
Swine Research Review 2005

Environmental Research

■ [The Development of an Electronic Nose, via Intelligent Modeling for Effective Measurement of Odour on Ontario Pork Farms](#)

S.X. Yang and R.R. Hacker

■ [Hematology and Biochemistry of Enviropig™ Blood](#)

R.G. Meidinger, A. Ajakaiye, D. Murray, S.P. Golovan, M.Z. Fan, J.P. Phillips, J. Zhang, R. R. Hacker, J.M. Kelly and C.W. Forsberg.

■ [Evaluation of Electrolysis for Oxidative Deodorization of Hog Manure](#)

D. Bejan and N.J. Bunce

■ [Manure Phosphorus was Reduced in the Cassie Line of the Enviropig™ Breed Fed Diets with Low Phosphorus and Low Crude Protein Compared with the Yorkshire Breed](#)

A. Ajakaiye, R. Meidinger, M.Z. Fan, D.A. Murray, J. Zhang, M. Mundia, J.P. Phillips, S.P. Golovan, J.M. Kelly, R.R. Hacker and C.W. Forsberg.

■ [Determination of True Digestible Calcium and True Digestible Phosphorus Requirements in Weanling Pigs](#)

M.Z. Fan, A. Holt, Y. Shen and T. Archbold

■ [Changes in the Plasma Citrulline Concentration are a Predictor of Alterations in Gut Mucosal Morphology and Functions in the Piglet](#)

D. Lackeyram and M.Z. Fan

■ [Phosphorus Digestibility are Affected by Graded Dietary Levels of Sodium Chloride Intake in Growing Pigs Fed Corn and Soybean Meal-Based Diets](#)

C. Huang, R.J. Fang, Y.L. Yin and M. Z. Fan

■ [Additivity of Apparent and True Fecal Phosphorus Digestibility Measured in Soybean Meal, Peas, Faba Bean, Corn, Oats, Broken Rice Meal, Rough Rice Meal, Buckwheat, and Sorghum for Growing Pigs](#)

R.J. Fang, Y.L. Yin and M.Z. Fan

■ [True Phosphorus Digestibility and the Endogenous Phosphorus Outputs Associated with Conventional Oat Grain for Weanling-Growing Pigs](#)

Y. Shen and M.Z. Fan

■ [Methodological Aspects of Determination of Phytase Activity and Phytate-Phosphorus Contents in Phosphorus Nutrition Studies with Pigs](#)

S.Y. Shen and M.Z. Fan

Food Safety and Pork Quality

■ [Characterization of *E. coli* O157:H7 from Pigs in Ontario](#)

C.L. Gyles and R. Friendship

■ [Porcine Lectins as Indicators of Resistance to Bacterial Disease](#)

B.N. Lillie, A.S. Brooks, N.D. Keirstead, J.D. Hammermueller, E.J. Squires, and M.A. Hayes

■ [Tetracycline use and Selection of Virulent Enterotoxigenic *Escherichia coli* \(ETEC\)](#)

P. Boerlin, C.L. Gyles and R. Friendship

■ [Molecular Epidemiology of Antimicrobial Resistance in *Escherichia coli* from Pigs in Ontario](#)

P. Boerlin and C.L. Gyles

■ [Inhibition of PRRS Virus Replication by Small Interfering RNAs](#)

D. Ran, J. Li, G. Li, C. Song, P. Dyce and D. Yoo*

■ [Evaluation of Serologic Tests to Determine the Presence of Salmonella on a Farm](#)

V. Farzan, R. Friendship, C. Dewey and K. Klotins

■ [A Baseline Study for Microbial Hazards Associated with Hogs](#)

R. Friendship, C. Dewey, D. Ojkic, C. Gyles and J. Odumeru

Production

■ [Production of GFP Transgenic Pig by Sperm-Mediated Gene Transfer \(SMGT\)](#)

J.H. Kang, M. Buhr, R. Friendship, C.W. Forsberg, and S. P. Golovan

■ [Digestive Capacity of the Small Intestinal Mucosal Maltase-Glucoamylase Is Increased in Early-Weaned Pigs](#)

D. Lackeyram and M.Z. Fan

■ [Factors Affecting Backfat as a Carcass Quality Parameter](#)

T. Cottrell, C. Dewey, R. Friendship, and C. Ribble

■ [Factors Affecting Depth of Muscle as a Carcass Quality Parameter](#)

T. Cottrell, C. Dewey, R. Friendship and C. Ribble

- [**The Effects of Gender, Grain Source and Feeding Method on Pig Growth Performance and Carcass Composition**](#)
The Effects of Gender, Grain Source and Feeding Method on Pig Growth Performance and Carcass Composition
P. McEwen and J. Morris, Ridgetown College - University of Guelph
- [**Impact of Feeding Fermentable Protein and Carbohydrates on Growth Performance, Gut Health and Digestive Function of Newly Weaned Pigs**](#)
E. A. Jeurond and C.F.M. de Lange
- [**Dynamics of Body Protein Deposition Following Changes in Amino Acid Intake**](#)
H. Martinez, E. Jeurond and K. de Lange
- [**Nutrition Induced Variation in Body Composition, Compensatory Growth, Blood Urea Nitrogen, Cortisol and Leptin in Growing Pigs**](#)
H. Martinez and K. de Lange
- [**An Algorithm to Estimate Body Protein and Body Lipid Deposition Patterns in Growing Pigs from Growth and Feed Intake Curves**](#)
G. Vander Voort and K. de Lange
- [**Swine Liquid Feeding: Feeding Value of Corn Condensed Distillers Solubles**](#)
J. Squire, C. Zhu, E. Jeurond and C.F.M. de Lange
- [**Effect of Single or Double Insemination on Fertility of Sows Bred at an Induced Estrus and Ovulation**](#)
Effect of Single or Double Insemination on Fertility of Sows Bred at an Induced Estrus and Ovulation
- [**The Effects of Feeding Fermented Liquid Whey Inoculated With Specific Lactic Acid Bacteria Using an *E. coli* Challenge Model**](#)
R. Amezcua, R. Friendship, C. Dewey, K. deLange and S. Weese
- [**Role of Uterine Lymphocytes in Angiogenesis During Early Pig Pregnancy**](#)
C. Tayade, G.P. Black, C. Fang and B.A. Croy

Behaviour and Well-Being

- [**Does Boar Presence Influence Aggression, Shoulder Scratches and Stress Among Newly Mixed Bred Sows?**](#)
M.J. Seguin, R.M. Friendship, R.N. Kirkwood, A.J. Zanella and T.M. Widowski
- [**Neurogenesis of Oxytocin-containing Neurons in the Paraventricular Nucleus of Puberty Gilts and Lactating Sows**](#)
G.D. Partlow and K.R.S. Fisher
- [**Effects of Sickness on Behaviour and Resource use of Pair-housed Piglets**](#)
S.T. Millman, K.C. Sheppard, A. Gallien and J.T. Gray
- [**Effects of Intermittent Lighting on Resting Behavior by Newly Weaned Piglets**](#)
S.T. Millman, K.C. Sheppard, M. Madden and A. Valliant

[[Home](#)] [[About Us](#)] [[People](#)] [[Academic Programs](#)] [[Research](#)] [[Facilities](#)] [[Links](#)] [[News](#)]

The Development of an Electronic Nose, via Intelligent Modeling for Effective Measurement of Odour on Ontario Pork Farms

Simon X. Yang¹ and Roger R. Hacker²

¹ School of Engineering; ² Dept. of Animal & Poultry Science
University of Guelph, Guelph, ON N1G 2W1
Tel.: (519) 824-4120x52437; Email: syang@uoguelph.ca

Objectives

This research is to develop intelligent odour modeling software and electronic nose system for measuring pork farm odour; (2) to identify all the relevant gas components and other contributing factors that result in the odour emissions from Ontario pork operations; and (3) to provide a reliable method for evaluating odour control efforts.

Methods

This research project will develop intelligent odour modeling software and prototype electronic nose system for measuring pork farm odour. All the relevant gas components and other contributing factors that result in the pig farm odours are analyzed and identified from data.

Results

We designed and implemented the first prototype robotic electronic nose for pork farm odours. Preliminary version of software for signal acquisition, signal processing, and user interface were developed. Some testing experiments were conducted using artificial odorant gas in research laboratory and also natural odorant gas at several livestock farms. The circuit and noise of the odorant gas sensors in our robotic nose were analyzed [4,5]. In addition, we developed both statistic and neural network approaches for modeling and analysis of pork odours using several single-component datasets and a multiple-component dataset [1,2,3]. Future work includes refinement of the hardware design, development of an integrated systems modeling framework for the pork farm odours, and creation of a user-friendly software suite.

- [1] K. R. Janes, S. X. Yang and R. R. Hacker: (2004) Single component modelling of pig farm odour with statistical methods and neural networks. *Biosystems Engineering*. **88** (3): 271-279.
- [2] K. R. Janes, S. X. Yang and R. R. Hacker: (In press) Pork farm odour modelling using multiple-component multiple-factor analysis and neural networks. *Applied Soft Computing*. Accepted in August 2004.
- [3] L. Pan, S. X. Yang, F. Tian, L. Otten and R. R. Hacker: (2004) Analysing contributions of components and factors to pork odour using structural learning with forgetting method. *Lecture Notes in Computer Sciences*. Vol. 3173, pp. 383-388.
- [4] F. Tian, S. X. Yang and K. Dong: (In press) Circuit and noise analysis of odorant gas sensors in an e-nose. *Sensors*. Accepted in Jan. 2005.
- [5] F. Tian, S. X. Yang and K. Dong: (2005) Study of noise feature in sensor array of an electronic nose. In: *Proc. of 2005 IEEE Intl. Conf. on Networking, Sensing and Control*, Tucson, USA, March 19-22, 2005. Accepted.

Acknowledgement

This work is funded by OMAF (Ontario Ministry of Agriculture and Food) and Ontario Pork.



- Prospective Students
- Current Students
- Faculty & Staff
- Alumni & Friends
- Parents & Visitors
- Media

the University of Guelph

September 12, 2005

web tools

The University of Guelph is renowned in Canada and around the world as a research-intensive and learner-centred institution and for its commitment to open learning, internationalism and collaboration.

Our vision is to be Canada's leader in creating, transmitting and applying knowledge to improve the social, cultural and economic quality of life of people in Canada and around the world.

campus news

- Planning Process Moves Forward, Organizational Recommendations Made
- "Mardi Gras" for Hurricane Katrina Relief
- Prof Featured in National Newspaper
- Virtual Reality Driving Simulator Opens at U of G

more»

campus events

- Events Calendar

more»

- WebAdvisor
- WebMail
- Courselink (WebCT)
- Distance Education

A few clouds



now online

- Office of the President
- U of G Policies
- Start Online
- Giving to Guelph
- Science Complex
- Privacy Guidelines
- Graphic Standards Guide

Contact Us | Sitemap | Website Info

University of Guelph | Guelph, Ontario, Canada | N1G 2W1 | Tel: (519) 824-4120

© 2005 University of Guelph

Hematology and Biochemistry of EnviropigTM Blood

Roy G. Meidinger, Ayodele Ajakaiye, Dave Murray, Serguei P. Golovan, Ming Z. Fan, John P. Phillips, Jenny Zhang, Roger R. Hacker, John M. Kelly¹ and Cecil W. Forsberg.
University of Guelph, Guelph, Ontario, Canada, ¹MaRS Landing

Background

Environmental pollution from swine and poultry manure is an ongoing problem faced by agriculture. In order to alleviate this problem, a pig (EnviropigTM) has been developed that does not require supplemental phosphorus for optimal growth and excreted feces and urine with a reduced content of phosphorus.

Objective

Hematology and biochemistry of animal blood is a well documented standard method for assessing animal health. Therefore, we have used these parameters to assess the comparative biology of the conventional Yorkshire pig and the EnviropigTM.

Results

We have analyzed a total of 17 hematology and 25 biochemistry parameters on fresh blood samples to assess the health of the EnviropigTM (EP) Cassie line of pigs that secretes phytase in the saliva and a similar number of conventional Yorkshire pigs. Forty eight pigs (24 EP and 24 Yorkshire [YK]) comprised of 12 boars and 12 gilts of each breed were used in the trial, with blood collected at 54.6 ± 0.7 and 55.7 ± 0.5 , 90.6 ± 0.7 and 91.7 ± 0.5 and 125.6 ± 0.7 and 126.7 ± 0.5 days of age for weanling, growing and finishing phases, respectively. Growing and finishing pigs were individually housed in a temperature-controlled room maintained at 22°C. The experimental design was 2 x 2 factorial combinations of breed and gender. All growing and finishing pigs were fed at a percentage of their BW with weekly adjustments using the NRC (1998) model. The experimental diets for the growing and finishing pigs were formulated based on the available P with the Ca: P maintained at a ratio of 2:1. Blood samples were collected from the intraorbital sinus. There were either no significant differences in the assayed parameters across the treatments ($P < 0.05$), or if there were differences, the values were within published normal ranges.

Take Home Message

These data indicate normal levels for blood hematology and biochemistry for pigs, with no appreciable biological differences between the EP and YK.

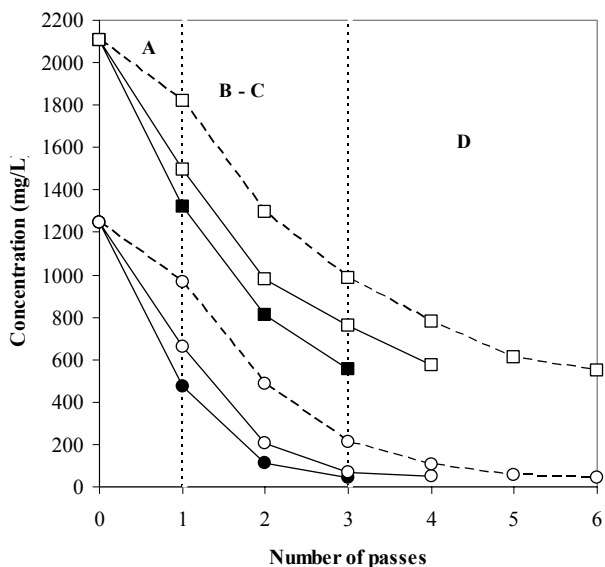
Financial support was provided by Ontario Pork, Ontario Ministry of Agriculture and Food, University of Guelph Food Systems Biotechnology Centre, and MaRS Landing.

Evaluation of electrolysis for oxidative deodorization of hog manure

Dorin Bejan and Nigel J. Bunce*, Department of Chemistry, University of Guelph,
Guelph, Ontario N1G 2W1

Objectives: This laboratory study is directed towards the use of electrolysis (passage of electric current) as a method for the amelioration of odor from liquid hog manure.

Results: Among several experimental approaches examined, the most promising involved the use of a commercially available “dimensionally stable anode” composed of tin dioxide coated onto a base of titanium, and the newly developed material boron-doped diamond (BDD), which has an exceptional stability to both oxidizing and reducing electrolytic conditions. These anodes promote the formation, at the anode surface, of hydroxyl radicals, which migrate into the bulk solution to oxidize odorous constituents of the manure. The Figure below shows the amelioration of odor and the loss of “Total Organic Carbon” (TOC) with the progress of the electrolysis, using a BDD anode and a stainless steel cathode. Dissolved nitrogen, and hence fertilizer value, is not lost from the solution upon electrolysis (not shown in diagram).



Variation of total carbon (squares) and total organic carbon (circles) at the BDD anode as a function of current, in multiple passes through the electrochemical reactor. Interrupted line, empty symbols = 400 mA; full line, empty symbols = 600 mA; full line, closed symbols = 800 mA. Symbols for smell: A = raw manure; B = “barn-like” odor; C = slight barn-like odor; D = no smell or solvent-like odor.

Take-home message: Ongoing work is directed towards achieving odor control with a single-pass through the reactor, and developing cheap, long-lasting anode materials.

Acknowledgements: OMAF Animal Program; Ontario Pork.

Manure Phosphorus was Reduced in the Cassie Line of the Enviropig™ Breed Fed Diets with Low Phosphorus and Low Crude Protein Compared with the Yorkshire Breed

A. Ajakaiye¹, R. Meidinger¹, M.Z. Fan^{*}, D.A. Murray¹, J. Zhang², M. Mundia¹, J.P. Phillips¹, S.P. Golovan, J.M. Kelly³, R.R. Hacker and C.W. Forsberg^{*1}.

Departments of Animal and Poultry Science, Molecular and Cellular Biology¹, Ponsonby Research Station², University of Guelph, Guelph, Ontario N1G 2W1 and MaRS Landing³

*Corresponding authors: (519) 824-4120, *ext. 53656; E-mail: mfan@uoguelph.ca or ‡ext. 53433; E-mail: cforsber@uoguelph.ca

Background

Phosphorus (P) absorption is related directly to dietary P concentration and the proportion of soluble inorganic forms of P relative to organically bound P present in the form of phytate P (Pond et al., 2005). The Cassie line is one of the founder lines of the Enviropig™ developed to secrete phytase in the saliva, from the parotid, sublingual and submaxillary glands to release bound phytate P for absorption in pigs (Golovan et al., 2001).

Objective

The objectives of this study were to determine P utilization by the Enviropig™ (EP) during the growing phase and to compare the values obtained with that derived from the Yorkshire (YK) breed.

Results

Fecal P values were significantly ($P < 0.05$) reduced in the EP by up to 39% on the diet with supplemental inorganic phosphate, 70% with the low P diet, and 68% with the low P and low crude protein (CP) diet compared to the YK. In comparison with the YK, there were no differences in the urine P when the EP was fed diets with low P (1.41 ± 0.97 vs. 0.01 ± 0.94 g/pig/day) and low P-low CP (1.82 ± 1.02 vs. -0.36 ± 0.92 g/pig/day). Apparent P digestibility was increased ($P < 0.05$) in the EP relative to that of the YK. The total manure P excretion by the EP was reduced as compared to YK when fed diets with low P (2.82 ± 0.99 vs. 4.56 ± 0.96 g/pig/day) and low P-low CP (3.37 ± 1.05 vs. 4.28 ± 0.94 g/pig/day).

Take Home Messages

The Enviropig™ costs less to feed because supplemental P or phytase enzyme does not need to be included in the diet, and the reduced P in the manure from the Enviropig™ is more compatible with stringent nutrient management legislation.

Financial support was provided by Ontario Pork, Ontario Ministry of Agriculture and Food, University of Guelph Food Systems Biotechnology Centre, and MaRS Landing.

References

Pond, W.G. et.al. Basic animal nutrition and feeding. John Wiley and Sons, Inc. (2005) 5th ed. pp. 172.
Golovan, S. et.al. (2001). Pigs expressing salivary phytase produce low-phosphorus manure. *Nat. Biotech.* 19:741–745.

Determination of True Digestible Calcium and True Digestible Phosphorus Requirements in Weanling Pigs

M.Z. Fan*, A. Holt, Y. Shen and T. Archbold

Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario N1G 2W1

*Corresponding author: (519) 824-4120, *ext. 53656; E-mail: mfan@uoguelph.ca

Background

True rather than apparent digestible calcium (Ca) and phosphorus (P) should be determined in the major feed ingredients for swine diet formulation (Fan et al., 2001). True P digestibility values in corn and soybean meal for weanling pigs have been determined in our previous studies. However, the present Ca and P requirements for pigs, as suggested by NRC (1998), are still based on total and apparent digestible Ca and P supply. Therefore, it is essential to measure true digestible Ca and P requirements for pigs for minimizing manure Ca and P excretion.

Objective

This study was conducted to determine true digestible calcium (Ca) and phosphorus (P) requirements in weanling pigs (10-20 kg).

Methods and Procedures

Thirty-six Yorkshire pigs (18 barrows and 18 gilts), initial and final BW of 10 and 18 kg, were fed six experimental diets for six periods according to a completely randomized block design. The diets were corn and soybean meal-based, and formulated to contain six levels of total Ca at 0.49, 0.58, 0.67, 0.74, 0.83, and 0.92%, respectively, and total P at 0.42, 0.50, 0.58, 0.64, 0.72, and 0.80%, respectively, through supplementing limestone and dicalcium phosphate. Diet 1 was the control diet and contained 0.49% total Ca and 0.42% total P corresponding to 0.40% true digestible Ca and 0.21% true digestible P without supplemental P but with limestone supplementation. Each experimental period lasted 25 d with 20-d adaptation and 4-d collection of total urine excretion and fecal samples. BW gain and feed intake were recorded.

Results

- Graded levels of Ca and P did not affect ($P > 0.05$) feed intake, weight gain, and feed conversion. Supplementation of P did not improve ($P > 0.05$) P retention, whereas Ca supplementation increased ($P < 0.05$) Ca retention.
- Diet 1, with true digestible Ca at 0.40% and true digestible P at 0.21% and total Ca and P contents below the NRC (1998) recommendations, was associated with the minimal levels of total manure Ca and P excretion.

Take Home Messages

In conclusion, the current NRC (1998) recommendations of Ca and P requirements for weaned pigs are likely overestimated, therefore resulting in excessive manure Ca and P excretion.

Financial support was provided by Ontario Pork and the OMAF-University of Guelph Animal Research Program.

Reference

Fan, M.Z., Archbold, T., Sauer, W.C., Lackeyram, D., Rideout, T., Gao, Y., de Lange, C.F.M. and Hacker, R.R. (2001). Novel methodology allows simultaneous measurement of true phosphorus digestibility and the gastrointestinal endogenous phosphorus outputs in studies with pigs. *The Journal of Nutrition* 131: 2388-2396.

Changes in the Plasma Citrulline Concentration Are a Predictor of Alterations in Gut Mucosal Morphology and Functions in the Piglet

D. Lackeyram and M.Z. Fan*

*Department of Animal and Poultry Science, University of Guelph
Guelph, Ontario N1G 2W1*

*Correspondence author: (519) 824-4120, ext. 53656; E-mail: mfan@uoguelph.ca

Background

Feeding programs usually affect growth performance and the gastrointestinal system development in weanling pigs. Reliable and quick plasma analysis based bio-markers need to be established for assessing how feeding regimes affect the gut functions in nursery pigs.

Objectives

This study determined quantitative relationships between the plasma urea and amino acid (AA) concentrations and the gut mucosal morphological changes and body weight gains in early weaning (EW) and suckling piglets.

Methods and Procedures

The study was conducted for 12 d with 24 Yorkshire piglets of an average initial body weight of 3.4 kg at d 10 of age. The suckling pigs (12) were with sows for the duration. The weaned pigs (12) were fed a corn and soybean meal-based diet. All the piglets were sacrificed to collect plasma samples for the analyses of urea and AA and intestinal tissues for measuring gut morphology.

Results

- There were no sex effects ($P>0.05$) on any of the endpoint measurements. The EW pig had 32% ($P<0.05$) of the whole body growth rate of the suckling pigs.
- The EW pig experienced an elevated whole body AA catabolism ($P<0.05$) as indicated by significant increases in plasma urea concentration.
- Weaning decreased ($P<0.05$) the total counts of mucin-filled goblet cells along the crypt-villus axis. Weaning also caused gut mucosal villus atrophy and crypt hyperplasia ($P<0.05$) in comparison with suckling piglets.
- There were linear relationships ($P<0.05$) between the plasma urea concentration and average daily gain and gut mucosal morphological measurements, supporting the concept that gut mucosal crypt cells are metabolically of a catabolic phenotype, whereas the villus cells are predominantly of an anabolic phenotype.
- There were also linear relationships ($P<0.05$) between plasma concentrations of urea and several AA including carnitine, citrulline, glutamate, glutamine, phenylalanine, and taurine. Similarly, there were linear relationships ($P<0.05$) between the gut mucosal morphological measurements and several AA, with citrulline showing the best correlation.

Take Home Messages

- In conclusion, gut mucosal crypt hyperplasia is partially responsible for the weaning-associated elevation in whole body AA catabolism and growth repression. Change in the plasma citrulline concentration is a reliable plasma marker for predicting alterations of gut mucosal morphology and functions in piglets.

Financial support from Ontario Pork, OMAF-University of Guelph Animal Research Program and NSERC is appreciated.

Phosphorus Digestibility Are Affected by Graded Dietary Levels of Sodium Chloride Intake in Growing Pigs Fed Corn and Soybean Meal-Based Diets

C. Huang¹, R. J. Fang¹, Y. L. Yin^{1,2} and M. Z. Fan^{2*}

¹Institute of Subtropical Agriculture, the Chinese Academy of Sciences, Changsha, Hunan, China, and ²Department of Animal and Poultry Science

University of Guelph, Guelph, ON, Canada

*Correspondence author: (519) 824-4120, ext. 53656; E-mail: mfan@uoguelph.ca

Background

Amino acids, monosaccharides and inorganic phosphate are hydrolyzed from both dietary and endogenous sources of nutrient polymers by digestive enzymes and are primarily transported across the small intestinal apical membrane via sodium (Na⁺)-substrate co-transport systems (Fan et al., 2001; Fan et al., 2004).

Objectives: The objective of this study was to examine effects of graded levels of sodium chloride (NaCl) intake on apparent and true fecal crude protein (CP), dry matter (DM) and phosphorus (P) digestibility in growing pigs fed corn and soybean meal-based diets.

Methods and Procedures

Six crossbred commercial barrows, with an average initial BW of 22 kg, were fed six diets according to a 6x6 Latin square design. The diets were corn and soybean meal based and formulated to meet all other nutrient requirements with NaCl supplemented at 0.1, 0.2, 0.3, 0.4, 0.5, and 0.6%, respectively. Chromic oxide (0.35%) was included as a digestibility marker. Each experimental period consisted of 12 d with 6-d adaptation and 6-d collection of fecal samples.

Results

- No significant effects ($P>0.05$) of NaCl on the digestibility of DM, CP and Ca were observed.
- However, dietary NaCl levels had quadratic effects ($P<0.05$) on the apparent and true P digestibility with 0.3% NaCl being the optimal level.

Take Home Messages

- Thus, dietary levels of NaCl affect phosphorus digestibility in growing pigs. An optimal dietary NaCl level of 0.30% is recommended for growing pigs fed corn and soybean meal-based diets for their optimal digestive utilization of dietary phosphorus.

Financial support from the Chinese Academy of Sciences, Ontario Pork and OMAF-University of Guelph Animal and Environmental Research Programs is appreciated.

References

- Fan M.Z., T. Archbold, W.C. Sauer, D. Lackeyram, T. Rideout, Y. Gao, C.F.M. de Lange and R.R. Hacker. (2001). Novel methodology allows measurement of true phosphorus digestibility and the gastrointestinal endogenous phosphorus outputs in studies with pigs. *The Journal of Nutrition* 131: 2388-2396.
- Fan M.Z., J. Matthews, N.M.P. Etienne, B. Stoll, D. Lackeyram and D.G. Burrin. (2004). Expression of brush border L-glutamate transporters in epithelial cells along the crypt-villus axis in the neonatal pig. *American Journal of Physiology* 287:G385-G398.

Additivity of Apparent and True Fecal Phosphorus Digestibility Measured in Soybean Meal, Peas, Faba Bean, Corn, Oats, Broken Rice Meal, Rough Rice Meal, Buckwheat, and Sorghum for Growing Pigs

R. J. Fang¹, Y. L. Yin^{1,2} and M. Z. Fan^{2*}

¹Institute of Subtropical Agriculture, the Chinese Academy of Sciences, Changsha, Hunan, China, and ²Department of Animal and Poultry Science
University of Guelph, Guelph, ON, Canada

*Correspondence author: (519) 824-4120, ext. 53656; E-mail: mfan@uoguelph.ca

Background

True rather than apparent digestible phosphorus (P) should be determined in the major feed ingredients for swine diet formulation (Ajakaiye et al., 2003).

Objective: Two digestion experiments were conducted to determine the additivity of the apparent and true fecal P digestibility measured in soybean meal, peas, faba bean, corn, oats, broken rice meal, rough rice meal, buckwheat, and sorghum for growing pigs.

Methods and Procedures: In experiment 1, six diets were formulated with the soybean meal (SBM) as the basal, and four other diets were substituted with corn, oats, rough rice meal, and broken rice meal at the expense of SBM, respectively. In experiment 2, six diets were formulated with SBM as the basal, and four other diets were substituted with buckwheat, sorghum, peas, and faba bean at the expense of SBM, respectively. The last diet was a mixture of soybean meal, buckwheat, sorghum, peas, and faba bean. Chromic oxide (0.3%) was used as a digestibility marker in both experiments. Each period lasted for 8 d with a 4-d adaptation to the diets and 4 d of fecal collection. In both experiments, six barrows, with average initial BW of 20.5±2.0 kg, were used and fed the six diets according to a 6 × 6 Latin square design. The apparent and true fecal P digestibility values in the 9 tested ingredients were measured by the substitution method.

Results

- There were differences ($P<0.05$) between the directly determined and the predicted apparent fecal P digestibility values in the mixture of the experiment 1 but no differences ($P>0.05$) between the directly determined and the predicted apparent fecal P digestibility values in the mixture of the experiment 2.
- However, there were no differences ($P>0.05$) between the directly determined and the predicted true fecal P digestibility values in both experiments.

Take Home Messages

- These results have indicated that true fecal P digestibility values are additive, whereas the apparent fecal P digestibility values measured in single feed ingredients are not always additive in growing pigs.

Financial support from the Chinese Academy of Sciences, Ontario Pork, and OMAF-University of Guelph Animal and Environmental Research Programs is appreciated.

References

Ajakaiye, A., M.Z. Fan, T. Archbold, R.R. Hacker, C.W. Forsberg and J.P. Phillips. (2003). Determination of true phosphorus digestibility and the endogenous loss associated with soybean meal for growing-finishing pigs. *Journal of Animal Science* 81: 2766-2775.

True Phosphorus Digestibility and the Endogenous Phosphorus Outputs Associated with Conventional Oat Grain for Weanling-Growing Pigs

Y. Shen, and M.Z. Fan*

*Department of Animal and Poultry Science, University of Guelph
Guelph, Ontario N1G 2W1*

*Correspondence author: (519) 824-4120, ext. 53656; E-mail: mfan@uoguelph.ca

Background

Swine diets should be formulated on the basis of true digestible phosphorus supply in order to reduce feeding cost and manure phosphorus (P) excretion (Shen et al., 2002). Oat grain is an alternative cereal grain for pig diets.

Objectives

Two digestion trials were conducted to measure true fecal digestibility and the fecal endogenous P loss associated with a conventional oat grain in pigs by the regression analysis technique.

Methods and Procedures

Four weanling and four growing pigs with an average initial BW of 6.8 and 26.4 kg were fitted with a T-cannula at the distal ileum. Both the weaned and growing pigs were fed four semi-purified diets according to a 4x4 Latin square design. The diets were cornstarch-based and contained four levels of P from a hulled oat grain with 61% of its total P as phytate P.

Results

◆ There were no differences ($P>0.05$) in the true P digestibility (81.2 ± 3.7 vs. $83.5\pm4.0\%$, $n=16$) between the weanling and the growing pigs.

◆ There were also no differences ($P>0.05$) in the fecal endogenous P loss (0.304 ± 0.058 vs. 0.320 ± 0.068 g/kg DMI, $n=16$) between the weanling and the growing pigs.

Take Home Messages

◆ Phosphorus associated with the conventional oat grain is relatively digestible in pigs.

Financial support from Ontario Pork, NSERC, Agriculture and Agri-Food Canada and Canadian Pork Council Multi-Partner Hog Environmental Management Strategy Program, and OMAF-University of Guelph Animal Research Program is appreciated.

References

Shen Y., M.Z. Fan, A. Ajakaiye and T. Archbold. (2002). True phosphorus digestibility and the endogenous phosphorus loss associated with corn for growing-finishing pigs are determined with the regression analysis technique. *The Journal of Nutrition* 132: 1199-1206.

food, life, leadership

Our Vision: We are global leaders in innovative life sciences education and research for agriculture, food, the rural community and the environment.

Our Mandate: Is to deliver world-class education, research and innovation that meet the needs of contemporary society. We do this through a multi-campus system, working with alumni and our communities, in English and French.



Advancing Research

keep current

2.aug.2005 :: Study Delves Into Consumer Acceptance of Food Technologies

22.jun.2005 :: U of G Earns Awards for Agri-Food Innovation

8.jun.2005 :: Farmland Preservation Group Receives Grant

careers + research



OAC Career week

Each year the Student Federation of the Ontario Agricultural College (SFOAC) presents a ...



OAC Research Database

Looking for information on the research programs currently underway in OAC? Use the searchable

Methodological Aspects of Determination of Phytase Activity and Phytate-Phosphorus Contents in Phosphorus Nutrition Studies with Pigs

Sam Yingran Shen and M.Z. Fan*

Department of Animal and Poultry Science, University of Guelph, Guelph, ON, Canada

Correspondence author: (519) 824-4120, ext. 53656; E-mail: mfan@uoguelph.ca

Background

Phytase hydrolysis of phytate is the limiting step in the digestive utilization of plant sources of phosphorus (P) in pigs.

Objective: This study was to examine time course of sample-specific linearity of intrinsic phytase hydrolysis in major cereal grains. The second aim was to examine time course of the microbial Natuphos® phytase-catalyzed hydrolysis of purified phytate and phytate associated with selected cereal grain samples and intestinal samples collected from pigs fed cereal-based diets for estimating phytate-P content.

Methods and Procedures: Barley, corn, oats and wheat were the selected cereal grains. The intrinsic phytase activity was measured over multiple time points from 0 to 120 min with 1.5 mM of sodium phytate buffer at pH 5.5 and 37°C. Time course of phytate hydrolysis of purified phytate and phytate associated with the cereal grain samples and the pig intestinal sample were measured with the Natuphos® phytase over multiple time points from 0 to 48 h of incubations.

Results:

- The intrinsic phytase hydrolysis was linear ($P < 0.05$) for up to 120 min for barley, corn and wheat samples, whereas in the oats sample, the hydrolysis was only linear ($P < 0.05$) for up to 30 min of incubation.
- The intrinsic phytase activity (phytase unit: $\mu\text{mol}\cdot\text{kg}^{-1}\text{ dry matter}\cdot\text{min}^{-1}$) for the barley, corn, and wheat samples was estimated to be 693, 86, and 1189 by linear regression analysis.
- Intrinsic phytase activity (412 phytase units) for the oat sample based on a 30-min incubation was considerably higher than the value (103 phytase units) determined from the 120-min incubation for the same oat sample.
- There were quadratic with plateau relationships ($P < 0.05$) between the hydrolytic release of inorganic P from various sources of phytate and the incubation time. The minimal incubation time required for the complete hydrolysis of phytate was estimated to be 4, 3, and 11 h for the purified phytate, the cereal grain samples and the pig digesta and feces, respectively

Take Home Messages

- We conclude that multiple time point experiments need to be conducted to determine valid intrinsic phytase activity and phytate-P content in samples through intrinsic and microbial phytase hydrolysis incubations. Current literature data on intrinsic phytase activity associated with oats are likely underestimated.

Financial support from Ontario Pork, OMAF-University of Guelph Animal and Environmental Research Programs and NSERC is appreciated.

Characterization of *E. coli* O157:H7 from Pigs in Ontario

C. L. Gyles¹, R. Friendship²

¹Department of Pathobiology, ²Department of Population Medicine,
Ontario Veterinary College, University of Guelph, Guelph, Ontario N1G 2W1

Background

It is well established that cattle are the major reservoir of *E. coli* O157:H7. However, *E. coli* O157:H7 were isolated from a low percentage of pigs in Ontario in 2000-2002.

Objectives

This study was undertaken to determine whether the prevalence of *E. coli* O157:H7 in pig feces varied between warm and cold months, to estimate the concentrations of the bacteria shed by pigs, and to characterize the isolates so they may be compared with those implicated in disease in humans.

Results

- *E. coli* O157:H7 were isolated from pigs on 7 of 88 farms. One of these farms yielded a nontoxigenic *E. coli* O157:H7.
- Six of the seven positive farms were positive in warm months (July to September) and one was positive in February.
- Of 22 positive fecal samples that were tested quantitatively, 13 had *E. coli* O157:H7 at a concentration of < 50 organisms per gram of feces and 13 had the bacterium at 0.5 to 5.9 x 10² per gram of feces.
- The toxigenic *E. coli* O157:H7 isolates all had the *stx2*, *eae*, and *ehx* genes, characteristic of *E. coli* O157:H7 implicated in human disease. Most isolates also had the *stx1* gene. Phage type 14 was most common.

Take Home Message

E. coli O157:H7 is excreted in low concentrations by pigs on some farms, with a higher prevalence in the warmer months. Some of the *E. coli* O157:H7 are nontoxigenic and therefore of low public health significance. Others are similar to the *E. coli* O157:H7 that cause disease in humans. Pork has not been implicated as a source of infection in humans but a low level of environmental contamination may occur from swine feces.

This work was supported by grants from the Ontario Ministry of Agriculture and Food, and the Natural Sciences and Engineering Research Council

Porcine lectins as indicators of resistance to bacterial disease

B.N. Lillie, A.S. Brooks, N.D. Keirstead, J.D. Hammermueller, E.J. Squires, M.A. Hayes
Department of Pathobiology, University of Guelph
Tel 8244120 ext 54367 ahayes@uoguelph.ca

Background

Newborn animals must employ their genetically-determined innate immune systems to defend themselves against bacteria before they have developed antibodies. Within a group of pigs exposed to various infections, the severity of disease is variable, sometimes ranging from subclinical to fatal. This suggests that there might be genetic variation in the ability to respond successfully to infection. There is clear evidence that some mutations in genes for antimicrobial lectins, especially mannan-binding lectin (MBL), explain why some young children are more severely affected by various common infections. These studies will determine whether similar lectin-gene defects occur in pigs, and if there is a potential for improving health and productivity by eliminating the genetic defects by selective breeding.

Objectives

- Identify porcine lectins that provide innate resistance to infection by binding to the polysaccharide surfaces of bacteria that cause economically important infections in young pigs
- Determine if there are genetic differences among pigs that explain why some in an exposed group are more likely to get disease

Results

Pigs produce two forms of ficolins. The main one in the blood comes from the liver and it binds to the surfaces of some strains of *Actinobacillus pleuropneumoniae*. Another form from a different gene is produced in phagocytic white blood cells (neutrophils) that destroy bacteria in inflammatory sites. Pigs also have two forms of MBL. One of these was found to be the major blood lectin that binds various *Actinobacillus* and *Haemophilus* bacteria that infect pigs. The gene for this new form (MBL-A) and previously known MBL-C were sequenced in many pigs. Several genetic changes were found in both genes in some pigs. Genetic tests for these defects are being developed.

Take Home Message:

These studies demonstrate that pigs have several antibacterial lectins. Some pigs have genetic defects that likely interfere with the ability of their mannan-binding lectins to protect young pigs from infections before they develop immunity.

Financial support: Natural Sciences and Engineering Research Council of Canada (NSERC), NSERC Canadian Research Network on Bacterial Pathogens of Swine, Ontario Ministry of Agriculture and Food, Ontario Veterinary College Graduate Fellowship and CIHR Fellowship.

Tetracycline Use and Selection of Virulent Enterotoxigenic *Escherichia coli* (ETEC)

Patrick Boerlin¹, Carlton L. Gyles¹, Robert Friendship²

¹Department of Pathobiology, ²Department of Population Medicine, University of Guelph

519-824-4120 ext. 54647, pboerlin@uoguelph.ca

Background

A new O149 ETEC variant has recently emerged in swine in Ontario and is apparently associated with an increased severity of post-weaning diarrhea. A plasmid (pTENT2) carrying a tetracycline resistance gene and several virulence genes not previously known to occur in ETEC from pigs in Ontario is present in this new ETEC variant. This plasmid can be transferred at low frequency between laboratory strains of bacteria in the laboratory, but nothing is known about its transferability *in vivo*. It is likely that the use of tetracycline in swine may select for the persistence of the new ETEC variant. In addition, tetracycline may also select for other bacteria, which have received the pTENT2 plasmid from the new ETEC variant and therefore select for the spread of virulence genes in bacterial populations and for the creation of new potential pathogens.

Objectives

- Develop a multiplex PCR for rapid identification of the new virulent ETEC variant present in pigs in Ontario.
- Study the effect of the new combined virulence-resistance plasmid pTENT2 of ETEC on severity of post-weaning diarrhea in pigs.
- Study the effect of tetracycline use on persistence of the new virulent ETEC variant in pigs.

Results

A new multiplex PCR for the identification of pTENT2 positive ETEC has been developed and evaluated on a collection of porcine ETEC and commensal *E. coli* strains. We have demonstrated that the transfer of pTENT2 between wild-type *E. coli* strains is highly repressed *in vitro*. ETEC strains devoid of the pTENT2 plasmid have been prepared for comparative experiments on the role of pTENT2 in virulence *in vivo*. We are currently sequencing the *rfb* gene cluster of a representative O149 ETEC strain in order to develop a real time PCR for the direct detection of O149 ETEC strains in clinical samples.

Take Home Message

New diagnostic tools for the rapid identification of the new porcine ETEC-variant recently emerged in Ontario are available. Further tools will be developed for its direct detection in clinical samples.

Financial support was received from Ontario Pork, the Ontario ministry of Agriculture and Food.

Molecular Epidemiology of Antimicrobial Resistance in *Escherichia coli* from Pigs in Ontario

Patrick Boerlin and Carlton L. Gyles

Department of Pathobiology, University of Guelph
519-824-4120 ext. 54647, pboerlin@uoguelph.ca

Background

Antimicrobial resistance is a major problem in human and veterinary medicine but our understanding of its epidemiology is only partial. The phenomenon is complicated by the ability of bacteria to transmit resistance genes from one to another. In addition, resistance genes are frequently linked and transferred together between bacteria. Transfer of resistance genes can also occur between bacteria of the normal flora and bacterial pathogens. Therefore, molecular characterization of the genes responsible for antimicrobial resistance and the study of their distribution in bacterial populations is a key to a better understanding of antimicrobial resistance epidemiology.

Objectives

- To assess the distribution of resistance genes in *Escherichia coli* (normal flora and pathogens) from swine in Ontario.
- To identify possible associations between resistance genes, and between virulence (ability to cause disease) and antimicrobial resistance.

Results

Major differences exist in the distribution of resistance genes between *E. coli* from the normal flora and pathogenic *E. coli* from swine. Linkages between antimicrobial resistance genes and between resistance and virulence genes are present in *E. coli* from swine. These linkages are due to the co-location of resistance and virulence genes on single plasmids (extra-chromosomal genetic element potentially transferable from bacterium to another).

Take Home Message

Use of one antimicrobial agent may not only select for resistance to other antimicrobial agents, it is also likely to select for virulence genes and therefore for pathogenic organisms.

Financial support was received from Ontario Pork, the Ontario ministry of Agriculture and Food, and the Public Health Agency of Canada.

Inhibition of PRRS Virus Replication by Small Interfering RNAs

Duoliang Ran¹, Julang Li², Gang Li¹, Cheng Song², Paul Dyce², and Dongwan Yoo^{1*}

¹Department of Pathobiology, Ontario Veterinary College, and ²Department of Animal and Poultry Sciences, University of Guelph

*519-824-4120 ext 54729, dyoo@uoguelph.ca

Background

Porcine reproductive and respiratory syndrome virus (PRRSV) is an emerged infectious disease in swine and causes significant economic losses to pork industry worldwide. The current vaccine has a little effect to prevent the spread of virus, and it is urgent to develop an effective way of controlling the disease. The nucleocapsid (N) protein of PRRSV is an essential component of the virus, and the virus infectivity has been shown to be intolerable to a subtle change in the capsid protein gene. Small interfering RNAs (siRNA) are newly discovered RNA species capable of silencing a particular gene expression in cells via targeted mRNA destruction. In the present study, we examined if the siRNA approach could be applied to PRRS to block the virus replication in cells.

Objectives

To determine if PRRS virus replication can be blocked by siRNA technology.

Results

Two pairs of specific siRNAs were made to target the N gene of PRRS virus and the siRNAs were introduced into cells. The siRNA-expressing cells became resistant to PRRS virus infection, and PRRS-specific cytopathic effects were suppressed in these cells. The inhibitory effects were extended to at least 3 days post-infection. Real-time RT-PCR showed that the inhibition of N gene expression by siRNA was more than 1,000-folds. Immunofluorescence cell staining also indicated up to 80% reduction of PRRS virus protein expression in siRNA-expressing cells.

Take Home Message

The PRRS-specific siRNA inhibited virus replication effectively in cells. Gene silencing using siRNAs may be a potential approach to controlling PRRS virus replication in pigs.

We appreciate the financial support from Ontario Pork, Ontario Ministry of Agriculture and Food Animal Research Program (Pork), and Natural Sciences and Engineering Research Council (NSERC) of Canada.

Evaluation of Serologic Tests to Determine the Presence of Salmonella on a Farm

Vahab Farzan¹, R. Friendship¹, C. Dewey¹, K. Klotins²

¹Department of Population Medicine, University of Guelph, Guelph, Ontario N1G 2W1

²Ontario Ministry of Agriculture and Food, 1 Stone Rd, Guelph, Ontario N1G 4Y2

Background

In recent years, the use of *Salmonella* - ELISAs (enzyme linked immunoserological assays) have become available to screen pigs for serological evidence of exposure to *Salmonella* (22,23). In Denmark, the use of an ELISA screening program using meat juices is the basis of their monitoring efforts to identify farms with high *Salmonella* prevalence (9).

Objective

To determine the agreement between two commercially available ELISA tests and culture results to assess the usefulness of these serological tests in monitoring farms for a high prevalence of *Salmonella*.

Results

Sera from the same 600 pigs were analyzed for the presence of antibodies to *Salmonella* by means of two ELISA kits (Salmotype and IDEXX). Testing was performed by BioVet Labs in Montreal. The two tests demonstrated moderate agreement with culture results at a herd level but not on an individual pig level. At the herd level there was good agreement between the two serologic tests ($k = 0.8$, $p < 0.001$), but the tests showed poor agreement at the individual pig level. We estimated that almost half the serovars isolated in our study of 80 Ontario farms would not produce antibodies detectable by these serologic tests. However the most common serovar identified from our survey of 80 pig farms was *S. Typhimurium*, and both tests would identify antibodies to this serovar.

Take Home Message

Serology is a quicker and less expensive means to screen herds to determine farms with a high prevalence of *Salmonella*, but the current tests may need to be modified to make them applicable to Ontario conditions.

Support was received from Ontario Pork, the Ontario Ministry of Agriculture and Food, and the University of Guelph-OMAF Animal Research Program

A Baseline Study for Microbial Hazards Associated with Hogs

R. Friendship,¹ C. Dewey,¹ D. Ojkic², C. Gyles³, J. Odumeru²

¹Department of Population Medicine, ² Department of Pathobiology,

³Veterinary Laboratory Services, University of Guelph, Guelph, Ontario N1G 2W1

Background

The Ontario pork industry is strongly export-oriented and relies on an image of a high quality and safe product. A baseline study to determine the prevalence of food-borne pathogens and to determine risk factors is an important first step in developing a strategy for controlling these diseases.

Objectives

To determine the presence, prevalence and levels of specific food-borne pathogens in Ontario hog farms.

Results

Table 1: Prevalence of food-safety pathogens at different levels.

Pathogen	Pig %	Farm %	N tested
<i>Salmonella enterica</i>	11.4	47.5	799
<i>Yersinia enterocolitica</i>	13.4	38.8	799
<i>Campylobacter. spp</i>	99.9	100	799
<i>Campylobacter jejuni</i>	0.3	3.5	377
<i>Escherchia coli</i> O157	1.9	13.8	799
<i>E.coli</i> O157:H7	0.1	1.2	799

Take Home Message

Salmonella serovars and *Yersinia enterocolitica* sero/biotypes commonly associated with human illness were commonly isolated and need to be considered important from a public health perspective. Almost all the *Campylobacter* isolated were *C. coli* and not *C. jejuni*, the species most commonly associated with human illness. And *E.coli* O157:H7 was shown to be very rare in the Ontario pig population.

This work was supported by grants from Ontario Pork, the Ontario Ministry of Agriculture and Food, and the University of Guelph-OMAF Animal Research Program.

Production of GFP transgenic pig by sperm-mediated gene transfer (SMGT)

J.H. Kang¹, M. Buhr¹, R. Friendship², C.W. Forsberg³, S.P. Golovan^{1*}

¹Department of Animal and Poultry Science, ²Department of Population Medicine, ³Department of Molecular and Cellular Biology, University of Guelph, Ontario N1G 2W1

*Corresponding author: (519) 824-4120, ext. 56281; E-mail: sgolovan@uoguelph.ca

Background

Sperm mediated gene transfer (SMGT) is a new technique to produce transgenic pigs using natural ability of spermatozoa to transfer DNA into the eggs^{1,2}. It is cheap, efficient and could be used directly on the farm. Selection of donor boars by evaluation of sperm quality using several parameters such as motility, progressive motility and exogenous DNA uptake of sperm is critical for the successful SMGT.

Objective

The objectives of this study are to determine sperm factors which affect success of SMGT and to validate the SMGT technology by producing green fluorescence protein (GFP) transgenic pig.

Results

Twenty boars have been evaluated using standard sperm quality parameters. Motility has not shown significant variation among majority of boars with most semen sample showing high motility (>85%) and high progressive motility (>75%). The range of DNA uptake rate by sperm varied from 16% to 37%. After sperm incubation with exogenous DNA both sperm motility (79% average) and progressive motility (43% average) was significantly decreased in every boar, although samples from some boars were affected more than others. This study is the first time this effect have been demonstrated, and it may explain some of the variation observed with SMGT. However, incubation of sperm with exogenous DNA had little effect on sperm viability and does not seems to kill sperm. Further study of this effect are in progress.

Take home messages

SMGT method would be efficient method to produce transgenic pigs directly on the farm if sperm factors responsible for variation are identified. **Financial support was provided by Ontario Pork, Ontario Ministry of Agriculture and Food, and NSERC-CRD.**

1. M. Lavitrano et al., *Mol Reprod Dev* 64, 284-91 (2003).
2. M. Lavitrano et al., *Proc.Natl.Acad.Sci.U.S.A* 99, 14230-14235 (2002).

Digestive Capacity of the Small Intestinal Mucosal Maltase-Glucoamylase Is Increased in Early-Weaned Pigs

D. Lackeyram and M.Z. Fan*

Department of Animal and Poultry Science, University of Guelph, Guelph, ON, Canada

Correspondence author: (519) 824-4120, ext. 53656; E-mail: mfan@uoguelph.ca

Background

Early-weaned piglets are usually fed animal protein-based expensive starter diets. Corn and soybean meal-based diets are economical. However, gut mucosal atrophy occurs in early-weaned piglets fed soybean meal (SBM)-based weaning diets. The small intestinal maltase-glucoamylase (MGAM) and Sucrase-isomaltase (SIM) serve as final activities in the pathway of starch digestion to glucose in the pig.

Objective: This study was conducted to examine changes in the digestive capacity of the small intestinal MGAM in hydrolysis of purified amylose and maltose in responses to early weaning (EW) stress in weaned piglets fed a corn and SBM-based weaning diet.

Methods and Procedures: A total of 12 Yorkshire piglets, with an average BW of 3 kg, were weaned from sows at the age of d 10 and fed a weaner diet at *ad libitum* intake for 12 d. The weaner diet was corn and SBM-based and formulated to meet the NRC (1998) nutrient requirements. In comparison, 12 suckling (SU) piglets were selected, marked and continued their suckling for 12 d. The entire small intestine of all the piglets was harvested and divided into the segments of duodenum, proximal jejunum, distal jejunum (DIS) and the terminal ileum. Enzymatic kinetic experiments of MGAM activity were conducted with purified amylose (0-100 μ M) and maltose (0-75 mM) at 37°C and pH 6.0.

Results:

- Weaning increased ($P<0.05$) the MGAM maximal specific activity (V_{max} : EW, 1.82 ± 0.01 vs. SU, 1.66 ± 0.03 , nmol/mg protein.min, $n=48$) by 9% and the enzyme affinity (K_m : EW, 19.64 ± 1.70 vs. SU, 26.95 ± 2.66 , μ M, $n=48$) by 14% primarily in the jejunum for hydrolyzing starch.
- Weaning also increased ($P<0.05$) the digestive capacity of the MGAM action (EW, 10.46 ± 0.29 vs. SU, 9.14 ± 0.44 , mol/kg BW.d, $n=16$) by 14% for hydrolyzing starch.
- Weaning increased ($P<0.05$) the combined SIM maximal specific enzyme activities (V_{max} : EW, 29.42 ± 0.60 vs. SU, 24.69 ± 0.39 , nmol/mg protein.min, $n=48$) by 19% and the combined SIM enzyme affinities (K_m : EW, 4.16 ± 0.37 vs. SU, 5.86 ± 0.68 , mM, $n=48$) by 29% primarily in the jejunum for hydrolyzing maltose.
- Weaning also increased ($P<0.05$) the digestive capacity of the combined SIM enzyme action (EW, 169.29 ± 3.49 vs. SU, 135.54 ± 3.16 , mol/kg BW.d, $n=16$) by 25% for hydrolyzing maltose.

Take Home Messages

- We conclude that early-weaning piglets on solid diets up-regulates the capacity of MGAM hydrolysis of amylose and SIM hydrolyzing maltose by increasing both the enzyme activities and their affinities as an adaptation to vegetal diets.

Financial support from NSERC and OMAF-University of Guelph Animal Research Program is appreciated.

Factors affecting backfat as a carcass quality parameter

T. Cottrell, C. Dewey, R. Friendship, C. Ribble

Department of Population Medicine, University of Guelph, Guelph, Ontario N1G 2W1

Background

Pigs produced with consistently low back fat are valuable for both the packer and the producer. The pork is more valuable for the packer because it meets the demands of the consumer. The producer is rewarded economically by receiving a higher dollar value for these pigs. However, producing a consistently lean, heavily muscled pig is difficult.

Objectives

To determine the farm-level factors associated with producing pigs with carcasses with low back fat.

Results

A survey of 90 farms was conducted to determine the relationship between farm-level factors and carcass quality as measured over a 2-year time period. All pigs were weighed prior to marketing by 47% of the producers and a further 32% of the producers weighed some of their pigs. On average, 58% of pigs were weighed before marketing. Most producers used a single source of genetics for their gilts and boars but usually these sources differed. The average back fat recorded was 19.5 mm (SD=4.5) with a median of 19 mm and a farm level coefficient of variation of 21%. Compared to farms using multiple sources of genetics, using one source of gilts and one source of boars reduced the variation in the fat depth.

Farms with PRRS in the grower pigs had a higher fat depth (by 0.54 mm). Increasing hot carcass weight increased fat depth by 0.15 mm. Producers who do not weigh any pigs had leaner pigs (-0.80 mm) but they also had lighter weight pigs. Decreasing the minimum space allowed for grower pigs decreased the fat depth. Pigs raised in nursery units managed all in all out by pen (-4 mm) or room (-1.5 mm) had a lower fat depth than pigs managed in a continuous flow nurseries.

Take Home Message

To reduce fat depth of carcasses, producers would be advised to

- control PRRS in the grower barn
- raise nursery pigs in all in all out units either by pen or room rather than in continuous flow systems

To reduce variation in fat depth in the pigs shipped from one farm

- use a single source of gilt genetics and a single source of boar genetics

We appreciate the support provided to us by the producers and packing plant who through their generosity gave of their time to complete surveys and shared their data. This study has received funding from the University of Guelph-OMAF animal research program.

Factors affecting depth of muscle as a carcass quality parameter

T. Cottrell, C. Dewey, R. Friendship, C. Ribble

Department of Population Medicine, University of Guelph, Guelph, Ontario N1G 2W1

Background

Pigs produced with consistently large muscle depth are valuable for both the packer and the producer. The pork is more valuable for the packer because it meets the demands of the consumer. The producer is rewarded economically by receiving a higher dollar value for these pigs. However, producing a consistently lean, heavily muscled pig is difficult.

Objectives

To determine the farm-level factors associated with producing pigs with carcasses with large muscle depth. .

Results

A survey of 90 farms was conducted to determine the relationship between farm-level factors and carcass quality as measured over a 2-year time period. All pigs were weighed prior to marketing by 47% of the producers and a further 32% of the producers weighed some of their pigs. On average, 58% of pigs were weighed before marketing. Most producers used a single source of genetics for their gilts and boars but usually these sources differed. The average muscle depth recorded was 62 mm (SD=7.7) with a median of 62.5 mm and a farm level coefficient of variation of 12%. Compared to farms using multiple sources of genetics, using a specific source of gilts and a specific source of boars reduced the variation in the muscle depth.

Increasing hot carcass weight by 1 kg increased muscle depth by 0.34 mm. Producers raising the grower pigs in a continuous flow barn had a reduction in muscle depth (-70 mm) compared to producers who raised grower pigs in all in all out facilities (by barn, room or pen). Increasing the size of the sow herd by 50 sows, increased the muscle depth by .10 mm. However, farms with more boars had lower muscle depth. This may be a reflection of the positive effect of purchased semen used for AI.

Take Home Message

To increase muscle depth of carcasses, producers would be advised to

- Use all in all out finisher facilities (by pen, room or barn)
- Focus on using boars that have a high EBV for muscle depth

To reduce variation in fat depth in the pigs shipped from one farm

- use a specific single source of gilt genetics and boar genetics known for muscle depth

We appreciate the support provided to us by the producers and packing plant who through their generosity gave of their time to complete surveys and shared their data. This study has received funding from the University of Guelph-OMAF animal research program.

The effects of gender, grain source and feeding method on pig growth performance and carcass composition

Phil McEwen and Jim Morris, Ridgetown College - University of Guelph
519-764-1541, pmcewen@ridgetownc.uoguelph.ca

Background

Previous research at Ridgetown College (RCAT Animal Research Report, 1986/87) indicated that a controlled feeding program could reduce feed intake (per pig) and production cost. However, the current swine population has advanced in their genetic potential for growth and leanness. Therefore the historic economic advantage associated with a controlled (restricted) feeding program may have dissipated due to an improved feed efficiency by present day genetics.

Objective

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

Experimental Procedures:

Ninety-six feeder pigs (61.9 ± 1.6) were randomly assigned to pens by gender. Each pen of six gilts or barrows was then assigned to either barley (BG) or corn (CG) based diets. Pens were fed a grower diet (0.9% lysine) until 75 kg followed by a 0.7% lysine finisher diet. Eight pens were full fed (FF) until market while the remaining groups were restricted (RF) to 2.6 kg of daily feed per pig after achieving a 75 kg average body weight (BW). The pigs were weighed weekly and pens were marketed after achieving a 110 kg average BW.

Results:

- 1) Daily gains (kg) were similar for gilts and barrows while corn fed pigs grew at an increased rate. Gains were also increased for full (FF) versus restrictive (RF) feeding.
- 2) Feed to gain (F/G) was similar for FF versus RF while F/G was reduced for RF pigs during the finishing period (75 to 110 kg).
- 3) While F/G was unaffected by gender a significant two-way interaction between gender and feeding method was observed.

Take home message:

Limit feeding barrows may be economical as feed to gain was improved and was comparable to their gilt fed counterparts.

Financial support from the Ontario Ministry of Agriculture and Food (OMAF) was very much appreciated.

Impact of Feeding Fermentable Protein and Carbohydrates on Growth Performance, Gut Health and Digestive Function of Newly Weaned Pigs

E. A. Jeaurond and C.F.M. de Lange

Department of Animal and Poultry Science, University of Guelph
519-824-4120 ext. 56477, cdelange@uoguelph.ca

Background

In feed formulation, feed ingredients are routinely characterized in terms of available or digestible nutrient supply, while the impact of indigestible nutrients is generally ignored.

Objective

To investigate the impact of feeding fermentable protein (FP) (poultry meal) and fermentable carbohydrates (FC) (sugar beet pulp) on growth performance, health, proteolytic fermentation and gut microflora in newly-weaned pigs.

Dietary treatments were: (1) basal diet (control), (2) control + 10% poultry meal (PM) as FP source, (3) control + 5% beet pulp (BP) as FC source and (4) control + PM and BP. Diets were formulated to be similar in DE and digestible amino acid contents.

Results

Diet (treatment)	Cont.	PM	BP	PM+BP	SE	P values		
						FP	FC	FP x FC
Ferment. Carbohydrates	-	-	+	+				
Ferment. Protein	-	+	-	+				
ADG (g/d) ^y week 1	129	106	116	101	11.0	0.09	0.41	0.76
week 2	237	196	247	235	13.4	0.07	0.09	0.31
week 3	410	377	471	440	20.5	0.13	0.01	0.99
week 1-3	259	226	279	258	10.6	0.02	0.02	0.58
week 4	627	594	629	607	24.8	0.26	0.78	0.74
week 1-4	357	321	378	340	10.4	<0.01	0.08	0.94
ADFI (g/d) ^x week 1-4	497	454	503	481	0.02	0.06	0.33	0.52
Gain:Feed week 1-4	0.721	0.710	0.752	0.708	0.02	0.25	0.52	0.47

^y Average daily gain ^x Average daily feed intake

No interactive effects of feeding FC and FP were observed ($P>0.10$). During the first 3 weeks post-weaning, feeding FP reduced ADG (269 vs. 242 g/d), while FC increased ADG (243 vs. 269 g/d). Overall feed intake did not differ between treatments.

Take Home Messages

- No interactive effects of feeding fermentable protein and fermentable carbohydrates on growth performance or digestive function were observed.
- It is important to consider the negative impact of feeding fermentable protein and beneficial impact of fermentable carbohydrates on gut health and growth performance when formulating pig diets.

This research was supported by Degussa, the OMAF research program at the University of Guelph, and Agriculture and Agri-food Canada.

Dynamics of Body Protein Deposition Following Changes in Amino Acid Intake

Héctor Martínez, Eric Jeaurond and Kees de Lange
Department of Animal and Poultry Science, University of Guelph
519-824-4120 ext 56477, cdelange@uoguelph.ca

Background

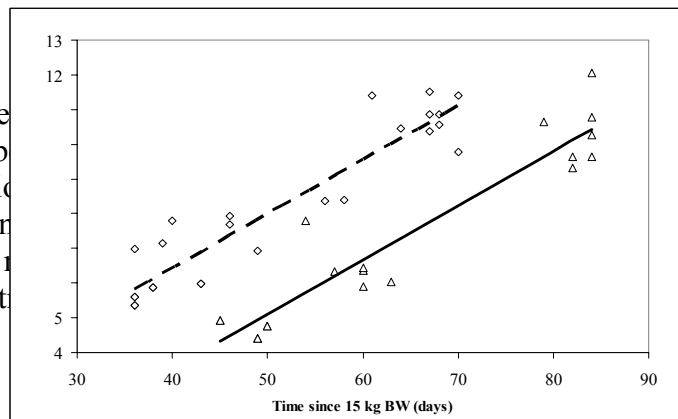
Compensatory or catch up growth (CG) is defined as accelerated and faster growth following a period of growth restriction as compared to unrestricted animals. CG represents a means to manipulate nutrient utilization efficiency, carcass and meat quality, and reduces the need to meet the animal's nutrient requirements at all stages of growth. The extent and dynamics of CG in different pig types is not well understood, especially CG of lean tissue growth which is closely associated with body protein deposition (PD),.

Objectives

To investigate the dynamics of PD and changes in body composition following a period of amino acids intake restriction in pigs with differing lean tissue growth potentials.

Results

In barrows, with medium lean tissue growth potential, following amino acid intake restriction between 15 and 35 kg body weight, when the amino acid intake restriction was lifted, the pigs reached a similar body composition as compared to non-restricted pigs.



Take home messages

- Based on growth performance data and body composition, no CG occurred in barrows following AA intake restriction, while entire male pigs showed full CG.
- The lean tissue growth potential (or the upper limit to Pd) appears to limit the extent of CG. CG occurs primarily during the energy dependent phase of lean tissue growth and in pigs with high lean tissue growth potentials.
- This study suggests that CG might take place within the energy dependent phase for Pd. The concept of maximum PD may be used to explain why CG is observed in some studies and not others.
- The results support the need to represent dynamically the effects of previous nutrition on growth in different pig types. The latter may be achieved by using dynamic mathematical pig growth models and represents a means to manipulate nutrient utilization and production costs in growing finishing pigs.

This project was supported by Ontario Pork, Degussa AG and Ontario Ministry of Agriculture and Food.

Nutrition Induced Variation in Body Composition, Compensatory Growth, Blood Urea Nitrogen, Cortisol and Leptin in Growing Pigs

Héctor Martínez and Kees de Lange

Department of Animal and poultry Science, University of Guelph
519-824-4120 ext 56477, cdelange@uoguelph.ca

Background

The phenomenon of compensatory (or catch-up) growth (CG) in pigs can be used to manipulate growth performance, carcass characteristics, meat tenderness and to reduce nutrient excretion to the environment. The extent of CG following amino acid intake restriction varies with pig type and appears to take place during the energy dependent phase of body protein deposition (PD). The underlying mechanisms that control CG are not well understood.

Objective

To determine the effects of amino acid intake restriction between 15 and 38 kg BW (restriction phase) on growth performance, blood urea nitrogen (BUN), cortisol (Co), leptin (Le) and final body composition during the subsequent re-alimentation phase (38 to 110 kg BW) in entire male pigs with high lean tissue growth potentials.

Results

Amino acid intake restriction resulted in reduced growth and fatter pigs during the restriction phase. During the re-alimentation phase, pigs previously restricted in amino acid intake showed full CG in terms of body weight gain ADG (1077 vs. 1170 g/d; SE 16), PD (163 vs. 179 g/d; SE 2.7; $P < 0.05$) and body composition at 110 kg BW (body lipid/body protein: 1.15 vs. 1.14; SE 0.04; $P > 0.10$). There were no effects of previous amino acid intake restriction on Le and BUN at 45, 53 and 68 kg BW ($P > 0.10$). Carcass characteristics at 110 kg BW were not influenced by previous amino acid intake restriction ($P > 0.10$): back fat (17.0 vs. 18.2 mm; SE 1.4), loin eye area (46.3 vs. 45.6 cm²; SE 1.14) and loin colour.

Take home message:

- Circulating Le levels allow for involvement of the brain in control of body composition. Plasma BUN level is not a sensitive indicator for compensatory PD.
- Plasma Co levels may act as indicator of amino acid induced restriction in PD in growing pigs.
- CG was observed during the energy dependent phase of Pd and is driven by a target body composition (LB/PB), possibly mediated via plasma Le levels.

This project was supported by Ontario Pork, Degussa AG and Ontario Ministry of Agriculture and Food.

An Algorithm To Estimate Body Protein And Body Lipid Deposition Patterns In Growing Pigs From Growth And Feed Intake Curves

G.Vander Voort and C.F.M. de Lange

Department of Animal and Poultry Science, University of Guelph
(519) 824-4120 ext. 56477;: cdelange@uoguelph.ca

Background

The evaluation of alternative management strategies for growing-finishing pigs requires accurate estimation of body protein (PD) and body lipid deposition (LD) patterns. A biological and dynamic nutrient partitioning model has been applied to represent utilization of energy and protein intake for growth. Biological pig type parameters that can be varied to derive different growth curves include maximum PD, body weight at which maximum PD starts to decline and the minimum ratio between whole body lipid and whole body protein (minL/P).

Objective

The objective of this research was to develop an automated algorithm to establish PD and LD patterns for individual pigs based on observed feed intake and growth curves.

Results

Daily weight gain and feed intake curves were established for 40 individual pigs using random regression methodology and from daily records of ad libitum feed intake and body weight. Pigs were group-housed in pens with computerized feed intake and body weight recording equipment. For each pig and based on the observed feed intake curve, 1000 different growth patterns were generated by varying the pig type parameters in the pig growth model. Best fit pig type parameters were chosen based on minimizing the sum of squared differences between simulated and recorded daily weight gain. The difference between observed and recorded daily gain was homogenous across BW with a mean of 10 ± 10 g/d (mean $\pm$ SD). In this group of pigs, maximum PD was 164.4 ± 32.6 g/d, body weight at which maximum PD starts to decline was 76.7 ± 15.2 kg, while minL/P was 0.03 ± 0.01 per MJ daily ME intake.

Take Home Message

The automated algorithm was effective in establishing PD and LD curves in individual growing-finishing pigs. Based on PD and LD patterns, effective management strategies for growing-finishing pigs can be developed.

This research is supported by Ontario Pork, the Natural Sciences and Engineering Research Council of Canada and the Ontario Ministry of Agriculture and Food.

Swine Liquid Feeding: Feeding Value Of Corn Condensed Distillers Solubles

J. Squire, C. Zhu, E. Jeaurond and C.F.M. de Lange
Department of Animal and Poultry Science, University of Guelph
(519) 824-4120 ext. 56477, cdelange@uoguelph.ca

Background

Condensed corn distillers' solubles (CDS), a co-product from the ethanol industry, has become available as feedstuff for swine liquid feeding. CDS has a pH of about 3.5, contains about 28% dry matter, and - on a dry matter basis - 24% protein, 21% fat and 9% ash.

Objectives

Studies were conducted to evaluate the influence of feeding fresh and fermented CDS (fermCDS) on pig growth performance and carcass quality.

Results

Optimum fermentation conditions were established previously and involved raising pH to about 6.0, inoculation with *L. acidophilus* and *B. subtilis*, and a minimum of 2 days storage. In a palatability study, it was established that increasing the dietary inclusion level of CDS from 15.0 to 22.5% of diet DM reduced feed intake. In a performance study, pigs were assigned to a corn and soybean meal based diet (control), or diets containing either 15% CDS or 15% fermCDS and fed semi-ad libitum using a Big Dutchman Hydrojet© computerized liquid feeding system. Feeding CDS reduced growth rates and daily feed intake by about 10 % as compared to the control. Pigs on fermCDS had intermediate growth performance. Feeding CDS did not impact carcass dressing percentage, backfat depth, muscle depth, and estimated carcass lean yield.

Take Home Message

The feeding value of CDS can be enhanced by controlled fermentation. Feeding CDS slightly reduced pig growth performance, but did not influence routine carcass measurements.

This research was initiated in close collaboration with the swine liquid feeding association (www.slfa.ca) and is supported by a number of organizations (www.slfa.ca).

Effect of single or double insemination on fertility of sows bred at an induced estrus and ovulation.

Glen Cassar¹, Roy N. Kirkwood², Kristina Bennett-Steward³, Robert M. Friendship¹
¹Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, Ontario N1G 2W1; ²Department of Large Animal Clinical Sciences, Michigan State University;
³Bioniche Animal Health, Belleville, Ontario.

Background

Optimal sow fertility is achieved by insemination of fresh extended semen during the 24-hour period before ovulation. However, among sows, there is a great variation in the wean-estrus interval, duration of estrus and consequently also in the estrus-to-ovulation interval. This variability presents a challenge in determining a reliable AI schedule since the onset of estrus is not a good predictor for the optimal time of insemination. The lifespan of eggs after ovulation and the lifespan of a sufficient number of sperm cells capable of fertilization within the oviduct define the time during which inseminations can lead to successful fertilization relative to ovulation. The use of exogenous pharmaceutical products for the synchronization of estrus and ovulation would allow for the application of the appropriate timing of successful AI.

Objectives

To determine the time of ovulation in weaned sows treated with eCG at weaning and pLH injected 80 hours later, and secondly, to examine sow fertility to fixed-time insemination at an induced estrus with a controlled ovulation.

Results

Sow fertility to single or double insemination at an eCG-induced estrus with or without ovulation induced by pLH. ¹					
	Control	eCG	pLH	eCG+pLH	eCG+pLH1
Sows weaned	131	111	113	110	102
Sows bred	119	103	103	103	102
30-d Pregnant, %	65.6	68.5	75.2a	80.9c	89.2c
30-d Pregnant, %	72.3	73.8	82.5a	86.4c	89.2c
Farrowing rate, %	68.7	69.0	81.4b	84.2c	86.1c
Litter size (total)	11.1±2.6	10.7±3.2	10.3±3.3	10.3±3.1	10.6±3.5
Mean parity	7.2±4.8	6.7±4.5	7.2±4.8	7.8±5.0	8.0±4.5
abc, means different from Control; a, $P \leq 0.1$; b, $P < 0.05$; c, $P \leq 0.01$					
¹ eCG injected at weaning, pLH injected at 80 h after weaning; AI am/pm day 5 (Control and eCG), at 36 and 44 h after pLH (pLH and eCG+pLH2) or single AI at 36 h (eCG+pLH1).					

Support was received from Bioniche Animal Health, the University of Guelph-OMAF animal research program and Ontario Pork.

The Effects of Feeding Fermented Liquid Whey Inoculated With Specific Lactic Acid Bacteria Using an *E. coli* Challenge Model

R. Amezcua¹, R. Friendship¹, C. Dewey¹, K. deLange², S. Weese³

¹Department of Population Medicine, ²Department of Animal and Poultry Science,

³Department of Clinical Studies, University of Guelph, Guelph, Ontario N1G 2W1

Background

Gut microflora contribute to the resistance of pathogens colonizing the intestines of a healthy pig. The normal bacterial flora of the pig's gut is disrupted at the time of weaning because of diet change and other stresses, making the pig susceptible to infection by pathogenic types of *E. coli* leading to diarrhea. It is reported that fermented feed containing high levels of lactic acid-producing bacteria reduces gastric pH, and lowers *E. coli* activity in the intestine.

Objectives

To determine the efficacy of using fermented liquid whey inoculated with specific lactic acid bacteria of pig origin to reduce the severity of diarrhea in pigs experimentally challenged with disease-causing *E. coli*.

Results

As lactic acid-producing bacteria increased in the fermented liquid whey the pH decreased to about pH 4 within 4 days. Pigs were challenged with 5 ml*10⁹ of *E. coli* inoculum and in each group approximately half the pigs developed watery diarrhea. There was no difference between the groups of pigs receiving fermented whey diets inoculated with lactic acid bacteria, and pigs being fed a non-fermented liquid diet, and pigs fed a conventional dry starter ration. The use of fermented whey inoculated with specific lactic acid-producing bacteria did not prevent disease when pigs were experimentally challenged with *E. coli*. These results are similar to earlier studies with natural challenge.

Take Home Message

Probiotics may not be effective in the control of post-weaning *E. coli* diarrhea.

This study has received funding support from the Ontario Research Challenge fund in collaboration with the Lawson Research Centre, London and support from the University of Guelph-OMAF animal research program and OMAF Food Safety Program.

Role of Uterine Lymphocytes in Angiogenesis during Early Pig pregnancy

Chandrakant Tayade, Gordon P. Black, C. Fang, B. Anne Croy

Department of Biomedical Sciences, University of Guelph, Guelph, ON, Canada

519-824-4120 Ex 54955, E-mail: croya@post.queensu.ca; ctayade@uoguelph.ca

Background

Prenatal mortality (up to 30% by gestation day (gd) 30 and an additional 10-15% by gd 50) is a prime concern to Ontario and North American swine producers. Poor blood supply to implantation sites is thought to contribute to these losses. Porcine conceptuses recruit maternal uterine natural killer cells during early pregnancy but functions of these cells are undefined. Analogous cells in mice and humans trigger changes in mother's arteries that supply implantation sites. Here we show that porcine uterine lymphocytes regulate and contribute to maternal angiogenesis immediately after fetal attachment to the uterus.

Objectives

- To identify and quantify angiogenic factors in pig uterus during embryo attachment.
- To determine if genes promoting angiogenesis are expressed by uterine lymphocytes.
- To determine if porcine uterine lymphocytes produce proteins from the transcribed genes that will enlarge maternal blood flow to implantation sites, promoting fetal survival.

Methods

Endometria have been collected from gilts, unmated or at gestation days (gd) 15, 19, 23. Work is in progress to collect to gd 50. Samples are processed to acquire RNA from whole endometrium and from 500-1000 endometrial lymphocytes collected by Laser Capture Microdissection (LCM). Gene expression is quantified by realtime polymerase chain reaction analysis of RNA. Lymphocyte and total endometrial expression are compared. New gene coding sequences are cloned and the data deposited into international Gene Banks. Protein analyses are in progress.

Results

- ❖ 19 porcine partial gene coding sequences for angiogenic, cytokine and apoptosis regulation molecules were obtained from endometrial lymphocytes or endometrium and deposited to GeneBank.
- ❖ Living and dying littermates were identified from gd19 and compared within a uterus.
- ❖ Comprehensive analyses of endometrial anatomical microdomains and implantation sites with viable and arresting are completed. Lymphocytes have more angiogenic potential than fetal trophoblasts (placental cells) or whole endometrium. Lymphocyte angiogenesis is abruptly stopped and a cytokine storm erupts as fetuses arrest.

Take Home Messages

- Endometrium is not uniform in expression of angiogenic molecules.
- Endometrial lymphocytes play an active role in implantation site angiogenesis.
- Dynamic differences in maternal gene expression exist between implantation sites with healthy and dying conceptuses. These changes may be directed to the dams' blood vessels and not the fetus, since fetal cells induce suicide pathways during arrest.
- These studies provide insights into early fetal death of benefit to pork producers. They also provide a new model for investigation of pathways of early human embryo failure.

We appreciate the financial support of Ontario Pork, Agriculture Canada, Natural Sciences and Engineering Research Council, Canada and Ontario Ministry of Agriculture and Food.

Does boar presence influence aggression, shoulder scratches and stress among newly mixed bred sows?

M. J. Séguin¹, R.M. Friendship², R.N. Kirkwood³, A.J. Zanella⁴ and T.M. Widowski^{1*}

¹Animal & Poultry Science, ²Population Medicine, University of Guelph

³Large Animal Clinical Sciences, ⁴Animal Science, Michigan State University

*519-824-4120 ext. 52408 E-mail: twidowsk@uoguelph.ca

Background

In group housing systems, the mixing of unfamiliar sows often results in aggression within the first few days which can cause injury and stress. The use of boar pheromones or boar presence have been shown to reducing fighting among young pigs, weaned sows and slaughter-weight pigs, but any effect of boar presence on aggression among groups of newly mixed bred sows has not been previously reported. Furthermore, there is no research documenting the impact of boar removal after hierarchy formation on the behaviour of group-housed sows.

Objectives

- To determine how different levels of boar presence affected aggression, shoulder scratches and acute stress response (stress hormone, cortisol) among newly mixed group-housed bred sows.
- To determine the effect of boar removal one week later on these measurements.

Methods

Groups of 15 bred sows (2.3m²/sow) were mixed while exposed to one of three levels of boar presence (N=5 per trt): PHYSICAL (boar in pen with sows), FENCELINE (boar in pen next to sows) or CONTROL (no boar present in room). The boar was removed six days after mixing. During the 24h pre- and 24h post-mixing and boar removal the number of shoulder scratches were scored and saliva samples were collected twice daily. The frequency and duration of fights were collected from video-recordings.

Results

- PHYSICAL presence of the boar reduced scratches 24h post-mixing compared to CONTROL ($P < 0.05$).
- The stress hormone, cortisol, was highest in the PHYSICAL treatment 24h post-mixing (0.41 ± 0.12 ng/mL) compared to the FENCELINE (0.19 ± 0.04 ng/mL , $P < 0.05$) and CONTROL (0.26 ± 0.03 ng/mL; $P > 0.10$).
- Frequency and duration of fighting were not affected by boar presence.
- Removing the boar did not affect behaviour, scratches or stress response.

Take Home Message

There was no clear advantage of boar presence on reducing aggression or stress among newly mixed bred sows.

We appreciate the financial support from the National Pork Board of the United States and the OMAF-Animal Research Program at the University of Guelph

Neurogenesis of oxytocin-containing neurons in the paraventricular nucleus of puberty gilts and lactating sows

GD Partlow, KRS Fisher Department of Biomedical Sciences, University of Guelph
(519) 824-4120 ext.54917, gpartlow@uoguelph.ca

Background:

The paraventricular nucleus (PVN) is a collection of nerve cells in the hypothalamus that produce oxytocin and vasopressin in response to hormonal and biological changes. Oxytocin-containing neurons are present in high numbers in this nucleus. Oxytocin (OT) is known to initiate smooth muscle contraction and play a role in lactation, gut motility, and labour. Thus the PVN likely plays a large role in normal reproductive functions. Since lactation causes increased demand for oxytocin, it is suggested that higher numbers of oxytocin-containing neurons are formed, through neurogenesis, in the lactating sow.

Objectives:

- To obtain a qualitative morphological analysis of the PVN.
- To determine whether neurogenesis occurs in oxytocin-producing neurons of the PVN.
- To establish if there is an increased rate of neurogenesis in lactating pigs.

Results:

- Nissl stained sections indicate that the PVN is located symmetrically about the third ventricle and is divided into subdivisions similar to the rat and human.
- No noticeable morphological or cytoarchitectural differences were noticed between puberty gilts and lactating sows.
- Localization of oxytocin-containing neurons was established using immunohistochemical techniques.
- Cells were stained with a specific antibody for Oxytocin (OT) and PCNA (a marker for proliferating cells).
- Cells stained for both OT and PCNA were considered to be oxytocin-containing neurons that had recently divided, hence describing the process of neurogenesis.
- Neurogenesis was consistently observed in oxytocin-containing neurons of both puberty gilts and lactating sows.
- Quantification is currently in process to determine if reproductive status has an effect on the rate of neurogenesis.

Take Home Messages:

- The morphology and orientation of the PVN in pigs has now been described in detail, allowing more efficient study of this important structure.
- Neurogenesis of oxytocin-containing neurons has been shown in the PVN of puberty and lactating pigs.
- This response raises the possibility that a correlation exists between lactation and neurogenesis.
- When quantification is complete, we expect to observe a higher level of neurogenesis in the lactating sow, due to the increased demand for oxytocin.

We appreciate the financial support of the Ontario Ministry of Agriculture and Food

Effects of sickness on behaviour and resource use of pair-housed piglets

ST Millman, KC Sheppard, A Gallien, JT Gray

Department of Population Medicine, University of Guelph

519-824-4120 ext. 53677 E-mail: smillman@ovc.uoguelph.ca

Background

Sick animals often display characteristic behavioural changes including lethargy, anorexia, increased thermoregulatory behaviour, increased slow-wave sleep, avoidance of social contact, and reduced exploratory behaviour. The motivation to display this behaviour during sickness has been described as a highly organized evolutionary strategy to combat infection and injury. However, the manner in which sick animals are housed may not allow for full expression of “sickness behaviour”, leading to longer recovery periods and increased use of antimicrobials. Little is known on the environmental resources a sick pig will use to aid in recovery.

Objectives

The first objective of this study was to develop a reliable model for inducing non-infectious illness in swine. The second objective was to determine how one element of sickness, diarrhea, affects the behaviour and resource use of pair housed piglets.

Methods

A total of twelve piglets were used, over 3 trials. Piglets were balanced for sex, and housed in pairs in 4’x8’ pens. Each pen contained a feed hopper and nipple drinker, a heat lamp, a cold plate, rubber comfort mats below the heat lamp and in a temperature-neutral area of the pen, an enclosed box for seclusion, a chain (toy), and a bristle brush for scratching. An oral antibiotic (ampicillin) was fed, mixed with jam, on two consecutive days, to disrupt intestinal function. Piglet behaviour was scored from time-lapse video recordings on one day before (day -1), and 2 days after (days +1 and +2) the first dose day. Severity of diarrhea was monitored several times daily.

Results

Ampicillin induced diarrhea in all 12 piglets by day +1 and all pigs recovered by day+3. Piglets spent significantly less time resting on day +1 compared to day -1 ($P<0.01$). Significantly more time was spent resting under the heat lamp on day +1 compared to day -1 ($P<0.005$) and less oral nasal behaviour was directed at the pen or at pen mates on day +2 compared to day -1 ($P<0.05$).

Take Home Message

A non-infectious sickness model was successfully developed using oral ampicillin to reliably induce mild to moderate diarrhea in weaned piglets. Piglets alter their behavioural patterns during diarrhea, and should be provided with sufficient heat lamps or mats to aid recovery. The increase in activity levels may be indicative of intestinal pain, and could be used as a pain assessment tool in future. The performance of less oral-nasal behaviours 48 hours after dosing may be associated with changes in the intestinal microflora as a result of the antibiotic.

We appreciate the financial support of NSERC and the OMAF-Animal Research Program at the University of Guelph

Effects of intermittent lighting on resting behavior by newly weaned piglets

ST Millman, KC Sheppard, M Madden, A Valliant
Department of Population Medicine, University of Guelph
519-824-4120 ext. 53677 E-mail: smillman@ovc.uoguelph.ca

Background

Piglets are challenged with a number of stressors during weaning, including environmental, social, and diet changes, and potential introduction to new pathogens. Combined effect of these changes can compromise welfare, immune status, and profitability of commercial operations due to the higher incidence of infections common with weaning. One explanation is that piglets may not attain the ideal amount of rest to cope with the challenges of weaning, since sows cue rest and activity of their piglets with hourly nursing bouts. The importance of rest by piglets is unknown, but has been shown to be an important prognosis of recovery from infections in other species. It is not known if, in the absence of the sow, lighting schedule has an effect on piglet resting behaviour.

Objectives

The objective of this study was to determine if an intermittent lighting regimen would facilitate rest activity of group-housed piglets after weaning.

Methods

Piglets were weaned at weaned at 21 days of age. Two high-weight (thrifty) and two low-weight (unthrifty) were selected from 16 litters, for a total of 64 piglets. One of each type from a litter was mixed with one of each type from another litter for sixteen final groupings of 4 piglets. Over two trials, 8 pens were lit using a standard (8Light:16Dark) lighting regimen, and 8 pens were lit using an intermittent lighting regimen, consisting of 4 periods of 2Light:4Dark. Heat lamps provided dim light during the Dark phase in all treatments. Piglet behaviour was continually recorded on 24hr video-cassette. Videos were scanned every 5-minutes to determine whether piglets were resting or active. Behaviour was compared during 3 days post-weaning.

Results

Overall, resting was not affected by light treatment or whether the piglet was thrifty or unthrifty ($P > 0.05$). However, time spent resting was significantly affected by day, with piglets resting during 80% of observations on the first day post-weaning, but 87% on the fifth day post-weaning ($P < 0.05$). Weight gain was not affected by lighting treatment, total time spent resting or thriftiness of piglets at weaning. However, there was a trend toward a negative correlation between resting and weight gain for unthrifty piglets ($P = 0.0591$). There were no immediate effects of lighting on piglet behaviour since piglets did not alter their behaviour during the periods when lights turned on or off.

Take Home Message

Intermittent lighting regimen has little impact on resting behaviour and weight gain of newly weaned piglets, in pens where some light is provided through heat lamps.

We appreciate the financial support of NSERC and the OMAF-Animal Research Program at the University of Guelph