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Abstract

A total of 1,076 pigs (PIC 337 Ã— C22, initially 87.4 lb) were used to determine the effect of a commercial enzyme product on the growth performance of pig fed diets containing dried distillers grains with solubles (DDGS). Pigs were randomly allotted to 1 of 3 treatments balanced by average initial BW within gender. There were 13 replicate pens (7 barrow and 6 gilt pens) per treatment. Treatments included: (1) diet with 3% added fat (control); (2) diet supplemented with enzyme with only 2% added fat but formulated to have an energy content equal to that of the control diet on the basis of calculated increased ME from the enzyme (Nutrase; Nutrex, Lille, Belgium); and (3) diet with 2% added fat without enzyme formulated using the same energy values for the control diet (low energy). Diets were corn-soybean meal-based, contained DDGS, and were fed in 3 phases (87 to 130 lb, 130 to 185 lb, and 185 to 210 lb BW for Phases 1, 2, and 3, respectively). Thirty percent DDGS was included in diets from 87 to 185 lb, and 15% DDGS was included in the last phase from 187 to 210 lb. The control and Nutrase dietary treatments were balanced to a constant lysine:calorie ratio at 2.69, 2.29, and 1.97 g/Mcal ME for Phases 1, 2, and 3, respectively, whereas the low energy dietary treatment had calculated lysine:calorie ratios of 2.73, 2.32, and 2.00 g/Mcal ME for Phases 1, 2, and 3, respectively. There were no treatment Ã— gender interactions (P > 0.25) observed for any response criteria evaluated. The expected differences (P > 0.03) in growth performance between barrows and gilts were observed in all periods and overall. Barrows had greater ADG, ADFI, and final weight but poorer F/G compared with gilts. Except for the poorer F/G (P < 0.01) of pigs fed the enzyme treatment compared with pigs fed diets without enzyme from d 0 to 28, there were no differences among treatments for ADG (P > 0.70), ADFI (P > 0.77), and F/G (P > 0.66) at any of the periods or for the overall study. In conclusion, under the conditions of the present experiment, the commercial enzyme used at the manufacturerâ€™s recommended level did not affect growth performance of growing pigs fed diets containing DDGS.; Swine Day, Manhattan, KS, November 19, 2009

Keywords

Swine day, 2009; Kansas Agricultural Experiment Station contribution; no. 10-014-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1020; Dried distillers grains with solubles; Enzyme; Swine

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Effect of a Commercial Enzyme (Nutrase) on Growth Performance of Growing Pigs Fed Diets Containing Dried Distillers Grains with Solubles[1]

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Summary

A total of 1,076 pigs (PIC 337 × C22, initially 87.4 lb) were used to determine the effect of a commercial enzyme product on the growth performance of pig fed diets containing dried distillers grains with solubles (DDGS). Pigs were randomly allotted to 1 of 3 treatments balanced by average initial BW within gender. There were 13 replicate pens (7 barrow and 6 gilt pens) per treatment. Treatments included: (1) diet with 3% added fat (control); (2) diet supplemented with enzyme with only 2% added fat but formulated to have an energy content equal to that of the control diet on the basis of calculated increased ME from the enzyme (Nutrase; Nutrex, Lille, Belgium); and (3) diet with 2% added fat without enzyme formulated using the same energy values for the control diet (low energy). Diets were corn-soybean meal-based, contained DDGS, and were fed in 3 phases (87 to 130 lb, 130 to 185 lb, and 185 to 210 lb BW for Phases 1, 2, and 3, respectively). Thirty percent DDGS was included in diets from 87 to 185 lb, and 15% DDGS was included in the last phase from 187 to 210 lb. The control and Nutrase dietary treatments were balanced to a constant lysine:calorie ratio at 2.69, 2.29, and 1.97 g/Mcal ME for Phases 1, 2, and 3, respectively, whereas the low energy dietary treatment had calculated lysine:calorie ratios of 2.73, 2.32, and 2.00 g/Mcal ME for Phases 1, 2, and 3, respectively. There were no treatment × gender interactions ($P > 0.25$) observed for any response criteria evaluated. The expected differences ($P > 0.03$) in growth performance between barrows and gilts were observed in all periods and overall. Barrows had greater ADG, ADFI, and final weight but poorer F/G compared with gilts. Except for the poorer F/G ($P < 0.01$) of pigs fed the enzyme treatment compared with pigs fed diets without enzyme from d 0 to 28, there were no differences among treatments for ADG ($P > 0.70$), ADFI ($P > 0.77$), and F/G ($P > 0.66$) at any of the periods or for the overall study. In conclusion, under the conditions of the present experiment, the commercial enzyme used at the manufacturer's recommended level did not affect growth performance of growing pigs fed diets containing DDGS.

Key words: dried distillers grains with solubles, enzyme

Introduction

A considerable number of studies have shown that dried distillers grains with solubles (DDGS) can be a suitable replacement for a portion of the corn and soybean meal commonly used in swine diets. Adding up to 30% DDGS in nursery and grow-finish

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diets can result in growth performance similar to that of pigs fed corn-soybean meal-based diets. However, DDGS inclusion levels greater than 30% can have negative effects on both performance and carcass quality[3]. One factor that limits the use of DDGS in swine diets is its high fiber content. High-fiber feedstuffs such as DDGS contain non-starch polysaccharides (NSP), which are referred to as anti-nutritional factors because of their negative effects on the digestibility of energy and other nutrients such as amino acids.

Because pigs lack the enzymes to break down NSP, the use of exogenous enzymes to maximize nutrient utilization from high-fiber feedstuffs has been evaluated in numerous studies, mostly in diets containing wheat or barley, with mixed results. The inconsistent results obtained from these trials may be due to a number of factors including the substrate present in the ingredient and the use of appropriate enzymes. Enzymes are known to act on specific substrates. In theory, there should be enough substrate for the specific enzyme used to achieve a measurable response. Corn DDGS, for example, has been found to contain appreciable amounts of arabinoxylans, a major NSP found in most grains. Thus, an enzyme containing xylanase activity that can break down arabinoxylans may aid in improving the digestibility of nutrients in corn DDGS. Available energy also can be potentially increased with enzyme supplementation. Thus, energy source ingredients such as added fat can be reduced in the diets and still meet the targeted energy level of the diet because of the expected uplift in energy value resulting from the addition of enzyme. This also can have a significant impact on economics by reducing the overall diet cost. Therefore, we conducted this study to determine the energy replacement value and effect of a commercial enzyme product containing bacterial endo-1,4-beta-xylanase on the growth performance of growing pigs fed diets containing DDGS.

Procedures

Procedures used in this experiment were approved by the Kansas State University Institutional Animal Care and Use Committee. The trial was conducted in a commercial swine research facility in southwestern Minnesota. The barns were naturally ventilated and double curtain sided. Pens were 18 × 10 ft with completely slatted flooring and deep pits for manure storage. Each pen was equipped with a self-feeder and a cup waterer. The barn had an automated feeding system (FeedPro; Feedlogic Corp., Willmar, MN) capable of delivering and recording feed amounts on an individual pen basis.

A total of 1,076 pigs (PIC 337 × C22), initially 87.4 lb, were randomly allotted to 1 of the 3 treatments balanced by average BW within gender. There were 27 pigs per pen and 13 replicate pens (7 barrow and 6 gilt pens) per treatment. A diet with 3% added fat (control) was formulated using NRC (1998[4]) values for ME of corn and soybean meal (1,551 and 1,533 kcal ME/lb, respectively; Tables 1 and 2). Note that for DDGS, we did not use NRC (1998) ME values to formulate the diets but rather an ME value equal to that of corn. As directed by the manufacturer of the enzyme product tested in this study, an increased ME value was calculated for corn, soybean meal, and DDGS to account for the expected increase in ME with the addition of enzyme (Table 1). This

[3] Stein, H. H., and G. C. Shurson. 2009. Board-invited review: The use and application of distillers dried grains with solubles in swine diets. J. Anim. Sci. 87(4):1292-1303.
[4] NRC. 1998. Nutrient Requirements of Swine. 10th rev. ed. Natl. Acad. Press, Washington, DC.

was based on the assumption that the addition of enzyme will increase the energy value of the ingredients. Using the calculated increased ME values, dietary fat was removed proportionately in the second dietary treatment with added enzyme (Nutrase) so that the dietary energy value was similar to the control diet. The enzyme evaluated in the experiment was a commercial product containing bacterial endo-1,4-beta-xylanase (Nutrase; Nutrex, Lille, Belgium) added at the expense of corn. A third diet similar to the Nutrase diet with 2% added fat but without added enzyme (low energy) was formulated on the basis of the ME values used in the control diets. Thus, the calculated dietary energy content was lower than that of the control and Nutrase diets (Table 2). Diets were corn-soybean meal-based, contained DDGS, and were fed in 3 phases (87 to 130 lb, 130 to 185 lb, and 185 to 210 lb BW for Phases 1, 2, and 3, respectively). Thirty percent DDGS was included in diets from 87 to 185 lb, and 15% DDGS was included in the last phase from 187 to 210 lb. The control and Nutrase dietary treatments were balanced to a constant lysine:calorie ratio at 2.69, 2.29, and 1.97 g/Mcal ME for Phases 1, 2, and 3, respectively, whereas the low energy dietary treatment had calculated lysine:calorie ratios of 2.73, 2.32, and 2.00 g/Mcal ME for Phases 1, 2, and 3, respectively.

Pigs from each pen were weighed as a group every 2 wk to determine ADG. Feed delivery data generated through the automated feeding system every weigh day were used to calculate feed consumption per pen and determine ADFI and F/G.

Statistical analysis was performed by analysis of variance with the MIXED procedure of SAS (SAS Institute, Inc., Cary, NC). Data were analyzed as a completely randomized design with pen as the experimental unit. The main effects of dietary treatment and gender as well as their interactions were tested.

Results and Discussion

There were no treatment × gender interactions ($P > 0.25$) observed for any criteria evaluated at any time during the experiment. The expected differences ($P > 0.03$) between genders were observed in all periods and overall as barrows exhibited greater ADG, ADFI, and final weight but poorer F/G than gilts (Table 3).

With the exception of poorer F/G ($P < 0.01$) from d 0 to 28 of pigs fed the enzyme treatment compared with pigs fed diets without enzyme, there were no differences for ADG ($P > 0.70$), ADFI ($P > 0.77$), and F/G ($P > 0.66$) in all periods or the overall study. It is not clear what contributed to the poor F/G of pigs fed the enzyme treatment during the first period. We believe this may have been due to random variability. We were also unable to detect a significant improvement in F/G in pigs fed the 3% added fat diets compared with pigs fed 2% added fat. Thus, even though pigs fed diets with enzyme performed similarly to pigs fed the basal diets, we were unable to conclude that the addition of enzyme was able to increase the energy value of the diets because pigs fed the low energy diets also performed similarly to the control pigs.

The absence of an enzyme effect on growth performance of growing pigs relative to pigs fed the low energy diets in this experiment is similar to results we observed in our previous studies with different enzyme products. In the past, we performed several experiments that used combinations of enzymes in an attempt to improve the nutritional

value of corn-soybean meal-based diets with added DDGS. We did not observe a positive response in pig performance in these previous studies. A number of other researchers have suggested that other factors can contribute to the effect of enzymes, such as enzyme dose and amount of substrate in the actual diet. It is worth mentioning that before conducting the trial, corn DDGS samples used in diets from a previous enzyme experiment were analyzed to quantify the arabinoxylan content. These samples were obtained from the same source as the DDGS used for the present trial. Results of the analysis showed that corn DDGS contains a considerable amount of total arabinoxylans (11.1% of DM). Theoretically, because an enzyme product with xylanase activity was used, an improvement in the nutrient value of the DDGS used in this trial and, consequently, an improvement in growth performance should be possible. However, this was not the case in the present study, even at the manufacturer's recommended usage level of the enzyme product. Therefore, under the conditions of the present experiment, we conclude that the enzyme product used did not affect growth performance of growing pigs fed diets containing DDGS.

Table 1. Metabolizeable energy values used for diet formulation

Ingredient	Control[1]	Nutrase[2]
Corn	1,551	1,576
Soybean meal	1,533	1,546
Dried distillers grains with solubles	1,551	1,576

[1] Based on NRC (1998) values, except for DDGS, which was assigned an ME value equal to corn NRC (1998) value.
[2] Calculated uplift values for ME when enzyme was added as recommended by the manufacturer based on arabinoxylan content.

Table 2. Diet composition (as-fed basis)[1,2]

	Phase 1		Phase 2		Phase 3	
Ingredient, %	Control	Low energy	Control	Low energy	Control	Low energy
Corn	49.42	50.60	53.82	55.00	70.47	71.60
Soybean meal (46.5% CP)	15.60	15.50	11.22	11.15	9.72	9.65
Dried distillers grains with solubles	30.00	30.00	30.00	30.00	15.00	15.00
Choice white grease	3.00	1.92	3.00	1.92	3.00	1.92
Limestone	1.08	1.08	1.10	1.10	1.00	1.00
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin and trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
Phytase[3]	0.0075	0.0075	0.006	0.006	0.0125	0.0125
L-lysine HCl	0.45	0.45	0.40	0.40	0.35	0.35
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
Standardized ileal digestible (SID) amino acids, %						
Lysine	0.94	0.94	0.80	0.80	0.69	0.69
Isoleucine:lysine ratio	69	69	72	72	68	69
Leucine:lysine ratio	186	187	206	207	196	198
Methionine:lysine ratio	33	33	36	36	34	34
Met & Cys:lysine ratio	66	66	73	73	70	70
Threonine:lysine ratio	63	63	67	67	63	63
Tryptophan:lysine ratio	17	17	17	17	17	17
Valine:lysine ratio	83	83	89	89	85	85
Total lysine, %	1.10	1.10	0.95	0.95	0.80	0.80
MD, kcal/lb	1,586	1,564	1,587	1,565	1,589	1,566
SID lysine:ME ratio, g/Mcal	2.69	2.73	2.29	2.32	1.97	2.00
Ca, %	0.49	0.49	0.48	0.48	0.44	0.44
P, %	0.46	0.46	0.44	0.44	0.37	0.37
Available P, %	0.29	0.29	0.27	0.27	0.23	0.23

[1] Phases 1, 2, and 3 fed from approximately 87 to 130 lb, 130 to 185 lb, and 185 to 210 lb BW, respectively.
[2] A commercial enzyme product containing bacterial endo-1,4-beta-xylanase (Nutrase) replaced corn in the low energy diet at 0.25 lb/ton to make the third dietary treatment.
[3] OptiPhos 2000 (Enzyvia LLC, Sheridan, IN); provided 136, 109, and 227 phytase units per pound of diet in Phases 1, 2, and 3, respectively.

Table 3. Effect of a commercial enzyme product and gender on performance of growing pigs[1,2]

	Treatment				Gender			Probability, $P <$ [3]	
Item	Low control	High control	Enzyme	SEM	Barrows	Gilts	SEM	Treatment	Gender
Weight									
d 0	87.2	87.6	87.3	2.08	87.8	86.9	1.76	0.99	0.71
d 28	138.0	138.6	137.6	2.65	139.6	136.5	2.25	0.97	0.33
d 66	209.8	210.2	208.0	3.25	213.9	204.8	2.75	0.88	0.02
d 0 to 28									
ADG, lb	1.81	1.82	1.79	0.031	1.85	1.77	0.026	0.80	0.03
ADFI, lb	3.89	3.88	3.96	0.081	4.05	3.77	0.069	0.77	0.01
F/G	2.15[a]	2.13[a]	2.21[b]	0.017	2.19	2.13	0.014	0.01	0.003
d 28 to 66									
ADG, lb	1.83	1.79	1.81	0.032	1.87	1.75	0.027	0.70	0.001
ADFI, lb	5.25	5.19	5.18	0.084	5.50	4.91	0.072	0.82	<0.0001
F/G	2.87	2.90	2.86	0.037	2.94	2.81	0.031	0.66	0.01
d 0 to 66									
ADG, lb	1.82	1.80	1.80	0.026	1.86	1.76	0.022	0.86	0.001
ADFI, lb	4.66	4.62	4.65	0.075	4.87	4.42	0.064	0.93	<0.0001
F/G	2.56	2.56	2.58	0.021	2.62	2.52	0.018	0.88	0.0003

[1] A total of 1,076 pigs (PIC 337 × C22, initially 87.4 lb) were used with 27 pigs per pen and 13 replications per treatment.
[2] Bacterial endo-1,4-beta-xylanase (Nutrase; Nutrex, Lille, Belgium).
[3] Treatment × gender interactions for all criteria were not significant ($P > 0.05$).
[ab] Within a row, means without a common superscript differ ($P < 0.05$).