Effects of Ractopamine and Hemicell® Addition to Corn-Soybean Meal Diets on Growth Performance and Carcass Characteristics of Finishing Pigs

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Story in Brief

An experiment was conducted using 96 pigs, weighing approximately 174 lb, to evaluate the effects of adding Ractopamine (RAC) and Hemicell® to a corn-soybean meal (SBM) diet on growth performance and carcass traits of finishing pigs. Pigs were blocked by initial weight, sex, and litter, and allotted randomly to four dietary treatments (6 reps of 4 pigs/pen). Dietary treatments were: 1) a fortified corn-soybean meal diet, 2) as Diet 1 with 10 ppm RAC, 3) as Diet 1 with .05% Hemicell, and 4) as Diet 1 with 10 ppm RAC and .05% Hemicell. Pigs were housed in an environmentally-controlled finishing facility and were allowed *ad libitum* access to feed and water. Feed consumption and weight gain were measured at 7-d intervals. Overall, RAC addition increased ADG and gain:feed as compared with pigs not receiving RAC. Hemicell supplementation had no effect on growth performance, and no interaction between RAC and Hemicell were noted for growth performance. Pigs were harvested at approximately 249 lb and carcass measurements were taken 24-h postmortem. Addition of RAC decreased average backfat and 10th rib fat depth. Also, LMA and percent lean were increased in pigs fed RAC as compared with those not fed RAC. Hemicell had no effect on carcass traits; however, the reduction in average backfat tended to be greater in pigs fed RAC plus Hemicell compared with those fed RAC only. Based on these results, RAC appears to improve rate and efficiency of gain and measures of carcass leanness, and these effects were not affected by Hemicell supplementation.

Key Words: Ractopamine, Hemicell, Growth Performance, Carcass Traits

Introduction

As swine progress through the finishing phase, weight gain is associated with increased adipose tissue deposition and a decrease in feed efficiency. Also 55 to 70 % of the total cost of pork production is feed (Luce et al., 1991). Recently, the demand for lean pork products has increased, and feed additives such as ractopamine and Hemicell may be used to improve lean tissue accretion. Therefore, the efficiency and amount of lean gain is very important to not only the producer, but also to the packer and consumer.

Ractopamine hydrochloride (RAC) is a phenethanolamine β-adrenergic agonist that has been shown to have positive effects on growth performance (Anderson et al., 1987) and carcass leanness (Merkel, 1988). Ractopamine is a leanness-enhancing agent that has gained regulatory approval for use in market swine in the United States (FDA, 2000). Lower daily feed intake and improved feed efficiency have consistently been reported when swine have been administered 10 to 20 ppm of RAC (Jones et al., 1988). Several other authors have reported significant decreases in the percentage of carcass fat and increases in the percentage of carcass protein in many types of pigs (Nelson et al., 1987; Jones et al., 1988).

Hemicell^{Ò} (β-d-mannanase, ChemGen, Gaithersburg, MD) is a commercially available enzyme that has been shown in previous studies in our lab (Pettey et al., 2000) to increase growth performance in pigs. Also, chicks fed corn-soybean meal based diets with Hemicell had higher ADG, lower feed/gain, and higher energy digestibility (McNaughton et al., 1998). The proposed action of Hemicell is to degrade β-mannans present in feedstuffs used in swine diets. One of the anti-nutritional factors present in monogastric diets is β-mannan, a non-starch polysaccharide (NSP). Soybean meal (SBM) is a common protein source in swine diets; however, it contains 22% NSP (Chessen, 1987), and swine lack the endogenous enzymes to hydrolyze NSP and β-mannans in feedstuffs.

The objectives of this study were to determine the effects of RAC and Hemicell on growth performance and carcass traits of finishing pigs. Additionally, we were interested in determining if there were any additive effects of RAC and Hemicell, when fed together, on swine growth performance and carcass traits.

Materials and Methods

A total of 96 pigs (average initial BW of 174 lb) was used to determine the effects of RAC and Hemicell addition to a corn-soybean meal based diet on growth performance and carcass characteristics of finishing pigs. Pigs were blocked by weight and sex and allotted randomly to one of four dietary treatments in a randomized complete block design. There were 6 pens/trt with 4 pigs/pen. Pigs were housed in an environmentally-controlled finishing facility. Each pen had a two-hole feeder and one water nipple, and pigs were allowed *ad libitum* access to feed and water.

The four dietary treatments (Table 1) were: 1) a fortified corn-soybean meal diet; 2) as Diet 1 with 10 ppm RAC; 3) as Diet 1 with .05% Hemicell; and 4) as Diet 1 with 10 ppm RAC and .05% Hemicell. Ractopamine and Hemicell were added at the expense of cornstarch in order to formulate the four dietary treatments. All diets were formulated to contain 1.00% lysine, .60% calcium, and .40% phosphorus. Diets were fed in meal form.

Table 1. Composition of Diets

	Diet 1	Diet 2	Diet 3	Diet 4
Ractopamine:	-	+	-	+
Hemicell:	-	-	+	+
Ingredients, %				
Corn	70.13	70.13	70.13	70.13
Soybean meal	27.07	27.07	27.07	27.07
Dicalcium Phosphate	.63	.63	.63	.63
Limestone	.97	.97	.97	.97
Salt	.35	.35	.35	.35
TM/Vitamin premix	.25	.25	.25	.25
Cornstarch	.55	.05	.50	0
Antibiotic	.05	.05	.05	.05
Ractopamine HCL	0	.50	0	.50

Hemicell	0	0	.05	.05

The pigs and feeders were weighed every 7 d to allow calculation of average daily gain (ADG), average feed intake (ADFI), and gain:feed (G:F). When an average block weight reached 249 lb, the pigs were killed at a commercial slaughter facility. Hot carcass weights were recorded to calculate dressing percentage. Backfat thickness was measured at the first rib, last rib and last lumbar on the right half of the carcasses at the midline with a stainless steel ruler. Also, fat depth and loin muscle area (LMA) at the 10th rib were recorded to calculate the percentage of fat-free lean (NPPC, 2000).

Data were analyzed as 2 x 2 factorial arrangement of treatments in a randomized complete block design using procedures described by Steel et al. (1997). The model included the effects of block (rep), treatment, and block x treatment (error). Orthogonal contrasts were used to determine the effects of RAC, Hemicell and their interaction. For the carcass traits, hot carcass weight was used as a covariate. In all cases, pen served as the experimental unit.

Results and Discussion

Throughout the experiment, pigs fed RAC performed as expected compared with pigs not fed RAC (Table 2). Overall, RAC addition increased (P<.01) ADG and G:F compared with pigs not receiving RAC; yet, there was no difference in ADFI. Contradictory to previous studies in our lab (Pettey et al., 2000), there was no effect (P>.10) of Hemicell on growth performance. As well, there were no interactions (P>.10) between RAC and Hemicell on growth performance.

Table 2. Effects of RAC and Hemicell⑨ on growth performance of growing pigs[a]

	Ractopamine, ppm							
	0	10	0	10				
	Hemicell, %					Probability, P<:		
Item	0	0	.05	.05	SE	RAC	HC[b]	RAC x HC
ADG, lb	1.79	2.06	1.74	2.09	.08	.01	.92	.64
ADFI, lb	6.41	6.07	6.18	6.16	.19	.23	.72	.30
G:F, lb	.28	.34	.28	.34	.14	.01	.95	.76

[a]Least squares means for 6 pens/treatment of 4 pigs/pen.

[b]Hemicell

The marked increase in ADG and G:F associated with RAC is comparable to other reports (Nelson et al., 1987; Jones et al., 1988). Average daily gain and G:F was improved by 18 and 21%, respectively. The improvement in ADG resulted in 30 lbs less feed needed per pig to reach 249 lbs. Unlike previous reports from our lab, Hemicell did not affect any measure of growth performance. This lack of response could be due to the length of time pigs were fed diets with added Hemicell. Pettey et al. (2000) fed diets with Hemicell from 50 to 240 lb whereas in this

experiment pigs were only fed Hemicell from 174 to 249 lb. Thus, in the present experiment the lack of response to Hemicell may have been due to pigs receiving Hemicell only during the late finisher phase.

The effects of RAC and Hemicell on carcass traits are shown in Table 3. Dressing percent was not affected (P>.10) by either RAC or Hemicell. However, a decrease (P<.02) in average backfat and 10th rib fat depth was observed in pigs fed RAC. Furthermore, pigs fed RAC had larger (P<.01) LMA and increased (P<.01) FFL when compared to the pigs not fed RAC. There were no differences (P>.10) in carcass traits due to Hemicell supplementation. However, the decrease in average backfat associated with RAC supplementation tended to be slightly more pronounced (P=.12) when Hemicell was included in the diet.

Table 3. Effects of RAC and Hemicell® on carcass traits of growing pigs[a,b]

	Ractopamine, ppm							
	0	10	0	10				
	Hemicell, %					Probability, P<:		
Item	0	0	.05	.05	SE	RAC	HC[c]	RACxHC
DP, %	73.78	75.07	73.95	73.69	.38	.19	.70	.18
Avg BF, in	.86	.84	.87	.78	.28	.02	.60	.12
10th BF, in	.66	.60	.64	.57	.03	.02	.66	.69
LMA, in^2	7.12	7.56	7.16	7.80	.11	.01	.14	.50
Lean, %	55.02	56.28	55.38	57.06	.48	.01	.35	.55

[a]Least squares means for 6 pens/treatment of 4 pigs/pen.

[b]Hot carcass weight used as covariate.

[c]Hemicell.

The effects of RAC on carcass traits are consistent with other studies evaluating RAC addition to finishing swine diets (Crome et al., 1996; Crenshaw et al., 1987). We observed a decrease of 10% in 10th rib fat depth and an 8 percent increase in LMA. These improvements in carcass leanness resulted in a marked increase in carcass fat-free lean. Previous results from our lab (Pettey et al., 2000) indicated that Hemicell supplementation to growing-finishing diets decreased 10th rib fat depth and increased fat-free lean gain. Although not significant, Hemicell supplementation numerically decreased 10th rib backfat, and increased LMA and the percentage of fat-free lean. These slight improvements may have become greater if Hemicell had been supplemented throughout the growing-finishing phase (50 to 250 lb) as was performed by Pettey et al. (2000).

Even though marked improvements in growth rate and carcass traits were noted with RAC supplementation, no adverse effects of RAC on soundness or health were observed.

Implications

The addition of ractopamine to corn-soybean meal diets greatly increased daily gain, gain:feed, and lean gain while reducing fat deposition. On the other hand, Hemicell addition did not affect growth performance or carcass characteristics of finishing pigs when fed from 174 to 249 lb. This lack of response to Hemicell supplementation, which is contrary to previous reports from our lab, may have been due to the short time the enzyme was fed. There were no additive effects of a combination RAC and Hemicell addition on growth performance or carcass traits. These results suggest that the response to ractopamine was independent of Hemicell supplementation.

Literature Cited

Anderson, D.B et al. 1987. Fed. Proc. 46:1021

Chessen, A. 1987. Recent Advance in Animal Nutrition. Haresign, W. and D.J.A. Cole p 71. Butterworths, Boston, MA.

Crenshaw, J.D. et al. 1987. J. Anim. Sci. 65(Suppl.1):308

Crome, P.K. et al. 1996 J. Anim. Sci. 71:2439-2569

FDA 2000. New animal drugs for use in animal feeds; Ractopamine hydrochloride. Fed. Reg. 65:4111-4112.

Jones, D.J. et al. 1988. J. Anim. Sci. 66(Suppl. 1):324 (Abstract)

Luce, W.G. et al. 1991. Oklahoma State University Cooperative Extension Service

Mchaughton, J.L. et al., 1998. Poultry Sci. 77(Suppl 1):153

Merkel, R.A. 1988. Proc. Recip. Meat Conf. 41:101

Nelson, J.R. et al. 1987. Can. J. Anim. Sci. 67(Suppl. 1):1168 (Abstract)

NPPC. 2000. National Pork Producers Counsel, Des Moines, IA.

Pettey, L.A et al. 2002. J. Anim. Sci. 80:1012-1019.

Steel, R.G.D. and J.H. Torrie. 1997. Principle and Procedures of Statistics: A Biometrical Approach (3rd Ed.). McGraw-Hill Book Co., New York.
