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Evaluation of Corn Protein Source on Feed Intake Preference in Nursery Pigs

Abstract

A total of 180 pigs (241 × 600, DNA; initially 17.0 ± 1.6 lb) were used to determine feed intake preference from various corn protein sources. A series of 5-day preference trials were used with two diets offered within each comparison with feeder location rotated daily within each pen. Feed consumption was used to determine preference between each diet comparison. There were 6 replicates of each diet comparison. The corn protein sources utilized in this experiment included: fermented corn protein, high protein distillers dried grains with solubles (HPDDGs), whole stillage solids (approximately 2/3 content of fermented corn protein), and thin stillage solids (approximately 1/3 content of fermented corn protein). Fermented corn protein and HPDDGs were included in the diet at 15% as a replacement for corn. Whole stillage solids and thin stillage solids were included in the diet at 10% and 5%, respectively, as a replacement to corn to match its contribution in fermented corn protein. The control diet was a standard nursery diet. Diet comparisons included: 1) Control vs. Fermented corn protein; 2) Whole stillage solids vs. Fermented corn protein; 3) Thin stillage solids vs. Fermented corn protein; 4) HPDDGs vs. Fermented corn protein; 5) Control vs. Whole stillage solids; 6) Control vs. Thin stillage solids. For comparison 1, pigs preferred ($P < 0.001$) the control diet by consuming 82.5% of their intake with this diet compared with the diet containing fermented corn protein. For comparison 2, there was no difference ($P > 0.05$) in feed consumption of diets containing whole stillage solids and the fermented corn protein. For comparison 3, pigs preferred ($P = 0.001$) the diet containing thin stillage solids by consuming 75.8% of their intake with this diet compared to the diet containing fermented corn protein. There was no difference when comparing fermented corn protein and whole stillage solids, but thin stillage solids had a higher percentage intake than fermented corn protein. Therefore, it is likely that whole stillage solids are the component of fermented corn protein that negatively affect feed consumption.

Keywords

corn protein, feed intake, preference, nursery pig

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Summary

A total of 180 pigs (241 × 600, DNA; initially 17.0 ± 1.6 lb) were used to determine feed intake preference from various corn protein sources. A series of 5-day preference trials were used with two diets offered within each comparison with feeder location rotated daily within each pen. Feed consumption was used to determine preference between each diet comparison. There were 6 replicates of each diet comparison. The corn protein sources utilized in this experiment included: fermented corn protein, high protein distillers dried grains with solubles (HPDDGs), whole stillage solids (approximately 2/3 content of fermented corn protein), and thin stillage solids (approximately 1/3 content of fermented corn protein). Fermented corn protein and HPDDGs were included in the diet at 15% as a replacement for corn. Whole stillage solids and thin stillage solids were included in the diet at 10% and 5%, respectively, as a replacement to corn to match its contribution in fermented corn protein. The control diet was a standard nursery diet. Diet comparisons included: 1) Control vs. Fermented corn protein; 2) Whole stillage solids vs. Fermented corn protein; 3) Thin stillage solids vs. Fermented corn protein; 4) HPDDGs vs. Fermented corn protein; 5) Control vs. Whole stillage solids; 6) Control vs. Thin stillage solids. For comparison 1, pigs preferred ($P < 0.001$) the control diet by consuming 82.5% of their intake with this diet compared with the diet containing fermented corn protein. For comparison 2, there was no difference ($P > 0.05$) in feed consumption of diets containing whole stillage solids and the fermented corn protein. For comparison 3, pigs preferred ($P = 0.001$) the diet containing thin stillage solids by consuming 75.8% of their intake with this diet compared to the diet containing fermented corn protein. There was no difference when comparing fermented corn protein and whole stillage solids, but thin stillage solids had a higher percentage intake than fermented corn protein. Therefore, it is likely that whole stillage solids are the component of fermented corn protein that negatively affect feed consumption.

Introduction

The removal of fibrous components from corn before fermentation yields a high crude protein DDGS (40% crude protein). When various protein and yeast components of the fermentation process are added back to HPDDGs, it results in a fermented corn protein product with up to 50% crude protein and 2% Lys. Because of its high Lys

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content, fermented corn protein has the potential to become an excellent replacement for specialty soy protein products, such as enzymatically treated or fermented soybean meal in nursery pig diets.

A previous study by Stas et al.² observed a negative effect on growth performance with pigs fed fermented corn protein compared to enzymatically treated soybean meal in diets for nursery pigs weighing between 13.2 to 34.9 lb. However, it is unknown which component of fermented corn protein resulted in the poorer growth performance that was observed. Further investigation is needed to determine the effect fermented corn protein has on feed preference compared to its components of whole stillage solids or thin stillage solids. Therefore, the objective of this study was to evaluate corn protein source as well as its components on feed intake preference in nursery diets during this weight range.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The experiment was conducted at the Kansas State University Swine Teaching and Research Center. Each pen was equipped with two 4-hole, dry self-feeder and a nipple waterer to provide *ad libitum* access to feed and water.

Animals and diets

A total of 180 pigs (241 × 600, DNA) were used in three 5-d trials with a different set of 60 pigs each trial to determine feed intake preference from various corn protein sources in nursery pigs weighing 17 to 30 lb. Pigs were weaned at approximately 21 d of age and placed in pens of 5 pigs, each based on initial weight and gender. To determine feed intake preference, each pen was equipped with two identical feeders containing different diets. Feeders were rotated daily within pen to minimize feeder location bias. The corn protein sources utilized in the diets included: fermented corn protein, HPDDGs, whole stillage solids (approximately 2/3 content of fermented corn protein), and thin stillage solids (approximately 1/3 content of fermented corn protein). Fermented corn protein and HPDDGs were included in the diet at 15% as a replacement to corn. Whole stillage solids and thin stillage solids were included in the diet at 10% and 5%, respectively, as a replacement to corn to match its contribution in fermented corn protein. In addition to the corn protein sources, a standard corn-soybean meal control diet was also utilized with 15% added corn to match the contribution of the corn protein sources used for the previous diets.

Three 5-d preference trials were conducted with 12 pens each. Each trial used a different set of 60 pigs, so there was no carryover effect from one set of comparisons vs. another. The first set of 60 pigs were weighed and allotted to 1 of 4 diet comparisons on d 17 after weaning. The second set of 60 pigs were weighed and allotted to the same 4 diet comparisons as the first set of pigs (a total of 6 replications) on d 22 after weaning. The third set of 60 pigs were weighed and allotted to 1 of 2 additional diet comparisons

² Stas, E. B., J. A. Chance, R. D. Goodband, M. D. Tokach, J. C. Woodworth, J. M. DeRouchey, and J. T. Gebhardt. 2021. Evaluation of how nursery pig performance is affected by fermented corn protein as a replacement to enzymatically treated soybean meal along with high or low branch chain amino acid to leucine ratios. Kansas Agricultural Experiment Station Research Reports. Vol. 7, Issue 11. <https://doi.org/10.4148/2378-5977.8194>.

(6 replications) on d 27 after weaning. The diet comparisons utilized for the first and second set of pigs included: 1) Control vs. Fermented corn protein; 2) Whole stillage solids vs. Fermented corn protein; 3) Thin stillage solids vs. Fermented corn protein; and 4) HPDDGs vs. Fermented corn protein. The diet comparisons utilized for the third set of pigs included: 5) Control vs. Whole stillage solids; 6) Control vs. Thin stillage solids.

The basal diet (Table 1) was manufactured at Hubbard Feeds in Beloit, KS, and divided into 5 batches. Corn protein sources were added and mixed at the Kansas State University O.H. Kruse Feed Technology Innovation Center in Manhattan, KS, to form 5 experimental diets. Feed disappearance was measured at the end of each 5-d trial to determine average daily feed disappearance per pen of each diet.

Statistical analysis

Data were analyzed as a completely randomized design using the RStudio environment (Version 1.3.1093, Rstudio, Inc., Boston, MA) using R programming language [Version 4.0.2 (2020-06-22), R Core Team, R Foundation for Statistical Computing, Vienna, Austria] with feeder within pen as the experimental unit. Pen and trial were included in the model as a random effect for the first four comparisons. Pen was included in the model as a random effect for comparison 5 and 6. The lmer procedure of Rstudio was used to evaluate within pen mean difference in average daily feed disappearance and was expressed as percentage of the total consumed for each diet. Results were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

Results and Discussion

For comparison 1, pigs preferred ($P < 0.001$) the control diet over the diet containing fermented corn protein exhibited by 82.5% of the intake coming from the control diet (Table 2). For comparison 2, there was no difference ($P > 0.05$) in feed consumption of diets containing whole stillage solids and fermented corn protein. For comparison 3, pigs preferred ($P = 0.001$) the diet containing thin stillage solids by consuming 75.8% of the total pen intake with this diet compared to the diet containing fermented corn protein. For comparison 4, pigs tended ($P = 0.067$) to prefer the diet containing HPDDGs (59.7% of their intake) compared to the fermented corn protein diet. For comparison 5, pigs preferred ($P < 0.001$) the control diet by consuming 86.7% of their total pen intake with this diet compared with the diet containing whole stillage solids. For comparison 6, pigs preferred ($P = 0.028$) the control diet compared to the diet containing thin stillage solids because 56.9% of total pen intake was from the control diet.

In summary, there was no difference when comparing fermented corn protein and whole stillage solids, but pigs had a greater percentage intake of a diet containing thin stillage solids when compared to a diet with fermented corn protein. Therefore, it is likely that whole stillage solids are the component of fermented corn protein that negatively affects pigs' feed intake observed in previous studies. The standard control diet had a higher intake when compared to fermented corn protein and its components.

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Table 1. Basal diet composition (as-fed basis)¹

Item	Basal diet²
Ingredients, %	
Corn	56.95
Soybean meal, 46.5% CP	25.95
Whey powder	10.00
Fish meal	2.50
Choice white grease	1.00
Limestone	0.75
Monocalcium phosphate	0.60
Salt	0.50
L-Lys HCl	0.48
DL-Met	0.20
L-Thr	0.21
L-Trp	0.04
L-Val	0.15
Zinc oxide	0.25
Vitamin premix with phytase ³	0.25
Trace mineral premix	0.15
Alltech Cerdanase	0.01
Total	100

continued

Table 1. Basal diet composition (as-fed basis)¹

Item	Basal diet²
SID amino acids, %	
Lys	1.35
Ile:Lys	55
Leu:Lys	111
Met:Lys	36
Met and Cys:Lys	57
Thr:Lys	63
Trp:Lys	18.8
Val:Lys	70
His:Lys	34
Total Lys, %	1.49
NE NRC, ⁴ kcal/lb	1,136
SID Lys:NE, g/Mcal	5.40
CP, %	20.7
Ca, %	0.74
P, %	0.60
STTD P, %	0.49

¹Diets were fed from approximately 17 to 30 lb.

²The basal diet was approximately 85% of the experimental diets. Corn protein sources were included at 15% of the experimental diets. Corn protein source inclusion of experimental diets included: control (15% corn), fermented corn protein (15% fermented corn protein), whole stillage solids (10% whole stillage solids; 5% corn), thin stillage solids (5% thin stillage solids; 10% corn), and HPDDGs (15% HPDDGs).

³Vitamin premix with phytase provided an estimated release of 0.13% STTD P.

⁴National Research Council. 2012. Nutrient Requirements of Swine: Eleventh Revised Edition. Washington, DC: The National Academies Press. <https://doi.org/10.17226/13298>.

Table 2. Effect of corn protein source on feed intake preference in nursery pigs^{1,2}

Item	Daily feed disappearance, lb ³	Daily feed disappearance, % ⁴
Comparison 1 ⁵		
Control	5.10	82.5
Fermented corn protein	1.09	17.5
SEM	0.418	3.24
<i>P</i> =	< 0.001	< 0.001
Comparison 2 ⁵		
Whole stillage solids	2.77	52.0
Fermented corn protein	2.53	48.0
SEM	0.203	2.99
<i>P</i> =	0.423	0.377
Comparison 3 ⁵		
Thin stillage solids	4.35	75.8
Fermented corn protein	1.38	24.2
SEM	0.332	2.45
<i>P</i> =	0.001	< 0.001
Comparison 4 ⁵		
HPDDGs	3.34	59.7
Fermented corn protein	2.33	40.3
SEM	0.426	6.66
<i>P</i> =	0.086	0.067
Comparison 5 ⁶		
Control	6.23	86.7
Whole stillage solids	1.02	13.3
SEM	0.407	4.07
<i>P</i> =	< 0.001	< 0.001
Comparison 6 ⁶		
Control	3.89	56.9
Thin stillage solids	3.00	43.1
SEM	0.402	3.81
<i>P</i> =	0.172	0.028

¹ A total of 180 pigs were used in a 15-d preference trial with 5 pigs per pen and 6 replications per comparison. Three 5-d preference trials were evaluated with a different set of 12 pens and 60 pigs per trial.

² Feeders were rotated once daily within each pen to eliminate any feeder location bias.

³ Feed disappearance was analyzed on a per pen basis.

⁴ Feed disappearance, % is the percentage of total feed intake for each treatment within a comparison.

⁵ Comparison 1 to 4 were utilized in the first (d 17 to 22 after weaning) and second (d 22 to 27 after weaning) set of 60 pigs. Comparisons were randomly assigned to 12 pens within a trial for a total of 6 replications per comparison.

⁶ Comparisons 5 and 6 were utilized in the third (d 27 to 32 after weaning) set of 60 pigs. Comparisons were randomly assigned to 12 pens for a total of 6 replications per comparison.