THE INFLUENCE OF NEOMYCIN, BACITRACIN AND SP-250 IN A COMMERCIAL HOG FINISHING OPERATION

by

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INTRODUCTION

In 1946, Moore et al. first reported that small amounts of "animal protein factor" stimulated growth of chicks. This was soon followed by a report indicating that a similar effect could be obtained with pigs by a small quantity of aureomycin, an antibiotic. The term antibiotic means against life or destruction of life. An antibiotic is a compound synthesized by a living organism which inhibits the growth of another.

The use of antibiotics in the control of harmful bacteria is a culmination of years of searching for what has been aptly termed as a "Magic Bullet", a substance that will kill a pathological organism without harming its host. Antibiotics when added to the feed of animals are able to improve performance by producing changes in the intestinal bacteria.

There is clear evidence that antibiotics, added to well balanced rations, as well as inadequate ones, improved the growth of pigs. The total feed consumed each day is usually increased by antibiotic feeding and the amount of feed required per pound of gain is often smaller. The commonly reported effect is a more uniform growth response of the animal and fewer unthrifty, slow growing individuals occur in the experimental groups, thus the average rate of gain is increased.

Only the most recent investigations have been designed to measure the effect of combinations of antibiotics, which may offer added performance where the proper time of administration, level of supplementation, environment, and disease load are all integrated in a growing-finishing swine program.

Most commercial feeders in Virginia purchase feeder pigs from many sources. Often, these pigs have been exposed to unsanitary conditions, stress, and diseases. Few studies have been designed for and conducted under commercial hog feeding conditions.

This study was designed to aid in the development of an antibiotic supplementation program that will improve the overall performance of pigs during the growing-finishing period on a commercial hog feeding floor.

REVIEW OF LITERATURE

To review completely the work done with antibiotics since their discovery in the late 1940's would result in a rather lengthy review. In view of the magnitude of information available, it is felt that the use of several excellent reviews covering the early years of antibiotic usage may be justified.

Braude et al. (1953) made a comprehensive study and summarized the results of a large number of publications dealing with the use of antibiotics in swine rations from 1949 to 1953. The specific objective of this undertaking was to determine the relative effectiveness of the different antibiotics, to determine the magnitude of their effects under different conditions, to study the factors affecting antibiotic response and to obtain clues which might be helpful in elucidating the mode of action of the antibiotics. As of 1953, these authors reported that five antibiotics effectively stimulated growth of swine. They are aureomycin, penicillin, streptomycin, terramycin, and bacitracin. Other antibiotics were ineffective or had not been adequately tested. Under normal conditions of diet and health it appears that penicillin, streptomycin, and bacitracin increases the growth rate of growing-fattening pigs about ten percent. Under similar conditions, aureomycin and terramycin are approximately 30 percent more effective on the average than penicillin, streptomycin, and bacitracin and elicit an average improvement of around 15 percent. Under certain conditions of stress, such as inadequate rations and digestive disorders, the antibiotic effect is much more pronounced.

These workers indicated all five antibiotics produced an improvement in feed efficiency of a magnitude ranging from two to five percent. Again, under conditions of stress, this improvement has been much greater. Runts respond to antibiotic feeding more strikingly than normal pigs. In 12 comparisons with runts an average growth stimulation of 82.2 percent was recorded. Antibiotics appear to be most effective during the early growth period; however, there is ample evidence to indicate that they significantly stimulate growth of hogs during the late stages of fattening as well. It is important that the antibiotics not be withdrawn from the ration at any time during the growth and fattening period.

Studies on pasture (Braude et al., (1953)) have resulted in an average improvement in growth rate of 13.7 percent as the result of antibiotic supplementation. This compares favorably with results obtained under dry lot conditions.

The type of rations fed materially influences the antibiotic response. Other factors being equal, pigs fed balanced rations will respond less to antibiotic supplementation than those fed unbalanced rations. Although it is true that poor rations are improved considerably by antibiotics, these rations are still incapable of top performance. Antibiotics should not be looked on as a substitute for well balanced rations.

Braude et al. (1953) have summarized in tabular form the relative effectiveness of the various antibiotics studied up to 1953. The relative antibiotic response is shown in table 1. The mean indices

TABLE 1. GROWTH AND EFFICIENCY OF FEED UTILIZATION MEAN INDICES FOR GROWING FATTENING PIGS RECEIVING VARIOUS ANTIBIOTICS.[a]

Antibiotic	Growth Index				Food Utilization Index			
	All*	Florida+	Hormel Institute**	Others++	All	Florida	Hormel Institute	Others
Aureomycin	135.9(187)***	179.3(36)	161.5(34)	115.1(117)	90.2(146)	78.4(12)	69.5(24)	96.0(110)
Penicillin	110.6(53)	97.0(4)	142.5(2)	110.4(47)	94.3(44)		76.5(2)	95.1(42)
Streptomycin	115.2(50)	128.0(1)	157.2(6)	109.0(43)	94.4(41)		77.8(6)	97.3(35)
Terramycin	123.7(23)	190.0(1)	151.5(2)	117.6(20)	93.9(17)	96.0(1)	69.5(2)	97.2(14)
Bacitracin	109.0(12)	99.5(2)		110.9(10)	103.0(10)	153.0(1)		97.4(9)
Chloromycetin	105.5(6)	106.0(1)	116.5(2)	98.0(3)	98.2(6)	128.0(1)	86.5(2)	96.0(3)
Neomycin	93.3(4)			93.3(4)	87.6(3)			87.6(3)
Polymyxin	96.0(1)			96.0(1)	100.0(1)			100.0(1)
Subtilin	89.0(1)	89.0(1)			130.0(1)	130.0(1)		

* Includes all comparisons available from the various Experiment Stations.

\+ Results from the Florida Agricultural Experiment Station are for reasons explained in the text, treated separately.

** Results from the Hormel Institute, Minnesota, are for reasons explained in the text, treated separately. This column also includes some data from the Nebraska Agricultural Experiment Station.

++ This column includes all comparisons from the various Experiment Stations except those found in the columns headed "Florida" and "Hormel Institute."

*** Number of comparisons given in parentheses.

[a] Braude *et al.* 1953.

listed are based on the difference in growth and feed utilization between the treated and control lots in the various studies used in the review.

Jukes (1955) reviewed the work done during 1953 and 1954. He stated that many of the diets used in the experiments during this period were deficient in Vitamin B_{12} and consisted predominantly of corn and soybean oil meal. The growth response obtained through the use of crude chlortetracycline fermentation materials was due to both Vitamin B_{12} and the antibiotic. Experiments with crystalline antibiotics and B_{12} soon established that both supplements were needed for optimum growth of pigs. This was clearly shown in the work of Catron et al. (1951) in an experiment on the effects of different levels of aureomycin fed without Vitamin B_{12} on growing-fattening swine.

Hanson (1958) concluded that antibiotics were quickly accepted by swine producers following their introduction. In 1954 alone 490,000 pounds of antibiotics were used in feed for all livestock. The results obtained by feeding these drugs to swine on many farms and in many experiment stations bordered on the miraculous. Prior to the advent of the antibiotic, diarrhea in young pigs in many station herds was a constant problem. Reports of experiments from many stations almost invariably carried footnotes to the effect that the number of pigs from one lot or another were removed from the test due to unthriftiness. Levels of the various drugs used have varied and recommendations of various stations have varied. However, levels of 10 or 15 gm. per ton of total feed have been commonly employed for weanling pigs. For starter or creep feeds, levels have been generally in the range of 20 to 50 gms. per ton of feed. Much higher levels, 50-200 gms., have been used in therapeutic formulas.

Aureomycin

The use of aureomycin (chlortetracycline) in swine growing-finishing rations has been reported in many studies conducted under a wide range of conditions.

Wallace *et al.* (1954) reported that when aureomycin was added to the ration, the average daily gain (ADG) for low (14.3%) intermediate (17.6%) and high (20.9%) protein level groups, respectively, were 1.17, 1.13, and 1.09 lbs. daily from weaning to slaughter. The use of aureomycin did not improve gains significantly at any protein level, although on the high protein ration aureomycin improved feed efficiency noticeably.

Wahlstrom (1955) used three different levels (25, 50, and 100 grams per ton) of aureomycin in a finishing ration for swine. The antibiotic produced a highly significant increase in ADG. There was very little difference in the ADG of pigs fed the three different levels, but the pigs fed the two higher levels (50, 100 grams per ton) required 5% less feed than the control group.

Jenson *et al.* (1955) fed rations containing either 10, 12, 14, 16, or 18% protein, with and without 5 milligrams of aureomycin per pound of ration. Aureomycin significantly improved the ADG and feed efficiency at all levels of protein but the pigs reached the maximum growth rate between 16 and 18% without aureomycin and 14% protein with aureomycin. This suggests a protein sparing effect with aureomycin. Bohman et al. (1955) also reported aureomycin accelerated growth rate and decreased the feed required per pound of gain, even with a high level of alfalfa meal in the ration.

Hanson et al. (1955) and Speer et al. (1956) also demonstrated that when aureomycin was added to growing-finishing rations there was a significant increase in growth, feed intake and feed efficiency.

More recently, various workers (Sewell et al. 1958, Rutledge et al. 1958, Conrad et al. 1960, Thrasher et al. 1960, Conrad et al. 1960, and Wood et al. 1964) have reported that aureomycin in growing-finishing pig rations improved average daily gain, feed per lb. of gain, and feed intake significantly over unsupplemented controls.

Bacitracin

The use of bacitracin in swine growing-finishing rations has not been as extensive as that of aureomycin. Bridges et al. (1954) concluded that the use of bacitracin in fattening pig rations did not improve ADG but did significantly improve feed efficiency. Thrasher et al. (1960), using 20 grams of zinc bacitracin per ton of a corn-soy finishing ration reported a significant increase in rate of gain, and feed intake. Zinc bacitracin also improved feed conversion by 5.4% over the control ration in this study. Miller et al. (1962) reported that the use of 20 gm. of zinc bacitracin per ton of a growing-finishing ration resulted in a significantly faster rate of gain. Feed efficiency was improved slightly but not significantly with this level of zinc bacitracin.

More recently, Wood *et al*. (1964) compared the use of 10 gm. of zinc bacitracin per ton with 10 gm. of bacitracin in swine growing-finishing rations. The pigs fed 10 gm. of zinc bacitracin per ton gained 10.6% faster, and were 6.1% more efficient than the controls. The bacitracin-fed pigs gained no better than controls and were less efficient. The feed conversion of the control group was quite good, therefore the results were not significant.

Terramycin

Terramycin (oxytetracycline) has been used and tested in various studies: Hanson *et al*. (1955) studied the effect of 10 gm. terramycin + 10 mg. vitamin B_{12} in corn-soy rations for pigs from weaning to 125 lbs. and from 125 lbs. to slaughter. Terramycin and B_{12} addition increased gains significantly in both weight groups, although the withdrawal of terramycin when the pigs weighed 125 lbs. had a pronounced depressing effect on ADG and feed consumption. These workers concluded than when environmental conditions are such that an antibiotic will have a significant effect on growth rate of the newly weaned pig, the antibiotic should be fed from weaning to market weight.

Jenson *et al*. (1955) stated that terramycin increased the rate of gain of pigs during the 36 to 75 pound period. However, this effect had disappeared by the time the pigs reached 200 pounds. The improved rate of gain initially did, however, reduce the feed required per 100 of gain by 18 pounds by the end of the trial.

More recently, Conrad _et al._ (1960) used levels of terramycin ranging from 50 to 250 gm. per ton of protein supplement. Terramycin produced a highly significant increase in ADG and feed intake at all levels, but feed efficiency was not consistently improved.

Conrad _et al._ (1960), Miller _et al._ (1962), and Wood _et al._ (1964) all report more efficient gains and greater feed consumption when terramycin is added to growing-finishing rations for pigs.

Penicillin

Wahlstrom (1954) found in a series of three experiments that adding 5 mg. of penicillin per lb. of feed a growing-finishing ration resulted in a highly significant increase in ADG consistently in all three studies. On the other hand, Bridges _et al._ (1954) reported that 2 gm. per ton of penicillin in a growing-finishing milo-soybean oil meal ration resulted in average daily gains of 1.59 lbs. and 1.52 for the treated and control groups, respectively, which were not statistically different. However, feed efficiency was significantly improved.

Hanson _et al._ (1955) and Wahlstrom (1956) reported highly significant increases in feed efficiency and average daily gain when penicillin was added to growing-finishing swine rations.

Neomycin

Braude _et al._ (1953) reported neomycin to be ineffective in stimulating growth of pigs at the level studied. The results of four early studies are presented in table 1. There have been no recent studied reported in the literature on neomycin supplementation in pig rations.

Combination Antibiotics

In addition to studying the response of pigs to single antibiotics, numerous workers have investigated the effect of adding two or more antibiotics to a ration to see if the response can be increased over that obtained with one antibiotic alone.

Elliott et al. (1964) reported on a series of six experiments involving 370 3-week-old-pigs comparing chlortetracycline (100 gm. per ton) sulfamethazine (100 gm. per ton) and procaine penicillin (50 gm. per ton) alone and in each possible combination on the performance of early-weaned pigs. The addition of a combination of the three antibiotics when fed from three weeks to nine weeks, resulted in a significantly increased ADG. The combinations of antibiotics produced significantly greater ADG than any of the antibiotics alone. Feed required per pound of gain was reduced and feed intake increased with both the single drug and combination of antibiotics.

Bridges et al. (1954) reported that a combination of bacitracin and penicillin added to a milo-soybean ration did not significantly increase the growth rate above the control, however, significant improvement in feed efficiency was obtained over the control lot.

Thrasher et al. (1960) reported a significant increase in rate of gain and feed conversion when a combination of zinc bacitracin and penicillin was fed in a 42-day feeding period. For the entire feeding period (98 days) the combination of antibiotics increased rate of gain 7.6% approaching significance at 5% level over the controls.

Conrad _et al_.(1957) reported a significant (13%) increase in gains and a 5% improvement in feed efficiency when a combination of penicillin-bacitracin were added to basal ration at levels of 5 gm./ton procaine penicillin and 15 gm./ton bacitracin over unsupplemented controls.

Antibiotics Effect on Carcass Quality

In an effort to determine if antibiotics had a harmful or beneficial effect on carcass composition, several workers have studied carcass traits of pigs fed antibiotics.

Kelly _et al_.(1954) reported on the use of 20 mg. each of aureomycin and Vitamin B_{12} per kg. of ration alone and in combination for growing-finishing swine in two experiments at protein levels of 20, 17, and 14 percent. In the first experiment the feeding of aureomycin with or without supplements of B_{12} lowered the concentration of Vitamin B_{12} in pork muscle except at medium protein level. In the second experiment the depression of B_{12} deposition in the muscle tissue was again found in the lots receiving aureomycin alone, although in this experiment the interaction of aureomycin and B_{12} was not present. The deposition of intramuscular fat under the conditions of these two experiments appears to be an inverse response to the level of protein fed rather than to treatment with Vitamin B_{12} and antibiotic.

Wallace *et al*. (1954) reported satisfactory weight gains of weanling pigs fed rations containing 14.3, 17.6, and 20.9% crude protein. Aureomycin did not conclusively improve protein utilization. Carcass studies indicated a non-significant increase in back fat thickness as a result of aureomycin supplementation. Dressing percentages averaged slightly higher for the pigs that received the antibiotic but again not significantly so.

Hanson *et al*. (1955) concluded that aureomycin, terramycin, and procaine penicillin per se did not directly affect carcass quality. Speer *et al*. (1956) reported that aureomycin added to a growing-finishing ration did not influence the variation in back fat thickness.

Conrad *et al*. (1959) reported no significant difference due to any antibiotic treatment (terramycin, aureomycin, penicillin, zinc bacitracin, streptomycin, and sulfate) in the dressing percentage, carcass length, back fat, lean cut yield, and loin eye area of the carcass.

EXPERIMENTAL PROCEDURE

This study was a cooperative project with Valleydale Packers, Inc., who operate a large commercial hog feeding program near Salem, Virginia. The study consisted of one trial involving 312 crossbred pigs. They originated from five sources of feeder pigs in Virginia and West Virginia. They were shipped by truck to Salem, Virginia, where extremely large and small pigs were sorted out of each group. Pigs were then assigned from each source group by weight to six treatment lots. The six experimental rations were then assigned at random to the lots. Each lot contained 52 pigs averaging 52 pounds per pig. The feeder pigs were vaccinated for cholera, ear notched, sprayed with lindane and placed on test on June 2, 1964.

The composition of the ration used in the study is presented in table 2. The initial level of crude protein fed was 16 percent. This was lowered to 14 percent when the pigs averaged approximately 75 pounds body weight and to 12 percent at approximately 125 pounds. The rations used in this study were mixed by a commercial mill (Big Spring Mill, Inc., Elliston, Virginia.)

The same basal ration was fed to each lot during the study. The various antibiotic supplements for each lot were added to the basal ration at the mill. The antibiotic supplement received by each treatment lot is shown in table 3.

TABLE 2. COMPOSITION OF BASAL RATION

	Feeding Periods		
	6/2 to 7/6	7/7 to 8/17	8/18 to 9/27
Ingredients	%	%	%
Ground shelled corn -----	76.5	84.5	89.5
Soybean meal 50% --------	7.0	1.5	.55
Premix[1]	16.5	14.0	9.95
	100.0	100.0	100.0
Calculated chemical composition			
Crude protein % ---------	16	14	12
Fat % ------------------	4	3.5	3.5
Fiber % ----------------	2.7	2.8	2.8

[1] Exact composition of the premix was confidential. The ingredients used in the premix were as follows: dehydrated alfalfa meal, meat and bone scraps, limestone, defl. phosphate and salt.

TABLE 3. EXPERIMENTAL DESIGN

	Treatment Lots 1	2	3	4[a]	5[a]	6
Antibiotic[b]						
SP-250, 5 lbs. Premix/ton for 10 days	-	-	-	+	+	+
Neomycin, 80 grams/ton	+	-	-	+	-	-
Bacitracin MD, 40 grams/ton	-	+	-	-	+	-

a. Lots 4 and 5 received neomycin and bacitracin respectively after the first ten-day period.

b. SP-250 contains a combination of the following antibacterial drugs: chlortetracycline, 20 grams per pound; sulfamethazine, 4.4 per cent and penicillin from procaine penicillin, 10 grams per pound. The SP-250 used for this experiment was furnished through the courtesy of American Cyanamid Company, Princeton, New Jersey.

Neomycin (Veterinary Grade) contains: 325 gms. Neomycin Sulfate per pound, equivalent to 227.5 gms. Neomycin base activity per pound. Bacitracin MD supplement contains 25 gms. of bacitracin MD (methylene disalicycate) per pound. Neomycin and Bacitracin for this experiment were furnished through the courtesy of S. B. Penick and Company, 100 Church Street, New York 8, New York.

Lot one received Neomycin 80 grams per ton of basal ration; lot two received 40 grams of bacitracin MD per ton, and lot three received no antibiotic. Lot 4 received SP-250 (5 pounds per ton) for the first 10 days. This lot then received 80 grams of Neomycin per ton of feed for the remainder of the study. Lot 5 was supplemented with SP-250 for 10 days, followed by Bacitracin MD (40 grams per ton) for the rest of the study. Lot 6 received SP-250 (5 pounds per ton) for 10 days and the no antibiotic was used in this lot for the remainder of the study.

Feed efficiency values were calculated for each lot for the 91-day feeding period.

At the end of the feeding period, the first draft of hogs, which included all hogs in each lot weighing approximately 200 pounds, was removed and transported by truck to Valleydale Packing Plant, approximately 12 miles, for slaughter. Hogs from each lot were tattooed on the shoulder with a lot number and weighed by lots.

A second draft of hogs was slaughtered 14 days later as they reached 200 pounds; the remaining hogs in each lot were all removed 32 days later. The last two drafts were handled in the same manner at the packing plant as the first. The second and third drafts were held in their respective pens on their experimental rations until slaughter.

At the packing plant, the carcasses were allowed to chill overnight at 36-40 degrees Fahrenheit for approximately 20 hours after which time the weight of each chilled carcass was recorded. Backfat thickness was determined on the split carcass at the first rib, last rib and last lumbar vertebra; carcass length was measured from the first rib to aitch bone.

An attempt was made to determine the presence of pathogentic organisms in the intestinal tract of the pigs. Anal swab samples from 6 pigs in each lot were taken at the beginning of the experiment and after 27 days on test. These swabs were cultured and the bacterial growth was classified.

ADG of the pigs in the six experimental lots were subjected to a statistical analysis to determine if real differences existed among the ADG of the six lots. Initially, a straightforward analysis of variance was conducted. Recognizing the possible effect of marked difference in initial body weight within lots on the growth rate of the pigs, an analysis of co-variance was then conducted to evaluate this potential source of variance. The lot mean ADG were then adjusted on the basis of a common initial weight of the pigs within each lot. The differences among the adjusted mean ADG were then tested for significance.

The feed intake and feed efficiency data were not analyzed statistically due to lack of replications of the six treatments.

RESULTS

Average Daily Gain

The influence of the various antibiotic treatments on pig growth rate is shown in table 4. The statistical analysis revealed a significant ($P < .01$) increase in ADG by feeding SP-250 for the first 10 days of the study. This was an average increase of 0.2 of a pound daily due to SP-250 supplementation. The significance of this increase was indicated by both an analysis of variance test (table 5) and an analysis of co-variance (table 8) in which the pig gains were adjusted for initial body weight.

The variance among lots was broken down for the single comparisons of interest in the study. These comparisons and their associated mean squares are shown in table 6. It should be pointed out that the design of this experiment does not permit a direct comparison of the various antibiotics used since the levels of the respective antibiotic agents were not equal. The various antibiotics can, however, be compared to the control lots and their effectiveness measured against that of the controls. It is evident from the analysis that the addition of 80 gm. (per ton of feed) of neomycin (lot 1) did not increase the ADG over that of control group (lot 3). Similarly, 40 gm. per ton of bacitracin did not significantly vary the ADG of lot 2 from that of the control lot. There was, on the other hand, a highly significant difference ($P < .01$) between the ADG of lot 3

TABLE 4. EFFECT OF ANTIBIOTIC SUPPLEMENTATION ON DAILY GAIN, FEED INTAKE, AND FEED EFFICIENCY (91 DAYS)

	Treatment					
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
	Neomycin	Bacitracin	No antibiotic	SP-250 for 10 days then Neomycin	SP-250 for 10 days then Bacitracin	SP-250 for 10 days then no antibiotic
No. pigs	50	50	50	50	50	50
Initial weight, lbs.	52	52	52	52	52	52
Average final weight, lbs.	173	177	177	198	195	191
ADG, lbs.	1.35[a]	1.40[a]	1.36[a]	1.57[b]	1.59[b]	1.53[b]
Average daily feed intake, lbs.	4.64	4.83	5.12	4.69	5.07	4.56
Average feed efficiency, lbs.	3.48	3.55	3.87	2.96	3.25	2.98

[a] Means bearing the same superscript are not significantly different.

TABLE 5. ANALYSIS OF VARIANCE OF AVERAGE DAILY GAINS

Source	D.F.	Sum of Squares	Mean Squares	F
Total	299	20.4619		
Among Lots	5	2.9583	0.5917	9.94**
Within Lots	294	17.5036	0.0595	

TABLE 6. INDIVIDUAL COMPARISONS OF INTEREST FOR AVERAGE DAILY GAIN

Source of Variation	D.F.	Sum of Sq.	Mean Sq.	F
Total	299	20.4619		
Among Lots	5	2.9583		
Control vs. Neomycin	1		.0010	
Control vs. Bacitracin	1		.0502	
Control vs. SP250	1		.7674	12.89**
SP250 vs. SP250 + Neo.	1		.0353	
SP250 + Neo. vs. SP250 + Baci.	1		.0756	
Within Lots	294	17.5036	.0595	

TABLE 7. CALCULATION OF ADJUSTED LOT MEANS AVERAGE DAILY GAIN

Lot	X	Deviation from Experiment Mean X	Product bx	Average Daily Gain Y		Adjusted Daily Gain Y-bx	
1	51.78	-0.07	-.000231	1.3512	6*	1.3510	6
2	51.46	0.25	.000825	1.4024	4	1.4032	4
3	52.00	-0.29	-.000957	1.3576	5	1.3566	5
4	52.00	-0.29	-.000957	1.5704	2	1.5694	2
5	51.40	0.31	.001023	1.5878	1	1.5888	1
6	51.62	0.09	.000297	1.5328	3	1.5331	3
Sums	310.26	0.00	0.0	8.8022		8.8021	

* Rank

TABLE 8. ANALYSIS OF COVARIANCE AND TEST OF SIGNIFICANCE OF ADJUSTED LOT MEAN AVERAGE DAILY GAIN

		Sums of Sqs. & Products			Errors of Estimate			
Source	D.F.	Ex^2	Exy	Ey^2	Sum of Sq.	D.F.	M.S.	F
Total	299	41762	136.65	20.4619	20.0148	298		
Lots	5	17	-1.86	2.9583				
Within Lots	294	41745	138.51	17.5036	17.0440	293	0.0582	
For test of significance of adjusted means					2.9708	5	0.5942	10.21**

and that of lot 6 (1.36 vs. 1.53 lbs. per day). The 10-day period of SP-250 supplementation (lot 6) produced gains comparable to that of SP-250 plus neomycin (lot 4). There was no significant difference in ADG between lots 4 and 5, indicating that levels of 80 gm. of neomycin and 40 gm. of bacitracin produced similar responses. It is of interest to note that this similarity existed when the two antibiotics were used alone or when they were used after a 10-day period in which SP-250 was fed.

A comparison of the unadjusted and adjusted lot means for ADG is presented in table 7. Adjusting the lot means for initial body weight did not alter the rank of the six means. The discrepancies between the adjusted and unadjusted means were small in all cases.

Feed Intake

While statistical analysis of the feed intake data was not possible, the variation in daily feed intake was not marked.

Examination of the data presented in table 4 shows a range of 4.56 lbs. (lot 6) to 5.12 lbs. (lot 3) in daily feed consumption. It is interesting to note that the feed intake of the lots which received neomycin alone (lot 1) or SP-250 for 10 days, then neomycin (lot 4), were very similar. There appeared to be no definite trend however, among the six lots.

Feed Efficiency

There appears to be a definite trend toward improved feed efficiency due to the supplementation of SP-250. The data presented in table 4 indicate this relationship between lots 1, 2, and 3 which did not receive SP-250 and lots 4, 5, and 6 which did.

Neomycin and bacitracin (lot 1 and lot 2) did not appear to materially improve feed efficiency when compared with no antibiotic (lot 3). It is evident from the figures in table 4 that the apparent improvement in feed efficiency is the result primarily of the increased ADG in lots receiving SP-250 since there was no marked difference in feed consumption.

This reduction of feed required per pound of gain due to the addition of SP-250 is most interesting and would suggest further investigation.

Carcass Characteristics

The results of the carcass evaluations are shown in table 9. There was little difference in the number or weight of the pigs removed in the first two drafts. The live weights for the various lots were similar except in the 3rd draft. The remaining hogs slaughtered in the 3rd draft from lots 4, 5, and 6 were somewhat heavier than those in lots 1, 2, and 3. This may reflect the improved ADG from SP-250 supplementation. The overall mean live weight at slaughter also had a tendency to be greater for lots 4, 5, and 6. There was essentially no difference among lots 1, 2, and 3 or among lots 4, 5, and 6 in live weight at slaughter. Mean slaughter weights were 220 lbs. and 212 lbs. for those supplemented with SP-250 and those not, respectively.

TABLE 9. EFFECT OF TREATMENTS ON THE WEIGHTS AND MEASURES OF CARCASS CHARACTERISTICS

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
	Neomycin	Bacitracin	No Antibiotic	SP-250 for 10 days then Neomycin	SP-250 for 10 days then Bacitracin	SP-250 for 10 days then no antibiotic
No. of Hogs						
1st Draft	9(212)[a]	18(200)	9(225)	28(206)	24(212)	12(216)
2nd Draft	10(212)	2(202)	12(217)	7(218)	4(222)	6(213)
3rd Draft	31(215)	24(216)[b]	28(211)[b]	15(231)	22(234)	32(234)
Total or average	50(213)	44(206)	49(217)	50(218)	50(222)	50(221)
Average Chilled Carcass Wt., Lbs.[c]	156.4	156.1	157.4	161.0	163.7	164.4
Average Dressing Percent[c]	72.97	72.89	73.54	73.54	73.47	72.09
Average Carcass Length, inches[c]	29.87	30.20	30.25	29.87	30.11	30.32
Average Back Fat Thickness, inches[c]	1.70	1.76	1.71	1.80	1.78	1.78

[a]Number in parenthesis is the mean live weight of each draft.

[b]Six carcasses in lot 2 and 1 carcass in lot 3 were lost in slaughtering process.

[c]Values presented are weighed averages of the three drafts.

Looking at the mean chilled carcass weights of pens 4, 5, and 6, there still was evidence of the slightly greater live weights as compared to lots 1, 2, and 3. The experimental treatments had essentially no effect on dressing % or carcass length (table 9).

While there were no marked differences in average back fat thickness observed among the lots, those lots receiving SP-250 had a tendency to have slightly thicker back fat. This occurrence is not unexpected in view of the greater carcass weights.

Bacteriological Study

The initial bacteria population present in the colon of the pigs sampled in each lot is presented in table 10. In lot 1, after 27 days of treatment, there were no proteus or hemolytic coliform noted. In lot 2 there was no marked change in the enteric flora noted; this was also true in lot 3. There was a reduction in the hemolytic coliforms and the numbers of streptococcus appeared to be reduced and no proteus was noted in lot 4. There appeared to be no significant change in the enteric flora in lot 5. Some reduction in streptococcus was noted in lot 6. The neomycin supplementation appeared to be effective in reducing the concentration of hemolytic coliform and proteus organisms. SP-250 and Bacitracin MD had a more obscure influence on the microbial population found in the intestinal tract.

TABLE 10. EFFECT OF ANTIBIOTICS ON INTESTINAL MICRO-FLORA

	Microorganism Isolated[a] 6/2/64	Microorganism Isolated 6/29/64
Lot 1 Neomycin	Coliform Proteus Hemolytic Coliform Streptococcus E. Coli	Coliform E. Coli
Lot 2 Bacitracin	Streptococcus Coliform Hemolytic Streptococcus Hemolytic Coliform E. Coli	E. Coli Hemolytic Coliforms Coliforms
Lot 3 No Antibiotic	Hemolytic Streptococcus Coliform Hemolytic Coliforms Non-Hemo Streptococcus E. Coli	Streptococcus Streptococcus like Coliform E. Coli
Lot 4 SP-250 and Neomycin	Coliform Hemolytic Coliform Streptococcus Proteus E. Coli	Coliform Streptococcus
Lot 5 SP-250 and Bacitracin	Hemolytic Coliform Hemolytic Streptococcus Streptococcus, Hemolytic Coliform Coliform E. Coli Hemolytic E. Coli	Coliform, Streptococcus Tiny Colony?
Lot 6 SP-250 then No Antibiotic	Coliform Hemolytic Coliform Streptococcus, Paracolon E. Coli	Tiny Colonies? Coliform

[a]The isolation and identification of microorganisms were done by the Vet. Sci. Dept. of the Va. Ag. Exp. Sta., Blacksburg.

DISCUSSION

Feed lot performance as measured by average daily gain in this study revealed a significant increase in gain (0.2 of a pound daily) by feeding SP-250 for the first 10 days of the trial. This improvement agrees with that reported by Elliott et al. (1964) in their work with SP-250. Other workers (Thrasher et al. 1960 and Conrad et al. 1957) report similar results where combination antibiotic supplementation was used in growing-finishing rations.

Neomycin and Bacitracin MD when supplemented alone at rates of 80 gm. and 40 gm. per ton of ration respectively were not effective in improving ADG. When considering the levels used, it may be entirely possible that improved performance from these two antibiotics could be obtained by supplementing at higher levels (100 gm. or higher per ton) for the first two weeks of the feeding period and followed by low levels (10-20 gm. per ton) to slaughter weight. Braude et al. (1953) reported inconclusive results with the addition of neomycin to pig rations. Bridges et al. (1954) also reported no improvement in ADG was obtained by the addition of bacitracin. Thrasher et al. (1960) however, using 20 gm. of zinc bacitracin per ton of finishing ration, reported a significant increase in rate of gain, feed intake and feed efficiency. The higher level of bacitracin used in the present study (40 gm. per ton) may explain in part the lack of improvement in ADG This study did not show any marked increase or decrease in feed intake among the six treatments. Apparently, the addition of antibiotics alone or in combination under these conditions did not stimulate or depress appetite. There appeared to be an improvement in feed efficiency in lots 4, 5, and 6 in this study. As there was little difference in feed intake, the improved efficiency was due to greater gains in the three lots receiving SP-250.

Several workers have reported improved feed efficiency when antibiotics were added to pig rations. Braude et al. (1953) have summarized (table 1) the early investigations and other workers, (Wallace et al. 1954, Jenson et al. 1955 and Hanson et al. 1955) all report that aureomycin or penicillin supplementation improves feed efficiency. Bacitracin also has been shown to improve feed efficiency (Bridges et al. 1954, Thrasher et al. 1960, and Wood et al. 1964). Bridges et al. (1954) reported that a combination of bacitracin and penicillin added to growing-finishing rations did not significantly increase growth rate, although, improved feed efficiency was obtained over the control lot. Thrasher et al. (1960) and Conrad et al. (1957) on the other hand reported results that were in agreement with this study, where a combination antibiotic supplementation improved growth rate and feed efficiency.

The improvement obtained in this study in growth rate and apparently feed efficiency due to combination antibiotic supplementation, would suggest that hog producers could well profit by the use of combination antibiotic addition to rations fed during the initial phases of the growing-finishing period. This may be particularly important to the hog feeder who purchases feeder pigs from varied sources.

The absence of any marked effect on the various carcass criteria measured in this study agrees with other workers (Wallace et al. 1954, Hanson et al. 1955 and Speer et al. 1956) who also reported no direct effect on carcass quality with the use of antibiotics in the ration. It would seem that hog feeders can use antibiotics as a means of improving production efficiency without detrimentally affecting quality of pork produced.

In determining type of micro-organisms present, when dealing with feeder pigs going on hog finishing floors, it is doubtful that the procedure used in the study would be feasible for determining the presence of the various organisms. However, this method may be valuable when visible signs of enteric disease are noticeable.

SUMMARY

A 91-day feeding trial involving 312 52-pound feeder pigs was conducted to determine the effect of five antibiotic treatments on performance and carcass characteristics under commercial feedlot conditions. The different antibiotic supplements were added to a common basal growing-finishing ration.

The five antibiotic treatments were: (1) 80 grams of Neomycin per ton, (2) 40 grams of Bacitracin MD per ton, (3) control, (4) SP-250 (5 lbs. per ton) for 10 days followed by 80 grams Neomycin, (5) SP-250 (5 lbs. per ton) for 10 days then 40 grams of Bacitracin MD and (6) SP-250 for 10 days alone.

The supplementation of SP-250 (lots 4, 5, and 6) for 10 days increased ($P < .01$) the ADG by 0.2 pounds over the controls. Neomycin and Bacitracin MD did not significantly affect the ADG. Combinations of SP-250 and Neomycin or Bacitracin MD produced gains similar to those of SP-250 alone.

While not statistically analyzed, feed intake did not appear to be affected by any of the treatments. Feed efficiency appeared to be improved by the addition of SP-250 to the ration due to the greater gains in these lots.

None of the treatments had a marked effect on the carcass length, carcass weight, back fat thickness, or dressing percent.

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VITA

Roie Monroe Godsey, born Gate City, Scott County, Virginia August 12, 1926, son of William E. and Sylvia E. Godsey. He was graduated from Midway High School in June 1944, and Virginia Polytechnic Institute in June 1950 receiving a B. S. degree in Animal Husbandry. In April 1950, he accepted a position as Assistant County Agricultural Agent for Tazewell County, Virginia. In February 1952, he was promoted to County Agricultural Agent for Clarke County, Virginia and in June 1953 transferred back to Tazewell County, as County Agricultural Agent. The author was promoted to a position as Assistant Professor of Animal Husbandry and Extension Swine Specialist, Virginia Polytechnic Institute, January 1955. The writer has accepted a position as Vice-President and Director of Agri-Business Department, Virginia National Bank, Norfolk, Virginia effective January 1, 1965.

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ABSTRACT OF THESIS
Submitted in Candidacy for Degree of
MASTER OF SCIENCE
in
ANIMAL SCIENCE

The Influence of Neomycin, Bacitracin and SP-250 In a Commercial Hog Finishing Operation

by
Roie M. Godsey

Three hundred and twelve feeder pigs, six lots of 52 pigs each (52 pounds) were used to study the response of five antibiotic supplementations in a commercial hog finishing operation.

Lot one received neomycin 80 grams per ton, lot two Bacitracin MD (40 grams per ton), and lot three no antibiotic. Lots four, five and six received SP-250 for 10 days (five pounds per ton). After termination of SP-250, lot four received neomycin (80 grams per ton), lot five bacitracin MD (40 grams per ton) and lot six no antibiotic.

At the end of the 91-day feeding period, the first draft of hogs, which included all hogs weighing approximately 200 pounds, was removed for slaughter. A second draft of hogs was slaughtered 14 days later, the remaining hogs in each lot were all removed 32 days later.

The supplementation of SP-250 (lots 4, 5 and 6) for 10 days increased (P .01) the ADG by 0.2 pounds over control. Neomycin and Bacitracin MD did not affect the ADG. Combinations of SP-250 and Neomycin or Bacitracin MD produced gains similar to those of SP-250 alone. Carcass length was measured from the first rib to the aitch bone, also average chilled carcass weight and dressing per cent were

obtained at the packing plant.

Feed intake did not appear to be affected by any of the treatments. Feed efficiency appeared to be improved by SP-250 due to the greater gains.

The overall mean live weight at slaughter also had a tendency to be greater for lots 4, 5, and 6. There was essentially no difference among lots 1, 2, and 3 or among lots 4, 5, and 6 in live weight at slaughter. Mean slaughter weights were 220 lbs. and 212 lbs. for those supplemented with SP-250 and those not, respectively.

Chilled carcass weights of pens 4, 5, and 6 evidenced the slightly greater live weights as compared to lots 1, 2, and 3. The treatments had no effect on dressing % or carcass length.

Those lots receiving SP-250 tended to have slightly thicker back fat.