Effects of a Novel Protease Enzyme (CIBENZA DP100) on Finishing Pig Growth Performance and Carcass Characteristics[1]

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Summary

A total of 1,170 pigs (PIC 337 × 1050; initial BW 56.3 lb) were used in a 131-d study to determine the effects of a protease enzyme on growth performance and carcass characteristics of finishing pigs. Dietary treatments consisted of: (1) a positive control diet formulated to provide 90% of the standardized ileal digestible (SID) lysine requirement for these pigs; (2) a negative control diet formulated to provide 90% of the SID lysine requirement minus the expected nutrient release (both amino acids and dietary energy) from the protease enzyme (CIBENZA DP100, Novus International, Inc., St. Charles, MO), and (3) the negative control diet with the addition of 0.05% CIBENZA DP100. The diets were formulated such that the negative control diet containing the protease enzyme had calculated nutrient concentrations similar to the positive control. Pens of pigs were randomly allotted to 1 of 3 treatments with 26 pigs per pen and 15 replicates per treatment.

Overall (d 0 to 131), pigs fed the positive control diet had increased ($P < 0.05$) ADG compared with pigs fed the negative control diet. Pigs fed the negative control diet plus CIBENZA DP100 had improved ($P < 0.05$) ADFI and a tendency for improved ($P = 0.09$) ADG compared with pigs fed the negative control diet without the enzyme. No differences were observed in ADG, ADFI, or F/G between pigs fed the positive control diet and those fed the negative control diet plus the protease enzyme, which suggests that the release values attributed to the enzyme are accurate. The only observed effect on carcass characteristics was for yield, in which the pigs fed the negative control diet with the enzyme had lower ($P < 0.05$) carcass yield than pigs fed the negative control diet without the enzyme.

Although differences did exist in feed cost per pig and feed cost per pound of gain, no differences were observed for income over feed cost (IOFC) between treatments. These data suggest that the protease enzyme CIBENZA DP100 will elicit improved growth performance when added to diets formulated at 90% of the pig's estimated SID lysine requirement.

Key words: finishing pig, carcass characteristics, protease enzyme

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Introduction

With ever-increasing feed prices, the swine industry continues to search for alternatives to reduce feed cost and extract more nutrients from feed ingredients. Proteases are endogenous enzymes that are required for the digestion and utilization of dietary proteins. Recently it has been suggested that supplemental protease enzymes can be added to diets to improve protein utilization. Preliminary results indicate that a new protease enzyme (CIBENZA DP100, Novus International, Inc., St. Charles, MO) may be able to increase digestibility of dietary protein and increase dietary energy utilization, consequently eliciting improved growth performance. Although research has been conducted with nursery pigs, none is available to verify this response in finishing pigs housed in commercial research facilities.

Therefore, the objective of this study was to determine if the addition of CIBENZA DP100 could improve growth performance, carcass characteristics, and economic return of finishing pigs housed in a commercial setting.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at a commercial research-finishing site in southwest Minnesota. The barn was naturally ventilated and double-curtain-sided. Each pen was equipped with a 5-hole stainless steel feeder and bowl waterer for ad libitum access to feed and water. Feed additions to each individual pen were made and recorded by a robotic feeding system (FeedPro; Feedlogic Corp., Wilmar, MN).

A total of 1,170 mixed sex pigs (PIC 337 × 1050; initial BW 56.3 lb) were used in a 131-d study. Pens were blocked by BW and were randomly assigned to diets with 15 pens per treatment and 26 pigs per pen. Dietary treatments consisted of: (1) a positive control diet formulated to provide 90% of the standardized ileal digestible (SID) lysine requirement for these pigs; (2) a negative control diet formulated to provide 90% of the SID lysine requirement minus the expected nutrient release (both amino acids and dietary energy) from the protease enzyme (CIBENZA DP100), and (3) the negative control diet with the addition of 0.05% CIBENZA DP100 (Tables 1 and 2). The diets were formulated such that the negative control diet containing the protease enzyme had calculated nutrient concentrations similar to the positive control. Samples of the complete feed were taken from the feeder at the beginning and end of each phase and proximate analysis was conducted (Ward Laboratories, Inc., Kearney, NE) on each diet (Tables 3 and 4).

Pens of pigs were weighed and feeder measurements were recorded on d 0, 12, 26, 45, 63, 81, 94, 108, and 131 to calculate ADG, ADFI, F/G, and caloric efficiency. On d 108, the 3 heaviest pigs in each pen were weighed and sold according to standard farm procedures. Prior to marketing, the remaining pigs were individually tattooed with a pen ID number to allow for carcass measurements to be recorded on a pen basis. On d 131, final pen weights were taken, and pigs were transported to a commercial packing plant (JBS Swift and Company, Worthington, MN) for processing and carcass data collection. Carcass measurements taken at the plant included HCW, loin depth, backfat, and percentage lean. Percentage carcass yield was also calculated by dividing the individual HCW at the plant by the pig's pen average final live weight at the farm.

An economic analysis was completed at the conclusion of the trial to determine the financial impact of the protease addition. The total feed cost per pig was calculated by multiplying the ADFI by the feed cost per pound and the number of days in each respective period, then taking the sum of those values for each period. Cost per pound of gain was calculated by dividing the total feed cost per pig by the total pounds gained overall. Value of the gain was calculated by multiplying the final live weight by an assumed live value of $78.00/cwt then subtracting an initial pig cost, which was determined by multiplying the initial weight by an assumed cost of $78.00/cwt. To calculate income over feed cost (IOFC), total feed cost was subtracted from the value of the gain.

The experimental data were analyzed as a randomized complete block design using the MIXED procedure of SAS (SAS Institute, Cary, NC) with pen as the experimental unit and initial BW as a blocking factor. Hot carcass weight served as a covariate for the analysis of backfat, loin depth, and lean percentage. LSMEANS was used to analyze the data, with $P \leq 0.05$ being a significant difference and a tendency being recorded between $P > 0.05$ and $P \leq 0.10$.

Results and Discussion

Analysis of diets revealed that nutrients were similar to calculated values considering normal analytical variation (Tables 3 and 4).

Overall (d 0 to 131), pigs fed the positive control diet had increased ($P < 0.05$) ADG compared with pigs fed the negative control diet, which illustrates that we were, in fact, below the estimated SID lysine requirement of the pigs (Table 4). Pigs fed the negative control diet plus CIBENZA DP100 had increased ($P < 0.05$) ADFI, which led to a tendency for improved ($P < 0.10$) ADG compared with pigs fed the negative control diet without the enzyme (Table 5). Final BW was greater ($P < 0.05$) for pigs fed the positive control diet compared with those fed the negative control diet, with the pigs fed the negative control diet plus enzyme being intermediate. Overall feed and caloric efficiency were unaffected by treatments. The only impact on carcass characteristics that was observed was for yield, in which the pigs fed the negative control diet with the enzyme had lower ($P < 0.05$) yield than pigs fed the negative control diet without the enzyme.

Total feed cost per pig and feed cost per pound of gain were lower ($P < 0.05$) for pigs fed the negative control diet compared to either of the other treatments. Gain value was higher ($P < 0.05$) for pigs fed the positive control diet than for pigs fed the negative control diet, with pigs fed the negative control diet with enzyme being intermediate. No differences were observed between treatments for IOFC.

In summary, our data confirm the importance of not under-formulating the dietary SID lysine level if maximum growth performance is desired. The addition of CIBENZA DP100 to a nutrient deficient diet increased ADFI and tended to increase ADG, which supports the hypothesis that the enzyme allowed for better nutrient utilization. Additional research should be conducted to determine if a similar improvement in growth performance will be observed when pigs are fed diets formulated closer to their nutrient requirement estimates.

Table 1. Phase 1, 2, and 3 diet composition (as-fed basis)[1]

	Phase 1			Phase 2			Phase 3		
Item	PC[2]	NC+DP100	NC	PC	NC+DP100	NC	PC	NC+DP100	NC
Ingredient, %									
Corn	45.22	49.91	49.96	49.38	52.20	52.25	52.33	55.01	55.06
Soybean meal, (46.5% CP)	19.58	15.50	15.50	15.49	13.30	13.30	12.61	10.50	10.50
DDGS[3]	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Beef tallow	3.00	2.20	2.20	3.00	2.25	2.25	3.00	2.30	2.30
Limestone	1.40	1.40	1.40	1.35	1.35	1.35	1.30	1.30	1.30
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
L-threonine	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
L-lysine sulfate[4]	0.26	0.34	0.34	0.24	0.27	0.27	0.23	0.25	0.25
Dicalcium P (18% P)	0.00	0.05	0.05	0.00	0.05	0.05	0.00	0.05	0.05
Phytase[5]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vitamin premix	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Enzyme[6]	0.00	0.05	0.00	0.00	0.05	0.00	0.00	0.05	0.00
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

continued

Table 1. Phase 1, 2, and 3 diet composition (as-fed basis)[1]

	Phase 1			Phase 2			Phase 3		
Item	PC[2]	NC+DP100	NC	PC	NC+DP100	NC	PC	NC+DP100	NC
Calculated analysis									
Standard ileal digestible (SID) amino acids, %									
Lysine	0.99	0.99	0.95	0.76	0.75	0.74	0.77	0.77	0.76
Isoleucine:lysine	0.74	0.71	0.70	1.97	1.97	2.00	2.09	2.09	2.12
Leucine:lysine	1.84	1.80	1.83	0.35	0.35	0.35	0.37	0.37	0.37
Methionine:lysine	0.33	0.32	0.32	0.67	0.67	0.67	0.70	0.71	0.71
Met & Cys:lysine	0.63	0.62	0.62	0.69	0.71	0.68	0.71	0.73	0.70
Threonine:lysine	0.66	0.67	0.64	0.19	0.18	0.18	0.18	0.18	0.18
Tryptophan:lysine	0.19	0.17	0.17	0.85	0.87	0.84	0.88	0.90	0.87
Valine:lysine	0.81	0.81	0.78	0.74	0.76	0.70	0.69	0.71	0.66
SID lysine:ME, g/Mcal	2.90	2.91	2.82	2.55	2.56	2.48	2.31	2.32	2.23
ME, kcal/lb	1542	1543	1529	1545	1545	1544	1547	1546	1534
CP, %	22.2	21.6	20.8	20.5	20.4	19.7	19.3	19.2	18.5
Ca, %	0.60	0.60	0.60	0.57	0.58	0.58	0.54	0.55	0.55
P, %	0.47	0.47	0.47	0.45	0.45	0.46	0.44	0.44	0.44
Available P, %	0.31	0.31	0.21	0.20	0.21	0.21	0.30	0.31	0.31
Standard digestible P, %	0.30	0.30	0.30	0.30	0.30	0.30	0.29	0.30	0.30

[1] Phase 1, 2, and 3 diets were fed from d 0 to 26, d 26 to 45, and d 45 to 63, respectively.
[2] Treatments were designed as follows: PC (positive control) = 90% of SID lysine requirement of pigs in each phase; NC + DP100 = negative control plus nutrient release expected from CIBENZA DP100 to meet the nutrient contribution of the positive control; and negative control.
[3] Dried distillers grains with solubles.
[4] L-lysine sulfate provided by Biolys (Evonik Corporation, Kennesaw, GA).
[5] Optiphos 2000 (Enzyvia LLC, Sheridan, IN) provided 227 phytase units (FTU)/lb, with a release of 0.07% available P.
[6] CIBENZA DP100 (Novus International, St. Charles, MO).

Table 2. Phase 4 and 5 diet composition (as-fed basis)[1]

	Phase 4			Phase 5		
Item	PC[2]	NC+DP100	NC	PC	NC+DP100	NC
Ingredient, %						
Corn	55.22	57.07	57.12	58.14	59.74	59.79
Soybean meal, (46.5% CP)	9.78	8.50	8.50	6.88	5.80	5.80
DDGS[3]	30.00	30.00	30.00	30.00	30.00	30.00
Beef tallow	3.00	2.35	2.35	3.00	2.40	2.40
Limestone	1.25	1.25	1.25	1.25	1.25	1.25
Salt	0.35	0.35	0.35	0.35	0.35	0.35
L-threonine	0.00	0.00	0.00	0.00	0.00	0.00
L-lysine sulfate[4]	0.21	0.22	0.22	0.20	0.20	0.20
Dicalcium P, (18% P)	0.00	0.03	0.03	0.00	0.03	0.03
Phytase[5]	0.01	0.01	0.01	0.01	0.01	0.01
Vitamin premix	0.08	0.08	0.08	0.08	0.08	0.08
Trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
Enzyme[6]	0.00	0.05	0.00	0.00	0.05	0.00
Total	100.0	100.0	100.0	100.0	100.0	100.0
Calculated analysis						
Standard ileal digestible (SID) amino acids, %						
Lysine	0.71	0.71	0.68	0.62	0.62	0.59
Isoleucine:lysine	0.79	0.80	0.80	0.82	0.83	0.83
Leucine:lysine	2.24	2.25	2.29	2.43	2.45	2.51
Methionine:lysine	0.39	0.40	0.40	0.42	0.43	0.44
Met & Cys:lysine	0.75	0.76	0.76	0.80	0.82	0.82
Threonine:lysine	0.73	0.77	0.74	0.77	0.81	0.78
Tryptophan:lysine	0.18	0.18	0.18	0.18	0.18	0.18
Valine:lysine	0.91	0.96	0.93	0.96	1.02	0.98
SID lysine:ME, g/Mcal	2.06	2.08	2.00	1.82	1.83	1.75
ME, kcal/lb	1549	1548	1536	1550	1549	1539
CP, %	18.2	18.3	17.7	17.0	17.2	16.6
Ca, %	0.52	0.52	0.52	0.51	0.51	0.51
P, %	0.43	0.43	0.43	0.42	0.42	0.42
Available P, %	0.29	0.30	0.30	0.29	0.30	0.30
Standard digestible P, %	0.29	0.29	0.29	0.28	0.29	0.29

[1] Phase 4 and 5 diets were fed from d 63 to 94 and d 94 to 131, respectively.
[2] Treatments were designed as follows: PC (positive control) = 90% of SID lysine requirement of pigs in each phase; NC + DP100 = negative control plus nutrient release expected from CIBENZA DP100 to meet the nutrient contribution of the positive control; and negative control.
[3] Dried distillers grains with solubles.
[4] L-lysine sulfate provided by Biolys (Evonik Corporation, Kennesaw, GA).
[5] Optiphos 2000 (Enzyvia LLC, Sheridan, IN) provided 227 phytase units (FTU)/lb, with a release of 0.07% available P.
[6] CIBENZA DP100 (Novus International, St. Charles, MO).

Table 3. Proximate analysis of diets (as-fed basis)[1]

	Phase 1[2]			Phase 2[2]			Phase 3[2]		
Item, %[3]	PC	NC+DP100	NC	PC	NC+DP100	NC	PC	NC+DP100	NC
DM	89.32	89.20	89.25	88.31	88.63	88.19	88.80	88.80	88.53
CP	20.5	19.2	20.2	19.6	18.3	16.9	18.9	18.2	17.9
ADF	4.9	5.2	5.1	4.3	4.6	4.4	5.2	4.8	5.4
NDF	11.7	12.0	12.7	12.5	12.0	11.8	13.3	12.1	12.4
Crude fiber	3.6	3.6	3.6	3.4	3.2	2.9	3.8	3.4	3.8
Nitrogen Free Extract	54.2	55.7	54.2	55.1	56.8	58.8	54.5	56.3	56.3
Fat	6.5	6.0	6.3	5.8	5.4	4.9	7.1	6.4	6.4
Ash	4.22	4.15	4.41	4.42	4.37	4.07	4.10	4.11	3.64

[1] Phase 1, 2, and 3 diets were fed from d 0 to 26, d 26 to 45, d 45 to 63, respectively.
[2] PC = positive control, NC + DP100 = negative control with the addition of CIBENZA DP100, NC = negative control.
[3] Values represent the mean of samples collected from feeders, then pooled and subsampled, and one composite sample of each diet was finally analyzed.

Table 4. Proximate analysis of diets (as-fed basis)[1]

	Phase 4[2]			Phase 5[2]		
Item, %[3]	PC	NC+DP100	NC	PC	NC+DP100	NC
DM	89.11	89.07	89.16	89.06	88.78	89.00
CP	17.8	17.6	17.2	17.3	17.3	16.7
ADF	4.9	5.1	5.5	5.7	5.4	5.1
NDF	11.6	12.1	13.5	13.2	11.7	12.8
Crude Fiber	4.0	4.3	3.9	3.5	3.0	3.4
Nitrogen Free Extract	53.4	55.7	55.7	56.7	56.2	57.6
Fat	9.6	7.9	7.9	6.9	6.7	6.8
Ash	4.40	3.84	3.95	3.65	4.25	3.78

[1] Phase 4 and 5 diets were fed from d 63 to 94 and d 94 to 131, respectively.
[2] PC = positive control, NC + DP100 = negative control with the addition of CIBENZA DP100, NC = negative control.
[3] Values represent the mean of samples collected from feeders, then pooled and subsampled, and one composite sample of each diet was finally analyzed.

Table 5. The effects of CIBENZA DP100 on finishing pig growth performance[1,2]

					Probability, $P <$			
Item	PC[3]	NC+DP100	NC	SEM	Treatment	PC vs. DP100	PC vs. NC	NC vs. DP100
BW, lb								
d 0	56.3	56.3	56.2	1.052	0.988	0.961	0.882	0.921
d 131	294.0	292.3	287.0	2.763	0.090	0.598	0.036	0.107
d 0 to 131								
ADG, lb	1.83	1.82	1.79	0.014	0.074	0.612	0.031	0.088
ADFI, lb	4.82	4.87	4.73	0.046	0.090	0.391	0.172	0.031
F:G	2.63	2.67	2.65	0.048	0.478	0.228	0.549	0.537
Caloric efficiency								
ME	4,979	4,976	4,961	52.485	0.968	0.973	0.812	0.838
Carcass characteristics								
HCW, lb	216.9	214.8	213.45	1.991	0.277	0.330	0.115	0.530
Yield, %	73.8	73.5	74.4	0.258	0.052	0.420	0.101	0.018
Backfat, in.[4]	0.76	0.75	0.75	0.012	0.796	0.751	0.504	0.718
Loin depth, in.[4]	2.63	2.65	2.63	0.035	0.849	0.608	0.961	0.642
Lean, %[4]	55.1	55.3	55.3	0.260	0.859	0.664	0.612	0.937
Economics, $/pig								
Feed cost[5]	63.89	63.42	60.34	0.608	0.001	0.531	0.001	0.001
Feed cost/lb gain	0.266	0.266	0.258	0.002	0.022	0.854	0.013	0.012
Gain value[6]	185.39	184.07	179.95	1.740	0.088	0.597	0.036	0.105
IOFC	121.49	120.65	119.61	1.491	0.675	0.692	0.380	0.628

[1] A total of 1,170 (PIC 337 × 1050) were used with 26 pigs per pen and 15 replications per treatment.
[2] Treatments were designed as follows: Positive control = 90% of SID lysine requirement of pigs in each phase; negative control + DP100 = negative control plus nutrient release expected from CIBENZA DP100 to meet the nutrient contribution of the positive control; and negative control.
[3] PC = positive control, NC + DP100 = negative control with the addition of CIBENZA DP100, NC = negative control.
[4] HCW was used as a covariate.
[5] Corn was valued at $4.17/bushel, soybean meal at $457.64/ton, DDGS at $146.25/ton, beef tallow at $0.32/lb, and CIBENZA DP100 at $4.92/lb.
[6] Gain value was calculated using (Final wt. x $78.00/cwt) – (initial wt. × $78.00/cwt).