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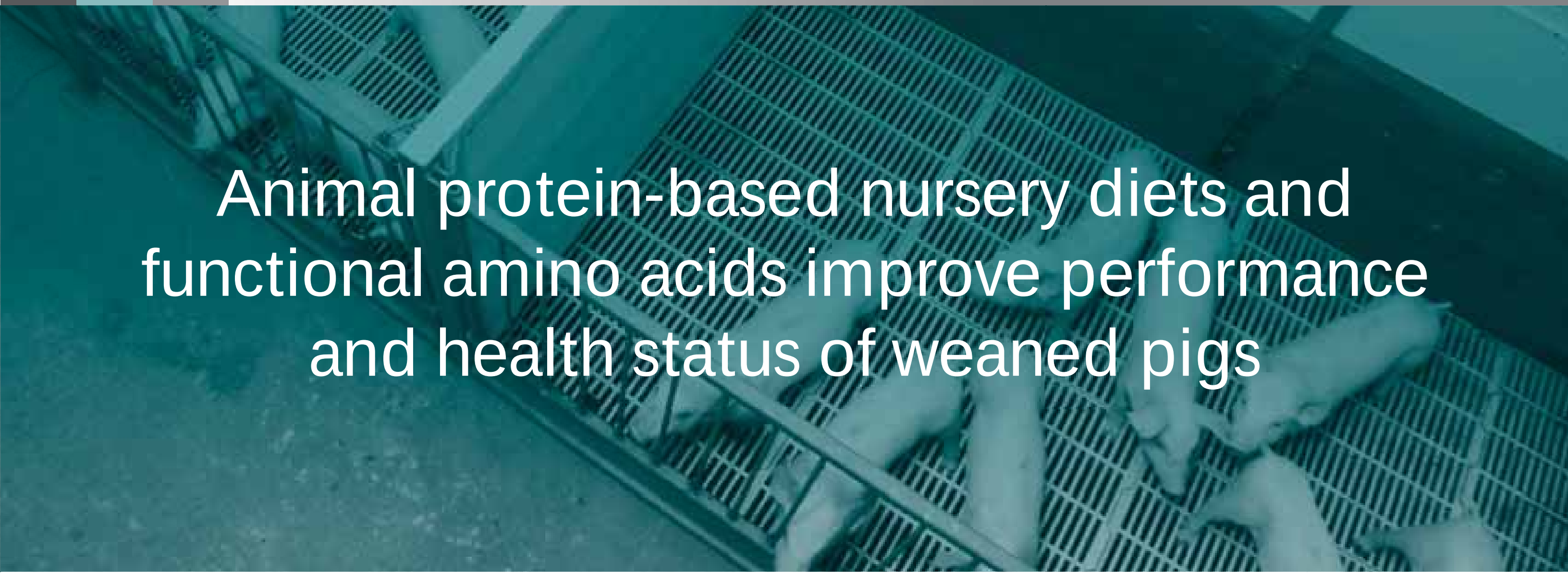

Animal protein-based nursery diets and functional amino acids improve performance and health status of weaned pigs

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Are complex nursery diets required?

Nutrition strategies in the post-weaning period are geared towards providing high quality diets (i.e., inclusion of animal-based protein sources) to mitigate the effect of weaning stress and immature digestive and immune systems. Due to increased diet complexity and inclusion of highly digestible ingredients and feed additives, the cost of diets is highest in the nursery phase of production. However, the provision of high quality diets in the post-weaning period does not always result in improved performance, with some studies suggesting that inclusion of animal-based protein sources (e.g., fish meal, spray-dried blood plasma, whey) may not be necessary. For instance, previous studies (Wolter et al., 2003; Skinner et al.,

(Animal protein-based nursery diets... cont'd on page 2)

Inside This Edition

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(Animal protein-based nursery diets... cont'd from page 1)

2014; Collins et al., 2017; Hutig et al., 2018) found that while growth performance in the nursery was compromised with provision of plant-based diets, overall growth performance to market weight was not different compared to those pigs that received animal-based proteins in the nursery.

Plant-based nursery diets may be detrimental to health However, in the study by Skinner et al. (2014), reduced growth performance and increased mortality was observed in pigs fed plant-based diets when an unexpected disease challenge occurred. This indicates that while growth performance was not affected by diet, pigs fed a plant-based diet vs. a diet containing

animal-based proteins in the nursery may be more susceptible to subsequent disease challenges. There have been no further studies to verify the effects of removal of animal-based protein sources in nursery diets on piglet susceptibility to disease challenge. More fully understanding the impact of nursery diets on long-term health is especially important as many 'raised without antibiotics' programs require the removal of animal-based ingredients from diet formulations (i.e., use of plant-based diets).

Functional amino acid supplementation may improve health status

We have shown previously that providing pigs with a blend of functional amino acids (FAA; methionine, threonine, and tryptophan) at 120% of NRC (2012) requirements improves growth performance and immune status of pigs during an enteric disease challenge (i.e., Salmonella) and that supplementation for longer periods prior to the disease challenge improves the effectiveness of FAA. We have also shown that feeding FAA during the nursery period improved growth performance of pigs during a subsequent Salmonella challenge.

What we did

Thirty-two weanling pigs (8.7 ± 0.23 kg) were assigned to a feeding program for 31 days. Pigs were fed a diet containing only plant-based (PB) proteins or including animal-based (AB) proteins (i.e., meat meal, fish meal, blood meal, whey protein) and either containing a basal amino acid profile (FAA-) or supplemented with FAA (methionine, threonine, and tryptophan at 120% of requirements). After the 31 day nursery period, pigs were placed on common grower diet and, after a 7-d adaptation, were inoculated with Salmonella and monitored for 7 d post-inoculation.

What we found

There was no impact of diet on pre-inoculation growth performance. Post-inoculation, AB-fed pigs had greater average daily gain compared to pigs fed PB diets with no FAA, with pigs fed PB diets with the FAA+ profile being intermediate.

Feeding PB diets negatively impacted fecal score and FAA improved fecal score throughout the study. Feeding AB diets reduced Salmonella shedding and hindgut colonization of Salmonella, regardless of FAA supplementation.
There was no impact of protein source or FAA supplementation on any blood measures of immune or antioxidant status. Feeding AB diets reduce hindgut myeloperoxidase, an indicator of intestinal damage, and FAA reduced small intestinal myeloperoxidase.

> "Plant based diets may have a negative affect on pigs during a subsequent disease challenge."

Conclusions

Overall, our findings show that simple, plant-based nursery diets may have a negative effect on pigs during a subsequent disease challenge. Further, when plant-based diets were supplemented with FAA, specifically with Thr, Met, and Trp, above estimated requirements for growth, the negative effects of Salmonella on growth performance were reduced. The effects of protein

Pre- and post-inoculation growth performance of pigs fed plant- or animal-based nursery diets with or without functional amino acids supplementation[1]

	Plant-based		Animal-based		
Item	**FAA-**	**FAA+**	**FAA-**	**FAA+**	**SEM**
Phase I (day 0 to 10)					
Initial body weight, kg	8.73	8.73	8.72	8.73	0.129
Average daily gain, kg	0.209	0.208	0.198	0.176	0.116
Average daily feed intake, kg	0.358	0.367	0.374	0.325	0.114
Gain:Feed, kg/kg	0.584	0.567	0.529	0.541	0.061
Phase II (day 10 to 31)					
Initial body weight, kg	10.82	10.81	10.70	10.49	0.718
Average daily gain, kg	0.490	0.492	0.474	0.467	0.045
Average daily feed intake, kg	0.803	0.793	0.769	0.722	0.109
Gain:Feed, kg/kg	0.610	0.620	0.616	0.647	0.035
Pre-inoculation (day 31 to 38)					
Initial body weight, kg	21.11	21.14	20.65	20.30	1.882
Average daily gain, kg	0.789	0.800	0.789	0.741	0.046
Average daily feed intake, kg	1.320	1.360	1.290	1.275	0.072
Gain:Feed, kg/kg	0.597	0.588	0.611	0.581	0.035
Post-inoculation (day 38 to 45)					
Initial body weight, kg	26.63	26.74	26.17	25.49	2.342
Average daily gain, kg	0.516[b]	0.605[ab]	0.726[a]	0.716[a]	0.065
Average daily feed intake, kg	1.173[b]	1.315[ab]	1.452[a]	1.325[ab]	0.084
Gain:Feed, kg/kg	0.439[b]	0.406[ab]	0.500[ab]	0.540[a]	0.047
Final body weight, kg	30.34	30.98	31.25	30.50	1.371

FAA-, Basal amino acid profile; FAA+, Functional amino acid profile (Thr, Met, and Trp at 120% of requirements for growth).
[1]Values are least squares means; n=8 pigs/treatment.
[a–b]Means within a row with different superscripts differ ($P \leq 0.05$).

source and FAA supplementation seem to be largely due to effects on intestinal health, as there were no diet effects on systemic markers of immune status or antioxidant balance, however, fecal score and Salmonella colonization and shedding were improved with animal-based proteins and or FAA supplementation.

Producers may want to consider the continued use of animal-based protein sources in nursery diets in order to improve health status of piglets. When this is not possible, FAA supplementation may provide a useful tool to mitigate the potential negative effects of plant-based diets.

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Can slat-compatible enrichment influence the behaviour and response of pigs to a disease challenge?

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Disease is a leading cause of economic loss and reduced animal welfare in the swine industry. Outbreaks of disease such as Porcine Epidemic Diarrhea (PED) demonstrate the conventional approaches to health management do not always suffice. Biosecurity measures may not always prevent disease spread, vaccines take time and investment to develop, and efforts to reduce antimicrobial use must continue to support longer term human and animal health. Therefore, the fundamental resilience of the animal is an important component of health management, and the question shifts from "how do we control disease?" to "how do we make animals less susceptible to disease?". Breeding animals for greater disease resilience, the ability to maintain production performance regardless of disease status or pathogen load, is one approach. But whether and how the rearing environment can influence disease resilience is also of value to understand, especially considering that stress will influence immune function.

Provision of environmental enrichment is considered an important component of good animal care for swine and is a requirement in the Code of Practice for the care and handling of pigs (NFACC, 2014). Environmental enrichment should improve the biological functioning of a captively reared animal (Newberry, 1995). For pigs, enrichment can provide an outlet for the performance of species-specific behaviours such as rooting and chewing for exploration and foraging, and in turn may reduce the likelihood of pigs redirecting nosing and biting towards pen-mates and pen fixtures, with the former potentially reducing chronic social stress within the group.

> "The aim of this work was to determine if provision of a rotation of slat compatible enrichments could beneficially influence the physiological responses of pigs when exposed to a disease challenge."

Rearing pigs in highly enriched environments with a greater space allowance and provision of substrates (straw, mushroom compost, sawdust, wood branches) for rooting and chewing has been found to reduce the disease susceptibility of pigs to co-infection with porcine reproductive and respiratory syndrome virus (PRRSV) and Actinobacillus pleuropneumoniae, increasing

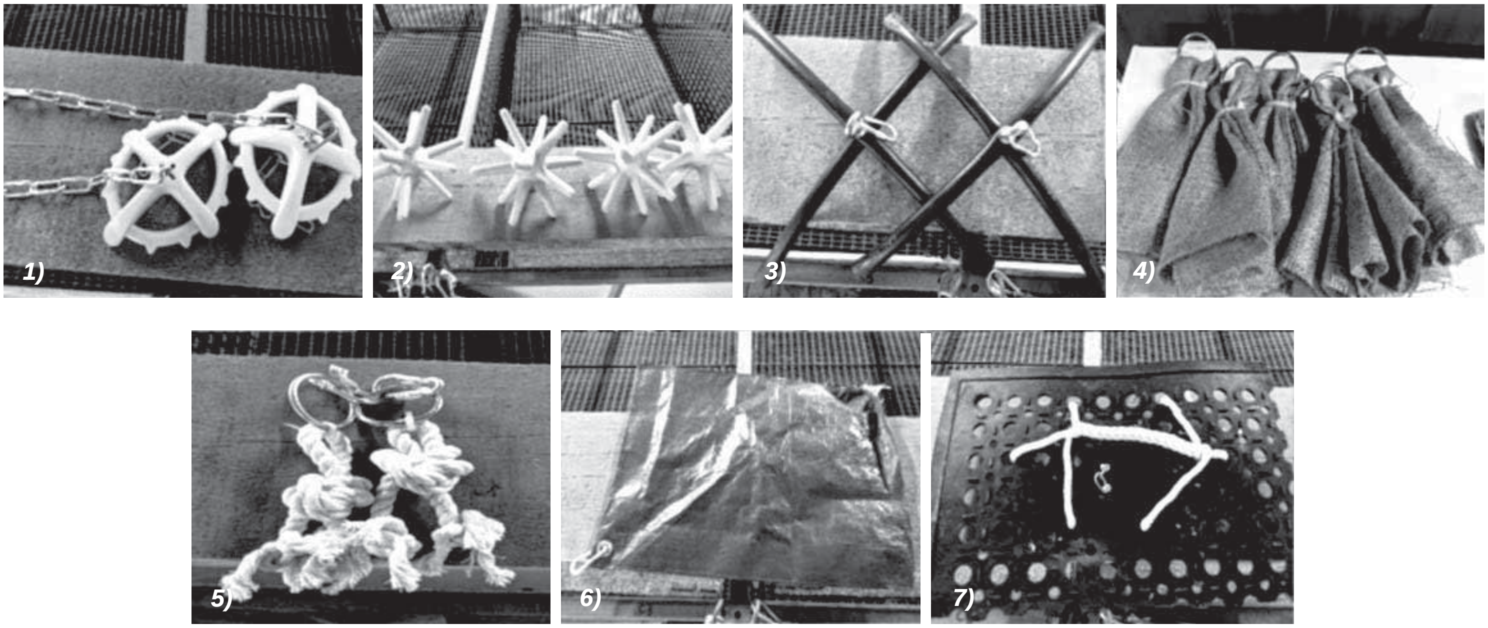

Figure 1. Point-source enrichment objects provided to growing swine during a natural disease challenge. One type of enrichment was provided at a time and the type of object presented was rotated three times weekly. Top row (left to right): 1) Porchichew (NutraPet, East Yorkshire, UK); 2) EasyFix Luna ((EasyFix, Ballinasloe, Ireland); 3) Flexible PVC pipe, 4) jute (burlap) sack. Bottom row (left to right): 5) cotton rope; 6) tarpaulin; 7) rubber rooting mat with cotton rope treaded through.

the speed of viral clearance and reducing the prevalence of lung lesions (van Dixhoorn et al., 2016). However, provision of these types of substrates is not practical in fully slatted rearing systems and may present a biosecurity risk. Instead, slat compatible enrichment, such as reusable commercial pig 'toys' or chewable materials such as natural rope, flexible PVC pipe, or rubber, are more readily provided to pigs in fully-slatted farms. However, scientific evidence is limited and conflicting on the efficacy of chewable, inedible enrichments to influence the productivity, behaviour, or immune function of pigs. The aim of this work was to determine if provision of a rotation of slat compatible enrichments could beneficially influence the physiological responses of pigs when exposed to a disease challenge. Individual pig behaviour within a group influences the health and welfare of pen mates. Enrichment is also known to influence the social behaviour of swine. Therefore, observations of individual pig behaviour were also taken to determine if and how the provision of slat compatible enrichment shaped social behaviour during the disease challenge, and whether relationships between individual pig behaviour and performance (growth and immune response) to a disease challenge exist. The information learnt from this study can help to develop strategies to optimize herd health management, enrichment provision, and phenotypic identification of pigs that perform well under challenge.

Study Methodology

Nineteen batches of barrows (n=1220) were studied at the Deschambault Swine Testing Station, QC. Pigs were transported to the station at weaning, where they first entered a high-health quarantine nursery where they remained for 19 days (day -18 to day 0). Upon arrival each batch of pigs was split equally into pens assigned to a treatment group (Enriched) or to control pens. Enriched pens were reared with a rotation of seven different inedible point-source enrichment objects (Figure 1), with control pens receiving up to two metal chains as a basic enrichment. Point-source enrichment is an item of a limited size that is typically fixed in location, such as by suspending the enrichments. Each type of enrichment was presented to pigs one at a time, at a rate of one enrichment object per seven pigs. To help support novelty and retain interest, objects were rotated three times weekly (Monday, Wednesday, Friday) so that each type of object was presented for two to three days at a time and then not re-presented to the pigs for a period of nine days.

On day 0 at 37-40 days of age, pigs were transferred into a continuous flow barn and exposed to a polymicrobial natural disease challenge including economically significant pathogens such as porcine reproductive and respiratory syndrome virus (PRRSV), swine influenza A, and Salmonella spp. for a period of four weeks, after which they were transferred to a finisher barn where they remained until slaughter.

Pens of pigs remained in their respective control or treatment groups throughout each growth phase, with enriched pens continuing to receive a rotation of enrichment from quarantine, through the disease challenge, and to grow-finish. Measurements of pig behaviour (enrichment interaction and postures), productivity (average daily gain and feed efficiency), morbidity and mortality, and immune cell counts (white blood cells, red blood cells, haematocrit and haemoglobin) were collected and compared between the two treatment groups at time points before (quarantine phase), during, and after disease challenge (finisher phase). Additionally, to understand how enrichment shapes behaviour, and the characteristics of successful pigs, a preliminary exploration into relationships

(Can slat compatible enrichment... cont'd on page 6

(Can slat compatible enrichment... cont'd from page 5)

between the performance of social and exploratory behaviours by individual pigs when exposed to a disease challenge and their performance (growth, cellular immune response) was performed on a subset of 70 pigs. For this, the social behaviour (positive: gentle nosing, and negative: biting) of pigs towards pen mates and the environment (exploring enrichment, rooting pen fittings) was recorded at two-minute intervals over four hours in the quarantine phase (day -18) and in the natural disease challenge barn on day 13 following exposure.

Results & Discussion

Results showed that pigs provided with a rotation of point-source enrichments were more likely to interact with these objects than control pigs interacted with the chains that they were provided with as the only point-source enrichment (Figure 2). However, the probability of interaction with the point-source enrichment declined over time within each growth phase. This was particularly evident in the finisher phase, where the probability of observing a pig interacting with the enrichment was 0% in the control pens and 1-2% in the enrichment pens. Enriched pens did not differ from control pens in mortality, average daily gain, feed conversion ratio, or the change in immune cell concentrations from baseline to post-disease challenge (day 42). Therefore, despite frequent rotation, the enrichment objects were not able to generate a benefit in terms of pig performance or response to disease challenge. This may be because the enrichment was not rewarding enough to the pigs, which is also reflected in the decline in their use over time. If reduced use of enrichment is taking place, it can be expected there is minimal benefit. Despite this, observations of pig postures found that pigs in enriched pens were more likely to be observed lying laterally (side lying) and performed less standing and lying sternally (stomach lying) throughout the quarantine and disease challenge phases (P<0.001), which could indicate that enriched pigs were resting more comfortably and spending less time awake and inactive, which may also reflect the increased expenditure of activity on enrichment.

Observations of individual social and exploratory behaviour performed by 70 pigs identified that pigs in enriched pens were more active in the quarantine phase, performing more positive and negative social behaviours and more pen rooting than pigs in control pens (P<0.05 for all). On day 13 of disease challenge, pigs in enriched pens displayed greater levels of enrichment use (P<0.001) and negative social behaviour (P=0.04), but pigs in control and enriched pens did not differ in positive social behaviour and pen rooting. An examination of relationships between the behaviours found that pigs in enriched pens on day -18 (Figure 3) showed positive correlations of moderate strength of enrichment interaction with positive social nosing, negative social behaviours, and pen-directed rooting. These relationships were not significant for pigs in the control pens, suggesting the presence of enrichment increased the overall oral-nasal-facial behaviour of pigs. In control pens, interacting with the chain enrichment showed a positive relationship with levels of negative biting behaviour.

It has been suggested that when enrichment does not meet the behavioural needs of the pigs, their behaviour is redirected towards penmates or towards pen fixtures, walls, and floors. Whereas, when enrichment is effective, it is associated with a reduction in pen-mate manipulation. This suggests that provision of a rotation of point-source enrichment may not have met the enrichment needs of the pigs in our study. Additionally,

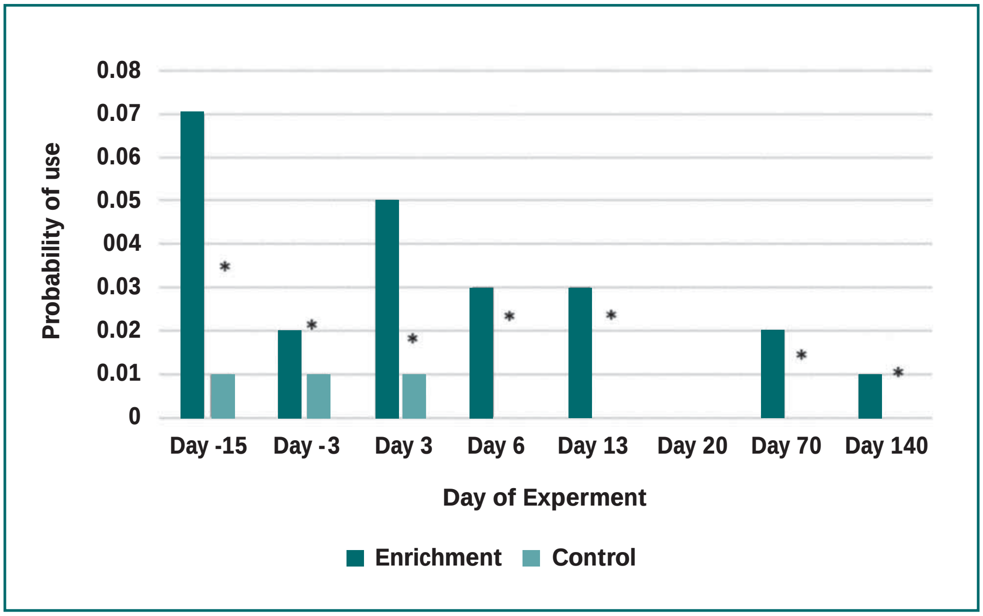

Figure 2. Probability of pens of pigs in interacting with a point-source enrichment object (Enrichment) or a metal chain (Control) during a two-hour observation period on sampling days within three experimental phases: quarantine phase (Day -15, Day -3), disease challenge phase (Day 3, Day 6, Day 13, Day 20) and finisher phase (Day 70, Day 140). Statistically significant differences (P<0.05) between treatment groups are denoted by an asterisk (*).

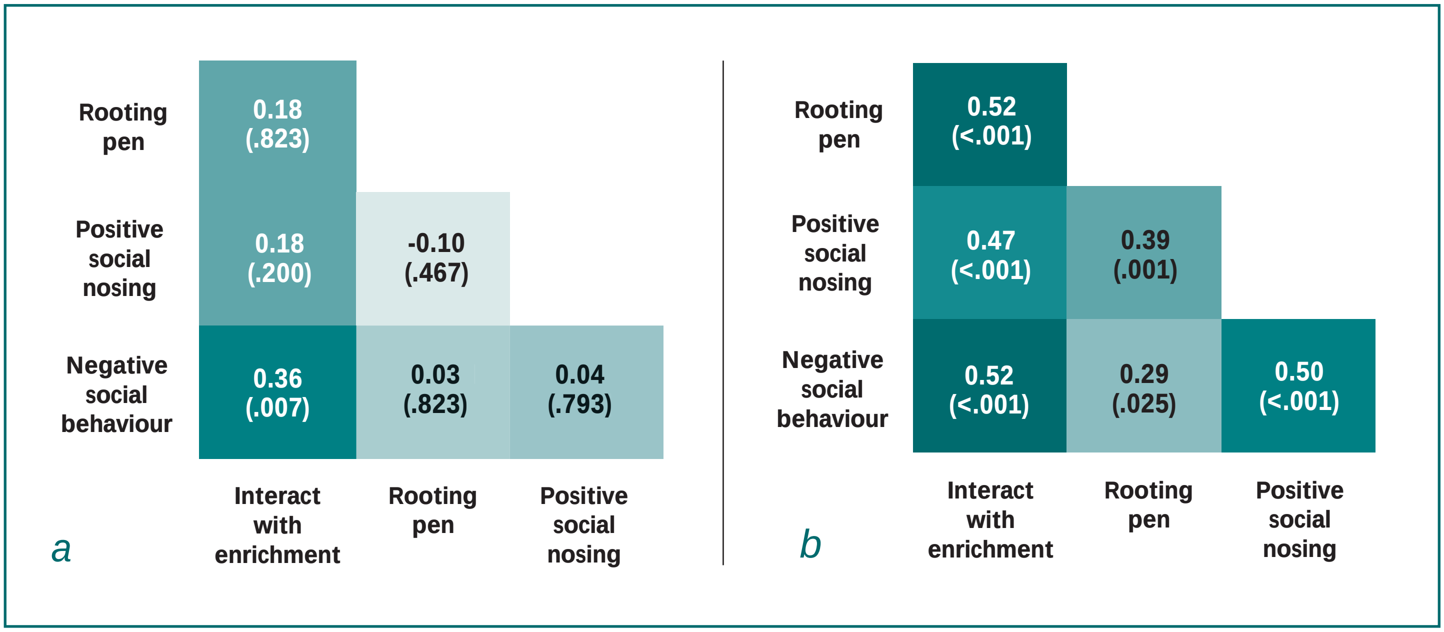

Figure 3. Heat map representation of a Spearman correlation matrix of behaviour frequencies of pig social and exploratory behaviour within enrichment ("a" n = 30) and control ("b" n = 30) treatment groups during a quarantine phase (Day -18). P-values of the correlations are in parentheses. Significance is established as P≤0.003.

the interpretation of social behaviour may not always have been accurate and could have been a precursor for negative behaviours, or simply exploratory behaviour towards another pig.

Relationships were found between the performance of specific behaviours and performance in the disease challenge for both control and enriched pens. In both treatment groups, animals that performed a greater frequency of pen rooting during disease challenge had a greater average daily gain in the finisher phase (P<0.01). For enriched pens only, there was a moderate, positive relationship of the performance of pen rooting with positive social behaviour and higher counts of total white blood cells, lymphocytes, total red blood cells, and hemoglobin measured at day 42 post disease exposure. This suggests that pigs that perform functional (rooting) and positive social behaviour may perform better under challenge, showing higher growth rate and quicker recovery. Based on this preliminary exploration in a sub-sample of pigs, there could be value in further categorizing individuals based on their behaviour, for their ability to perform when under challenge. Furthermore, because the relationships were between functional (rooting) and positive social behaviour, there may also be value in exploring ways to encourage supporting expression of these behaviours to improve performance of pigs under challenge.

Implications

The provision of a rotation of inedible point-source enrichments to pigs reared in fully slatted housing increased the interaction with enrichment compared to provision of a single chain but was not effective at beneficially influencing the response of pigs to a natural disease challenge. Further research on providing enrichment that sustains pig interaction, that satisfies motivational needs, and that can deliver biological benefits is warranted. This will ensure investments made into enrichment that meet Code of Practice requirements can deliver good benefits for pig welfare and for the producer. Relationships between individual pig behaviour and performance when under challenge suggests there is value in exploring this further, which may lead to development of additional phenotypic measures for resilient animals.

The results of this work can help provide information for the development of sustainable and effective environmental enrichment practices that meet animal care requirements while supporting the health and economic viability of Canadian swine production.

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Play behaviour and its role to enhance pig welfare and production

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Play behaviour in non-human animals has been associated with feelings of pleasure as playing animals seem to be excited and "having fun" (Špinka et al. 2001). Play usually occurs in a stress-free environment when no threats are present, and all animal needs are satisfied (Burghardt 2005). This suggests the welfare status of the playing animals is likely to be high. But can promotion of play be used to enhance the welfare of the animals and support beneficial production characteristics?

Traditionally, approaches to improve animal welfare have focused on the elimination of negative experiences, such as pain. However, there has been a shift towards the promotion of positive experiences, with a focus on consideration and improvement of the quality of life for animals. Concepts that also resonate with consumer expectations for animals farmed for food.

Joyful activities such as play might have positive mental state-inducing effects on pigs. This could be beneficial for pigs in many aspects. For instance, a positive mindset could have immune-boosting properties which are confirmed in humans (Pressman et al. 2019). Pigs housed in alternative systems (e.g., an environment enriched with substrates, extra space, social enrichment, or cognitive enrichment) are able to recover faster or more efficiently from various challenges such as disease (van Dixhoorn et al. 2016), injuries (Ernst et al. 2006), transport, or temperature changes (Parois et al. 2022) compared to pigs from a barren environment. These pigs are also less excitable and less fearful in novel situations (Puppe et al. 2007, Zebunke et al. 2013). Research furthermore has identified that pigs from an enriched environment are in a more positive mental state and show more optimism when faced with an ambiguous situation (Douglas et al. 2012). Although no clear link has been made between the mental state and performance in pigs, the evidence suggests that pigs with an enhanced welfare status maintain a positive mental state which could have beneficial effects on the performance and resilience. This is intriguing for the fact that intensively farmed pigs are challenged with various environmental and social challenges throughout their life and the promotion of positive welfare could be a means by which to support a greater resilience in pigs against challenges. Promoting positive experience through play behaviour may be one approach and could also have a stress-reducing effect which could further facilitate husbandry practices with less excitable animals and easier handling. Additionally, the performance of play at key time points early in the life of the pig is integral to the development of species specific behaviour, emotional regulation, and social skills. Therefore, providing outlets for expression of play may also support the conferring of beneficial traits to pigs. Lastly, the practical side of the strategy must not be neglected because only realistic options will be seriously considered by pig producers. The enrichment used in alternative systems is not viable in commercial conditions. However, play behaviour is naturally occurring in juvenile pigs even in intensive production units which makes it a good candidate to fulfil the role of promoting positive experience and beneficial traits in existing systems.

"Joyful activities such as play might have positive mental state-inducing effects on pigs. This could be beneficial for pigs in many aspects."

This project is funded by the NSERC Industrial Research Chair program, a five-year research program focusing on emerging questions in swine welfare, led by Dr. Yolande Seddon and developed in collaboration with 14 industry partners representing Canadian producers, processors and swine genetics company. There are four overarching Goals of the program. Goal 2 will investigate whether play can be used as a tool to support positive welfare and beneficial production characteristics in pigs reared in the existing systems. Data collection is divided into a series of experiments that started in late 2020 and will continue until late 2023. The experiments are conducted at the Prairie Swine Centre, the University of Saskatchewan with final concepts to be tested at commercial facilities.

An upcoming experiment will address how the promotion of a positive mental state through play behaviour affects immunocompetency. Play could be stress-reducing but could also beneficially influence the immune response as a result of the relationship between a positive mental state and the benefits for the immune system (Ernst et al. 2006, van Dixhoorn et al. 2016). Lastly, assuming beneficial findings result, the promotion of play behaviour will be taken to a commercial barn. There, practicability, viability as well as the effect on the alleviation of common welfare challenges will be tested in real conditions.

Picture 1. Researcher with pigs that have experienced a play session in a play pen.

Picture 2. Measuring heart rate variability during a play session in a play pen.

Because play is usually observed only in piglets between 2-6 weeks of age (Newberry et al. 1988), the first trial is exploring the promotion of play during its natural period of expression (pre-weaning), and testing pigs to establish whether the performance of different types of play, such as object play, social play and locomotor play, influences the response of piglets to weaning and the development of social skills when meeting with unfamiliar pigs. Data collection for this study is complete, and data analysis is underway.

A second trial explores whether play can be repeatedly promoted and sustained in older pigs, beyond the age at which play is naturally expressed, and aims to determine if promotion of play confers stress-relieving properties and results in a pleasurable/positive mental state. Play was promoted in finishing pigs by regular play opportunities either stimulated through enrichment items accompanied with scents in their home pen or, alternatively when given access to a larger, specific play pen area. Behaviour of animals exposed to play sessions was recorded throughout the trial to identify the response and will be compared to control pigs who receive no play opportunities. Weights were taken at the start and end of the trial from which to evaluate growth rate, and saliva samples were collected at specific time points for the assessment of levels of cortisol and alpha-amylase which are emerging markers of positive emotions and arousal. The effect of play on the mental state was researched in pigs that received play opportunities through heart rate variability and a behavioural test. Heart rate variability is a proxy measure of the autonomic nervous system and can indicate a psychological state by the interplay between the sympathetic ("fight or flight") and parasympathetic ("rest and digest") branches. The behavioural test (cognitive bias) assesses pigs' optimism and pessimism while being faced with a neutral situation. The results of this trial will identify if it is viable to promote play, and whether it confers positive mental states for pigs, which is a tool for enhancing quality of life in production systems.

Implications

This project opens up a new approach by which the quality of life and performance of intensively farmed pigs could be enhanced by a means that will also resonate with consumers. By exploring the relationship between play behaviour, the pigs' emotions and productivity, the project aims to deliver a powerful tool with beneficial outcomes for production characteristics such as improved immune response and more effective responses to stress. Importantly, the tool will be designed and evaluated for application in the existing commercial systems. Therefore, the findings of this project will support the sustainability of the Canadian swine industry and benefit consumers of Canadian pork products. Finally – we are sure producers and barn staff will enjoy seeing pigs play!

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(Play behaviour and it's role ... cont'd on page11)

Effectiveness of functional amino acids in Salmonella-challenged low and normal birth weight pigs

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We have shown previously that providing pigs with a blend of functional amino acids (FAA; methionine, threonine, and tryptophan) at 120% of NRC (2012) requirements improves growth performance and immune status of pigs during an enteric disease challenge (i.e., Salmonella). In order to develop feeding programs that maximize pig robustness and performance, it is important to understand how the effectiveness of strategies, such as FAA supplementation, are affected by different factors. The increase in sow prolificacy over the past decade has resulted in an increase in the incidence of low birth weight (LBW) pigs. These pigs have reduced growth performance and impaired gut and immune development. We wanted to determine the influence of birth weight on pig response to a subsequent disease challenge and on the effectiveness of FAA supplementation in ameliorating this response.

Pigs were identified as low or normal birth weight category (BWC) with piglets of 0.9 kg to 1.3 kg initial body weight considered LBW and piglets of 1.4 kg to 1.8 kg initial body weight considered normal birth weight (NBW). At weaning (28 d), a total of 32 mixed-sex piglets (16 LBW, 16 NBW) were individual housed and placed on 1 of 2 dietary treatments (n=8 pigs/BWC-dietary treatment combination). Dietary treatments consisted of corn-wheat-barley-soybean meal-based diets with a basal (FAA-) or functional (FAA+) amino acid profile. The FAA- diets met NRC (2012) requirements and FAA+ diets contained methionine, threonine, and tryptophan supplemented at 120% of requirements. Diets were fed in 2-phases, with phase 1 and 2 fed for 10 d and 21 d, respectively. Dietary treatments were fed for 31 d post-weaning at which point all pigs were placed on a common grower diet with no functional amino acid supplementation. One week after switching to the grower diet, all pigs were inoculated with Salmonella Typhimurium, and euthanized 1 week post-inoculation.

Pre-inoculation growth performance was not affected by dietary treatment. Low birth weight pigs had reduced body weight and growth performance compared to NBW pigs throughout the study, regardless of dietary treatment.

We found that LBW pigs are more susceptible to Salmonella inoculation than NBW pigs. This was demonstrated by a greater rise in body temperature, lower glutathione, and decreased intestinal alkaline phosphatase activity in LBW compared to NBW pigs post-inoculation. This suggests that LBW pigs have reduced antioxidant capacity, increased intestinal dysbiosis, and a greater overall inflammatory state than NBW pigs.

Functional amino acid supplementation improved average daily gain in NBW pigs, but not LBW pigs, post-inoculation. Also, while FAA supplementation reduced cecal myeloperoxidase in NBW pigs, the same effect was not observed in LBW pigs. Supplementation with FAA also reduced fecal shedding of Salmonella and translocation of Salmonella to the spleen only in NBW pigs. Overall, our findings show that LBW pigs are more susceptible to the negative effects of disease challenge than NBW pigs. We also found that supplementation of nursery diets with FAA improve growth performance, reduce pathogen shedding and translocation, and improve antioxidant capacity and acute phase response. However, the beneficial effects of FAA were dependent on birth weight, with NBW pigs having a more beneficial response to FAA than LBW pigs.

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This study is available in full (open access): LA Rodrigues, JC Panisson, LA kpogo, JC Gonzalez-Vega, JK Htoo, AG Van Kessel, and DA Columbus (2022) Functional amino acid supplementation post-weaning mitigates the response of normal birth weight more than for low birth weight pigs to a subsequent Salmonella challenge. Animal. 16:100566.

Table 1 Pre- and post-inoculation growth performance of low and normal birth weight pigs inoculated with Salmonella[1]

Low birth weight	Normal birth weight						P-value	
Item	**FAA-**	**FAA+**	**FAA-**	**FAA+**	**SEM**	**BWC**	**FAA**	**BWC×FAA**
Phase I (day 0 to 10)								
Phase I (d 25 to 35 of the experiment)								
Initial body weight, kg	6.79	6.98	8.24	8.72	0.347	<0.01	0.64	0.27
Average daily gain, kg	0.246	0.249	0.287	0.313	0.044	0.45	0.22	0.16
Average daily feed intake, kg	0.386ab	0.405ab	0.361b	0.446a	0.025	0.73	0.21	0.05
Gain:Feed, kg/kg	0.64	0.62	0.79	0.70	0.093	0.28	0.86	0.89
Phase II (d 35 to 56 of the experiment)								
Initial body weight, kg	9.25	9.47	11.11	11.85	0.605	<0.01	0.44	0.68
Average daily gain, kg	0.382	0.400	0.360	0.403	0.036	0.80	0.41	0.72
Average daily feed intake, kg	0.699	0.721	0.780	0.773	0.050	0.20	0.88	0.79
Gain:Feed, kg/kg	0.55	0.55	0.46	0.52	0.043	0.17	0.36	0.63
Pre-inoculation (d 56 to 63 of the experiment)								
Initial body weight, kg	17.27	17.87	18.67	20.31	0.460	0.05	0.70	0.15
Average daily gain, kg	0.416	0.529	0.718	0.784	0.157	0.07	0.56	0.88
Average daily feed intake, kg	0.854	0.914	0.926	1.099	0.106	0.21	0.26	0.58
Gain:Feed, kg/kg	0.49	0.58	0.78	0.71	0.153	0.55	0.71	0.35
Post-inoculation (d 63 to 70 of the experiment)								
Initial body weight, kg	20.18	21.57	23.70	25.80	0.967	0.01	0.63	0.16
Average daily gain, kg	0.436b	0.446b	0.477b	0.565a	0.034	0.33	0.08	0.03
Average daily feed intake, kg	0.831	0.913	0.938	1.065	0.146	0.55	0.31	0.34
Gain:Feed, kg/kg	0.52	0.49	0.51	0.53	0.038	0.43	0.76	0.82
Final body weight, kg	23.23	24.69	27.04	29.76	0.841	0.03	0.07	0.48

[1]Values are least squares means; n=8 pigs/treatment. Phase I, d 0-10 post-weaning. Phase I, d 10-31 post-weaning. Pre-inoculation, d 31-38 post-weaning. Post-inoculation, d 38-45 post-weaning.
a–bMeans within a row with different superscripts differ (P ≤ 0.05).

(Play behaviour and it's role ... cont'd from page 9)

Biography

Karolína Steinerová is a PhD student in pig welfare at the University of Saskatchewan, Western College of Veterinary Medicine working under the supervision of Dr. Yolande Seddon. She obtained an MSc in Animal Science from the Swedish University of Agricultural Sciences, SE, and a BSc in Animal Welfare and Protection from the University of Veterinary and Pharmaceutical Sciences, CZ. Karolína incorporates her experience from animal husbandry from different parts of the world to improve the quality of life of farmed animals in Canada.

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Personal Profile

Bria Bentley
M.Sc. student

Bria Bentley graduated from the University of Saskatchewan this spring with a BSc in Animal Science. Originally from Calgary AB, she was able to gain experience within various livestock operations including swine, poultry, dairy, and equine. Bria developed a passion for the swine industry after working for Olymel as a Pork Production Technician in the farrowing department. Through work experience and academics Bria has aspiration to continue her pathway in the swine industry. Bria has chosen to pursue a master's degree in swine nutrition under the guidance of Dr. Denise Beaulieu and Dr. Dan Columbus at the University of Saskatchewan. Bria will be involved in evaluating "swine bioavailability of resistance starch derived from pulse starches." After completion of her master's, Bria would like to become an animal nutritionist in the industry.

Coming Events

Alberta Livestock Expo
Lethbridge, AB.
October 5, 2022

Red Deer Swine Technology Workshop
Red Deer, AB.
October 19, 2022

Saskatchewan Pork Symposium
Saskatoon, SK.
November 15 - 16, 2022

Banff Pork Seminar
Banff, Alberta
January 10-12, 2023

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