry.

The deadstock industry has always been a volatile one at the mercy of by-product market fluctuations. However, currently, the driving force and challenges to the industry are much more dramatic and appear to be here to stay.

Lower demands for products and loss of markets, product accountability and the introduction of rendering tippage fees seem to be the future challenges for the industry.

Changes regarding restricted products like sheep, goats and mink began about a decade ago. Concerns over TSE and possible implication over health issues resulted in renderers removing these products from their rendering industry.

In the fall of 1998 the livestock markets went through a very dramatic down turn. During this time period escalating operating costs and downward markets forced the collectors to revisit their survival plan.

By the fall of 1999 most collectors found it necessary to establish a fee for service. The fee for service was put in to place to offset rising operational costs and the newly introduced tippage fees charged by the renderers when the collectors delivered products to them. In some areas the collectors began to report a dramatic drop in the number of dead animal being picked up when compared to the time period prior to the introduction of user fees. Collectors were voicing their concerns over reduced numbers of animals for pick-up and escalating operational cost; this was especially true of collectors east of Hwy 400 where livestock density is far less than in the Southwestern region of the province.

Industry and government consultation led to the creation of a supportive funding project called the Livestock Mortality Recycling Project (LMRP). It was established as a short term funding project to assist with funding in modernizing facilities and handling emergency repairs to equipment to allow time for the development of a strategy survival plan.

Farmers during this time period were greatly affected financially by the downward markets. For many years they were also accustomed to the free services of the collectors, 24/7 service and many farmers were not fully aware of the complex changes occurring in the collection industry. Many changes had occurred very quickly and farmers began asking, why they should be forced to pay for a dead animal disposal when they had already suffered from lost production profits. Many farmers felt this was just another example of down loading on the farming community.

It's a small world, after all:

World events in UK and other countries continue to impact on the policies and future markets of Canada. Bovine Spongiform Encephalopathy (BSE), Chronic Wasting Disease (CWD), Transmissible Spongiform Encephalopathy (TSE), West Nile Virus (WNV) and sulfa compound residue concerns greatly impact on the dead animal collection and rendering industry. In the last 2-3 years markets are demanding more accountability for products, consumers are becoming more aware of food safety issues and world media events have alerted consumers of the potential risk in the food chain.

Monitoring programs for BSE, CWD, TSE, WNV, trace back for residues and ID tag systems are becoming a normal part of doing business and all indications are these monitoring systems will be intensified.

On August 1st 2001 Rothsay renderers introduced its new policy regarding additional products to its non -acceptance list as well as some new areas of concerns. The policy banned any animal carcasses containing Sulfamethazine residues. It also extended to its list, deer and elk as non-acceptable products for rendering.

This restriction posed new challenges on the livestock production units and collectors. Both producer and collector would now have to pursue other legal methods of disposal for those animals on the restricted list, i.e. composting or burial.

In September 2002, Rothsay once again, through its monitoring program, announced to deadstock collectors and livestock producers they were still receiving carcasses containing sulfa residues. Rothsay announced continuing violations with any sulfa compounds would not be acceptable and **sulfa compounds** posed an added risk for reduction or loss of export markets. This led to the announcement of their new sulfa compound policy. Effective September 15th, 2002 animal carcasses containing sulfa compounds would not be accepted for rendering. Collectors would be required to sign a letter of certification that they would only deliver non-sulfa product for rendering.

Many livestock operators using sulfa compounds or producing species on the restricted list found the changes to be very problematic. The lack of advanced warning to the changes, weather conditions, and equipment and material requirements and often the lack of knowledge of the remaining options i.e. burial and composting quickly became very frustrating.

Government and industry stakeholders rallied to form a working alliance to educate and alert the stakeholders of the potential issues of this policy and the pending changes facing their industry. Jointly they developed brochures, infosheets and news articles.

Various meetings were held to review disposal options and encourage new technologies and research projects to offer alternatives for the growing list of restricted products now banned from the rendering industry. From these initiatives a number of research project proposals have come forward. Proposals for composting and incineration are now under review. Other options for alternative disposal are being encouraged.

Deciding on your options for disposal:

Under the present Dead Animal Disposal Act producers are required to dispose of their mortalities within 48 hours after death in one of three methods: picked up by a provincial licensed collector, composting or burial. Depending on location, weather, species, and other restrictions, your options may be limited.

It is generally agreed that collection and recycling of dead animal carcasses offers potentially the least amount of risk to the environment.

Producers are encouraged to discuss their collection needs with their local collection service provider.

Items for discussion should include: (Protocol for service)

- Hours of operation (emergency contact number)
- Special certification agreements
- Requirements of storage while awaiting pick-up
- Special tagging or identification requirements
- Special cost i.e. handling restricted product
- Contingency plans for large numbers of mortality
- Other services provided- i.e. handling of restricted product
- Euthanasia services availability
- Payment agreements

Currently Bill # 81 has been passed and on-farm dead animal disposal standards are now being developed. Bill #81 will address the changes in the way we dispose of on-farm mortalities in the future. Livestock operators are encouraged to participate in the up-coming consultation process regarding these changes. In the meantime if you have any questions regarding disposal of dead animals please contact the OMAF Information Contract Centre at 1-877-424-1300 or check out the OMAF mortality web site: http://www.gov.on.ca .

Using a Decision Tree to Enhance the Handling of Compromised Pigs

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In 1999, the Recommended Code of Practice for the Care and Handling of Animals – Transportation was introduced, to educate producers and truckers in the proper methods of transporting livestock. One of the areas highlighted in the new Code was the transportation of "animals at risk" or compromised animals. Compromised animals are defined as " animals with reduced capacity to withstand the stress of transportation, due to injury, fatigue, infirmity, poor health, distress, very young or old age, impending birth or any other cause." Compromised animals need to be handled and transported with special provisions to ensure that pain and suffering are minimised.

In 2002, the Ontario Humane Transport Working Group (OHTWG) developed and distributed a decision tree for use with compromised cattle, sheep and goats. The decision tree was laminated and circulated to producers and veterinarians. Feedback was very positive – both groups commented that the decision tree allowed them to discuss the outcome for compromised animals in a meaningful way and helped to ensure that compromised animals were properly identified and dealt with accordingly.

Late in 2002, the OHTWG began the development of a similar resource for use by the pork industry. The latest draft of the decision tree is included (Figure 1).

The decision tree includes a back page with detailed information on lameness classes and contact information for further information. The back page also contains the new *Canadian Food Inspection Agency Transport Emergency Number: 1-877-814-2342*. This number is staffed 24/7 and provides immediate support to truckers, police and fire crews involved in traffic accidents involving livestock. If you call this number, an operator will put you in touch with the emergency contact employee of the Canadian Food Inspection Agency (CFIA) who will:

1. Provide assessment of on-site requirements.
2. Provide information on dealing with sick, injured or escaped animals.
3. Contact local assistance. CFIA inspectors for on-scene response or advice, other Agencies such as OSPCA and OMAF as required.

The transportation of animals is regulated under the Health of Animals Act *(to view the complete document visit:* http://laws.justice.gc.ca/en/H-3.3/). This legislation is enforced by the Canadian Food Inspection Agency.

The OHTWG is in the process of finalizing the decision tree for pigs and would appreciate comments form producers. If you have any comments, please forward them to Penny Lawlis at penny.lawlis@omaf.gov.on.ca Copies of the finalized version will be distributed to producers later this year.

The OHTWG is made up of representatives from Ontario Ministry of Agriculture and Food, the Ontario Farm Animal Council, the Canadian Food Inspection Agency, the Ontario Veterinary Medical Association and the Ontario Society for the Prevention to Cruelty to Animals. The OHTWG is grateful for the continued support of staff from Ontario Pork and the Association of Swine Practitioners, who continue to work on the development of the decision tree for compromised pigs.

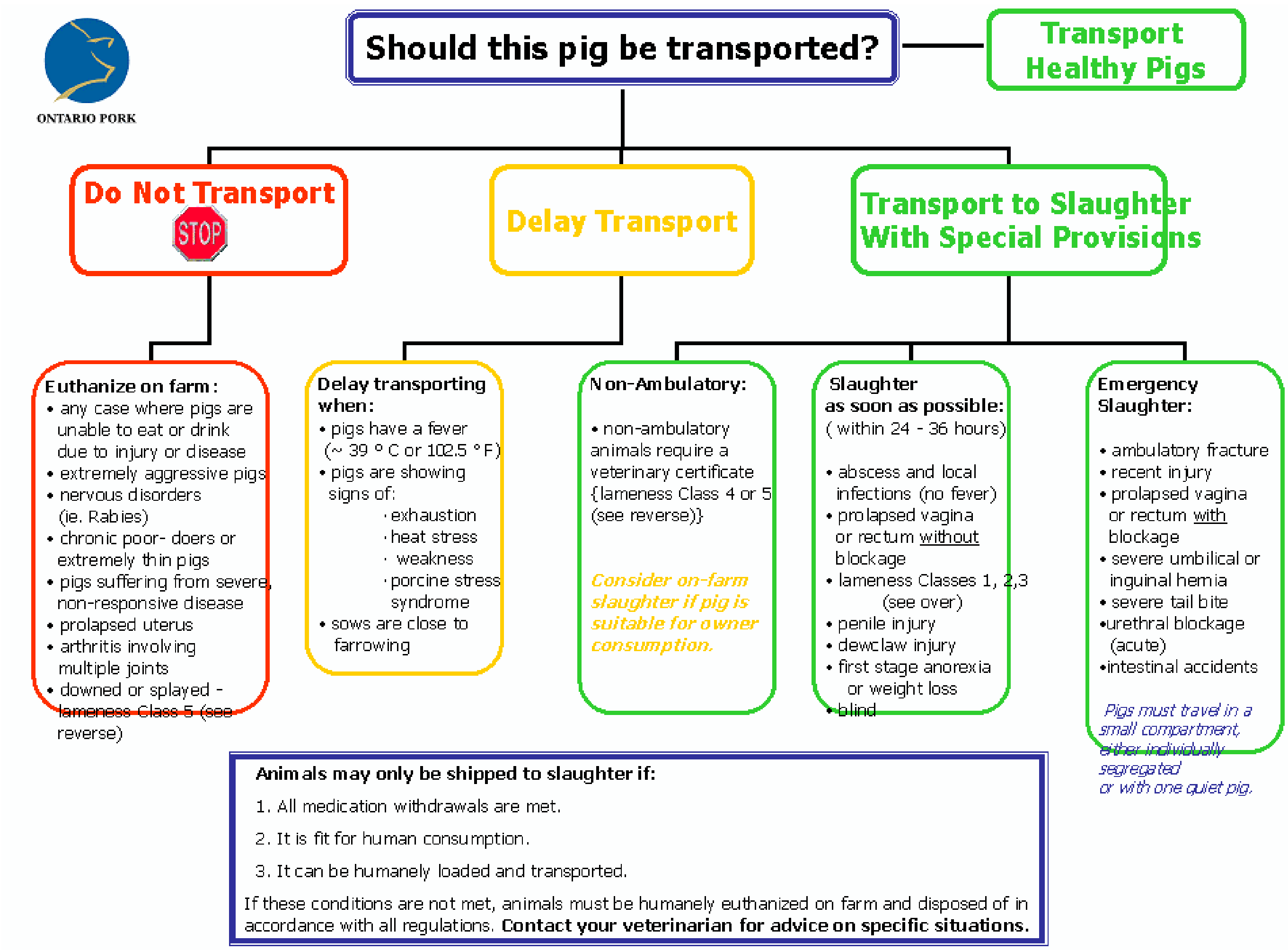

Figure 1: Front panel of the **draft** decision tree for pigs.

Ontario Pork Industry Council Update

Richard Smelski
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The Ontario Pork Industry Council is an organization of dedicated stakeholders, who are working together in gathering information and solving common problems. The mission statement of OPIC is "to facilitate the movement of information and the implementation of business management practices that will lead to improved profitability for the Ontario Pork Industry."

Presently several challenges are facing the Ontario Pork Industry—Nutrient Management Plan-Bill 81, Foreign Animal Diseases, Country of Origin Labeling, Food Safety, Feed medications, AMMTO, and Career Development. OPIC is gathering information and creating dialogue on each of these topics.

OPIC needs the stakeholders, not only to purchase memberships, but also to participate in the dialogue in order to reach consensus. The easiest route is to wait for someone to do something, but this often comes at a bigger expense than communicating within the industry in the first place.

Take any one of the issues that OPIC is working on and each of these issues affects the total industry, not only farmers. As an example- Bill 81 will change everyone's ways of doing business—contractors will encounter more building liabilities, feed suppliers will be required to accurately balance N.P.K., genetic suppliers will need to define feed efficiencies, bankers will take on more environmental liabilities, employees will be assigned more responsibility, more participants will be involved in litigation, and not to mention the industry's chain involvement in the integrity of the paper trail and the related costs. The Industry will not be the same after the Bill's introduction. The suppliers and producers initially involved in the information gathering, will be the first to see the problems and help create the solutions. Alliances will be more important than ever, not only to get information but also to get endorsement to do business. A similar chain of events will occur in each of these issues. OPIC'S role is to inform their stakeholders of all current information and begin anticipating cost-effective ways of competing in a global marketplace.

The Ontario Pork Industry Council respects and works very closely with Ontario Pork. OPIC's mission and clientele is different but much of the information is overlapping. Ontario Pork Industry Council is more of a voluntary group, therefore, requiring industry participation to accomplish tasks. For more information please contact Ingrid Chyc, Managing Director at Ingrid.Chyc@sympatico.ca or the OPIC website - www.OPIC.on.ca.

Canadian Quality Assurance®

Christine Ritter
CQA Coordinator, Ontario Pork

As of January 2003, 2,545 producers have been recognized as Canadian Quality Assured®, representing over 3.7 million market hogs. There are 4,025 producers enrolled in the program which represents over 4.4 million market hogs.

Contract Requirements

Several processors have notified producers with contracts who have fallen out of the CQA® compliance that there will be no contract renewals if their operation is not CQA® validated. In addition, any producer that wants to sign up on the Pool Plus program, must have their CQA® validation completed prior to being considered.

Program Evaluations

Ontario Pork, along with other Provincial delivery agents of the CQA® program, conducted voluntary on-farm assessments of CQA® validated operations to determine the compliance level and effectiveness of the program. Each operation was reviewed through a simulated validation to determine accurate records, verify that all required areas of the program were being addressed, noted any variations amongst validators, and examined how the program was being interpreted. The feedback received by these pilot farm visits was to help us evaluate the program and was used to determine where changes and/or improvements could be made at the National Coordinators meeting this past September. This is one of the many steps that we are taking to prepare for federal recognition of our CQA® program. The Canadian Pork Council has submitted the documentation required to initiate the official recognition process from the Canadian Food Inspection Agency, which will begin the technical review for program soundness. There are no other Food Safety Programs that we are aware of that go under review by the Federal Government in the world and therefore this will give us a very firm status in Canada for our export market.
The CQA® program has been in use for over 3 years on Canadian hog farms, and presently 75% of Ontario market hogs are under the program.

For further information on the CQA® program, please contact Christine Ritter – CQA® Coordinator for Ontario Pork at 1-877-668-7675 or christine.ritter@ontariopork.on.ca.

Trucker Quality Assurance (TQA)

Christine Ritter
CQA Coordinator, Ontario Pork

USA processors have indicated that it will become a requirement for Ontario transporters delivering hogs to their plants to become Trucker Quality Assurance (TQA) certified shortly. Ontario Pork has taken a proactive approach to ensure that this requirement is completed by having 2 staff from the Business Development Team trained as TQA facilitators who can administer the 3 hour course in Ontario.

Since October 2002, Ontario Pork has hosted six (6) sessions with 102 drivers achieving certification. Transportation firms have been prioritized according to shipping frequency in to the US. These firms have been contacted and asked to send representatives to these sessions. Each participant is required to write an exam and achieve 90% or above based on the information provided during the seminar. This exam is graded by the National Pork Board TQA staff.

The TQA program was created by the National Pork Board to educate truckers on the importance of proper handling, loading, and transporting of hogs, with attention to biosecurity and animal welfare. Training sessions focus on reducing stress levels of pigs, loading in extreme weather, techniques to handle downers, recognizing pig flight zones and points of balance, proper biosecurity procedures, and proper cleaning and disinfecting of their truck.

2002 Research Projects Funded by Ontario Pork

Jean Howden
Research Coordinator, Ontario Pork

Researcher: Tina Widowski
Title: Assessment of an Innovative Group Housing System for Gestating Sows
Synopsis: Recently, one of the two gestation rooms at the Arkell Swine Research Centre was renovated to accommodate group housing of sows. While this design appears to offer a viable option for alternative gestation housing for pork producers, detailed information about sow productivity and behaviour in the
system has not yet been generated. A long-term analysis of production statistics and management in this system will be conducted to provide information to producers interested in adopting a similar housing design.

Researcher: Harold Gonyou
Title: Gestation Housing for Sows: Studies on Electronic 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: Roy Kirkwood
Title: Sow and litter performance following farrowing induction with PGF: Effect of adjunct treatment with oxytocin and corticosteroid
Synopsis: This study will test the ability of corticosteriods to improve maturation of the piglet at birth. It will also study whether interrupted farrowings associated with the use of oxytocin are due to incomplete cervical dilation. A third component will determine whether pain relief will reduce obstetric problems.

Researcher: Cate Dewey
Title: Improving health and growth performance of newly weaned piglets without the use of in-feed antimicrobials.
Synopsis: The overall aim is to improve health and growth of nursery pigs in the absence of routine antimicrobial medication. The study will determine:

I - the effect of feeding (a) specific mixtures of dietary acids, (b) varying diet fermentable protein levels and (c) pre and probiotics targeted towards E. coli and salmonellas, on performance of newly weaned pigs exposed to E. coli and on the presence of harmful bacteria in feces; II - the immune status, histology and microflora in the various segments of the gut in sub samples of pigs used in the performance studies; III - the timing of respiratory disease outbreaks in nursery barns and the best time to target pulse medication.

Researcher: Cecil Forsberg
Title: Porcine Saliva: The Unexploited First Line of Defense Against Pathogenic Microorganisms
Synopsis: The antimicrobial agents present in procine saliva will be identified by standard radial diffusion or colony-forming assays. These agents will then be purified and immunochemical and biochemical assay methods will be applied for quantifying the levels of these agents in the saliva of various commercial breeds.
It should be noted here that although this project arises out of and will benefit from our analytical expertise with the salivary gland system of pigs we obtained in developing the salivary phytase Enviropig TM, the approach we are taking in this proposal is aimed at developing and enhancing the natural chemical microbial defense capacity of pigs without the use of transgenic methodology of any

kind. This research complements other approaches including the selection of high immune response pigs and site-directed transgenic technologies applied elsewhere.

Researcher: Gaylan Josephson
Title: Determination of the prevalence of Clostridium difficile in neonatal piglet diarrheas in Ontario
Synopsis: Fecal material for 100 scouring, suckling piglets, submitted to the Animal Health Laboratory for diagnostic purposes, will be tested for the presence of Clostridium difficile toxins A and B. The same samples will be cultured anaerobically, to determine if this organism is present within the intestinal tract of diarrheic piglets.

Researcher: Hugh Cai
Title: Rapid detection of the pathogens of swine dysentery and swine intestinal spirochetosis
Synopsis: To develop rapid PCR tests for the detection of B. hyodysenteriae and B. pilosicoli from culture plates and directly from fecal samples. We will increase the PCR sensitivity by improving the fecal DNA extraction method and using a real-time PCR method. We expect that this method will reduce the turnaround time by one week compared to the culture isolation method, and by 4 days compared to the conventional PCR method.

Researcher: Robert Friendship
Title: Sentinel Herd Project
Synopsis: Feed, blood and fecal samples will be collected from weanling and finisher pigs on 100 farms. Analysis will include mycotoxin levels, nutrient levels in feed and manure, serology for respiratory pathogens.

Researcher: Mario Jacques
Title: Canadian Research Network on Bacterial Pathogens
Synopsis: The Canadian Research Network on Bacterial Pathogens of Swine is a Canadian initiative created in June 2000. It brings together 32 researchers from 11 research-based institutions across Canada to work on bacterial diseases of swine. The network has an initial time horizon of 5 years and an annual budget of approximately $840,000/yr. More than $600,000/yr comes from the Natural Sciences and Engineering Research Council of Canada while the rest of the funds have been obtained from commercial partners and producers groups such as Ontario Pork.

Researcher: Ming Fan
Title: Determination of Optimal True Digestible Phosphorus and Calcium Requirements in Pigs for Minimizing Phosphorus Pollution to the Environment
Synopsis: Excessive swine manure phosphorus excretion is a leading nutrient management and environmental issue facing the Ontario pork industry. One of the major reasons is that current feeding regime over-supply pigs with inorganic supplemental phosphates due to inaccurate knowledge of phosphorus utilization.

Researcher: C.F.M. de Lange
Title: Characterization of the dynamic response in terms of body protein deposition following sudden changes in ideal protein intake.
Synopsis: Serial slaughter and N-balance observations will be made in growing pigs following a rapid change in lysine intake, to assess the impact of previous nutrition on composition of body weight gain (experiment 1) and on the efficiency of lysine utilization for lean tissue growth (experiment 2). These experiments are part of a larger investigation of amino acid utilization in the growing pig. Results will yield information that is of direct benefit to developing feeding strategies for growing pigs.

Researcher: C.F.M. de Lange
Title: Liquid Feeding of Swine: Potential for Reducing Environmental Impact and Improving Productivity and Food Safety.

Synopsis: A series of studies will be conducted to assess the impact of dry vs. liquid feeding of grower-finisher pigs and starter pigs on gut health, nutrient utilization and excretion, carcass and meat quality, aspects of animal behavior, and growth performance. Mechanisms whereby liquid feeding enhances these various aspects of pork production will be explored, for transfer of benefits to dry feeding systems. Studies are also targeted towards enhancing phosphorus utilization and assessing impacts of feeding fermented feed ingredients on the various aspects of pork production. Financial support for establishing a liquid feeding technology center at the University of Guelph is sought from a variety of sources.

Researcher: Ting Zhou
Title: Identification and characterization of vomitoxin-transforming microorganisms of chicken gut and their application in detoxifying vomitoxin in swine feed.
Synopsis: The research will start with identifying gut microorganisms capable of transforming vomitoxin to metabolites that will be much less toxic. The identified microorganisms will be characterized with regard to their efficacy in vomitoxin transformation, growth rate and requirements in different environmental conditions. The promising microorganisms will systematically be studied for their potential application in swine feeding systems. Animal trials will be conducted to determine the effects of the microorganisms on swine performance and nutrient

Researcher: Jim Morris
Title: The effect of an innovative farrowing crate device on piglet survival
Synopsis: The study utilizes a rectangular farrowing crate and a crate fitted with the piglet saving device. Piglet mortality and its causes will be recorded over a period of one year with a minimum of 35 sows per crate.

Researcher: Chantal Farmer
Title: New Farrowing pen design adapted for high ambient temperatures
Synopsis: Determine the production welfare and environmental impacts of a new farrowing pen design in two breeds of sows at 22 and 29 degrees Celsius

Researcher: Roger Hacker
Title: Solving the Piglet Mortality Problem
Synopsis: The researchers will attempt to establish a routine to allow pork producers to decrease mortality rates below 1% on day 2-7 of life, to reach a total mortality under 7%. This routine will involve the following possible treatments: heat lamp behind the sows during farrowing, oxygen after farrowing, MCT, lepin enhanced sheep colostrum, bovine colostrum, dexamethasone, dextran and water.

Researcher: B. Anne Croy
Title: Evaluation of Pig Uterine Lympocytes for Promotion of Blood Vessel Growth During Pregnancy
Synopsis: Angioenic factors are reported in uterine lymphocytes of mice and women. Uterine lymphocytes are recruited early in porcine pregnancy but their functions are unknown. A molecular (RT-PCR) approach will be used to evaluate lymphocytes isolated from pregnant pig uteri by flow cytometry or laser capture microdissection for expression of known angiogenic genes.

Researcher: Roy Kirkwood
Title: Effect of estrogen formulation and its site of deposition on serum PGFM concentrations, uterine contractility, time of ovulation, and fertility of artificially inseminated sows
Synopsis: The researchers will examine whether a vaginal deposition of estrogen-in-oil results in a more prolonged uptake, and so mimic the gel fraction of the ejaculate. The researchers will determine

whether a slower release of estrogen at the time of AI enhances uterine contractions and subsequent sow fertility.

Researcher: Ron Fleming
Title: Evaluation of Mechanical Liquid/Solid Manure Separators
Synopsis: Using several manure separators, develop a standard performance test. Run quantities of manure from several sources through each separator. Measure effectiveness of each unit.

Researcher: Ed Topp
Title: Optimization of Manure Storage and Handling for the Benefit of the Environment and Crop Production
Synopsis: On-farm and laboratory research will be undertaken to determine the persistence of chemical contaminants (hormones, antibiotics) and microorganisms during manure storage in lagoons and anaerobic biogas producing reactors. Key parameters, which can accelerate the degradation of contaminants, will be identified. The persistence and mobility of chemical contaminants and bacteria will be determined in different soil types
following injection or broadcast application.

Researcher: George Lazarovits
Title: Optimization of Liquid Swine Manure for Control of Soil-Borne Diseases of High-Value Crops
Synopsis: The project will optimize use of a thermophilic aerobic digester to kill pathogens in liquid swine manure. Microbial and environmental conditions will be studied to maximize plant disease suppressive characteristics.

Researcher: John Lauzon
Title: Best Management Practices for Fall-Applied Manure
Synopsis: Five trials will be conducted to examine the impact of tillage, crop rotation, and manure application timing, cover crop, and manure type. Measurements will then be taken to describe nitrogen losses and subsequent crop response.

Researcher: Ken Hough
Title: Fusarium Resistance and Genetic Improvements in Ontario Corn through Biotechnology - Phase III
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.

Researcher: Ray Pennings
Title: The affect of swine production facilities on human health
Synopsis: This funding granted to OAHRC is to develop a more comprehensive research proposal that will address the issues of the effects of the environment in swine production facilities on human health.

Researcher: Cecil Forsberg
Title: Enviropig Phase IV
Synopsis: To further research a pig that has the capabilities to digest phosphorus resulting in decreased excretion of phosphorus

Researcher: Chris Duke
Title: GPS of Ontario Swine Farms
Synopsis: Mapping the location and basic demographics of all swine farms in Ontario.

Feeding Green Roasted Soybeans Does Not Affect Growth Performance and Carcass Quality of Finishing Pigs

Eric Jeaurond[1], Janice Murphy[2], Peter Vingerhoeds[3], Kees de Lange[1]
[1]Department of Animal and Poultry Science, University of Guelph;
[2]Ontario Ministry of Agriculture and Food; [3]BSC Animal Nutrition

Summary

A small growth performance study was conducted to determine the effect of feeding green roasted soybeans to pigs. A total of 20 pigs were fed a finishing diet that contained either 15.0% regular roasted beans or 16.85% roasted green beans. No negative effects were observed when feeding green roasted beans to finishing pigs for any of the growth and carcass characteristics that were evaluated.

Background

The dry conditions we experienced in Ontario this summer, aggravated by long periods of extremely hot weather, sapped precious moisture and left many soybean fields without enough water to allow the soybeans to naturally reach maturity. The result is similar in some ways to an early frost, but without the usual problem of high moisture seeds that won't dry down. On harvest, producers saw dry soybeans that either had a green seed coat or were green throughout the entire soybean because of the presence of chlorophyll.

Whole soybeans typically contain 16 to 20 percent fat (dry matter basis). In the literature, drought-damaged soybeans, particularly green-colored beans, have been reported to have lower protein (anywhere from 25-38%) and fat (14-18%). Results to date, from this year's crop, indicate that protein and fat levels are running at the upper end of these ranges. However, due to variability in composition, soybeans should be analyzed for nutrient content before formulating rations.

A study conducted at South Dakota in 1992 determined the feeding value of frost-damaged soybeans for grow-finish pigs. In this study, diets were formulated based on analyzed nutrient content of the soybeans. Essentially, there was no difference in the feeding value of extruded frost-damaged soybeans or mature soybeans. Pigs fed extruded soybeans (either frost-damaged or mature) gained as fast as pigs fed a soybean meal-based diet, and there was no difference in carcass quality. Since nutritional value of frost-damaged soybeans may differ from drought-stressed soybeans, further research is necessary to determine the impact of high levels of green soybeans in swine rations on performance and carcass quality. Since there is the potential that the green chlorophyll may be incorporated into body fat, fat quality and colour should be monitored.

Objective

- To assess the impact of feeding green soybeans on pig performance and carcass quality.

Experimental procedures

- Nutrient analyses were conducted on two samples of roasted green and regular soybeans. Both samples were roasted at Blythe Brae farms under very similar conditions.
- Two treatment rations were formulated on the basis of nutrient analysis of the roasted soybeans: roasted green vs. roasted regular soybeans (Table 1). Regular soybeans were included at 15% of the ration. The inclusion level of the green beans was slightly higher to supply a similar amount of fat from soybeans in the diet. These inclusion levels are slightly higher than the recommended maximum of 10%, to ensure that any negative impact of feeding green soybeans to finishing pigs on carcass quality could be noted. Rations were fed in a meal form.

- A total of 20 pigs were assigned to pens and treatments based on body weight, sex and litter. There were 2 pigs per pen, 5 pens per treatment and an equal number of barrows and gilts per treatment.
- Pigs were fed the rations ad libitum until they reached slaughter weight.
- Observations and analyses:
    - Weekly body weight (per pig) and feed usage (per pen).
    - Animals were observed daily for abnormalities in behavior or signs of disease or discomfort.
    - Routine carcass evaluation: live body weight at slaughter, hot carcass weight, loin and fat depth, weight of cold carcass sides, meat colour, fat firmness and colour.
    - statistical analyses of all response variables

Results and discussion

The pigs readily accepted and consumed the experimental diets. One pig on the regular beans showed lameness for about one week, which likely attributed to reductions in growth rate and feed intake in this pen of pigs. Data from this pen of pigs was excluded from statistical analyses of growth performance data.

As indicated in Table 2, pigs achieved high growth rates on both treatments and no differences (P>0.10) were observed between the two dietary treatments.

There were no effects of dietary treatments on any of the carcass characteristics that were evaluated. This was consistent with visual and subjective evaluation of carcass quality and meat color.

In conclusion, no negative effects were observed for any of the growth and carcass characteristics that were evaluated. There is no concern about feeding green roasted beans to pigs.

Acknowledgement:

Support provided by staff at the feed mill, swine unit and the abattoir at the University of Guelph is greatly appreciated.

Table 1. Ingredient and calculated nutrient composition of finisher diets (mash)

	Treatment (type of roasted soybeans)	
	Green soybeans	Regular soybeans
Ingredient composition (%):		
Corn (8.3 CP)	74.35	73.8
Soybean meal (47.5% CP)	6.0	8.4
Full fat beans, GREEN	16.85	
Full fat beans, regular		15.0
Lysine HCL	0.10	0.10
Limestone	1.00	1.00
Dicalcium Phosphate	0.80	0.80
Salt	0.30	0.30
Micro-mineral swine	0.10	0.10
Vitamin swine	0.50	0.50
Calculated nutrient composition:		
DE (MJ/kg)	14.76	14.79
Crude protein (%)	16.13	16.00
Stand ileal dig lysine (%)	.75	0.75
Total Calcium (%)	.60	0.60
Total Phosphorus (%)	.50	0.50

Table 2. Impact of Feeding Green Soybeans on Pig Performance[2]

	Green Soybeans	Regular Soybeans	SEM[+]	P value[*]
Number of pens (pigs)	5 (10)	4 (8)		
Initial body weight (kg/pig)[#]	77.8	75.9	1.72	0.45
Final body weight (kg/pig)	104.7	104.0	0.88	0.58
Average daily feed intake (g/day/pig)	3671	3716	138.6	0.83
ADG	1027	1000	32.4	0.58
Feed : Gain	3.58	3.73	0.16	0.55

[2] Values are Least Square Means and adjusted for initial body weight in the statistical model
[#] Initial body weight was not used as a co-variate in the model
[+] SEM based on n= 5
[*] Probability of treatment effect.

Table 3. The Impact of Feeding Green Soybeans on Pig Carcass Quality[1]

	Green Soybeans	Regular Soybeans	SEM[+]	P[*] value
Number of pigs	10	10		
Live Body Weight (kg)	104.4	102	0.59	0.45
Hot Carcass Weight (kg)[#]	85.1	84.5	1.83	0.80
Dressing (%)	84.3	83.8	0.49	0.47
Cold Carcass Weight (kg)	75.1	75.2	0.36	0.86
Fat Depth (mm)	16.3	17.3	1.14	0.50
Lean Depth (mm)	52.4	55.1	1.65	0.22
% Yield	61.2	60.9	0.55	0.69
Fat Firmness	3.61	3.49	0.22	0.70
Meat color score				
L (brightness)	47.7	49.0	1.16	0.38
a (green vs red)	6.58	7.02	0.54	0.52
b (blue vs yellow)	4.50	4.43	0.38	0.88
Fat color score				
L	71.1	70.6	0.26	0.11
a	2.95	3.55	0.31	0.13
b	5.62	5.15	0.24	0.14

[1] Values are SAS Least Square Means and adjusted for Hot Carcass Weight in the statistical model.
[#] Hot Carcass Weight was not used as a co-variate in the model.
[+] SEM based on n= 20.
[*] Probability of treatment effect.

An Update on CIPHER - A Swine Enterprise Bench Marking Project

Ken McEwan
Economics and Business Group, Ridgetown College - University of Guelph

1. Introduction

The acronym (i.e. CIPHER) stands for Comparative Information Process for Hog Enterprise Reporting and the project represents a collaboration of Ontario hog producers who wanted to use a reliable and tested means for comparing swine enterprise performance. The results are used to improve on-farm decision making and to provide a basis from which to discuss best management practices. Financial and production information is tabulated for six month intervals with particular care to ensure that comparisons are equivalent between enterprises so far as can be assured, and noting any differences in definition where strict comparability is not possible. In graphical format producers have the opportunity to see how their operation compares to others on specific measures. The variables measured have been determined by the participating producers themselves to be the most relevant and determinable by a swine enterprise. Variables measured include revenues, feed conversions (i.e. adjusted for carcass weight), mortality rates, sow productivity, and other efficiency measures.

The swine operations in the project represent a wide range of scale of operations including family farms and larger loops. Further, participating enterprises also represent a mix of production types with the predominant systems being either sow or finishing operations. A producer steering committee oversees the project and the control and ownership of the information remains with the producers themselves.

2. Project Objectives

One of the key objectives of this project is to establish a culture or an approach among producers in which they are willing to share their data with one another as a step towards mutual improvement. Rather than viewing the swine farm down the road as the competitor, the farm down the road is viewed as a collaborator, with the real competition coming from swine farms in other regions of North America. For the last few information cycles, the group has reached the stage whereby each producer knows the identity of the other participants. This open disclosure of producer identity has invigorated the discussions and enhanced the confidence in the information shared.

Other objectives include:

(i) use the gathering and reporting of information as an opportunity to bring participating producers together into management quality circles. Workshops are organized and serve as a "management clinic" in which producers discuss and assess the implications of the results for their businesses. The meetings are constructive, thought provoking, and participative.

(ii) to continuously improve the method of gathering data (i.e. use of electronic templates rather than paper) to enhance the accuracy and reliability of the information presented.

(iii) provide the information back to the producers in an easily interpreted format that identifies individual producer results. When possible variable trend lines are used to provide a long run perspective.

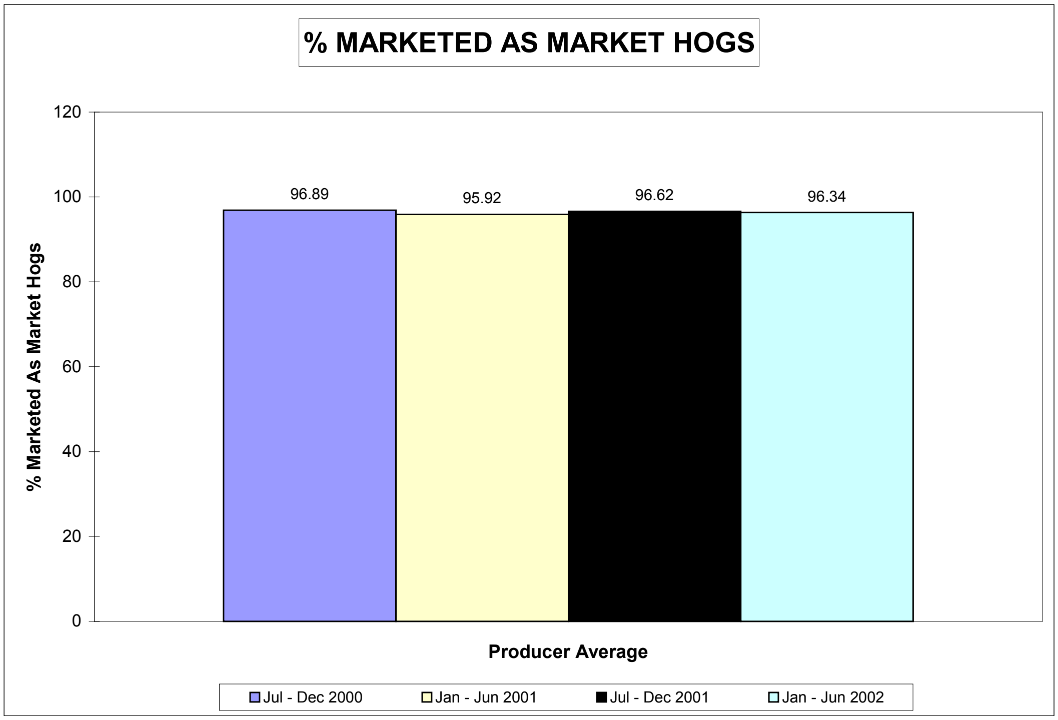
3. Challenges

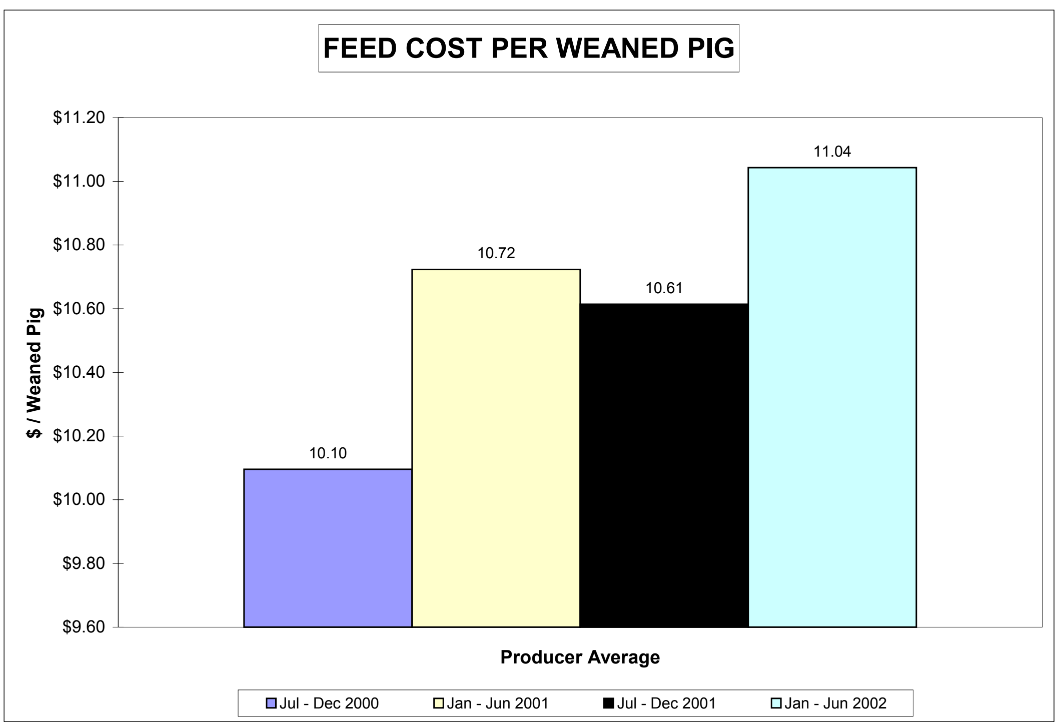
One of the obstacles the group had to wrestle with was "How far can the performance of the swine enterprise be probed?" This is an important question since swine production performance links directly to financial performance. With this producer group, it was decided that balance sheet information was not to be discussed nor should any references to other farm enterprises such as cropping.

A second issue continues to be the standardization of data amongst participants. Despite attempts to drill-down precisely on specific variables, differences in production record keeping systems and accounting packages make this difficult to accomplish. However with open disclosure amongst producers, individuals are able to ask each other how the variable was calculated for their operation and determine how there numbers compare to the other participants

4. Results

The graphs shown below are group averages for the variables: % marketed as market hogs; and feed cost per weaned pig.





Animal Welfare Audits

Tina Widowski, Department of Animal and Poultry Science, University of Guelph
Penny Lawlis, Ontario Ministry of Agriculture and Food

The Food Marketing Institute (FMI) and the National Council of Chain Restaurants (NCCR) released their first set of guidelines for animal agriculture in June 2002. These two groups represent the majority of US wholesale and retail food distributors and restaurant chains. FMI and NCCR developed these guidelines with a panel of animal welfare experts in consultation with producer groups. The guidelines address everything from breeding and rearing to handling and transportation to slaughter practices and start with those commodities that provide the greatest volume (dairy, beef, pork). While these guidelines do not have the same authority as legislation, they mark a new recognition that farm animal welfare is a growing concern to many American consumers -- as it is in Europe -- and an issue that food retailers are eager to address before it gets more contentious.

Various schemes for auditing welfare at the farm or herd level have been evolving in Europe since the 1980's – the earliest were developed for certification of organic animal products in Austria and Germany (Johnsen et al., 2001). Increasingly, animal welfare standards are being included in quality assurance schemes around the world (Andersen, 1997; Gready, 1997; RIRDC, 2001). In Australia, The Rural Industries Research and Development Corporation is developing welfare audits for various livestock industries. The Welfare Audit for the Chicken Meat Industry was completed in 2001, and the Pork welfare audit is expected to be released in June 2003. The Australian welfare auditing system comprises a series of questionnaires used to document husbandry and management practices. It is based much more on a "resources and management" approach in that the forms consist of series of yes or no questions about housing and management (e.g. "[At bird placement] Were waterers at the correct height? Was water available at all nipples/cups/bells? Were unthrifty birds culled?"). Auditors are to refer to these forms as well as barn records for verification. Questions are divided into three categories: "critical for welfare", "good practice" and "hard to verify". A certain number of required questions on each page must be answered in order to pass the audit. What is interesting about this approach is that excerpts from the Australian Codes of Practice are used throughout the forms as bases for recommendation (e.g. specifications for barn temperatures, minimum fan capacities). Some of the questions, although not verifiable, are simply intended to increase awareness of best practices (e.g. "Were the chicks tipped gently …")

At the time of writing this article, the National Pork Board in the U.S. was in the final stages of developing the Swine Welfare Assurance Program^{SM} (SWAP ^{SM}). The first phase of the program concentrated on gestating sows (Swine Welfare Indexing System^{SM}), but now the program has been expanded to include two parts: breed-to-wean and wean-to-finish. Although details of the system have not yet been released, background information on the index for gestating sows have described it as an "outcome" based system. It primarily uses farm records for mortality and health, in addition to observations such as body condition and skin lesions as measures. It was intended to be applicable to all production systems, independent of type of housing (indoor or outdoor, loose or gestation stalls) or size of operation. Certain aspects of the facility, such as use of a warning or alarm system and hospital pens, are also included as measures. Each measure is given a score, and some measures are weighted more heavily than others in calculating the final overall score for the farm. SWAP^{SM} was developed as a voluntary program for producers, similar to the PQA, and designed to easily fit within an educator to verifier program. The NPB will begin training veterinatians as educators/auditors at the American

Association of Swine Veterinarians that will be held in March, 2003.The NPB is also funding several animal welfare research projects, including five on gestation sow housing.

Currently, the NPB's Pork Quality Assurance Checklist (Level 3) includes points on animal care under the heading "Provide proper swine care." The checklist asks if all employees and family members have been trained in the Pork Producer code of Practice, if facilities are adequate, if swine are handled properly during loading and transporting and whether there is a standard operating procedure for euthanasia.

A recent report by the George Morris Centre (Mayer, 2002) states that although the Canadian food animal industries have not (yet) felt the pressure from food retailers as in the U.S., "commodity groups… should move ahead with developing compatible animal welfare standards and auditable programs to implement these standards." The report also recommends that the Canadian Codes of Practice should serve as a basis for the development of measurable animal welfare standards, and that quality assurance and on-farm-food safety programs should serve as vehicles for implementing third-party animal welfare audits in Canada.

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Medicated Feeds – Where are We Now?

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New legislation promoting safe production and handling of medicated livestock feeds will help alleviate the growing public concern over food safety.

In the winter of 2000, the Canadian Food Inspection Agency (CFIA) first introduced the *Regulations Respecting the Making of Medicated Feed*, which fall under the authority of the federal *Health of Animals Act*. Based on HACCP principles, the proposed regulations will require licensing and increased control measures by anyone mixing medicated animal feeds in Canada. This initiative shows a strengthened commitment to animal health and human safety by putting in place proactive controls aimed at reducing errors in the food production chain. The legislation will also help to facilitate trace-backs in the event of a possible contamination.

Licensing

According to the regulations, a medicated feed is meant for consumption by an animal that is intended to be used as food for humans or that produces food for them, and has a medicating ingredient mixed into it. A medicating ingredient is a substance with a drug identification number (DIN) that is used to prevent or treat animal disease, to promote growth, or to affect an animal's body structure or functioning. By definition, dietary supplements such as vitamins, minerals, amino acids and enzymes will be excluded. Medicated feed production for fur-bearing species such as mink and fox will only be controlled by the standards of the *Feeds Act*, unless the premises is also used to make medicated feeds for food-producing animals.

Both commercial and farm-based operations mixing medicated feeds are considered manufacturers and will need to be licensed. In each case, it is the operator of the establishment that will require a license. The operator is the person responsible for the operation of the facility and its workers. Medicated feed ingredients and medicated feeds needing further mixing can only be sold to licensed operators.

To obtain a license, medicated feed manufacturers apply in writing to the CFIA. The application must include the results of mixer efficiency tests, scale and metering device verification tests, and drug concentration tests from representative feed samples. If the drug levels are out of tolerance, records of investigations into the sources of error and corrective actions taken must also be included. If the application is approved and the facility passes an inspection by the CFIA, a license will be granted for three years.

Verifying Equipment Accuracy

Licensed feed manufacturers will have to prove that their equipment functions properly. This is achieved through regular testing of mixing and weighing equipment. The details for conducting the tests will be described in the *Manual of Procedures* that will accompany the regulations.

Mixer Performance Testing

It is essential that medications get mixed evenly throughout feed so that animals receive the correct dosage. In order to show that a mixer is working properly, nine or more feed samples containing a measurable test substance are collected from the mixer at the time of installation and at least once per year afterwards. This is known as mixer performance testing. The test substance, such as sodium, is added to the feed in amounts similar to the levels of medication normally used. After mixing, the samples are collected and sent to a laboratory accredited by the Standards Council of Canada. Upon request, the lab measures the levels of test substance in each of the samples, and determines the degree of difference among them. The amount of variation across the samples is indicated by a statistical measure known as the coefficient of variation (CV). The lower the CV, the more uniform the mix. The regulations limit the coefficient of variation in feed samples, depending on the concentration of medicating ingredient used. The CV must be no greater than 5% for concentrated drug premixes, 10% for micro or macro premixes and supplements, and 15% for complete feeds and total mixed rations. Licensed manufacturers must have written procedures describing mixer performance testing protocol. Farmers may be able to save costs by asking that mixer performance testing be done by the company that installs any new mixing equipment.

Scale and Metering Device Verification
The ability to measure ingredients accurately is critical to producing safe and effective medicated feeds. Scales and metering devices must be appropriate for the range of weights or volumes they are being used to measure. In addition, regular calibration and maintenance of equipment are essential for ensuring continuing accuracy. Licensed mixers must have written directions describing the calibration of scales and metering devices. To verify measuring equipment accuracy, testing must be carried out at the time of installation and no less than once per year afterwards. This can be done either by a scale company or independently, using a set of test weights. The testing procedure and record sheets will be included in the *Manual of Procedures*.

Safety
A series of handling and manufacturing practices ensuring feed safety are also outlined in the legislation. All medicating ingredients and medicated feeds must be received, handled and stored in a way that preserves their potency. To prevent contamination, the regulations require that manufacturers practise sequential production, unless all equipment coming into contact with the feed is cleaned or flushed using validated cleaning procedures between batches. Acceptable sequencing, cleaning and flushing techniques will be described in detail in the *Manual of Procedures*. The regulations further specify appropriate methods for dealing with the materials recovered after flushing and cleaning. Licensed operators must have written procedures describing sequencing, flushing and cleaning of medicated feed manufacturing equipment as well as evidence supporting the effectiveness of the cleaning procedures used.

Recordkeeping
In addition to the written procedures describing testing, handling and manufacturing protocol, medicated feed manufacturers will be asked to document certain activities. Records must be maintained for three years. The *Manual of Procedures* requires the use of a daily production log for each piece of cross-utilised equipment used in making medicated feeds. This log should track the manufacturing dates, feed names (in order) and amounts coming in contact with the equipment, plus any safety precautions (such as cleaning or flushing) taken between feed batches. Records of equipment calibration, clean out, maintenance, repair and testing are also required. These should include dates and details of each procedure. Along with written directions for dealing with non-compliant feed samples, licensed manufacturers should also keep records of investigations into the sources of error and of any corrective actions taken. For those who sell medicated feed, an individual lot number must identify each lot of feed. Distribution records are also required in this case.

The requirement for a daily medication inventory that was originally described in the regulations remains under discussion and no final decisions have been reached. The inventory's purpose is to reconcile the theoretical amount of each medicating ingredient added to feeds with the actual amount used. Keeping such an inventory would have much the same effect as balancing a chequebook. Any revisions to the daily inventory requirement will be included in the final version of the *Manual of Procedures.*

The regulations are scheduled to be phased in over a two-year period, with a possible start date as early as April 2003. The regulations will apply to commercial feed mills first, followed by on-farm operations using concentrated drug sources fourteen months later. On-farm operations using non-concentrated medication sources would be the last to require licenses, beginning eighteen months from the start of implementation. CFIA expects funding to implement the on-farm portion of these regulations to come from the food safety component of the Agricultural Policy Framework currently being negotiated between the federal government and the provinces.

The proposed *Regulations Respecting the Making of Medicated Feed* are available for viewing on the CFIA website at http://www.inspection.gc.ca/english/reg/consultation/97021_e.shtml .

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Sow and Litter Performance Following Farrowing Induction with $PGF_{2\alpha}$ and Dexamethasone

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Introduction

Induced farrowing allows increased supervision of piglet delivery to improve neonatal survival (1). Parturition is triggered by a fall in progesterone concentration due to leutolytic effects of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) (2,3). To induce parturition, manufacturers recommend a single intramuscular (IM) injection of $PGF_{2\alpha}$ or $PGF_{2\alpha}$ analogue, administered up to two days before due date, which results in approximately 50% to 60% of sows farrowing the next working day (4,5). This increased to 80% with two injections administered 6-hours apart (6), but even with increased predictability of the day of farrowing, the time of day remained variable.

Vulvomucosal injection of $PGF_{2\alpha}$ at half the recommended dose, has been shown to be as effective as the IM route at recommended dose, presenting both a cost advantage and fewer side effects (7). Induction of parturition before day 112 of gestation results in reduced viability of newborn piglets (8), so success requires accurate breeding records.

Peripartum endocrine changes may also influence early post-natal survival. High levels of circulating maternal estrogen was associated with increased vigour of neonatal pigs (9,10). As well, high circulating levels of maternal corticosteroids may advance fetal visceral (eg. lung and intestinal) maturation and enhance postnatal survival (11,12). Prepartum injection of 100mg prednisolone was associated with reduced duration of farrowing and increased piglet survival to 3 days of age (13). Corticosteroids administered at very high doses daily for 4 days can induce farrowing (14) indicating that the anti-inflammatory effects may not adversely affect, and in fact, may even augment, the sow's ability to produce $PGF_{2\alpha}$.

Parturition is potentially stressful and painful, even with a completely dilated cervix. The level of pain and associated stress is likely greater in younger animals delivering first litters and may trigger some primiparous sows to savage their litters. We wish to investigate the efficacy of pharmacological combinations for inducing a predictable farrowing with concurrent relief of pain and/or stress. The specific objectives of this experiment were to evaluate 2 doses of $PGF_{2\alpha}$ injected vulvomucosally and to determine whether an injection of dexamethasone at 6 hours after an initial PGF injection will reduce the variance in time to delivery of the first pig, the duration of farrowing, and improve neonatal growth and survival.

Materials and Methods

The trial was conducted on two facilities, a commercial 700-sow farrow to feeder pig operation in Guelph, Ontario and the other a 220-sow farrow to finish unit at The Michigan State University Swine facility. Treatments 0, 1 and 2 were used in Ontario and treatments 3 and 4 in Michigan. Mixed parity sows (n=124) were assigned 2 days before their due-to-farrow date to one of 5 treatments as follows: 0=No induction of farrowing (control, n=20); 1=Injection of .5 ml $PGF_{2\alpha}$ (Lutalyse, Upjohn Animal Health, Orangeville, Ontario) followed in 6 hours (h) by a 2nd injection of $PGF_{2\alpha}$ (n=20); 2=Injection of .5 ml $PGF_{2\alpha}$ followed in 6 h by a 2nd injection of $PGF_{2\alpha}$ and 20 mg. Dexamethasone (Dexadreson, Intervet Canada, Whitby Ontario) (n=20); 3=Injection of 1ml $PGF_{2\alpha}$ followed in 6 h by a 2nd injection of $PGF_{2\alpha}$ (n=33); 4=Injection of 1 ml $PGF_{2\alpha}$ followed in 6 h by a 2nd injection of $PGF_{2\alpha}$ and 20 mg. dexamethasone (n=31).

The combined dose of $PGF_{2\alpha}$ (1ml) in treatments 1 and 2 was 50 percent of the labeled dose, whereas in treatments 3 and 4 (2ml), it reflected the labeled dose. All $PGF_{2\alpha}$ injections were administered intravulvally. Dexamethasone (20 mg) was administered IM in the neck. The gestation length at the Ontario farm was 115 days, at Michigan it was 116 days. Initial treatments were done between 7 and 8 am on day 113 of pregnancy at the Ontario farm and on day 114 in Michigan. Next morning sows were monitored continuously until farrowing was complete. If the interval between piglet deliveries exceeded 30 minutes manual intervention was employed. If farrowing did not commence by 32 hours after initial $PGF_{2\alpha}$ injection, the sow was deemed to be non-responsive to the induction protocol. All piglets were individually identified by ear notching and weighed at birth and at intervals to determine their neonatal growth rate. Records were maintained for: (a) interval from initial $PGF_{2\alpha}$ injection to onset of farrowing. (b) total farrowing time. (c) litter size born (alive and still born). (d) piglet weights and survival at birth and 3, 10 and 20 days of age. (e) all instances of piglet savaging and the parities of sows involved. Data was analyzed with the SAS system using General Linear Models procedure.

Results

The Ontario herd was much older than the Michigan herd. Mean parity number for treatments 0, 1 and 2 (Ontario) were 7.95, 7.1 and 7.75 respectively whereas the means for treatment 3 and 4 (Michigan) were 3.03 and 2.83. In Ontario, 67 of 78 sows (89%) on treatment 1 and 2 farrowed within 32 hours from the initial $PGF_{2\alpha}$ injection. Data were only used from the sows where the complete farrowing process was observed and the piglets were weighed up to day 20 after birth. In Michigan, 64 of 65 sows (98.5) on treatments 3 and 4 farrowed within 32 hours of initial treatment. A total of 1317 piglets were produced in the 128 litters with 226, 216, 224, 334 and 319 born to sows in treatments 0 to 4 respectively. Piglets from 8 treatment 3 and 4 treatment 4 sows were weaned before weighing on day 20. As a result, survival rates were not calculated for these two treatment groups after day 10. Treatment had no effect on piglet survival rate to day 10 across all treatments (P>.05) and to day 20 (P>.05) in treatments 0,1 and 2. The parameters analysed are summarized in the following tables.

Analyses showed that treatment did not influence (P>.05) treatment-to-farrow time, mean birth weight, total litter size, live births, still births, total farrowing time or farrowing interval (total farrowing time/litter size). Weight change for neonatal piglets calculated as a proportion of birth weight were not influenced by treatment (P>.05). Numbers of stillborn piglets were not influenced by treatment groups but across all litters it was found that parity had a significant effect, with higher parity sows having a greater number of stillborns (F<0.05).

Table 1. Number of piglets and survival rates. Similar superscripts in the same row are not significantly different.

	Treatment 0	Treatment 1	Treatment 2	Treatment 3	Treatment 4
No. of litters:	**20**	**20**	**20**	**33**	**31**
Mean total litter size	12.5 ± 2.19 [a]	11.6 ± 2.84 [a]	11.85 ± 2.87 [a]	10.58 ± 2.92 [a]	11.1 ± 2.97 [a]
Mean live births	11.3 ± 1.87 [a]	10.7 ± 2.36 [a]	11.2 ± 2.57 [a]	10.12 ± 2.68 [a]	10.35 ± 2.98 [a]
Mean stillbirths	1.2 ± 1.06 [a]	0.9 ± 1.45 [a]	0.65 ± 0.93 [a]	0.45 ± 0.87 [a]	0.74 ± 1.03 [a]
No. of piglets at birth	226	214	224	334	319
Survival to day 3	202 (89.4%) [a]	204 (95.3%) [a]	210 (93.8%) [a]	303 (90.7%) [a]	287 (90%) [a]
Survival d3-d10	197 (97.5%) [a]	196 (96.1%) [a]	202 (96.2%) [a]	295 (97.4%) [a]	286 (99.7%) [a]
Survival d10-d20	195 (99%) [a]	187 (95.4%) [a]	200 (99%) [a]		

Table 2. Treatment to farrow times and farrowing times. Similar superscripts in the same row are not significantly different.

	Treatment 0	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Treatment to farrow time (h)		27.1± 2.74[a] (n=20)	27.21±2.05 [a] (n=20)	26.2 4± 2.1 [a] (n=23)	26.83 ±2.21 [a] (n=19)
Total farrowing time (h)	2.59 ± .50[a] (n=20)	2.25 ± 1.00 [a] (n=20)	2.72 ± .98 [a] (n=20)	3.87 ± 3.51 [a] (n=21)	3.41 ± 2.18 [a] (n=19)
Birth interval (farrow time/ litter size) (h)	0.21 ± 0.05 [a]	0.20 ± 0.90 [a]	0.22 ± 0.07 [a]	0.36 ± 0.26 [a]	0.31 ± 0.19 [a]

Discussion

Sows induced with the labeled dose of PGF had a higher farrowing response than those given half the labeled dose (98.5% vs 89%). However, those sows were also induced one day later in gestation. The mean interval from induction treatment to the onset of farrowing is shortened when sows are injected very close to their expected farrowing date (15). In this trial, vulvomucosal administration of $PGF_{2\alpha}$ at half the labeled dose (treatments 1 and 2) produced an induction response (89%) comparable to IM administration at twice the labeled dose (6). This represents a tremendous cost saving in the absence of side effects usually associated with higher doses of $PGF_{2\alpha}$ and confirms findings of previous research (7). This farrowing response was achieved within 32 hours of initial treatment. Previous studies have described farrowing responses up to 48 hours after initial induction treatment (4), but the benefit of supervised farrowing is best achieved if the time from treatment to farrowing is more predictable and if the majority of farrowings occur during normal working hours. The lack of predictability of farrowing response following induction might be a major reason that these protocols are not widely accepted. In this trial 91.6% percent of all treated sows responded to the induction protocols within 32 hours from initial treatment with mean treatment to farrowing times ranging from 26.24 ± 2.10h (treatment 3) to 27.21 ± 2.05h (treatment 2). Dexamethasone was not shown to be effective in contributing to reduction in farrowing time or early piglet survival or weight gain . The potential benefit of reduction in pain and stress to the sows was not measured

Table 3. Comparison of mean piglet weights. Weight gain index = (weight-birth weight) / birth weight. Similar superscripts in the same row are not significantly different.

	Treatment 0	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Mean birth weight (kg)	1.51 ± 0.32 [a]	1.45 ± 0.38 [a]	1.50 ± 0.34 [a]	1.45 ± 0.35 [a]	1.49 ± 0.35 [a]
Mean weight d 3 (kg)	1.92 ± 0.48 [a]	1.77 ± 0.46 [a]	1.86 ± 0.41 [a]	1.87 ± 0.40 [a]	1.98 ± 0.43 [a]
Mean weight d 10 (kg)	3.50 ± 0.89 [a]	3.18 ± 0.90 [a]	3.45 ± 0.77 [a]	3.60 ±0.77 [a]	3.76 ±1.14 [a]
Mean weight d 20	6.09 ± 1.31 [a]	5.98 ± 1.39 [a]	6.16 ± 1.21 [a]	6.22 ± 1.24 [a]	6.23 ± 1.16 [a]
Weight gain index d 3	0.24 ± 0.14 [a]	0.20 ± 0.12 [a]	0.24 ± 0.10 [a]	0.29 ± 0.18 [a]	0.30 ± 0.16 [a]
Weight gain index d 10	1.28 ± 0.46 [a]	1.16 ± 0.40 [a]	1.29 ± 0.36 [a]	1.49 ± 0.50 [a]	1.52 ± 0.71 [a]
Weight gain index d 20	3.00 ± 0.83 [a]	3.07 ± 0.80 [a]	3.11 ± 0.76 [a]	3.43 ± 0.87 [a]	3.24 ± 0.89 [a]

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Induction of Farrowing with Vulvomucosally Administered $PGF_{2\alpha}$ and Oxytocin

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Induced farrowing in sows aims at achieving some degree of synchronization of farrowing time, which allows for increased supervision of piglet delivery and improved neonatal survival (1). To induce parturition, manufacturers recommend that a single intramuscular (IM) injection of $PGF_{2\alpha}$ or $PGF_{2\alpha}$ analogue, be administered up to two days before due date. This protocol will result in approximately 50% to 60% of sows farrowing the next working day (2), but the farrowing response could be markedly improved (80% farrowing the next day) when two injections are administered 6-hours apart (3). However, even though the predictability of the day of farrowing was improved, the time of day at which the sows farrowed remained variable. Vulvomucosal injection of $PGF_{2\alpha}$ at half the recommended dose has been shown to be as effective as the IM route at recommended dose. This represents a cost advantage as well as fewer side effects than when recommended doses are used intramuscularly (4).

To improve the synchronization of farrowing, some producers use an injection of oxytocin 20 to 24 hours after a single $PGF_{2\alpha}$ injection, which often results in more rapid delivery of the first pig. However, the use of oxytocin also often increases the need for manual intervention because of its association with a higher incidence of interrupted farrowings (5,6). An interrupted farrowing occurs when a sow delivers one or two piglets, then stops delivery for one or more hours. If unsupervised, it provides an increased risk of stillbirths. Interrupted farrowings might occur because oxytocin is administered before complete cervical dilation, resulting in a more painful delivery. Although the prepartum administration of oxytocin is not recommended, such use is not uncommon. When oxytocin was given at the onset of a normal farrowing (i.e. without induction) a shorter duration of farrowing resulted, and decreased intervals between expulsion of piglets. However, this protocol also resulted in higher numbers of stillbirths per litter, increased incidence of umbilical cord abnormalities with the potential to cause asphyxiation and death (7). The main objective of this trial was to evaluate the farrowing response to induction with $PGF_{2\alpha}$ either as a single injection or as two injections administered 6 hours apart plus 0 or 20 IU of oxytocin at 24 hours after initial $PGF_{2\alpha}$ injection. This trial is one half of a study which is still in progress at a different location.

Materials and Methods:

The trial was conducted on a commercial 700-sow farrow to feeder pig operation in Guelph, Ontario. Mixed parity sows (n=79) were assigned 2 days before their due-to-farrow date to one of 4 treatments as follows: 1= injection of 1 ml $PGF_{2\alpha}$ (Lutalyse, Upjohn Animal Health, Orangeville, Ontario) (n=17); 2= injection of 1ml $PGF_{2\alpha}$ followed by 20 IU oxytocin (Bimeda-MTC Pharmaceuticals, Cambridge, Ontario) 24 hours later (n= 21); 3= injection of .5ml $PGF_{2\alpha}$ followed in 6 hours by a 2nd injection (.5ml) of $PGF_{2\alpha}$ (n=21); 4= injection of .5 ml $PGF_{2\alpha}$ followed in 6 hours by a 2nd injection (.5ml) of $PGF_{2\alpha}$ and 20 IU oxytocin 24 hours after the initial $PGF_{2\alpha}$ injection (n=20).

The total dose of $PGF_{2\alpha}$ (1ml) was 50 percent of the labelled dose and was administered intravulvally. The dose of oxytocin was administered IM in the neck. Initial treatments were done between 7 and 8 am on day 113 of pregnancy. Next morning, following oxytocin treatments to sows in treatments 2 and 4, all sows were monitored continuously for piglet delivery until farrowing was complete. If the interval between piglet deliveries exceeded 30 minutes manual intervention was employed. Any sow that failed to commence farrowing by 32 hours after initial $PGF_{2\alpha}$ injection was deemed to be non-responsive to the induction protocol. Prior to injection of oxytocin, an assessment of cervical dilation was done on sows in treatment 2 and 4. Records were maintained for: (a) interval from initial $PGF_{2\alpha}$ injection to onset of farrowing; (b) the duration of farrowing, incidences of interrupted farrowing and manual intervention. (c) litter size born (total, alive and still born).

Results

The sow herd used was older than average with mean parity number for treatments 1 to 4 being 6.4, 8.0, 8.4 and 8.4 respectively. Data were only used from the sows where the complete farrowing process was observed. A total of 44 of 56 sows (78.5%) induced with a single injection of $PGF_{2\alpha}$ (treatments 1 and 2) farrowed within 32 hours of treatment. Among sows that received the split $PGF_{2\alpha}$, 45 of 49 (92%) farrowed within 32 hours of the initial injection. In sows that responded to induction, treatment did not affect percentage live births, treatment to farrow time, total farrow time and the number of litters with interrupted farrowings or the need for manual interventions. Four treatment-2 sows and 3 treatment-4 sows did not have a dilated cervix at the time of oxytocin treatment and did not respond to induction. One of the treatment-3 sows had 100% stillbirths and became recumbent and died a few days later. Among the treatment-4 non-responders, one had 100% stillbirths and a total of 20 of 29 piglets (69%) were stillborn. Generally oxytocin-treated sows had short farrowing times, but 7 of them had interrupted farrowings with extended farrowing times, which raised the mean farrowing time for the group. The parameters analysed are summarized in the following tables.

Table 1. Farrowing variables for $PGF_{2\alpha}$ induction with or without oxytocin. Similar superscripts in the same row are not significantly different.

	Treatment 1 (single $PGF_{2\alpha}$)	**Treatment 2 (single $PGF_{2\alpha}$ + oxytocin)**	**Treatment 3 (split $PGF_{2\alpha}$)**	**Treatment 4 (split $PGF_{2\alpha}$ + oxytocin)**
No.of litters:	**17**	**21**	**22**	**20**
Mean total litter size	11.65 ± 2.6 [a]	10.48 ± 2.9 [a]	11.95 ± 2.5 [a]	10.55 ± 2.8 [a]
% live births	91.85 ± 13.8 [a]	92.18 ±10.3 [a]	91.51 ± 9.77 [a]	92.44 ± 15.6 [a]
Treatment to farrow time (h)	25.79 ± 2.3 [a]	24.76 ± 0.43[a]	26.29 ± 3.11 [a]	24.77 ± 0.57 [a]
Total farrowing time (h)	3.06 ± 0.95 [a]	2.68 ± 1.6[a]	2.84 ± 1.19 [a]	2.57 ± 1.14 [a]
Litters with interventions	8 [a]	17 [a]	12 [a]	13 [a]
Interrupted farrowings	0 [a]	2 [a]	2 [a]	5 [a]

Discussion

The farrowing response to induction supports previous reports that the vulvomucosal route for $PGF_{2\alpha}$ injection produces acceptable results at lower dosages that the recommended IM route (4). The split dose of $PGF_{2\alpha}$ produced a superior response compared to the single dose. Hence, split dose $PGF_{2\alpha}$ induction may be suggested as a cost effective protocol for producing a fairly predictable farrowing to allow for supervision during normal working hours. Oxytocin did not result in increased stillbirths in sows with a dilated cervix, but may have been a factor in the farrowing complications and high number of stillbirths in sows with a closed cervix at the time of oxytocin treatment. Since evaluation of cervical dilation is not routinely done, prepartum use of oxytocin cannot be encouraged. Indeed, recent research has suggested that the use of oxytocin even at the onset of farrowing, might produce undesirable results (7). Oxytocin treated sows had a higher number of interrupted farrowings (7 vs 2). The treatment differences were not statistically significant, but larger sample sizes might reveal differences of economic and practical importance.

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Mechanical Solid-Liquid Separation of Livestock Manure

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Why Separate Liquids from Solids?

The interest today in solid-liquid separation of liquid manure is reminiscent of the early 1980's. At that time a few Ontario farmers installed mechanical separators, for a few reasons: to improve the handling, processing and storage properties of the manure (the liquid effluent was much easier to agitate, there was much less risk of plugging transfer pipes, there was less power needed to pump the liquid); and to create a value-added product, such as bedding or feed. The same advantages still apply today, but we now have a few newer challenges that were not as significant 20 years ago:

- Farmers face greater manure transportation costs as facility sizes continue to increase and manure must be transported greater distances (enforced using Nutrient Management legislation). Reducing the N and P concentration in the liquid effluent would be an advantage.
- There is much greater attention placed on pathogens in manure and the potential risks of water contamination during spreading. Separation, by itself, or with other processes may help reduce these risks.
- There is even greater pressure to reduce odours, and separation may help - again, either by itself or as part of a bigger treatment system.
- The solids may be composted, or otherwise treated, to produce value-added products that may be sold off the farm.

The main methods of separation have included settling (gravity), chemical separation, and mechanical separation. The mechanical systems are relatively expensive but are the most compact and the quickest. There are performance differences between the different methods and between mechanical separators. New equipment is on the market now, and technologies that have been very effective in the wastewater industry (e.g. membrane systems) are now being considered as part of manure treatment systems.

For the variety of mechanical separators being marketed today, it is not always possible to get good performance data. Even when this information is available, it is not in a standard format, thus making comparisons between types of equipment difficult. Depending on the role of the separator in a farmer's manure system, the performance characteristics may be quite different. For example, one farmer may want a system that removes as much N and P as possible in the solids portion, while another may want an effluent that can be used in a flushing system and may want a less expensive unit.

Objectives:

A project is currently underway at Ridgetown College (University of Guelph), funded by Ontario Pork and the Ontario Ministry of Agriculture and Food (OMAF). Objectives are:

1. Measure the effectiveness of several mechanical manure separators at removing solids from liquid swine manure.
2. Compare the characteristics of the liquid and solid phases of separated manure using several mechanical separators.
3. Develop a test procedure that can be used to perform standard tests of mechanical manure separators to rate their effectiveness.

The first phase of the project is complete - it involved a literature review to summarize the various studies on mechanical separators. This report may be downloaded from the Ridgetown College website (www.ridgetownc.com) - "Mechanical Solid-Liquid Separation of Livestock Manure - Literature Review" by Marcy Ford and Ron Fleming. The main findings are summarized in the following sections.

Main categories of separators

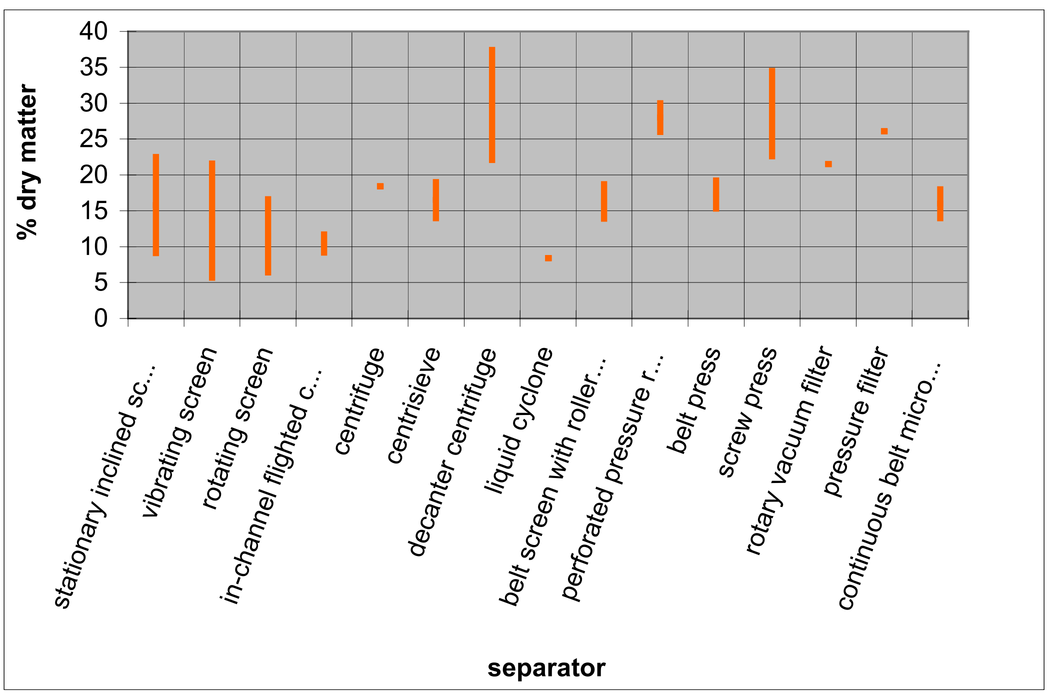
A - Screen Separation	Stationary Inclined Screen Vibrating Screen Rotating Screen In-channel Flighted Conveyor Screen
B - Centrifugation	Centrifuge Hydrocyclone
C - Filtration/Pressing	Roller Press Belt Press Screw Press Filter Press
D - Combinations	
E - Emerging Technologies	- e.g. membrane filtration

Specific comments

- The shortfall of many studies has been their limited focus on certain constituents. Some parameters which should be considered more often by researchers evaluating a particular separator's performance include: particle size distribution, maintenance requirements, odour observations, energy consumption, and cost.
- Many studies have not reported or measured enough parameters to conduct a mass balance. The flow rate of the influent and liquid effluent streams should be reported, to make mass balance calculations possible.
- Great variability in the test conditions existed among the manure type and dilution, influent flow rate, operational parameters, and the length of testing. Because of this variability, it is very difficult to draw general conclusions about the performance of generic separator types.
- There is a misconception that phosphorus can be easily concentrated in the separated solids portion. In all but one of the studies reviewed, less than 30 % of the TP was removed into the solids fraction for swine and dairy manure of varying dilutions and influent flow rates.

Dry Matter Removal

The following graph shows the range of dry matter contents for the separated solids fraction achieved using the different mechanical separators. The ranges of values are given. They take into account variations in flow rate, manure type, influent.



Update on Maximal Care of Piglets

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Maximal/Minimum Care Study

In 2000 a study was performed giving half of the randomly selected sows maximal care or standard care. Maximal care consisted of putting mats in the creep area for the first three days of life, providing electrolytes from birth to weaning, the processing equipment being dipped in a disinfectant and processing wounds being sprayed with iodine. Processing was delayed if piglet weight or health deemed it necessary. Hot water bottles, drying by towel and shavings were used for comfort, glucose, milk replacer and help with nursing was at times employed. The sow crates were cleaned twice daily and the sows were given an extra meal at "lunch".

All piglets were individually tagged and weighed at birth, 16 days, and approximately 55 days. Small birth weight pigs (less than 1 kg) were only half as likely to die if they were in maximum care litters than if they were in standard care litters. All the pigs that were between 400 and 600 grams at birth died before 16 days. Of the pigs that were 700 - 900 grams at birth, 47% died if they were in standard care litters (33/71) whereas 30% of them died if they were in maximum care litters (24/79). On average there were 9.8 pigs born alive per litter, 0.8 pigs stillborn per litter and 0.3 mummified pigs per litters. The overall pre-weaning mortality in the study was 9.9%. These numbers did not differ by treatment group.

The pigs from the maximum care litters grew more than the pigs from the standard care litters. On average, the pigs from the maximum care litters weighed 4.91 kg at 16 days and had gained 3.5 kg from birth. The pigs from the standard care litters weighed 4.75 kg at 16 days and had gained 3.35 kg. This weight gain benefit was seen for all birth weight groups (small, medium and large). It appears that all sizes of pigs can take advantage of the growth benefits of being in a maximum care litter.

Managing low-birth-weight piglets

A field trial to examine the relationship between weight gain and survivability of small birth weight pigs raised with other small pigs versus being raised with larger pigs was also conducted. The hypothesis was that small birth weight pigs should be removed from all sows and put together in one litter so that they have no unfair competition. Specifically we matched two litters born within 12 hours of one another. All pigs were weighed, and the five smallest pigs were included in the study. These pigs were put on one sow with either the next 5 smallest pigs or a random group of five pigs. In these litters of 10 pigs, there was no significant difference in the survivability or weight gain of those piglets that were in litters of all small piglets or 5 small/5 random sized piglets. These results may have differed if the pigs were raised in larger litters.

Tools that might help low-birth-weight piglets are being put into litters with smaller numbers, nursing middle parity, healthy sows and given some or all of the other maximal care attention that was used in our first study.

The OARSC Pork Research and Services Committee

Jaydee Smith, Ontario Ministry of Agriculture and Food

The Pork Research and Services Sub-Committee is one of several sub-committees of the Ontario Animal Research and Services Committee (O.A.R.S.C.). The others are Aquaculture, Beef, Broiler, Dairy, Deer, Egg, Equine, Fur-Bearing, Goat, Sheep and Turkey. The Pork committee is made up of representatives from across the industry, and normally includes the chair the Research Committee of Ontario Pork.

Put simply, the Pork sub-committee's job is to produce recommendations for research that should ensure the future viability and sustainability of the pork industry in Ontario. It does this by:

1. Identifying issues facing the idustry and research needs arising from those issues. The broad representation of the industry on the committee facilitates this. In addition, meetings are held and other efforts are made to obtain input.
2. Prioritizing the research needs. Some of these needs will already be the focus of current research programs, in Ontario or elsewhere.
3. Identify those needs which are **not** being addressed currently. These will be formulated into recommendations for research in order to stimulate development or initiation of research programs that will begin to address these needs.

These priorities and recommendations are reported to O.A.R.S.C. A major report is made every four years, with annual updates. The recommendations are provided to other funding agencies, including Federal research stations. The report influences the University of Guelph's OMAF Pork Program funding.

O.A.R.S.C., together with a number of other committees (field crops, engineering, agricultural economics, etc., etc.) reports to the Ontario Agricultural Services Coordinating Committee, which reports to the Agricultural Research Institute of Ontario (A.R.I.O.). The A.R.I.O. provides direction to the Ministry based on the reports fed up through the O.A.S.C.C. process. This structure provides for a broad base of input ensuring that relevant research priorities are identified.

The four priority areas and their main objectives identified in the 2000 Strategic Report follow. The full annual reports are available on the Ministry website (http://www.gov.on.ca/OMAF) under "Research".

1. To Focus Research on Environmental Issues
Objectives

1. To evaluate current methods of manure storage, processing, and application to determine the environmental impact of swine production and to determine methods of reducing negative effects and maximizing the positive benefits. Alternative manure systems need to be evaluated to determine the technical feasibility, applicability, strengths, weaknesses, economic viability, and environmental impact. Computer models to simulate nutrient flow might be useful in evaluating and determining guidelines.
2. To explore technologies which will reduce the negative impact of swine production through the reduction or balancing of the nutrient content of the feed, the improvement in feed utilization, and/or the manipulation of the microbial flora of the pig's intestine.
3. To focus research into the reduction of odour from swine operations including the assessment of housing systems, manure application, techniques, and storage systems. In addition to developing methods to reduce odours, there is a need for better instrumentation for the assessment of odours.
4. To evaluate the safety of pigs and people. Specifically there is a need to investigate techniques to reduce the health risks associated with manure gases such as hydrogen sulfide particularly at the time of manure removal. Health concerns such as the long-term inhalation of barn dust by farm workers needs to be investigated.

To Assure Superior Pork Quality and Safety
Objectives:

1 To focus research in the area of food safety and in particular to develop better techniques to control food borne pathogens and to investigate micro-organisms of swine which may have zoonotic potential.
2. To develop strategies and technology which will reduce antimicrobial drug use. Alternative methods of disease control such as techniques to improve immunity and the use of probiotics should be investigated. Techniques to more effectively monitor drug or chemical residues to ensure product purity are also needed.
3. To improve pork quality by identifying genetic factors associated with flavour and tenderness, by investigating the impact of new opportunity feeds on taste and oxidative stability, and by continuing to develop quantification and control measures for factors in meat that affect quality and consumer acceptance. The elimination of undesirable smell associated with skatole or boar taint needs to continue to be investigated.
4. To continue to develop technology for the prediction of meat quality from measurements in the live animal for genetic selection programs and on carcasses to reward producers and stimulate genetic improvement with regard to meat quality. Research needs to be conducted in order to determine and evaluate the relative importance of the factors responsible for the wide variation in composition of pork carcasses and to develop production systems to produce more uniform carcasses.

To Improve Production Efficiency for a Continued Competitive and Viable Industry
Objectives:

1. To develop innovative feeding technologies and improved nutritional programs in order to make Ontario pork production more efficient. Liquid feeding systems need to be evaluated under Ontario conditions. There is a need to evaluate the nutrient requirements of swine using a factorial (modelling) approach. Models could be used to determine the strategy needed to feed a specific group of pigs to their genetic and environmental potential as economically as possible. In addition, work needs to continue to reduce the adverse effects of mycotoxins on swine and to develop fusarium resistant corn varieties.
2. To investigate the impact of disease and methods to control or eradicate economically significant diseases. In particular, diseases that cause reduced growth rates and weight gain variability need to be studied. Research needs to continue to improve our understanding of the pathogenesis, epidemiology, and control strategies of economically important diseases. Emphasis needs to be placed on monitoring and biosecurity.
3. To improve reproductive performance and piglet survival by investigating boar physiology and factors associated with semen quality, by investigating factors associated with embryo viability and exploring techniques to improve embryo transfer, and by investigating physiological, environmental, and disease factors associated with parturition and neonatal viability including lactation failure. Artificial insemination and synchronization of the sow's estrus cycle are important areas of investigation.
4. To apply transgenic methodology for the introduction of genetic traits into pigs to modify specific characteristics and to explore other opportunities in genome research.

To Improve Animal Well-being
Objectives:

1. To better understand the social and aggressive behaviour of swine in order to reduce detrimental effects and design more appropriate housing/management systems to minimize behavioural problems and reduce stress including stress of transport and slaughter. In addition, better methods of measuring stress, pain, or discomfort need to be developed and applied in solving this problem.
2. To investigate methods of euthanasia so that crippled or sick animals can be killed in a prompt and humane manner.
3. To identify social and environmental factors associated with vices such as tail-biting and other forms of cannibalism as well as inappropriate dunging/urinating patterns and to devise means to minimize these problems.

Current Engineering Projects at Prairie Swine Centre Inc.

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SUMMARY

New engineering projects have been initiated in 2001 and many on-going studies will come to completion over the course of 2002 at Prairie Swine Centre Inc. (PSCI). Considering the stage of those experiments, no final analysis can be discussed yet. Consequently, this paper presents an overview of the current engineering research activities at PSCI by providing a brief description of each project.

CURRENT PROJECTS

Establishing and comparing the water inputs and outputs in grower-finisher rooms using dry and wet/dry feeders (S.K. Christianson, S.P. Lemay, H.W. Gonyou, J.F. Patience and L. Chénard; funded by the Natural Sciences and Engineering Research Council of Canada (NSERC))

Intensive swine operations require large amounts of water and any wasted water increases the demand on the water source, manure storage requirement and handling costs. The objective of this study is to establish and compare the water balance between two grower-finisher rooms, one room equipped with dry feeders and the other with wet/dry feeders. The sources of water identified in this study include water disappearance from the drinker, feed moisture, metabolic water produced by the pig, water content of the pig and moisture of the incoming ventilation air. The sinks of water include the manure water content, water content of the pig and moisture in the outgoing ventilation air. Two rooms with identical features have been used with feeder type as the variable. Three grower and three finisher cycles have been studied over an 11-month period. Preliminary analyses indicate the major source of water is at the drinker, and the major sink of water is in the manure. An accurate description of room water inputs and outputs constitutes a valuable tool in guiding water conservation initiatives.

A low protein diet combined with oil sprinkling for reducing odour and gas emissions of pig barns (M. Payeur, S.P. Lemay, R.T. Zijlstra, S. Godbout, L. Chénard and E.M. Barber; funded by the Canadian Pork Council and the Livestock Environmental Initiative)

Odours and gases produced from the ventilation system of a hog barn can be an important nuisance for the environment and the neighbourhood. This study constitutes the second phase of a larger project and is conducted to determine the combined impact of canola oil sprinkling with a low protein diet on odour and gas emissions of grower-finisher rooms. Four commercial rooms at PSCI were used to measure the effects of two oil application rates and two feed formulations over three different grower-finisher cycles of 10 weeks each. The room ventilation rate, temperature, relative humidity, ammonia, carbon dioxide, odour and dust concentrations were monitored in the four rooms. The trends obtained in the first phase of the project were observed in the second phase as well. The preliminary analysis of the data shows that a low protein diet including fermentable carbohydrates can reduce the ammonia concentration at the exhaust fan by up to 50%. The canola oil application reduced total dust concentration by 50 to 80%.

Modelling of ammonia emissions from swine buildings (S.P. Lemay, E.M. Barber, H.W. Gonyou, J.F. Patience and S. Godbout; funded by NSERC)

Ammonia production from livestock operations can contribute to environmental acidification and pollution of ground and surface water by nitrogen enrichment. Excessive ammonia concentrations within the barn also affect air quality for the animals and stock persons. The ultimate goal of that research is to develop a computer model simulating the ammonia production rate from a pig barn including the impact of the diet formulation. At the same time modelling work is being developed, experimental measurements have been performed to understand how ammonia emission varies on a daily basis and how it is related to pig behaviour. Those measurements will also be used to calibrate and verify the precision of the computer model. Modelling the ammonia emission process will help to understand how the ammonia is produced and how its production rate can be reduced. This research will lead toward reduction of the ammonia concentration in barns and of emissions.

Hydrogen Sulphide Risks Assessment for the Saskatchewan Swine Industry (S.P. Lemay, C. Laguë and L. Chénard; funded by SaskPork)

Hydrogen sulphide (H_2S) is a life threatening gas that is produced by the anaerobic degradation of swine liquid manure. Hydrogen sulphide is released from the manure when the latter is agitated (e.g. while pulling the pit plugs, at the lift station, when the manure storage is agitated prior to emptying). Since this gas is heavier than air, it can be trapped inside pits and buildings where it can present a real hazard for human and pigs. Even though the H_2S concentration in a production room is generally very low, certain incidents lead us to believe that manure management tasks can result in high H_2S concentration. Swine workers may be assigned to specific tasks related to manure management that can significantly increase their exposure to H_2S (e.g. manure application contractors, workers assigned to manure management and maintenance of equipment in the barn, crews assigned to power washing). Up to now, those exposures have not been well evaluated and documented in the swine industry.

The main objective of that project is to monitor the H_2S concentration at the worker level related to specific manure management tasks such as emptying manure pits, power washing, working around the lift station, agitating manure before land application and pumping of manure from the manure storage facility. The H_2S concentration associated with in-barn tasks is being measured at six different farms, in all four sections of the buildings (farrowing, gestation, nursery and finisher rooms) and during two seasons (summer and winter conditions). It is very important to fully characterize this exposure for ensuring that barn workers can complete their daily duties in a safe manner.

Evaluation of the Dräger microPac performance for hydrogen sulphide monitoring in pig barns (S.P. Lemay and L. Chénard; funded by Dräger)

Hydrogen sulphide monitors are available on the market but most of them have not been continuously used in swine buildings, so their long-term performance under these conditions is not well known. Monitors in swine building environment are submitted to a harsh environment where dust, humidity and gases are generally present. Monitors are worn by workers and they may be submitted to accidental falls on the concrete or in the manure during normal barn procedures. As pig barns are submitted to strict biosecurity rules, monitors would have to be fumigated if moved between different farms or production sites. Thus the swine production conditions are likely to challenge the H_2S monitor and its sensor and a systematic testing done in real barn conditions would provide valuable information on the monitor's reliability and durability when submitted to a typical pig barn environment.

The objective of this project is to evaluate the performance of the DRÄGER microPAC unit for H_2S monitoring under pig barn conditions for a period of one year. This experiment will define the microPAC performance under real working conditions and will provide essential information to pork producers in selecting a good H_2S monitor for themselves or their employees.

Feasibility Study for Concrete Swine Buildings in Western Canada (S.P. Lemay, C. Laguë and L. Chénard; funded by the Cement Association of Canada)

Swine buildings in Western Canada traditionally consist of a wood structure built over concrete foundations and have an average lifetime of 20 to 25 years. However, the industry is presently changing and most of the expansion taking place in the Prairies is done by companies of various size that could be interested in investing in facilities that are more efficient, durable and require less maintenance. The objective of that feasibility study is to evaluate the potential of concrete swine buildings with or without incorporating built-in in-barn manure storage in Western Canada. General building concepts will be developed for each section of the barn (gestation, farrowing, nursery, and grow-finish) and they will be compared in terms of total volume of concrete used for construction, advantages/disadvantages of the design and life cycle cost.

PROJECT COMPLETION

Except for the ammonia modelling project which will be pursed over the following year, all the studies previously described will be completed in 2002. Therefore, the results of those experiments will be included in the next year Annual Report edition.

ACKNOWLEDGEMENTS

Strategic program funding is provided by SaskPork, Alberta Pork, Manitoba Pork and Saskatchewan Agriculture and Development Fund.

Thermoregulation of the Nursery by Early Weaned Piglets Through Operant Conditioning

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Summary
A study was designed to determine the optimal temperature preferred by early weaned piglets in a standard nursery environment through the use of operant conditioning. Results indicate that current practices of keeping temperatures constant over time do not meet the pigs need for comfort and does not minimize heating costs.

Introduction
Thermal environment has a large effect on the health and productivity of growing swine. This is especially critical in the case of newly weaned piglets, which require warmer temperatures in the nursery environment. Today's confined pigs are often prevented from selecting their optimal temperature. Instead, the farm manager selects the temperature setpoint. During the colder months, nursery temperatures are often kept relatively uniform over space and constant over time. This deprives young pigs of the chance to select an environment more comfortable than the one the barn manager chooses. Previous studies on thermal preference in swine have concentrated on pigs four weeks of age and older, and have not investigated the ideal temperature for early weaned pigs. Through the use of operant conditioning in these previous studies, pigs have demonstrated the ability to respond to heat rewards and successfully control their thermal environment.

Experimental Procedure
Temperature preference was studied in piglets early weaned at 12-14 days of age in five consecutive replications during the winter of 2000. Each replication of the study lasted 21 days and took place in a single nursery room of six pens with eight piglets per pen.
Through the use of operant conditioning, in which an infrared heat lamp was used as a heat reward, one pen of eight pigs controlled the gas heater in the nursery room. Within the controlling (C) pen, a box was mounted which had both an operating (0) and nonoperating (NO) lever. The infrared heat lamp was positioned over the 0 lever. The position of the 0 and N01 levers were switched between replications. A second pen within the room was also equipped with a box mounted with a N02 lever. Temperature data was collected every five minutes by means of thermocouples positioned throughout the nursery room connected to a datalogger. All hits to the 0, NOI, and N02 levers were recorded via the datalogger as they occurred. Relative humidity readings were taken daily with a psychrometer. Pigs were weighed at weaning and at 21 days post-wean.

Results and Discussion
The results demonstrate that piglets early weaned at 12-14 days are aware to a degree that allows them to learn to control their thermal environment successfully through the use of operant conditioning. As age increased, the average preferred temperature for the early weaned piglets decreased by approximately 1.0°C per week ($P = 0.29$; Figure 1). Average temperature preferences were 26.33°C, 25.71°C, and 25.24°C for days 3-5, 10-12, and 17-19, respectively. While the average maximum temperature each week did not differ significantly ($P = 0.67$; Figure 1), the average minimum temperature was highest for days 3-5 post-wean ($P < 0.05$; Figure 1). Furthermore, minimum temperature in the room did not drop below 19°C (lower temperature safety setting), which kept average minimum temperatures between 22-23°C. Thermal preferences consistently ranged between 22-29°C each week post-weaning.

Thermal preferences reflected a circadian sinusoidal pattern in which the piglets preferred the highest temperatures during the day and the lowest temperatures during the night ($P < 0.0001$; Figure 2). These results agree with trends found in studies done in grow/finish hogs.

Implications

While it is known that early weaned piglets need warmer temperatures in the nursery, these data suggest that keeping the thermal environment uniform over space and constant over time is not preferred by piglets. Temperature settings for the nursery should be based on size and age of the animal as well as time of day. This challenges hog producers to consider more fuel efficient (and welfare friendly!) ways of managing the thermal environment of the early weaned piglet.

Acknowledgements

Funding provided by NSERC along with strategic funding provided by Sask Pork, Alberta Pork, Manitoba Pork and Saskatchewan Agriculture and Food Development Fund.

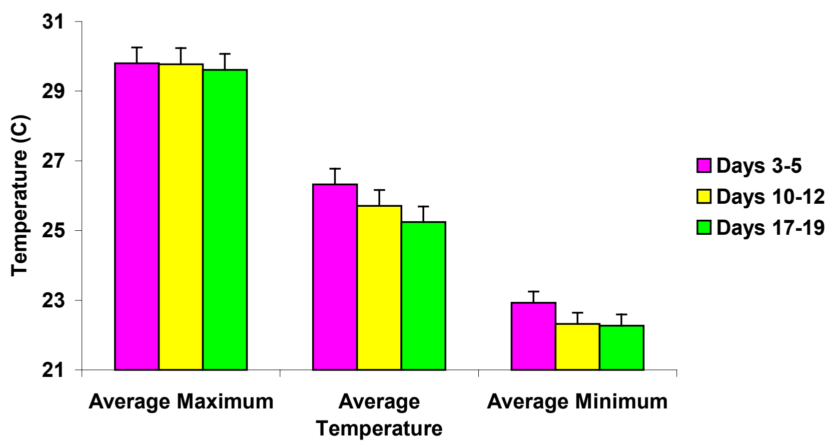

Figure 1. Average preferred temperature with minimum and maximums for days 3-5, 10-12, and 17-19 days post-weaning.

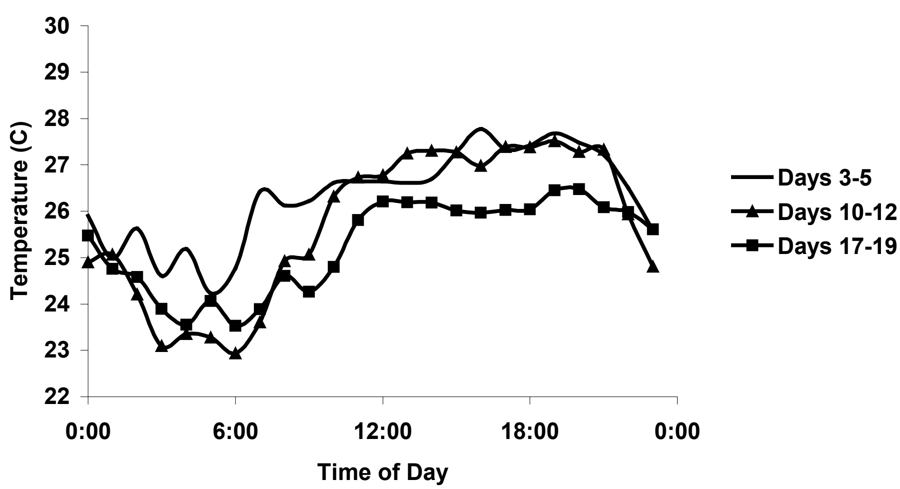

Figure 2. Circadian pattern of thermal preferences.

The Impact of Feeder Adjustment and Group Size/Density on Weanling Pig Performance

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Summary
An experiment was conducted to examine the impact of group size / density and feeder adjustment on the performance of weanling pigs. Providing more floor space resulted in increased body weight at 10 weeks of age. Performance was maximized when the feeder gap allowed for 40% of the trough to be covered with feed. Moreover, proper adjustment of the feeder reduced the time spent eating and thus increased feeder capacity.

Introduction
Crowding and /or reduced floor space allowance negatively affects nursery performance and exacerbates social vices such as tail-biting, side-nudging and ear chewing. Feeder adjustment impacts feed intake and can alter feeder capacity. Since some of the detrimental effects of crowding are due to decreased feed intake, adequate floor space and proper feeder adjustment may act in a synergistic fashion to improve pig performance.

Experimental Procedures
Seven hundred and sixteen pigs weaned at an average of 18.2 days of age were assigned to: 1) 24 pigs per pen, 2.5 ft^2 per pig; 2) 20 pigs per pen, 3.0 ft^2 per pig [approximates commercial conditions]; and 3) 16 pigs per pen, 3.75 ft^2 per pig [approximates the Canadian Code of Practice] for a 42 day trial. Eight days later (dO of exp.) feeders were adjusted to provide gap openings of 9.2, 11.8, 17.9, 24.8 and 31.5 mm (see Figures 1 to 3). Only a small bead of feed was available with an opening of 9.2 mm while the entire trough was covered with an opening of 31.5 mm. Feeding behaviour was videotaped on days 3 to 6 and on days 39 to 42. On day 42, each pig was scored for incidence and severity of tail biting, side nudging and ear chewing.

Results and Discussion
The effect of treatment on body weight and feed intake were not apparent until the second half of the experiment. Body weight, daily gain and feed intake were maximized with a minimum feeder gap size of 18 mm ($P < 0.05$) or when at least 40% of the feeder trough was covered with feed ($P < 0.05$; Table 1). Younger pigs spent more time eating with a reduced feeder gap; however feed intake and daily gain were lower ($P < 0.05$; Table 1). Assuming feeder capacity is achieved when it is being used 90% of the time, the maximum capacity of a nursery feeder space would be nine pigs when adjusted to a 9 Turn gap, but 11 pigs when adjusted to a 25 Turn gap. The optimal feeder gap would change with different feed particle size and form; however it is achieved when at least 40 % of the trough is covered with feed. Feeders with smaller gaps also required frequent unclogging (data not shown).

Decreasing group size and providing more floor space per pig resulted in increased final weight, daily gain, and feed intake (Table 1). When expressed on pork produced per square foot of floor space, the results favour crowding. However, previous research at PSC Elstow revealed that for every kilogram increase in body weight at 11 weeks of age, body weight at 17 weeks of age increased by 1.5 to 1.8 kg. The economics favour reduced crowding when considering the increased growth rate.

The effects of density/group size on final weight was more dramatic with a reduced feeder gap opening (feeder adjustment and group size/density interaction, $P < 0.05$; Figure 4). Neither floor space allowance or feeder adjustment affected the incidents of aggression, measured by skin lesion scores.

Implications
Providing more floor space per pig resulted in increased body weights at 10 weeks of age. Previous research at PSC Elstow revealed that for every I kg increase in bodyweight at I I weeks of age, body weight at 17 weeks of age increased by 1.5 to 1.8 kg. Therefore, attempts to increase body weight at market, a key indicator of profitability, can be influenced by nursery management. One can estimate that for every increase in nursery exit weight of I kg, gross income would rise by about **$2.50 per** pig; if we assume the feed cost per kg of gain above 110 kg is $0.75, then the net income per pig would be $1.36 to $1.63 per pig sold.

When expressed on pork produced per ft2 of floor space, the current results favour crowding. In the present example, bodyweight gain during the 6 weeks of the experiment was 6.02 kg per ft' for the least crowded pigs, 7.4 kg per ft' for the intermediate pen density and 8.4 kg per ft2 for the most crowded pigs. Increasing floor space per pig in the nursery is expensive. Assuming the cost of floor space in a nursery is about $251fe, increasing the floor space from 2.5 ft2 per pig to 3.75 ft2 per pig would cost about $3 1; assuming the nursery turns 6.5 times per year, the cost would be $4.81 per pig capacity. Amortized over the expected 20 year life of the barn translates to $0.24 per pig sold.

Considering the potential for increased revenue, the net income, calculated above, still favours increased floor space after adjusting for increased building costs. The value of the increased bodyweight of 1.36 to 1.63 kg per pig is well above the added amortized building cost.

Feeder adjustment also affected performance, with 68-day weights ranging from a low of 27.9 kg with the narrowest feeder gap to 29.6 kg with the widest gap. It would appear that performance was maximized when the feeder gap was 18 mm or more; since the desirable gap would change with different feed particle size and form, the most desirable feeder gap is achieved when at leastv%~ of the feeder trough is covered with feed, or the feed in the trough reaches an average depth of at least 3 n1m.

The adjustment of the feeder not only affects animal performance, but it also can affect feeder capacity. Assuming that the feeder capacity is achieved when it is being used 90% of the time, the maximum capacity of a nursery feeder space would be 9 pigs when adjusted to a 9 mm gap, but 11 pigs when adjusted to a 25 mm or 32 mm gap.

Acknowledgements
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Table 1. The impact of feeder gap and group size/density on pig performance, feeder characteristics, time spent eating and lesion scores.

	Feeder Gap, mm					Pig Density, ft^2/pig			SEM	Significant Effects[1]
	9.2	11.8	17.9	24.8	31.5	2.5	3.0	3.75		
Weight, kg										
Initial	6.96	7.10	7.12	7.18	7.03	7.03	7.10	7.09	0.044	ns
Final	27.91	28.97	29.55	29.50	29.56	28.03	29.39	29.69	0.093	F, D, FxD
Daily Gain, kg/d	0.48	0.52	0.53	0.52	0.53	0.50	0.52	0.53	0.002	F, D
Feed Intake, kg/d	0.72	0.75	0.78	0.77	0.78	0.74	0.77	0.79	0.005	F, D
Gain:Feed	0.66	0.69	0.68	0.67	0.68	0.67	0.68	0.68	0.004	ns
Feeder										
Area Clear, %	94.1	88.0	62.6	31.8	8.8	51.9	53.8	59.0	2.28	F
Feed Depth, cm	0.06	0.04	0.30	0.69	1.27	0.48	0.50	0.44	0.028	F
Total duration of eating, min/pig d^{-1}										
Days 3-6	142	118	125	116	116	122	127	121	5.99	F, FxD
Days 39-42	97	90	85	79	75	82	85	88	8.93	ns
Skin lesion score[2]	0.06	0.04	0.04	0.05	0.05	0.05	0.05	0.03	0.001	ns

[1]Effect of F (feeder adjustment), D (group size/density), or F x D, significant if $P < 0.05$.
[2]The mean score for belly, ears, body and tail. A score of 0 indicated no lesion, 2 indicated severe lesions.

Figure 1. Feeder trough coverage with a gap adjustment providing a gap opening of 9.2 mm.

Figure 2. Feeder trough coverage with a gap adjustment providing a gap opening of 17.9 mm.

Figure 3. Feeder trough coverage with a gap adjustment providing a gap opening of 31.5 mm.

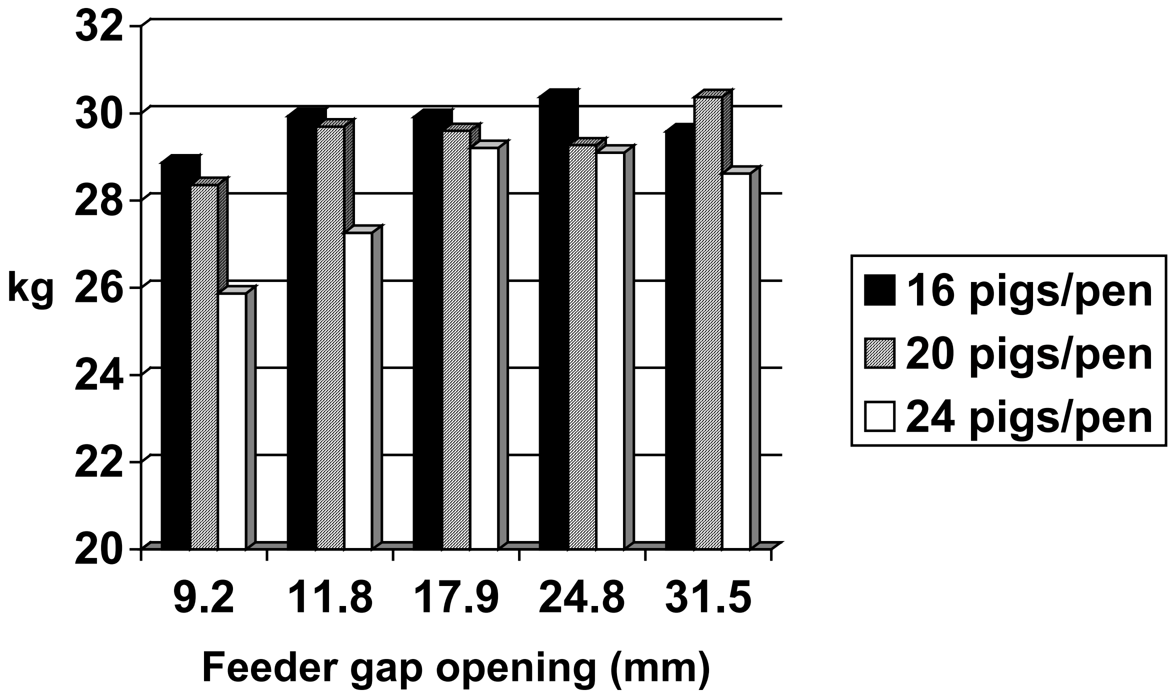

Figure 4. The impact of treatment on final (d42) weight of pigs. There was an interaction of feeder adjustment and group size/density ($P < 0.05$).