MICROFLORA MANIPULATION OF ARTIFICIALLY REARED PIGLETS

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Summary

Three experiments were conducted with pigs to examine the influence of two antimicrobial agents on growth, blood parameters, the intestinal flora population and the therapeutic action on mycoplasma pneumonia. The pigs were fed a medicated milk replacer for 21 days in individual cages in an environmentally controlled room. In Experiment 1, pigs received two levels of lincomycin (L): 5 mg (LILO) and 10 mg (LIHI) injection per pound of body weight, and two levels of long-acting oxytetracycline (LAO): 100 mg (LALO) and 200 mg (LAHI) per injection and were compared to a control. Growth, feed efficiency, scour score, severity of mycoplasma pneumonia, leukocyte and erythrocyte counts were evaluated. LAHI reduced growth, feed efficiency and blood parameters. The LIHI pigs had a slight improvement in growth, feed efficiency and leukocyte count over the LILO pigs. These data suggest that the correct dosage rate of LAO is 100 mg per injection and of L is 10 mg per pound of body weight for improvement in performance of artificially reared piglets. In Experiment 2, coliform (EC) and lactobacillus (LB) counts from five portions of the gastrointestinal tract plus the feces were enumerated. The LAO increased EC and LB in the stomach. A combination treatment of LAO+L decreased LB in the stomach and depressed EC in the colon. Forty additional piglets were allotted to a nursery study to determine the effect of isolation after antimicrobial therapy on growth parameters and mycoplasma pneumonia. Isolation had no effect on growth or mycoplasma pneumonia during the nursery phase. In Experiment 3, piglets were challenged with mycoplasma pneumonia after antimicrobial therapy. No differences were observed in any portion of the lung for severity of mycoplasma pneumonia. The culture of mycoplasma pneumonia either did not infect the piglets or they showed no evidence of it's presence.

Introduction

Establishing and maintaining a healthy swine herd is a major factor in modern pork production. In herds that have a serious problem with mycoplasma pneumonia, production efficiency is greatly reduced. The experiments reported herein were conducted to determine the effect of a method which is easy to employ, cost-efficient, and applicable to the present management practices of the swine industry. The use of the early-weaned, artificially-reared piglets combined with treatment of lincomycin and long-acting oxytetracycline was evaluated as a system of manipulation of the microflora to eliminate some major pathogens endemic in swine herds.

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Experimental Procedures

Pigs were removed from sows at 12-24 hours of age and placed in an environmentally controlled room with temperatures maintained at 90-95 F. Piglets were placed in individual cages (1'x2'x1') made of welded wire, with 1/4" netting on the floor of the cages. Each cage was equipped with a plastic feeding cup with a 200 ml capacity. Piglets were allotted to the treatments by litter and weight. Piglets were fed four times daily on day one, three times on day two, and twice a day throughout the rest of the trials. They were fed a medicated milk replacer[3] mixed at the rate of three parts water to one part dried milk.

In Experiment 1, 55 piglets from 11 litters were assigned to one of five treatments to determine a dosage rate for manipulating the microflora. They received two levels of L: 5mg and 10mg per pound of body weight, and two levels of LAO: 100 mg and 200 mg per injection. The control group received no antibiotics. Lincomycin was administered intramuscularly for 3 days after birth and from day 14 to 16 of the experiment. Long-acting oxytetracycline was administered on day 1 and 14. Growth, feed efficiency, scour score, leukocyte and erythrocyte counts were evaluated. Piglets were sacrificed and lobes of the lung were scored for severity of mycoplasma pneumonia.

In Experiment 2, the effect of antimicrobial therapy on the intestinal flora was evaluated in 20 piglets from four litters, which were assigned to one of five treatements. The five treatments were: (1) control with non-medicated milk replacer; (2) control with neomycin medicated milk replacer; (3) lincomycin at 10 mg per pound of body weight; (4) long-acting oxytetracycline at 100 mg per injection; (5) and a combination of L and LAO. Pigs were reared and the same parameters were evaluated as in experiment 1. Coliform (EC) and lactobacillus (LB) counts from five portions of the gastrointestinal tract (GIT) and feces were enumerated. Cell-mediated immunity was evaluated by injecting phytohemagglutinin intradermally in the flank. Forty additional piglets were assigned to treatments 2-5 to evaluate the effect of isolation after antimicrobial therapy. The piglets were allotted randomly to either the research herd nursery or an isolation room. At the end of the 7-week nursery period the pigs were evalutated for growth parameters and severity of mycoplasma pneumonia.

In Experiment 3, 40 piglets from 10 litters were assigned by litter to one of four treatments to evaluate the influence of a challenge of mycoplasma pneumonia after antimicrobial therapy. All piglets were exposed at day 3 to a virulent culture of mycoplasma pneumonia inoculated intranasally. Control piglets were reared in a separate room to prevent continuous exposure of mycoplasma pneumonia to the other treatments.

Results and Discussion

Experiment 1. The performance and scours of the piglets are shown in table 1. Treatment with LAHI reduced final weight, average daily gain and feed efficiency compared to LALO and tended to depress the same parameters compared

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[3] Land O'Lakes

to the control. Treatment with lincomycin did not alter performance. Lincomycin treatment gave the highest average scour scores, with the incidence of scours increasing with increasing dosages of lincomycin. The increase in scours did not have adverse effects on performance. This is contrary to common belief that a scour belief that a scouring pig is less efficient and slower growing.

In Experiment 1, LALO-treated pigs had the greatest number of lung lesions in the right apical lobe, the right cardiac lobe and in the total lung average (table 2). More lesions appeared on the right side of the lung as is expected for mycoplasma pneumonia. Although there were no differences among the treatments for the right apical and cardiac lobes, the litter origin had a greater effect on the incidence of mycoplasma pneumonia lung lesions.

The blood data for this experiment are found in tables 3 and 4 for the two respective bleedings. The LAHI treatment reduced leukocyte counts, erythrocyte counts, hemoglobin, hematocrit, and neutrophils in bleeding 1. In bleeding 2 only hematocrit and hemoglobin were different from the other treatments. The LILO treatment depressed leukocytes in bleeding 1, which is reflected in a lower number of neutrophils compared to the control.

Experiment 2. The performance and scours of the piglets are shown in table 5. Piglets treated with lincomycin had the highest final weight and average daily gain. Feed efficiency tended to improve by treatment with L compared to the control. Adding L to LAO tended to improve average daily gain and feed efficiency. Lincomycin again gave the highest average scour score and combining it with LAO tended to increases scours. Lincomycin has been shown in other studies to be a growth promotant and these results support that idea.

The gastrointestinal flora were evaluated in 19 piglets from 4 litters (tables 6 and 7). Injecting the animals with LAO alone increased the number of coliforms and lactobacilli in the cardiac region of the stomach. The differences in the stomach were not carried through the remaining portion of the GIT. Lincomycin + LAO decreased LB in the stomach and depressed EC in the colon. A lower number of coliforms also was observed in the feces, but no reduction of scours was seen. Lincomycin by itself did not alter bacterial counts in any portion of the GIT.

The injection of phytohemagglutinin intradermally into the flank has been shown to determine the immune status of the pig. No change in the immune status was observed (table 8) among the treatments.

The effect of isolation on nursery performance is shown in table 9. Data were pooled by location, since no location effect was determined. Pigs from all treatments performed similarly during the nursery phase in final weight and average daily gain.

Experiment 3. The performance of piglets in Experiment 3 is shown in table 10. Realizing that location difference was confounded with treatment in this trial, it was necessary to avoid cross-contamination of mycoplasma pneumonia. No differences in performance or severity of lung lesions (table 11) were observed for any of the treatments.

Table 1. Effect of Dosage Level on Performance and Scours, Trial 1.[ab]

Item	Treatments[c]					
	CTRL	LILO	LIHI	LALO	LAHI	SEM[g]
No. piglets initially	11	11	11	11	11	
Initial wt, lbs	3.48	3.48	3.40	3.37	3.43	.06
Final wt, lbs[de]	8.29	8.07	8.36	8.97	7.32	.39
Average daily gain, lbs[de]	.24	.23	.25	.28	.20	8
Feed:gain[de]	1.05	0.99	0.93	0.94	1.18	.05
Average scour score[df]	1.37	2.08	2.14	1.39	1.54	.15
No. piglets survived	10	10	11	11	11	

[a]Each value is the mean of the number of surviving piglets.

[b]Trial endpoint at 20 days.

[c]CTRL=control, LILO=lincomycin 5 mg/lb. body wt, LIHI=lincomycin 10 mg/lb. body wt, LALO=long-acting oxytetracycline 100 mg/injection, LAHI=long-acting oxytetracycline 200 mg/injection.

[d]Treatment effect ($P<.05$).

[e]Significant ($P<.05$) quadratic effect of long-acting oxytetracycline.

[f]Significant ($P<.05$) linear effect of lincomycin.

[g]Standard error of the mean.

Table 2. Effect of Dosage Level on Macroscopic Lung Lesions, Trial 1.[ab]

Item	Treatments[c]					
	CTRL	LILO	LIHI	LALO	LAHI	SEM
Right cardiac lobe[d]	.305	.175	.112	.727	0.00	.21
Right apical lobe[d]	.405	0.00	.118	.727	0.00	.24
Left cardiac lobe	.097	0.00	0.00	0.00	0.91	.06
Left apical lobe	.061	.061	0.00	.182	0.00	.08
Total lung avg.[de]	.217	.057	.055	.409	.023	.12

[a]Each value is the mean of the number of surviving piglets.

[b]Trial endpoint at 20 days.

[c]CTRL=control, LILO=lincomycin 5 mg/lb. body wt, LIHI=lincomycin 10 mg/lb. body wt, LALO=long-acting oxytetracycline 100 mg/injection, LAHI=long-acting oxytetracycline 200 mg/injection.

[d]Treatment effect ($P<.05$).

[e]Total lung avg. = Summation of lobe lung lesion means for each treatment/4.

Table 3. Effect of Dosage Level on Blood Parameters - First Bleeding, Trial 1.[ab]

Item	Treatments[c]					
	CTRL	LILO	LIHI	LALO	LAHI	SEM
Leukocytes[dfg] x 10^3	16.6	11.5	15.1	15.7	10.9	1.1
Erythrocytes[d] x 10^6	5.91	6.15	6.11	5.94	5.48	.18
Hemoglobin[dg] g/dl	11.8	11.8	11.6	11.3	10.2	.3
Hematocrit[dg] %	37.8	37.4	36.3	36.2	33.5	.9
Neutrophils[dfg]	10866	6236	9406	9801	5046	900
Band cells	526	671	532	558	494	100
Lymphocytes[defgh]	3994	4146	4467	4690	4556	400
Monocytes[defgh]	993	358	524	469	599	100
Eosinophils	128	56	73	135	160	34
Basophils[g]	52	8	23	17	5	15
Myelocytes	0	0	0	0	5	2
Metamyelocytes	87	53	56	37	80	28

[a]Each value is the mean of the number of surviving piglets.

[b]Piglets bled on day 4 of trial.

[c]CTRL=control, LILO=lincomycin 5 mg/lb. body wt, LIHI=lincomyci 10 mg/lb. body wt, LALO=long-acting oxytetracycline 100 mg/injection, LAHI=long-acting oxytetracycline 200 mg/injection.

[d]Treatment effect (P<.05).

[e]Significant (P<.05) linear effect of lincomycin.

[f]Significant (P<.05) quadratic effect of lincomycin.

[g]Significant (P<.05) linear effect of long-acting oxytetracycline.

[h]Significant (P<.05) quadratic effect of long-acting oxytetracycline.

Table 4. Effect of Dosage Level on Blood Parameters - Second Bleeding, Trial 1[ab]

Item	Treatments[c]					
	CTRL	LILO	LIHI	LALO	LAHI	SEM
Leukocytes x 10^3	14.2	13.5	15.3	13.1	11.9	1.1
Erythrocytes x 10^6	7.13	6.88	6.84	6.93	6.79	.22
Hemoglobin[d] g/dl	12.6	12.2	12.1	12.0	11.2	.3
Hematocrit[d] %	38.4	37.6	36.7	36.8	35.5	.9
Neutrophils	6748	5900	8104	6301	4951	1200
Band cells	240	130	272	83	182	94
Lumphocytes	6449	6626	5848	6062	6024	380
Monocytes[d]	541	528	815	444	463	120
Eosinophils	151	125	206	171	196	36
Basophils	28	0	25	11	7	19
Myelocytes	10	0	0	0	0	3
Metamyelocytes	39	46	66		7	31

[a]Each value is the mean of the number of surviving piglets.

[b]Piglets bled on day 18 of trial.

[c]CTRL=control, LILO=lincomycin 5 mg/lb. body wt, LIHI=linconiycin 10 mg/lb. body wt, LALO=long-acting oxytetracycline 100 mg/injection, LAHI=long-acting oxytetacycline 200 mg/inejction.

[d]Treatment effect (P<.05).

Table 5. Effect of Anitmicrobials on Performance and Scours, Trial 2.[ab]

Item	Treatments[c]					SEM
	CTO	CTN	LIN	LAO	L+L	
No. piglets initially	4	14	14	14	14	
Initial weight (lbs)	4.08	4.06	4.12	3.73	4.17	.13
Final weight (lbs)	9.52	9.32	10.58	9.15	10.16	.41
Average daily gain, lbs	.25	.24	.29	.25	.27	7
Feed:gain	1.00	1.10	0.91	0.98	0.96	.08
Average scour score	1.41	1.29	1.63	1.40	1.51	.08
No. piglets survived	4	14	14	13	12	

[a]Each value is the mean of the number of surviving piglets.

[b]Trial endpoint at 22 days.

[c]CTO=control with nonmedicated milk replacer, CTN=control with neomycin-medicated milk replacer, LIN=lincomycin 10 mg/lb. body wt, LAO=long-acting oxytetacycline 100 mg/injection, L+L=combination of LIN and LAO.

[d]Treatment effect (P<.05).

Table 6. Effect of Antimicrobials on Coliforms, Trial 2.[ab]

Item	Treatments[c]					SEM
	CTO	CTN	LIN	LAO	L+L	
	Log CFU per g of tissue[d]					
Stomach[e]	Nil[f]	2.87	Nil	5.25	1.16	.9
Duodenum	Nil	1.82	1.23	3.69	2.44	1.5
Ileum	2.51	4.89	2.72	2.79	1.98	1.7
Cecum	6.99	7.72	5.34	5.32	6.74	1.4
Colon[e]	7.49	8.20	7.20	7.99	7.04	.3
Feces	7.89	8.44	7.46	7.03	5.31	1.7

[a]Four litters sacrificed on consecutive days, day 20 - 23 of the trial.

[b]Each value is the mean of four piglets.

[c]CTO=control with nonmedicated milk replacer, CTN=control with neomycin-medicated milk replacer, LIN=lincomycin 10 mg/lb. body wt, LAO=long-acting oxytetracycline 100 mg/injection, L+L=combination of LIN and LAO.

[d]Log of colony-forming units.

[e]Treatment effect ($P<.05$).

[f]Too few to count.

Table 7. Effect of Anitmicrobials on Lactobacillus, Trial 2.[ab]

Item	Treatments[c]					SEM
	CTO	CTN	LIN	LAO	L+L	
	Log CFU per g of tissue[d]					
Stomach[e]	7.62	7.52	7.77	8.17	6.61	.4
Duodenum	7.10	6.88	6.17	7.31	7.78	.4
Ileum	7.03	8.18	7.81	7.90	8.12	.6
Cecum	8.54	9.32	9.35	7.60	9.35	1.2
Colon[e]	9.59	9.31	9.54	9.60	9.22	.3
Feces	9.33	9.63	10.17	10.04	9.77	.4

[a]Four litters sacrificed on consecutive days, day 20-23 of the trial.

[b]Each value is the mean of number of piglets.

[c]CTO=control with nonmedicated milk replacer, CTN=control with neomycin-medicated milk replacer, LIN=lincomycin 10 mg/lb. body wt, LAO=long-acting oxtetracycline 100 mg/injection, L+L=combination of LIN and LAO.

[d]Log of colony-forming units.

[e]Treatment effect ($P<.05$).

Table 8. Effect of Antimicrobials on Cell-Mediated Immunity and Microscopic Lung Lesions, Trial 2.

Item	Treatments[a]					
	CTO	CTN	LIN	LAO	L+L	SEM
Skin Fold Difference (mm)[bc]	5.94	7.06	6.79	6.88	6.54	.78
Total Lung Ave.[d]	-	1.30	1.10	1.40	1.20	.20

[a]CTO=control with nonmedicated milk replacer, CTN=control with neomycin-medicated milk replacer, LIN-lincomycin 10 mg/lb. body wt, LAO=long-acting oxytetracycline 100 mg/injection, L+L=combination of LIN and LAO.

[b]Each value is the mean of all artificially reared piglets.

[c]Cell-mediated immunity from day 20-21.

[d]Each value is the mean of piglets in the nursery.

Table 9. Effect of Antimicrobials and Isolation on Subsequent Nursery Performance, Trial 2.[ab]

Item	Treatments[c]				SEM
	CTO	LIN	LAO	L+L	
No. piglets initially	9	10	9	10	
Weaning wt (lbs)	9.85	10.97	9.72	10.23	.5
Final wt. (lbs)	49.27	47.42	48.24	48.66	2.4
Average daily gain (lbs)	1.65	1.52	1.61	1.63	.04
Feed:gain[d]	2.03	1.92	2.00	2.03	.13
No. piglets finish	9	10	9	10	

[a]Since no location difference (P>.05) on performance was observed each value is the pooled mean of two pens with five pigs in each pen.

[b]Trial endpoint at 52 day.

[c]CTN=control with neomycin-medicated milk replacer, LIN=lincomycin 10 mg/lb. body wt, LAO=long-acting oxytetracycline 100 mg/injection, L+L=combination of LIN and LAO.

[d]Treatment effect (P<.05).

Table 10. Effect of Challenge of Mycoplasma Pneumonia on Performance, Trial 3.[ab]

Item	Treatments[c]				
	CTO	LIN	LAO	L+L	SEM
No. piglets initially	10	10	10	10	
Initial weight (lbs)	3.55	3.59	3.59	3.73	.05
Final weight (lbs)	10.89	10.43	9.24	10.93	.69
Average daily gain (lbs)	.32	.30	.25	.31	14
Feed:gain[d]	.83	1.08	1.17	1.00	.09
Number of piglets finish	9	8	6	4	

[a]Each value is the mean of the number of surviving piglets.

[b]Trial endpoint at 23 days; Challenge given on day 5.

[c]CTN=control with neomycin-medicated milk replacer, LIN=lincomycin 10 mg/lb. body wt, LAO=long-acting oxytetracycline 100 mg/injection, L+L=combinatin of LI and LAO.

[d]Treatment effect ($P<.05$).

Table 11. Effect of Challenge of Mycoplasma Pneumonia on Macroscopic Lung Lesions, Trial 3.[ab]

Item	Treatments[c]				
	CTO	LIN	LAO	L+L	SEM
Right cardiac lobe	0.06	0.00	0.43	0.13	.17
Right apical lobe	0.00	0.04	0.04	0.11	.08
Left cardiac lobe	0.00	0.00	0.21	0.13	.11
Left apical lobe	0.00	0.00	0.00	0.25	.11
Total lung avg.[d]	0.01	0.00	0.17	0.16	.09

[a]Each value is the mean of the number of surviving piglets.

[b]Trial endpoint at 23 day.

[c]CTN=control with neomycin-medicated milk replacer, LIN=lincomycin 10 mg/lb. body wt, LAO=long-acting oxytetracycline 100 mg/injection, L+L=combination of LIN and LAO.

[d]Total lung avg. = Summation of lobe lesion means of each treatment/4.