Table 4. Average litter size and survival rate

	Number of live pigs			Survival rate (%)			
	Birth	21 days lactation	42 days (weaning)	Birth[1]	21 days[2] lactation	42 days[3] (weaning)	21-42[4] days
Normal intake	9.14	8.02	6.86	87.7	88.1	75.6	83.8
High intake	8.14	7.81	7.39	89.0	89.9	85.0	94.5

[1]Number of pigs born alive ÷ total pigs born.
[2]Number of pigs alive at 21 days ÷ number of pigs born alive.
[3]Number of pigs alive at 42 days ÷ number of pigs born alive.
[4]Number of pigs alive at 42 days ÷ number of pigs alive at 21 days.

Direct Comparisons of Antibiotics for Growing-Finishing Swine

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Story in Brief

Two trials were conducted to make direct comparisons among antibiotics commonly used by Oklahoma swine producers. In the first trial, gain, feed efficiency and daily feed intake were similar for pigs receiving the non-medicated control diet and pigs receiving chlortetracycline, tylosin or bambermycins. Pigs fed bambermycins tended to grow more slowly than pigs fed the other treatments during the growing period. In the second trial, pigs fed virginiamycin grew 9 percent faster and were 5 percent more efficient than pigs fed chlortetracycline.The pigs fed virginiamycin also grew 6 percent faster and were 4 percent more efficient than pigs fed the non-medicated control diet during the growing period. During the finishing period, average daily gain was similar among all treatments. Chlortetracycline in the diet during the finishing period improved feed efficiency by 4 percent when compared with virginiamycin-fed pigs. Backfat thickness was greater in antibiotic-fed pigs. Results of these trials suggest that substantial differences in antibiotic responses are likely to occur. More direct comparisons are needed to formulate specific antibiotic recommendations over the wide variety of environmental and management conditions found among swine producers.

Introduction

Antibiotics have been used extensively in growing-finishing swine rations for three decades. Such wide acceptance is attributed to their established benefits of

increasing growth rate, improving feed efficiency and reducing the adverse effects of specific swine diseases.

Although a considerable volume of data concerning the effectiveness of antibiotics in improving performance for growing-finishing hogs has been published, the continued evaluation of the relative efficacy of both currently available and new drugs is needed. Most current data permits only indirect comparison of the relative effects of available antibiotics on performance. Data making direct comparisons are more limited. The objective of the research was to compare the feedlot performance of growing-finishing swine fed diets containing several antibiotics currently used by swine producers.

Materials and Methods

All pigs were housed in indoor concrete pens equipped with self feeders and waterers. Both trials were conducted at the Southwestern Livestock and Forage Research Station near El Reno, Oklahoma. In both trials, pigs from various breed groups in the animal breeding herd were randonly allotted within breed group, sex and litter to the experimental treatments.

Trial 1 consisted of 80 pigs with four pens (five pigs per pen) on each of four treatments. A 0.75 percent lysine corn-soybean meal ration (Table 1) was fed to all pigs fron an average weight of 49 to 112 lb. The lysine level was reduced to 0.62 percent during the finishing phase (122 to 222 lb). The four treatments consisted of a non-medicated control and three antibiotics: (1) chlortetracycline (Aureomycin[1]), (2) tylosin (Tylan[2]) and (3) bambermycins (Flavomycin[3]) fed at the highest levels recommended for increased rate of weight gain and improved feed effi-

Table 1. Composition of experimental rations

Ingredient	Trial 1, %		Trial 2, %	
	Grower	Finisher	Grower	Finisher
Corn, yellow	78.25	83.0	—	—
Wheat, hard red winter	—	—	81.70	86.93
Soybean meal (44%)	19.00	14.25	15.36	10.10
Dicalcium phosphate	1.35	1.25	0.97	1.00
Calcium carbonate	0.75	0.85	0.97	0.97
Salt	0.40	0.40	0.50	0.50
Vitamin trace-mineral mix[a]	0.25	0.25	0.50	0.50
Total	100.00	100.00	100.00	100.00
% Lysine	0.75	0.62	0.75	0.62
% Calcium	0.68	0.65	0.66	0.65
% Phosphorus	0.59	0.55	0.55	0.54

[a]Supplied 4,000,000 IU vitamin A, 400,000 IU vitamin D, 4 g riboflavin, 20 g pantothenic acid, 20 g niacin, 400 g choline chloride, 20 mg vitamin B_{12}, 10,000 IU vitamin E, 1 g menadione, 680 mg iodine, 45 g iron, 25 g manganese, 5 g copper, 90 g zinc, and 90 mg selenium per ton of feed in Trial 1 and 4,000,000 IU vitamin A, 300,000 IU vitamin D, 4 g riboflavin, 20 g pantothenic acid, 30 g niacin, 800 g choline chloride, 15 mg vitamin B_{12}, 10,000 IU vitamin E, 2 g menadione, 200 mg iodine, 90 g iron, 20 g manganese, 10 g copper, 90 g zinc and 100 mg selenium per ton of feed in Trial 2.

[1]Diamond Shamrock Corporation, Animal Health Division, Cleveland, Ohio.
[2]Elanco, Division of Eli Lilly Company, Indianapolis, IN.
[3]American Hoechst Corporation, Animal Health Division, Somerville, N.J.

ciency in growing-finishing swine. Levels of each antibiotic during both the growing and finishing phases are given in Table 2.

Trial 2 consisted of 498 pigs with 9 pens on treatment 1, 16 pens on treatment 2 and 17 pens on treatment 3. The unbalanced design was employed in this study because antibiotic responses compared to a negative control are well documented; therefore, the primary objective of this study was to make direct comparisons between the two antibiotics. A 0.75 percent lysine wheat-soybean meal ration (Table 1) was fed to all pigs from an average weight of 40 to 118 lb. The lysine level was reduced to 0.62 percent during the finishing phase (118 to 214 lb). The three treatments were: (1) a wheat-soybean meal non-medicated basal diet, (2) basal plus 10 g of virginiamycin (Stafac[4]) per ton during both the growing and finishing phase and (3) basal plus 50 g of chlortetracycline per ton of feed (Table 2). These levels of antibiotics are the highest levels recommended for increased rate of weight gain and improvement in feed efficiency in growing-finishing swine.

Table 2. Treatments and antibiotic levels used

Item	Antibiotic level, g/ton	
Treatment - Trial 1	Grower	Finisher
Basal	0	0
Basal plus Chlortetracycline	50	50
Basal plus Tylosin	100	20
Basal plus Bambermycins	4	2
Treatment - Trial 2		
Basal	0	0
Basal plus Virginiamycin	10	10
Basal plus Chlortetracycline	50	50

Results and Discussion

Results of Trial 1 for the growing, finishing and combined growing-finishing periods are presented in Tables 3, 4 and 5, respectively. Average daily gain was affected by treatment only during the growing period where pigs fed bambermycins tended to grow more slowly ($P<.1$) than pigs fed tylosin, chlortetracycline or the non-medicated control diet. It should be noted, however, that American Hoechst Corporation recommends starting pigs on bambermycin only after they reach 75 lb. Pigs fed tylosin had the highest average daily gain during the growing period, with pigs growing 9 percent faster than those fed bambermycins, 4 percent faster than those fed chlortetracycline and 3 percent faster than those receiving the non-medicated control diet, but differences were not significant. Gains during both the finishing and combined growing-finishing periods were similar across all treatments.

Average daily feed intake followed a pattern similar to that observed for average daily gain with pigs fed bambermycins consuming less feed ($P<.1$) than those fed tylosin, chlortetracycline or the non-medicated control diet during the

[4]SmithKline Animal Health Products, Philidelphia, PA.

Table 3. The effect of chlortetracycline, tylosin and bambermycins on performance and feed efficiency in growing swine: Trial 1

	Treatments			
	1 Control	2 Chlortetracycline	3 Tylosin	4 Bambermycins
	Antibiotic level, g/ton			
Item	0	50	100	4
Pigs per treatment, no.[a]	20	20	20	20
Pens per treatment, no.	4	4	4	4
Avg. initial wt, lb	49.6	49.3	50.3	48.2
Avg. final wt, lb	121.9	121.9	126.3	118.1
Avg. daily gain, lb	1.48[b]	1.47[b]	1.53[b]	1.40[c]
Avg. daily feed intake, lb	3.67[b]	3.69[b]	3.99[b]	3.36[c]
Feed per lb gain, lb	2.62	2.58	2.63	2.58

[a]One pig was removed from treatments 1 and 3, and one pig on treatment 4 died.
[b,c]Values with different superscripts are significantly different $P<.1$.

Table 4. The effect of chlortetracycline, tylosin and bambermycins on performance and feed efficiency of finishing swine: Trial 1

	Treatments			
	1 Control	2 Chlortetracycline	3 Tylosin	4 Bambermycins
	Antibiotic level, g/ton			
Item	0	50	20	2
Pigs per treatment, no.[a]	20	20	20	20
Pens per treatment, no.	4	4	4	4
Avg. initial wt, lb	121.9	121.9	126.3	118.1
Avg. final wt, lb	218.6	222.5	226.6	221
Avg. daily gain, lb	1.68	1.66	1.75	1.67
Avg. daily feed intake, lb	5.28	5.36	5.51	5.38
Feed per lb gain, lb	3.59	3.40	3.50	3.35

[a]One pig was removed from treatments 1 and 3, and one pig on treatment 4 died.

Table 5. The effect of chlortetracyclin, tylosin and bambermycins on performance, feed efficiency and backfat of growing-finishing swine: Trial 1

	Treatments			
	1 Control	2 Chlortetracycline	3 Tylosin	4 Bambermycins
Item	Antibiotic level, g/ton			
Growing	0	50	100	4
Finishing	0	50	20	2
Pigs per treatment, no.[a]	20	20	20	20
Pens per treatment, no.	4	4	4	4
Avg. initial wt, lb	49.6	49.3	50.3	48.2
Avg. final wt, lb	218.6	222.5	226.6	221
Avg. daily gain, lb	1.58	1.58	1.64	1.55
Avg. daily feed intake, lb	4.56	4.62	4.83	4.42
Feed per lb gain, lb	3.10	3.06	3.10	3.04
Avg. adjusted backfat, in.	0.88	0.91	0.88	0.88

[a]One pig was removed from treatments 1 and 3 and one pig on treatment 4 died.

growing period. Differences in average daily feed intake were non-significant during both the finishing and combined growing-finishing periods. Likewise, feed efficiency of pigs fed all three antibiotics and those receiving the non-medicated control diet was similar in the growing, finishing and growing-finishing periods.

The lack of an antibiotic response in this trial is inconsistent with a considerable volume of published literature demonstrating improved gains and efficiency of gain with antibiotic supplementation. There are, however, many studies in the literature in which little or no response was observed to a recommended level of an antibiotic. It should be noted that the population density of animals in this trial was low, which is consistent with the observations that either a low disease level or low animal density may tend to reduce the antibiotic response.

In Trial 2 pigs fed virginiamycin during the growing period (40 to 118 lb, Table 6) grew faster ($P<.05$) and were more efficient ($P<.05$) than those receiving chlortetracycline. Likewise, pigs fed virginiamycin grew faster ($P<.05$) and tended to be more efficient ($P<.1$) than pigs fed the non-medicated control diet.

Table 6. The effect of virginiamycin and chlortetracycline on performance of growing swine: Trial 2

	Treatments		
	1 Control	2 Virginiamycin	3 Chlortetracycline
		Antibiotic level (g/ton)	
Item	0	10	50
Pigs per treatment, no.	93	196	209
Pens per treatment, no.	9	16	17
Avg. initial wt, lb	42.2[a]	42.3[a]	36.7[b]
Avg. final wt, lb	118.8	117.7	118.3
Avg. daily gain, lb	1.33[a]	1.41[b]	1.29[a]
Avg. daily feed intake, lb	3.56	3.60	3.56
Feed per lb gain, lb	2.67[ab]	2.56[b]	2.69[a]

[a,b] Means in the same row with different superscripts differ significantly ($P<.05$).

Average daily gain of pigs receiving virginiamycin was 9 percent faster than in pigs receiving the non-medicated control diet. Feed efficiency of pigs receiving virginiamycin during the growing period was improved by 5 percent over that observed in pigs fed chlortetracycline and 4 percent over that observed in pigs fed the non-medicated control diet. Average daily feed intake was similar for all three treatment groups. The lack of a response in pigs fed chlortetracycline may have been due to lighter weights ($P<.05$) at the initiation of the trial for chlortetracycline-fed pigs compared to pigs fed virginiamycin or the non-medicated controls. Since pigs were randomly allotted to treatments, this lower initial weight can only be attributed to chance.

The overall average daily gain response to virginiamycin and chlortetracycline was positive during the finishing period (118 to 214 lb, Table 7) although differences were not significant. Pigs fed chlortetracycline and virginiamycin grew 3 and 1 percent faster, respectively, than pigs fed the non-medicated control diet. Chlortetracycline tended to improve feed efficiency ($P<.1$) when compared with virginiamycin fed pigs. This represented an improvement in feed efficiency of 4 percent. Feed efficiency in pigs fed the non-medicated control diet and vir-

Table 7. The effect of virginiamycin and chlortetracycline on performance of growing swine: Trial 2

	Treatments		
	1 Control	2 Virginiamycin	3 Chlortetracycline
	Antibiotic level (g/ton)		
Item	0	10	50
Pigs per treatment, no.	93	196	209
Pens per treatment, no.	9	16	17
Avg. initial wt, lb	118.8	117.7	118.3
Avg. final wt, lb	213.0	215.9	212.6
Avg. daily gain, lb	1.46	1.49	1.51
Avg. daily feed intake, lb	4.56	4.78	4.86
Feed per lb gain, lb	3.49[ab]	3.50[a]	3.36[b]

[a,b] Means in the same row with different superscripts differ significantly ($P<.1$).

giniamycin during the finishing phase was similar. Likewise, average daily feed intake was similar across all dietary treatments.

Means for average daily gain, feed efficiency, average daily feed intake and backfat during the entire growing-finshing phase are presented in Table 8. Pigs fed virginiamycin grew 5 percent ($P<.05$) than pigs fed chlortetracycline. Differences in gain between either antibiotic and non-medicated control were not significant. The overall response to chlortetracycline and virginiamycin was positive for both average daily feed intake and feed efficiency during the entire growing-finishing period although these differences were not significant. Backfat thickness was higher in pigs fed either virginiamycin or chlortetracycline when compared to the non-medicated control-fed pigs. This may be due to the faster rate of gain observed in pigs fed virginiamycin during both the growing and the finishing phases and chlortetracycline during the finishing period.

Table 8. The effect of virginiamycin and chlortetracycline on performance of growing-finishing swine: Trial 2

	Treatments		
	1 Control	2 Virginiamycin	3 Chlortetracycline
	Antibiotic level (g/ton)		
Item			
Growing	0	10	50
Finishing	0	10	50
Pigs per treatment, no.	93	196	209
Pens per treatment, no.	9	16	17
Avg. initial wt, lb	42.2[a]	42.3[a]	36.7[b]
Avg. final wt, lb	213.0	215.9	212.6
Avg. daily gain, lb	1.42[ab]	1.47[a]	1.40[b]
Avg. daily feed intake, lb	4.09	4.24	4.24
Feed per lb gain, lb	3.10	3.05	3.05
Avg. adjusted backfat, in.	0.93[a]	0.96[b]	0.96[b]

[a,b] Means in the same row with different superscripts differ significantly ($P<.05$).