centred on SWiNe

PRAIRIE SWINE CENTRE

Spring 2020 Volume 26, Number 2

Amino Acids can Enhance Pig Robustness

Lucas A. Rodrigues, Msc, DVM.
Department of Animal and Poultry Science,
University of Saskatchewan

Dan Columbus, PhD,
Research Scientist,
Prairie Swine Centre

Highlights

- Average daily gain and feed efficiency in diseased pigs may be improved by a combination of functional amino acids supplemented above requirements for growth
- Functional amino acids improved the immune response associated with Salmonella infection
- Bacterial shedding and intestinal colonization can be reduced by functional amino acid supplementation
- Dietary protein level had limited effect on pig response

Research conducted at the Prairie Swine Centre and the University of Saskatchewan investigated the interaction between functional amino acid (AA) supplementation and dietary protein during disease challenge in growing pigs. To achieve this, growing pigs were either inoculated with an enteric pathogen (Salmonella typhimurium, ST) or received saline control (CT) and had ad libitum access to diets differing in crude protein content (low (16%, LP) vs high (20%, HP) containing either basal supplementation of amino acids at requirements according to NRC (2012) (AA-) or supplemented with a functional amino acid profile in which threonine, methionine, and tryptophan were provided at 20% above requirements (AA+). Diets contained no animal products or antibiotics.

(Amino Acids can Enhance Pig Robustness ... cont'd on page 3)

Inside This Edition

Program funding provided by

Sask PORK
Manitoba Pork
Alberta PORK
ONTARIO PORK
Saskatchewan Ministry of Agriculture

Publication # 40010021

Pigs Consume More Water When Stressed

Bernardo Predicala, PhD, Research Scientist – Prairie Swine Centre

Two novel technologies consisting of an individual water consumption system (IWCS) and infrared thermography system (ITHS) were installed in a finishing room. The individual water consumption system (installed in each pen) was composed of a nipple drinker attached to a water flow meter, and an RFID reader (and antenna) to capture individual pig data. The infrared thermography system was composed of two types of infrared cameras, one to capture images of individual pigs drinking, a second to capture an image of all the pigs in the pen. To assess whether the novel technologies were capable of detecting pigs that may be stressed due to routine practices, two stressors were introduced during the trial: (1) moving pigs to the barn hallway and handling them through a pre-defined route for 10 minutes, and (2) mixing unfamiliar groups of pigs.

As part of a larger Swine Innovation Porc project (#1237) entitled 'Use of novel technologies to optimize pig performance, welfare and carcass value', various technologies were developed and pilot- tested in different universities and research centers throughout Canada (under CCSI coordination). After pilot studies were completed by the original developers of the technologies, the next step was to conduct commercial trials where selected developed technologies were applied in a production environment and evaluated under typical commercial practices. Commercial trials were a critical step after the research and development phase, providing the opportunity to make adjustments to the technologies, facilitating their adoption in commercial barns.

Two novel technologies (IWCS and ITHS) were installed in a grow-finish room with six pens containing 14 pigs per pen (Figure 1). The IWCS was comprised of a nipple drinker attached to a water flow meter, and RFID reader and antenna together with electronic ear tag transponders. ITHS was composed of two types of infrared cameras: C3 camera (FLIR C3 Compact Thermal Imaging Camera) and A325 IRT camera (FLIR A325sc Infrared Camera). The A325 IRT cameras were used to capture the image of all the pigs in the pen while the C3 cameras were installed on top of the drinker to capture the image of an individual pig while drinking. Pigs were transferred into the room at 20-25 kg and remained in the room for 10 weeks until reaching 105-110 kg.

RESULTS AND DISCUSSION

Water Consumption and Handling

Figure 2 shows the comparison of average water consumption before and after the moving activity. Regardless of stress induction, water consumption increased as the trial progressed. At the start of the trial, grower pigs had an average water consumption of about 4,014 mL/day; this increased to 5,876 mL/day towards the end of the trial when pigs were nearing market weight.

(Pigs Consume More Water ... continued on page 4

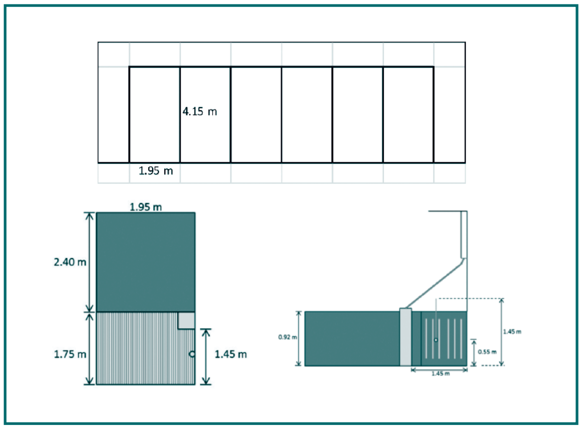


Figure 1. Floor layout (a) of the grow-finish room used in the study. Details of the pen showing the location of the feeder and drinker – top view (b) and side view (c).

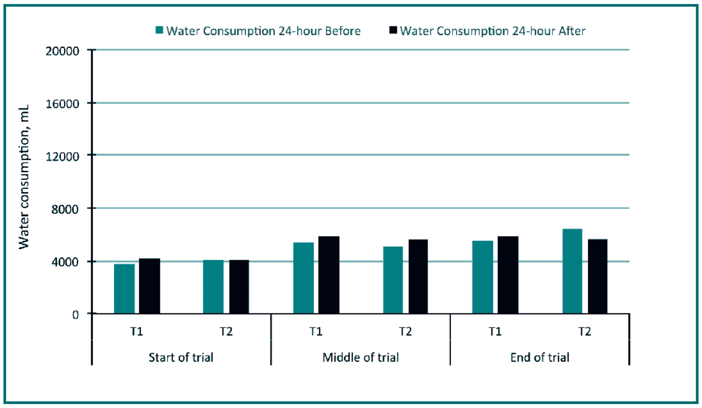


Figure 2. Average water consumption of pigs 24 hours before and 24 hours after the moving activity during the start (n=12), middle (n=12) and end (n=10) of the trial.

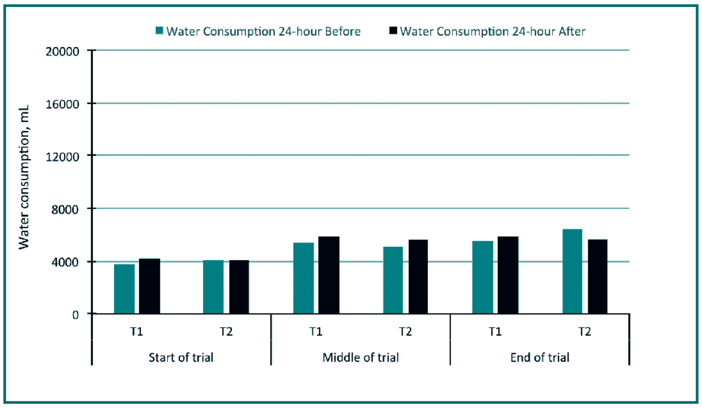


Figure 3. Average water consumption of pigs 24 hours before and 24 hours after unfamiliar pigs were introduced into the pen during the start (n=16), middle (n=16) and end (n=12) of the trial.

(Functional amino acids ... continued from pg.1)

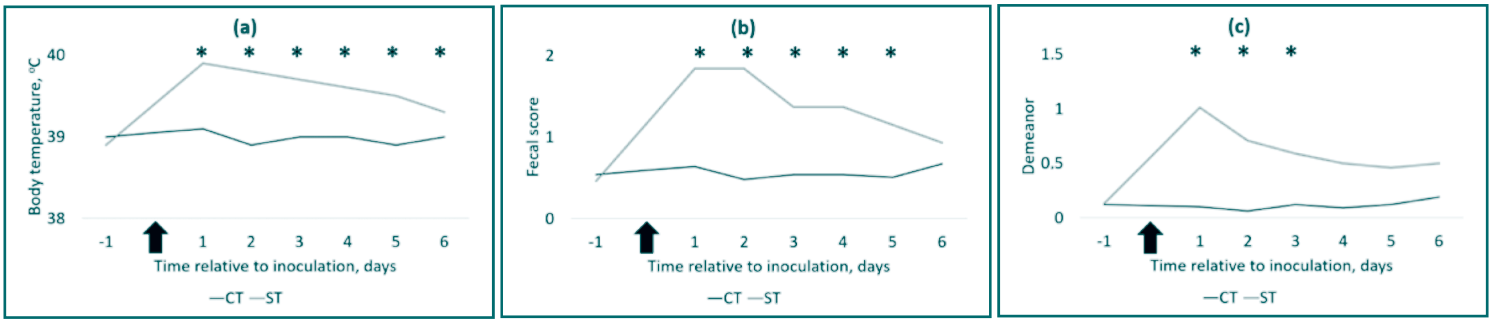


Figure 1. Performance parameters of growing pigs challenged or not with Salmonella typhimurium and fed diets differing in protein content and functional amino acid supplementation.

Clinical signs associated with infection

The post-weaning period is a stressful time for growing pigs, with increased susceptibility to several enteric pathogens, including Salmonella. Pigs infected with Salmonella experience a pronounced inflammatory reaction in the gut, consequently showing compromised performance. The researchers monitored body temperature, fecal score and demeanor daily for each pig over a period of 7 days (day -1, 1, 2, 3, 4, 5 and 6 relative to inoculation). Fecal score and demeanor were then scored from 0 to 3 according to severity (Table 1). Inoculation with Salmonella typhimurium increased body temperature within 24 h which remained elevated for the duration of the study (Figure 1). Demeanor and fecal score were negatively affected by ST inoculation during the first 3 and 5 days after challenge, respectively (Figure 1). There were no diet effects on any clinical signs.

Table 1. Scoring of clinical signs

Clinical sign	Score	Classification
Fecal score	0	Normal consistency
	1	Semisolid, no blood
	2	Watery, no blood
	3	Blood tinged feces
Demeanor	0	Normal behavior
	1	Listless, will stand
	2	Recumbent, will not stand
	3	Moderately depressed

High protein diets: are they harmful?

More susceptible post-weaned pigs also experience an abrupt change from a milk-based to a cereal-based diet. Besides that, highly digestible nutrient sources are not always available, and pigs are commonly fed diets high in protein sources potentially harmful for gut health. As a result, current dietary recommendation in the post-weaning period is to provide lower protein diets that have been supplemented with necessary essential amino acids to meet requirements. This reduces the amount of undigested protein available for fermentation

(Functional amino acids ... continued on page 4

Table 2. Performance parameters of growing pigs challenged or not with Salmonella typhimurium and fed diets differing in protein content and functional amino acid supplementation.

	CT[1]				ST[1]				
	LP[2]		HP[2]		LP		HP		SEM[4]
Item	AA-[3]	AA+[3]	AA-	AA+	AA-	AA+	AA-	AA+	
Average daily gain, kg/d									
Pre-inoculation	0.423	0.486	0.450	0.463	0.451	0.456	0.460	0.474	0.051
Post-inoculation	0.571[A]	0.576[A]	0.586[A]	0.580[A]	0.297B[b]	0.458B[a]	0.300B[b]	0.456B[a]	0.063[3]
Average daily feed intake, kg/d									
Pre-inoculation	0.580	0.602	0.563	0.636	0.614	0.646	0.632	0.648	0.054
Post-inoculation	0.880[A]	0.906[A]	0.916[A]	0.936[A]	0.738[B]	0.673[B]	0.744[B]	0.686[B]	0.086
Feed efficiency (gain:feed), kg/kg									
Pre-inoculation	0.73	0.81	0.80	0.73	0.73	0.71	0.73	0.73	0.109
Post-inoculation	0.65	0.64	0.64	0.60	0.40†	0.68*	0.40†	0.66*	0.104

1 CT = control group; ST = Salmonella-challenged group.
2 LP = low protein diet; HP = high protein diet.
3 AA- = basal dietary amino acid profile; AA+ = supplemented dietary amino acid profile containing 120% of NRC (2012) requirements for Met, Thr, and Trp.
4 SEM = pooled SEM. Means are presented as least squares means.
AB = means lacking the same letter are significantly different (CT vs ST) ($P \leq 0.05$)
ab = means lacking the same letter are significantly different (STAA- vs STAA+) ($P \leq 0.05$)
*† = means lacking the same sign showed a trend towards significance (STAA- vs STAA+) ($P < 0.10$)

(Pigs Consume More Water ... continued from page 2)

At the start and middle of the trial, pigs tend to consume more water after the moving activity. On average, pigs consumed about 3,890 and 5,226 mL 24 hours before stress was induced at the start of the trial and middle of the trial respectively, increasing to 4,138 and 5,878 mL after the stress was induced. These results may imply that grower pigs consumed more water when stressed. No apparent trend was observed for water consumption towards the end of the trial.

Water Consumption and Mixing

A comparison of average water consumption of pigs 24 hours before and 24 hours after unfamiliar pigs were introduced into the pen is shown in Figure 3. In contrast to the moving activity, water consumption generally decreased 24 hours after mixing unfamiliar pigs into the pen. Pigs consumed an average of about 5,387 mL/day of water prior to the mixing activity; this decreased to 4,738 mL/day 24 hours after mixing occurred. The decrease in water consumption might be due to aggression that occurred after mixing, which subsequently prevented some of the pigs from drinking. This observation may have also caused the no apparent increase in water consumption from the start to the end of each trial.

Infrared Thermography - Handling

During the start and middle of the trial, no considerable change in body temperatures was observed. Towards the end of the trial when pigs were close to market weight, a slight increase in body temperature was observed after the moving activity. Pig average body temperature was 36.5°C before the moving exercise; this increased to 36.8°C after the mixing activity. This minimal change in body temperature could indicate that the moving activity was not strenuous enough to cause a marked change in body temperature of pigs.

CONCLUSION

1. Using the individual water consumption system, it was observed that grower pigs tend to consume more water when stressed. The system also confirmed that water consumption increased as the pig grew regardless of stress induction.
2. As captured by the infrared thermography system, aggression as a result of mixing unfamiliar pigs to the pen caused an increase in the recorded body temperature of pigs. The system also showed that the pigs' body temperature was affected by changes in room temperatures.
3. In this study, installation of the individual water consumption system and infrared thermography system and inducing stress due to moving and mixing had no considerable negative impact on pig production performance.

ACKNOWLEDGEMENTS
We would like to acknowledge the financial support for this research project provided by Swine Innovation Porc. The authors would also like to acknowledge the collaboration of researchers from CCSI, CDPQ, and Lacombe Research Centre in carrying out this study. Strategic program funding provided by Saskatchewan Pork Development Board, Alberta Pork, Ontario Pork, the Manitoba Pork Council and the Saskatchewan Agriculture Development Fund is also acknowledged. In addition, we also wish to acknowledge the support of the production and research technicians at Prairie Swine Centre that make it possible to conduct this research.

(Amino Acids can Enhance Pig Robustness ... cont'd from pg.3)

in the gut, reducing the inflammatory response. Therefore, it was hypothesized that the severity and incidence of diarrhea in Salmonella-challenged pigs would be aggravated by high protein diets. However, there was no effect of dietary protein content on fecal score. On the other hand, Salmonella counts in cecal digesta were increased in HP pigs compared to LP pigs. Thus, lowering dietary protein levels may be useful to suppress proliferation of microbial metabolites and consequently minimize intestinal disturbances in commercial settings with enteric problems.

During an immune response amino acids which are utilized for growth in healthy animals, are redirected towards immune support in diseased animals, decreasing their availability for protein deposition. Thus, supplementing functional AA may be necessary to support both the immune response and growth performance, reducing the negative effects of disease on performance.

As expected, inoculation with ST resulted in reduced average daily gain and average daily feed intake in the post-inoculation period compared to CT pigs regardless of dietary treatment (Table 2). However, ST pigs fed the AA+ diet had increased ADG and a tendency for improved feed efficiency (gain:feed) in the post-inoculation period, regardless of dietary protein level. While this performance was still reduced compared to healthy pigs, this shows that functional AA supplementation may provide an additional strategy for reducing the negative impact of disease challenge on animal performance.

In addition to the impact on performance, the supplemental AA profile attenuated the immune response through modulation of acute-phase protein levels in Salmonella-challenged animals. Disease-challenged animals showed increased serum concentration of haptoglobin and decreased concentration of albumin, respectively. However, when fed the AA+ profile, challenged pigs showed reduced overall levels of haptoglobin and increased levels of albumin compared to those fed the AA- profile. These findings corroborate the role of functional AA as regulators of metabolic pathways during inflammation, particularly through regulation of immune response.

Functional AA supplementation also decreased overall shedding of Salmonella compared to pigs fed AA- diets and Salmonella counts in colon were reduced in AA+ pigs compared to AA- pigs. Pathogen shedding is important as infected feces are a major source for cross infection between individual pigs and in a commercial setting reduced shedding could reflect in decreased incidence of natural exposure.

Overall, supplementation of key functional amino acids (methionine, threonine, tryptophan) above requirements appears to be a potential strategy for improving growth performance and health status of pigs exposed to an enteric pathogen.

Acknowledgments: Funding for this project was provided by Swine Innovation Porc. Evonik Nutrition & Care GmbH, and MITACS. Prairie Swine Centre receives program funding from the Government of Saskatchewan, Sask Pork, Alberta Pork, Manitoba Pork, and Ontario Pork.

Competitive Feeding System

Floor Feeding

- Lowest conversion cost
- Need solid areas for feed drops

Shoulder Stalls

- Low conversion cost
- Can use existing feed lines

Competitive Feeding System

- Suitable for small static groups of 10 to 20 sows
- Good stockmanship required: form small, uniform groups and monitor sows daily at feeding
- Expect variation in body condition, feed wastage and production challenges due to competition
- Small pens require more space per pig in pens and more alleyways for access
- Feeding aggression is reduced in shoulder stalls compared to floor feeding

Non-competitive Feeding System

High Tech

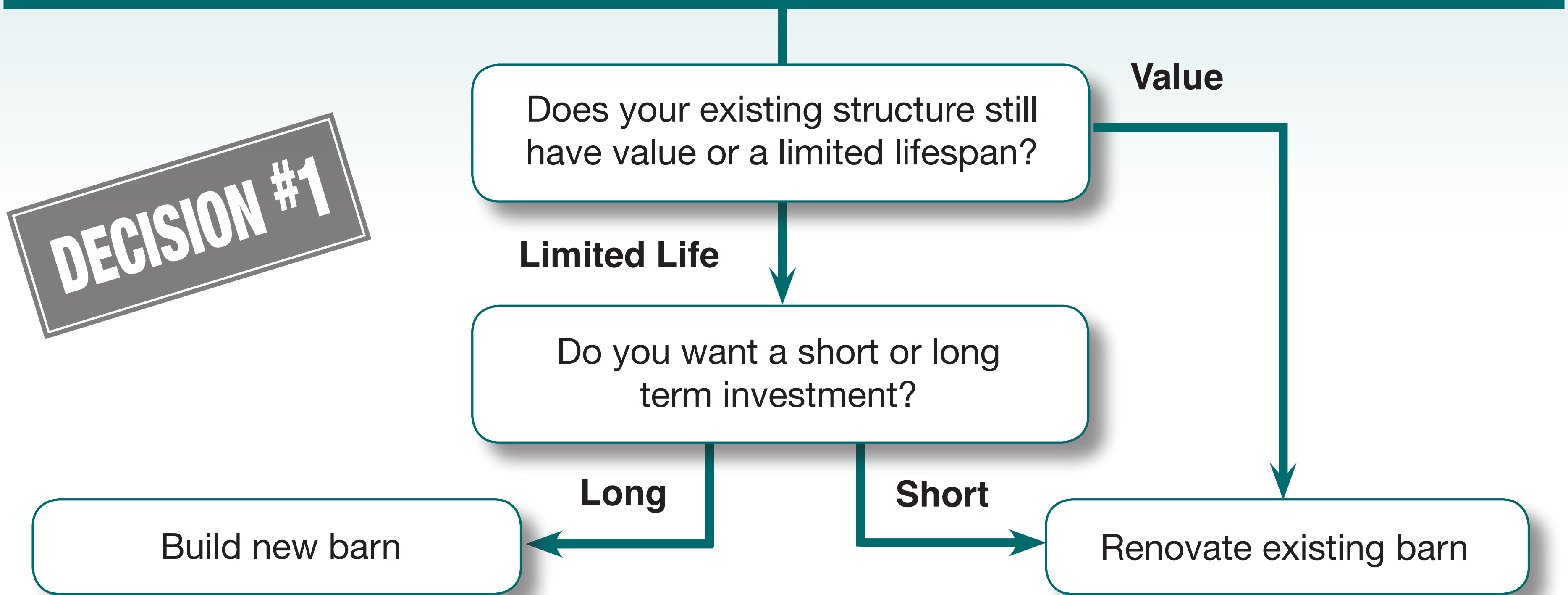
Low Tech

Group Sow Housing Decision Tree

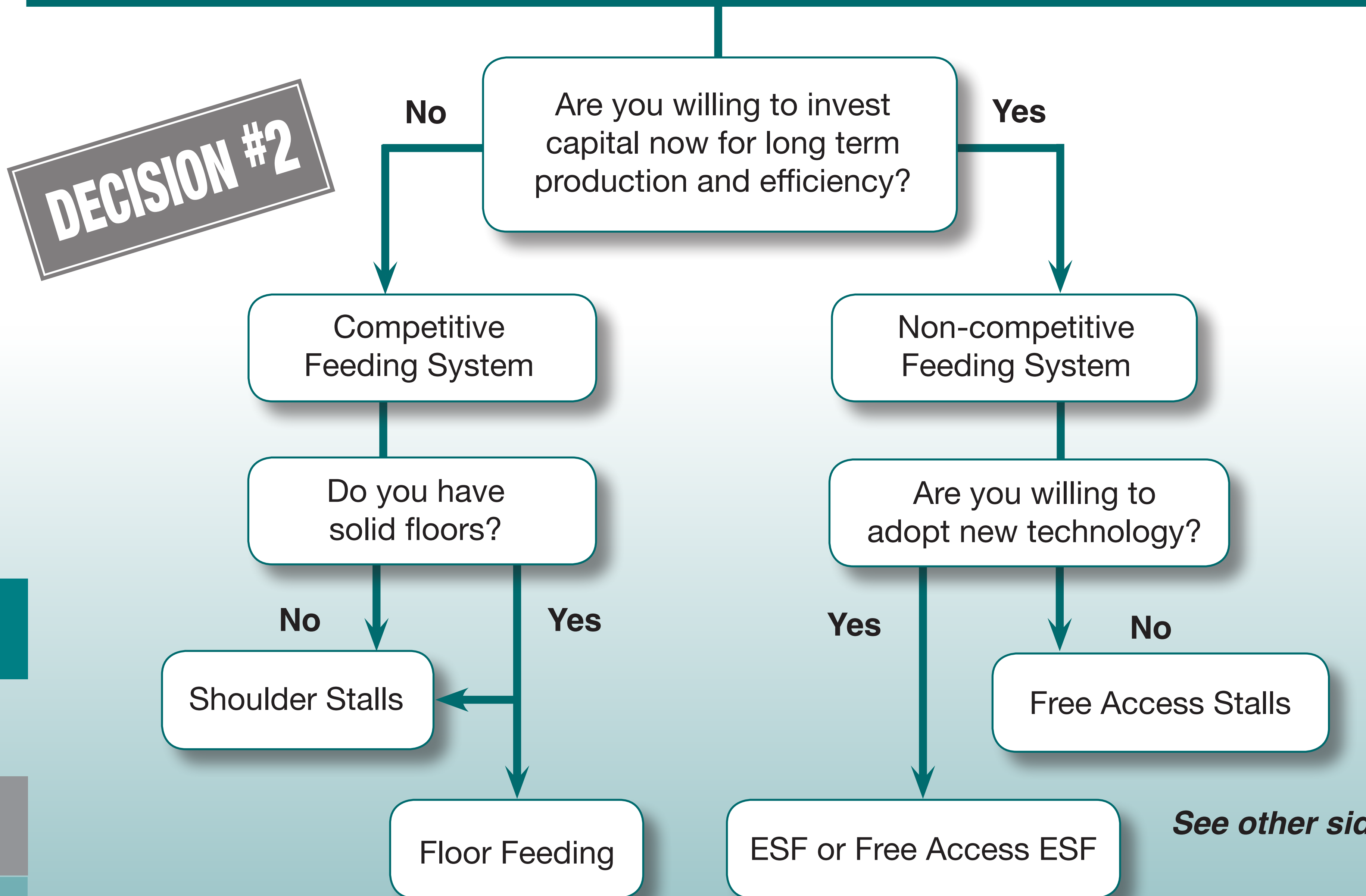
PRAIRIE SWINE CENTRE

Determining which group housing system to use can be a daunting task. There are multiple systems to chose from, and no hard rules to follow. This decision tree provides a rough guide based on key questions you need to ask yourself.

Should I renovate my existing barn or build a new barn?



Should I choose a competitive or non-competitive feeding system?



See other side...

Free-Access ESF

- Static pens of 20 to 60 sows
- Individual feeding is electronic
- Moderate conversion cost
- Efficient use of space

ESF

- Static pens of 50 to 60 sows OR dynamic pens of 60 to >300 sows
- Individual feeding is electronic
- High conversion cost
- Efficient use of space

Free-Access Stalls

- Static pens of 20 to 40 sows
- All sows in a pen receive the same amount of feed
- Minimal aggression and competition
- High cost

Non-Competitive Feeding Systems

- Individual feeding allows for more uniform body condition
- Reduced feed costs due to less wastage and overfeeding
- Can still have competition at the feeder stall
- Small pens require more space per pig in pens and more alleyways for access
- Potential for precision feeding as technology and data management improve

Prairie Swine Centre would like to acknowledge the Ontario Ministry of Agriculture, Food & Rural Affairs swine team for their assistance in developing this decision tree.

For more information on group sow housing visit
www.groupsowhousing.com

Heart Health's Potential Link to Early-life Nutrition

Breanna Patton,
University of
Saskatchewan

While researchers are well versed in the cardiovascular risks associated with a bad diet, a lack of exercise, and smoking, they're still learning about another possible risk factor that could lead to poor cardiac health: what you consume in the first few weeks of your life.

Dr. Daniel Columbus, an adjunct professor at the University of Saskatchewan's (USask) College of Agriculture and Bioresources, is looking at the effects of early life nutrition and associated long-term health outcomes in people and animals.

"We are learning more and more that in agriculture as well as in humans, early-life nutrition really sets them up for [long-term health] success or failure," says Columbus, who is also a research scientist at the Prairie Swine Centre near Saskatoon, Sask.

Heart disease is the second leading cause of death in Canadians, according to the Public Health Agency of Canada. One in 12 adults over the age of 20 are diagnosed and living with this chronic condition.

Columbus and a team of USask researchers are looking at cardiac development during the period immediately after birth when many organs are still maturing — a stage of development that hasn't been thoroughly studied before.

Columbus, along with Western College of Veterinary Medicine (WCVM) researcher Dr. Lynn Weber, have created a team of human and animal health researchers to look at how poor nutrition affects this critical period of heart development. Using pigs as models, the team is investigating how this study of early-life malnutrition could translate to human health.

Columbus explains that if a newborn animal or human isn't getting enough nutrition, it will use the energy it does have to protect organ development at the cost of building up muscle. What scientists are discovering is that it's not just skeletal muscle that's lost when under-nutrition occurs — it's also cardiac muscle.

But can a healthy diet and lifestyle allow a pig or a human to recover from this early period of under-nutrition? That's another important mystery the USask team is working to solve.

Previous research using mice models showed that poor nutrition in the first weeks of life resulted in impaired heart development. Mice that had poor nutrition as infants performed poorly compared to their normally-fed counterparts, even after being fed a healthy diet later in life.

> "Analysis could show whether these pigs benefit from extra management and feed."

For this study, USask researchers are working with pigs — an animal model that's closer to humans in anatomy and physiology than mice. Piglets also have a similar period of organ development in early infancy as humans.

The USask researchers are comparing the cardiovascular health and development in piglets that have had access to adequate nutrition to piglets that have had poor nutrition. As well, they're investigating whether the changes seen from poor nutrition are reversible by examining piglets that have been fed a proper diet after a certain amount of time on the low-nutrition diet.

To make these comparisons, the researchers are using echocardiography to analyze the piglets' cardiovascular health, along with exams of the animals' hearts and other organs.

The team's work will help to fill some gaps in researchers' understanding about how cardiovascular diseases develop and how they can be prevented in people. More information about the diseases' origin can also help scientists investigate the effects of nutritional deficits and create a push for better public health programs to educate and guide new parents about the importance of early infant nutrition.

(Heart health potential ... continued on page 11)

Feeding Mycotoxin Contaminated Grain

Mycotoxins are chemicals (secondary metabolites) produced by moulds or fungi infecting grains. There are over 400 known mycotoxins; however only a small number of these probably affect pig performance on a regular basis. It is important to note that the presence of the mould or fungi does not guarantee the presence of mycotoxins; conversely, mycotoxins can be present in a sample with no obvious mould contamination.

The mycotoxins of major concern in Canada are listed in Table 1. Several factors contribute to the production of mycotoxins in grain, including humidity and temperature during the growing and harvest periods, oxygen availability during growth, harvest, transport or storage and insect or bird damage. Multiple mycotoxins may be present at the same time and mycotoxins may be "masked". These are mycotoxins bound to another molecule which may make them undetectable by routine assays. They will however, break down in the gut, and cause problems.

Pigs are more susceptible to the effects of most mycotoxins than other species, especially ruminants. The age of the animal and production status are important considerations. Table 2 outlines the mycotoxins of major concern, and their impact on animal performance. In order to determine optimal feeding strategies, it is critical to know which mycotoxins are present and the approximate concentration. Many commercial laboratories can analyze for the common mycotoxins.

The difficulty is obtaining a sample that is representative of the entire lot. When sampling grains or feeds, subsamples from 12-20 locations should be collected and mixed thoroughly (Whitlow et al., 2014). Once a sample is collected, it is also important to store it in a dry, cool area to impede further mycotoxin development before the analysis. Mycotoxins are often distributed unevenly throughout the load, and very small quantities can cause problems (1 part per million (ppm) is equal to 1 contaminated grain in 1 million non-contaminated grains). The more subsamples collected, the better the likelihood of obtaining a laboratory analysis which really represents what is in the feed.

The CFIA has regulatory guidelines for the feeding of mycotoxins to livestock. This document reminds us that mycotoxin contamination is typically higher in the lighter fractions (grain dust, screenings, shrivelled kernels, etc.), and that while removing these fractions from the parent stock may help to reduce overall Mycotoxins, which are produced from moulds, can contaminate all grains and grain-by-products commonly fed to swine in Western Canada. Personnel working with grains should avoid inhaling the dust and wear a mask. Dilution is (only partially) the solution.

Table 1. Legislated maximums, regulatory guidelines and recommended maximums for different mycotoxins into swine diets (adapted from Charmley and Trenholm, 2012)*

Low	Target	High
Mycotoxin	Commodity	Levels
Deoxynivalenol1	Diets for swine	1 ppm
Aflatoxins2	Animal feeding stuffs	20 ppb
T-2 toxin3	Swine diets	< 1 ppm
Zearalenone3	Gilt diets	< 1-3 ppm
	Swine diets	< 0.25-5 ppm
Ochratoxin A3	Swine diets (kidney damage)	0.2 ppm
	Swine diets (reduced weight gain)	2 ppm
Ergot Alkaloids3	Swine diets	4-6 ppm
Fumonisins3	Swine diets	10 ppm

* ppm is parts per million (mg/kg) and ppb is parts per billion.
1 Regulatory guidelines (Worldwide regulations for mycotoxins. FAO Food and Nutrition Paper 64, 1997)
2 Legislated maximum tolerated level (Worldwide regulations for mycotoxins. FAO Food and Nutrition Paper 64, 1997)
3 Recommended tolerance levels in Canada and the United States

Table 2. Major effects of mycotoxins on swine performance

Mycotoxin	Primary Effect	Stage Affected	Clinical Signs
Deoxynivalenol (DON, vomitoxin)	Affects serotonin receptors and cytokine production	All stages (younger pigs may be more susceptible)	Reduced ADFI and ADG[1,2] Vomiting[2] Diarrhea (soft or watery feces)[3] Reduced immune function[3] Mild changes to kidney, thyroid, blood[4]
Aflatoxins	Mutagenic and carcinogenic	All stages	Reduced ADFI and ADG[5] Reduced milk production[5] Lethargy[6] Ataxia (lack of coordination)[6] Rough hair coat[6] Hemorrhage[6] Fatty liver[6]
Zearalenone	Estrogenic	Pre-pubertal gilts, sows and pre-pubertal boars	Swelling and reddening of the vulva[7] Vaginal and/or rectal prolapse[7] Anestrus[8] Reduced litter size[8] Fetal resorption8 Implantation failure8 Decreased libido and testosterone[9] Feminization[9]
Ochratoxin A	Disrupts phenylalanine (an amino acid) metabolism	All stages	Kidney damage[10] Decreased ADFI and ADG[11] Immunosuppression, increased risk of infection[12]
Fumonisins	Disrupts lipid metabolism	All stages, especially young pigs	Pulmonary edema[3] Reduced immunity[3] Decreased ADFI and ADG[13] Shortness of breath[3] Weakness[3] Cyanosis (blue/purple colour of skin/membranes)[3]
T-2 and HT-2 Toxins	Inhibits protein synthesis	All stages	Unthriftiness[6] Low ADFI and ADG[6] Reproductive failure[6] Gastric upset (diarrhea)[6] Cellular necrosis[6] Immunosuppression [6]
Ergot Alkaloids	Neurological	All stages, especially the reproductive herd	Lameness[14] Gangrene[14] Decreased ADG[14] Abortion[14] Agalactia (absence of milk production)[14] Ataxia[14]

1 Decreased ADFI and feed refusals have been shown at levels as low as 0.5-1 ppm (Smith et al., 2005),
2 > 2-5 ppm is for decreased ADFI and ADG, vomiting and complete feed refusal at > 20 ppm (Haschek et al., 2002),
3 Pierce and Diaz, 2014,
4 JECFA, 2001,
5 Nibbelink, 1986,
6 Whitlow et al., 2014,
7 Friend et al., 1990,
8 Smith et al., 2005,
9 Osweiller, 1986,
10 Kidney damage occurs at levels as low as 0.5 ppm (Lippold et al., 1992),
11 Performance is affected at levels of 2 ppm or greater (Lippold et al., 1992; Stoev et al., 2000),
12 Can occur when levels > 2 ppm are fed for longer periods of time (Harvey et al., 1992),
13 ADG reduced by 11% when 10 ppm fumonisin B1 was fed to starter pigs for 8 weeks (Rotter et al., 1996),
14 Strickland et al., 2011

(Heart Health ... cont'd from page 9)
"Eventually, we would look in to bringing in human health experts [such as] dietitians, and use this information to develop those protocols and resources," says Columbus. "And those programs are already out there. We know that good food is essential, but we know that it can be a problem even in regular birth-weight infants. And so how do we promote that even more"?

The study's results will also give Canadian swine producers insight about whether young piglets that are less competitive at nursing and receive less nutrition from their mothers will be able to respond to nutritional therapies later in life and recover — maturing to fully-grown healthy animals.

As Columbus explains, the analysis could show whether these pigs benefit from extra management and feed, and whether they need a better diet once they are weaned.

"Or is it just they will always be small so we just have to accept that and then incorporate that into the [pigs'] production and management?" he adds.

In addition to the research being done by Columbus and Weber, several other USask researchers are working with the same group of piglets to optimize their use and the amount of knowledge gained from the project — a One Health approach to research that's a critical part of the university's research program.

"We brought in so many researchers on this one study," says Columbus. "[We] are trying to get as many samples and analyses done as possible because then it gives all these people ideas as to what can we pursue in the future — beyond the cardiovascular, beyond the muscle development."

The Natural Sciences and Engineering Research Council of Canada (NSERC) provided financial support for this USask research study.

Breanna Patton of Calgary, Alta., is a second-year veterinary student at the WCVM. Her story is part of a series of articles written by WCVM summer research students.

Personal Profiles

Cristina Prade Ramos

Before obtaining her degree in Veterinary Medicine in 2019 from the Federal University of Santa Maria, Cristina always shown interest in animal welfare. In 2015 she went to the University of Guelph for an exchange year where she was an intern in the Pathobiology Department under Dr. Rob Foster and Dr. Brandon Lillie, supervision and volunteer at Guelph Humane Society. Back to Brazil in 2017, she joined the Animal Rights Research Group and also the Department of Veterinary Pathology as an intern at the Federal University of Santa Maria. As part of the last semester of graduation in 2018, Cristina was an intern at the Defense and Animal Protection Network Department of the Curitiba city, assisting veterinarians in the animal cruelty investigations under the guidance of Dr. Rita de Cassia Maria. Cristina is currently a M.Sc. student under Dr. Jennifer Brown supervision and her project will be examining factors affecting sow mortality in the Canadian sow herd, and understand factors influencing sow removals/culling. The project is funded by Swine Innovation Porc.

Coming Events

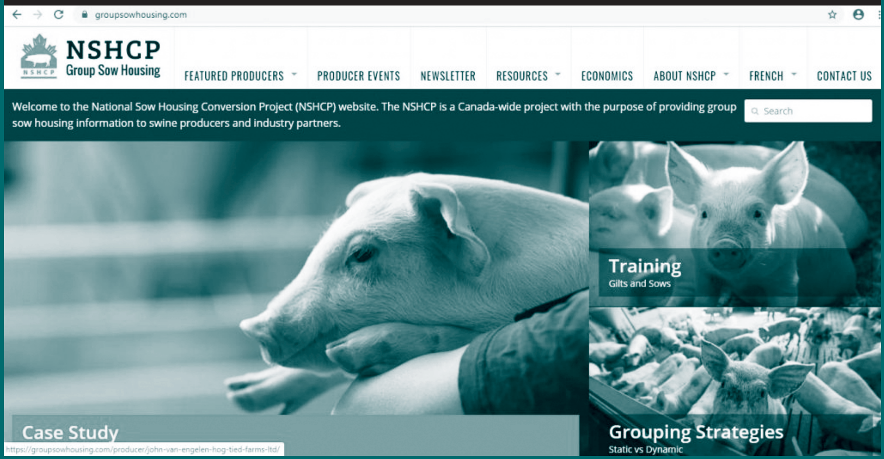
Cramer Livestock Expo
February 13, 2020
Swift Current, Saskatchewan

London Swine Conference
London, Ontario
March 31 – April 1, 2020

Alberta Pork Congress
June 9-11, 2020
Red Deer, Alberta

Ontario Pork Congress
June 17-18, 2020
Stratford, Ontario

Alberta Livestock Expo
October 9-10, 2019
Lethbridge, Alberta



PRAIRIE SWINE CENTRE

Centred on Swine is a semi-annual newsletter produced by Prairie Swine Centre Inc. (PSCI).

Prairie Swine Centre Inc.
P.O. Box 21057, 2105 - 8th St. E.
Saskatoon, SK S7H 5N9 Canada

Tel:(306) 373-9922
Fax:(306) 955-2510
www.prairieswine.com

Prairie Swine Centre is an affiliate of University of Saskatchewan