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Effects of intermittent usage of water-based neomycin sulfate on the growth performance of weanling pigs

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EFFECTS OF INTERMITTENT USAGE OF WATER-BASED NEOMYCIN SULFATE ON THE GROWTH PERFORMANCE OF WEANLING PIGS

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Summary

A total of 360 weanling pigs (initially 11.4 lb and 18 ± 3 d of age, PIC) were used to determine the effects of intermittent use of water-based medication on nursery pig growth performance. Pigs were given one of eight experimental treatments: negative control (no antibiotics in the feed or water); positive control with Neo-Terramycin® in the feed (140 g/ton Neomycin sulfate, 140 g/ton Oxytetracycline HCl); continuous use of either 38.0 or 75.5 mg Neomycin sulfate per L of water; use of either 38.0 or 75.5 mg of Neomycin sulfate per L of water, during weeks 1 and 3 after weaning; and use of either 38.0 or 75.5 mg Neomycin sulfate per L of water during weeks 2 and 4 after weaning. Overall (d 0 to 28 after weaning), pigs provided Neomycin sulfate in the water continuously and pigs fed the positive control diet had greater ADG (P<0.05) and ADFI (P<0.04) than did pigs provided non-medicated water and feed. Pigs fed the positive control diet tended (P<0.15) to have greater ADG than did pigs provided an intermittent supply of water-based Neomycin sulfate, but there was no difference in growth performance and feed efficiency between pigs fed the positive control diet and those provided a continuous supply of water-based Neomycin sulfate. Pigs provided a continuous supply of either dosage of Neomycin sulfate in the water had greater (P<0.05) ADG and ADFI than did pigs provided water-based Neomycin sulfate on an intermittent basis. These data demonstrate that providing neomycin in the feed or water results in a growth response, but there is no carryover effect. Thus, pig performance returns to the control level immediately after the supply of Neomycin is removed.

(Key Words: Nursery Pig, Antibiotics, Water, Growth.)

Introduction

Recent research conducted at Kansas State University SEW facility showed that the use of water-based medication for nursery pigs improved growth performance, compared with that of pigs fed non-medicated feed and water. The majority of the response occurred at the lowest dosage level. Because of concern for medication cost and the amount of antimicrobial delivered to the pig, intermittent use of water-based medication could be a viable alternative to continuous dosage. If weanling pigs could be provided water-based Neomycin during alternating weeks of the nursery phase without sacrificing growth performance, producers could greatly save on the cost of medication delivery and reduce the total amount of antimicrobial delivered to the pig. Therefore, the objective of this experiment was to determine the effects of intermittent usage of wa-

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ter-based Neomycin on the growth performance of weanling pigs.

Procedures

A total of 360 weanling pigs (initially 11.4 lb and 18 ± 3 d of age, PIC) were blocked by initial weight, and were randomly allotted to one of eight dietary and/or water treatments. Individual pens were the experimental units and water was supplied by an individual line and bowl waterer in each pen. There were 5 pigs per pen and 9 pens per treatment. Pigs remained on the same treatments for 28 d after weaning. There were eight experimental treatments: negative control (no antibiotics in the feed or water); positive control with Neo-Terramycin® in the feed (140 g/ton Neomycin sulfate, 140 g/ton Oxytetracycline HCl); continuous use of either 38.0 or 75.5 mg Neomycin sulfate per L of water; use of either 38.0 or 75.5 mg of Neomycin sulfate per L of water during weeks 1 and 3 after weaning; and use of either 38.0 or 75.5 mg Neomycin sulfate per L of water during weeks 2 and 4 after weaning. When used, 19.0 or 37.8 ml of Neomycin liquid (200 mg/ml Neomycin sulfate) was provided per L of water. This provided 38.0 or 75.5 mg of Neomycin sulfate per L of water. Pigs that received water-based antibiotics were fed the negative control diet that did not contain an antibiotic.

Water-based medication was administered through SelectDoser™ peristaltic pumps (Genesis Instruments; Elmwood, WI). This type of doser is powered by electricity, and siphons a concentrated, pre-mixed stock solution through a tube and doses the medication into the existing water supply. Concentrated stock solutions were made once every two days throughout the experiment. Each concentrated solution consisted of 220.0 g citric acid (as a water-line cleaner and drug solubility aid) and 4 L of water with either 76 or 151 ml Neomycin liquid. Pigs not receiving water-based medication were administered a control water treatment only containing citric acid. These concentrated stock solutions were dosed into the existing water line at a ratio of 1:100 to achieve the desired dosage of medication.

Dietary treatments were fed in meal form (Table 1). Phase 1 (d 0 to 14 after weaning) diets were formulated to contain 1.41% true ileal digestible (TID) lysine, 0.90% Ca, and 0.50% available phosphorus. Phase 2 (d 14 to 28 after weaning) diets were formulated to contain 1.31% TID lysine, 0.83% Ca, and 0.39% available phosphorus. The trial was conducted in an environmentally controlled segregated early-weaning nursery facility at Kansas State University. Each pen was 5 × 5 ft and contained one self-feeder and one bowl waterer to provide *ad libitum* access to feed and water. Average daily gain, ADFI, and F/G were determined by weighing pigs and feeders on d 7, 14, 21, and 28 after weaning. In addition, water disappearance was measured. Data were analyzed as a randomized complete-block design, with pen as the experimental unit. Analysis of variance was performed by using the MIXED procedure of SAS.

Results and Discussion

From d 0 to 7 after weaning, the mean of pigs provided continuous water-based Neomycin sulfate had greater ($P<0.02$) ADFI and tended ($P<0.12$) to have greater ADG than did pigs provided non-medicated water and feed. There were no differences in growth performance between pigs provided continuous water-based Neomycin sulfate and those provided the positive control diet and non-medicated water, but, compared with the mean of pigs provided Neomycin sulfate intermittently, those provided medication continuously had greater ($P<0.03$) ADFI and tended ($P<0.06$) to have greater ADG.

From d 7 to 14, the mean of pigs provided continuous water-based Neomycin sulfate had greater ($P<0.02$) ADG and tended ($P<0.07$) to have greater ADFI than did pigs provided non-medicated water and feed. The mean of pigs provided water-based Neomycin sulfate on a continuous basis had greater ($P<0.01$) ADG and tended to have improved ($P<0.07$) ADFI, compared with the mean of pigs provided medication intermittently.

From d 14 to 21, pigs provided either continuous or intermittent water-based Neomycin sulfate and pigs provided the positive control diet with non-medicated water had greater ADG ($P<0.01$) and ADFI ($P<0.02$) than did pigs provided non-medicated water and feed. Pigs provided the positive control diet with non-medicated water also had greater ($P<0.05$) ADG than did the mean of pigs provided intermittent water-based medication. Pigs provided a continuous supply of water-based Neomycin sulfate had greater ($P<0.01$) ADG and tended ($P<0.08$) to have greater ADFI than did the mean of pigs provided medication intermittently.

From d 21 to 28, the mean of pigs continuously provided water-based Neomycin sulfate had poorer ($P<0.01$) F/G than did pigs provided non-medicated water and feed. Furthermore, pigs intermittently provided water-based Neomycin sulfate had improved ($P<0.02$) F/G, compared with that of pigs provided the same dosage of medication continuously.

Overall (d 0 to 28 after weaning), pigs provided Neomycin sulfate in the water continuously and pigs fed the positive control diet had greater ADG ($P<0.05$) and ADFI ($P<0.04$) than did pigs provided non-medicated water and feed. In addition, pigs fed the positive control diet tended ($P<0.15$) to have greater ADG than did pigs provided an intermittent supply of water-based Neomycin sulfate. There was no difference, however, in growth performance and feed efficiency between pigs fed the positive control diet and those provided a continuous supply of water-based Neomycin sulfate. Pigs provided a continuous supply of water-based Neomycin sulfate had greater ADG ($P<0.02$) and ADFI ($P<0.04$), compared with that of pigs provided water-based Neomycin sulfate on an intermittent basis.

Economic analysis was performed on all treatments and data calculated included: antimicrobial cost per pig (d 0 to 28), feed- and water-based antimicrobial (if applicable) cost per pound of gain, margin over feed and water-based antimicrobial (if applicable). Overall (d 0 to 28), pigs provided either continuous or intermittent water-based Neomycin sulfate and pigs provided the positive control diet and non-medicated water had a greater ($P<0.03$) antimicrobial cost per pig and cost per pound of gain than did pigs provided non-medicated feed and water. Pigs provided either continuous or intermittent water-based Neomycin sulfate also had greater ($P<0.01$) antimicrobial cost per pig and cost per pound of gain than did pigs provided the positive control diet and non-medicated water. Among pigs provided water-based medication, pigs provided Neomycin sulfate continuously had a greater ($P<0.01$) antimicrobial cost per pig and cost per pound of gain than did those provided medication intermittently.

For margin over feed and antimicrobial costs, pigs provided the positive control diet and non-medicated water had a greater ($P<0.04$) margin than did pigs provided intermittent water-based Neomycin sulfate and non-medicated feed; the margin for pigs provided continuous water-based Neomycin sulfate was intermediate. Although there was no significant difference for margin over feed and antimicrobial costs between pigs fed the positive control diet and those provided the negative control or continuous water-based medication, numerical differences were observed. Pigs provided non-medicated water and feed had a $0.40 lower margin over feed and antimicrobial cost per pig, whereas pigs provided water-based Neomycin sulfate at 38.0 and 75.5 mg/L had $0.24 and $0.39 lower margin over feed and antimicrobial costs per pig, respectively, than did pigs fed the positive control diet.

In this experiment, water disappearance was slightly less than expected, but followed similar trends in relation to the age of the pigs. In terms of percentage of BW, water disappearance was 15.11% from d 0 to 7. This rate increased slightly during Week 2 of the experiment, but then decreased to 11.36% during Week 4. The overall (d 0 to 28) average water disappearance for the experiment was 14.35% of BW. When expressed as liters per day, however, there is a steady increase in the volumetric disappearance of water as the pigs get older (Table 4).

During the first week of the experiment, water disappearance was 1.98 L/d. This steadily increased to 4.26 L/d by Week 4 of the trial. The overall (d 0 to 28) average water disappearance was 3.32 L/d. Figure 1 shows the increase in water disappearance with the increase in age of the early-weaned nursery pig.

In conclusion, intermittent use of Neomycin sulfate in the water decreased growth performance, compared with that of pigs provided Neomycin sulfate continuously. This indicates that there must be a continual supply of antimicrobials to the nursery pig to optimize growth performance. In addition, antimicrobial cost per pig and feed plus antimicrobial cost per pound of gain is increased by using water as the mode of medication delivery. Margin over feed plus antimicrobial cost is significantly reduced by providing water-based medication to pigs intermittently, whereas only a numerical decrease, lacking significance, was observed with pigs provided water-based medication continuously. The improvement in nursery pig growth performance and resulting increased revenue per pig as a result of continuous feed- or water-based medication offsets the increased cost, compared with results from intermittent use. Further research is needed to determine the lowest dosage of growth-promoting antimicrobial that can be used without sacrificing health and performance, and thus profit. In addition, further research is needed to more accurately quantify the water disappearance and actual water intake of nursery pigs.

Table 1. Phase 1 Diet Composition (As-fed Basis)[a]

Ingredient, %	Negative Control	Positive Control
Corn	51.11	51.11
Soybean meal (46.5% CP)	30.16	30.16
Spray dried whey	10.00	10.00
Select menhaden fish meal	3.75	3.75
Soy oil	1.00	1.00
Monocalcium P (21% P)	1.20	1.20
Limestone	0.75	0.75
Salt	0.35	0.35
Vitamin premix	0.25	0.25
Trace mineral premix	0.15	0.15
L-threonine	0.15	0.15
DL-methionine	0.13	0.13
L-lysine HCl	0.30	0.30
Corn starch	0.70	---
Neo-Terramycin® [b]	---	0.70
Total	100.00	100.00
Calculated analysis		
Total lysine, %	1.55	1.55
True digestible amino acids		
Lysine, %	1.41	1.41
Isoleucine:lysine ratio, %	60	60
Leucine:lysine ratio, %	122	122
Methionine:lysine ratio, %	32	32
Met & cys:lysine ratio, %	56	56
Threonine:lysine ratio, %	66	66
Tryptophan:lysine ratio, %	17	17
Valine:lysine ratio, %	68	68
ME, kcal/lb	1,493	1,493
CP, %	21.9	21.9
Ca, %	0.90	0.90
P, %	0.79	0.79
Available P, %	0.50	0.50

[a]Fed from d 0 to 14 after weaning.
[b]Neo-Terramycin® (140 g/ton Neomycin sulfate, 140 g/ton Oxytetracycline HCl).

Table 2. Phase 2 Diet Composition (As-fed Basis)[a]

Ingredient, %	Negative Control	Positive Control
Corn	59.27	59.27
Soybean meal (46.5% CP)	35.10	35.10
Spray dried whey	---	---
Select menhaden fish meal	---	---
Soy oil	1.00	1.00
Monocalcium P (21% P)	0.50	0.50
Limestone	1.10	1.10
Salt	0.35	0.35
Vitamin premix	0.25	0.25
Trace mineral premix	0.15	0.15
L-threonine	0.15	0.15
DL-methionine	0.13	0.13
L-lysine HCl	0.30	0.30
Corn starch	0.70	---
Neo-Terramycin® [b]	---	0.70
Total		
Calculated analysis		
Total lysine, %	1.45	1.45
True digestible amino acids		
Lysine, %	1.31	1.31
Isoleucine:lysine ratio, %	62	62
Leucine:lysine ratio, %	129	129
Methionine:lysine ratio, %	32	32
Met & cys:lysine ratio, %	57	57
Threonine:lysine ratio, %	67	67
Tryptophan:lysine ratio, %	18	18
Valine:lysine ratio, %	71	71
ME, kcal/lb	1,494	1,494
CP, %	21.4	21.4
Ca, %	0.83	0.83
P, %	0.72	0.72
Available P, %	0.39	0.39

[a]Fed from d 14 to 28 after weaning.
[b]Neo-Terramycin® (140 g/ton Neomycin sulfate, 140 g/ton Oxytetracycline HCl).

Table 3. Weekly Growth Performance of Early-weaned Nursery Pigs Provided Intermittent Water-based Medication[a]

			Neomycin Sulfate (mg/L water)						Probability, P<							
					Intermittent											
	Neg	Pos	Continuous		Weeks 1/3		Weeks 2/4			Neg Control vs.		Pos Control vs.			Continuous vs.	
Item	Con	Con[b]	38.0	75.5	38.0	75.5	38.0	75.5	Trt	Cont[c]	Int[c]	Neg	Cont	Int	Intermittent	SE
d 0 to 7																
ADG, lb	0.46	0.51	0.49	0.54	0.49	0.52	0.43	0.45	0.05	0.12	0.81	0.20	0.95	0.16	0.06	0.035
ADFI, lb	0.50	0.53	0.54	0.59	0.52	0.53	0.50	0.54	0.14	0.02	0.38	0.30	0.23	0.66	0.03	0.031
F/G	1.12	1.05	1.12	1.10	1.06	1.02	1.18	1.20	0.02	0.92	0.99	0.24	0.21	0.14	0.88	0.052
d 7 to 14																
ADG, lb	0.84	0.88	0.92	0.95	0.80	0.80	0.94	0.90	0.01	0.02	0.59	0.38	0.16	0.57	0.01	0.043
ADFI, lb	1.00	1.07	1.06	1.10	1.00	1.01	1.06	1.06	0.42	0.07	0.38	0.20	0.71	0.45	0.14	0.053
F/G	1.18	1.21	1.16	1.16	1.24	1.27	1.13	1.18	0.01	0.54	0.45	0.40	0.12	0.77	0.07	0.037
d 14 to 21																
ADG, lb	0.88	1.05	1.00	1.10	1.03	1.09	0.83	0.94	0.01	0.01	0.01	0.01	0.97	0.05	0.01	0.046
ADFI, lb	1.23	1.43	1.38	1.50	1.40	1.38	1.29	1.38	0.02	0.01	0.02	0.01	0.90	0.20	0.08	0.069
F/G	1.41	1.37	1.38	1.36	1.37	1.27	1.55	1.46	0.01	0.44	0.94	0.48	0.96	0.34	0.25	0.058
d 21 to 28																
ADG, lb	1.20	1.16	1.19	1.11	1.10	1.08	1.24	1.25	0.01	0.22	0.39	0.44	0.73	0.89	0.52	0.045
ADFI, lb	1.63	1.66	1.67	1.68	1.58	1.56	1.65	1.73	0.06	0.33	0.99	0.56	0.76	0.46	0.18	0.052
F/G	1.37	1.43	1.42	1.52	1.45	1.44	1.34	1.39	0.01	0.01	0.23	0.12	0.31	0.42	0.02	0.040
d 0 to 28																
ADG, lb	0.84	0.90	0.90	0.92	0.85	0.87	0.86	0.89	0.09	0.01	0.28	0.05	0.66	0.15	0.02	0.028
ADFI, lb	1.09	1.17	1.16	1.22	1.13	1.12	1.13	1.18	0.06	0.01	0.13	0.04	0.61	0.26	0.04	0.040
F/G	1.29	1.30	1.30	1.32	1.31	1.28	1.31	1.33	0.74	0.48	0.43	0.69	0.81	0.77	0.98	0.026

Table 3. (continued)

Antimicrobial Cost/pig[d]	$0.000	$0.145	$0.353	$0.700	$0.176	$0.350	$0.176	$0.350	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002
Feed + Water Cost/lb of gain[e]	$0.108	$0.114	$0.123	$0.137	$0.117	$0.122	$0.117	$0.125	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.002
Margin Over Feed & Water[f]	$7.44	$7.84	$7.60	$7.45	$7.37	$7.40	$7.42	$7.44	0.64	0.70	0.87	0.12	0.16	0.04	0.46	0.258

[a]A total of 360 weanling pigs, initially 11.4 lb and 18 ± 3 d of age (PIC L337 × C22). Values are the mean of 9 replications.
[b]Containing Neo-Terramycin® (140 g/ton Neomycin sulfate, 140 g/ton Oxytetracycline HCl).
[c]Cont refers to continuous use and Int refers to intermittent use.
[d]Includes antimicrobials in the feed or water consumed over the 28-d experimental period. Based on water-based Neomycin sulfate solution (200mg/ml) cost of $72.95/gal., and feed-grade Neo-Terramycin (10 g/lb Neomycin sulfate, 10 g Oxytetracycline/lb) cost of $0.63/lb
[e]Includes the cost of applicable water-based Neomycin sulfate solution and feed cost over the 28-d experimental period. Based on a negative-control feed cost of $206.64/ton and a positive-control feed cost of $214.34/ton.
[f]Based on current market price of $42.50/cwt. Calculated as gain × $42.50/cwt minus feed and antimicrobial cost per pig.

Table 4. Water Disappearance of Early-weaned Nursery Pigs[a]

Item	% Body Weight	Liters/day
d 0 to 7	15.11	1.98
d 7 to 14	16.08	3.35
d 14 to 21	14.84	3.69
d 21 to 28	11.36	4.26
d 0 to 28	14.35	3.32

[a]A total of 360 weanling pigs, initially 11.4 lb and 18 ± 3 d of age (PIC L337 × C22). Each value is the mean of 2 replications.

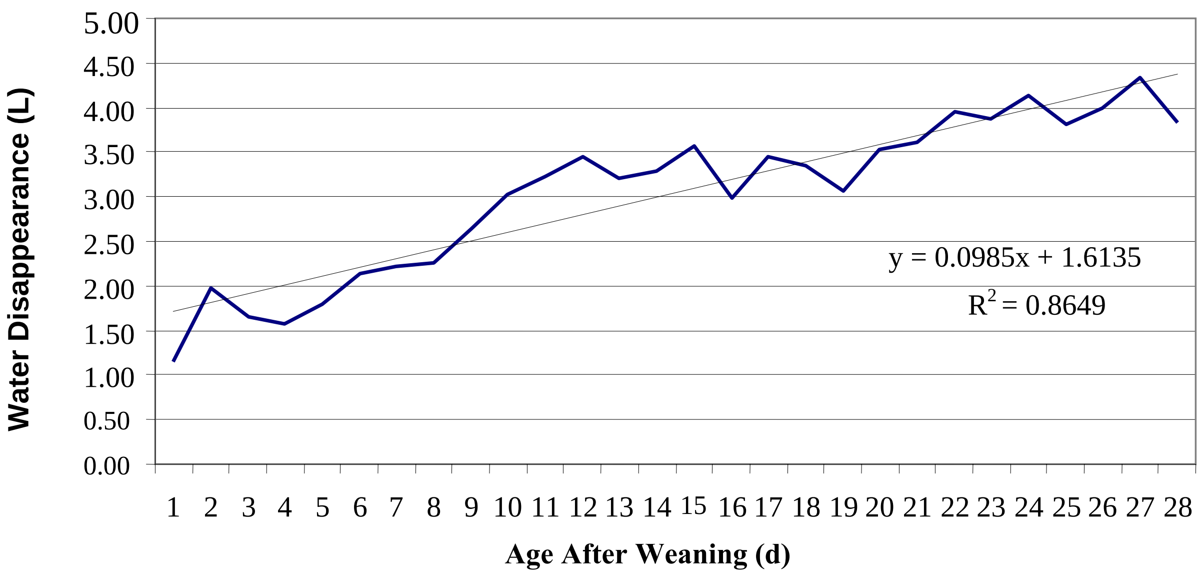

Figure 1. Volumetric Water Disappearance of Early-weaned Nursery Pigs. A total of 360 weanling pigs, initially 11.4 lb and 18 ± 3 d of age (PIC L337 × C22). Each value is the mean of 2 replications.