EFFECTS OF DIFFERENT DOSAGES OF WATER-BASED NEOMYCIN SULFATE ON GROWTH PERFORMANCE OF WEANLING PIGS

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Summary

A total of 360 weanling pigs (initially 14.1 lb and 21 ± 3 d of age, PIC) were used to determine the effects of different rates 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); 38.0, 75.5, or 113.5 mg of Neomycin sulfate per L of water; 100 or 200 g/ton of Neomycin sulfate in the feed; and Neo-Terramycin® in the feed and 75.5 mg of Neomycin per L of water. Overall (d 0 to 24 after weaning), pigs provided Neomycin sulfate in the water, pigs fed diets containing Neomycin sulfate, and pigs fed the positive control diet had greater ADG (P<0.02) and ADFI (P<0.05) than did pigs provided non-medicated water and feed. Pigs provided Neomycin sulfate in the water or feed also had improved F/G (P<0.05), compared with the F/G of pigs provided non-medicated feed and water. Pigs provided the combination of the positive control diet and Neomycin sulfate in the water had greater ADFI (P<0.04) and tended to have greater ADG (P<0.09) than did pigs fed the positive control with non-medicated water or pigs fed the negative control with Neomycin sulfate in the water. Increasing Neomycin sulfate in the water improved ADG (P<0.03) and ADFI (P<0.05). Increasing Neomycin sulfate in the feed improved ADG and ADFI (P<0.01) and improved F/G (P<0.03). There were no differences in growth performance between pigs provided Neomycin sulfate in the water and in the feed. Finally, there were no water medication × feed medication interactions for the overall treatment period, but main effects for water and feed medication were significant (P<0.02) for ADG and ADFI.

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

Introduction

A recent trial conducted at the Kansas State University SEW facility showed that the use of water-based medication for nursery pigs improved growth performance over that of pigs fed non-medicated feed and water. When compared with pigs fed in-feed medication, however, growth differences were not significant. The response shown by including medication in the water indicated the potential for improved growth performance at slightly larger doses and warranted further research to determine what dosages are optimal to meet or exceed the growth response shown in weanling pigs fed medication via the feed. Therefore, the objective of this experiment was to determine the optimal dosage of water-

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based Neomycin sulfate for weanling pigs and determine if it provides similar growth performance when fed separately or in combination with different amounts of in-feed medication.

Procedures

A total of 360 weanling pigs (initially 14.1 lb and 14 ± 3 d of age, PIC) were blocked by initial weight, and randomly allotted to one of eight dietary treatments. Individual bowl waterers replaced pairs of nipple waterers in the facility to allow the use of each pen as an experimental unit. There were 5 pigs per pen and 9 pens per treatment. Pigs remained on the same treatments for 24 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); 38.0, 75.5, or 113.5 mg of Neomycin sulfate per L of water; 100 or 200 g/ton Neomycin sulfate; and Neo-Terramycin® in the feed and 75.5 mg of Neomycin sulfate per L of water. When used, 19, 37.75, and 56.75 ml of Neomycin (200 mg/ml Neomycin sulfate) was provided per L of water, which provided 38.0, 75.5, and 113.5 mg, respectively, of Neomycin sulfate per L of water. Pigs that received only 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 solution consisted of citric acid (as a water-line cleaner and drug solubility aid) and 4 L of water, with either 76, 151, or 227 ml Neomycin. 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 24 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, and 24 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 14, pigs provided Neomycin sulfate in the water or the feed had greater ADG and ADFI ($P<0.01$) than did pigs provided non-medicated water and feed. Pigs provided Neomycin sulfate in the water also tended to have improved F/G ($P<0.11$), and pigs fed the positive control diet with non-medicated water tended to have greater ADG ($P<0.08$), compared with that of pigs provided non-medicated water and feed. Pigs provided the combination of the positive control diet and Neomycin sulfate in the water (75.5 mg/L) tended to have greater ADG and ADFI ($P<0.07$) than did pigs fed the positive control with non-medicated water. Increasing Neomycin sulfate in the water improved ADG and ADFI (linear, $P<0.03$) as did increasing Neomycin sulfate in the feed (linear, $P<0.02$).

From d 14 to 24, pigs provided Neomycin sulfate in the feed had greater ADG and ADFI ($P<0.01$), and tended to have improved F/G ($P<0.10$), compared with that of pigs provided non-medicated water and feed. Also, compared with pigs provided non-medicated water and feed, pigs provided Neomycin sulfate in the water and pigs fed the positive control diet tended to have greater ADG and ADFI ($P<0.08$). Pigs provided the combination of the positive control diet and Neomycin sulfate in the water (75.5 mg/L) tended to have greater ADFI ($P<0.07$) than did pigs fed the positive control with non-medicated water, and they had greater ADFI ($P<0.01$) than did pigs provided 75.5 mg Neomycin sulfate per L of water and non-medicated feed. Although increasing Neomycin sulfate in the water did not affect growth performance from d 14 to 24 after weaning, increasing Neomycin sulfate in the feed improved ADG (linear, $P<0.01$) and ADFI (linear, $P<0.02$), and tended to improve F/G (linear, $P<0.07$).

Overall (d 0 to 24 after weaning), pigs provided Neomycin sulfate in the water, pigs fed diets containing Neomycin sulfate, and pigs fed the positive control diet had greater ADG ($P<0.02$) and ADFI ($P<0.05$) than did pigs provided non-medicated water and feed. Pigs provided Neomycin sulfate in the water or feed also had improved F/G ($P<0.05$), compared with that of pigs provided non-medicated feed and water. Pigs provided the combination of the positive control diet and Neomycin sulfate in the water (75.5 mg/L) had greater ADFI ($P<0.04$), and tended to have greater ADG ($P<0.09$), than did pigs fed the positive control with non-medicated water or pigs fed the negative control with 75.5 mg of Neomycin sulfate per L of water. Increasing Neomycin sulfate in the water improved ADG (linear, $P<0.03$) and ADFI (linear, $P<0.05$). Increasing Neomycin sulfate in the feed improved ADG and ADFI (linear, $P<0.01$), and improved F/G (linear, $P<0.03$). There were no differences in growth performance between pigs provided Neomycin sulfate in the water or in the feed. There were no water medication × feed medication interactions for the overall treatment period, but main effects for water and feed medication were significant ($P<0.02$) for ADG and ADFI.

As reported in a previous experiment, water disappearance was variable within time periods. In this experiment, however, water disappearance was very similar to that seen in commercial nurseries using bowl waterers. In our experiment, also using bowl waterers, water disappearance was relatively similar throughout the trial, with an overall (d 0 to 24 after weaning) average of 22.9% of pig body weight (BW). As a result of installing new bowl waterers in our facility, water usage decreased by nearly 21% from that in a previous experiment, in which nipple waterers were used (22.9 vs. 28.9 % BW)

Water medication consumed by pigs in a previous experiment was less than expected because of water wastage. In this experiment, medication concentrations were based on an estimated consumption of 10% of BW, rather than disappearance. This allowed for increased medication consumption by the pigs and, thus, a greater response to the water-based medication treatments.

In this experiment, liquid Neomycin sulfate was used for water-based medication. In addition, citric acid was used as a water-line cleaner and drug solubility aid. All pigs received water with the same concentration of citric acid. There were fewer plugged nipples throughout the trial period when using Neomycin sulfate and citric acid. Citric acid is thought to increase water intake, but the response to this factor was not measured in this experiment.

The use of Neomycin sulfate in the water or feed resulted in improved growth performance, compared with that of pigs fed non-medicated feed and water. No differences were found in growth performance of pigs provided medication by either method. This indicates that water-based medication can be used in place of medication in the feed to yield similar growth performance. Furthermore, water usage by all pigs was improved by installing bowl waterers, which in turn can potentially reduce the cost of water-based medication practices through increased efficiency. Further research is needed to evaluate the use of citric acid a water-line cleaner, solubility aid, and water intake stimulant. In addition, research is needed to evaluate the costs of providing various dosages of water-based Neomycin sulfate and the growth performance and water consumption of nursery pigs using similar treatment protocols.

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

Ingredient, %	Negative Control	Positive Control	Neomycin Sulfate	
			100 g/ton	200 g/ton
Corn	51.11	51.11	51.11	51.11
Soybean meal (46.5% CP)	30.16	30.16	30.16	30.16
Spray dried whey	10.00	10.00	10.00	10.00
Select menhaden fish meal	3.75	3.75	3.75	3.75
Soy oil	1.00	1.00	1.00	1.00
Monocalcium P (21% P)	1.20	1.20	1.20	1.20
Limestone	0.75	0.75	0.75	0.75
Salt	0.35	0.35	0.35	0.35
Vitamin premix	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15
L-threonine	0.15	0.15	0.15	0.15
DL-methionine	0.13	0.13	0.13	0.13
Lysine HCl	0.30	0.30	0.30	0.30
Corn starch	0.70	---	0.65	0.60
Neo-Terramycin® [b]	---	0.70	---	---
Neomycin[c]	---	---	0.05	0.10
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Total lysine, %	1.55	1.55	1.55	1.55
True digestible amino acids				
Lysine	1.41	1.41	1.41	1.41
Isoleucine:lysine ratio, %	60	60	60	60
Leucine:lysine ratio, %	122	122	122	122
Methionine:lysine ratio, %	32	32	32	32
Met & cys:lysine ratio, %	56	56	56	56
Threonine:lysine ratio, %	66	66	66	66
Tryptophan:lysine ratio, %	17	17	17	17
Valine:lysine ratio, %	68	68	68	68
ME, kcal/lb	1,493	1,493	1,493	1,493
CP, %	21.9	21.9	21.9	21.9
Ca, %	0.90	0.90	0.90	0.90
P, %	0.79	0.79	0.79	0.79
Available P, %	0.50	0.50	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).
[c]Neomycin (100 g/lb Neomycin sulfate).

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

Ingredient, %	Negative Control	Positive Control	Neomycin Sulfate	
			100 g/ton	200 g/ton
Corn	59.27	59.27	59.27	59.27
Soybean meal (46.5% CP)	35.10	35.10	35.10	35.10
Spray dried whey	---	---	---	---
Select menhaden fish meal	---	---	---	---
Soy oil	1.00	1.00	1.00	1.00
Monocalcium P (21% P)	0.50	0.50	0.50	0.50
Limestone	1.10	1.10	1.10	1.10
Salt	0.35	0.35	0.35	0.35
Vitamin premix	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15
L-threonine	0.15	0.15	0.15	0.15
DL-methionine	0.13	0.13	0.13	0.13
Lysine HCl	0.30	0.30	0.30	0.30
Corn starch	0.70	---	0.65	0.60
Neo-Terramycin® [b]	---	0.70	---	---
Neomycin[c]	---	---	0.05	0.10
Total				
Calculated analysis				
Total lysine, %	1.45	1.45	1.45	1.45
True digestible amino acids				
Lysine	1.31	1.31	1.31	1.31
Isoleucine:lysine ratio, %	62	62	62	62
Leucine:lysine ratio, %	129	129	129	129
Methionine:lysine ratio, %	32	32	32	32
Met & cys:lysine ratio, %	57	57	57	57
Threonine:lysine ratio, %	67	67	67	67
Tryptophan:lysine ratio, %	18	18	18	18
Valine:lysine ratio, %	71	71	71	71
ME, kcal/lb	1,494	1,494	1,494	1,494
CP, %	21.4	21.4	21.4	21.4
Ca, %	0.83	0.83	0.83	0.83
P, %	0.72	0.72	0.72	0.72
Available P, %	0.39	0.39	0.39	0.39

[a]Fed from d 14 to 24 after weaning.
[b]Neo-Terramycin® (140 g/ton Neomycin sulfate, 140 g/ton Oxytetracycline HCl).
[c]Neomycin (100 g/lb Neomycin sulfate).

Table 3. Growth Performance of Early-weaned Nursery Pigs Provided Neomycin Sulfate in the Water and Feed[a]

									Probability, P<												
			Neomycin Sulfate mg/L Water			Neomycin Sulfate, g/ton eed			Neg control vs.			Pos control vs.			Combo vs.	Feed Med vs.					
Item	Neg Con	Pos Con[b]	38.0	75.5	113.5	100	200	Combo[c]	Pos Con	Water Med	Feed Med	Water Med	Feed Med	Combo	Water Neo 75.5	Water med	Water med Lin	Water med Quad	Feed med Lin	Feed med Quad	SE
d 0 to 14																					
ADG, lb	0.60	0.67	0.71	0.69	0.70	0.68	0.71	0.75	0.08	0.01	0.01	0.39	0.52	0.07	0.17	0.83	0.03	0.09	0.01	0.41	0.029
ADFI, lb	0.72	0.78	0.80	0.79	0.82	0.81	0.82	0.85	0.15	0.01	0.01	0.38	0.27	0.06	0.13	0.70	0.03	0.31	0.02	0.25	0.032
F/G	1.20	1.16	1.14	1.14	1.17	1.20	1.17	1.14	0.27	0.11	0.52	0.79	0.53	0.68	0.98	0.24	0.44	0.11	0.37	0.80	0.036
d 14 to 24																					
ADG, lb	1.10	1.20	1.20	1.15	1.19	1.22	1.25	1.24	0.08	0.08	0.01	0.65	0.46	0.49	0.13	0.12	0.22	0.41	0.01	0.36	0.041
ADFI, lb	1.56	1.66	1.66	1.60	1.64	1.68	1.68	1.75	0.06	0.08	0.01	0.57	0.63	0.08	0.01	0.17	0.28	0.42	0.02	0.21	0.046
F/G	1.43	1.39	1.40	1.39	1.39	1.38	1.35	1.42	0.30	0.26	0.10	0.90	0.61	0.48	0.50	0.41	0.32	0.56	0.07	0.81	0.030
d 0 to 24																					
ADG, lb	0.81	0.89	0.91	0.89	0.90	0.91	0.93	0.95	0.02	0.01	0.01	0.78	0.36	0.09	0.06	0.38	0.03	0.09	0.01	0.24	0.027
ADFI, lb	1.07	1.14	1.16	1.13	1.16	1.17	1.18	1.23	0.05	0.01	0.01	0.83	0.35	0.04	0.02	0.33	0.05	0.27	0.01	0.16	0.035
F/G	1.33	1.28	1.27	1.27	1.29	1.29	1.26	1.29	0.11	0.03	0.05	0.84	0.89	0.85	0.61	0.96	0.16	0.09	0.03	0.96	0.020

[a]A total of 360 weanling pigs, initially 14.1 lb and 21 ± 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]Containing Neomycin sulfate in the water (75.5 mg/L) and Neo-Terramycin® in the feed (140 g/ton Neomycin sulfate, 140 g/ton Oxytetracycline HCl).

Table 4. Water Disappearance of Early-weaned Pigs Provided Water-based Medication (% BW)[a]

		Neomycin Sulfate, mg/L Water			Overall
Item	Control	38.0	75.5	113.5	Mean
d 0 to 7	14.7	19.8	21.0	29.0	21.1
d 7 to 14	19.6	25.5	29.3	31.3	26.4
d 14 to 24	18.5	19.7	25.1	21.7	21.2
d 0 to 24	17.6	21.7	25.1	27.4	22.9

[a]A total of 360 weanling pigs, initially 14.1 lb and 21 ± 3 d of age (PIC L337 × C22). Each value is the mean of 2 replications.