MISSION STATEMENT

"To provide a Centre of Excellence in Research, Technology Transfer, and Graduate Education, all directed at efficient sustainable pork production in Canada."

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2006 Report Highlights

Research Profits Everyone

Water with up to 1,800 ppm sulphate had no adverse effect on pig performance, odour emissions, or nutrient levels. The one exception is higher H_2S spikes when manure is agitated.
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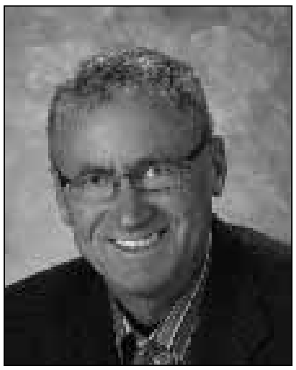
Chairman's Report

Prairie Swine Centre Local Presence - Global Influence

ERIC PETERS, Chairman of the Board



From the perspective of a pork producer living in Manitoba, the issues surrounding intensive livestock and the environment have always been important. This point is being made even clearer as moratoriums to growth in our industry become more prevalent, with North Carolina, Quebec and now Manitoba falling under questionable regulation to meet a political need. Now more than ever the science of agriculture and nutrient management in particular must be articulated. I am pleased that the contributions of organizations like Prairie Swine Centre are there to provide balanced and rational argument based in scientific fact. It is in times like these that our investment in research as an industry pays big dividends. There will continue to be challenges and concerns from special interest groups, we acknowledge that research can only be effective when it is proactive and ahead of the need, since research can provide many things but quick answers are the domain of politicians not research.

On this note I was particularly pleased this year to see the Centre continue to expand its influence and funding beyond western Canada. The most recent example was the Schothorst agreement connecting the Centre to a leading institute in the Netherlands, but also includes the evolution of the relationship with National Pork Board in the US which is now the number two pork industry funding group at the Centre after Sask Pork. Good relationships take time and depend on trust for their longevity, we see many additional opportunities in the years ahead to build stronger links with like-minded institutions, academics and businesses around the world. These relationships not only provide intellectual stimulation and collaboration opportunities for the scientists, but provide access to unique funding opportunities we were not previously eligible for and increase the sphere of influence that the Centre and by extension western Canada has on the rest of the pork producing world. Truly this is the basis for the concept of Local Presence – Global Influence.

The year of course was not without its challenges. Prairie Swine Centre is a business, a unique and complex business that shares the same opportunities and challenges as any pork producer. Those were front and centre this year as hog market cycles and feed grain prices conspired against the two production units. In addition we are in a very competitive job market which saw our production people challenged to fill vacancies and maintain productivity to service the mortgage. The last chapter in this story isn't written yet but the production personnel have the situation well in hand. The unique aspect of having the pig barn as a source of profits to be used to fund public research is one that speaks to the business plan of avoiding reliance on any one sector for funding. However this does not come without some risk and challenge to management. We should never lose site as a pork producers that it is our contribution through our various research check-off programs that are the real fuel behind the research. That while other sources such as market hog revenues and government grants may ebb and flow we remain steadfast in our support for research that is focused, near-market, and credible.

"We should never lose site as pork producers that it is our contribution through our various research check-off programs that are the real fuel behind the research."

Lastly, I wanted to thank members of the Board that have served you well through their volunteer contribution to the Centre, and recognize those that are now moving on. Linda Ball, as Manager of Finance and Administration has provided the Board with detailed and insightful financial information for the past seven years, and Roger Charbonneau who served two terms representing the pork producers in Alberta. I saved my last comments for Mac Shepphard who has been with Board since its early inception, serving firstly as Controller for the University of Saskatchewan and more recently bringing to Prairie Swine Centre that accounting expertise gained over decades prior to his retirement from the University. We are indebted to your vision of what Prairie Swine Centre could become and even more so for the assistance in helping us develop a financial structure that can help us fulfill the expectations of the industry.

President's Report

Knowledge and Collaboration in a Ever-Evolving Industry

JOHN PATIENCE, Ph.D. • CEO / President

Prairie Swine Centre's goal is to meet the technology needs of the pork industry by focusing on both economic efficiency and industry sustainability. We recognize that to accomplish our goal we must provide information pork producers can use. Our product is information, our strength is the reliability in the research – and indeed is - applied by the industry. Currently, with feed costs up $25 to $30 per pig from last year and downward pressure on market prices, no one can afford to leave money on the table. Consequently, it is at times like these that the Prairie Swine Centre provides its most immediate and essential benefit to producers – lowering costs and increasing revenues.

As acute as financial survival is at the present time, there remains a need to also address important sustainability issues, such as animal well-being and the environment. These issues may ebb and flow in their public profile, but we know that they remain important to the long-term viability of our industry.

We believe that it is important for the Prairie Swine Centre to maintain a balance between these two areas of research – economic efficiency and sustainability - because to lose focus on one could leave us unprepared for the changing tides of industry issues. Obviously, at the present time, we will have a great focus on economic issues, because the need is so acute.

Just as producers seek to be as efficient as possible, the Prairie Swine Centre also pursues economic efficiency – as a research organization and as a pork producer. The Prairie Swine Centre generates more than $1 million in revenues from the sale of stock (most years!) and PSC Elstow generates another $2 million. Thus, our financial success is dependent on hog markets and like pork producers, we too must maintain a focus on reducing costs and increasing revenues. Our success was demonstrated again last year when PSC Elstow received the Maple Leaf Foods award for the herd with the largest average loin size delivered to Mitchell's Gourmet Foods. We did this with a feeding and breeding program designed to maximize net income, not maximize loin size or minimize backfat thickness. Recognition like this is significant because it illustrates that we operate pig herds at a high standard, meeting industry expectations.

"Prairie Swine Centre is relentless in its pursuit to be an efficient pork producer."

Increasingly, businesses in all sectors are finding that strategic collaborations are an important way to utilize resources effectively and build partnerships that lead to mutual success. Working in isolation no longer works in business, nor does it work in research. For example, in the past year, management of the Pork Interpretive Gallery was transferred to Sask Pork, since part of their mandate is communication with the general public; the "fit" made a lot of sense. We thank Sask Pork for their participation in this important partnership.

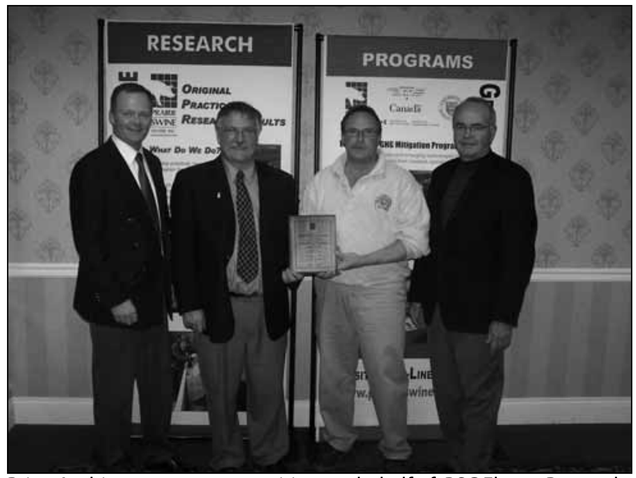
On a global scale, we announced the signing of a Memorandum of Understanding with Schothorst Feed Research, an applied nutrition research institute in the Netherlands. This new partnership will allow us to share with our producers, new information from Europe to which we previously would not have had access – and to do so

at minimal cost. At the present time, the Prairie Swine Centre has active collaborations with 5 Canadian, 2 American and 2 European universities, plus 2 Canadian, 2 European and 1 New Zealand research institutions. Just as pork production is an increasingly global activity, so to is research. The fact that so many national and international organizations collaborate with the Prairie Swine Centre speaks to our reputation in the global research community.

None of this would have happened without the commitment of many individuals and organizations, especially the pork boards of Saskatchewan, Manitoba and Alberta who continue to provide – along with the Saskatchewan Agriculture and Food – important core funding to the Centre. More than 30 other agencies and organizations provided funding for specific research projects. Of course, the dedication of our own staff and students is essential to this success as well. Their dedication and enthusiasm is contagious and sustains our whole organization. Finally, I would like to recognize the critical role of our Board of Directors, who represent many segments of the pork industry and bring that knowledge to the Centre. I reserve special thanks for Eric Peters, Board Chairman, for his commitment and counsel. I would also like to acknowledge with gratitude Roger Charbonneau of St. Lina, Alberta who completed two terms (6 years) on our Board. Our new Alberta Director will be Ray Price of Sunterra Farms.

"Global competitiveness, economic efficiency, and responsibility to our publics... these are among our core values."

I hope you find the information in this Annual Research Report valuable. Please also visit www.prairieswine.ca, to access new information from the Centre. And of course, please feel free to contact us directly so we can help address your questions and problems on an individual basis.



Brian Andries accepts a recognition, on behalf of PSC Elstow Research Farm, from Jim Haggins (PIC Canada Ltd.) for achieving the largest average loin award at Mitchell's Gourmet Foods for two years in a row.

Left to Right. Lee Whittington, John Patience, Brian Andries, and Jim Haggins

Technology Transfer Report

What's in A Name?

LEE WHITTINGTON, MBA. • Manager, Information Services

PorkInsight The Knowledge Network

It is essential to show our stakeholders value for their support of Prairie Swine Centre's research and technology transfer activities. We do this by making pork producers and their operations our focus. This means having a research program that addresses the needs of pork producers today and into the future. Most research programs take many months or years to complete, they may be composed of several individual research trials that when combined answer one or several questions.

The question we ask ourselves with each new study is, "How can we best communicate this information to the industry?" There are basically three methods: personal communication (on the phone, at meetings or at the farm), through printed materials (such as Centred on Swine newsletter), and via electronic means. This last area received a great deal of attention in 2006 as we completely reworked the website, enlarged and simplified the information search process and gave that part of the communication business a unique name and look- Pork Insight.

PORKINSIGHT

Pork Insight, is our information 'brand'. This is how we present the large volumes of information that we generate, place it along side other information from other sources that will be of benefit when pork producers are making management decisions, and then organize it so that you can actually find it when you want it! Did you know there are

Table 1. Technology Transfer activities for 2005

Activity	Frequency/Distribution
Annual Research Report	1 • 1,250
Centred on Swine	4 • 3,500
Telephone Inquiries	800+
Speaking Engagements	60 • 2,000+
Industry Magazine Articles	14
Fact Sheets	2
H_2S Training Program	239
Conference Posters	4
Tradeshow Attendance	3
Website Visitors	30,000
Bi-Weekly E-zine	20 • 350
Focus on the Future Conference	1 • 125
CD Distribution	500+
Magazine Advertising	2
Media Releases	7

over 3,000 entries in the information database! The name PorkInsight was the winning name selected among a number of entries at last years Focus on the Future Conference in Saskatoon. The name combined the elements of referring specifically to pork and leant some description of the value it provides 'Insight'. You will see the new PorkInsight logo appear whenever we are directing you back to our website for additional information.

"A brand is a symbolic embodiment of all the information connected to a company, product or service."

15th ANNIVERSARY

This is also our 15th Anniversary of operating, and this symbol will be used on posters and other materials in celebration of this milestone of service to the industry. As part of the recognition of our 15th year we did a search of images and headlines from 1992-93, you can find these in Centred on Swine and our Website (www.prairieswine.ca).

Celebrating 15 Years OF INNOVATION

The year was marked with significant activity in the areas large group and autosort housing, litter size/birth weight comparison, energy metabolism and feeding lentils, and teaching the H_2S Awareness course, and you will find this and more within this Annual Report and at the newly redeveloped website – just click on PorkInsight!

As always, we welcome hearing from you regarding how well we are meeting your expectations for production research information.

Operations Manager Report

New Facilities Expand Research Capacity

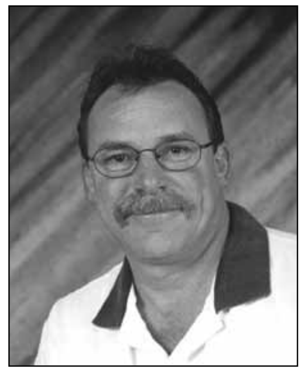
BRIAN ANDRIES, BSA. • Manager, Operations

Production at the Floral facility improved substantially over this last fiscal year 2005-2006 and is improving into this fiscal year starting July 1, 2006. This is in part due to improved replacement gilt management and the stabilization of the herd as we have converted over 90% of sows to new genetics utilizing Camborough Plus females from Pig Improvement (Canada) Ltd. to derive our terminal cross. We still have C-22 females at both the Floral and Elstow facilities, these animals are incorporated into the breeding herd only when we require females to ensure breeding targets are met for all breeding weeks.

PRODUCTION

Our gilt development program that targeted housing, nutrition and environment in the replacement barn in conjunction with proper handling and mixing, appears to have had a beneficial effect on production performance. It has allowed an average of 14-16, 130 kg cycling gilts to be shipped weekly to the Floral and Elstow facilities. Our most recent management change involves the selection of gilts to ensure that no replacement females are chosen from gilt litters, and that females are only selected if they are above the average birth weight of the entire litter. It is suspected that females from gilt litters and those from older parity animals that were lighter at birth due to crowding in the uterus, perform poorer reproductively than their larger litter mates.

The National body of the Canadian Council on Animal Care (CCAC) conducted an assessment of the animal care and research use program at Prairie Swine Centre (PSC) Inc. on September 19, 2006 in furtherance of the CCAC's objective to work towards optimal standards of experimental animal care and use in Canada.



They concluded that the animal care staff at both facilities are qualified and dedicated indicating that there was a good continuing education program in place for animal care staff and that staff were being appropriately trained through the U of S.

We met all of our production targets at the Floral barns this year. The production team made significant progress in improving farrowing rate again this year. In addition pigs born alive per litter rose to 11.4 and were accompanied by a decrease in pre-weaning mortality. We are very pleased with the performance of our stock and staff achieving 25.1 weaned/female in inventory. By maximizing productivity of our breeding heard, we are able to provide additional income that is uded to support of the public research program.

"Maximizing productivity and performance help provide additional resources to the public research program."

Table 1. Production parameters for the 2002-2005 fiscal years

	2003-2004	2004-2005	2005-2006
Sows farrowed, #	759	826	773
Farrowing rate, %	82.0	81.5	87.5
Pigs born alive/litter	11.2	10.8	11.4
Pre-weaning mortality	12.8	11.6	10.1
Litters weaned	757	835	766
Pigs weaned	7,759	8,025	7,922
Weaned/female inventory	24.2	23.8	25.1

Table 2. Research usage 1998-2005

	1998	1999	2000	2001	2002	2003	2004	2005
# Experiments Started	54	32	42	36	28	50	41	24
# Sows on trial	280	0	0	605	674	1.444	1,351	1,223
# Nursery pigs on trial	2,185	1,114	2,432	7,360	2,868	7,184	3,504	1,908
# Grow-finish pigs on trial	3,227	2,331	2,001	4,780	4,648	4,660	3,588	4,757
Total pigs on trial	5,692	3,445	4,433	12,745	8,190	13,188	8,443	7,888

HUMAN RESOURCES

Over the last six months staffing for production has changed considerably mainly due to health problems experienced by two permanent staff and a maternity leave. This has lead us to re-evaluate how and where we seek out potential employees, what type of experience and knowledge we are looking for in production staff and how to communicate to prospective employees exactly what the job is about, and what Prairie Swine Centre Inc. has to offer. Our experience has been that a desire and aptitude for working with animals, not necessarily pig barn experience is the best predictor to ensure a good match between employer and employee.

We are committed to training new employees, this is used as an important part of the recruitment process. Examples of training offered this year include training for H_2S Awareness, Animal Handling, and Quality Assurance. New staff and students are also instructed in biosecurity, and orientation to the Centre's general policies and procedures as part of our human resources orientation program.

P.I.G. Report

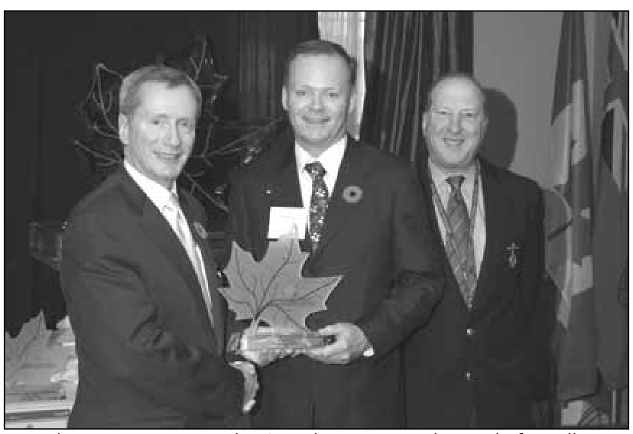
Complementing Agri-Education

LEE WHITTINGTON and JESSICA PODHORDESKI

With financial and in-kind support from across the Canadian pork industry, Prairie Swine Centre (PSC) has successfully operated the P.I.G. for three years following the fundraising, design and construction of the project. The Pork Interpretive Gallery (PIG) is a unique public communications vehicle and will now be an in-house project for Sask Pork effective September 2006. This will allow PSC to focus on its primary mandate of providing a Centre of Excellence in applied swine production research.

AGRI-EDUCATION PROGRAM

The Gallery complements Sask Pork's communications and agri-education programs. To support the project, Sask Pork has added a new staff member, Jessica Podhordeski, who joins the organization as Agri-Education Coordinator. Jessica is familiar with the P.I.G., as the 2006 summer student in technology transfer at PSC she was responsible for organizing tours and developing the new displays under construction. Her role at Sask Pork will include the management and promotion of the Pork Interpretive Gallery to schools, international visitors and the public. The tasks associated with daily operations include hiring and training tour guides, hosting tours, funding and promoting and marketing the site to various target groups that the industry wants to communicate with, including youth, governments on all levels, and the general public.



Lee Whittington receives the Canadian Agri-Food Award of Excellence for his work devoted to the development of the Pork Interpretive Gallery.

Left to Right. Leonard Edwards - Deputy Minister of Agriculture & Agri-Food Canada, Lee Whittington - Prairie Swine Centre, Bill Duron - CEO, Royal Winter Fair.

The link between Prairie Swine Centre and the industry through Sask Pork has always been important for both organizations. The transfer of management to Sask Pork ensures that this valuable asset will continue to receive the attention it deserves as a uniquely effective approach to public awareness of the changing role or agriculture in the community and the province. The P.I.G. will still be the site for various industry training sessions sponsored by PSC as in the past as it provides that unique perspective of classroom and visual access to the barn. This has become increasingly important since many people working in pig barns never see inside a barn other than the one they work in.

CAREERS IN ANIMAL AGRICULTURE

The next display and website component to be added to the PIG is designed to profile the interesting careers available in the pork industry. A large mural will be the centrepiece of this display providing a large visual image of the diverse careers available. The mural will highlight both in-barn careers as well as those outside the barn. Many of these careers will receive additional attention in the interactive display kiosks which provide information about the career, education and training required, some aspects of daily activities and a tactile (touch) component that will feature some of the common tools used in that career. Sask Pork is also developing a companion brochure to the display.

The new display and associated website will be launched in time for the spring school tours.

P.I.G. VISITOR UPDATE

The Pork Interpretive Gallery began 2007 by welcoming 172 visitors in the month of January. Among these visitors was the Agriculture 112 class from the University of Saskatchewan, College of Agriculture and Bioresources. Many of the students left the gallery with an improved impression of the swine industry in terms of animal welfare and animal management. Students said they would recommend the tour to subsequent years.

"*… this is a valuable addition to the class and look forward to a continuing relationship in future years.*" – Dr. Andrew Van Kessel, Associate Professor, Dept. of Animal and Poultry Science

To book a tour call 1-866-PIG-TOUR (744-8687), or visit www.porkinterpretivegallery.ca.

H_2S Awareness Training Update

Over 2,500 and Growing

LEE WHITTINGTON and SHANNON LaROCHE

Over 2,500 served and growing!

That's the number of people that have been trained and certified with the H_2S Awareness program since its inception. The course manual has been reprinted and revised three times based on new information about H_2S and safety in the barn. The course has grown to serve the area from Alberta to Ontario with the first course planned for the Atlantic provinces in 2007. We have three trained course instructors located in Saskatchewan, Manitoba and Ontario who work with pork production companies or industry associations to deliver training right in the community where the barns are located.

Case studies form the basis of the learning. Using real-life barn examples the course takes the pork producer through the areas in the barn and the activities that are most likely to place them or their animals in danger of exposure to H_2S. For example, pit plug pulling is the most obvious risk from agitating manure and releasing H_2S into the room, however even simple power washing results in rising H_2S levels. The course teaches how to protect yourself in these common barn situations including use of monitors, adjusting ventilation controls and alerting co-workers when such procedures are taking place.

Shannon LaRoche (centre) delivers the H_2S Awareness Program.

The other important aspect of the course is learning from the experience of others, including any exposures they are familiar with, or animal knock-downs. The hands-on aspect of the course ensures it is practical and active. The take-home is not only greater awareness but participants get to work on what a standard operating procedure might look like for their barn.

Thank you to Darwin Whyte who has been delivering the course in western Manitoba. Darwin will be retiring from training in 2007, we wish him well in retirement.

Courses are available in Saskatchewan, Alberta and Manitoba by contacting:

Shannon LaRoche

Phone: (306) 423-5458

E-Mail: callintoyou@sasktel.net

Research Objectives

The Value of Providing information

Objective #1
To increase net income through the development of feeding programs which emphasize economic efficiency and final product quality.

Objective #2
To maximize the economic value gained from feeding locally available ingredients and ingredient fractions by characterizing and modifying their nutritional and functional characteristics.

Objective #3
To increase net income by developing housing systems that optimize pig performance considering both construction and operating costs.

Objective #4
To ensure that the animal care and welfare interests of pigs, producers and the marketplace are met in a productive and profitable manner through the development of acceptable housing and management systems and practices.

Objective #5
To improve indoor air quality through the development of economical and practical techniques ensuring the health and safety of barn workers and animals.

Objective #6
To reduce odour and gas emissions or improve nutrient and water management by developing in-barn operating systems and management procedures that ensure the long-term environmental sustainability and acceptability of pork production.

Impact of Drinking Water Sulphate Levels on Gas Emissions and Manure Nutrients

B.Z. Predicala and J.F. Patience

SUMMARY

The impact of varying sulphate levels in drinking water on odour and gaseous emissions and on swine manure properties was evaluated. Results showed that drinking water with up to 1,800 ppm sulphate had no adverse effect on pig performance, gas and odour emissions, and manure nutrient levels. This can allow the pork industry to expand into areas previously considered as having unacceptable or undesirable sulphate levels in drinking water sources.

INTRODUCTION

Odour and gaseous emissions from swine operations is a major environmental concern for the pork industry. Out of the 10 most odourous components of swine odour identified, six are sulphur-containing compounds. No studies have been undertaken to fully assess the extent of the impact of the pig's sulphur intake levels on air quality and on manure characteristics, especially under actual production conditions. The overall goal of this study was to assess the impact of animal drinking water quality on swine manure nutrients and on air emissions.

"Water with up to 1,800 ppm sulphate had no adverse effect on pig performance, gas and odour emissions, and nutrient levels."

RESULTS AND DISCUSSION

The concentrations and emissions of NH_3 and CO_2 were not significantly (p>0.05) affected by the increasing levels of water sulphate (Table 1). No measurable impact on levels of H_2S gas was observed when manure was undisturbed. However, the average peak H_2S values obtained during plug-pulling from each treatment room was significantly (p<0.01) affected by the treatment. During individual replicates, the maximum peak H_2S values measured during pit-plug pulling in the treatment rooms provided with drinking water with 1,200 and 1800 ppm sulphate were 288 and 134 ppm H_2S, respectively; these spikes occurred for only a short period of time and the high levels dissipated to less than 10 ppm in less than 10 min. These observations would appear to indicate that high-sulphate levels in drinking water could contribute to the generation of high H_2S levels during manure clearing operations.

Table 1. Average weekly gas (NH_3 and CO_2) concentration and emission levels from the treatment rooms during the replicates.

	Ammonia Concentration (ppm)			Ammonia Emission Rate (g/hr)			CO_2 Concentration (ppm)			CO_2 Emission Rate (g/hr)		
Treatment	Mean[a]	n	SE	Mean[a]	n	SE	Mean[a]	n	SE	Mean[a]	n	SE
Control	9.9	40	0.5	12.1	38	2.0	728.6	40	36.4	1,880.1	39	154.4
600 ppm	10.7	40	0.6	13.4	40	1.5	769.6	40	44.9	2,052.3	40	69.4
1,200 ppm	10.0	40	0.4	12.5	38	1.6	740.8	40	38.0	2,077.7	38	93.3
1,800 ppm	9.7	40	0.4	9.8	37	1.4	735.0	40	36.1	1,896.5	37	108.9

a – Treatment mean values not significantly different (p>0.05)

Table 2. Average H_2S concentrations measured in each room throughout the study

	Peak H_2S Concentration (ppm)			Day-long H_2S Monitoring (ppm)	
Treatment	Mean*	n	SE	Mean**	n
Control	22.5a	17	8.4	0.0	11
600 ppm	21.0a	17	7.6	0.0	2
1,200 ppm	54.2b	17	22.4	0.0	2
1,800 ppm	27.9a	17	8.4	0.0	6

* Treatment mean values followed by the same letter are not significantly different
** Below detection limit

Odour concentration and emissions from the rooms were not significantly ($p>0.05$) affected by the treatment applied. Wide variability in the measured odour values contributed to the difference being not statistically significant.

In general, the measured manure nutrient levels were consistent with typical reported levels for swine manure. Except for the levels of sulphur, the nutrient properties of fresh manure from the treatment rooms were generally not affected by the amount of sulphate in the drinking water. Fresh manure generally had higher nutrient levels compared to stored manure (Figure 1). Stored manure from pigs given high-sulphate water tended to retain nutrients better compared to stored manure from pigs with low-sulphate water (Figure 2).

Pig performance was not adversely affected by high levels of sulphate in the pig's drinking water. For all replicates, the average daily gain ranged between 0.86 to 1.12 kg/day. During the study, no notable incidence of scouring or diarrhea was observed.

CONCLUSION

Elevated levels of sulphur intake from water had no adverse impact on manure nutrient composition, odour and gas (NH_3 and CO_2) emissions or on the performance of grower-finisher pigs. Thus, for water sources with up to about 1600 to 1800 ppm sulphate content, water treatment is not necessary. However, when using high-sulphate drinking water, proper measures should be in place to consider the increased potential for generating high spikes in H_2S levels during manure handling operations. These results support the possibility of constructing pig barns in locations where the available ground water is high in sulphate (up to 1600 ppm), without concern for adverse impact on growing-finishing pig performance, odour emissions, and manure nutrient value.

ACKNOWLEDGEMENTS

Strategic funding provided by Sask Pork, Alberta Pork, Manitoba Pork Council and Saskatchewan Agriculture and Food. Project funding provided by U.S. National Pork Board. Technical assistance provided by Scott Cortus, Robert Fengler, and Erin Cortus is acknowledged.

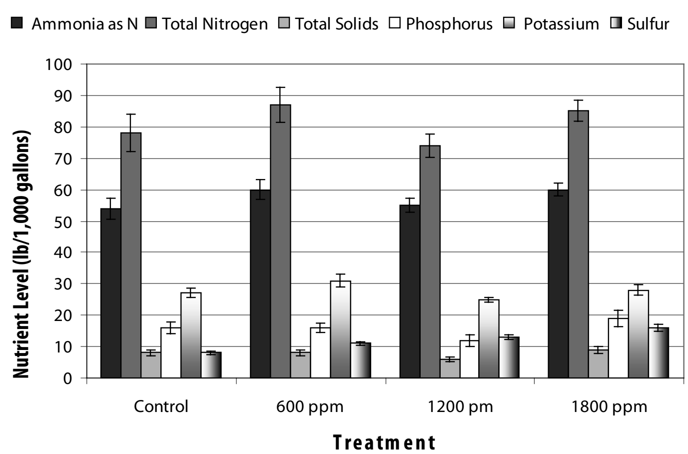


Figure 1. Nutrient properties of manure in the pits of the treatment rooms (each bar, n=15).

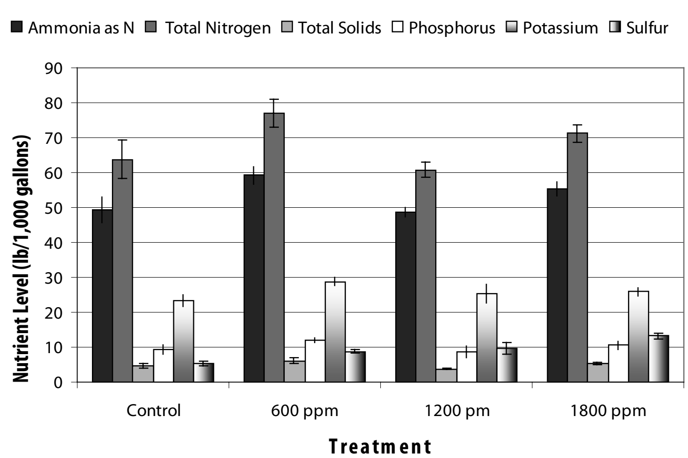


Figure 2. Nutrient properties of manure from the barrels used to simulate long-term storage (n=12).

Belt Conveyor Manure Separation System: Impact on Odour and Gas Emissions

B.Z. Predicala, S.P. Lemay and C. Laguë

SUMMARY

A new housing system for grower-finisher pigs that incorporates a belt conveyor (BC) system to separate feces from the urine at the pen level was developed. Comparative tests showed that the performance and well-being of the animals were not adversely affected by the use of the BC pen design. The system was effective in isolating most of the phosphorus in a low mass solid phase. The overall trends in gas emission rates showed that the BC pen design concept can help reduce the emission rate of carbon dioxide. No significant impact was observed for ammonia and odour emissions.

INTRODUCTION

Environmental concerns from handling large volumes of manure from livestock operations have led to exploration of new and innovative strategies to be able to manage manure in an economical and environment-friendly manner. In this research project, a new pen design concept for swine barns in which the slatted portion of the pen was replaced with a tilted belt conveyor (BC) to separate the feces and urine at the pen level was investigated. This project was implemented in two phases: Phase 1 conducted at the IRDA facilities in Québec involved the development of the BC pen design concept and assessment of efficiency of separation of the solid and liquid components. The main goal of Phase 2 trials conducted at PSCI was to compare the odour and gaseous emissions from a chamber with the BC system (Figure 1) with those from another chamber with a conventional (slats and under floor gutter) manure handling system.

"The new pen design concept showed potential to isolate up to 80% of the phosphorus in the solid phase."

RESULTS AND DISCUSSION

Results of four trials conducted at IRDA showed that the BC system has been very effective in isolating most of the phosphorus in a low mass solid phase; 76 to 81% of the phosphorus excreted by the pigs in the BC room was isolated within the solid phase of excreta. Results also showed that 39 to 48% of total nitrogen were retained in the urine while feces contained almost the same nitrogen concentration (40 to 45% of total nitrogen). The total ammonia nitrogen (TAN) content of the urine ranged from 75 to 79%, which was the level expected because TAN originates mainly from urea degradation produced in urine. From a phosphorus management perspective, the new pen design concept thus showed the potential to isolate approximately 80% of the phosphorus in a solid phase representing 20% of the total manure mass.

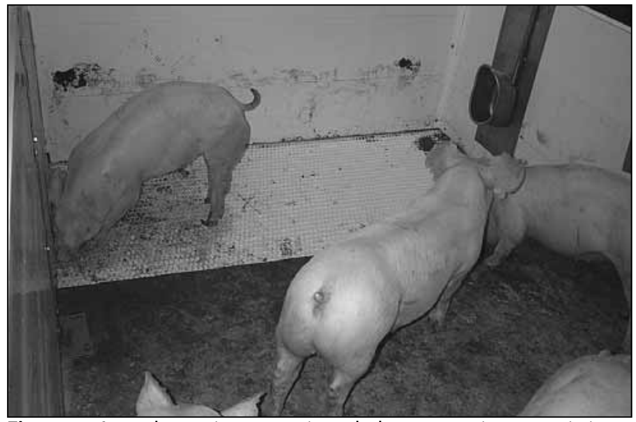


Figure 1. A pen layout incorporating a belt conveyor into an existing pen design

Pigs housed in the pen equipped with the BC system were more frequently observed lying down in the resting area than pigs housed in the conventional (control) pen. They also tended to use the dunging zone less frequently for lying than pigs in the control pen, suggesting that the BC system may possibly promote pen cleanliness. The frequency of feeding and drinking episodes was unaffected by the BC system, which is in agreement with the feed intake and feed conversion data.

The overall trends in gas concentration levels (e.g., ammonia (NH_3) and carbon dioxide (CO_2)) observed in trials conducted at PSCI and IRDA indicated that the BC pen design tended to reduce the levels of these gases. The odour concentration values for samples taken from the conventional and BC rooms were highly variable, thus statistical comparison of the odour values from the two chambers showed no significant difference ($p>0.05$). In terms of gas emissions, the BC pen design concept can help reduce the emission rate of specific gases (e.g., CO_2) compared to the conventional room (Table 1). No statistically significant impact of the system was observed for emissions of other gases (e.g., NH_3) and odour.

CONCLUSION

1. The BC pen design concept proved effective in separating the urine and solid manure components on a continuous basis, thereby allowing more effective management and handling of the nutrients (particularly phosphorus and nitrogen) in the separated components.
2. The performance and well-being of the animals were not adversely affected by the use of the BC pen design.

3. The overall trends in gas (ammonia and carbon dioxide) concentration levels observed indicated that the BC pen design contributed to the reduction in the levels of these gases.
4. The odour concentration values for the samples taken from the conventional and BC rooms were highly variable, thus statistical comparison of the odour values from the two chambers showed no significant difference.
5. The overall trends in gas emission rates showed that the BC pen design concept can help reduce the emission rate of carbon dioxide compared to the conventional room design. However, the BC system had no significant impact on ammonia and odour emissions. Further work to better assess the technology can be made with enhanced control of inlet air contaminant levels and improved techniques for measuring odour.

The experiments with the BC pen design concept also revealed potential areas for further work to optimize the system and to realize significant benefits from the use of such a system in addition to those already identified. By separating the manure into two streams, the BC system can help mitigate the hazard from H_2S exposure in swine barns. An optimized BC pen design can be potentially incorporated into a deep-pit barn construction with separate in-barn long-term storage for the separated components, without the typical hazards from high H_2S levels associated with conventional deep-pit barns.

ACKNOWLEDGEMENTS

Strategic funding provided by Sask Pork, Alberta Pork, Manitoba Pork Council and Saskatchewan Agriculture and Food. Project funding provided by Cement Association of Canada and Institut de Recherche et de Développement en Agroenvironnement. Technical assistance provided by Garth MacDonald, Scott Cortus, Robert Fengler, and Erin Cortus is acknowledged.

Table 1. Gas Concentrations and Emissions Measured in the Two Chambers

Trial #	Week #	Start Day	Mean NH_3 Concentration (ppm)			Mean CO_2 Concentration (ppm)			Mean NH_3 Emission ((mg/h-kg_{pig})		Mean CO_2 Emission ((mg/h-kg_{pig})	
			Inlet	Conv.	BC	Inlet	Conv.	BC	Conv.	BC	Conv.	BC
1	1	08-Jun	6.6	8.0	88.1	420	536	536	2.6	2.3	552	451
	2	15-Jun	6.9	7.9	8.1	412	523	510	1.6	1.9	489	434
	3	22-Jun	7.3	9.4	8.6	435	552	516	3.0	1.8	476	342
	4	29-Jun	9.6	11.9	11.4	454	549	527	4.0	3.7	454	370
2	1	12-Jul	7.6	8.2	8.4	462	511	501	2.4	4.2	211	203
	2	19-Jul	9.9	11.1	11.3	479	535	530	4.4	5.2	217	195
	3	26-Jul	8.5	10.1	9.9	455	520	507	4.7	4.5	199	176
	4	2-Aug	8.0	10.3	9.8	481	569	551	5.7	4.7	211	182
3	1	01-Sep	8.2	10.3	9.7	455	540	530	5.8	5.1	541	487
	2	08-Sep	13.4	16.0	15.6	461	547	531	4.5	4.8	519	499
	3	15-Sep	8.6	10.9	11.0	445	553	550	4.0	3.1	497	384
	4	22-Sep	6.5	9.3	9.1	453	594	581	2.8	1.9	403	313
4	1	06-Oct	7.6	8.6	8.9	479	550	551	3.6	3.6	516	423
	2	13-Oct	8.9	10.7	10.6	476	561	538	4.3	4.1	491	358
	3	20-Oct	6.2	8.4	8.4	504	603	582	5.1	3.2	521	322
	4	27-Oct	4.3	7.4	6.1	512	635	584	4.2	2.0	467	245

A Review of On-Going Projects in the Engineering Research Program

B.Z. Predicala, D. Asis, and E. Navia

Dr. Bernardo Predicala
Research Scientist, Engineering

SUMMARY

Three research projects were started within the PSCI Engineering Research Program that involve controlling emissions using nanoparticles, assessing barn energy use to reduce utility costs, and evaluating a new housing system for grower-finisher pigs. The goals and the activities within each project are described in further detail.

INTRODUCTION

Research activities within the PSCI Engineering Research Program are aimed to address environmental sustainability concerns relevant to the pork industry and to optimize the physical and management systems within swine operations to improve net profitability. In line with these goals, three research projects were started within the program during the past year. However, these studies are in the early stages of the research process, thus, discussion of final results is not yet possible. This overview provides a brief description of each project and the activities that will be undertaken over the coming year.

USE OF NANOPARTICLES TO CONTROL EMISSIONS FROM SWINE MANURE SLURRY

B. Predicala, D. Asis; funded by the Natural Sciences and Engineering Research Council of Canada (NSERC)

The overall goal of this research is to determine the technical feasibility of using reactive nanoparticles to reduce odour and gaseous emissions from swine barns. The rationale for this research is to take advantage of recent advances in nanoparticle technology to develop control measures for odour and gaseous emissions from swine facilities.

"Nanoparticle technology has the potential to significantly reduce Ammonia and Hydrogen Sulphide levels."

Nanotechnology refers broadly to the control and manipulation of atoms and molecules to create structures and devices at nanoscale dimensions with novel properties and functions attributed to their small size. Nanoparticles are nanoscale materials that are created by controlled processes to attain specific properties. The multitude of uses of nanoparticles includes environmental applications such as wastewater remediation, destruction of toxins and pathogenic microorganisms, as well as air filtration and purification. These applications were mainly due to inherent properties of nanoparticles which can be highly-reactive when in contact with the target compounds, particles, or microorganisms. Because emissions from swine barns consist mainly of gaseous compounds (e.g., odour, hydrogen sulphide (H_2S), ammonia (NH_3)) and aerosolized particles of biological origin (i.e., bioaerosols), it is hypothesized that reactive nanoparticles could also be effective in controlling emissions from swine operations.

Initial experiments were conducted to test the impact of nanoparticles on selected target gases at known concentration. Six types of nanoparticles were selected based on their performance in previous similar applications, their reported chemical and physical properties, and from consultation with technical staff of a company that manufactures these materials.

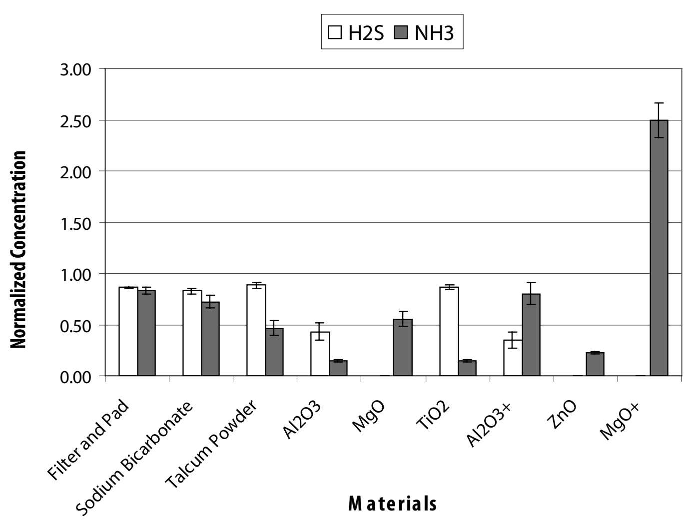


Figure 1. Average normalized concentrations of target gases passed through various powder materials. Each value is the average of three replicates and the error bars represent standard error of the mean.

Using the sampling flow rate and amount of particles determined from preliminary tests, the results of the tests on these six types of nanoparticles and other common materials are shown in Figure 1. The values shown are the normalized concentrations, meaning lower values (<1.0) indicate better effectiveness in reducing the target gas concentration. Among the nanoparticles tested, the top three materials based on effect on 50-ppm NH_3 target gas were Al_2O_3, TiO_2 and ZnO, which corresponded to a reduction of 85.6%, 85.2%, and 78%, respectively.

Using MgO, MgO+ and ZnO nanoparticles, the concentration of H_2S was reduced to <1.0 ppm (below detection level of the H_2S monitor used) from an initial 25-ppm concentration. Additionally, Al_2O_3 and TiO_2, which were previously found to be effective for NH_3, were able to reduce the concentration of H_2S by 57% and 13%, respectively.

Further tests will be conducted to test the impact of various nanoparticles on other target gases and on the actual gas mixtures emitted from swine slurry. In addition to air filtration, other deployment techniques such as mixing of the nanoparticles with slurry and dispersion of the particles to treat the emitted gas will also be evaluated. Additional room-scale tests will be conducted to ensure that the nanoparticles proven to be effective in controlling the gas emissions can be used safely in swine barns in a cost-effective manner.

REDUCING ENERGY COSTS IN SWINE BARNS

B. Predicala, J. Patience, E. Navia; funded by the Advancing Canadian Agriculture and Agri-food Saskatchewan (ACAAFS) Program

> *"Energy costs are the third highest variable cost, after feed and labour, ranging from $6-$10 per hog sold."*

The overall objective of this project is to reduce energy costs in swine operations in order to reduce overall production costs. With energy costs rising on a global basis, the ability to produce pork with lower energy inputs could represent a significant competitive advantage to our industry, particularly with respect to our main global competitors, which are typically dependent on intensive energy inputs. Current estimates of utility costs (gas and electricity) indicate that they range from about $6-10 per pig sold on a farrow-to-finish basis and thus are the third largest variable cost, after feed and labour. However, there is a need to conduct a comprehensive evaluation of actual energy use in typical swine production facilities in western Canada to be able to

establish a relevant benchmark on current energy cost per pig sold and to identify the energy intensive tasks in barns and potential areas for improvement.

This project will be conducted in four phases. Currently, the first phase is on-going which involves a survey of a representative sample of different types of swine operations to gather baseline information on current energy usage. A series of energy audits of selected facilities will be done over winter and summer seasons to validate the survey results, to assess the relationship of level of energy input to overall productivity of the operation and indoor air quality, and to document current management practices for efficient energy utilization.

The second phase will involve the assessment of the impact of different energy-saving strategies on overall energy costs using computer simulation. Using information gathered from the survey and from barn audits, a computer model will be set up to enable us to conduct a thorough evaluation of various energy-conservation measures in a cost-effective manner without having to apply and test each measure in an actual set-up. In subsequent phase of the project, the most promising measures based on the results of the simulation phase will be selected and applied in an actual swine barn to demonstrate their actual impact on total energy costs. The fourth phase will involve the development of a user-friendly software tool for use by pork producers to evaluate current energy use in their own facilities, and to help in the decision making process on adopting specific energy conservation measures appropriate for their operations.

A view during construction of the low-cost housing facility, utilizing a pole structure in combination with flax straw.

ASSESSMENT OF AN ALTERNATIVE SWINE GROW-OUT FACILITY

B. Predicala, J. Patience, H. Gonyou; funded by the Advancing Canadian Agriculture and Agri-food Saskatchewan (ACAAFS) Program and the Saskatchewan Pork Development Board

Barn construction and capitalization represent a significant percentage of the cost of producing a market hog. Furthermore, because of the current construction environment in western Canada, this cost component can be a major disadvantage to our industry, especially with respect to our main global competitors. Additionally, barn design and construction can have a major impact on the operation and management of the barn, thus significantly influencing the performance of animals and the general work environment for barn workers. Hence, a newly- constructed grow-out facility using non-conventional, low-cost building techniques presents a valuable opportunity to closely investigate a means for reducing capital costs, while documenting as well its impact on overall productivity, and other operational aspects that could be affected.

The overall objective of this work is to conduct a comprehensive evaluation of the economic and operational aspects of building and operating a non-conventional confinement barn constructed using low-cost building methods and materials. The main approach of this work is to assess and monitor different parameters and various aspects of the operation that may likely be impacted by the difference in building construction approach, relative to a conventional barn. Additionally, any new costs or benefits and operational requirements unique to these swine housing units will also be documented.

This work will be divided into different modules, each dealing with a different aspect of the operation. The different modules include: 1. capital costs, 2. productivity and operational efficiency 3. environment and manure management, 4. animal welfare and handling, and 5. economic and feasibility analysis. Each module will be implemented as a sub-project, with its own protocols developed to meet the specific module objectives. The time line for each module would include baseline data gathering for the initial year of operation, analysis of the data to identify strengths and weaknesses of the system, development of improvement measures whenever appropriate, implementation of those measures, and subsequent monitoring of the impact on the parameters within the scope of the module. Current activities for this project include the setting up of the environmental monitoring system in the barn, and collection of data on the construction of the barn units and on the performance of the first batch of pigs.

EXPECTED ACTIVITIES AND PROJECT COMPLETION

All these on-going studies are multi-year projects, thus, results from the activities over the coming year will be reported in subsequent Annual Research Reports. The bench-scale tests on evaluating various types of nanoparticles and deployment techniques will be completed in 2007, as well as the benchmark survey and energy audits for the energy cost reduction project. Over the next year, data on several room turns in the low-cost barn units will be collected. Combined with the data on barn construction and operation costs, this will enable us to make a preliminary assessment of the overall performance of the operation.

ACKNOWLEDGEMENTS

Strategic funding provided by Sask Pork, Alberta Pork, Manitoba Pork Council and Saskatchewan Agriculture and Food.

Belly Nosing, Belly Suckling, and Tail Biting in Early Weaned Pigs

C.J. Bench and H.W. Gonyou

SUMMARY

Observations were made on the incidence of belly nosing, belly sucking, tail biting and other oral-nasal behaviours of pigs weaned at 14 days-of-age, at intervals up to the finishing stage. Belly nosing peaked approximately 2 weeks after weaning at 5% of the time, while belly sucking remained at less than 1% of the time throughout the animal's life. Tail biting only occurred in the finishing phase and occurred at approximately 0.5% of the time. Although the peak incidence of belly nosing by a pig was correlated with belly sucking, tail biting was only weakly related with any of the other behaviours.

INTRODUCTION

Early weaning of piglets, at less than 3 weeks of age, was widely adopted by the industry in the late 90's. Although the practice has some distinct advantages, it is also recognized that it results in some problems and management must be very good. One of the problems associated with early weaning is a higher incidence of behavioural vices, such as belly directed behaviour. Close observation of pigs performing belly directed behaviour indicates that it exists in two forms, belly nosing and belly sucking. The objective of this study was to investigate the incidence and frequency of belly nosing and belly sucking behaviour in early-weaned pigs and how these relate to other oral-nasal behaviour of pigs, including tail biting, in the grow-finish stage.

"Different tools will be needed to control belly nosing and tail biting, as their causative motivations appear to be specific and distinct from each other."

EXPERIMENTAL PROCEDURES

We studied 242 piglets, from 24 litters weaned at 14 days-of-age and observed belly nosing, belly sucking, other nosing (to other parts of the body) other sucking, and biting behaviours at 18, 23, 28, 50, 63 and 91 days-of-age. We used instantaneous scan sampling (observations at 5-min intervals) to determine the amount of time spent in each behaviour, and continuous observations (for 4 hours on days 21 and 35) to determine the frequency and bout lengths of each behaviour. Pigs were individually identified with paint and ear tags prior to observations in the nursery and finishing pens, respectively.

RESULTS AND DISCUSSION

Belly nosing was found to begin within 4 days of weaning, peak at 23-28 days of age, and gradually decrease with age thereafter (Table 1). At its peak, pigs spent an average of 5% of their time, or 70 min/day belly nosing. Belly sucking increased with age throughout the nursery and reached a peak in the grow-finish phase. Pigs in the finishing phase spent approximately 1% of their time belly sucking, or about 14 min/day. The length of belly nosing and sucking bouts increased with age, ranging from 17 to 27 sec/bout for belly nosing, and 23 to 58 sec/bout for belly sucking. Other nosing remained fairly consistent at 2-4% of the time at different ages, as did other biting at 1-2% of the time. Other sucking was low until late in the finishing phase when it reached 4% of the time. Tail biting, recognized as a damaging behaviour, did not appear until the grow-finish phase and only reached 0.5% of the time, or an average of 3-4 min/day.

Table 1. Time budgets for the performance of belly nosing, belly sucking, and tail biting from 18-91 days-of-age by early-weaned pigs.

	Age (days)					
	18	23	28	50	63	91
Belly Nosing (%)	1.5	4.1	5.4	1.8	1.4	0.9
Belly Suckling (%)	0.1	0.3	0.3	0.7	0.8	0.9
Tail iting (%)	-	-	-	-	0.4	0.5

Our previous research indicated that there is considerable variation among piglets in how much belly nosing they perform, with some exceeding 10% of their total time. In this study we determined by correlation analysis that piglets that performed the greatest amount of belly nosing during the peak of this behaviour at 28 days-of-age were more likely to belly nose and belly suck other pigs in grow-finish. In general, tail biting was only weakly correlated with nosing and sucking behaviours in the nursery.

CONCLUSIONS

Belly nosing and tail biting peak at two distinctly different stages in a pig's life, early nursery and finishing, respectively. A poor association between the two vices indicates that they probably originate from two different motivational systems. Other oral behaviours, such as nosing, sucking and biting directed at different parts of the body are relatively stable throughout the pig's life to 91 days-of-age. Different management tools will be needed to control belly nosing and tail biting, as their causative motivations appear to be specific and distinct from each other.

ACKNOWLEDGEMENTS

Strategic program funding was provided by Sask Pork, Alberta Pork, Manitoba Pork, and the Saskatchewan Agriculture Development Fund.

Space Allowance for Finishing Pigs Affects Productivity, Health and Behaviour

B.R. Street and H.W. Gonyou

SUMMARY

The reduction in average daily gain due to reduced space allowance for pigs in both small and large groups occurs at a similar point as that previously reported in the literature (k = approximately 0.033 – 0.036 $m^2/BW(kg)^{0.667}$). Lameness was more common in the less spacious treatment during the final weeks of the study. Pigs in crowded conditions had fewer meals and less total time spent eating compared to the more spacious treatment. Space allowance can affect health and behaviour as well as productivity.

INTRODUCTION

Space allowance is an important consideration in finishing pig production as it has both economic and animal care implications. Producers must balance the efficiency of production while maintaining acceptable levels of animal care. Most studies on space allowance have been limited to the effects on animal productivity, and were designed to 'stand alone' and yield results specific to the conditions studied. In the case of space allowance, for which numerous studies have been published, it is possible to conduct an analysis of all of their results to obtain a more precise measure of the effects on productivity. We conducted such an analysis on previously published results on space allowance. We also conducted a study combining both space allowance and group size as a part of a larger series of studies on the effects of space allowance.

EXPERIMENTAL PROCEDURE

We collected previously published material on the effects of space allowance on animal productivity. We restricted our analysis to average daily gain, feed intake and feed efficiency as these were consistently reported while few other variables were. We analyzed the data on a relative basis, that is, the results of the more crowded treatments were expressed as a proportion of the least crowded treatment within each study. In this way we were able to control for housing conditions, general health, genotype and nutritional programs that differed among studies, but were consistent within each study. We expressed space allowance using the allometric equation Area = k * body weight$^{0.667}$, which allowed us to use studies based on different final weights. To obtain a precise estimate of the point at which reduced space allowance results in a reduction in performance, we conducted a broken line analysis of the data.

A small-pen, crowded scenario was one of the four scenarios examined within the experiment.

"The effects of reduced space allowance may be seen in both health and behaviour, as well as in productivity.."

We conducted a study on finishing pigs kept in either small (18 pigs/pen) or large (108 pigs/pen) groups, under two space allowances (0.52 vs 0.78 m^2/pig; 5.6 vs 8.4 sq^{ft}/pig). Within group size we analyzed production variables on a relative basis and applied a broken line analysis. We also examined the pigs for injuries and lameness, and observed their behaviour at 2-week intervals throughout the study. We limit our analysis of this study to the effects of space allowance for this article.

RESULTS AND DISCUSSION

The data obtained from the literature resulted from studies in Canada, Europe and the United States (see Figure 1). Analysis of this published data published identified the point at which space allowance began to reduce average daily gain as a 'k' value of 0.0336 $m^2/kg^{0.667}$. For a typical finishing barn with a target market of 115 kg, and making their first pull when 10% of their pigs reach this target, this 'k' value represents 0.72 m^2/pig (7.75 sq^{ft}/pig). The space allowance per pig would differ if market weight or the 1st pull percentage varied from these levels. For every 1% reduction in space allowance below this level, average daily gain over the entire trial was reduced by an average of 0.33%. The same pattern was detected in the data on average daily feed intake. No effect of space allowance was seen for feed efficiency.

In our study we saw no significant difference in the effect of space allowance in the two group size treatments (Table 1). Average daily gain was reduced by crowding in both small and large groups. The

"Pigs in the crowded scenario experienced less total eating time, and had a greater health problems near the end of the finishing period."

broken line analysis indicated that average daily gain began to be depressed when space allowance fell below a k value of 0.036, slightly higher than the literature value. However, the difference would not be considered statistically significant. The key production result is that our average daily gain results identified a break point similar to previous studies.

In terms of health and injuries, the pigs in our less spacious treatment evidenced more lameness during the final weeks of the study. This is in agreement with our expectations that health problems associated with space allowance should only develop at the end of the study when pigs become more crowded. A second difference that we observed was that crowded pigs had fewer meals, of the same length as uncrowded pigs, and therefore less eating time. This pattern is that of an animal with a reduced appetite. In contrast, pigs in large groups, that had to travel further to eat, had fewer but longer meals, and maintained their total daily eating time. This 'reduced appetite' effect of crowding is supported by previous research indicating that crowded pigs will reduce their energy intake even if the feed is made more energy dense, which should have enabled the pigs to maintain daily nutrient intake if they wanted to.

Table 1. Effects of crowding on productivity of pigs in large and small groups

	Average Daily Gain (grams)		Reduction Due to Crowding	
	Uncrowded	Crowded	Grams/Day	Percent
Small group (18 pigs)	1,098	1,049	49	4.4
Large Group (108 pigs)	1,055	1,016	39	3.6

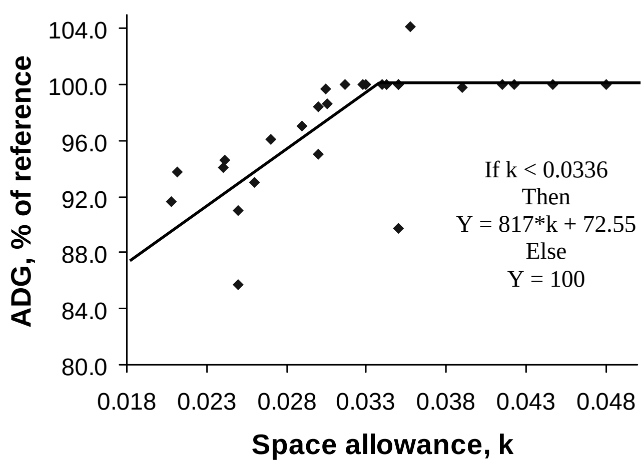


Figure 1. Broken line analysis of ADG for grower-finisher pigs on fully slatted floors. The allometric expression of space allowance is k where k = Area (m2) / BW (kg).667. ADG is expressed as a percentage of that in the most spacious treatment within each experiment. $r^2 = 0.90$, $P < 0.001$.

IMPLICATIONS

Results obtained under conditions more typical of commercial production confirm that reductions in space allowance below a 'k' value of approximately 0.0336 $m^2/kg^{0.667}$ will reduce productivity. The effects of reduced space allowance may also be seen in health variables, such as lameness, but only near the end of the finishing period. The eating patterns of pigs in crowded conditions suggest a reduction in appetite rather than a simple restriction of feeder access.

ACKNOWLEDGEMENTS

Strategic program funding was provided by Sask Pork, Alberta Pork and Manitoba Pork. Specific project funding was provided by the National Pork Board (US), the Natural Sciences and Engineering Research Council, and Agriculture and Agri-Food Canada.

Impact of Prod Use on the Incidence of Highly Stressed Pigs

H.W. Gonyou

SUMMARY

We subjected pigs to three different handling treatments as we moved them through a 300m handling course. Despite traveling the same distance as the others, pigs moved at a moderate pace with only a board, quiet voice and gentle slaps, were essentially unstressed by the procedure. Pigs handled aggressively, at a fast pace, with shouting and slapping, but without use of electric prods had a higher incidence of stress, but none showed extremes that might lead to animal losses. Use of the electric prod resulted in a large proportion of the pigs showing both behavioural and physiological signs of stress, with some being extreme to the point of stumbling and falling. We should minimize the use of the electric prod by changing our handling techniques and/or modifying our load out facilities.

INTRODUCTION

The shipping of finishing pigs is a stressful time for the animals, and each year several thousand pigs die or are euthanized in Canada during this process. Although the percentage of animals that are lost is quite low, at less than half of a percent, these animals represent a considerable financial loss to the industry and are a major welfare concern. Although many factors such as temperature and genotype likely contribute to these losses, the data strongly suggest that poor handling is a major cause. We were involved in a study to develop an experimental protocol to study stress induced losses of finishing pigs. The protocol has since been used to study the physiological responses of pigs to handling. As part of our study we examined the role of prod use during handling on the incidence of highly-stressed pigs.

Loading and unloading pigs with paddles can be an effective method of minimizing stress.

EXPERIMENTAL PROCEDURES

Our study included 192 near market weight animals. These animals were taken from their finishing pen, in groups of six, and herded through a handling course. The course was approximately 300 m in length, and involved numerous turns, reversals, and partially obstructed alleys. It took approximately 10 minutes to herd the animals through the course. We imposed three handling treatments on the animals. The Gentle treatment involved herding the animals with a herding board, voice and occasional slapping, at a comfortable walking pace. No electric prod was used in the Gentle treatment. We also used an Aggressive treatment that herded pigs at a fast walk, used a louder voice and involved slapping and/or use of the electric prod. Within each group of six pigs in the Aggressive treatment we identified two animals that were not to be prodded. They were encouraged to move only with slapping by the hand and pushing. The remaining four pigs were prodded frequently.

'Clearly, we should be minimizing the use of the electric prod when handling animals, in our test groups, over 40% showed severe stress when prodded.'

We attempted to identify signs of stress in the animals before they reached the extreme of falling down. These signs included laboured breathing, blotchy skin, stumbling and a strained squeal. If a pig evidenced two or more of these signs it was left behind the remainder of the group and termed a highly stressed animal. Approximately 4% of the animals stumbled and fell during handling and were euthanized if they did not show immediate signs of recovery. Although this level of loss is high compared to the industry average, some commercial loads of pigs will reach similar levels. Numerous physiological measures were taken before and after the handling procedure.

RESULTS AND DISCUSSION

Within the Gentle handling treatment only 1 of 48 pigs was considered to be highly stressed by the procedure (Table 1). The Aggressive treatment, including the use of the prod resulted in over 40% of the animals being highly stressed, including all of the pigs which actually went down and had to be euthanized. When the pigs were moved aggressively, but without the use of the electric prod, the proportion of highly stressed pigs was intermediate to the other treatments. The Gentle treatment pigs moved the same distance as the Aggressively handled animals, so the stress was not due to the exercise per se, but rather to the handling methods. The Aggressive treatment components of more rapid movement, additional shouting and slapping did increase

Table 1. The incidence of highly stressed pigs in three different handling treatments.

	Gentle	Aggressive	
		No-Prod	Prodded
No signs of stress	47	41	54
Highly stressed but not falling	1	7	23
Highly stressed and falling	0	0	9
Total # of Pigs	48	48	96
Handling time in course (sec)	701	467	467

the level of stress, but did not put the lives of the pigs in danger. Only when we used the electric prods did we see an extreme stress response in the animals. Prod use in the study would be higher than typical when loading pigs, but under commercial conditions it would be possible for individual pigs that were confused or overly hesitant to be prodded as frequently as our experimental pigs were. These are the pigs that would be susceptible to extreme stress.

The physiological measures indicated that highly stressed pigs had higher temperatures, lower blood pH, and higher blood ammonia levels than did the pigs with no overt signs of stress. Among Aggressively handled pigs, those that received the electric prod showed extremes in these measures. It is also noteworthy that although blood lactate was similar in those showing low and high levels of stress, it was considerably higher in prodded animals than in non-prodded.

IMPLICATIONS

Clearly we should be minimizing the use of the electric prod when handling animals. Before prodding a pig while it is being loaded the handler should consider if another means of encouraging movement could be effective, even if it took slightly longer. If one pig is repeatedly being difficult to move it should be left behind and perhaps herded separately rather than prodding it again. If a producer finds that they must use the electric prod frequently during the load out process, they should consider changes to their load out design and/or general handling techniques.

ACKNOWLEDGEMENTS

Program funding is provided by Sask Pork, Alberta Pork, Manitoba Pork and the Saskatchewan Agricultural Development Fund. Project funds were provided by Elanco Animal Health.

Large Group Auto-Sort: Potential and Problems

H.W. Gonyou and D.L. Whittington

SUMMARY

Large Group Auto Sort (LGAS) systems are being used successfully on a number of operations. In general they are achieving their potential in terms of sorting pigs for market. They are infrequently used to sort pigs towards different diets, even though considerable potential exists for improved efficiency. Loss of productivity remains a significant problem on some operations, although better designed food courts and better training generally address the problem. LGAS requires the collaboration and dedication of the manufacturer/distributor, the farm manager, and staff to ensure its success.

INTRODUCTION

Large Group Auto Sort (LGAS) is a relatively new system that applies electronic technology to the management of grow-finish pigs. The ability of the modern industry to assemble several hundred animals of a similar weight into one pen has made the application of electronic scales and sorting gates cost effective. But the method has received mixed reviews. A number of operations have removed the scales or are using them at less than their planned efficiency, yet others are enthusiastic about the benefits to their operation. We have been monitoring progress in the technology over the past few years, been involved in a producer satisfaction survey, and are conducting a series of trials at our PSC Elstow Research Farm. LGAS has a number of potential advantages, but a number of problems have also been identified.

Individual pigs are weighed each time they pass through the sorter in order to enter the food court

POTENTIAL

1. Reduced labour at sorting. Rather than herding pigs to and through a set of scales, LGAS weighs and sorts pigs as they enter the food court.
2. Hitting the grid. Pigs can be sorted for market the day before shipping, reducing the error involved in pulling pigs based on week-old weights.
3. Split phase feeding. Large and small pigs within the same pen can be fed separate diets that better match their nutrient requirements. Although recognized as a potential for the system, it is rarely practiced. Most systems have not installed additional feed lines that would be needed to accomplish this option.
4. Paylean management. As pigs approach market weight they can be sorted to the heavy feed court to receive Paylean for the maximum allowable period. All pigs in the group can receive Paylean rather than the final two groups to be marketed. Again, this potential has rarely been achieved.
5. Easier handling, reduced losses during transport. Easier handling and loading has been anecdotally reported, and transport surveys have confirmed an advantage of LGAS.

'While there are many benefits to a large group, auto-sort system, one must ensure the system is managed properly to ensure the greatest potential possible.'

PROBLEMS

1. Poor performance. The most successful operations report losses of less than 3% in average daily gain, but some report in excess of 10%. Food court design probably accounts for much of this discrepancy. It is critical that the food court provide easily accessible feeding spaces.
2. Training of pigs. LGAS only works if pigs move easily through the scale en-route to the food court. Most producers favour a gradual training method in which the food court is accessible through several openings for the first few weeks. These openings are gradually closed until the pigs must enter through the scale only. Fewer than 5% of pigs should fail to learn the system.
3. Managing the pigs. Although pigs in large groups are generally as healthy as pigs in conventional pens, they do require health checks and occasional treatment. Health checking requires walking through all areas of the pen. Relief pens, for suspect animals at the beginning of the grow-out period, for those requiring treatment, and for those that fail to learn the system.

4. Managing the program. Although the software is generally easy to manage, there is a learning curve. Managers must ensure that their staff understands the need to monitor pig performance and ensure the program sorts properly.
5. Manufacturer/distributor support. A number of operations have indicated that they could have used more support from the manufacturers or distributors in planning their system, installation, and initial operation.

A one-way gate allows pigs to re-enter the lying area from the food court, but ensures the sorter remains the only access to the food court from the lying area.

Although results from LGAS are improving, and the majority of operations that have used them would install them again, some operations continue to report substantial problems even though they have done everything according to recommendations. The causes of these problems are sometimes difficult to identify, and some producers consider the program a failure.

FURTHER RESEARCH AT PRAIRIE SWINE CENTRE

In 2005, two fully-slatted large group grower-finisher rooms with capacity for 280 pigs each were modified to include auto sorters. A series of studies have been proposed to identify aspects of pen layout, design and pig behaviour that are limiting productivity or impacting on pig behaviour. The first series of studies will be completed in early 2007 and look at the question of handling ease and indicators of stress at transport and comparing pigs housed in large groups (approx. 280 pigs/pen versus small groups (18 pigs per pen).

During the grow-out period animals will be housed and managed as per typical industry norms in each housing system. Measures included are days of transport, physiological sampling for breathing rate, body temperature, skin blotching and cortical (hormone levels). These measure were taken in the barn, on the truck and at the packing plant After being off loaded from the truck. Comparison of these indicators of stress will help to determine any physiological differences on animals linked to differences in ease of handling at market. Additional observations of speed of pig movement at loading and the amount of required use of pushing or use of prod were also made.

IMPLICATIONS

Manufacturers, distributors and managers must be aware that LGAS requires their attention during the design, installation, and initial operating phases. Only when staff feel comfortable with the day to day management of the system will LGAS be capable of achieving its potential. The potential to differentially feed animals of different weights within a pen is yet to be achieved, and requires greater attention to feed delivery systems.

Productivity of Sows and Gilts in Various Management Programs with ESF

H.W. Gonyou, Y. Z. Li, and M.L. Strawford

SUMMARY

In this study we examined the effect of management methods on the productivity of gilts and sows in a group housing system using electronic sow feeders. Dynamic groups, provided animals were not removed or added more often than every 5 weeks, did not affect sow productivity. Grouping animals prior to embryonic implantation resulted in lower productivity than for sows spending 6 weeks in stalls after breeding. This difference was largely due to a reduced farrowing rate rather than poor litter size. Performance of sows in stalls was intermediate to the various group housing methods.

INTRODUCTION

The restriction on movement placed upon sows in gestation stalls has led numerous consumer groups to advocate a move to group housing. The challenge to group housing is to ensure appropriate levels of feed intake for all animals, and to create a social group that can minimize the effects of aggression at the time of group formation. Group housing actually refers to a variety of housing systems and management options, ranging from floor feeding to electronic sow feeders; group sizes from four to several hundred; and regrouping at weaning through to some time after pregnancy is confirmed. It is important for producers to be aware of the effects of these options if they intend to consider alternatives to gestation stalls. Electronic sow feeders (ESF) provide a feeding station that allows one animal at a time to enter and be fed its specific amount of feed. We examined two social management options within an ESF system to determine their effects on productivity.

'It is important to note the management methods used in group housing studies, as these can affect the outcome of the comparison.'

EXPERIMENTAL PROCEDURES

The study was conducted over six breeding cycles at PSC Elstow Research Farm. In total, over 800 breedings were involved, with animals ranging in age from gilt to 5th parity. New animals were added each reproductive cycle. Within the ESF system we considered small groups of approximately 35 sows that were all added to the pen at the same time (static) vs larger (120 sows) that were dynamic, that is groups of approximately 35 sows were removed for farrowing and others added at 5 week intervals. We also considered two stages of gestation at which to place the animals. Animals were either moved to the ESF 8-10 days after breeding, or approximately 45 days after

breeding, by which time embryonic implantation should have occurred. We also collected data from animals kept in stalls for their entire gestation.

RESULTS AND DISCUSSION

Farrowing rate was determined based on all sows mated. We also recorded live piglets born, and calculated the number of live piglets per 100 sows mated. This measure combined farrowing rate and litter size. We classified the sows by parity as gilts, 1st, 2nd and mature, and calculated an adjusted performance assuming a standard distribution of ages in each system. Animal flow problems developed during our first two breeding cycles leading to a decision to house gilts separately from sows in order to be trained to the ESF system.

The farrowing rate of the animals differed with parity, being lowest for gilts and not differing among the older animals (Table 1). This is not an uncommon finding on commercial herds, but the depression was greater within the ESF system. Once gilts were housed by themselves we did not see such a difference. There were no differences between the static and dynamic groups for farrowing rate. Although the farrowing rate for post-implant sows was 4% higher than for pre-implant animals, the difference was not significant. Although such a difference would be a major concern on a commercial farm, the week to week variation in farrowing rate was substantial and precluded a significant treatment effect. Stalled sows were intermediate to the ESF groups of sows. Litter size was smaller for gilts than for other parities, and total live piglets per 100 sows bred was highest for the post-implant than for pre-implant treatment (Table 2). Again, stalled animals were intermediate.

CONCLUSION

Productivity equal to that obtained in stalls can be achieved in an ESF system, but this was only possible in our study if animals were already past implantation when the group was formed. Other studies using only pre-implant grouping tend to report lower productivity in groups. Static and dynamic systems did not differ, but it should be pointed out that our dynamic system involved adding new animals at 5 week intervals, not weekly as in several other studies. It is important to note the management methods used in group housing studies, as these can affect the outcome of the comparison.

ACKNOWLEDGEMENTS

Strategic program funding provided by Sask Pork, Alberta Pork, Manitoba Pork, and the Saskatchewan Agricultural Development Fund. Project funding was provided by Ontario Pork, the Natural Sciences and Engineering Research Council, and Agriculture and Agri-Food Canada.

Table 1. Farrowing rate of gilts and sows in Stalls and various management programs within an Electronic Sow Feeder system[1]

		Pre-Implant		Post-Implant	
	Stalls	Static	Dynamic	Static	Dynamic
Gilt	793	678	681	734	763
1st Parity	898	874	865	929	910
2nd Parity	922	879	956	896	1,008
Mature	948	896	896	982	980
Adjusted[2]	895	834	845	894	917
Adjusted Sows[3]	929	886	898	948	968

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

Effect of Ractopamine in Finishing Diets: Performance and Carcass Composition

J.F. Patience[1], A.D. Beaulieu[1], J. Merrill[2], D.A. Gillis[1], and G. Vessie[2]

SUMMARY

Ractopamine at 5 ppm/kg feed improved growth and feed efficiency by 13% when fed for an average of 26 to 27 days. Ractopamine decreased backfat and improved loin thickness. Transit losses were higher in the ractopamine fed group.

INTRODUCTION

Paylean® is a feed additive that was recently registered in Canada. The active ingredient of Paylean® is ractopamine, a beta-adrenergic agonist known to stimulate muscle growth and inhibit lipid deposition. It has been registered in numerous countries around the world and is actively used by the pork industry in those countries to improve the profitability of pork production. Because the marketing and grading systems in Canada differ from those in other countries, there was a need to evaluate this product locally.

The overall objective of this experiment was to evaluate the effectiveness of Paylean, fed to deliver 5 ppm ractopamine, on performance, carcass characteristics, carcass quality, and the economics of pork production in finishing pigs.

MATERIALS AND METHODS

The experiment was designed so that the average starting weight within a treatment would be 87 kg. This was to provide an average of 28 days on Paylean prior to slaughter. All available pigs in two rooms (1 room started each week) at PSC Elstow were randomly allocated within gender to one of 8 pens. Only pigs with obvious health problems were excluded from the experiment so the variation observed was typical of normal practise.

At the end of the room turn, all remaining pigs were weighed and any feed remaining in the feeder was weighed. Any pigs failing to achieve the minimum market weight at the end of the room-turn were marketed and carcass information obtained from the packing plant. The number of "light" or "tail-ender" pigs was recorded by gender and treatment.

All animals were fed a diet comparable to the barn's normal gilt finisher, The experiment consisted of two treatments: control or 0.25% Paylean®, equivalent to 5 ppm ractopamine (RAC). Except for total lysine which was increased to 1.00 % and the 5 ppm ractopamine; the Paylean-fed pigs were fed a diet formulated to the same specification as the controls.

'The faster growth associated with pigs fed Paylean reduced tail-enders from 7.5% to less than 1%.'

RESULTS AND DISCUSSION

A total of 271 barrows, and 259 gilts started the experiment (Table 1). During the experiment 5 pigs were removed from the experiment, all for reasons unrelated to the trial. Three RAC gilts died during transport to market, and two RAC barrows were condemned at the plant. In this size of experiment, we can't conclude that these deaths were a result of treatment or were a random effect. However, it has been suggested by others that RAC pigs may be more susceptible to stress during shipping.

Average daily gain was 13% higher in the RAC pigs, relative to the controls ($P < 0.001$); genders responded similarly. There was no effect of treatment on feed intake, thus feed conversion also increased by 13% in the RAC pigs ($P < 0.001$). Because they grew more efficiently, the RAC pigs used about 11.5 kg less feed than the control pigs to reach market weight. Thus, this experiment confirms that even at 5 ppm, RAC has positive effects on growth rate in both barrows and gilts. The RAC pigs were on test an average of 26.5 days; the control pigs, 30.1 days (Table 1), thus tail-enders were reduced in the RAC group.

Table 3 shows weekly pig performance, within treatment, according to the week in which the pig was marketed. It can be seen that during the first week of the experiment, except for those pigs shipped during week 5, the RAC pigs consistently outperformed the control treatment. However, these slower growing pigs appeared to respond to RAC during their second week on test. For the pigs marketed during the 5th and

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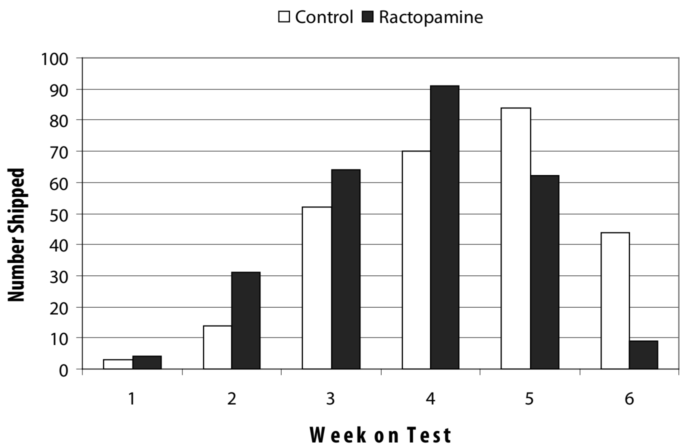

Figure 1. Number of pigs, receiving either the control or ractopamine diets, shipped per week.

6th weeks of the experiment, the response to RAC had diminished. As shown in Figure 1, because of the faster growth by the RAC pigs during the initial weeks of the experiment, more control than treatment pigs were shipped during the final two weeks. This decline in the response to RAC with longer exposure to the product is well documented. The faster growing pigs (> 1.3 kg/d) demonstrated a 13 % increase and the slower growing pigs (< 1.3 kg/d) had a 7 % improvement in growth rate during the first two weeks of the experiment.

The faster growth of the RAC pigs reduced the number of tail-end pigs from 7.5 % to 0.8%, a noteworthy response because of the heavy penalties associated with marketing lightweight pigs.

Table 4 describes the carcass response to RAC. Dressing percent was unaffected by treatment (P > 0.20). RAC reduced backfat thickness by an average of 1 mm (P < 0.02); however, this decrease was 1.8 mm in barrows and only about 0.3 mm in gilts (treatment by gender, P = 0.06). Loin thickness was increased by 2.5 mm, lean yield was improved (P < 0.001) and carcass index tended to improve in the RAC treated pigs (P = 0.06). This results are consistent with the mode of action of RAC

CONCLUSION

Including RAC in the diet at 5 ppm, results in faster growth rate, increased carcass lean and faster barn throughput. The response to RAC diminishes if pigs receive it for more than 28 days.

ACKNOWLEDGEMENTS

Strategic funding provided by Sask Pork, Alberta Pork, Manitoba Pork Council and Saskatchewan Agriculture and Food Development Fund. Specific funding for this project from Elanco Animal Health is gratefully acknowledged.

Table 1. The effect of 5 ppm ractopamine on descriptive statistics of experimental animals

	Control	5 ppm Ractopamine
No. Pigs started[a]		
Males	135	136
Females	131	128
Total	*266*	*264*
No. Pigs Shipped[b]		
Males	135	135
Females	130	126
Total	*265*	*261*
Days on test[b c]		
Males	28.3	25.3
Females	32.1	27.6
Total	*30.1*	*26.5*
Tail-enders[d]		
Males	2	0
Females	18	2
Total	*20*	*2*
No. Condemned		
Males	0	2
Females	0	0
Total	*0*	*2*
No. pigs DOA		
Males	0	0
Females	0	3
Total	0	3

[a] Started on test diets when the average weight of the room was 86 kg. Target was for pigs to be fed ractopamine for an average of 28 days.
[b] Pigs were shipped at 116 kg, or on test for 6 wks.
[c] Effect of treatment (P < 0.001; gender, P < 0.0001; gender by treatment, P = 0.23), SEM = 1.78.
[d] Number of pigs not reaching the minimum live shipping weight of 116 kg, within the available 6 week experimental period.

Table 2. The effect of 5 ppm ractopamine on the overall growth performance

	Control	5ppm Ractopamine	S.E.M.	Treatment	Gender	Trt X Gender
Initial Weight, Kg			P Values [a]			
Males, min	60.7	54.0				
Males, max	114.7	109.1				
Females, min	57.9	62.2				
Females, max	103.6	107.0				
Final Weight, kg						
Males	118.9	118.5				
Females	117.9	117.8				
Average	118.4	118.1	0.03	0.51	0.04	0.65
Overall ADG, kg/d						
Males	1.14	1.30				
Females	1.01	1.14				
Average	1.08	1.22	0.03	0.001	0.001	0.81
Overall ADFI, kg/d						
Males	3.61	3.59				
Females	3.12	3.14				
Average	3.37	3.36	0.04	0.93	0.001	0.74
Overall Feed Conversion Efficiency						
Males	0.32	0.36				
Females	0.32	0.36				
Average	0.32	0.36	0.01	0.001	0.33	0.89
Kg feed/pig started						
Males	102.5	90.5				
Females	99.5	87.8				
Average	101.0	89.2				

[a] Model included the effects of treatment, gender and the treatment by gender interaction. Room (n=2) was considered random. Pen (n=32) was the experimental unit. Initial weight and kg feed/pig started refer to entire cohort within treatment, therefore not analyzed statistically.

Table 3. The effect of ractopamine on average weekly growth rate according to the week of shipping

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

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

Effect of Ractopamine in Finishing Diets: Meat Quality

J.F. Patience[1], A.D. Beaulieu[1], P. Shand[2], Z. Pietrasik[2], J. Merrill[3], D.A. Gillis[1] and G. Vessie[3]

SUMMARY

Ractopamine at 5 ppm/kg feed improved growth and feed efficiency by 13% when fed for an average of 26 to 27 days. Ractopamine decreased backfat and improved loin thickness. Transit losses were higher in the ractopamine fed group.

INTRODUCTION

Paylean® is a feed additive that was recently registered in Canada. The active ingredient of Paylean® is ractopamine, a beta-adrenergic agonist known to stimulate muscle growth and inhibit lipid deposition. There is limited information available on the impact of RAC on the eating quality of pork and the results available are inconclusive. Moreover, few studies used taste panel evaluation. Those studies that did evaluate meat quality suggested that RAC had no effect on visual colour, firmness, marbling or sensory juiciness and flavour properties. However, the effect of RAC was inconsistent for some quality traits, specifically, meat tenderness or Warner-Bratzler shear force. The acceptance of pork by the consumer is critical to the industry's success, therefore it is important to determine if RAC has an impact on eating quality. The data reported here was from a larger trial (see page 28). The specific objective of part 2 was to evaluate the impact of feeding 5 ppm RAC on meat quality and the sensory characteristics of pork.

Table 1. The effect of 5 ppm ractopamine on loin quality and cooking characteristics.

	Control	RAC	SEM	P value
pH	5.74	5.74	0.09	0.93
Drip loss				
24 hrs	4.77	4.28	0.78	0.35
48 hrs	6.73	6.21	0.80	0.38
CIE colour				
L*	54.47	43.13	0.65	0.62
a*	8.19	7.43	0.23	<0.001
b*	13.93	13.10	0.13	<0.001
Visual colour score				
Candian[a]	2.7	2.7	0.17	0.74
USA[b]	2.9	3.0	0.08	0.64
Japanese[c]	2.8	2.8	0.09	0.64
Marbling[d]	1.8	1.8	0.13	0.84
Back fat , mm	15.7	12.6	0.75	< 0.001
Loin-eye area, cm^2	52.2	56.0	1.62	< 0.001
Cook loss, %	20.3	20.5	0.63	0.73
Cook time, min	15.2	15.8	0.2	0.03
Shear force	64.9	72.8	2.7	< 0.001

[a]Scale of 1 to 5; 1=extremely pale, 5=extremely dark
[b]Scale of 1 to 6; 1=pale pinkish gray to white, 6=dark purplish red
[c]Scale of 1 to 6; 1=light, 6=dark
[d]Marbling scores correspond to estimated intramuscular lipid content

MATERIALS AND METHODS

The experiment was designed so that the average starting weight within a treatment would be 87 kg. This was to provide an average of 28 days on Paylean prior to slaughter.

All animals were fed a diet comparable to the barn's normal gilt finisher, The experiment consisted of two treatments: control or 0.25% Paylean®, equivalent to 5 ppm ractopamine (RAC).

In each of two weeks, a total of 8 animals from each gender and treatment (32 animals per week) selected for shipping, were randomly selected for detailed meat quality analysis. Loin eye area and backfat measurements were determined following chilling. Loins were harvested one day post-slaughter, and cut into one inch chops for measurement of drip loss, subjective colour scores, chemical composition, sensory evaluation and shear force. Sensory analysis was conducted using 11 trained panelists. They were provided individual cubes of meat cooked to an internal temperature of 70°C.

'Including ractopamine in the diet at 5 ppm did not markedly affect meat quality parameters.'

[1]Prairie Swine Centre, [2]University of Saskatchewan, Dept. of Applied Microbiology & Food Science, [3]Elanco Animal Health, Guelph, Ontario

Table 2. The effect of 5 ppm ractopamine on loin quality and cooking characteristics.

	Control	RAC	SEM	P-Value
Initial tenderness[a]	5.6	5.2	0.16	0.04
Overall tenderness[a]	5.7	5.3	0.16	0.05
Connective tissue[b]	5.8	5.7	0.23	0.79
Juiciness[a]	5.2	5.2	0.17	0.85
Pork flavour intensity[a]	5.2	4.9	0.13	0.09
Flavour desirability	5.6	5.5	0.17	0.67
Overall acceptability	5.6	5.3	0.16	0.22

[a]Intensity of sensory attributes was evaluated based on an 8-point scale (8=extremely tender, juicy, desirable flavour to 1 = extremely tough, dry and bland)
[b]Amount of perceptible connective tissue.

RESULTS AND DISCUSSION

Similar to the results shown by those feeding ractopamine at 10 ppm or 20 ppm, including ractopamine in the diet at 5 ppm did not markedly affect meat quality parameters (Table 1). pH, drip loss, and visual colour scores were unaffected ($P > 0.05$). Changes in some of the colour scores were statistically significant, however, the absolute differences are of uncertain significance from a consumer perspective.

Our observation that RAC had no effect on marbling is consistent with some published reports, but not others. The lack of an effect in our study may be due to our low inclusion rate. The decrease in back fat, and improvement in loin-eye area are consistent with the known mechanism of action of ractopamine.

The increase in shear force, and decreases in observed tenderness supports previous reports that RAC may produce less tender pork. The effect of RAC on shear force was more pronounced in gilts, than barrows. Overall acceptability however, was not affected by the inclusion of RAC in the diet at 5 ppm (Table 2).

ACKNOWLEDGEMENTS

Strategic funding provided by Sask Pork, Alberta Pork, Manitoba Pork Council and Saskatchewan Agriculture and Food Development Fund. Specific funding for this project from Elanco Animal Health is gratefully acknowledged.

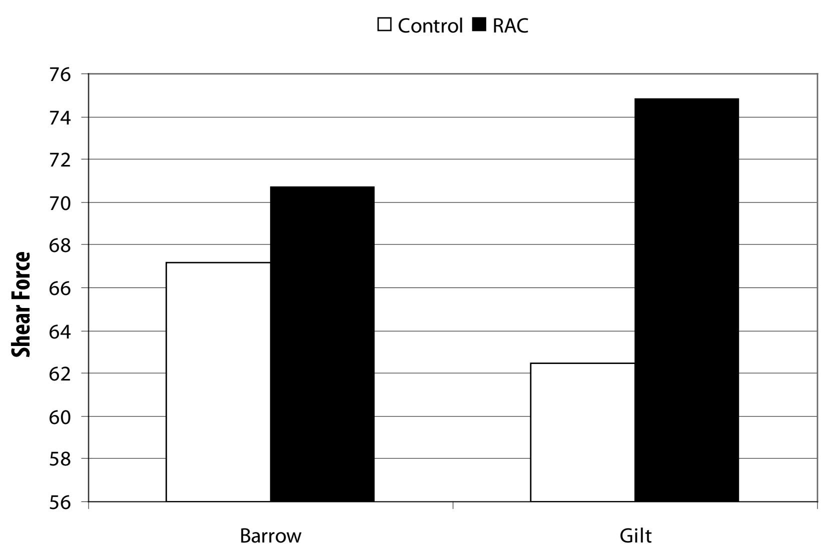

Figure 1. The effect of RAC and tenderness on Warner-Bratzler shear force (treatment, $P < 0.01$; gender $P = 0.83$; gender by treatment interaction, $P < 0.01$). A lower number indicates improved tenderness.

Effect of Ractopamine in Finishing Diets: Economics

J.F. Patience[1], A.D. Beaulieu[1], J. Merrill[2], D.A. Gillis[1], and G. Vessie[2]

SUMMARY

Pigs were fed a control diet, or that diet supplemented with 5 ppm/kg ractopamine for an average of 27 days. Ractopamine improved growth and feed conversion, decreased backfat and improved loin thickness. The economic benefit accruing from the use of ractopamine will depend on market prices, grading grids and the current farm's carcass quality. Based on our experiment we estimate a "typical" return in the range of $2 to $3 per pig sold.

INTRODUCTION

Paylean® is a feed additive that was recently registered in Canada. The active ingredient of Paylean® is ractopamine, a beta-adrenergic agonist known to stimulate muscle growth and inhibit fat deposition. The final decision to use Paylean® will depend on the relative economics. Similar to other feed additives, there is a cost to using this product. Apart from the cost of the product there are costs associated with the additional nutrients and management required to exploit the performance expected with Paylean®.

MATERIALS AND METHODS

Approximately 530 animals were assigned to receive either a control or a diet supplemented with Paylean® to supply 5 mg/kg ractopamine (RAC). This was to provide an average of 28 days on Paylean® prior to slaughter.

All animals were fed a diet comparable to the barn's normal gilt finisher. The experiment consisted of two treatments: control or 0.25% Paylean®, equivalent to 5 ppm ractopamine. Except for total lysine which was increased to 1.00 % and the 5 ppm ractopamine; the Paylean®-fed pigs were fed a diet formulated to the same specification as the controls.

All pigs were shipped to Mitchell's Gourmet Foods in Saskatoon. Shipping occurred once per week. Pigs were shipped at 116 kg. Market weights were recorded on the morning prior to marketing. The room was completely emptied on week 14 of the growout period (week 6 of the experiment) as per normal barn procedure. Pigs not attaining 116 kg after 14 wk of growout are classified as tail-enders.

Because the economic impact of using ractopamine is dependent on individual farm circumstances, the calculations used different scenarios. We assumed a market price of $1.40 kg and a net market value of $149.00. Other assumptions are described under the appropriate table.

RESULTS AND DISCUSSION

Table 1 shows the performance and carcass parameters, which influence the economics of pork production. Additionally, the feed costs, associated with the use of ractopamine are described.

'Based on our data, the use of RAC would permit the close-out of a room or barn approximately one week earlier.'

Based on our data, the use of RAC would permit the close-out of a room or barn approximately one week earlier. Assuming that pigs are available to refill that room one week earlier, the net return per pig place would increase by almost $5.00 per year (Table 2). Alternatively, the number of tail-end pigs could be reduced. Reducing the proportion of tail-end pigs from 7.5 % to 0.75 % would increase gross income by about $2.17 per pig sold in a $1.40 /kg market and assuming the tail-end pigs weigh an average of 81 kg, have an average index of 101.9 and receive a loin bonus of $1.86.

Table 1. The effect of 5 ppm ractopamine on parameters influencing the economics of pork production.

Parameter	Control	RAC
Days on test	30.1	26.5
Tail-enders	20	2
# pigs condemned	0	2
# pigs DOA	0	3
Overall ADG, kg/d	1.08	1.22
Overall FCE	0.32	0.36
Kg feed/pig started	100.7	89.2
Backfat, mm	18.1	17.1
Loin thickness, mm	68.26	70.79
Carcass index	109.96	110.57
Carcass premium, $	1.64	1.34
Carcass value, $	118.77	119.08
Feed Cost ($/Pig)		
Basal cost	13.73	12.19
Extra amino acids	0.00	0.59
Extra minerals and vitamins	0.00	0.21
Ractopamine	0.00	1.72
Total feed cost	13.73	14.71

[1]Prairie Swine Centre, [2]Elanco Animal Health, Guelph, Ontario

Table 2. The impact of reducing the growout period by 1 week[a]

	Control	RAC	Difference, $/pig
Barn turn, wk	16	15	
Gross revenue, $/pig	149	149	0.00
Feeder pig cost, $/pig	67	67	0.00
Contract barn cost, $/turn	16	15	1.00
Feed, trucking, etc, $/pig	60	60	0.00
Net, $/pig	6.00	6.00	1.00
Net, $/pig place	19.50	24.29	4.79

[a]Assumptions: Contract barn cost is $52 per pig place per year; feeder pig valued at 45% of market hog; trucking cost is $5; other cost $5.

If producers are operating under a grading system that does not penalize heavier carcasses, the increase in growth rate could be converted directly into heavier pigs sold (rather than pigs of the same weight sold earlier). Using the growth data obtained from our experiment, and accounting for the additional feed required the return over feed cost would be an additional $3.94 per pig sold (Table 3).

RAC decreased back fat thickness by 1 mm and increased loin thickness by 2.5 mm. In gilts, where backfat was unchanged and loin thickness increased by 2.4 mm, carcass index actually declined by 0.3. In barrows, backfat was reduced by 1.8 mm and loin thickness increased by 2.6 mm, carcass index actually increased by 1.6. Based on the results of our experiment, this increase in carcass index would increase gross income per pig by only $0.80 in a $1.40/kg market.

The increase in loin thickness observed as a consequence of using RAC would increase loin premiums on most farms. However, in our experiment, the control pigs already had a loin thickness of 68.3 mm, and loin premiums dropped from $3.50 to 0.50 when loins exceeded 70 mm. However, if average loin thickness is 62.8 mm (Mitchell's Gourmet Foods, personal communication) and assuming a standard deviation of 6.8 mm (PSC Elstow Research Farm, unpublished) RAC would decrease loin premiums from $2.56 to $2.46 (Table 4). A change in loin premium structure would dramatically alter this scenario.

CONCLUSION

The actual benefit accruing from the use of RAC will depend on individual farm circumstances. However, based on our data, the "typical" farm will see a return of $2 to $3 per pig sold.

ACKNOWLEDGEMENTS

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Table 3. The impact of marketing heavier pigs

	Control	RAC	Difference, $/pigRAC - control
Market price, $/kg	1.40	1.40	$0.00
Value of heavier carcass[a]	0.00	5.83	$5.83
Finishing feed cost, $/tonne	150	150	$0.00
Finishing feed cost, additional $/pig[b]	0.00	1.89	-$1.89
Net return			$3.94

[a]Pigs on Paylean grew 13% more than control pigs over the 26 day feeding period, this resulted in a 3.6 kg more live weight, or a 2.9 kg heavier carcass. The value of the additional carcass is: $1.40/kg x 2.9 kg x 1.1057 (index) + $1.34 (loin premium)

[b]Finishing feed requirement; 3.6 kg gain x 3.5 kg feed/kg gain = 12.6 kg feed x $150/tonne.

Table 4. The impact of marketing heavier loins[b]

	Control	RAC	Difference RAC - control
Average loin thickness, mm	62.8	65.3	+2.5 mm
Standard deviation, mm	6.8	6.8	0.00
Percentage of loins falling within;			
50 to 54 mm	12.7	6.6	
54 to 59 mm	21.4	15.2	
60 to 70 mm	51.2	53.7	
71 + mm	14.7	24.5	
Mean premium, $/pig sold	2.56	2.46	$ - 0.10

[a]Loin premium: $1.25 (50 to 54 mm); $2.50 (55 to 59 mm); $3.50 (60 to 70 mm), $0.50 (71 + mm).

Impact of Piglet Birth Weight on Growout Performance and Carcass Quality

J.F. Patience, A.D. Beaulieu and T. Osmanagic

SUMMARY

Increased litter size resulted in decreased average birth weight, but had no effect on body weight variability at birth or later in life. Carcass quality was unaffected by litter size.

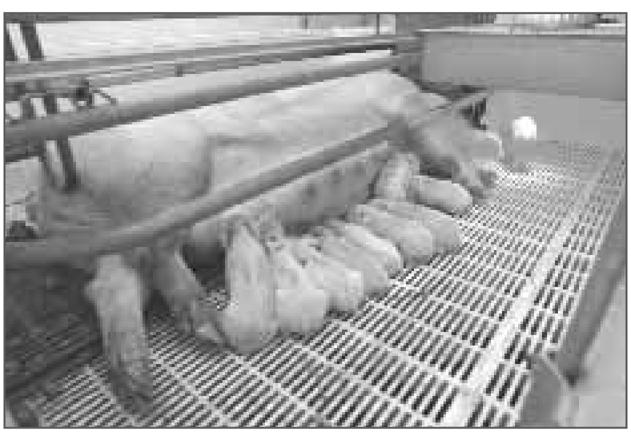
INTRODUCTION

Muscles contain primary and secondary fibres. One consequence of reduced birth weight are changes in the proportions of these fibre types in the muscles. The effect of this on the adult muscle composition and subsequent eating quality of the meat is not known. Increased litter size results in a reduced mean birth weight. Recent analysis (Patience, unpublished data) showed that increasing litter size by 1 pig, reduced average birth weight by 100g and doubled the proportion of piglets with a birth weight below 800g.

The objective of this experiment was to determine if there is a relationship among birth weight and post-weaning growth performance on carcass quality, muscle histology and subsequent eating quality. Secondly, we wanted to determine if increased litter size was associated with increased variability of piglet weight at birth and during later life. The muscle histology and eating quality results will be presented in a later report.

MATERIALS AND METHODS

All farrowings were attended during a 5 week period at PSC Elstow. At the time of farrowing, each live-borne piglet was identified individually, weighed and then re-weighed on the day of weaning, 5 weeks post-weaning, at nursery exit, at first pull, and at the time of marketing. The number of mummies and stillborn piglets were also recorded, but not weighed and not included in the birth order. Management followed normal barn protocols.



RESULTS AND DISCUSSION

Litter size. Data was collected from 98 litters and 1,114 piglets (Table 1). Litters were divided into “small” (3 to 10 piglets born alive), “medium” (11 to 13 born alive) and “large”, (14 to 19 born alive). Interestingly, 91% of the total born were born alive in the small and medium groups, while greater than 98 % of those born in the large litters were born alive. The proportion of pigs weaned of those born alive was about 85% for all groups.

‘Increased litter size resulted in decreased average birth weight, but had no effect on body weight variability at birth.’

Average birth weight was 1.59, 1.41 and 1.35 kg for the small, medium and large groups, respectively (Table 1). The standard deviation (SD) of birth weight was very similar between groups, 0.30 to 0.32 kg, and therefore the coefficient of variation (CV=SD/mean * 100) was slightly less for the large litters.

Weaning weights. Average weaning weight was 6.55 kg, and ranged from 1.55 kg to 10.7 kg. The average SD for weaning weight was 1.45 kg, which is similar to the SD for the “large” litter group. The SD for the “small” litter groups was slightly higher, 1.59, and therefore the CV for weaning weight was similar among groups. The 5 and 7 week weights show a similar trend. Average weights were similar between groups, and the SD was actually slightly lower for the “large” litter groups, resulting in a similar CV between groups.

Market Data. Dressing weight was approximately 94.30 kg, and was similar between litter size groups, as was the SD and therefore the CV (Table 2). The lean yield, loin area, and mm of fat varied more within a litter group than between.

CONCLUSIONS

As expected, increased litter size, results in decreased average birth weight, however, it was surprising to observe that larger litters does not result in increased variability in body weight at birth.

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Table 1. The effect of litter size on the growth and variability of growth

	Small 1/3 of litters	Medium 1/3 of litters	Large 1/3 of litters	All Litters
Litter n	38	39	21	98
	------------------------------------TOTAL BORN ALIVE, n----------------------------------			
Mean	8.37	12.10	15.43	11.37
StDev	1.75	0.85	1.50	3.04
Min	3.00	11.00	14.00	3.00
Max	10.00	13.00	19.00	19.00
CV, %	20.91	7.02	9.72	26.74
	--------------------------------------TOTAL WEANED, n--------------------------------------			
Mean	7.29	10.31	12.86	9.68
StDev	1.99	1.66	3.17	3.04
Min	2.00	5.00	2.00	2.00
Max	10.00	13.00	17.00	17.00
CV, %	27.30	15.42	24.63	31.44
	--------------------------------------d0 BODY WEIGHT. kg--------------------------------------			
Mean	1.59	1.41	1.35	1.44
StDev	0.32	0.30	0.32	0.33
Min	0.80	0.75	0.75	0.75
Max	2.50	2.50	2.35	2.50
CV, %	20.13	21.27	23.76	22.61
	--------------------------------------WEANING WEIGHT, kg--------------------------------------			
Mean	6.78	6.43	6.47	6.55
StDev	1.59	1.33	1.45	1.45
Min	1.55	2.00	2.05	1.55
Max	10.70	9.75	10.10	10.70
CV, %	23.45	20.67	22.39	22.11
	--5 WK WEIGHTS, kg--			
Mean	22.73	21.98	22.66	22.39
StDev	4.11	3.44	3.65	3.72
Min	8.30	11.35	7.75	7.75
Max	33.50	30.05	31.85	33.50
CV, %	18.09	15.66	16.11	16.60
	--7 WK WEIGHTS, kg--			
Mean	32.57	31.67	32.88	32.28
StDev	5.00	4.28	4.63	4.62
Min	11.90	18.75	14.50	11.90
Max	44.40	43.85	44.90	44.90
CV, %	15.36	13.50	14.10	14.33
	-------------------------------------1st PULL WEIGHTS, kg--------------------------------------			
Mean	97.66	97.42	98.7	97.93
StDev	10.73	9.98	10.50	10.40
Min	59.9	65.8	63.7	63,13
Max	122.4	118.4	122.2	121.0
CV, %	10.98	10.25	10.64	10.62

Table 2. The effect of litter size on carcass quality

	Small 1/3 of litters	Med 1/3 of litters	Large 1/3 of litters	All Litters
# OF PIGS	222	222	199	
		------DRESSING WT, kg------		
Mean, kg	94.39	94.30	94.42	94.36
StDev, kg	3.56	4.21	3.63	3.86
Min, kg	79.90	75.60	74.30	74.30
Max, kg	79.90	107.20	104.20	107.20
CV, %	3.77	4.47	3.84	4.09
		------YIELD, %------		
Mean	60.40	60.54	60.16	60.39
StDev	1.84	2.03	1.99	1.96
Min	55.10	55.20	54.90	54.90
Max	64.70	65.40	65.00	65.40
CV	3.04	3.35	3.30	3.25
		------LOIN. mm------		
Mean, mm	66.41	67.11	66.42	66.70
StDev, mm	5.84	6.67	7.25	6.60
Min, mm	46.00	44.00	34.00	34.00
Max, mm	78.00	81.00	79.50	81.00
CV, %	8.80	9.94	10.91	9.89
		------FAT, mm------		
Mean, mm	19.74	19.56	20.28	19.82
StDev, mm	4.24	4.74	4.48	4.52
Min, mm	11.00	10.00	11.00	10.00
Max, mm	36.00	35.00	32.50	36.00
CV, %	21.27	24.25	22.07	22.82
		------INDEX------		
Mean	109.30	108.90	108.62	108.95
StDev	6.41	7.02	7.57	6.99
Min	50.00	50.00	50.00	50.00
Max	113.00	113.00	113.00	113.00
CV, %	5.86	6.45	6.97	6.42

Interaction of Dietary Energy and Phytase on Performance of Weanling Pigs

A.D. Beaulieu, K.A. Ross, D.A. Gillis and J.F. Patience

SUMMARY

Adding 500 FTU/kg phytase enzyme to a barley, corn, SBM diet improved the performance of weanling pigs, regardless of the energy content of the diet. Growth of pigs fed low energy diets deficient in available phosphorus was equal to that of a high energy diet with sufficient aP (available phosphorus).

INTRODUCTION

Approximately 60 to 80% of the phosphorus (P) in cereal grains and oil seeds is bound to phytate and unavailable to monograstics, including swine. Supplementing swine diets with the phytase enzyme improves P availability and retention (ie. Prairie Swine Centre, Inc., Annual Research Report, 2004). The phytate molecule complexes other minerals, proteins, and starch, however, the research examining the effect of the phytase enzyme on the utilization of these nutrients has demonstrated inconsistent responses and the conclusions are equivocal.

Phytase, a protein, is subject to heat damage and is thus not suitable for use in pelleted diets. However, the developer of the enzyme used in this study reported improved thermotolerance, thus we examined the efficacy of this enzyme in pelleted diets. The overall objective of this experiment was to examine the interaction between phytase and dietary energy content. Secondly, the results we report are relevant for producers using pelleted feed.

EXPERIMENTAL PROCEDURES

The experiment used a total of 406 pigs housed in two nurseries of 28 pens each. Pigs were started on the 42-day trial at 5 days post weaning (9.30 ± 0.51 kg). Pigs were blocked by weight and assigned to one of 7 dietary treatments. The treatments consisted of a positive control (PC) and 6 treatments arranged as a 3 x 2 factorial (3 dietary energy levels x 2 phytase levels). Diets were fed in two phases; phase 1 was fed for 2 weeks and phase 2 for 4 weeks. Diets were formulated using barley, corn, soybean meal, canola oil, spray dried plasma, red blood cells, and the necessary minerals, vitamins and amino acids to meet the requirements (except P) for pigs of this age. Energy, Ca and P content of the treatment diets is described in Table 1.

RESULTS AND DISCUSSION

Supplementing diets with 500 FTU phytase/kg increased average daily gain (ADG) from 500 to 560 g/d ($P < 0.01$), feed intake (ADFI) from 900 to 950 g/d ($P < 0.01$) and feed efficiency (FCE) from 0.58 to 0.62 ($P < 0.05$; Figure 1, Table 2). Increasing the energy content linearly improved ADG and FCE ($P < 0.02$), and quadratically improved ADFI ($P < 0.03$). The phytase by energy interaction was not significant for any performance variable. This indicates that the improvement observed with phytase is not dependent on dietary energy content (Table 2).

'Improved performance was observed when weanling pigs were fed lower energy diets supplemented with phytase.'

The ADG of pigs fed the PC diet, which was formulated to be adequate in Ca and P, and was higher in energy than the treatment diets, was similar to the ADG of pigs fed a diet containing 3.45 Mcal DE/kg regardless of phytase supplementation. When the pigs were fed the lower energy and 0 phytase treatment diets (treatments 4 and 6) the ADG was lower than seen with the PC ($P < 0.05$). However, the ADG of the low energy treatment diets was similar to the PC when these diets were supplemented with phytase ($P > 0.05$; Figure 1). From these results we conclude that the phytase enzyme, either directly or indirectly, improved energy availability to the pigs fed the lower energy diets in this experiment.

In our earlier work , the apparent digestibility of energy was not affected when weanling pigs were fed diets supplemented with 500 FTU/kg phytase. This both agrees and disagrees with various experiments reported by others. This discrepancy may be due to differences among experiments in nutrient concentrations, ingredients and length of feeding period. Explaining the effect of the phytase enzyme on overall performance is apparently more complex than simply meeting the P requirements of the pig.

CONCLUSION

An improvement in performance was observed when weanling pigs were fed lower energy diets and supplemented with phytase. Further research is needed to fully understand the mechanism responsible for this observation. The phytase enzyme continued to work even when used in pelleted diets.

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Table 1. Energy, calcium and phosphorous content of the experimental diets (as fed basis) compared to the requirements (NRC, 1998) for pigs of this weight class

Treatment	1	2	3	4	5	6	7	Requirement
Phytase, FTU/kg	0	0	500	0	500	0	500	
				Phase 1				10-22kg
DE, Mcal/kg	3.48	3.45	3.45	3.41	3.41	3.37	3.37	
Ca, %	0.70	0.58	0.58	0.58	0.58	0.58	0.58	0.70
tP, %	0.58	0.45	0.45	0.45	0.45	0.45	0.45	0.60
aPa, %	0.32	0.18	0.18	0.18	0.18	0.18	0.18	0.32
aPb, %	0.32	0.18	0.32	0.18	0.32	0.18	0.32	
				Phase 2				20-50 kg
DE, Mcal/kg	3.52	3.49	3.49	3.49	3.49	3.49	3.49	
Ca, %	0.60	0.48	0.48	0.48	0.48	0.48	0.48	0.60
tP, %	0.53	0.39	0.39	0.39	0.39	0.39	0.39	0.50
aPa, %	0.23	0.09	0.09	0.09	0.09	0.09	0.09	0.23
aPb, %	0.23	0.09	0.23	0.09	0.23	0.09	0.23	

[a]The available P content assuming the phytase enzyme is ineffective.
[b]The available P content using the values reported by the enzyme manufacturer for improvements in P availability.

Table 2. The performance response of weanling pigs when fed diets with 0 or 500 FTU phytase/kg and increasing DE content.

Treatment	1	2	3	4	5	6	7
Phytase, FTU/kg	0	0	500	0	500	0	500
ADG, kg/d	0.58a	0.54a	0.59a	0.48b	0.55a	0.49b	0.54a
ADFI, kg/d	0.95a	0.92a	0.94a	0.85b	0.94a	0.93a	0.95a
FCE	0.63a	0.61a	0.64a	0.58b	0.62a	0.56b	0.59a
P values	ADG	ADFI	FCE				
Phytase	0.0004	0.003	0.04				
Phytase x energy	0.66	0.10	0.99				
Energy, linear[c]	0.02	0.64	0.003				
Energy, quadratic[c]	0.05	0.03	0.74				

[a,b]Means in a row with the superscript "b" (and are in bold) are different ($P < 0.05$) from the positive control (treatment #1)
[c]Analysis excluded the PC and the 500 FTU/kg phytase treatments.

Does the Energy of Peas Depend on Their Composition

P. Leterme, A.D. Beaulieu, and J.F. Patience

SUMMARY

High variation in crude protein and starch content is observed among peas collected in farms of Western Canada. This paper evaluates the impact of that variation on the energy value of peas to pigs.

INTRODUCTION

Feed producers are concerned by the high variation of composition observed among the pea samples collected throughout the Prairies. However, it is unclear whether this variation affects the energy value of the peas.

RESULTS AND DISCUSSION

A total of 50 pea samples were collected in Saskatchewan, Alberta and Manitoba in 2005. Their analysis confirms the high rate of variation in composition, especially in crude protein and in starch content (Table 1). This is in agreement with the observations of the Canadian Grain Commission (20 to 26% for crude protein, Nang & Daun, 2004). However, a detailed analysis of the results shows that the majority of the samples had a protein content ranging from 22 to 24% of the dry matter (Figure 1).

Table 1. Average composition of 50 pea samples collected in Western Canada in 2006 (g/kg DM).

	Mean	Standard Deviation	Minimum	Maximum
Dry matter	12.0	1.0	9.6	13.6
Crude protein (N x 6.25)	232	14	199	281
Starch	488	25	386	511
Fat	12.5	3.2	7.9	20.4
Total dietary fibre	227	15	188	249
Ash	28.2	2.1	24.5	33.7
Calcium	0.6	0.3	0.2	1.2
Phosphorus	3.7	0.5	2.8	4.8

In 1998, Zijlstra et al. determined the digestible energy (DE) of 11 pea samples collected in Western Canada and obtained DE values ranging from 3100 to 3740 kcal/kg. This represents a 20% variation, which is lower than the variation observed for crude protein and starch, for example. Unlike what is observed in cereals, no relationship could be established between the neutral detergent fibre (NDF) content and the energy value.

'Pea samples showed a large variation in protein content, approximately two-thirds of the samples ranged between 22-26% protein.'

Different hypotheses have been developed to explain why NDF is as poor determinant of energy. First, the NDF content of peas does not reflect their actual dietary fibre content. Peas contain, on average, 10-12 % NDF whereas the real dietary fibre content ranges from 19 to 25% of the dry matter (Table 1). The difference is due to the fact that the NDF method with detergents is not appropriate for pulse grains and to the presence of soluble fibre, namely pectin and oligosaccharides. No information is available on the effect of these undetected components. Second, more than 90% of the pea fibres are fermented in the digestive tract of the pig and we do not know how this

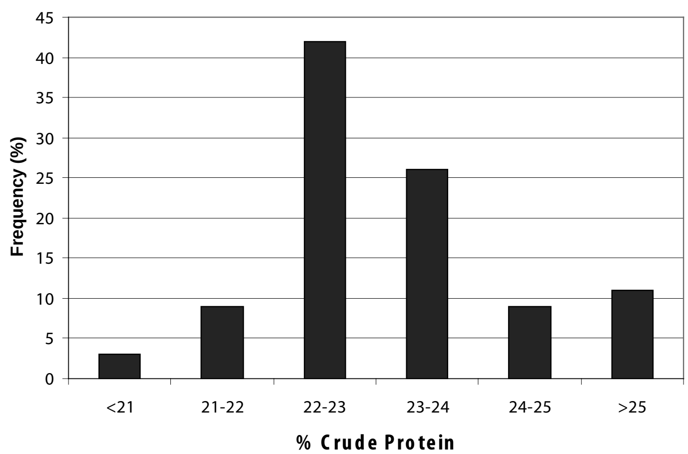

Figure 1. Variation in protein content among pea samples collected in western Canada.

affects the digestive processes. Finally, fibre fermentation provides energy to the pig, in the form of volatile fatty acids, but to an extent that still needs to be determined.

Researchers at Prairie Swine Centre are currently working on the estimation of the net energy value of pea samples differing in composition. They aim to use Noblet's equations of prediction. The latter are based on the composition and digestibility of the diet. Some equations are only based on composition (see example):

'The range of variation in energy content (8%) is thus much lower than the variation in protein or starch content of peas.'

NE = 2790 + 4.12 x EE + 0.81 x Starch – 6.65 x Ash – 4.72 x ADF where EE (ether extract) is the fat content and ADF the acid detergent fibre (ligno-cellulose) content (Noblet et al, 1994).

This equation was used here to estimate the NE value of the 50 pea samples and the results range from 2,460 to 2,680 kcal NE/kg. The range of variation in energy content (8%) is thus much lower than the variation observed in protein or starch content of peas.

According to that equation, ash is the main factor that affects NE, whereas starch plays a limited role and protein has no effect at all. Peas are quite low in ash but the content is very variable. Wang and Daun (2004) observed higher variation than in the present study (1.3 to 3.4%) and ascribe the variation to potassium, which represents 40% of the total mineral content. The fat content is also an important component of energy but, as for ash, the levels in peas are very limited. The last component is ADF or ligno-cellulose but the latter is the most stable components of peas (from 6.5 to 8.6%; Wang & Daun, 2004).

CONCLUSION

In summary, it is likely that the variation in energy value of peas will be lower that what the variation in protein and starch contents might suggest because the latter don't affect energy digestion very much and that the components that could affect energy supply are either present in low amounts in peas (ash, fat) or don't vary significantly (ADF).

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Invited Lectures: Canada

Leterme, P. 2006 Market potential for faba beans in animal nutrition. Faba Bean Industry Meeting, Canora, SK. March 15.

Patience, J.F. 2006. Variation in the finisher barn. Manitoba Swine Seminar, Winnipeg, MB. February 1-2.

Patience, J.F. 2006. Maximizing carcass quality using nutrition. PIC Canada Ltd. Winnipeg, MB. March 8.

Patience, J.F. 2006. Finishing for maximum profitability. PIC Canada Ltd. Winnipeg, MB. March 8.

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Patience, J.F. 2006. Maximizing carcass quality using nutrition. PIC Canada Ltd. Brandon, MB. March 9.

Patience, J.F. 2006. Practical approaches to increasing net income. Manitoba Pork Council. Winnipeg, MB. March 10.

Patience, J.F. 2006. The basics of swine nutrition. Big Sky Farms Manager in Training Course. Humboldt, SK. May 16.

Patience, J.F. 2006. A producer checklist to address the current financial environment. Alberta Pork Regional Meeting. Grand Prairie, AB. November 7.

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Patience, J.F. 2006. Maximizing net income by optimizing the portion of pigs marketed within core. Saskatchewan Pork Industry Symposium. Saskatoon, SK. November 14.

Patience, J.F. 2006. Biological variation in the pig. Department of Animal and Poultry Science, University of Saskatchewan. Saskatoon SK. November 27.

Whittington, D.L. 2006. Water Management-Tips for Saving Water. Swine Technology Conference, Red Deer, AB, October 26.

Whittington, D.L. and **J.F. Patience**. 2006. Your role in driving costs down. Swine Technology Conference, Red Deer, AB, October 26.

Whittington, D.L. 2006. Disease matrix – Linking knowledge to practical solutions. Banff Pork Seminar, Banff, AB. January 18-19.

Invited Lectures: International

Gonyou, H. W. 2006. Floor space requirements for grow/finish pigs in large groups. National Pork Board Research Symposium, Allen D. Leman Swine Conference. St. Paul, Minn. Sept 23-26.

Gonyou, H. W. 2006. Achieving a double-eagle with enough space and good pen dynamics. Annual Swine Conference, Carthage Veterinary Services. Macomb, Il. Aug. 29.

Gonyou, H. W. 2006. Social behaviour of pigs. Advanced Swine Production Technology Course. Univ. of Illinois. Champaign. June11-17.

Gonyou, H. W. 2006. Feeder and drinker design and management. Advanced Swine Production Technology Course. Univ. of Illinois. Champaign. June11-17.

Gonyou, H.W. 2006. Growth – environmental considerations. Advanced Swine Production Technology Course. University of Illinois, Urbana-Champaign, IL. June 14.

Gonyou, H.W. 2006. Feeder and drinking design and management. Advanced Swine Production Technology Course. University of Illinois, Urbana-Champaign, IL. June 14.

Gonyou, H.W. 2006. Workshop – Monitoring the animal's environment. Advanced Swine Production Technology Course. University of Illinois, Urbana-Champaign, IL. June 14.

Gonyou, H.W. 2006. Pig behavior as influenced by feeder design, group size and space allowance. Kansas State University 2006 Swine Profitability Conference, Manhattan, KS. February 7

Patience, J.F. 2006. The advantages of net energy systems for pigs. Pre-Symposium workshop on net energy systems for growing and fattening pigs, Digestive Physiology for Pigs. Vejle, Denmark. May 24.

Patience, J.F. 2006. The importance of water and water intake in pig nutrition. Farmville, PA. Lucta. May 3-5.

Patience, J.F. 2006. The role of energy and other dietary constituents on the utilization by pigs of free and protein bound amino acids. David Baker Symposium, Annual Meeting, Midwest Section, American Society of Animal Science. Des Moines, IA. March 20-22.

Patience, J.F. 2006. Distillers dried grains and solubles from Bio ethanol produced from cereal grains. Conference on Energy From Bio Fuels: Implications For The Feed Industry, de Schothorst, Leylstad, The Netherlands. October 19.

Patience, J.F. 2006. The practical management of animal variation. Carolina Swine Nutrition Conference, Research Triangle Park, NC. September 27.

Patience, J.F. 2006. Selected Prairie Swine Centre research. Akey/SCA Nutrition. Lewsiburg, OH. August 10.

Patience, J.F. 2006. Weaning age and how it influences feeding and management programs. World Pork Expo, Des Moines, IA. June 9.

Patience, J.F. 2006. The advantages of net energy systems for pigs. Pre-Symposium workshop on net energy systems for growing and fattening pigs, Digestive Physiology for Pigs, Vejle, Denmark. May 24.

Patience, J.F. 2006. The importance of water and water intake in pig nutrition. Lucta. Nemacolin Woods, PA. May 3-5.

Patience, J.F. 2006. The role of energy and other dietary constituents on the utilization by pigs of free and protein bound amino acids. David Baker Symposium, Annual Meeting, Midwest Section, American Society of Animal Science. March 20-22.

Other Lectures: Internally Organized

Gonyou, H. W. 2006. Better understanding the pig's perception of space. Focus on the Future, March 27-28, Saskatoon, SK

Leterme, P. 2006. How do I maximize my returns by incorporating feed peas and pulses in my diets? Focus on the Future, Saskatoon, SK. March 27-28.

Patience, J.F. 2006. Managing variation in the finishing barn. Big Sky Finishing Barn Managers Meeting sponsored by Prairie Swine Centre. April 25.

Whittington, D.L. 2006. Prairie Swine Centre research review. Schering-Plough Annual Veterinary Meeting. Elstow, SK. June 2.

Whittington, D.L. and **K.M. Engele**. 2006. Research profits everyone - Prairie Swine Centre research review. Big Sky Farms Finishers Managers Meeting. Elstow, SK. April 25.

Whittington, D.L., **J.F. Patience** and **K.M. Engele**. 2006. Prairie Swine Centre Research – A review. Manitoba Pork Council Research and Environment Committee Meeting. Winnipeg, MB. February 1.

Whittington, D.L. 2006. Livestock Issues Resource Centre – A review. Ontario Pork Research Committee Meeting. Guelph, ON. February 2.

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In addition to industry and government funding, the University of Saskatchewan contracts the facilities and services of PSCI for research and teaching. This ongoing agreement provides income for the Centre in return for the use of modern production and research facilities.

The following organizations have provided funding or donations in kind to support public research at the Centre for the 2006 year.

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