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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Glossary

ADF - A fibre fraction used to identify characteristics of feed stuffs.

ADFI - Average daily feed intake.

ADG - Average daily gain.

Ad Libitum - Full access to feed or unrestricted feeding.

Aerobic - Process that takes place with oxygen in the environment.

Ammonia - NH3 a nitrogen compound found in household cleaners, commercial fertilizers, and manure. Evaporates easily at relatively low temperatures.

Ammonium - NH4 a nitrogen compound found in commercial fertilizers and manure.

ANOVA - Analysis of variance. A statistical tool used to compare independent variables.

ß-glucanase - Beta glucanase; an enzyme that breaks down beta glucans, a type of carbohydrate.

BW - Body weight.

Caecum - the cal-de-sac where the large intestine begins.

Cannulated - To insert a small flexible tube into the small intestine to measure ingredient absorption.

Chromic Oxide - Cr2O5 a stable compound that doesn't dissolve in water and is largely unaffected by digestive acids.

CP - Crude protein.

CV - Coefficient of variation. A statistical tool for measuring dispersion.

DE - Dietary energy.

DM - Dry matter.

Digesta - Digested feed.

EMB - Earthen manure basin

Endotoxin - Poison produced by certain bacteria and released upon the destruction of the cell.

Glucosinolates - Naturally produced anti-nutritional chemicals that can hamper growth rate and cause thyroid problems in animals.

H_2S - Hydrogen sulphide. A colourless, poisonous gas that produces a "rotten egg" odour. In pig barns, it is produced by the breakdown of manure.

Hedonic tone - Subjective measure to the pleasantness or unpleasantness of odour.

Ileal - Pertaining to the latter part of the small intestine, or ileum. Nutrients from feed are absorbed in this area.

Ileum - Lowest portion of the small intestine

K - Potassium

Kcal - Kilocalorie, or one-thousand calories. One calorie is the amount of energy required to raise one gram of water one degree Celsius.

Lysine - An amino acid essential for growth. Cereal grains are generally ppor in lysine.

Nitrate - NO3 a nitrogen compund found in manure.

N - Nitrogen, a major component of the atmosphere and essential plant nutrient.

NDF - Neutral detergent fibre. One fraction of the total fibre found in a feed stuff.

P - Phosphorus.

Plasma Urea - Urea contained in blood plasma. Urea is the principal end product of nitrogen metabolism in mammals.

Proximate Analysis - A testing protocol used to determine the makeup of a food stuff. (ex. fats, proteins)

Psychrometer - An instrument used to measure water vapour or relative humidity using a pair of moist and dry thermometers.

Regression Analysis - A standard statistical tool for comparing the relative behaviour of two or more variables.

SEM - Standard error of the mean.

Sonicating - Mixing or homogenizing a liquid using sound waves.

Spectrophotometry - Using different wavelengths of light to analyze materials.

Xylanase - An enzyme ehichs breaks down xylans, a type of carbohydrate.

Chairman's Report

Positively Impacting Your Bottom Line

BYRAN PERKINS, Chairman of the Board

The importance of the work the Prairie Swine Centre conducts on behalf of producers is emphasized as markets cycle. PSC research helps us make changes that go directly to benefit the bottom lines of each of our operations across the Prairies.

Prairie Swine Centre was set up and designed to do the very kind of thing that it has been delivering. In fact we have come to count upon it to do nothing less. In my address in this space last year I said the Centre is "an important source of highly usable public research information." At the risk of sounding repetitive, this is such a key point regarding the Centre that I think it needs to be highlighted again.

Prairie Swine Centre remains challenged to strengthen the contract research base. Market cycles have caused various businesses to closely examine where and how they are spending their money.

Furthermore, the regulatory bodies involved in determining how various products and practices are used in Canada are providing challenges in terms of our ability to do contract research here in Canada.

Another ongoing challenge the Prairie Swine Centre faces is that of solidifying the base of its core funding. Core funding is so essential to the long-term functioning of any research institution and the Prairie Swine Centre, without question, is not immune to that.

On a personal note I would like to thank each of the board members I've had the pleasure to work with over the past six years. As board members we are always pleased to celebrate the successes of others and this year was special as Dr. Bryan Harvey, a retiring director, received recognition for his outstanding contributions to the agricultural industry.

I have also gained a great appreciation for the fine team who work on behalf of our industry. From skilled barn personnel, to administrators, to grad students, to the management team – all of these play an important role in helping make our farms better. I point to prestigious industry recognition and honours that have been bestowed to John Patience, Lee Whittington and Denise Beaulieu this past year as a demonstration of the calibre of people here on the team.

My term as a director of the Prairie Swine Centre was a wonderful opportunity to meet and work with dedicated and talented people. For that I say thank you to them and to the industry as a whole for having the chance to do so.

President's Report

Providing Practical Pertinent Information

JOHN PATIENCE, Ph.D. • President and CEO

The Canadian pork industry exports more than half of its total production. Knowing this, all of us in research must ensure that pork producers have access to information that is also of an international caliber. It is clearly impossible to be successful in the pork industry if we do not have a global perspective, and the research sector is no exception. A global perspective, with a local focus, describes the Prairie Swine Centre's approach to research and technology transfer. As an example of the Centre's international stature, about 25% of our research revenue is now earned from outside Canada, including the United States, Denmark, Great Britain and The Netherlands. Last year, Prairie Swine Centre staff gave presentations in Australia, China, Finland, Japan and the United States; next year, presentations in Denmark and England are already booked.

To achieve long-term success in pork production, we have to ensure that we are doing everything we can to maximize net income. There has been a subtle shift in our focus on the idea of economic efficiency at the Prairie Swine Centre, as we now emphasize both expenses and revenues. It has been our experience that in times of difficulty, there may in fact be more opportunity to increase income than to further reduce expenses. For example, sort losses at marketing can represent a significant drain on revenues, and failure to select the optimum market weight on a farm-by-farm basis can also adversely affect net income.

Historically, the pork industry has placed great emphasis on production targets. It explains in part the tremendous gains achieved in sow productivity, as one example. However, the importance to the farm of financial success means that overall unit targets should be based on financial information, with herd productivity and performance playing a more supportive role. This is not to say that performance and productivity is unimportant; for example, all other things being equal, highly productive sow herds will be more profitable than poorer producing herds, faster growing pigs make more money than slower growing pigs. However, it cannot be assumed that initiatives undertaken to improve performance and productivity will automatically increase net income, because there are too many examples of where it simply did not occur. Our research, therefore, focuses on providing information to help producers make decisions on where to invest money – or save money or increase revenues - to improve net income. Our new enterprise model, developed in collaboration with the George Morris Centre in Guelph, ON, increases our capability for such analysis and reflects our growing emphasis on economic returns.

Aerial view of PSC Elstow Research Farm

In a complex industry such as ours, which direct and indirect interface with consumers and society in general, economic efficiency will not guarantee long term industry success. That's why our research program deals with not only economic efficiency issues, but also sustainability issues, which include the environment and animal welfare.

This past year, we continued our emphasis on defining feeding programs that maximize net income, and on characterizing ingredients so they can be used most effectively in our feeding programs. For example, we worked on wheat distillers grains, a byproduct of ethanol, because of the expected expansion of the ethanol industry in Western Canada. In the coming year, pork producers will see us working on canola meal, whole seed canola, flax, lentils, field peas and flax meal.

From an engineering and ethology (animal behaviour) standpoint, we focused our research on looking at the environment inside the barn, and furthermore, how we can optimize the physical and the social environment to maximize net income as well.

On the sustainability issues, we are looking at sow housing and its impact on sow behaviour and on sow productivity. On the environment side, we are looking at some pretty exciting ways to improve the environment within the pig barn. These types of studies tend to be longer-term in nature because they are fairly difficult questions to answer. Nonetheless, they are important to the future of our industry.

Our financial support from SaskPork, Alberta Pork and Manitoba Pork Council and Saskatchewan Agriculture and Food are essential to our success. We are extremely happy to report that this past year saw us renew our funding agreement with SaskPork for another five years, through to the end of 2010. We thank Sask Pork for their long-term commitment to the future of the Centre.

Another equally critical component of the success of Prairie Swine Centre is the highly qualified and capable personnel we have on staff. A new addition to our team is Dr. Pascal Leterme, Research Scientist - Nutrition. He joins us from the National Veterinary School in Lyon, France and has a very extensive background in amino acid metabolism and in ingredient evaluation. I cannot emphasize how very fortunate we are to have someone of Pascal's stature on our staff.

In addition, our people won significant industry awards last year. For example, Lee Whittington, Manager - Information Services, won the Award for Excellence in Technology Transfer, Extension and Public Service from the Canadian Society of Animal Science. Dr. Denise Beaulieu won the Research Innovation Award, sponsored by the National Pork Board and given out by the Midwest Section of the American Society of Animal Science. In doing so, Denise was the first Canadian to be given this award and also is the first person to win this award in two species; her first came for her work in dairy cattle. Denise also won the Excellence in Production Research Award from SaskPork.

Clearly, we view these honours and awards as appropriate and welcome recognition of individual accomplishments, but also of how others view the work of the Centre as a whole. And for that, the entire staff of Prairie Swine Centre – and our subsidiary PSC Elstow Research Farm - is owed a sincere "pat on the back" for a job well done. The effort of the whole team is required for us to be truly successful. This applies across the board, to our animal support staff, our office staff, our researchers and managers, and of course, our graduate students.

Prairie Swine Centre Board of Directors
Back - *Left to Right*: Daryl Possberg, Bryan Harvey, Roger Charboneau, Jacquie Gibney, and Mac Sheppard
Front - *Left to Right*: Shannon Meyer, Judy Yungworth, Bryan Perkins, Eric Peters, and John Patience

Before we leave the topic of awards, this past year also saw PSC Elstow Research Farm, our subsidiary commercial research facility, win an award from Maple Leaf Foods for selling the largest loins to their plant last year. We're pleased that such recognition helps to validate the fact that Prairie Swine Centre is not only a good research organization, but we are also a relevant pork producer in our own right.

Finally, I would like to recognize our Board of Directors, who despite their hectic and demanding schedules, willingly volunteer their time to serve the Centre in this very important way. A special thank you goes to two retiring directors: Dr. Bryan Harvey and Bryan Perkins, the latter of whom served two, three-year terms and also served as Chair. Their dedication and commitment to the success of the Centre cannot be overestimated. Thank you very much.

At the same time, I would like to welcome two new directors, Arlee McGrath of Leroy, SK, and Dr. Bryan Schreiner, of Saskatoon. I would also like to report that Eric Peters from Steinbach, MB has agreed to serve as Chair of our Board.

The coming year holds many challenges. Some are financial, some are political and some are social. The past has shown that some of the greatest successes of our industry occurred when it worked to achieve common goals, for example, in export sales, in quality assurance and of course, in research. We accept the challenges of our industry to continue to provide practical information to help address the challenges of the future. And of course, we thank the pork industry for their continued support.

Technology Transfer Report

Providing Quality In-depth Information

LEE WHITTINGTON, MBA. • Manager, Information Services

Methods of developing a successful brand was the theme of a workshop I recently attended and speaks volumes on how to communicate to people effectively. The core of the message was that most organizations or marketers get it out of order, beginning with promotion or communication before the product/service is fully defined and developed. This can lead to a product that meets the market demand on first glance but fails to provide the product quality or depth of information required by the client.

The lesson in this is crystal clear, that to be successful, the company and its products must have the needs of the client well-defined and incorporated into the product/service. Prairie Swine Centre provides information. We use research in nutrition, engineering and behaviour to define the limits to production efficiency and seek solutions, but in the end what we deliver is information. Information that can reduce the cost of production, improve net income and improve the sustainability of a growing industry to meet the expectations of employees, neighbours, and the many stakeholders along the value chain all the way to the supermarket.

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	3
H_2S Training Program	425
Conference Posters	8
Tradeshow Attendance	3
Website Vistors	30,000
Bi-Weekly E-zine	20 • 500
Focus on the Future Conference	1 • 150
CD Dsitribution	500+
Magazine Advertising	3
Media Releases	10

As in past years, we have employed three basic methods to transfer this information: Personal, contact Electronic media; and Print. Each has its merits and shortcomings, with Personal communication still the preferred favourite of most pork producers, so our phone 306-477-PIGS gets a regular workout each day. This area is quickly yielding to the volume and speed of information available electronically, with daily emails measured in dozens, and the website serving 2,500 unique visitors each month. If you want to receive the latest information, sign up for our bi-weekly Ezine that is delivered to your electronic inbox with three to four stories addressing production challenges with the most recent research. Sign up by emailing ken.engele@usask.ca for a free subscription.

Print media is still the friendliest form of communication for the reader as they choose to pick it up and set it aside on their time. Industry magazines and pork board newsletters are an important supplement to the Prairie Swine publications. Our goal is to deliver to you, a minimum of 7 times, each major research project and its conclusions. Why 7? That's the number that agricultural media research tells us is required to inform, reinforce and encourage adoption of new ideas and technology.

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

Operations Manager Report

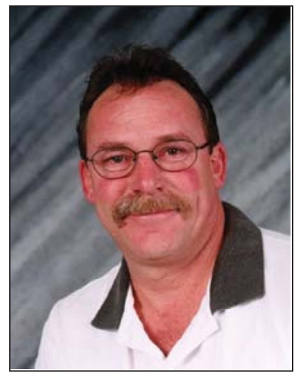
Fine Tuning Production and New Genetics

BRIAN ANDRIES, B.Sc. • Manager, Operations

Production at the Floral facility improved in the last half of fiscal year 2004-2005 and is further improving this year. Improvements in production at the Floral facility are in part due to improved replacement gilt management and the stabilization of the herd as we move closer to converting both the Floral and Elstow facilities to the new genetics through PIC Canada Ltd. Contractual obligations from PIC are ongoing as we continue to Caesarean section pure Line-03 females into the Floral facility ensuring current genetics in the nucleus herd producing Camborough Plus females for both Floral and Elstow.

Selection of replacement gilts begins in the nursery phase where all gilts are pre-selected on a weekly basis and remain together through the nursery and grower phase. Currently 72% of the herd have been converted to the new genetics. After the entire herd has been converted a more stringent selection process will be implemented on replacement gilts as selection estimates should be no more than 70% of the total mature gilts available. Pressure on conformation, feet and leg soundness and movement will be greatly increased. Daily boar exposure starts at 80 kg with breeding at a minimum of 130kg and second heat have greatly increased the numbers born alive on all gilt litters. Over the last 8 months on gilt litters we are averaging 12.5 total born, and 11.3 born alive.

Being a research facility tied to the pork industry as well as the Univeristy of Saskatchewan our staff often particiapte in a number of interesting projects throughout the year. Production staff for example are involved in providing hands-on experience for about 20 SIAST Kelsey campus Veterinary Technology students. Staff demonstrate proper management techniques dealing with



farrowing and nursery management, restraint in different age pigs, proper technique for giving injections and sampling techniques for blood, urine and feces. We have also accepted students form the Veterinary Technology Program who are doing their clinical externship program to gain practical experience as part of their program requirements. We will be working with the Canadian Council of Animal Care at the University of Saskatchewan to test a commercial pneumatic tool to evaluate a very humane and acceptable way of euthanasia in young animals.

The number of experiments started and the total number of animals used for research, at both Prairie Swine Centre Inc. and PSC Elstow Research Farm Inc. are monitored and reported on a yearly basis to the Canadian Council of Animal Care. All trials that are conducted at our research facilities are approved by the University of Saskatchewan Committee on Animal Care and Supply. The committee also inspects our facility once a year and the National body tours all research facilities every 4 years. This

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

	2002-2003	2003-2004	2004-2005
Sows farrowed, #	799	759	826
Farrowing rate, %	87.2	82.0	81.5
Pigs born alive/litter	10.7	11.2	10.8
Pre-weaning mortality	10.0	12.8	11.6
Litters weaned	793	757	835
Pigs weaned	7,618	7,759	8025
Weaned/female inventory	23.4	24.2	23.8

Table 2. Production parameters for the last 6 months of fiscal year 2005-2006

	Oct 05	Nov 05	Dec 05	Jan 06	Feb 06	Mar 06	Oct 05- Mar 06
Farrowing Rate, %	89.6	81	82.7	93.1	93.9	93.6	89.0
Avg. total pigs born	12.6	12.2	12.6	12.7	12.7	13.1	12.7
Avg. pigs born alive/litter	11.6	11.2	11.3	11.8	11.7	11.8	11.6
Pre-wean mortality	11.5	12.6	10.8	9.6	9.2	9.5	10.5
Weaned/female inventory	24.9	24.7	27.3	25	27.7	27.5	26.2

Table 3. Research usage 1998-2004

	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

ensures experimental protocols for research are being followed and staff are knowledgeable in dealing with all aspects of animal health and welfare. Facilities themselves are evaluated to ensure proper care, handling and safety of all animals.

Animals used for research trials took a big leap in 2001 with the stocking of PSC Elstow Research Farm Inc.. Sow trials in both the individual stall and group housing situation started in 2001 and continue to the present day. The ability to handle larger group sizes in nursery and grow-finish also expanded total research capabilities.

Pork Interpretive Gallery Report

Seeing is Believing

DEB EHMANN • Assistant Manager, Pork Interpretive Gallery

PIGS.SCIENCE.LEARNING is the theme threaded through a number of activities provided by the gallery. The Pork Interpretive Gallery continues to provide education and information on the pork industry through presentations, trade shows, safety displays, family tours, school visits, mail outs, fundraising events, the list goes on.

Pork Interpretive Gallery Staff
Back Row: Debra Stobbe, John Michael Pozniak
Front Row: Pauline Gryschuk, Deb Ehmann, Lynn Campbell, and Sandra Fonstad

The tours have been well received by visitors from near and far. A remark we hear time and time again" Really!! I didn't know that before! ." People continue to be delightfully overwhelmed with the information they are hearing about the pork industry.

"Showing is believing" is the old saying and it proves to be true time and time again as the guides inform our guests as they navigate through the Gallery. Many events during the year have provided a venue for the P.I.G. to bend a few ears and share information about the pork industry. Approximately 1,000 students were reached through the U of S Biotech Challenge and the Children's Rural Festival. The presentations made in conjunction with the Saskatchewan Pork Development Board at the Western Canadian Agribition and Livestock Expo were extremely well received as well.

The presentation to grade 7 & 8 students during the Western Canadian Agribition was a welcomed opportunity to set the stage for the launch of the new 'Careers in Agriculture' display that introduces the many career choices available to persons entering the work force or considering career options in agriculture.

A major fundraising event was held during the Saskatchewan Pork Symposium. 'Good Fun was had by all' during a silent auction and the new LIVE Auction.

The P.I.G. chart reflects the 1,355 people that participated in a guided tour over the past year. International visitors from Russia, China, Japan, Panama, Australia and Spain took advantage of the opportunity to experience this unique facility. Students from the University of Saskatchewan and as far away as Ile-A-La-Crosse and Glasyln, Saskatchewan have enjoyed a science-based learning experience at the gallery. 50% of our visitors are children.

P.I.G. combines tours with science-curriculum based education and information on the pork industry. The facility remains dedicated to swine research in the area of animal nutrition, engineering and housing, behaviour and has ongoing demonstration projects. It continues to demonstrate commitment in the area of animal care and environmentally responsible agriculture and livestock production.

'Make a Point' of coming to see the new "Hearing Protection Safety" display. It is a great new addition to the gallery. "Safety In Everything We Do" is the message being woven through the interactive gallery displays.

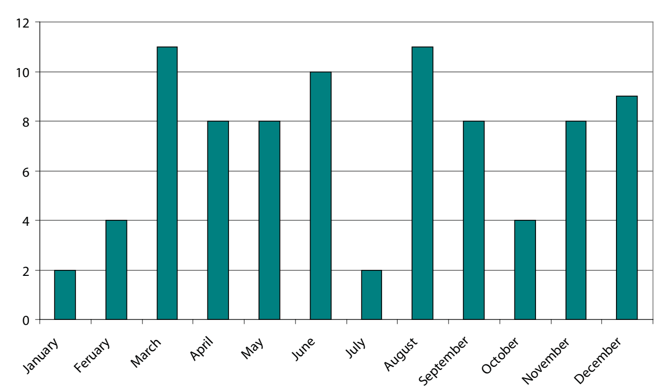


Figure 1. Number of Visitors to the Pork Interpretive Gallery

Research Objectives

Long Term Objectives to Improve Your Bottom Line

Goal #1
To meet the technology needs of the pork industry by developing original, practical information that ensures maximum profitability combined with acceptability of the industry and its products

Goal #2
To serve the pork industry by maintaining a timely, effective and focused technology transfer program

Goal #3
To ensure the relevance of the Prairie Swine Centre to the pork industry and to meet the needs of our research programs by operating efficient, highly productive and profitable pig herds at its research sites while concurrently meeting or exceeding the standards of the Canadian Council of Animal Care

Goal #4
To enhance the Centre's effectiveness and sustainability, and to encourage increased research on pigs, by developing collaborations, co-operative action and strategic alliances in research education, and technology transfer

Goal #5
To meet the long-term needs of our stakeholders through effective management of our human, financial, intellectual and physical resources

Goal #6
To achieve financial and operational sustainability through diversity of funding, efficiency of operations and accountability of stakeholders

Goal #7
To contribute to the development of highly qualified personnel through active and full participation in the graduate program at the University of Saskatchewan

Expanding Resources for Pork Producers: Livestock Issues Resource Centre

D.L. Whittington and K.M. Engele

Looking for information to cut the cost of operating your farm? Looking for information on what are the facts about pig welfare? Is your child doing an environment project at school and needs to know the facts about what is the impact of pork production on the environment? All these can be addressed by visiting the Prairieswine.ca website and searching the Livestock Issues Resource Centre.

Objectives:

To be the primary industry reference on environmental, and welfare issues, energy efficiency, and general production efficiency research for the Canadian pork industry.

Since 1998, the database-driven website has provided access to information on environmental research and technology applications for the pork industry. The program was expanded to include welfare related issues and information in 2001, and now hosts topics in production efficiency research, greenhouse gasses, and energy efficiency.

"This past year the website has averaged over 2,500 unique visitors each month."

In this past year a total of 584 new summaries of research have been added to the on-line information database. This information covers the strategic areas of environment (186 entries), animal welfare (350 entries), and production efficiency research (48 entries). To do this a summer student, Kirsten Jensen, was employed this past summer (University of Waterloo, 3rd year student in environment and business major), a Post Doctoral Fellow (Dr. Stephane Hayne) with a doctorate in animal behaviour is contracted one day per week to write the animal welfare components, and Ken Engele (Assistant Manager Information Services, Prairie Swine Centre) summarizes production research and manages the website interface.

Use of the on-line resource has been steady over the past year with over 2,500 visitors to the website each month. Funding from OFAC, Sask Pork, Manitoba Pork, and Alberta Pork, and Agriculture and AgriFood Canada (through ACAAF funding) was received during this period. Promotion of the website has been in pork producer's newsletters, advertising at conferences ISTMM (Integrated Solutions to Manure Management), Leman Swine Conference. Magazine articles or advertising has appeared in Better Pork, Manure Manager, Western Hog Journal, the pork board newsletters across western Canada, as well as in a number of Prairie Swine Centre publications such as Centred on Swine, and biweekly Ezine distributed to pork producers and industry across Canada.

The site is easy to use as demonstrated in Figures 1 through 3 showing how to use the website to conduct a search of the entire database on the pork production topic of your choice.

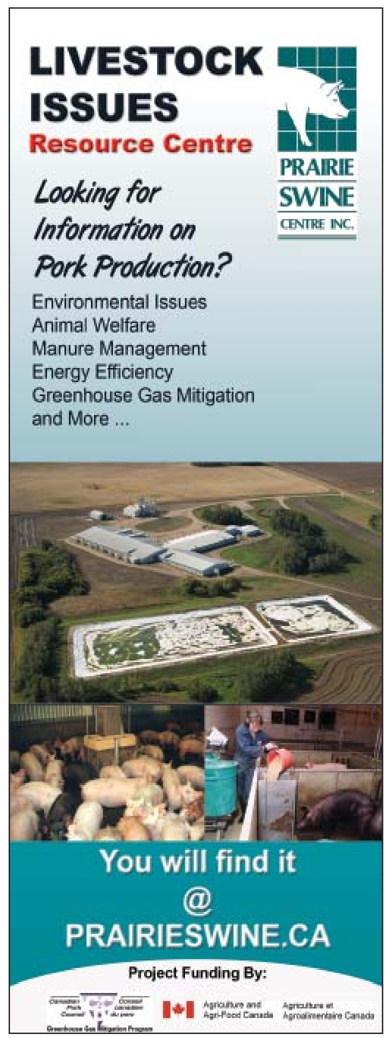


Figure 1. Search directly from the home page

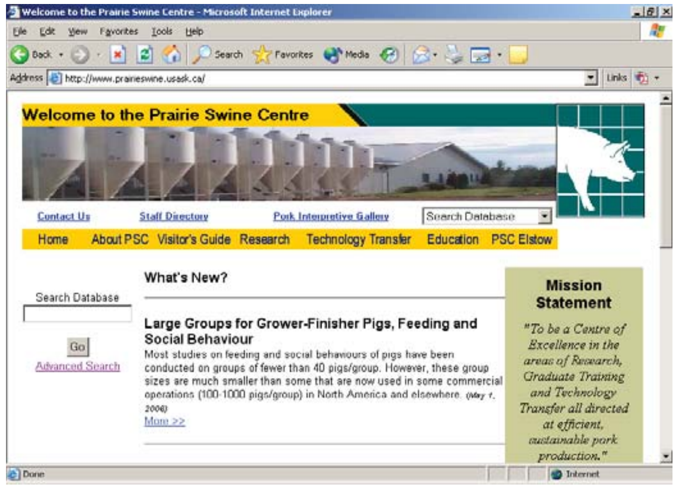


Figure 2. Advanced search provide detailed search results

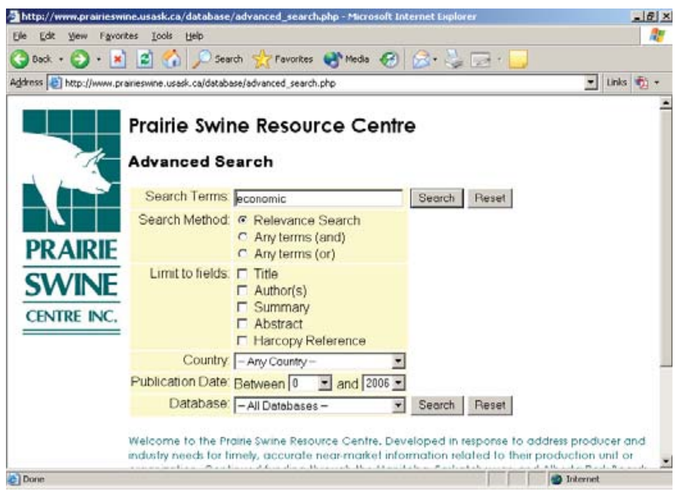


Figure 3. All publications with specified search term are displayed

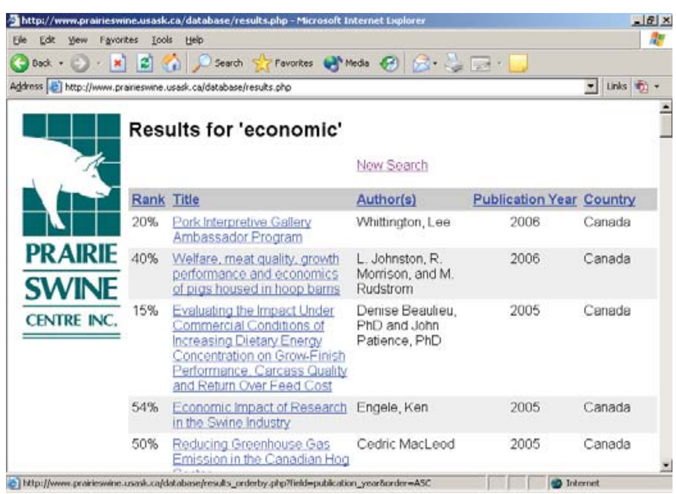


Figure 3. All related articles based on individual searches

Modeling the Economic Impact of Research in the Pork Industry

K.M. Engele and D.L. Whittington

Introduction

Today's pork industry is global in nature, and pork producers find themselves always looking for areas of competitive advantage. One significant area of competitive advantage is through the early adoption of research results. Producers who are successful in identifying and implementing new technologies and management strategies create an advantage through lowering their cost of production, or increasing the amount of revenue generated. However, the perceived financial risks and rewards may limit technological action. In order to provide more detail on the economic impact of research, Prairie Swine Centre in conjunction with the George Morris Centre developed an analytical tool to help provide a more detailed analysis of the economic benefit of research conducted at Prairie Swine Centre.

This financial model has the ability to simulate the economic impact and change in cost and revenue structures, by applying Prairie Swine Centre research results to commercial farms of various sizes. Estimating the economic impact of research on the commercial farm is extremely important when adopting new technologies or management strategies. To value the economic impact of research, a number of Prairie Swine Centre experiments between 1999-2004 were analyzed. In total 22 projects were selected for a detailed financial analysis, with the final result being the net benefit of specific research projects. Research projects were then prioritized in terms of net benefit per hog marketed and ease of adoption.

"If 10% of the benefit was to be adopted it would improve net return over $3.00 per hog marketed."

Throughout the 1999-2004 time period, specific research projects generated a range of net financial benefit to pork producers from $0.11 - $8.84 per hog marketed. In addition, approximately 25% of the projects analyzed generated a net benefit of at least $2.00 per hog marketed, while an additional 25% of research projects generated a return in excess of $1.00 per hog marketed. The overall objective of such a analytical tool is quite simply to assist pork producers in identifying ways to minimize costs and maximize revenues through: 1) Identifying those technologies that can be applied on their operation, and 2) Prioritize their implementation in terms of ease of adoption.

Research Results

In order to estimate the impact of research on different types of operations, 'default' farms of various size were developed based on industry data. It is very important to note there tends to be greater variability, in per hog costs and revenues, between similar sized operations than across different operation size. This is a function of different cost structures (example, related to age of facility), ability to adopt new technologies, and management styles. Table 1 provides a detailed economic evaluation for each research project, summarizing the range and average value (from default) on net income. Average net returns for all projects varied from $0.14 to $6.23 per hog marketed, while the minimum and maximum range in returns vary from $0.05 to $11.50 per hog marketed, depending on specific research criteria. Net benefit of each project was calculated independently; there was no attempt to look at the additive or competing effect of multiple projects implemented simultaneously.

Table 1. Economic Return and Ease of Adoption for Selected Prairie Swine Centre Research Projects 2002-2004

Research Project	$/Hog Marketed	Ease of Adoption*
2004		
Response of Growing and Finishing Pigs to Dietary Energy Concentration	$4.92	Moderate
Crowding Reduces Performance of Weanling Pigs	$0.88	Moderate
2003		
Soluable and Insoluable Non-Starch Polysaccharides on Digesta Passage Rate and Voluntary F.I. on Grower Pigs	$2.08	Difficult
The Effect of Starter Feeding Regimen on Performance in the Nursery	$1.22	Moderate
Intake and Growth Performance Diets Containing Mustard or Canola Meal	$1.25	Difficult
Electronic Sow Feeder: Update	$3.38	Difficult
2002		
Water Usage by Grower-Finisher Pigs Using Dry and Wet/Dry Feeders	$0.70	Easy
Reducing Water Waste from Nipple Drinkers by Grower-Finisher Pigs	$0.14	Easy
Nutritional Quality Among Wheat Classes Fed to Weaned Pigs	$1.08	Easy
Effects of Large Group Size on Productivity of Grower-Finisher Pigs	$0.38	Moderate
Effect of Dietary CP and Phase Feeding on Performance of Urinary N Excretion	$1.50	Difficult

Table 2. Economic Return and Ease of Adoption for Selected Prairie Swine Centre Research Projects 1999-2001

Research Project	$/Hog Marketed	Ease of Adoption*
2001		
Impact of Feeder Adjustment and Group Size Pig Performance	$0.69	Easy
Response to DE Concentration and Stocking Density in Weaned Pigs	$0.47	Moderate
Effect of Gender and Crowding on Variation in Days to Market	$2.16	Moderate
The Effect of Ergot on the Performance of Weanlings	$6.23	Easy
Effects of Nipple Drinker Height and Flow Rate on Water Wastage	$0.21	Easy
Nutritional Value of High-Oil Oat Groats	$0.70	Moderate
Replacement of Soybean Meal with Canola Meal in Weaned Pigs	$0.27	Moderate
2000		
Effect of Feed Presentation on the Feeding Behaviour of Finisher Pigs	$2.55	Easy
1999		
Performance and Carcass Quality of Pigs Submitted to Reduced Nocturnal Temperatures	$1.03	Easy
An Oil Sprinkling System for Dust Control in Pig Buildings	$0.18	Moderate
The DE Content of Hulless Barley	$1.49	Moderate

Ease of Adoption

Pork producers in Canada are recognized as innovative, many could be classified as early adopters of new information. With this in mind, the 22 research projects were evaluated for their ease of adoption, as seen in Table 2. Ease of adoption is defined in terms of the time, labour and capital required to implement the new research information on the commercial farm. Three classifications were created: Easy, Moderate and Difficult. We further describe "Easy" projects as those which can be implemented within 1-3 months, require little labour and little or no capital; "Moderate" can be implemented within 3-12 months, but still require little labour or capital; and "Difficult" projects require greater than 12 months to implement, and is either labour and/or capital intensive. Evaluating this list on the basis of ease of adoption may help to focus efforts on these projects which can provide immediate payback.

Table 3. Total Annual Research Contribution to Western Canadian Pork Industry

Ease of Adoption	Total Contribution ($000's)	Percent Contribution
Easy	$101,091	63.2%
Moderate	$50,737	31.7%
Difficult	$8,208	5.1%
Total	$160,037	100%

Impact on the Industry

Using this three-level description we estimated the extent to which the industry would adopt the research results. Easy projects, such as switching between wheat classes for starter diets, or adjusting water nipples to reduce water wastage, were estimated to be adopted by 80% of the industry. Moderate adoption projects included changing energy levels in the diet, require the specialized services of a nutritionist and perhaps pen reconfiguration. These "Moderate" adoption projects were estimated to be adopted by 40% of the industry. There were very few projects deemed to be Difficult to adopt. For example novel ingredients like mustard meal can be difficult to obtain on a regular basis, or in the case of moving to large group sow housing systems, extensive barn renovation or rebuilding is required to adopt this technology. These "Difficult" adoption projects were estimated to be adopted by 10% of the industry.

Table 2 summarizes the combination of improvement in net returns (over default) as described in Table 1 with the assumed levels of adoption for each research project. This provides an estimate of the value of Prairie Swine Centre research to the western Canadian pork industry. For example, "Effect of Starter Feeding Regime on Variability in Body Weight and Performance in the Nursery", is adopted on a Moderate basis (by 40% of the industry), and provides a net return benefit of $1.22 per pig marketed, and assuming the annual marketings of 10 million hogs in western Canada, the benefit annually to the industry for this one project is $4.88 million.

Conclusion

Research pays big dividends. Applied near market research conducted at Prairie Swine Centre for the pork industry has and continues to provide significant benefit to pork producers and the entire pork industry. All pork producers will not be able to adopt all research results, in addition not all research projects are completely additive. Pork producers would still realize a significant improvement to their bottom line through the incorporation of any number of research results. If only 10% of the benefit was to be adopted it would improve net return over $3.00 per hog marketed. Prairie Swine Centre would like to acknowledge Saskatchewan Agriculture and Food for their funding of this project.

Increasing Diet Tallow and Dietary Energy Concentration on Performance

A.D. Beaulieu, J.F. Patience, M. Rivard , and D.A. Gillis

Summary

An experiment was conducted on a commercial farm to examine the response of growing-finishing pigs to dietary energy concentration. Pigs receiving diets with an increased energy concentration grew faster from 37 kg to about 80 kg BW, however overall, from 37 kg to market there was no effect of dietary energy concentration on growth. Dietary energy concentration had modest effects on carcass composition and under current market conditions, the return to feed costs indicated an advantage for the lower energy diets.

Introduction

Energy is the most expensive nutrient in the diet of the pig, and yet, our understanding of energy metabolism, and more specifically, how the pig responds to changes in dietary energy concentration, is limited. This experiment was conducted as a follow-up to a previous experiment conducted at the Prairie Swine Centre, which showed that pigs are able to achieve equivalent performance across diets of quite differing energy concentration (Annual Research Report 2005, p. 22). These results were surprising, and therefore this experiment was conducted to re-evaluate this question, and determine if increasing dietary energy concentration would improve pig performance. The experiment was also designed to evaluate the impact of dietary energy concentration on carcass quality and on the uniformity of growth.

"Under typical market conditions, high energy diets may not result in the highest return over feed cost."

In our previous experiment, feed intake tended to decline and feed efficiency (gain:feed) was improved when oil was added to the diet. Feed intake may be an important factor in the response to dietary energy, and since feed intake can vary by up to 35 % among farms we decided to conduct this experiment at a different facility.

The overall objectives of this experiment were to: 1) determine the response of growing and finishing pigs to increasing dietary energy concentration on a commercial farm 2) to determine if increasing dietary energy concentration will help to reduce variation in pig performance, 3) to determine if net energy is a better predictor of pig performance than the more conventional DE and ME and 4) to improve the net income of pork producers through the development of feeding programs that best balance cost of feed and gross income per pig.

Experimental Procedure

The experiment was conducted in 3 grower and 3 finisher rooms (12 pens, 20 pigs/pen) in a commercial farrow-to-finish operation located in Saskatchewan. A total of 720 animals (initial BW 36.8 kg) were assigned to one of 3 dietary treatments. This represented all available pigs within a farrowing group except the lower 15 % which were moved to an off-site facility as per normal barn protocol. Treatments were 3.20, 3.35 and 3.50 Mcal DE/kg (calculated NE; 2.21, 2.31 and 2.42 Mcal/kg). The diets were formulated for 3 phases of growth. Males remained on phase 1 and 2 for 4 weeks each and on phase 3 until market. Females remained on phase 1 and 2 for 6 and 4 weeks respectively, and on phase 3 until marketing. Increasing energy density in the diet was accomplished by increasing the content of wheat and soybean meal at the expense of barley, and adding tallow. Tallow was restricted to 4.0 % of the diet. A constant digestible lysine: DE ratio was maintained as the concentration of energy increased. The actual energy concentration of the diets was determined at the mid-point of each phase by collecting faecal samples.

Table 1. Performance Impact of Feeding Finishing Pigs Diets, with Increased DE Concentration

	Formulated DE (Mcal/kg)				
	3.20	**3.35**	**3.50**	**SEM**	**P <**
BW (kg)					
d 0	37.4	36.6	36.5	0.87	---
d 21	55.9	57.0	57.8	1.32	0.005
d 42	75.0	78.1	79.2	1.47	0.008
d 57a	93.4	94.6	95.8	1.66	0.07
ADG (kg/d)					
d 0 – 21	0.91	0.96	1.00	0.06	0.003
d 22-42	0.97	1.00	1.06	0.05	0.02
d 43- 57	1.09	1.08	1.05	0.03	0.39
d 57 – market	0.98	0.91	0.94	0.02	0.08
d 0 – 57	0.99	1.01	1.03	0.03	0.10
ADFI (kg/d)					
d 0 – 21	2.07	2.12	2.09	0.08	0.49
d 22-42	2.76	2.72	2.67	0.08	0.11
d 43- 57	3.45	3.39	3.27	0.14	0.30
d 57 – market	3.53	3.34	3.20	0.08	0.02
d 0 – 57	2.68	2.67	2.61	0.09	0.18
FCE (gain:feed)					
d 0 – 21	0.44	0.46	0.48	0.01	<0.001
d 22-42	0.36	0.37	0.40	0.01	0.003
d 43- 57	0.32	0.32	0.33	0.02	0.34
d 57 – market	0.28	0.27	0.29	0.01	0.17
d 0 – 57	0.37	0.38	0.40	0.01	0.003
Tail-enders	48	45	37	---	---
Days to market	81	80	79	---	---

aday 57 = first pull

Results and Discussion

Average daily gain and BW were improved during the initial 6 weeks when diets with an increased energy concentration were fed (P < 0.05; Table 1). However overall, energy concentration had no effect on ADG or ADFI. Feed intake was reduced (P < 0.02) during the final period (d 57 to market), in groups consuming diets with increased energy concentration. This tendency (non-significant, P > 0.10) was observed in all but the first 3 weeks of the experiment. Apparently, as the pigs grew, they became able to compensate for the lower DE concentration with increased feed intake.

Table 2. Economic Impact of Feeding Finishing Pigs Diets, with Increased DE Concentration

Economic Analysis, $/pig			
Scenario #1b			
Gross income	149.93	150.59	151.51
Feed cost	39.55	42.42	43.42
Return c	110.37	108.18	108.08
Scenario #2b			
Gross income	153.04	154.68	154.33
Feed cost	41.38	44.32	44.91
Return c	111.66	110.36	109.42

After about 90 kg body weight, the pigs consuming the low DE diets had increased feed intake such that caloric intake was similar between treatments (data not shown). Feed efficiency was improved overall (P < 0.003), the result of slight improvements in gain and decreased feed intake as the DE concentration of the diet increased.

There were fewer tail-enders (those pigs remaining after 8 weeks in finishing) when pigs consumed the diets with increased energy concentration. Dressing percentage and loin thickness tended to increase when pigs consumed the diets with increased DE content (P < 0.10; data not shown). No other carcass parameters were affected by diet. However, regardless of the economic scenario employed, return over growout feed costs was improved when pigs were fed the diets with the lowest DE concentration.

Implications

Under typical market conditions, high energy diets do not necessarily result in the highest return over feed cost. Pork producers must frequently evaluate the dietary energy concentrations which maximize net income on their individual operations.

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Interaction of Net Energy Concentration and Feeding Level in Weaned Pigs

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

Summary

Weanling barrows were fed diets of 3 energy concentrations at 3 different feed restrictions to determine the effect of energy intake on piglet growth and body composition. Growth was not affected by dietary energy concentration but was improved with increased feed intake. Increased energy intake, whether from a higher energy concentration in the diet, or increased feed intake, resulted in an increased deposition of lipid. The NE system provided no advantage over the DE system in prediction of weanling pigs growth or body composition. Once again, increased dietary energy concentration failed to improve weanling pig performance

Introduction

Energy intake, perhaps due to restrictions in gut capacity, restricts growth in the weaned pig. Increasing dietary energy concentration, therefore, should increase energy intake and growth. However, in recent studies, increasing dietary energy concentration failed to improve weanling pig growth performance, primarily because feed intake declined and daily energy intake remained unchanged.

There have been no studies in weaned pigs comparing the impact of changing energy intake through control of daily feed intake to changes in dietary energy concentration. The objective of this study was to define the interaction between daily energy intake and dietary energy concentration on body weight gain and on tissue (protein, lipid ash and water) accretion rates and ratios.

"Bodyweight gain and carcass lipid and protein deposition are highly correlated with energy intake."

Experimental Procedure

A total of 81 barrows (9.5 ± 0.1 kg; 31.5 ± 0.3 days of age) were allotted to one of 9 treatments arranged as a 3 x 3 factorial (3 diets x 3 feed intake levels). Diets were formulated to contain either 2.21, 2.32 or 2.42 Mcal NE/kg. Digestible lysine to energy ratios were maintained constant. Three feed levels were employed corresponding to 100%, 80% and 70% of ad libitum intake. Freshly voided faeces were collected from each pig to determine actual DE content. Net energy was calculated from digestible nutrient content according to CVB (1998). Pigs were sacrificed when they reached 25 kg. The gastrointestinal tract was removed, weighed and analyzed separately. Carcass and organs were ground and analyzed for protein, lipid, water and ash content. The calculation of nutrient deposition was determined by comparing the composition of these pigs to a cohort slaughtered at experiment initiation.

Results and Discussion

Average daily gain and feed intake were unaffected by NE content of the diet but improved with increasing feeding level ($P < 0.0001$). Feed efficiency improved with feed intake restriction, but only at the highest NE concentration (interaction, $P < 0.03$). The efficiency of utilization of energy, for BW gain or lipid deposition, increased with NE content of the diet and feeding level ($P < 0.0001$). Conversely the efficiency of energy use for protein deposition decreased with increased energy content of the diet and feeding level ($P < 0.0001$). Except for protein deposition, which was unaffected by dietary NE content, the deposition of protein and lipid followed a similar pattern as the efficiency of energy utilization. Moreover, the carcass lipid:protein ratio increased with increased NE content of the diet and feeding level ($P < 0.0001$). A dramatic increase in the lipid:protein ratio of the carcass was seen at the highest dietary NE content and 100 % feeding level (interaction, $P < 0.002$). Energy intake was correlated positively with average daily gain, and carcass and protein lipid deposition, regardless of whether energy intake was calculated using the DE or NE system (Table 2).

Table 1. Effect of dietary energy concentration and intake on performance, energy utilization and carcass composition of weanling pigs (9.5kg initial to 25kg final BW)

	NE, Mcal/kg			Feeding Level, % of ad lib			P values			
Item	**2.15**	**2.26**	**2.37**	**70**	**80**	**100**	**SEM**	**NE**	**Feeding Level**	**NE x FL**
Number of Pigs	27	27	27	27	27	27				
Performance										
Days on test	27.1	28.4	27.3	31.0	29.0	22.8	0.6	0.03	0.0001	0.75
ADG, g/d	577	561	579	491	534	692	8.0	0.23	0.0001	0.34
ADFI, g/d	789	771	784	661	740	943	9.0	0.35	0.0001	0.15
Gain:Feed	0.73	0.73	0.74	0.74	0.72	0.73	0.01	0.53	0.28	0.03[a]
Energy Utilization										
Mcal intake, Mcal/d	2.07	2.12	2.26	1.86	2.04	2.54	0.03	0.0001	0.0001	0.47
Mcal NE/kg gain	2.43	2.59	2.75	2.44	2.60	2.73	0.04	0.0001	0.0001	0.14
g Protein/Mcal NE intake	68.0	63.9	59.4	68.0	63.9	59.3	1.0	0.0001	0.0001	0.24
g Lipid/Mcal NE intake	25.0	27.7	32.2	27.2	26.0	31.7	14.3	0.001	0.008	0.004[b]
Carcass Deposition										
Protein, g/d	77	75	77	67	72	89	2.0	0.17	0.0001	0.11
Lipid, g/d	33	37	51	30	34	57	3.0	0.0001	0.0001	0.0001[b]
Lipid:protein Ratio	0.42	0.49	0.64	0.45	0.47	0.63	0.02	0.0001	0.0001	0.002[b]

[a] Feed efficiency increased with increasing restriction, but only at the highest NE concentration.
[b] Efficiency of lipid deposition (g lipid/Mcal NE intake), lipid deposition (g/d) and the lipid:protein ratio increased at the highest NE concentration with 100 % ad libitum intake.

Table 2. Correlation between energy intake and performance

Variable	r coefficient	P value
DE intake, and		
ADG	0.92	0.0001
Gain:Feed	-0.14	0.23
Carcass protein deposition	0.93	0.0001
Carcass lipid deposition	0.80	0.0001
Carcass lipid:protein ratio	0.60	0.0001
NE intake, and		
ADG	0.90	0.0001
Gain:Feed	-0.12	0.28
Carcass protein deposition	0.91	0.0001
Carcass lipid deposition	0.85	0.0001
Carcass lipid:protein ratio	0.67	0.0001

Implications

Maximal energy intake in weaned pigs resulted in increased lipid deposition, not the desired increase in lean (protein) deposition, regardless of whether the energy intake was provided by increasing energy concentration of the diet or through increased feed intake. Bodyweight gain and carcass lipid and protein deposition are highly correlated with energy intake: however, the NE system was not shown to be superior to the DE system in this regard.

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Developing Weaning Pig Programs Based on Age and Weight

A.D. Beaulieu and J.F. Patience

Summary

Pigs were divided at weaning into 2 weight groups and 2 age groups and fed 3 different amounts of a Phase 1 diet to examine whether weaning feeding programs should be tailored to the age and/or weight of the pig. Bodyweight at weaning, but not age resulted in improved performance at day 53 post-weaning. Feeding program had no effect on growth or feed efficiency performance, or the variability in growth.

Introduction

Feeding the newly weaned pig is becoming an increasingly complex challenge, as multiple forces present themselves to pork producers. These forces include needs for lower cost, less antibiotic usage, improved performance and reduced variability. In this experiment, the impact of both the pig weight and age at weaning, as well as the quantity of each phase of diet offered to the pig were evaluated. We hypothesized that the lighter pig, and the younger pig within the lighter sub-group, would respond more to the higher quality diets; and therefore they would improve relative to similar pigs fed a poorer diet. This would result in improved overall performance and a reduction in body weight variability at the time of nursery exit.

Experimental Procedure

The experiment was designed using a 2 x 2 x 2 x 3 arrangement of treatments; 2 weight blocks of pigs, 2 ages of pigs, 2 dietary treatments, and 3 intake treatments. Since neither dietary nor intake treatment affected the results, data is reported averaged across these treatments. Four nursery rooms, each configured to provide 24 pens per room (8 pigs per pen, 768 pigs in total) were used for this experiment. At weaning, all available pigs were weighed individually and assigned to either the heavy or light block. Within each weight block, pigs were divided into the youngest and oldest. Groups were then randomly assigned to diet and intake treatments. The 3 intake treatments are summarized in Table 1. Diets were commercial nursery diets. As pigs were switched from phase 1 to 2 to 3 etc they received less spray dried whey, blood cells and supplemental amino acids.

Table 1. Summary of Feed Intake Treatments

	Feed Intake Treatment		
	Low	Medium	High
	kg/pig		
Phase 1	0	0.5	1.0
Phase 2	0	0.5	1.0
Phase 3	10	9	8
Phase 4	11	11	11
Phase 5	To end of trial	To end of trial	To end of trial

Results and Discussion

Diet nor intake treatment affected performance ($P > 0.05$).> Initial body weight group affected final BW (Table 2), ADG (Table 3) and ADFI (Table 4) throughout the trial ($P < 0.001$). Initial age affected BW and feed intake, but surprisingly had no effect on ADG or feed efficiency. Within a weight block, the older pigs began the trial 40 to 70 grams heavier than the younger pigs. The effect of initial weight and age on BW was observed at each weigh point, but

Table 2. Effect of Initial Weight or Age, or Intake Treatment on Body Weight

Weight block		**Heavy**			**Light**		
ıntake treatment		Low	Medium	High	Low	Medium	High
		Body weight (kg)			Body weight (kg)		
d 0	Young	6.98	6.96	7.02	4.92	4.92	4.93
	Old	7.07	7.05	7.06	5.01	4.94	4.94
d 8	Young	7.43	7.64	7.69	5.36	5.43	5.47
	Old	7.93	7.83	7.94	5.72	5.76	5.78
d 15	Young	9.37	9.36	9.51	6.77	6.83	7.03
	Old	10.12	9.98	10.03	7.38	7.64	7.56
d 22	Young	12.88	12.90	13.14	9.56	9.58	9.93
	Old	13.89	13.47	13.62	10.49	10.77	10.82
d 28	Young	16.99	16.99	17.22	12.97	12.89	13.27
	Old	18.12	17.61	17.68	14.11	14.41	14.32
d 35	Young	22.01	22.06	22.28	17.23	17.21	17.65
	Old	22.99	22.53	22.73	18.63	19.01	18.46
d 53	Young	36.12	36.95	36.68	31.04	30.87	31.06
	Old	37.13	36.26	36.63	32.03	32.62	31.82

Proc Mixed repeated measures test of fixed effects

Effect	P value	Effect	P Value
Weight	0.0001	Intake	0.35
Age	0.0001	Weight x age	0.12

Table 3. Effect of Initial Weight or Age, or Intake Treatment on Average Daily Gain

Weight block		Heavy			Light		
Intake treatment		Low	Medium	High	Low	Medium	High
		Average daily gain (kg/d)			Average daily gain (kg/d)		
d 0 –8	Young	0.16	0.16	0.17	0.12	0.13	0.14
	Old	0.20	0.20	0.20	0.16	0.18	0.17
d 9 – 15	Young	0.28	0.24	0.26	0.21	0.20	0.23
	Old	0.32	0.31	0.30	0.24	0.27	0.26
d 16 - 22	Young	0.50	0.51	0.52	0.39	0.38	0.41
	Old	0.54	0.50	0.51	0.45	0.45	0.46
d 23 - 28	Young	0.69	0.70	0.64	0.52	0.55	0.56
	Old	0.70	0.69	0.69	0.60	0.60	0.59
d 29 - 35	Young	0.72	0.73	0.72	0.61	0.62	0.63
	Old	0.70	0.70	0.72	0.65	0.66	0.60
d 36 - 53	Young	0.79	0.83	0.80	0.75	0.76	0.76
	Old	0.79	0.76	0.77	0.75	0.76	0.74
d 0 - 53	Young	0.56	0.57	0.55	0.48	0.49	0.49
	Old	0.57	0.55	0.56	0.51	0.53	0.51

Proc Mixed repeated measures test of fixed effects

Effect	P value	Effect	P value
Weight	0.0001	Intake	0.84
Age	0.68	Weight x age	0.06

Table 4. Effect of Initial Weight or Age, or Intake Treatment on Average Daily F.I.

Weight block		Heavy			Light		
Intake treatment		Low	Medium	High	Low	Medium	High
d 0 –8	Young	0.21	0.21	0.21	0.17	0.17	0.17
	Old	0.25	0.24	0.24	0.20	0.21	0.21
d 9 – 15	Young	0.32	0.32	0.32	0.25	0.25	0.25
	Old	0.38	0.36	0.35	0.29	0.31	0.30
d 16 - 22	Young	0.61	0.60	0.61	0.46	0.47	0.50
	Old	0.64	0.60	0.63	0.51	0.53	0.54
d 23 - 28	Young	0.85	0.83	0.85	0.68	0.68	0.68
	Old	0.85	0.82	0.86	0.73	0.73	0.73
d 29 - 35	Young	0.99	1.00	1.02	0.82	0.80	0.83
	Old	1.02	0.99	1.01	0.87	0.87	0.86
d 36 - 53	Young	1.26	1.28	1.29	1.07	1.08	1.10
	Old	1.26	1.28	1.27	1.11	1.12	1.11
d 0 - 53	Young	0.82	0.82	0.84	0.69	0.69	0.71
	Old	0.85	0.82	0.84	0.73	0.74	0.73

Proc Mixed repeated measures test of fixed effects

Effect	P value	Effect	P value
Weight	0.0001	Intake	0.32
Age	0.0001	Weight x age	0.02

became less pronounced as the trial progressed. Heavier pigs consistently grew faster than lighter pigs, and older pigs generally grew faster than younger pigs. Similar results were observed for feed intake. The effects of initial body weight group and age on feed efficiency (Table 5) were inconsistent. Generally, heavier pigs used feed more efficiently than lighter pigs; this effect achieved significance by the second half of the experiment. However, by the final week of the experiment, pigs in the young treatment group tended to have an improved feed efficiency relative to those which were older at weaning.

The coefficient of variability (CV) of body weight was calculated within pens (n = 8); therefore it is possible that single aberrant pigs may skew the result (Table 6) and these numbers are not representative of the CV of the weaning group. The CV was less for heavier pigs throughout the experiment. Since this effect was observed at d 0 it is a reflection of the variability observed with the light weight pigs at the experiment initiation. Age had no effect on CV.

Implications

Pigs which are heavier at weaning perform better than lighter pigs, regardless of age or intake of Phase 1 diet, which had only modest effects on performance.

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Table 5. Effect of Initial Weight or Age, or Intake Treatment on Feed Efficiency (G:F)

Weight block		Heavy			Light		
Intake treatment		Low	Medium	High	Low	Medium	High
d 0 –8	Young	0.41	0.66	0.36	0.50	0.54	0.62
	Old	0.74	0.68	0.74	0.72	0.80	0.74
d 9 – 15	Young	0.88	0.77	0.84	0.81	0.82	0.89
	Old	0.83	0.87	0.86	0.82	0.90	0.86
d 16 - 22	Young	0.84	0.85	0.86	0.86	0.81	0.84
	Old	0.86	0.84	0.81	0.88	0.85	0.86
d 23 - 28	Young	0.81	0.85	0.76	0.82	0.82	0.83
	Old	0.84	0.85	0.80	0.83	0.83	0.81
d 29 - 35	Young	0.73	0.74	0.72	0.76	0.78	0.76
	Old	0.69	0.71	0.72	0.75	0.77	0.70
d 36 - 53	Young	0.63	0.66	0.64	0.75	0.72	0.73
	Old	0.63	0.61	0.62	0.70	0.70	0.68
d 0 - 53	Young	0.67	0.69	0.66	0.70	0.71	0.70
	Old	0.68	0.68	0.67	0.70	0.71	0.70

Proc Mixed repeated measures test of fixed effects

Effect	P value	Effect	P value
Weight	0.11	Intake	0.24
Age	0.31	Weight x age	0.79

Table 6. Effect of Initial Weight or Age, or Intake Treatment on Variation in Growth[a]

Weight block		Heavy			Light		
Intake treatment		Low	Medium	High	Low	Medium	High
d 0	Young	9.5	9.9	11.3	14.5	12.6	14.0
	Old	12.1	10.9	11.2	14.7	13.1	15.2
d 8	Young	11.2	11.2	13.3	15.9	13.1	16.0
	Old	11.6	11.7	13.0	16.4	14.5	14.2
d 15	Young	13.1	11.8	13.6	17.9	15.4	17.9
	Old	12.8	11.9	14.0	16.9	16.5	14.9
d 53	Young	9.4	7.8	9.3	12.7	10.0	12.0
	Old	10.7	8.2	8.1	12.7	10.4	12.5

[a] Measured as the coefficient of variation or bodyweight within a pen (n=8)

Proc Mixed repeated measures test of fixed effects

Effect	P value	Effect	P value
Weight	0.0001	Intake	0.35
Age	0.0001	Weight x age	0.12

Response of Growing Pigs to Graded Levels of Flaxseed

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Summary

A growth experiment was carried out in young pigs (25-30 kg) in order to evaluate the response to flax in their diet and to determine if the feeding of relatively high levels of flaxseed causes changes in performance not predicted by the nutrient profile. Five levels of flaxseed in the diet were tested: 0, 5, 10, 15 and 20%. Four other diets were formulated in order to contain the same amounts of fat as those of the flaxseed-based diets but in the form of canola oil (1.7, 3.3, 5.0 and 6.7% oil). Each diet was tested on 8 pigs (4 males, 4 females), fed ad libitum and kept in individual pens of 1.7 m^2. The experiment lasted 28 days. Average daily gain (ADG), feed intake and feed efficiency were measured. Although a slight decline in growth occurred when flaxseed was added to the diet (-2.7 g ADG/% flaxseed, compared to -1 g ADG/% canola oil), no statistically significant differences between treatments was observed for ADG or average daily feed ($P > 0.05$); however, there was a tendency for ADG to decline at the highest flax level ($P = 0.08$). Feed conversion tended to improve with increasing levels of flax in the diet ($P = 0.07$). A decrease in feed intake was observed in pigs fed the diet containing 6.7% canola oil, compared to the other diets ($P=0.03$). It is concluded that flaxseed can be incorporated at 10 to 15% of the diet for growing pigs without adverse effects on ADG, feed intake and feed efficiency.

Introduction

The pork industry is continually seeking alternative ingredients for use in pig diets, either as a means of diversifying rations and thus reducing cost, or to achieve a final pork product that meets certain specifications, eg. omega-3 fatty acid enrichment. Thus, there is growing interest in the expanded use of flaxseed and related products by the pork industry. Flaxseed possesses properties that make it unique as a feed ingredient, not the least of which is a highly desirable fatty acid profile in the lipid fraction. Flax acreage is expected to increase substantially, thus expanding the quantity and consistency of supply. The pork industry has traditionally shunned, or heavily discounted, ingredients with an uncertain supply.

"Balanced diets containing up to 15% flaxseed will not adversely affect average daily gain."

However, whether or not flaxseed and related products will be viewed favourably by the pork industry will depend on a number of factors, the most important of which is a well-defined nutrient profile. There is also a need to determine how the pig will respond to increasing levels of flaxseed in its diet. By formulating diets based on the above-mentioned nutrients, nutritionists expect predictable performance. Because palatability and the impact of so-called anti-nutritional factors will not be determined in nutrient profiling, the only way to ensure that pigs perform as expected on diets containing flaxseed is to feed graded levels to the pig and evaluate performance compared to a known control. With a complete nutrient profile of flax in hand, and with objective information on the acceptability of flaxseed by the pig, a solid foundation is in place for future research on flaxseed in pig diets. Possible future uses for flax include the production of omega-3 fatty acid enriched pork, the development of alternatives to antimicrobial growth promoters and the enrichment of sow diets for essential fatty acids.

Experimental Procedures

Rooms and Animals

This experiment was conducted in an intensive room at PSCI. These rooms contain 76 pens, measuring 0.91 x 1.83 m (1.67 m2). The 4 extreme corner pens were not used, leaving 72 pens for use on this experiment. Floors are fully slatted, pre-cast concrete. Penning is solid PVC planking, with a 7.5 cm opening between the back walls, allowing pig-to-pig contact. Feeders are single space, dry feeders located at the front of each pen. Water is delivered through a nipple drinker located on the center of the back wall of the pen.

Table 1. Dietary treatments and number of pigs which will receive each treatment.

Treatment #	% Flaxseed	% Canola oil	# pigs	Flaxseed (kg)[a]
1	0	0	8	0
2	5	0	8	30
3	10	0	8	60
4	15	0	8	90
5	20	0	8	120
6	0	1.7	8	-
7	0	3.3	8	-
8	0	5.0	8	-
9	0	6.7	8	-

[a] assuming 600kgs per diet

Table 2. Amount of Basal Diets and Blending Regimes for Intermediate Diets

Percent	% Diet	20% Flaxseed Diet	8% Canola Oil Diet
Flaxseed Diets			
0	600	0	0
5	450	150	0
10	300	300	0
15	150	450	0
20	0	600	0
Canola Oil Diets			
1.7	450	0	150
3.3	300	0	300
5.0	150	0	450
6.7	0	0	600
Required Amount	2,400	1,500	1,500

One room of pigs were weighed at nursery exit and again when the pigs reached approximately nine weeks of age. Pre-test average daily gain was calculated from these weights. The pre-test average daily gain, and body-weight was used when the pigs reached approximately 9 weeks of age (25-30 kg) to select 36 barrows and 36 gilts. Pigs were blocked according to gender and weight. Within each block, pigs were randomly assigned to one of 9 experimental diets. Therefore, there were 4 blocks of barrows and 4 blocks of gilts for a total of 8 pigs (4 barrows, 4 gilts) per treatment. Animals were on test for 28 d (expected final weight ~50 kg).

Treatments

The experiment was designed as a randomized, complete block with 4 blocks of barrows and 4 blocks of gilts and a total of 9 pigs per block. Treatments were designed to represent the range of added flaxseed that might be anticipated in commercial practice: 0%, 5%, 10%, 15%, or 20% whole ground flaxseed, supplying 0%, 1.7%, 3.3%, 5%, or 6.7% added oil. To provide comparative data, additional diets contained 1.7%, 3.3%, 5%, or 6.7% canola oil; the exact amount of canola oil used was based on the assay results of the flaxseed. Canola oil is low in polyunsaturated omega-3 fatty acids, and high in monounsaturated fatty acids.

The required flaxseed (600 kg) was sourced from one supplier who ensured that the product purchased was derived from a variety of suppliers. In this way, the flaxseed was more representative of "typical" flaxseed than would be the case of employing a single source. The flaxseed was submitted for assay of crude protein, calcium, phosphorous and fat, in support of more accurate formulation of the experimental diets.

The control, the 20% flaxseed diet and the 6.7% canola oil diet were formulated using Brill. The diets containing 5, 10, and 15 % flax were prepared by blending the required amounts of the 0 and 20% flaxseed diets. Similarly, the intermediate canola oil diets were prepared by blending the 0% and 8% canola oil diets.

Data Collection and Records

Pigs were weighed at experiment initiation (day 0) and weekly thereafter (d7, 14, 21, 28). All feed was weighed into the feeders and feeder weigh backs done on weigh days, for the calculation of weekly feed intake. Feed samples were obtained at the time of mixing and weekly thereafter. Samples were composite by treatment. Faecal grab samples were collected during week 2 from 3 randomly selected male and 3 randomly selected female pens per treatment. Samples were composite by gender and treatment. All data were entered into the computer on the day of collection and stored on the main server to ensure regular back-ups were performed.

Laboratory Analysis

Feed samples were ground and analyzed for moisture, energy and acid-insoluble ash. Faecal samples were freeze-dried at PSCI, ground and analyzed for moisture, energy and acid-insoluble ash. All AIA analyses were conducted in quadruplicate, on approximately a 2 g sample.

Table 3. Total fat, fibre, and protein composition of experimental diets.

Trt #	Treatment Description	Average feed intake (g/d)	Average daily gain (g/d)	Feed efficiency
#1	basal diet	2,314 (211)a	1,038 (081)	0.450 (0.036)
#2	5 % flaxseed	2,384 (248)a	1,088 (106)	0.464 (0.029)
#3	10 % flaxseed	2,173 (196)ab	1,034 (103)	0.477 (0.031)
#4	15 % flaxseed	2,226 (339)ab	1,029 (110)	0.466 (0.035)
#5	20 % flaxseed	2,302 (377)a	1,001 (076)	0.441 (0.047)
#6	1.7 % canola oil	2,304 (331)a	1,069 (129)	0.467 (0.045)
#7	3.3 % canola oil	2,177 (236)ab	1,067 (153)	0.489 (0.030)
#8	5.0 % canola oil	2,324 (227)a	1,110 (023)	0.481 (0.042)
#9	6.7 % canola oil	2,035 (302)b	1,012 (118)	0.509 (0.030)

a, b for average feed intake: means with different superscripts differ significantly (P = 0.032)

No difference was observed for average daily gain (P = 0.081) and feed efficiency (P = 0.07)

Results and Discussion

Analysis of the ground flax seed indicated it contained (as fed basis) 33.3 % crude fat, 19.6 % crude protein and 8.6 % moisture. Analysis of the diets is described in Table 3. With the exception of treatment # 9, which contained more total fat than formulated, the basal diet and all the flaxseed diets contained more total fat than formulated and all the canola oil diets contained less total fat than formulated. The % difference between formulated and actual was greater in the canola oil diets than the corresponding flaxseed diets.

Pigs came off test September 14, 2005. Overall performance was excellent, and no pigs were removed from test during the 28-d experiment. Average initial weight was 27.5 and 27.4 kg for male and female pigs, respectively. The average initial weight and SD of blocks ranged from 24 ± 1.2 kg to 31.8 ± 2.3 kg. Average final weight was 63.01 and 63.12 for male and female pigs, respectively.

Implications

Balanced diets containing up to 15% flaxseed will not adversely affect average daily gain, feed intake, feed efficiency of growing pigs (30-55kgs). Growing pigs can adapt to high levels, approximately 7%, of fat in the form of flaxseed better than equivalent levels of canola oil.

Acknowledgements

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Effects of Housing Finishing Pigs in Varying Group Sizes and Space Allocations

B.R. Street and H.W. Gonyou

Summary
A study was conducted to determine whether the amount of space required by large groups differed from that of small groups, and whether space restriction affected pigs in large groups to the same extent as it does pigs in small groups. Some behavioural variables suggested that pigs in large groups were able to use space more efficiently. However, overall productivity and health variables indicated that pigs in large and small groups were similarly affected by crowding.

Introduction
Past studies on small groups (10-40) of pigs have found a negative impact of crowding on productivity and welfare. Studies examining large group (> 40) housing have found setbacks in the growth rate of pigs soon after mixing. Research on the effects of crowding pigs housed in large groups is minimal, although it has been hypothesized that pigs housed in large groups are able to use space more efficiently. This study was designed to assess the space requirements of both large and small groups, and the effects of space restriction on pig performance, behaviour, physiology, health and welfare.

Experimental Procedures
Group sizes were large (108 pigs) or small (18 pigs) and space allowances were crowded (0.52 m2/pig) or uncrowded (0.78 m2/pig), creating four treatments: large crowded, large uncrowded, small crowded, and small uncrowded. Eight 8-week blocks were carried out. A 1:1 ratio of barrows and gilts were used in the first two blocks. The remaining six blocks used barrows only. One wet/dry ad-libitum feeder space was provided for every nine pigs. Gains, feed intake, and feed efficiency were calculated on a weekly basis. Postural and feeding behaviour were assessed on a biweekly basis, as were injuries and salivary cortisol concentrations (indicative of stress). Carcass and adrenal gland data were collected at slaughter. Pig morbidity and mortality were determined for all eight blocks.

Results and Discussion
Crowded pigs had a lower growth rate, a lower feed efficiency, and a lower final body weight than uncrowded pigs (Table 1). Growth rate was depressed by 9.8 %, and feed efficiency by 11 %, during the final week of the study ($P < 0.05$). Crowded pigs ate fewer meals and spent less time eating overall, but feed intake did not differ from that of uncrowded pigs. Space allowance did not affect the level of injury, morbidity, or stress.

"Crowded pigs had a lower growth rate, lower feed efficiency, and a lower final body weight than uncrowded pigs."

Pigs in large groups had a lower growth rate than pigs in small groups (Table 1). Gains were most affected during the first two weeks, at which time they were depressed by 5.4 % ($P < 0.05$). The difference in initial body weights (Table 1) indicated that growth depression began in the first four days after group formation. Pigs housed in large groups ate fewer meals, but took longer to eat each meal, than pigs in small groups. Pigs housed in large groups had higher lameness and leg injury scores than pigs in small groups. Pigs in small groups spent more time sitting and lying on their sternum, and less time lying on their side, than pigs in large groups. Group size did not affect morbidity or stress levels.

The first sign of growth depression in response to crowding occurred much sooner for pigs in large groups compared with pigs in small groups. However, the rate of depression in gains was more gradual for pigs in large groups. Thus, by the final week of the trial, pigs in both large and small crowded groups had similar gains. Pigs in the small uncrowded groups had the highest carcass lean percentage while pigs in the large uncrowded groups had the highest fat depth. Pigs in large crowded groups had the highest lameness scores.

Table 1. Initial and final body weight, coefficient of variation, gains, feed intake, and feed efficiency of grow-finish pigs housed in large or small groups and at crowded or uncrowded space allowances

	Treatments					P-value[a]		
Item	Small Uncrowded	Small Crowded	Large Uncrowded	Large Crowded	SEM	Space Allowance	Group Size	Space x Group Size
# Pigs/Experimental Unit	36	36	108	A108	-	-	-	-
# Experimental Units/Block[b]	1	1	1	1	-	-	-	-
Space Allowance, m^2/pig	0.78	0.52	0.78	0.52	-	-	-	-
Initial Body Weight[c], kg	38.01	38.02	36.55	36.97	0.37	NS	0.003	NS
Coefficient of Variation, %	16.73	16.65	15.73	16.81	0.84	NS	NS	NS
Final Body Weight, kg	96.21	93.95	93.10	91.29	0.57	0.002	< .0001	NS
Coefficient of Variation, %	11.79	11.07	10.76	11.45	0.50	NS	NS	NS
Gain, kg/day	1.098	1.049	1.055	1.016	0.020	0.02	0.04	NS
Feed Intake, kg/day	2.782	2.867	2.766	2.801	0.066	NS	NS	NS
Efficiency, kg gain/kg feed	0.4108	0.3781	0.3807	0.3613	0.0080	0.002	0.005	NS

[a] NS = no significant difference (P > 0.05)

[b] Two adjacent small pens (18 pigs/pen) were equivalent to one experimental unit

[c] Taken after a habituation period of three days for blocks 1, 2, 6, and 8, four days for blocks 3, 4, and 5, and ten days for block 7

Implications

Both crowding and large group housing were found to negatively affect pig performance. Pigs housed in large groups were affected by space restriction sooner than pigs in small groups although, the depression in growth was much more gradual for pigs housed in large groups. There was limited evidence, and none related to productivity, that pigs in large groups were able to use space more efficiently than pigs in small groups.

Acknowledgements

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Feeding and Social Behaviour of Finishing Pigs in Fully Slatted Large Groups

T.S. Samarakone and H.W. Gonyou

Summary

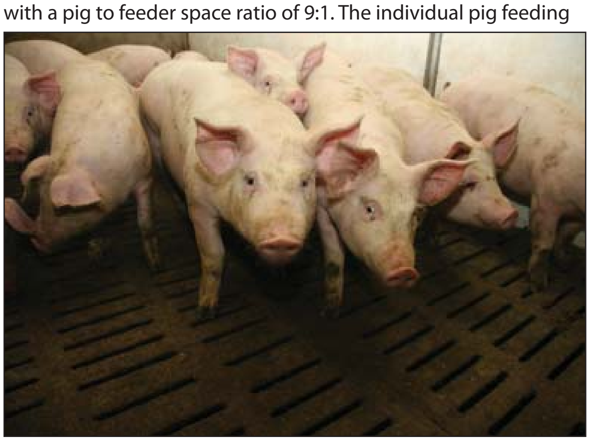
In this study we investigated feeding and social behaviours of grower-finisher pigs in larger groups, which are becoming popular among producers in North America. Pigs displayed some significant changes to feeding behaviour immediately following grouping into larger groups. However, long-term effects on feeding and other social behaviours were not apparent by the formation of pigs into larger groups.

Introduction

Most studies into feeding and social behaviours of pigs have been limited to relatively small group sizes (<40 pigs/group). However, these group sizes are much smaller than some that are now used in commercial operations in North America and elsewhere. The social dynamics of feeding and other behaviours of pigs in large social groups is not well understood, but it could be argued that the pigs may adapt themselves differently in larger groups compared to those in smaller social groups. Any adverse changes to feeding and social behaviours of pigs in larger groups may directly impair overall productivity and therefore welfare of animals. The main objective of the present study was to gain an insight into the feeding and social behaviours of grower-finisher pigs which are formed into larger social groups.

Experimental Procedures

Two blocks, each comprising four pens of 18 pigs (SG) and two pens of 108 pigs (LG) on fully slatted floors (0.76 m2/pig) were used in the experiment. The initial body weights of pigs averaged 34.6 ± 4.1 kg. An equal numbers of barrows and gilts (1:1) were used in each pen. Pigs were fed from multi-space wet/dry feeders, with a pig to feeder space ratio of 9:1. The individual pig feeding behaviour and group feeding patterns were studied during weeks 1, 5, 7 and 10 of the grower-finisher cycle. In addition, other behavioural activities such as percentage of time spent on eating/drinking, resting and standing/walking and diurnal patterns of these activities of pigs in both large and small groups were studied during weeks 2, 5 and 10 following re-grouping.



"Managing access to feeders in a large group system is critically important upon grouping."

Results and Discussion

The pigs in LG had more feeding bouts (35 vs. 25, P<0.05) and the bouts were shorter in duration (232 vs. 301 sec, P<0.05) during day 3 following re-grouping. No differences in feeding bouts and bout lengths were found during weeks 5, 7 and 10. More importantly, we found that the percentage of pigs queuing at the feeders to be high in LG than SG during day 3 (0.90 vs. 0.59, P<0.05), and there was a trend (P=0.08) for the percentage of pigs queuing at feeders to be high in LG than SG during day 6. There were similar 24 hr group feeding patterns in pigs of both SG and LG during weeks 1, 5, 7 and 10 (Figures 1 and 2). The average times spent on eating/drinking (5.2 vs. 5.2 %, for SG and LG), standing/walking (5.1 vs. 5.4 %, for SG and LG) and resting (89.6 vs. 89.3 %, for SG and LG) did not differ between the two group sizes. Furthermore, the diurnal patterns of these activities were also not affected by group size.

Conclusion

The feeding behaviours of pigs were disturbed immediately following re-grouping into larger groups. Pigs in larger groups seemed to take additional time to adapt their feeding behaviours as indicated by the similar patterns observed later in their grower-finisher cycle. Management of feeding behaviour in terms of accessing feeders may be critical immediately following formation of pigs into larger groups.

Acknowledgements

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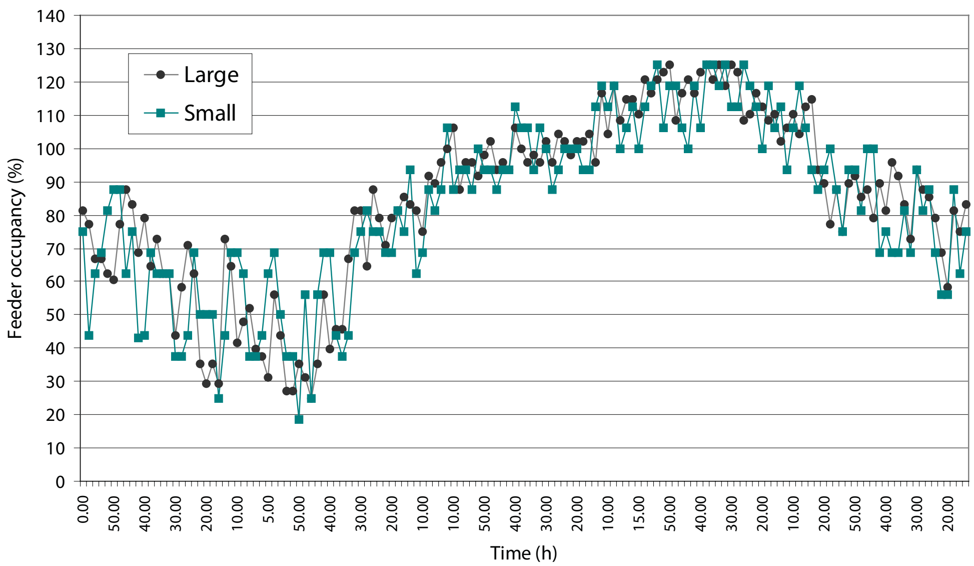

Figure 1. Daily feeding pattern of pigs at day 3 following group formations.

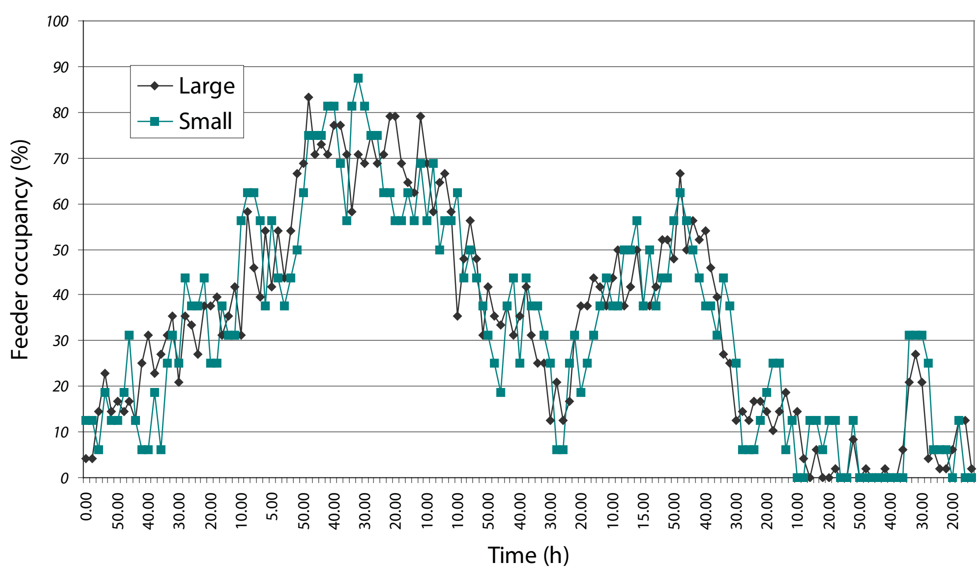

Figure 2. Daily feeding pattern of pigs during week 10 following group formations.

Measuring Ammonia Emissions from Urine Puddles

E.L. Cortus[1,2], S.P. Lemay[3], E.M. Barber[2,4] and B.Z. Predicala[1]

Summary

The ammonia emission from simulated urine puddles under controlled conditions was measured for a range of temperature, airspeed and concentration levels to determine if any or all of these factors affect the rate and amount that ammonia is produced from urine puddles on the floor of a barn. The measurements provide a basis for considering the effect of ammonia emissions from urine puddles on the amount of ammonia production and the ammonia production pattern in a swine barn.

Introduction

The slurry pit and urine puddles on the slatted and solid floor have been identified as the main sources of ammonia in a pig-housing unit. In urine puddles, the urea excreted by the animal is converted to ammonia by the enzyme urease on the floor surface. These enzymes are considered prevalent on barn floors because fecal bacteria produce them. As ammonia is being produced by the breakdown of urea, ammonia is also being released from the puddle to the surroundings. The relative rates of the urea breakdown and ammonia volatilization determine how much of the urea is converted to ammonia (and therefore the total emission), and the length of time required to release all the ammonia to the surroundings.

Experimental Procedures

The simulated urine consisted of urea and distilled water, with Jack Bean urease added to the solution to start the emission process. Each "puddle" was 250 ml of solution contained on a glass plate in an emission chamber. For each puddle, temperature and airspeed over the puddle surface were controlled and measured. Twelve treatment combinations were tested that included one of three temperatures (16, 21 and 26ºC), either 0.1 or 0.18 m s-1 airspeed over the puddle surface, and an initial urea concentration of either 0.2 M or 0.4 M. The ammonia concentration inside the emission chamber was used to determine the total emission, and periodic samples taken of the puddles were used to determine the ammonia concentration in the liquid and the pH.

Results and Discussion

Based on the measured emission, plus the amount of ammonia still left in the solution (if any) at the end of the tests, approximately 86% (range 79 to 96%) of the urea was converted to ammonia. There is no distinguishable pattern as to the effect of temperature, air velocity or initial urea concentration on the percent of urea converted. At this point, the results lead us to assume that for the range of conditions tested, there was sufficient time for the enzyme to convert the majority of the urea to ammonia, and temperature, air velocity or urea concentration do not have a large impact on the total amount of ammonia produced by urine puddles.

However, there were differences in the emission pattern for different levels of each variable. Since the puddles emitted differing amounts of ammonia based on the initial urea concentration and potentially, the amount of enzyme, the time required for the puddles to emit 75% of the available ammonia were compared. The minimum amount of time required by a puddle to emit 75% of the available ammonia was 19h (26ºC, 0.18 m s-1, 0.2 M). Urine puddles that started with 0.4 M urea took an average of 26% longer to reach the same point in the emission process as 0.2 M puddles. By decreasing the airflow rate across the puddle surface to 0.1 m s-1, the emission process required 28% more time than puddles with an airspeed of 0.18 m s-1. Higher temperatures resulted in faster emission rates. Urine puddles at temperatures of 16ºC and 21ºC required 52 and 24% more time than a puddle at 26ºC.

These measured results will also be compared to a mathematical model currently in development that attempts to define what processes the temperature, air velocity and urea concentration affect.

Implications

Where this information is useful, is by knowing when and where urinations occur on the floor of barns, we can have a better understanding of when that particular surface is at its maximum emission. Further understanding the floor emission will help determine if and what kind of ammonia mitigation methods could be employed for this ammonia production site.

Acknowledgements

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[1]Prairie Swine Centre, [2]Institut de Recherche et de Développement en Agroenvironnement, and [3]University of Saskatchewan

Manure Scraper System Reduces Hydrogen Sulphide Levels in Swine Barns

B.Z. Predicala[1], E.L. Cortus[1], S.P. Lemay[2], C. Laguë[3]

Summary

The effectiveness of a manure scraper system for reducing the risk of barn worker and animal exposure to hydrogen sulphide (H2S) was evaluated by comparing gas levels in two identical grow-finish rooms, one with manure scraper system installed (Scraper) and the other was a typical swine room (Control) with conventional manure pit-plug system. The H2S concentrations in the Scraper room were significantly lower by 90% compared to the Control room ($p<0.05$). Ammonia emission was not significantly affected by the manure removal system, but tended to increase over the 4-5 monitored weeks during each trial. Given the highly variable nature of H2S production and movement within a room, care should always be taken when emptying manure pits.

Introduction

A previous PSCI study found swine barn workers can be at risk of H2S exposure while performing manure management tasks, such as pulling pit-drain plugs to clear manure out of swine production rooms. Occupational regulations stipulate that worker exposure to H2S should not exceed an 8-h time-weighted average (TWA) of 10 ppm, or a 15-min short-term exposure limit (STEL) of 15 ppm. Out of 119 plug-pulling events monitored in different sections of various barns, 29% generated peak H2S values higher than 100 ppm, and 48% generated 15-min TWA values higher than the 15 ppm STEL value at the worker level. Because extended manure storage times can contribute to anaerobic degradation processes that give rise to H2S gas, an in-barn manure handling system that allows more frequent and complete removal of manure from production rooms has the potential to reduce H2S production. Hence, the goal of this study was to evaluate the effectiveness of a manure scraper system to reduce the risk of exposure of swine barn workers and animals to H2S gas.

Figure 1. Scraper system used to remove manure produced on a daily basis

Experimental Procedures

Two identical grower-finisher rooms at PSCI were used for this experiment. A total of 70 pigs per room were used at a starting weight of about 21.5 kg and remained in the rooms for 12 weeks for each trial. A manure scraper system (Fig. 1) was installed in one room (Scraper). The other room (Control) was operated normally, i.e., manure was allowed to accumulate in the pits, and was drained on a predetermined schedule by pulling the pit-drain plugs.

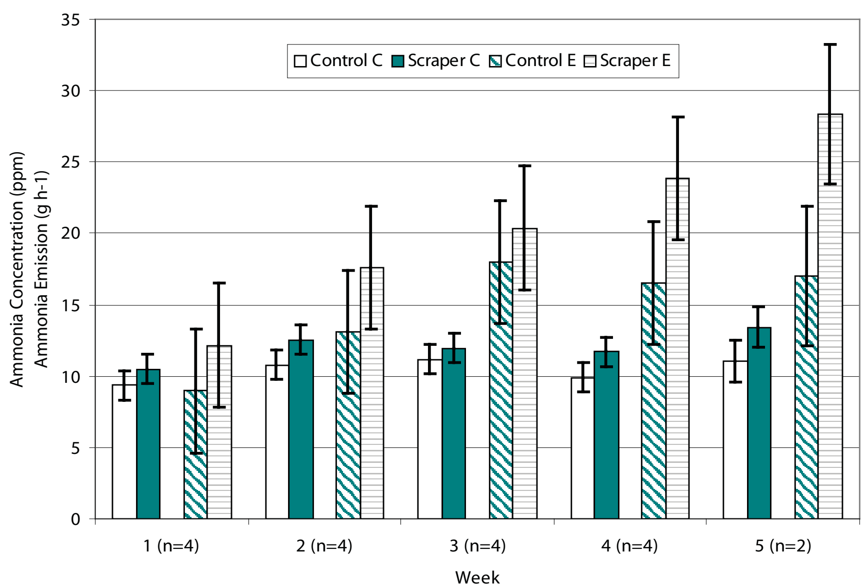

Figure 2. Weekly least square mean (LSM) ammonia concentrations (C) and emission rates (E) for the Scraper and Control rooms. Error bars represent SE, and n is the number of values used in the LSM.

[1]Prairie Swine Centre, [2]Institut de Recherche et de Développement en Agroenvironnement, and [3]University of Saskatchewan

Table 1. Summary of peak H2S concentrations (ppm) measured at two locations in the Control and Scraper rooms on days that pit-plugs were pulled in the Control room.

Trial No.	Date	Control		Scraper	
		Over plug	Middle pen	Over plug	Middle pen
Trial 1	10-Mar-04	4	2	0	0
	24-Mar-04	0	0	0	0
	07-Apr-04	9	0	11	7
	21-Apr-04	12	4	0	0
Trial 2	30-Jun-04	12	2	0	0
	21-Jul-04	95	n/a	6	n/a
	11-Aug-04	40	30	2	0
	25-Aug-04	30	10	1	2
Trial 3	13-Oct-04	0	0	0	0
	27-Oct-04	48	4	0	0
	10-Nov-04	55	0	0	0
	24-Nov-04	18	11	0	0
	15-Dec-04	18	7	0	0
Trial 4	09-Feb-05	7	3	19	0
	23-Feb-05	0	0	0	0
	09-Mar-05	0	0	0	0
	23-Mar-05	52	4	0	0
	06-Apr-05	23	5	0	3
Lest-Square Mean		23.4[a]	5.6[b]	2.0[b,c]	0.8[c]
Standard Error		4.5	4.6	4.5	4.6

n/a – data not available, instrument malfunction

[a,b,c] Letters accompanying LSM values indicate significant differences (α=0.05) determined using transformed data.

The room air quality and H2S concentrations in both rooms were monitored over four production cycles (trials). Two H2S monitors (Model Pac III, with XS EC 1000 ppm H2S sensor, Draeger, Lübeck, Germany) were installed in each room: one over the middle of the pit (middle pen) and another directly above the plug, both at about 1 m off the floor. Ammonia concentrations were measured at the inlet and outlet of both rooms using an ammonia analyzer (Model Chillgard RT, MSA Canada, Edmonton, AB).

Results and Discussion

Based on the average readings from both measuring locations, the Scraper room had significantly lower peak H2S concentration levels than the Control room ($p<0.05$), equivalent to an average reduction of 90% (Table 1). Similarly, the scraper system significantly lowered the TWA H2S concentrations ($p<0.05$) by an average of about 96%.

More frequent manure removal using the scraper system did not affect the ammonia concentration measured at the outlet of the rooms ($p>0.10$) (Fig. 2). On average, 35.6% more ammonia was emitted from the Scraper room compared to the Control room, indicating that the manure removal system tended to increase room emission ($p<0.10$). Weekly average ammonia emissions also increased significantly ($p<0.001$) as each trial progressed, mainly due to increased manure production and ventilation rates required to account for increased heat and moisture production.

Conclusions

Overall, the results demonstrated the effectiveness of the scraper system in reducing H2S exposure of swine barn workers, with marginal impact on ammonia production. Based on the installation and operating costs associated with this study, the estimated cost to construct and operate a similar scraper system in a new or existing facility is about $2 to $3 per pig sold, respectively. However, this cost does not take into account the benefits of improved worker safety.

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Reducing H_2S Exposure Through a Water Spray Method and Monitoring

B.Z. Predicala, E.L. Cortus, R. Fengler, and S.K. Christianson

Summary

The performance of commercial hydrogen sulphide (H2S) monitoring devices was verified by comparing readings with a reference analytical method using a gas chromatograph (GC). A spray treatment method was also evaluated for reducing worker exposure to H2S. Spraying with water was effective in reducing the levels of H2S released from agitated manure. An additive mixed with spray water did not help in reducing H2S levels.

Introduction

Various H2S control methods have been investigated at PSCI; one approach examined was the spraying of water-based liquid on the manure surface during agitation. Because H2S is water soluble, the rationale for this method was to try to put back into solution the H2S gas released during agitation, thereby reducing the airborne H2S concentration. Additionally, a commercially-available H2S monitoring instrument used in the preliminary studies on liquid spray effectiveness showed inconsistent readings when subjected to various conditions during spray application.

Experimental Procedures

The general experimental approach was to apply the spray treatment in an enclosed manure chamber while simultaneously collecting data using the H2S monitors (Draeger PacIII) and gas samples for analysis using the GC system. The performance of the H2S monitors was verified by comparing the readings from the monitor with readings from a GC-based reference analytical method. The effectiveness of the spray treatment was evaluated by comparing the H2S levels in the enclosed chamber during tests without spray (Control) and with the application of spray (Treatment). Treatment tests were conducted using water only, and with the chemical additive mixed with water at varying dilution levels.

Results and Discussion

Summarized in Table 1 are the H2S readings in bagged gas samples using the GC system and the H2S monitor. A paired t-test comparison showed no significant difference ($p>0.05$) between the GC values and the H2S monitor readings over the 0-1000 ppm range of the monitor.

Table 1. Summary of H_2S Values determined using the GC system and H_2S Monitor

	H_2S concentration (ppm)	
	GC method (reference)	H_2S monitor
Mean (n = 131)	341.2 a	345.7 a
Standard Error	19.3	20.0
Minimum	4.0	2.0
Maximum	905.2	985.0
95% Confidence interval	38.2	39.6

[a] indicates no significant difference between means at α=0.05.

Results from three trials showed that spraying with water only caused a slight initial increase in H2S levels (at t = 1), followed by subsequent significant reduction in H2S (Fig. 1). The water spray treatment was consistently effective in all trials, reducing the H2S levels by 87% relative to initial values, which is 23% lower than the Control tests. However, the spray with additive treatment did not help in reducing H2S levels.

Conclusion

Spraying water over the agitated manure surface can control the rate of release of H2S gas. Once fully investigated, incorporating this technology in swine barns can help prevent worker and animal exposure to high levels of H2S when emptying manure pits.

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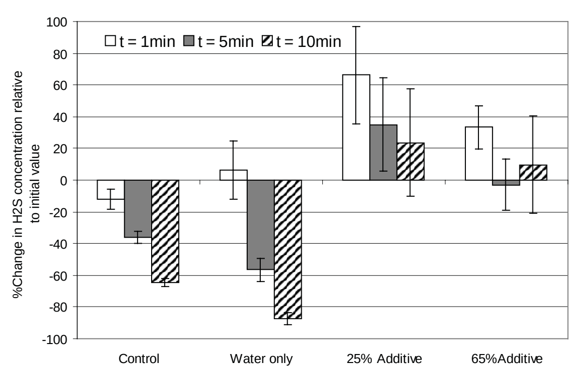

Figure 1. Average percent change in H2S levels relative to initial concentration (at t=0) as influenced by the treatments applied

Greenhouse Gas Emissions from Covered or Uncovered Earthen Manure Storage

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Summary

Samples were collected weekly during the spring and summer months and once every two to three weeks during the fall months. Weather conditions were also recorded on each sampling day. Sampling began in April, 2004 and continued through November, 2005. Average seasonal emissions were calculated for each cell and gas for the spring, summer, and fall seasons and are expressed in terms of g of CO2-equivalent/m2-day. Annual emissions were calculated by multiplying the seasonal emissions by the number of days in each season (91.25 days). Winter emissions were assumed to be negligible.

Results and Discussion

• Nitrous Oxide and Surface Emissions

Surface emissions and emissions of nitrous oxide were found to be negligible in the first five weeks of sampling and further sampling was therefore discontinued. The nitrous oxide emission results were consistent with those previously measured at that site for the uncovered and straw covered EMB (Laguë et al. 2004).

• Seasonal emissions comparison

As expected, emissions increased as the ambient temperature increased through the summer months and continued into the fall. Higher temperatures promote biological activity, thus increasing emissions from the storage. Emissions were highest in the summer and fall months for uncovered and covered storages. Unlike the emissions from the uncovered and straw-covered surfaces, the carbon dioxide and methane emissions from the exhaust fans of the NAP cover were well correlated with each other and nearly equivalent during the spring and summer of 2004. This correlation may be explained by the controlled manner in which the NAP-covered gases are vented. Uncovered and straw-covered surfaces may release 'burps' of gas from time to time, skewing the emissions results, while the emissions from the NAP-cover must travel to the perimeter of the storage before being vented through the fans. During the fall, 2004, however, the methane emissions remained high while the carbon dioxide emissions decreased to typical fall emissions. In spring and summer, 2005, this trend continued as the methane emissions were two to three times higher than the carbon dioxide emissions. This may be attributed to the increased rainfall in 2005, increased solids content in the primary cell, or different management strategies in the barn.

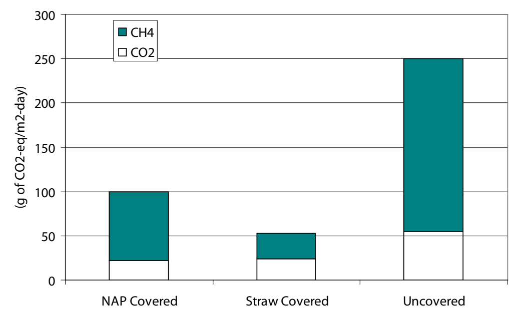

Figure 1. Annual emissions from uncovered, straw-covered and NAP-covered EMB.

• Annual Emissions Comparison

In a previous study, Laguë et al. 2004 published the GHG emissions from uncovered and straw-covered EMB's in Saskatchewan. In general, the straw cover reduced carbon dioxide and methane emissions by 57 and 85% respectively, compared to the uncovered surface (Figure 2). Nitrous oxide emissions were negligible in all cases. Using five seasons of emission data, the results show the NAP cover resulted in a 62 and 60% reduction in carbon dioxide and methane emissions respectively, compared to the uncovered surface. After one year of emission data (three seasons), the NAP cover efficiency was as high as the straw-cover at reducing CO2 and CH4 emissions. Again, the increased rainfall, increased solids content or changes in barn management may have resulted in higher emissions in 2005, particularly during the summer months.

• Emissions comparison from the primary and secondary cells of the EMB

The study by Laguë et al. 2004 showed the secondary cell emissions were significantly higher than primary cell emissions for the uncovered storage while the primary cell emissions were higher than the secondary cell for the straw-covered EMB. For the NAP cover, except for the spring 2005 season, the primary cell had higher CO2 and CH4 emissions than the secondary cell. Secondary cell emissions were twice as high as those from the primary cell in spring, 2005. In the summer months, emissions from the primary cell were twice as high compared to those from the secondary cell.

• Emissions on Agitation Day (NAP cover)

The EMB at Elstow was agitated and emptied on September 28 and 29, 2004. The agitation system for the NAP cover includes pumping air through perforated tubes placed at the bottom of the primary cell to aerate and agitate the manure. The cover was pulled back to expose approximately one third of the surface of the manure, but the fans continued to operate to exhaust any gas that became trapped under the remaining cover. Pump-out and land application occurred during the second day.

Exhaust samples were drawn from the NAP fans of the primary cell once an hour during the second day. The GHG emissions on the pump-out day were equivalent to the maximum GHG emissions observed in the summer months prior to agitation (550 g of CO2-equivalent/m2-day for each gas). In the weeks after the agitation day, the CO2 emissions dropped to typical fall emissions. However, the CH4 emissions remained as high as the summer emissions and were two to three times higher than the CO2 emissions. This may be due to the ineffective agitation and suspension of the solid material, resulting in the higher solids content in the primary cell.

• Economic Evaluation of NAP and Straw Covers

The costs associated with the application of a straw cover include the cost of the bales, manual labour, equipment for application and the coverage provided by each bale which all depend on the size of the storage. The improved nitrogen retention means that the manure has a fertilizer value and costs associated with land application. The costs of the NAP cover include the capital cost of the system, some early maintenance and the annual cost to run the fans. The improved nitrogen retention means the manure has a higher fertilizer value and a higher cost associated with land application. Assuming average values for these variables ($12/bale, 70 m2/bale, 2.5 kg NH3-N/m3 retained in straw storage and 3.0 kg NH3-N/m3 retained in NAP storage, $0.85/kg N value and an application rate of 150 kg N/ha at a rate of $75/ha), the straw cover has an annual cost benefit of $10,151. Annualizing the capital cost of the NAP cover over the 10 year life expectancy means the NAP cover has an annual cost benefit of $5,845.

Publications

ABSTRACTS – NON-REFEREED

Beaulieu, A.D., M.R. Bedford and **J.F. Patience**. 2005. The effect of phytase and dietary Ca:tP ratio on the excretion of total and soluble phosphorus by weanling pigs. Adv. Pork Prod., Univ. of Alberta, Edmonton, AB. Vol. 16. Abstr. #11.

Patience, J.F., **A.D. Beaulieu**, R.T. Zijlstra and N. Williams. 2005. Reduced diet DE content lowered feed costs, improved carcass quality and had no impact on growth rate in growing-finishing pigs. Adv. Pork Prod., Univ. of Alberta, Edmonton, AB. Vol. 16. Abstr. #10

Predicala, B.Z., **S.K. Christianson**, S.P. Lemay and C. Laguë. 2005. Controlling hydrogen sulfide gas in swine barns with a manure pit scraper system.. Adv. Pork Prod., Univ. of Alberta, Edmonton, AB Vol. 16. Abstr. #12.

Strawford, M. L., **Y. Z. Li**, and **H. W. Gonyou**. 2005. Social factors affecting injuries, eating order, and lying patterns of sows in electronic sow feeders. Adv. Pork Prod., Univ. of Alberta, Edmonton, AB Vol. 16. Abstr. #21.

Zijlstra, R.T., K Lopetinsky, B. Dening, G. S. Begin, and **J.F. Patience**. 2005. Zero-tannin fababean nutrient assessment and swine performance trials for Alberta. Adv. Pork Prod., Univ. of Alberta, Edmonton, AB. Vol. 16. Abstr. #9.

ABSTRACTS – REFEREED

Beaulieu, A.D., M. Bedford and **J.F. Patience**. 2005. The effect of phytase and dietary Ca:P ratio on the excretion of total and soluble phosphorus by weanling pigs. J. Anim. Sci. 83(Suppl.2):78.

Gonyou, H.W., **T.A. Done** and **Y.Z.Li**, 2005. The effects of crowding on the performance of grower and finisher pigs on full and partial slat floors. J. Anim. Sci. 83(Suppl.2):37.

Li, Y.Z. and **H.W Gonyou**, 2005. Effect of body size and stall width on behavior of gestating sows. J. Anim. Sci. 83(Suppl.2):37.

Nortey, T.N., **J.F. Patience**, P.H. Simmins and R.T. Zijlstra. 2005. Effect of xylanase and (or) phytase supplementation on nutrient digestibility and growth performance of grower pigs fed wheat-based diets containing wheat millrun. J. Anim. Sci. 83(Suppl.2):78.

Nortey, T.N., N.L. Trottier, **J.F. Patience**, P.H. Simmins and R.T. Zijlstra. 2005. Effect of xylanase and (or) phytase supplementation on amino acid digestibility of grower pigs fed wheat-based diets containing wheat millrun. J. Anim. Sci. 83 (Suppl. 1):390.

Oresanya, T. F., **A.D. Beaulieu** and **J.F. Patience**. 2005. The interaction of net energy concentration and feeding level in weaned pigs. I. Growth, nutrient digestibility and energy utilization. J. Anim. Sci. 83 (Suppl. 1):117

Oresanya, T.F., **A.D. Beaulieu** and **J.F. Patience**. 2005. The interaction of net energy concentration and feeding level in weaned pigs. II. Body composition, nutrient deposition rates and plasma IGF-1 concentration. J. Anim. Sci. 83 (Suppl. 1):117.

Oresanya, T.F., **A.D. Beaulieu** and **J.F. Patience**. 2005. Response of weanling pigs to declining energy intake when amino acid intake declines either in direct proportion to energy or at a reduced rate. J. Anim. Sci. 83(Suppl.2):71.

Pettitt, M.J. and J. S. Sands, 2005. Apparent digestibility of nutrients in sows fed wheat-based diets supplemented with phytase. Manipulating Pig Production X: Proceeding of the 10th Biennial Conference. Australasian Pig Science Assoc. Christchurch, New Zealand

Strawford, M.L., **Y.Z. Li** and **H.W. Gonyou**, 2005. Social factors affecting injuries, eating order, and lying patterns of sows in electronic sow feeders. J. Anim. Sci. 83(Suppl.2):37.

Street, B.R. and **H.W Gonyou**, 2005. The effects of housing grow-finish pigs at two different group sizes and space allowances. J. Anim. Sci. 83(Suppl.2):38.

CONFERENCE PROCEEDINGS

Li, Y.Z., L. Chenard, S.P. Lemay, **H.W. Gonyou**, 2005. Water intake and wastage at nipple drinkers by growing-finishing pigs. Proc. 7th Intern. Symp. Livestock Environment. Beijing, China. pp 458-464.

Patience, J.F. 2005. Barn efficiency - Your role in driving costs down. Proc. Sask. Pork Ind. Symp., Saskatoon, SK. pp. 23-26.

Patience, J.F. 2005. The merits, benefits and challenges of adopting the net energy system in a North American context. Proc. Minn. Nutr. Conf., Minneapolis, MN. pp. 134-150.

Predicala, B.Z., **E.L. Cortus** and **R. Fengler.**, 2005. Evaluation of hydrogen sulfide monitoring devices and a spray method to reduce worker exposure. CSAE-SCGR Paper No. 05-024. Canadian Society of Agricultural Engineers (CSAE) Annual Conference. Winnipeg, MB. June 27-29.

Whittington, D.L. 2005. Environmental Issues Resource Centre. Livestock Environmental Initiative Conference, Toronto, ON, February 7&8. pp20-21.

INVITED LECTURES

National - Canada

Gonyou, H.W. 2005. How different systems address welfare issues for gestating sows. Centralia Swine Research Update. Kirkton, ON. Jan. 26.

Gonyou, H.W. 2005. Potential for large groups and auto-sorting of grow/finish pigs. Centralia Swine Research Update. Kirkton, ON. Jan. 26.

Gonyou, H.W. and **Y.Z. Li**, 2005. Alternatives to gestation stalls: Experiences at the Prairie Swine Centre. Manitoba Swine Seminar, Winnipeg, MN. Jan. 27.

Gonyou, H.W. 2005. Practical approaches to ensure animal welfare on farms. London Swine Conference. April 7. London, ON.

Gonyou, H.W. 2005. Feeder and drinker design and management. I. Atlantic Canada Hog Feeding Strategies Workshop. Moncton, NB. . Feb. 23

Gonyou, H.W. 2005. Feeder and drinker design and management. II. Atlantic Canada Hog Feeding Strategies Workshop. Moncton, NB. Feb. 24

Patience, J.F. 2005. Maximizing carcass quality using nutrition. PIC Canada Ltd. December 2. Saskatoon, SK

Patience, J.F. 2005. Finishing for maximum profitability. PIC Canada Ltd. December 2. Saskatoon, SK

Patience, J.F. 2005. Maximizing carcass quality using nutrition. PIC Canada Ltd. December 1. Swift Current, SK.

Patience, J.F. 2005. Finishing for maximum profitability. PIC Canada Ltd. December 1. Swift Current, SK.

Patience, J.F. 2005. Maximizing carcass quality using nutrition. PIC Canada Ltd. November 24. Lethbridge, AB.

Patience, J.F. 2005. Finishing for maximum profitability. PIC Canada Ltd. November 24. Lethbridge, AB.

Patience, J.F. 2005. Maximizing carcass quality using nutrition. PIC Canada Ltd. November 23. Red Deer, AB

Patience, J.F. 2005. Finishing for maximum profitability. PIC Canada Ltd. November 23. Red Deer, AB

Patience, J.F. 2005. Barn efficiency - Your role in driving costs down. Saskatchewan Pork Industry Symposium. November 8. Saskatoon, SK

Patience, J.F. 2005. The profit potential of adopting the net energy system for swine. Cargill Animal Nutrition, September 7. Red Deer, AB.

Patience, J.F. 2005. The next 10 years in pork production: Prairie Swine's contribution to future opportunities and challenges. Big Sky Farms 10th Anniversary Think Tank. June 2. Nipawin, SK.

Patience, J.F. 2005. The Prairie Swine Centre ingredient research program. Department of Animal & Poultry Science, University of Saskatchewan. April 22. Saskatoon, SK

Patience, J.F. 2005. The basics of swine nutrition. Big Sky Farms Manager in Training Course. Humboldt, SK. May 24.

Patience, J.F. 2005. Optimizing net income and expenses. Fast Pigs. Spiritwood, SK February 23.

Patience, J.F. 2005. Feeding for optimum carcass and pork quality. Swine Management Seminar, Agribrands Purina Canada. Shakespeare, ON. February 16.

Patience, J.F. 2005. Optimizing the marketing of pigs. Big Sky Farms. Humboldt, SK. February 3.

Patience, J.F. 2005. Practical ways to reduce expenses and increase net income. Hutterite Brethren Meeting sponsored by Hypor Genetics. Swift Current, SK. January 25.

Patience, J.F. 2005. Practical ways to reduce expenses and increase net income. Hutterite Brethren Meeting sponsored by Hypor Genetics, Saskatoon, SK. January 24.

Whittington, D.L. 2005. Large Group Housing of Grower-Finisher Pigs – Challenges and Opportunities. Dick Rex Consulting Special Seminar, Winnipeg, MB. April 27.

Whittington, D.L. 2005. Livestock Issues Resource Centre. Livestock Environmental Initiative Conference, Toronto, ON. Feb 7&8.

Whittington, D.L. 2005. Moving from Technology Transfer to Technology Adoption. Keynote address CAMA Student Chapter Industry Reception, University of Saskatchewan Saskatoon, SK, Jan. 12.

International

Gonyou, H.W. 2005. Animal welfare in North America. Australia Pig Limited Management Group. Canberra, ACT. May 26.

Gonyou, H.W. 2005. Sow housing: group systems and stall research. Victoria Pig Producers. Bendigo, Vic. May 4.

Gonyou, H.W. 2005. Feeder and drinker design. Victoria Pig Producers. Bendigo, Vic. May 4.

Gonyou, H.W. 2005. Creating a feeding environment conducive to optimum feed intake. Advanced Swine Production Technology Course. University of Illinois. Urbana, IL. . June 16.

Gonyou, H.W. 2005. The procine social environment. Advanced Swine Production Technology Course. University of Illinois. Urbana, IL. . June 16.

Patience, J.F. 2005. Enhancing net energy system predictions based on nutrient types and intakes, expected body composition and animal age. Cargill Animal Health. Minnetonka, MN September 22.

Patience, J.F. 2005. The merits, benefits and challenges of adopting the net energy system in a North American context. Minnesota Nutrition Conference. Minneapolis, MN. September 21

Patience, J.F. 2005. Dietary electrolyte balance in swine nutrition. Church and Dwight Think Tank. Philadelphia, PA. April 19.

Patience, J.F. 2005. Net energy: Will its use save or cost us money & phytase and soluble phosphorus excretion: Here are the facts. Vita Plus Swine Summit 2005. Morton, MN. April 1.

Patience, J.F. 2005. Variation in pork production & the dollars and cents of feed budgeting. Vita Plus Swine Summit 2005. Morton, MN. March 31.

Predicala, B.Z., **E.L. Cortus**, S.P. Lemay and C. Laguë. 2005. Development and testing of a manure scraper system to reduce concentrations of hydrogen sulphide gas in a grower-finisher swine room. ASABE Paper No. SD05-802. American Society of Agricultural and Biological Engineers. St. Joseph, MI, U.S.A.

MONOGRAPHS

Patience, J.F., **A.D. Beaulieu**, **M. Rivard** and **D.A. Gillis**. 2005. Evaluating the impact under commercial conditions of increasing dietary tallow content and dietary energy concentration on grow-finish performance, carcass quality and return over feed costs. Monograph No. 05-07. Prairie Swine Centre Inc., Saskatoon, Canada. 36 pp.

REFEREED JOURNALS

Gonyou, H.W., 2005. Experiences with alternative methods of sow housing. JAVMA 226:1336-1340.

Guzik, A. C., **M. J. Pettitt**, E. Beltranena, L.L. Southern and B. J. Kerr. 2005. Threonine and tryptophan ratios fed to nursery pigs. J. An. Phys. An. Nut. 89:297-302.

Hayne, S. M. and **H. W. Gonyou**. 2005. Behavioural uniformity or diversity? Effects of behaviour and performance following regrouping in pigs. Appl. Anim. Behav. Sci. In Press.

Li, Y.Z., L. Chenard, S.P. Lemay, and **H.W. Gonyou**, 2005. Water intake and wastage at nipple drinkers by growing-finishing pigs. J. Anim. Sci. 83:1413-1422.

Nyachoti, C.M., R. Butler, I.R. Seddon and **J.F. Patience**. 2005. Effect of water source (ground versus surface) and treatment on nursery pig performance. Can. J. Anim. Sci. 85:405-407.

Patience, J.F., J.F. Umboh, R.K. Chaplin and C.M. Nyachoti. 2005. Nutritional and physiological responses of growing pigs exposed to a diurnal pattern of heat stress. Livestock Prod. Sci. 96:205-214.

THESIS SUPERVISED/CO-SUPERVISED

Oresanya, T.F. 2005. Energy Metabolism in the Weanling Pig: Effects of Energy Concentration and Intake on Growth, Body Composition and Nutrient Accretion in the Empty Body. Ph.D. Thesis. University of Saskatchewan, Saskatoon, SK. 261 p. – **Patience, J.F.**

Street, B.R. 2005. The Effects of Housing Grow-Finish Pigs in Two Different Group Sizes and Floor Space Allocations. M.Sc. Thesis. University of Saskatchewan, Saskatoon, SK. 136p. – **Gonyou, H.W.**

Bench, C.J. 2005. Environmental and Genetic Factors Influencing the Development of Belly Nosing in the Early-Weaned Pig. Ph.D. Thesis. University of Saskatchewan, Saskatoon, SK. 201p. -. **Gonyou, H.W.**

Widyaratne, G.P. 2005. Characterization and Improvement of the Nutritional Value of Ethanol By-Products for Swine. M.Sc. Thesis. University of Saskatchewan, Saskatoon, SK. 124p. – **Zijlstra, R.T.**

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The following organizations have provided funding or donations in kind to support public research at the Centre for the 2005 year.

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