Maximizing DDGS for Finishing Pigs in Bedded Hoop Barns

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Summary and Implications

Higher prices for corn and increasing supplies of DDGS have generated questions about feeding DDGS to market swine. The objective of this study was to evaluate various programs to maximize DDGS feeding to finishing pigs in bedded hoop barns. The project was conducted during 2008 and 2009 at the ISU Western Research Farm, Castana, IA. The pens were in small hoop barns with two pens per barn. Each pen was assigned to one of three dietary treatments—continuous 20% DDGS (Cont), a step-up program from 0% to 30% DDGS (Step), and a high DDGS program that rapidly got pigs to 30% DDGS (High). All treatments were fed a 20% DDGS diet for the last phase of the trial. There were 4 dietary phases in the 98-day trial. Phase 1 and 4 were each 21d. Phase 2 and 3 were each 28d. The diets were pelletted and fed ad libitum. Within each phase, the diets were formulated to be equal in apparent digestible amino acids—lysine, threonine, and tryptophan.

The pigs consumed the diets readily with no apparent problems making the transition among the diets. Feed intake (ADFI), growth (ADG), and feed per liveweight gain (F/G) did not differ among treatments ($P > 0.05$). No major differences were noted in backfat thickness (BF) and loin muscle area (LMA) ($P > 0.05$). Also, based on the means of fatty acid saturation, iodine values, and belly flop scores of selected pigs in trial (one, two or three), the differences in unsaturation percentages, iodine value and belly flop scores between treatments were minor.

On average, a pig fed the continuous program consumed 119 lb of DDGS or 20% of the total feed over the 98-day feeding trial (from 54 to 274 lb). A pig fed the Step-up program consumed 106 lb of DDGS or 17% of the total feed. A pig fed the High program consumed 162 lb of DDGS or 26% of the total feed. This work suggests that diets and feeding programs can be designed to increase DDGS usage by market swine without negatively affecting pig performance. Also formulating diets on apparent digestible amino acid content may be advantageous when using DDGS on swine diets. The pelleted diets worked well with no problems in feed flow or fines separation.

Introduction

Iowa's ethanol industry continues to expand rapidly. A major coproduct of ethanol production is dried distillers grains with solubles (DDGS). Higher prices for corn and increasing supplies of DDGS have generated questions about feeding DDGS to market swine. The objective of this study was to evaluate various programs to maximize DDGS feeding to finishing pigs in bedded hoop barns.

Materials and Methods

For each trial, crossbred finishing pigs (n = 60) were allocated to six pens with five barrows and five gilts per pen (54.4 lb avg. weight). The project consisted of three identical sequential trials beginning in April 2008. The project was conducted during 2008 and 2009 at the ISU Western Research Farm, Castana, IA. The pens were in small hoop barns with two pens per barn. Each pen had a self-feeder and an automatic waterer and was bedded with straw. The pigs were from the ISU Swine Nutrition Farm, Ames, IA and were the progeny of white sows crossed with Duroc terminal boars.

Each pen was assigned to one of three dietary treatments—continuous 20% DDGS (Cont), a step-up program from 0% to 30% DDGS (Step), and a high DDGS program that rapidly got pigs to 30% DDGS (High) (Table 1). All treatments were fed a 20% DDGS diet for the last phase of the trial. There were 4 dietary phases in the 98-day trial (Table 2). Phase 1 and 4 were each 21d. Phase 2 and 3 were each 28d. The diets were pelletted and fed ad libitum. Within each phase, the diets were formulated to be equal in apparent digestible amino acids—lysine, threonine, and tryptophan (Table 3). Diets were supplied by Arcadia Co-op, Arcadia, IA, using DDGS from the Amaizing Energy ethanol plant, Denison, IA. Diets for each phase were manufactured and delivered simultaneously at the beginning of each phase. DDGS values used in diet formulation were the average analysis values provided by the plant. DDGS nutrient values used were 28% CP, 0.62% total lysine, 0.29% apparent digestible lysine, 0.94% threonine, 0.25% tryptophan, 0.03% Ca, 0.52% available P, 7.0%, 9.5%, and 1,656 kcal/lb ME. All other values were from the ISU Lifecycle Swine Nutrition program. Each phase had at least 2 treatment diets in common (Table 1). The composition and calculated analysis of the diets are shown in Table 3.

The pigs were allotted to their pen and diet. The pigs were then continued in their respective pens on the assigned diets until market. Feed intake and weight gain were recorded. At the end of the trial, the pigs (avg. weight 274 lb) were scanned for backfat and loin muscle area and harvested at the Farmland plant, Denison, IA.

For the selected pigs, the bellies from 20 pigs per treatment (10 barrows and 10 gilts) were scored for belly flop and fat samples were collected for fatty acid analyses. Belly flop was a subjective score (1 – 5) given to each belly based on the handling characteristics of the belly. Belly flop is an indication of belly softness. The smaller the value, the softer the belly. Fatty acid analyses was performed on

samples of belly fat (4 pigs per treatment) using gas chromatography techniques and fatty acids were grouped as saturated (SFA), mono unsaturated (MUFA), and poly unsaturated (PUFA). Saturated fats are harder and unsaturated fats are softer and oilier. Iodine value was calculated based on the fatty acid profiles and is a measure of fat unsaturation. The higher the iodine value the softer and oilier or more unsaturated is the fat.

Results and Discussion

The pigs consumed the diets readily with no apparent problems making the transition among the diets. Results are shown in Table 4. Feed intake (ADFI), growth (ADG), and feed per liveweight gain (F/G) did not differ among treatments ($P > 0.05$). No major differences were noted in backfat thickness (BF) and loin muscle area (LMA) ($P > 0.05$).

On average, a pig fed the continuous program consumed 119 lb of DDGS or 20% of the total feed over the 98-day feeding trial (from 54 to 274 lb). A pig fed the Step-up program consumed 106 lb of DDGS or 17% of the total feed. A pig fed the High program consumed 162 lb of DDGS or 26% of the total feed. This work suggests that diets and feeding programs can be designed to increase DDGS usage by market swine without negatively affecting pig performance. Also formulating diets on apparent digestible amino acid content may be advantageous when using DDGS on swine diets. The pelleted diets worked well with no problems in feed flow or fines separation.

Based on the means of fatty acid saturation, iodine values, and belly flop scores of selected pigs in trial two (Table 5), the differences in unsaturation percentages, iodine values and belly flop scores among treatments were minor. Even though all pigs were fed the same level of DDGS during the final three weeks of the trial, the more DDGS fed during the entire feeding period the more unsaturated the fat depots became. This suggests that the pigs should have been fed the last phase longer to allow more time for the fat to become less unsaturated.

Acknowledgements

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Table 1. Percentage of DDGS in diet by phase and treatment.

	Phase			
Treatment	1	2	3	4
Cont[1]	20*	20*	20	20*
Step[2]	0	20*	30*	20*
High[3]	20*	30	30*	20*

*Within a phase or column, diets with an asterisk were identical.
[1]Cont = Every phase of treatment diets was 20% DDGS.
[2]Step = Phase 1 of the treatment diets was 0% DDGS, phases 2 and 4 were 20% DDGS, and phase 3 was 30% DDGS.
[3]High = Phases 1 and 4 of the treatment diets were 20% DDGS and phases 2 and 3 were 30% DDGS.

Table 2. Days for each dietary phase.

	Phase				
Treatment	1	2	3	4	Total
Cont[1]	21	28	28	21	98
Step[2]	21	28	28	21	98
High[3]	21	28	28	21	98

[1]Cont = Every phase of treatment diets was 20% DDGS.
[2]Step = Phase 1 of the treatment diets was 0% DDGS, phases 2 and 4 were 20% DDGS, and phase 3 was 30% DDGS.
[3]High = Phases 1 and 4 of the treatment diets were 20% DDGS and phases 2 and 3 were 30% DDGS.

Table 3. Composition and calculated analysis of diets, as-fed basis.

Phase	1	1	2	2	3	3	4
Treatment	Step[2]	Cont/High	Cont/Step	High[3]	Cont[1]	Step/High	All
Ingredient							
Corn	721.50	590.30	625.30	573.90	658.10	597.50	709.90
DDGS	0.00	200.00	200.00	300.00	200.00	300.00	200.00
SBM (hulless)	250.00	180.00	150.00	100.00	120.00	80.00	70.00
Dical phos	13.50	8.70	5.80	3.50	3.50	1.20	2.00
Limestone	8.20	11.50	11.50	13.20	12.00	13.50	11.80
Salt	3.50	3.70	3.50	3.50	3.20	3.20	3.20
LOL vit mix	1.00	1.00	0.70	0.70	0.60	0.60	0.50
LOL min mix	0.70	0.70	0.70	0.70	0.60	0.60	0.50
Lysine	1.40	3.30	2.50	4.00	2.00	3.10	2.10
Tryptophan	0.00	0.40	0.00	0.20	0.00	0.10	0.00
Threonine	0.20	0.40	0.00	0.30	0.00	0.20	0.00
	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calculated Analysis							
Cr. protein, %	18.0	19.4	18.2	18.3	17.0	17.5	15.0
Met. energy, kcal/	1502	1523	1531	1540	1536	1546	1539
Calcium, %	0.71	0.71	0.64	0.64	0.60	0.59	0.54
Total P, %	0.63	0.59	0.52	0.50	0.47	0.45	0.42
Avail P, %	0.32	0.32	0.26	0.26	0.21	0.22	0.18
Total lysine, %	1.05	1.08	0.93	0.95	0.81	0.82	0.68
App. dig. lysine	0.83	0.84	0.71	0.72	0.60	0.60	0.47
Threonine, %	0.69	0.73	0.65	0.66	0.60	0.62	0.52
App. dig. thr, %	0.51	0.51	0.44	0.44	0.40	0.40	0.34
Tryptophan, %	0.21	0.24	0.19	0.19	0.17	0.17	0.14
App. dig. trp, %	0.18	0.18	0.13	0.13	0.11	0.11	0.09

[1]Cont = Every phase of treatment diets was 20% DDGS.
[2]Step = Phase 1 of the treatment diets was 0% DDGS, phases 2 and 4 were 20% DDGS, and phase 3 was 30% DDGS.
[3]High = Phases 1 and 4 of the treatment diets were 20% DDGS and phases 2 and 3 were 30% DDGS.

Table 4. Pig performance of finishing pigs fed DDGS-based diets in bedded hoop barns.

	Cont[1]	Step[2]	High[3]	SEM	P-value
Start wt, lb	54.4	54.2	54.7	1.1	0.93
End wt, lb	275	273	275	4	0.93
ADFI, lb/d	6.19	6.32	6.31	0.07	0.35
ADG, lb/d	2.28	2.27	2.28	0.04	0.96
F/G	2.71	2.79	2.77	0.05	0.54
BF, in.[2]	0.99	0.99	1.00	0.07	0.99
LMA, sq in.	7.35	7.32	7.25	0.12	0.76
BF 250, in.	0.88	0.89	0.88	0.05	0.99
LMA 250, sq. in.	6.95	6.93	6.83	0.10	0.67
FFL, %	51.4	51.4	51.1	0.7	0.93
FFL, lb/d	0.88	0.88	0.87	0.01	0.32
Eff. of lean gain, lg feed/lb lean gain	7.02	7.22	7.23	0.11	0.32

[1]Cont = Every phase of treatment diets was 20% DDGS.
[2]Step = Phase 1 of the treatment diets was 0% DDGS, phases 2 and 4 were 20% DDGS, and phase 3 was 30% DDGS.
[3]High = Phases 1 and 4 of the treatment diets were 20% DDGS and phases 2 and 3 were 30% DDGS.

Table 5. Means of fatty acid saturation and iodine value for pigs fed DDGE-based diets in bedded hoop barns.

	Cont[1]	Step[2]	High[3]
Pigs	4	4	4
Saturated fatty acid (SFA), %	34.3	35.1	33.4
Mono unsaturated fatty acid (MUFA), %	37.9	39.0	38.6
Poly unsaturated fatty acid (PUFA), %	25.0	23.2	25.8
Total unsaturated fatty acid, %	62.9	62.2	64.4
Total fatty acid, %	97.2	97.3	97.8
Pigs	20	19	20
Iodine value	75.0	73.1	76.8
Belly flop[4]	2.2	2.5	2.3

[1]Cont = Every phase of treatment diets was 20% DDGS.
[2]Step = Phase 1 of the treatment diets was 0% DDGS, phases 2 and 4 were 20% DDGS, and phase 3 was 30% DDGS.
[3]High = Phases 1 and 4 of the treatment diets were 20% DDGS and phases 2 and 3 were 30% DDGS.
[4]Belly flop is an indication of belly softness. The smaller the value, the softer the belly.