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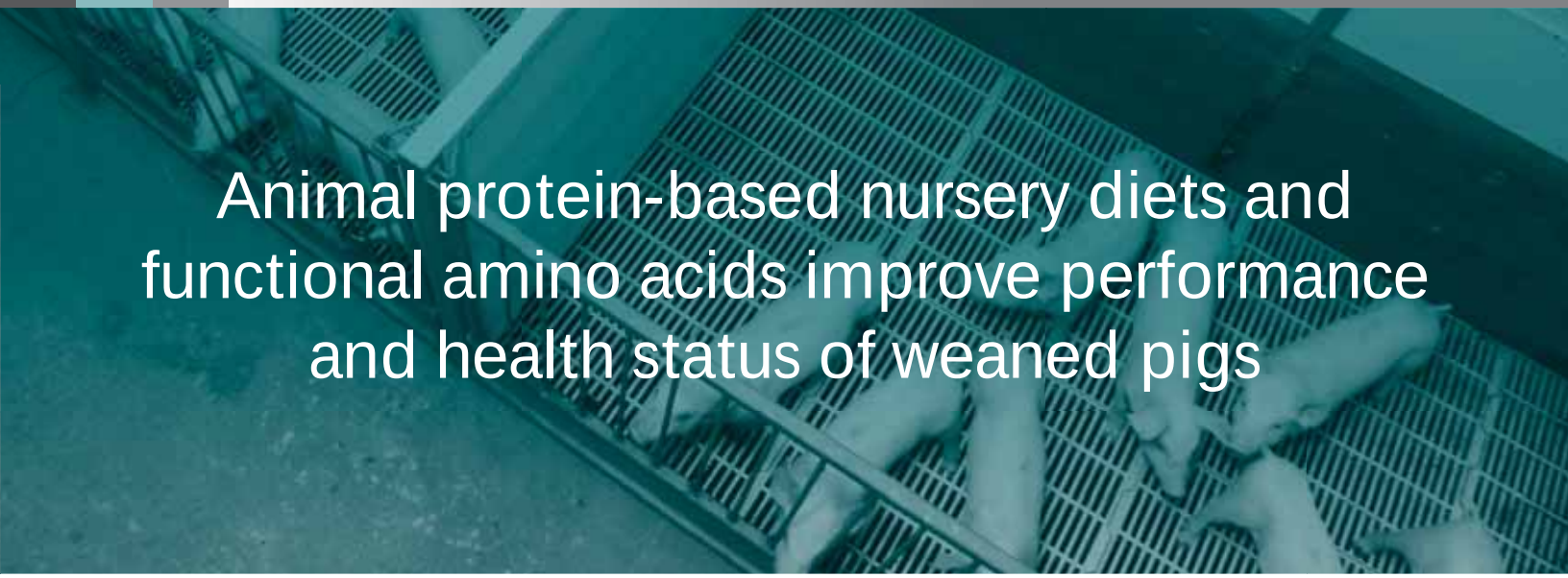

Animal protein-based nursery diets and functional amino acids improve performance and health status of weaned pigs

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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.,

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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 ≤ 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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