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Cover Page Footnote

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KANSAS STATE UNIVERSITY SWINE INDUSTRY DAY 2017

Effects of Increasing Salt Concentrations on Growth Performance of Pigs Weighing 60 to 140 lb[1]

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Summary

A total of 1,188 pigs (PIC 359 × 1050; initial BW 59.8 lb) were used in a 44-d growth trial to determine the effects of added salt on the growth performance of pigs weighing approximately 60 to 140 lb in a commercial setting. Pens of pigs were blocked by BW and randomly assigned to 1 of 4 dietary treatments in a completely randomized block design with 27 pigs per pen and 11 pens per treatment. Dietary treatments were corn-soybean meal-based with 20% dried distillers grain with soluble containing either 0.10, 0.33, 0.55, or 0.75% of added salt, which resulted in calculated dietary Na levels of 0.10, 0.19, 0.28, and 0.36%; and calculated Cl levels of 0.23, 0.36, 0.49, and 0.61%. From d 0 to 44, there was no evidence of difference to indicate that increasing salt beyond 0.10% influenced ADG, ADFI, F/G, or BW. This study reported that 0.10% of added salt in a diet containing 20% dried distillers grain with solubles was adequate for maximum growth performance in 60- to 140-lb grower pigs.

Introduction

Sodium and chloride are involved in several of the body's processes, such as the sodium potassium pump and osmotic regulation. Traditionally, the most common source of Na and Cl in swine diets is added salt. Hagsten et al.[3] noted improvements in ADG and F/G when at least 0.10% of salt was added to corn-soybean meal diets for pigs from 40 to 200 lb. However, Alcantara et al.[4] reported that in corn-soybean meal diets for growing pigs (55 to 110 lb), ADG and ADFI improved up to 0.08% added salt, with no further responses to higher salt additions. Honeyfield et al.[5] observed improvements in ADG, ADFI, and F/G as the Na and Cl concentration was increased up to 0.18%

[1] Appreciation is expressed to New Horizon Farm (Pipestone, MN) for providing the animals and research facilities, and to H. Houslog, M. Heintz, and C. Stech for technical assistance.

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[3] Hagsten, I., T. R. Cline, T. W. Perry, and M. P. Plumlee. 1976. Salt Supplementation of Corn-Soy Diets for Swine. J. Anim. Sci. 42:12-15. doi:10.2527/jas1976.42112x.

[4] Alcantara, P. F., L. E. Hanson, and J. D. Smith. 1980. Sodium Requirements, Balance and Tissue Composition of Growing Pigs. J. Anim. Sci. 50:1092-1101. doi:10.2527/jas1980.5061092x.

[5] Honeyfield, D. C., J. A. Froseth, and R. J. Barke. 1985. Dietary Sodium and Chloride Levels for Growing-Finishing Pigs. J. Anim. Sci. 60:691-698. doi:10.2527/jas1985.603691x.

and 0.08%, respectively, in corn-soybean meal diets or the equivalent of approximately 0.40% added salt (to meet the Na estimate).

The NRC[6] requirement estimates for Na and Cl are 0.10 and 0.08%, respectively, for 50- to 165-lb pigs. Typically, most grower diets will contain a fixed amount of 0.35 to 0.50% of salt to meet the requirement estimate but this may result in Na and Cl concentrations exceeding the NRC[6] requirement estimate. Therefore, the objective of this study was to determine the dietary salt requirements for pigs weighing 60 to 140 lb in a commercial setting.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this study. The experiment was conducted at a commercial research-finishing site in southwest Minnesota. Pigs were housed in a naturally ventilated and double-curtain-sided barn. Each pen (10 × 18 ft) contained a 4-hole stainless steel feeder and cup waterer for ad libitum access to feed and water. Feed additions to each individual pen were made and recorded by a robotic feeding system (FeedPro; Feedlogic Corp., Wilmar, MN).

A total of 1,188 pigs (PIC 359 × 1050; initial BW 59.8 lb) were used in a 44-d growth trial with 27 pigs per pen and 11 pens per treatment. Pens were blocked by BW and then randomly assigned to 1 of 4 dietary treatments in a completely randomized block design. Dietary treatments were corn-soybean meal-based and contained either 0.10, 0.33, 0.55, and 0.75% added salt (Table 1), which resulted in calculated dietary Na levels of 0.10, 0.19, 0.28, and 0.36% and calculated Cl levels of 0.23, 0.36, 0.49, and 0.61%. Pens of pigs were weighed and feed disappearance was recorded on d 0, 16, 31, and 44 of the trail to determine ADG, ADFI, and F/G.

Diet samples were taken from the feeder at the beginning and the end of the trial, pooled, and subsampled. Subsamples were analyzed for DM, CP, Na, and Cl (Ward Laboratories, Inc., Kearney, NE, Table 2).

Data were analyzed as a completely randomized block design using PROC GLIMMIX in SAS version 9.4 (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. Linear and quadratic polynomials were used to evaluate increasing levels of added salt. Results were considered significant at $P \leq 0.05$ and marginally significant between $P > 0.05$ and $P \leq 0.10$.

Results and Discussion

Chemical analysis indicated that calculated values for Na and Cl were similar to analyzed values. Sodium ranged from 0.11 to 0.34% and Cl ranged from 0.26 to 0.61% (Table 2).

For the overall study (d 0 to 44), there was no evidence of difference to indicate that increasing salt beyond 0.10% improved ADG, ADFI, F/G, or d 44 BW (Table 3).

[6] NRC. 2012. Nutrient requirements of swine. 11th rev. ed. Natl. Acad. Press, Washington, DC.

According to the chemical analysis, the 0.10% added salt diet had a Na concentration of 0.11% and a Cl concentration of 0.26%. The 0.10% added salt diet would have a similar Na concentration to the NRC[6] requirement estimate of 0.10% but would be slightly lower than the optimal concentration reported by Honeyfield et al.[5] which was 0.18%. The 0.10% added salt diet had a Cl concentration that was significantly greater than the requirement reported by Honeyfield et al.[5] of 0.08% and the NRC[6] requirement estimate of 0.08%. The 0.10% of added salt diet would agree with the optimal inclusion reported Hagsten et al.,[3] which was 0.10%, and was also similar to the ideal inclusion observed by Alcantara et al.,[4] which was 0.08%; however, their diets did not include dried distillers grain with solubles as in our experiment. In conclusion, 0.10% of added salt in a corn-soybean meal diet containing 20% dried distillers grain with solubles was adequate for maximum ADG, ADFI, and F/G in 60- to 140-lb grower pigs.

Table 1. Diet composition (as-fed basis)[1]

	Added salt, %			
Item	0.10	0.33	0.55	0.75
Ingredient, %				
Corn	54.15	53.75	53.35	52.97
Soybean meal (48% CP)[2]	22.72	22.75	22.78	22.81
DDGS[3]	20.00	20.00	20.00	20.00
Beef tallow	0.75	0.90	1.05	1.20
Monocalcium P (21% P)	0.20	0.20	0.20	0.20
Limestone	1.26	1.25	1.25	1.24
Salt	0.10	0.33	0.55	0.75
Vitamin and trace mineral premix	0.15	0.15	0.15	0.15
L-Lys- HCl	0.48	0.48	0.48	0.48
DL-Met	0.05	0.05	0.05	0.05
L-Thr	0.11	0.11	0.11	0.11
L-Trp	0.02	0.02	0.02	0.02
Phytase[4]	0.01	0.01	0.01	0.01
Total	100	100	100	100

continued

Table 1, *continued*. Diet composition (as-fed basis)[1]

	Added salt, %			
Item	0.10	0.33	0.55	0.75
Calculated analysis				
Standardized ileal digestible (SID) AA, %				
Lys	1.17	1.17	1.17	1.17
Ile:Lys	61	61	61	61
Leu:Lys	147	147	146	146
Met:Lys	31	31	31	31
Met and Cys:Lys	56	56	56	56
Thr:Lys	62	62	62	62
Tryp:Lys	18.5	18.5	18.5	18.5
Val:Lys	70	70	70	70
Total Lys, %	1.34	1.34	1.34	1.34
NE kcal/lb	1,122	1,122	1,122	1,122
SID Lys:ME, g/Mcal	3.54	3.54	3.54	3.54
CP, %	20.8	20.8	20.8	20.8
Ca, %	0.58	0.57	0.57	0.57
P, %	0.52	0.52	0.52	0.52
Available P, %	0.34	0.34	0.34	0.34
Na, %	0.10	0.19	0.28	0.36
Cl, %	0.23	0.36	0.49	0.61
K, %	0.68	0.68	0.68	0.68
Dietary electrolyte balance, mEq/kg[5]	155	156	157	158

[1] Experimental diets were fed for 44 d from approximately 60 to 140 lb.

[2] Results of chemical analysis from previous trials has indicated the Na and Cl concentration of soybean meal is 0.02% and 0.05%. Analyzed values were used in formulation.

[3] DDGS = dried distillers grain with solubles. The DDGS were analyzed for dietary Na (0.22%) and Cl (0.19%) and analyzed values were used in formulation.

[4] Optiphos 2000 (Huvepharma, Sofia, Bulgaria) provided an estimated release of 0.11% available P.

[5] Calculated as = ((Na × 434.98) + (K × 255.74) – (Cl × 282.06)).

Table 2. Chemical analysis of experimental diets (as-fed basis)[1]

	Added salt, %			
Item, %	0.10	0.33	0.55	0.75
DM	89.49	90.00	89.71	89.84
CP	19.9	18.5	19.4	20.1
Na	0.11	0.22	0.25	0.34
Cl	0.26	0.46	0.50	0.61

[1] Multiple samples were collected from each diet throughout the study, homogenized, and then subsampled for analysis (Ward Laboratories, Inc., Kearney, NE).

Table 3. Effects of increasing salt for 60- to 140-lb grower pigs[1]

	Added salt, %					*P* value	
Item	0.10	0.33	0.55	0.75	SEM	Linear	Quadratic
d 0 to 44							
ADG, lb	1.88	1.87	1.88	1.87	0.018	0.690	0.919
ADFI, lb	3.68	3.72	3.78	3.70	0.076	0.734	0.470
F/G	1.96	2.00	2.01	1.98	0.035	0.589	0.392
BW, lb							
d 0	60.0	59.8	59.8	59.6	0.689	0.205	0.872
d 44	142.6	142.0	142.5	142.3	1.195	0.855	0.747

[1] A total of 1,188 pigs (PIC 337 × 1050, initially 59.8 lb BW) were used in a 44-d study with 27 pigs per pen and 11 replications per treatment.