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Abstract

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Keywords

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USE OF SORGHUM-BASED DISTILLERS GRAINS IN DIETS FOR NURSERY AND FINISHING PIGS

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Summary

Two experiments were conducted to determine the effects of sorghum-based distillers dried grains with solubles in isocaloric diets for nursery and finishing pigs. Rate and efficiency of gain in nursery pigs were decreased with 45% or more distillers grains. For finishing pigs, efficiency of gain was improved as distillers grains was increased to 60% of the diet, and carcass fatness was increased by about .1 inch at the highest concentration.

(Key Words: Distillers Grains, Nursery Pigs, Finishing, Sorghum.)

Introduction

Distillers dried grains with solubles (DDGS) are a co-product of the ethanol industry. When grain is fermented to produce ethanol, primarily the starch is utilized, leaving a protein rich residue that can be used in animal diets. As the ethanol industry grows, greater quantities of DDGS will become available for use in pig diets at potentially reasonable prices.

In a previous study (see the 1995 KSU Swine Day Report), we demonstrated that as much as 30% sorghum-based DDGS could be added to isocaloric nursery and finishing pig diets without adverse effects on growth performance. Thus, we designed the experiments reported herein to determine the effects of adding as much as 60% DDGS to pig diets.

Procedures

A total of 180 nursery pigs (average initial wt of 13 lb) was blocked by weight and used in the first experiment. Each treatment had six pigs per pen and six pens (three pens of barrows and three pens of gilts per treatment). For 7 d postweaning, all pigs were fed the same complex starter diet (pelleted form) to allow for adjustment to the nursery environment. On d 7, the pigs were changed to a corn-soybean meal-based control diet or diets with 15, 30, 45, or 60% DDGS. All diets were formulated to 1.4% lysine, .9% Ca, and .8% P (Table 1) and fed in meal form for 21 d. The ME in all diets was adjusted to the same concentration by adding tallow.

The experiment was conducted in an environmentally controlled nursery room equipped with 4-ft x 5-ft pens. Each pen had a self-feeder and nipple waterer to provide ad libitum access to feed and water. Pigs and feeders were weighed at initiation and d 21 of the growth assay to determine ADG, ADFI, and F/G. The data were analyzed as a randomized complete block design with average pig weight at d 7 used as a covariable. Polynomial regression was used to characterize the shape of the response to concentration of DDGS in the diets.

In the second experiment, 80 barrows (average initial wt of 120 lb) were used in a 56-d experiment. The pigs were allotted by weight into 40 totally slatted pens (4-ft x 4-ft) with two pigs per pen and 10 pens per treatment. Treatments were a corn-soybean meal-based control and 20, 40, and 60% DDGS

(Table 2). The diets were fed in three phases with 1.25, 1.10, and .80 % lysine for 120 to 160 lb, 160 to 220 lb, and 220 lb to market weight, respectively. Pigs were allowed ad libitum access to feed and water, and diets were fed in meal form with tallow used to equalize ME.

Weights were taken at d 0 and 56 of the experiment to determine ADG, ADFI, and F/G. When weight in the first pen of a block averaged 250 lb, the pigs were slaughtered to determine last rib backfat thickness and hot carcass weight. Dressing percentage was calculated with hot carcass weight as a percentage of preshipping live weight, and fat-free lean index was calculated using NPPC equations. The data were analyzed as a randomized complete block design with initial weight as the blocking criterion. Slaughter weight was used as a covariate for analysis of the carcass data. Polynomial regression was used to characterize the shape of the response to concentration of DDGS in the diets.

Results and Discussion

Chemical analysis of ingredients (Table 3) indicated that the compositions of corn and sorghum were similar to one another and to values published for swine by the NRC (1988). However, fermentation (to ethanol) greatly concentrates the nonstarch components of the seed (e.g., protein, fat, fiber, ash, and amino acids). Thus, we would anticipate lower metabolizable energy in DDGS (from less starch) despite their high gross energy (i.e., 2.01 Mcal/lb for DDGS versus 1.86 and 1.81 Mcal/lb for the sorghum and corn, respectively).

In the nursery experiment (Table 4), ADG was not affected and F/G was actually improved by as much as 30% DDGS (quadratic effect, $P<.03$). However, with 45 and 60% DDGS, rate and efficiency of gain were decreased . It is important to note that diets with 45 and 60% DDGS had 11 and 15% tallow, respectively, which made feed flowability a problem. Thus, whether the decreased growth performance was caused by feed restriction resulting from continual bridging in the feeders (highly likely), palatability problems (possibly), or reduced nutritional value of the diets (least likely) is not clear.

In the finishing experiment (Table 5), ADG increased slightly (quadratic effect, $P<.01$). ADFI decreased (linear effect, $P<.003$) and F/G was improved (linear effect, $P<.001$) as the concentration of DDGS was increased. However, hot carcass weight (linear effect, $P<.05$), dressing percentage (linear effect, $P<.008$), and backfat thickness (linear effect, $P<.02$) increased as percentage DDGS was increased. These data (decreased feed intake, greater efficiency of gain, and fatter carcasses) suggest that energy content of the diets increased as percentage DDGS was increased. This most likely resulted from underestimation of the energy value of the tallow, DDGS, or both in this experiment.

In conclusion, DDGS can be used in greater concentrations than previously suggested for pigs, if energy content of diets is adjusted with added fat. Nutritionists should let ingredient prices and availability determine use of as much as 30% DDGS in diets for nursery pigs and 60% DDGS in diets for finishing pigs.

Table 1. Diet Composition for the Nursery Experiment[a]

		Dried Distillers Grains with Solubles, %			
Ingredient, %	Control	15	30	45	60
Corn	49.06	36.43	24.00	11.57	---
Soybean meal (46.5 % CP)	29.61	23.46	16.99	10.50	2.99
Dried whey	15.00	15.00	15.00	15.00	15.00
Dried distillers grains	---	15.00	30.00	45.00	60.00
Lysine·HCl	.15	.30	.46	.63	.83
Methionine	.06	.05	.05	.04	.04
Threonine	---	.01	.04	.07	.12
Tryptophan	---	---	.02	.05	.09
Fish meal	2.00	2.00	2.00	2.00	2.00
Tallow	---	3.69	7.44	11.20	15.03
Monocalcium phosphate	1.44	1.32	1.21	1.10	1.02
Limestone	.83	.89	.94	.99	1.03
Vitamin premix	.25	.25	.25	.25	.25
Trace mineral premix	.15	.15	.15	.15	.15
Salt	.20	.20	.20	.20	.20
Zinc oxide	.25	.25	.25	.25	.25
Antibiotic [b]	1.00	1.00	1.00	1.00	1.00

[a]Diets were formulated to 1.4 % lysine, .9 % Ca, .8 % P, and 1.46 Mcal ME/lb of diet.
[b]Supplied 50 g/ton of mecadox.

Table 2. Diet Composition for the Finishing Experiment[a]

		Dried Distillers Grains with Solubles %		
Ingredient, %	Control	20	40	60
Corn	78.55	63.05	48.05	26.30
Soybean meal 46.5 % CP	18.75	10.48	1.62	.13
Dried distillers grains	---	20.00	40.00	60.00
Lysine·HCl	.02	.22	.39	.45
Tryptophan	---	---	.03	.04
Tallow	---	3.68	7.42	10.81
Monocalcium phosphate	1.00	.83	.67	.38
Limestone	1.00	1.06	1.14	1.21
Salt	.30	.30	.30	.30
Vitamin premix	.20	.20	.20	.20
Trace mineral premix	.10	.10	.10	.10
Antibiotic [b]	.08	.08	.08	.08

[a]Diets were formulated to 1.25 % lysine, .75 % Ca, .65 % P, and 1.48 Mcal ME/lb for 120 to 160 lb, 1.10 % lysine, .75 % Ca, .65 % P, and 1.49 Mcal ME/lb for 160 to 220 lb, and .80 % lysine, .65 % Ca, .55 % P, and 1.51 Mcal ME/lb for 220 to 250 lb.
[b]Supplied 65 g/ton of tylosin.

Table 3. Composition of Corn, Sorghum, and Sorghum-Based Distillers Dried Grains with Solubles[a]

Ingredient	Corn	Sorghum	DDGS
DM, %	91.9	91.9	89.8
CP, %	7.3	8.7	22.7
Ether extract, %	3.6	2.7	7.2
Crude fiber, %	2.9	2.3	8.6
Ash, %	1.2	1.2	4.0
GE, Mcal/lb	1.6	1.6	1.8
ME, Mcal/lb	1.55[b]	1.49[b]	1.18[c]
Amino acids, %			
Arginine	.38	.29	.84
Histidine	.24	.19	.50
Isoleucine	.27	.31	.84
Leucine	.89	.95	2.16
Lysine	.26	.21	.52
Methionine + cystine	.38	.31	.87
Phenylalanine + tyrosine	.60	.62	1.67
Threonine	.25	.24	.73
Tryptophan	.05	.07	.18
Valine	.37	.40	1.08

[a]As fed basis.
[b]From NRC (1988). ,
[c]Determined in our laboratory via chick bioassays.

Table 4. Effects of Sorghum-Based Dried Distillers Grains with Solubles on Growth Performance of Nursery Pigs[ab]

		Dried Distillers Grains with Solubles, %					Contrasts		
Item	Control	15	30	45	60	CV	Linear	Quadratic	Cubic
ADG, lb	1.07	1.10	1.02	.88	.71	5.7	.001	.001	--[c]
ADFI, lb	1.72	1.62	1.43	1.42	1.28	13.8	.001	--	--
F/G	1.61	1.47	1.39	1.63	1.81	17.9	--	.03	--

[a]A total of 180 weanling pigs (six pigs per pen and six pens per treatment) with an avg initial wt of 13 lb.
[b]The experimental diets were fed from d 7 to 28 of the nursery phase (i.e., a 21 d experiment).
[c]Dashes indicate $P > .15$.

Table 5. Effects of Sorghum-Based Dried Distillers Grains with Solubles on Growth Performance and Carcass Characteristics of Finishing Pigs[ab]

		Dried Distillers Grains with Solubles, %				Contrasts		
Item	Control	20	40	60	CV	Linear	Quadratic	Cubic
ADG, lb	2.09	2.22	2.22	2.19	6.8	-[c]	.10	--
ADFI, lb	6.97	6.75	6.66	6.38	6.2	.003	--	--
F/G	3.34	3.04	3.00	2.91	5.6	.001	.06	--
HCW[d], lb.	169	174	175	175	3.6	.05	--	--
LRBF[e], in	.85	.98	.90	.98	10.2	.02	--	.007
Dressing %	71.1	70.8	71.4	71.9	1.0	.008	--	--
FFLI[f], %	49.0	48.1	48.8	48.0	1.4	.02	--	.003

[a]A total of 80 barrows (two pigs per pen and 10 pens per treatment) with an avg initial wt of 120 lb and avg final wt of 246 lb.
[b]The experimental diets were fed for 56 d.
[c]Dashes indicate $P > .15$.
[d]Hot carcass weight.
[e]Last rib backfat.
[f]Fat-free lean index.