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EFFECTS OF DIET COMPLEXITY AND PROCESSING METHOD ON GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY IN NURSERY PIGS

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Summary

A complex diet formulation resulted in greater digestibility of nutrients and a trend for greater ADG for d 0 to 14 of the experiment. However, for d 14 to 28 and overall (d 0 to 28), diet complexity did not affect growth performance. In contrast, pelleting improved essentially every response criterion especially in simple diets. Expander conditioning before pelleting increased overall digestibility of nutrients and of F/G compared to standard conditioning, but again, the response was most pronounced with the simple diet formulations.

(Key Words: Expander, Pellets, Nursery Pigs.)

Introduction

Expander conditioning is a relatively new processing technology to the U. S. feed manufacturing industry. Very few experiments have been conducted to evaluate the effects of expander processing on nutritional value of corn-soybean meal-based diets. The studies that exist show little consensus about the effects of expanding complex nursery diets. Thus, we designed an experiment to determine the effects of diet formulation and processing method on growth performance and nutrient digestibility in nursery pigs.

Procedures

A total of 150 weanling pigs (10 d postweaning and initial wt of 22.7 lb) were blocked by weight and sorted by sex and ancestry to pens. There were five pigs per pen (4 ft × 5 ft) and five pens per treatment. Treatments were arranged in a 2 × 3 factorial with the main effects of diet complexity and processing method. The corn-soybean meal-based simple (1.5% fish meal) and complex (3.0% fish meal and 20% whey) formulations had 1.45% lysine, .9% Ca, .8% P, and 1.50 Mcal of ME/lb (Table 1). The diets were fed as a meal control, standard-conditioned pellets, and expander-conditioned pellets.

The pigs were housed in an environmentally controlled nursery room and were allowed ad libitum access to feed and water. Pigs and feeders were recorded on d 0, 14, and 28 to allow calculation of ADG, ADFI, and F/G. Fecal samples were collected at 6 p.m. on d 16 and 6:00 a.m. on d 17. Fecal samples from each pen were dried; pooled within pen; and analyzed for DM, N, GE, and Cr concentrations to allow calculation of apparent nutrient digestibilities using the indirect ratio method.

The mash feed for both the standard and expander pellets was steam conditioned to 175°F and 145°F for the simple and complex formulations, respectively. The standard-conditioned pellets were prepared with a 30 horsepower (California Pellet Mill 1000 Series, Master H.D. Model®) pellet mill. The expanded diets were conditioned, expanded, and then pelleted using the same pellet mill and die specifications listed above. The expander (Amandus-Kahl, Model OE15.2) cone pressure was computer controlled such that the expander energy input (i.e., net energy) was held constant at

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12 kWh/t for both diets formulations. The pellet mill and expander motors were equipped with a recording volt-amp meter to allow calculation of electrical energy consumption for both pelleting and expanding. Net energy consumption was calculated as the difference between total energy consumption during processing and idle energy consumption.

Pellet samples were collected immediately after exiting the pellet die and cooled with ambient air. The cooled pellets were then analyzed for pellet durability index (PDI) using standard PDI procedures and by modifying the standard procedure by adding five (1/2") hexagonal nuts to the pellet sample before tumbling.

The data were analyzed as a randomized complete block design with pen as the experimental unit. Treatment comparisons were made by using orthogonal contrasts: 1) diet formulation; 2) meal vs pellets; 3) standard conditioning vs expander conditioning; 4) diet formulation × meal vs pellets; and 5) diet formulation × standard conditioning vs expander conditioning.

Results and Discussion

Net energy consumptions for the expander were 11.9 and 12.1 kWh/t for the simple and complex diet formulations, respectively (Table 2). However, energy required by the pellet mill was greater for the complex formulations than the simple formulations. This resulted from whey in the complex formulation causing increased adhesion of the pellet to the pellet die surface. Thus, this resistance increased the force required to push the pellets through the die. The PDI was greater for the complex diets than for the simple diets, and expander-conditioned pellets had greater PDI than the standard-conditioned pellets.

For d 0 to 14 of the growth assay, pigs fed the complex diets had 5% greater ADG ($P<.09$) and 3% better F/G than pigs fed the simple diets (Table 3). Pigs fed the pelleted diets had 7% greater ADG ($P<.04$) and 14% better F/G ($P<.001$), and 2.7, 2.7 and 3.5% greater digestibilities of DM, N, and GE than pigs fed the meal controls. For the overall period, rates and efficiencies of gain were not affected by diet formulation ($P>.12$), but ADG tended to be greater ($P<.08$) and F/G was better ($P<.01$) when pigs were fed pelleted diets. However, the effects of diet complexity and pelleting were not always independent for ADG; pelleting increased ADG only for pigs fed the simple diet formulations.

Overall (d 0 to 28) pigs fed the expanded pellets tended to have reduced ADG ($P<.07$) but better F/G ($P<.06$) and digestibilities of DM, N, and GE compared to pigs fed the standard-conditioned pellets.

In conclusion, our data suggest that pigs fed complex diets that were processed by expansion tended to have poorer ADG. However, pelleting improved efficiency of gain, and expander conditioning was beneficial for processing simple diets.

Table 1. Diet Composition[a]

Item	Formulation	
	Simple	Complex
Corn	61.56	45.98
Soybean meal (46.5%CP)	28.34	23.62
Whey powder	--	20.00
Soybean oil	2.76	3.04
Fish meal	1.50	3.00
Monocalcium phosphate	1.90	1.33
Limestone	1.00	.67
Salt	.50	.10
Lysine-HCl	.47	.37
Vit/Min/AA/Ab[b]	1.77	1.69
Chromic oxide[c]	.20	.20
Total	100.00	100.00

[a]Formulated to 1.45% lysine, .9 % Ca, .8 % P, and 1.50 Mcal of ME/lb.
[b]Provided 50 g/ton of carbadox.
[c]Used as an indigestible marker.

Table 2. Effects of Diet Complexity on Processing Characteristics

Item	Simple		Complex	
	Standard	Expander	Standard	Expander
Pelleting durability,%				
Standard	62.7	94.3	91.3	90.5
Modified	42.5	90.4	86.0	85.0
Energy consumption, kWh/t				
Expander total	-	34.6	-	35.0
Expander specific	-	11.9	-	12.1
Pellet mill total	6.8	9.4	7.8	9.4
Overall total	6.8	44.0	7.8	44.4

Table 3. Effects of Diet Complexity and Processing Method on Growth Performance and Nutrient Digestibility in Nursery Pigs[a]

	Simple			Complex				Contrasts[b]				
Item	Meal	Std	Exp	Meal	Std	Exp	SE	1	2	3	4	5
Growth performance												
Day 0 to 14												
ADG, lb	.96	1.12	1.13	1.14	1.16	1.08	.04	.09	.04	--[d]	.02	--
ADFI, lb	1.44	1.46	1.39	1.62	1.44	1.38	.04	.14	.004	.08	.009	--
F/G	1.50	1.30	1.23	1.42	1.24	1.28	.03	--	.001	--	--	.11
Day 14 to 28												
ADG, lb	1.51	1.64	1.59	1.65	1.59	1.52	.04	--	--	.13	.007	--
ADFI, lb	2.19	2.30	2.09	2.47	2.21	1.98	.07	--	.006	.004	.005	--
F/G	1.45	1.40	1.31	1.50	1.39	1.30	.04	--	.005	.05	--	--
Day 0 to 28												
ADG, lb	1.23	1.38	1.36	1.39	1.38	1.30	.03	.12	.08	.07	.003	--
ADFI, lb	1.81	1.88	1.74	2.04	1.83	1.68	.04	--	.001	.003	.001	--
F/G	1.47	1.36	1.28	1.47	1.33	1.29	.03	--	.001	.06	--	--
Nutrient digestibility (d 16), %												
DM	81.8	83.3	86.1	84.5	86.9	87.2	.5	.001	.001	.02	--	.04
N	78.5	79.3	82.8	79.2	81.5	83.0	.7	.06	.001	.001	--	.14
GE	81.9	83.5	87.6	83.9	87.4	88.4	.5	.001	.001	.001	--	.02
Diet DE, kcal/lb[c]	1,503	1,541	1,624	1,517	1,601	1,618	10	.02	.001	.001	--	.004

[a]A total of 150 weanling pigs (five pigs per pen and five pens per treatment) with an avg initial wt of 22.7 lb.

[b]Contrasts were: 1) diet formulation; 2) meal vs pellets; 3) standard conditioning vs expander conditioning; 4) diet formulation × meal vs pellets; and 5) diet formulation × standard conditioning vs expander conditioning.

[c]Calculated as percentage GE digestibility × GE of the diet in Mcal/kg.

[d]Dashes indicate P>.15.