

# Innovative piglet management strategies for optimum performance up to slaughter weight and profitable pork production

► Sixteen researchers from six research institutions worked in collaboration on this project

*Project Status: Completed in 2018*

The high cost of feed ingredients is a major challenge for the swine industry and has historically represented the largest portion of operating costs. In addition, the use of in-feed antibiotics is increasingly being restricted. Therefore, novel nutritional strategies must, in addition to minimizing costs, maintain or even possibly promote animal health and resistance to infectious challenges. To address these challenges, researchers worked on the subprojects below.

## Supplementing newborn piglets with vitamins A and D, copper and colostrum

**J. Jacques Matte,**  
Sherbrooke Research and Development Centre, AAFC

**Frédéric Guay,**  
Laval University

Results showed that providing an oral supplementation of a bovine colostrum extract before weaning increased piglet weight gain up to 8 weeks of age.

In addition to supplementing with a bovine colostrum extract, researchers found that the following strategy is an efficient way to avoid certain vitamin deficits in piglets:

- Provide piglets (until weaning) with an oral supplement of vitamin A, vitamin D, and copper; and
- Expose piglets with exposure to UVB light; and
- Supplement sow diets (during late pregnancy and lactation) with vitamin A, vitamin D, and copper

## Why was this study done?

Previous research has demonstrated that piglets are likely to suffer from a deficit in vitamin A, vitamin D, and copper until weaning. Therefore, researchers wanted to evaluate if using certain supplements could optimize piglet health and growth performance.

## What was done and what was the outcome?

The first step was to determine the best way to administer copper and vitamins A and D. Results showed that providing these supplements orally to piglets and sows, combined with exposing piglets to UVB light, was the most efficient way to increase these micronutrients in piglets up to weaning. This strategy also has the potential to influence the piglet microbiome and improve homogeneity of birth weight within litters.



UVB Meter. Source: Sherbrooke Research and Development Centre, AAFC



Piglets and colostrum feeder. Source: Sherbrooke Research and Development Centre, AAFC

The second and third steps were performed in research and semi-commercial conditions respectively and aimed at determining the impact of giving piglets a bovine colostrum extract as well as supplementing both sows and piglets with vitamins A and D and copper. Results showed that oral supplementation of bovine colostrum extract before weaning increased piglets' weight gain up to 8 weeks of age. It also had a positive effect on the piglet immune system.

Researchers also found that there was a considerable drop in piglets' copper reserves after weaning, even if a very high level of dietary copper was provided. These results were unexpected and merit further investigation.

### Collaborators

**Nathalie Bissonnette** Sherbrooke Research  
**Jérôme Lapointe** and Development  
**Martin Lessard** Centre, AAFC  
**Guyline Talbot**

### Fermenting and acidifying grains and co-products for weanling pig diets

**Denise Beaulieu and Andrew Van Kessel,**  
University of Saskatchewan

**Martin Nyachoti,**  
University of Manitoba

Results about fermented grains showed that:

- High moisture grains can be fermented by using bacterial inoculants. They can then be incorporated in standard dry diets.
- Including fermented low moisture grains into diets, particularly wheat, improved feed intake and growth performance of piglets.

Results about acid-preserved grains showed that:

- Weanling pigs fed with acid-preserved wheat or barley had equivalent performance to pigs fed with acidified diets.

### Why was this study done?

Researchers wanted to evaluate the efficacy of 1) ensiling (fermenting) and 2) acidifying high moisture cereal grains and protein co-products in order to reduce anti-nutritional factors and improve nutritive value, health and performance of pigs while reducing costs.

### What was done and what was the outcome?

A series of experiments were conducted with weanling piglets.

#### Fermentation (ensiling) of grains and co-products

It was demonstrated that fermenting high moisture grains (27% moisture), using lactic acid bacteria inoculants, provided good preservation for the grains. These grains could be incorporated into standard dry feeding systems.

Work undertaken at University of Saskatchewan: Preservation of inoculated moisture grain in barrels (above). Inoculation of high moisture cereal grain with two types of lactic acid (below).  
Source: University of Manitoba



Feeding trials showed that using fermented low moisture grains, especially wheat, improved feed intake and growth performance of piglets. Fermentation also improved nutrient and energy digestibility of diets containing barley. Additionally, fermented barley was beneficial for the gut health of piglets infected with *E. coli*.

These results are promising but more research and a cost-benefit analysis related to the use of fermented grains on the farm would be needed.

Finally, it was shown that, when included in post-weaning diets, fermented soybean meal obtained from five different sources was ineffective in improving post-weaning performance. This also did not show any impact on piglet gut health beyond what was observed with conventional soybean meal.

#### **Acidification of grains before storage**

It has been previously demonstrated that the acidification of weanling pig diets improves performance. Results of this project showed that feeding acid-preserved wheat or barley to weanling pigs also improved performance. Interestingly, the level of piglet performance obtained with acid-preserved wheat or barley was comparable to the ones obtained with direct acidified diets.

Researchers also looked at the interaction between acidification and the particle size of the grains. Results showed that when using acid-preserved barley, fine grinding was not necessary.

The acidification of high moisture grains (>15%) provides producers with another tool to utilize low quality (high moisture) grains. However, it is not recommended to use pure propionic acid, as it is too corrosive. More work would be required to identify storage methods which effectively preserve the grain and limit corrosion of the bins used to store acid-preserved grains.

#### **Simple versus complex post-weaning diets**

**Kees de Lange and Vahab Farzan,**  
University of Guelph

The results showed that a low complexity nursery diet containing only plant-based protein, used in a commercial setting, had no negative impact on pigs' immune response against *Salmonella*.

#### **Why was this study done?**

It was previously demonstrated that low complexity nursery diets had no negative impacts on pig growth and performance up to slaughter weight and carcass quality while reducing feed cost by \$2.81/pig. To go even further, researchers wanted to investigate the impact low complexity nursery diets would have on *Salmonella* shedding and antibody response in pigs from weaning to market. They also wanted to identify the related genetic variants.

#### **What was done and what was the outcome?**

As part of an epidemiology study, eight commercial farms with moderate to high health status were enrolled. A total of 809 pigs in 14 cohorts were monitored from birth up to slaughter. On each farm, half of the enrolled piglets was assigned to a simple nursery diet, i.e. plant-based protein, while the other half received conventional feed (complex diet).



Source:  
University  
of Guelph

Results showed that the low complexity diet had no negative impact on pigs' antibody response to *Salmonella* but that it may increase risk of *Salmonella* shedding. Furthermore, the results of this epidemiology study have contributed to the identification of several genetic variants that may be associated with *Salmonella* infection in pigs.

Although low complexity diets seem to have no negative impact on health and, as previously reported, had no adverse impact on growth performance and carcass quality, there might be variation from farm to farm. A careful future evaluation is therefore recommended.

### Collaborators

**Brandon Lillie** University  
**Robert Friendship** of Guelph

### Weanling pigs: Epidermal growth factor supplement

**Julang Li,**  
University of Guelph

Results suggest that supplementing piglets with recombinant porcine EGF (epidermal growth factor) enhanced early weaned piglet growth. However, the EGF product developed during this project has not yet been approved for use in animal production in Canada.

#### Why was this study done?

EGF is a powerful factor that naturally presents in sow's milk and stimulates gut health and development in newly-weaned piglets. Researchers aimed at using yeast to produce recombinant porcine EGF and to test its efficiency with piglets.

#### What was done and what was the outcome?

The EGF-producing yeast *Pichia pastoris* was utilized to produce recombinant EGF by fermentation. At the end of the process, the yeast was removed, leaving only the EGF product.

Two trials using this product were performed with live pigs. All pigs were fed common pig starter diets of high quality, but devoid of blood plasma. Diets were then supplemented with EGF and/or phytase. A control group did not receive any supplementation.

Results revealed that the recombinant EGF and phytase could improve growth parameters in post-weaning pigs. However, the recombinant EGF would have to be registered as livestock feed before it can be used.

### Alternatives to soybean meal in nursery diets

**Ruurd Zijlstra,**  
University of Alberta

Results from several studies showed that:

- Including 40% raw field pea in nursery diets maintained growth but reduced feed efficiency.
- Including 15% chickpea in nursery diets increased feed intake and pig growth performance. This also maintained feed efficiency.
- Replacing digestible whole grains with fermentable whole grains in nursery diets had a positive impact on weanling pigs' gut health and growth performance. However, the amount of fermentable carbohydrates used in diets should be carefully measured to prevent reduction in feed intake and growth performance.

#### Why was this study done?

A number of Canadian crops and plant-based co-products have the potential to serve as alternatives to soybean meal in nursery pig diets. However, if some of these alternative feedstuffs are to be used in these diets, residual protein content and an abundance of toxic fermentation products would increase in the piglets' gut, due to their lower protein digestibility. Through this project, researchers wanted to examine the impact that such protein alternatives would have on disease susceptibility and growth performance, especially in diets without antibiotics. They also wanted to study if the inclusion of fermentable carbohydrates could reduce the amount of protein toxic fermentation products in the gut.

## What was done and what was the outcome?

Several feeding trials with nursery pigs were carried out to test field pea, chickpea and whole grains use in diets.

### Field pea

Nursery diets were formulated by substituting the soybean meal and a portion of the wheat by 40% of field pea, either raw, cold pelleted, steam pelleted or extruded. Results showed that including this amount of field pea maintained growth but decreased feed efficiency compared to diets containing soybean meal. Also, it was found that processing field pea did not have any impact on feed efficiency.

### Chickpea

Researchers evaluated the effect that increasing the amount of dietary chickpea would have on nutrient digestibility and growth performance of nursery pigs. Results showed that substituting 15% of soy bean meal and wheat grain with chickpea in nursery diets increased feed intake, growth performance and sustained feed efficiency. However, increasing the amount of chickpea to 30% reduced piglets' growth performance.

### Whole grains

Two protein sources and three cereal grains were studied. These sources varied widely in composition and were classified as either fermentable or digestible based on their  $\beta$ -glucan and total dietary fiber (TDF): wheat (digestible: 14% TDF and 1%  $\beta$ -glucan), digestible hulless barley (15% TDF and 5%  $\beta$ -glucan) and fermentable hulless barley (18% TDF and 7%  $\beta$ -glucan).

Both types of hulless barley, which contains a higher level of  $\beta$ -glucan, increased feed efficiency and dry matter digestibility of weaned pigs. It also improved growth performance, regardless of protein source.

Another trial was conducted to study the impact of replacing wheat in nursery diets with one of five whole grains containing either low, moderate or high portions of fermentable carbohydrates, as follows:

- low-fermentable wheat
- low-fermentable hulled barley
- moderate-fermentable hullless barley
- high-fermentable and high-amylose hullless barley
- high-fermentable and high- $\beta$ -glucan hullless barley

Results showed that replacing wheat by barley (hulled and hullless) in nursery diets reduced energy and protein digestibility. Hullless barley, which contains more fermentable carbohydrates, also reduced feed intake. While both types of barley can replace wheat in nursery diets, the amount of fermentable carbohydrates in diets should be measured to prevent reduction in feed intake and growth performance.

## Organic acid, prebiotics and enzymes to reduce post-weaning diarrhea

Ruurd Zijlstra,  
University of Alberta

Results showed that, for weaning pigs:

- Formic acid dietary supplementation increased nutrient digestion and growth performance.
- Benzoic acid supplementation increased growth performances.
- Adding a combination of benzoic acid and enzyme blend to diets enhanced nutrient utilization and reduced post-weaning diarrhea.

## Why was this study done?

Post-weaning diarrhea can result in high rates of mortality and morbidity. Aiming at reducing post-weaning diarrhea without using antibiotics, nursery feeding trials were conducted to evaluate the impact that several organic acids, prebiotics and enzymes would have on weaning pigs.



Source: University of Guelph

### What was done and what was the outcome?

Three prebiotics (0.02% -glucan + Zn, 0.05% -glucan + Zn, and 0.25% mannan oligosaccharides [MOS]); and a formic acid (1.20% potassium di-formate) were studied under poor sanitary conditions.

It was found that supplementing diets with formic acid enhanced the pigs' average daily gain, feed efficiency and body weight at the end of the nursery stage. It also increased diet digestibility. Also, using two prebiotics including glucan and zinc (2 types) increased diet digestibility, but did not affect piglet growth. Finally, supplementing with the prebiotic that includes mannan oligosaccharides (MOS) did not affect piglet performance nor digestibility of the diet.

In another trial, benzoic acid (an organic acid) and an enzyme blend (including  $\beta$ -glucanase, phytase, xylanase and  $\alpha$ -amylase) were studied. Researchers saw that supplementing with benzoic acid enhanced pigs' average daily gain and feed intake. Interestingly, supplementing with a combination of benzoic acid and the enzyme blend increased diet digestibility and reduced the incidence of post-weaning diarrhea.

### Oral vaccine to reduce post-weaning diarrhea

Robert Friendship and Vahab Farzan,  
University of Guelph

The plant-based ETEC vaccine showed some promise in reducing signs of post-weaning diarrhea.

### Why was this work done?

Post-weaning diarrhea can be caused by enterotoxigenic *E. coli* (ETEC) and has historically been difficult to prevent. Researchers wanted to verify if the use of plant-based oral vaccine could provide protection against ETEC.

### What was done and what was the outcome?

Experimental challenge studies were conducted to determine the efficacy of a plant-based oral vaccine, which contains the *E. coli* FaeG protein. The vaccine showed some promise in reducing signs of post-weaning diarrhea. However, more work is needed before it could be commercially used in a farm situation.

# Additional project information

Click on the links below for further information on this project  
*Links were last updated in 2022*

## R&D Featured Articles—by Geoff Geddes for Swine Innovation Porc

Articles may be found at: <http://www.swineinnovationporc.ca/resources-e-newsletters.php>

- [Pork Industry has Appetite for Feed Options](#)  
- August 2019 (Vol. 4, No. 11.)
- [Can Micro-Nutrients make a Macro Difference for Piglets?](#)  
- July 2019 (Vol. 4, No. 9.)
- [Piglet Nutrition Research Feeds Hunger for Knowledge](#)  
- April 2019 (Vol. 4, No. 1.)
- [EGF Helps Piglets Get Growing](#)  
- April 2018 (Vol. 3, No. 1.)
- [Reducing Post-Weaning Diarrhea: Digesting the Results](#)  
- March 2018 (Vol. 2, No. 6.)
- [High Hopes for High Moisture Grain Treatment](#)  
- February 2018 (Vol. 2, No. 4.)
- [Post Weaning Diets: A Simple Solution](#)  
- January 2018 (Vol. 2, No. 3.)

## Farmscape Interviews:

- [Grain Acidification Improves Storage and Nutritional Value But Harms Storage Facilities](#)  
- August 24, 2018
- [Acidification improves Grain Preservation and Boosts Weanling Pig Performance](#)  
- August 17, 2018
- [Scientists Prepared to Scale Up Processing Straw for Feed to Commercial Levels](#)  
April 24, 2017
- [Canadian Feed Research Centre Develops Feed Processing Method for Straw](#)  
April 19, 2017
- [Palatability and Digestibility Key to Starting Piglets on Solid Feed](#)  
- February 23, 2016
- [Palatability Key to Maximizing Feed Intake When Weaning Piglets](#)  
- September 18, 2015



## Farmscape Interviews:

- [Scientists Target Improved Nutrition to Maximize Performance of Newly Weaned Pigs](#)  
- September 9, 2015
- [Canola Press-Cake and Canola Expeller Offer High Energy Options for Early Weaned Pigs](#)  
- August 27, 2015
- [Canola Press-Cake and Canola Expeller Viable Feed Ingredients for Young Pigs](#)  
- August 7, 2015
- [Researchers Strive to Improve Rations for Newly Weaned Piglets](#)  
- April 8, 2015
- [Feeding Lower Cost Nursery Diets Reduces Feeding Cost Without Compromising Performance or Profitability](#)  
- March 26, 2015
- [Addition of Fish Oil Boosts Nutritional Value of Low Cost Nursery Pig Diets](#)  
- March 16, 2015
- [Research Aimed at Improving Piglet Nutrition Expected to Benefit Feed Formulators, Feed Additive Manufacturers and Producers](#)  
- December 19, 2014
- [Researchers Target Increased Piglet Performance Through Improved Diet Formulations](#)  
- November 14, 2014

## Peer-reviewed articles and abstracts:

2019

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## Additional Resources:

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