the NRC (1994) requirements for broiler chickens. The analyzed composition of the Creamer consisted of moisture 5.21%, crude protein 3.02%, crude fat 5.86%, crude fiber 2.42%, and crude ash 3.27%. From d 28 to 35, chromic oxide (0.2%) as an indigestible marker was added to diets for determination of nutrient digestibility of dry matter (DM), Calcium (Ca), phosphorus (P), and nitrogen (N). All data were statistically analyzed using the GLM procedure of the SAS program (SAS Inst. Inc., Cary, NC, USA). Differences among treatments were separated by Tukey's range test. The broilers were weighed by pen and feed intake (FI) and the number of living broiler chickens were recorded on d 7, 21, and 35. This information was then used to calculate body weight gain (BWG), feed conversion ratio (FCR). With regards to meat quality, no adverse effects were observed among the treatments. However, a higher score ($P < 0.05$) in redness was observed in T3 (10.68) than T1 (9.63). In addition, the relative weight of breast muscle was reduced ($p < 0.05$) in T3 (13.97) compared with T1 (15.74). There were no significant differences on BWG, FCR and nutrient digestibility among the treatments in both starter and grower phases. There were no negative effects on growth performance, meat quality, and nutrient digestibility were observed. In conclusion, non-dairy creamer could be a kind of fat sources additive in broiler diets, but further studies are needed to test the optimum levels of NDC to be supplemented in the diets of broilers.

Key Words: non-dairy creamer, growth performance and nutrient digestibility, broilers

NONRUMINANT NUTRITION I: MINERALS

242 Effects of Dietary P Concentrations in Response to Increasing Dietary Ca Concentrations on Growth Performance of Nursery Pigs. F. Wu*, M. D. Tokach, J. M. DeRouchey, S. S. Dritz, J. C. Woodworth, R. D. Goodband, *Kansas State University, Manhattan, KS*

A total of 360 pigs (initially 6.0 ± 1.08 kg BW) were used in a 45-d study to determine the effects of 2 standardized total tract digestible (STTD) P concentrations on growth performance of nursery pigs fed increasing dietary Ca. In a completely randomized design, pens of pigs (6 pens/treatment) were randomly allotted to 1 of 6 dietary treatments. Dietary treatments were arranged in a 2 × 3 factorial with main effects of STTD P (at or above NRC, 2012 recommended levels) and total Ca (0.65, 0.90, and 1.20%). Experimental diets were fed during phase 1 (d 0 to 10) and 2 (d 10 to 24), followed by a common phase 3 diet from d 24 to 45. Diets formulated to meet NRC (2012) P requirements contained 0.45 or 0.40% STTD P in phases 1 and 2, respectively. Diets exceeding NRC (2012) P requirements contained 0.56 or 0.52% STTD P in phases 1 and 2, respectively. During the treatment period (d 0 to 24), no Ca×P interactions were observed for ADG and ADFI. Increasing Ca concentration decreased (linear, P=0.006) ADG, but did not affect ADFI. Feeding higher STTD P marginally increased (P=0.084) ADG, but did not affect ADFI, compared with pigs fed STTD P levels suggested by NRC (2012). When diets contained NRC (2012) levels of STTD P, pigs fed 1.20% Ca had lower (P<0.05) G:F than those fed 0.65 or 0.90% Ca; however, when high levels of STTD P were fed, G:F was not affected by the dietary Ca concentrations (Ca×P interaction, P=0.018). When common diets were fed from d 24 to 45, no interactive or main effects of Ca and STTD P were observed for ADG, ADFI, or final BW. However, pigs previously fed increasing concentrations of Ca had improved (linear, P=0.003) G:F regardless of dietary STTD P content, resulting in no evidence for difference in overall growth performance across treatments. In conclusion, excess dietary Ca decreased ADG and G:F of nursery pigs especially in low STTD P diets. The STTD P levels estimated by NRC (2012) meet the requirement of 6 to 12 kg pigs when diets contain low Ca concentrations, but result in decreased ADG and G:F when diets contain more than 0.90% Ca.

Key Words: calcium, nursery pigs, phosphorus

	Treatment						
STTD P:	NRC			>NRC			
Ca, %:	0.65	0.90	1.20	0.65	0.90	1.20	SEM
d 0 to 24							
ADG, g	230	226	195	236	226	224	8.1
G:F, g/kg	760	725	639	761	753	738	16.3

243 Effects of increasing salt concentration on growth performance of 11 to 30 and 27 to 65 kg pigs. D. J. Shawk*, A. B. Lerner, M. D. Tokach, S. S. Dritz, J. C. Woodworth, B. D. Goodband, J. M. DeRouchey, *Kansas State University, Manhattan, KS*

Two experiments were conducted to evaluate the effects of added salt on pigs weighing 11 to 30 kg and 27 to 65 kg. Treatments were assigned in a randomized complete block design based on BW with pen as the experimental unit. In Exp. 1, 300 pigs (DNA

Exp. 1 (d 0-27)

	Added salt, %					Probability, $P <$	
Item	0.20	0.35	0.50	0.65	0.80	Linear	Quadratic
ADG, g	661	695	718	721	723	0.001	0.005
ADFI, g	1,075	1,089	1,116	1,142	1,129	0.001	0.211
G/F	0.616	0.638	0.643	0.631	0.641	0.024	0.064

SEM = 10.0, 15.8, and 0.006 for ADG, ADFI, and G/F, respectively.

241 × 600; initial BW 11.3 ± 0.22 kg) were assigned to 1 of 5 dietary treatments containing 0.20, 0.35, 0.50, 0.65, or 0.80% salt which provided calculated total dietary Na concentrations of 0.10, 0.16, 0.22, 0.28, and 0.34% and calculated total dietary Cl concentrations of 0.23, 0.32, 0.41, 0.50, and 0.59%. There were 12 replications/treatment and 5 pigs/pen. Treatment diets were corn-soybean meal-based and fed for 27 d. From d 0 to 27, ADG and G:F improved (quadratic, $P<0.05$ and 0.064, respectively) up to 0.50% added salt with little benefit thereafter. In Exp. 2, 1,188 pigs (PIC 359 × 1050; initial BW 27.1 ± 0.31 kg) were assigned 1 of 4 dietary treatments containing either 0.10, 0.33, 0.55, or 0.75% added salt which corresponded to calculated total dietary Na concentrations of 0.10, 0.19, 0.28, and 0.36% and calculated total dietary Cl concentrations of 0.23, 0.36, 0.49, and 0.61% (all levels above NRC requirement estimates). There were 27 pigs/pen and 11 replications/treatment. Dietary treatments were corn-soybean meal-based with 20% dried distillers grain with solubles and fed for 44 d. Overall, there was no evidence for differences to indicate that increasing salt beyond 0.10% improved ADG (0.85, 0.85, 0.85, and 0.85 kg/d ± 0.008; $P>0.690$, respectively), ADFI (1.67, 1.69, 1.71, and 1.68 kg/d ± 0.035; $P>0.734$, respectively), or G:F (0.512, 0.502, 0.499, and 0.506 ± 0.009; $P>0.598$, respectively). In conclusion, results of these studies indicate a minimum inclusion of 0.50% added salt (total diet Na of 0.22% and Cl of 0.41%) for 11 to 30 kg pigs and there was no benefit to include over 0.10% added salt (total dietary Na of 0.10% and Cl of 0.23%) for 27 to 65 kg pigs.

Key Words: pig, salt, sodium

244 Requirement for Digestible Calcium at Different Dietary Concentrations of Digestible Phosphorus Indicated By Growth Performance and Bone Ash of 50 to 85 Kg Pigs. L. V. Lagos*[,1], C. L. Walk[2], H. H. Stein[3], [1]*University of Illinois, Urbana, IL,* [2]*AB Vista, Marlborough, United Kingdom,* [3]*University of Illinois at Urbana-Champaign, Urbana, IL*

An experiment was conducted to determine the requirement for standardized total tract digestible (STTD) Ca by 50 to 85 kg pigs and test the hypothesis that the requirement to maximize growth performance expressed as STTD Ca:STTD P ratio is less than 1.35:1. Fifteen corn-soybean meal based diets were formulated using a 3 × 5 factorial design. Diets contained 0.14, 0.27, or 0.41% STTD P and 0.13, 0.25, 0.38, 0.50, or 0.63% STTD Ca. Ninety barrows (50.21 ± 2.09 kg) were individually housed and randomly allotted to the 15 diets. Diets were fed for 30 d and the amount of feed offered was recorded. At the conclusion of the experiment, pig weights were recorded and ADG, ADFI, and G:F were calculated for each diet. On d 31, pigs were euthanized and the right femur was removed and ash, Ca, and P were determined in dried defatted femurs. Data were analyzed using the response surface model in NLREG by removing the terms in the model that were not significant ($P > 0.10$; Table 1). There was a linear nature of data for growth performance parameters,

Table 1. Estimated models for growth performance and bone mineralization[1]

Item	Model	*P*-value
Growth performance, kg		
ADG	$[0.91-(0.64\times Ca)+(2.31\times P)-(4.45\times P^2)+(1.75\times Ca\times P)]$	<0.001
ADFI	$[3.06-(0.41\times Ca)]$	0.040
G:F	$[0.39-(0.15\times Ca)-(0.05\times P)+(0.54\times Ca\times P)]$	<0.001
Bone, g		
Ash	$[18.25+(37.79\times Ca)-(62.16\times Ca^2)+(110.41\times P)-(234.13\times P^2)+(146.24\times Ca\times P)]$	<0.001
Ca	$[7.07+(14.63\times Ca)-(23.85\times Ca^2)+(36.99\times P)-(79.79\times P^2)+(56.01\times Ca\times P)]$	<0.001
P	$[3.34+(6.26\times Ca)-(11.48\times Ca^2)+(18.49\times P)-(39.81\times P^2)+(27.41\times Ca\times P)]$	<0.001
Bone, %		
Ash	$[56.26-(4.97\times Ca)-(7.64\times P)+(42.29\times Ca\times P)]$	<0.001
Ca	$[36.95+(0.95\times Ca)]$	0.014
P	$[17.79-(1.73\times Ca)-(0.30\times P)+(3.69\times Ca\times P)]$	<0.001

[1]Full model= $[a+(b\times Ca)+(c\times Ca^2)+(d\times P)+(e\times P^2)+(f\times Ca\times P)]$.