319 **Effect of a precision feeding strategy applied to groups of pigs in a commercial setting.** L. Cloutier*, J. Rivest, G. Berthiaume, M. Morin, *Centre de Développement du Porc du Québec Inc., Québec, QC, Canada*

The objective of this study was to validate the effect of a precision, i.e., multiphase, feeding strategy applied to groups of pigs segregated by sex and by weight in a commercial setting. Thus, 24 groups of 42 pigs (24.2 ± 2.9 kg) were used in this experiment according to a randomized complete block design with a factorial treatment structure. Pigs were initially divided by weight group (small, medium small, medium large, and large pigs) and then combined with room location to form a 6 level blocking factor, each block containing four double pens. Treatments were randomly assigned to double pens according to a 2 × 2 factorial arrangement with two feeding treatments (four-phase feeding program (4P) and multiphase group feeding program (MPG)) and two sexes (female and barrow). For MPG treatment, growth curves (as a function of growing-finishing days) were established for each sex within each weight group based on previous performances on the farm. Two feeding programs, one for each sex, defined the evolution of lysine concentration as function of weight. For each group of pigs (i.e., combination of weight group and sex), the desired lysine concentration was obtained by blending two feeds in different proportions. When compared to the 4P treatment, the MPG treatment significantly reduced lysine intake by 18% ($P < 0.001$). There was also no difference observed in terms of ADFI and feed efficiency between the two feeding treatments. Regarding ADG, MPG pigs tended to have a higher ADG (949 and 934 g/d; $P = 0.097$). Only one interaction between the feeding treatment and the sex was observed, and it was regarding lysine concentration ($P < 0,001$). Thus, MPG females had a higher lysine concentration in their feed when compared to barrows being given the same treatment (+0.17 g/kg; $P < 0.05$). As for the 4P treatment, there was no difference in lysine concentration between the feed given to the two sexes. For the effects of sex, females had a lower ADFI (-0.26 kg), ADG (-77 g), and fat depth (-2 mm) when compared to castrated males ($P < 0.05$). With reference to feed costs, when calculated with Quebec's 2013 feed prices, the multiphase strategy reduced feed costs by $3.80/pig. The results of this study show that the multiphase feeding strategy, which had no effect on growth performances, could reduce nitrogen and lysine intake as well as reduce feed costs for swine producers.

Key Words: feeding cost, pig, precision feeding

320 **Apparent digestible energy content of commercial lipid sources fed to growing pigs.** P. L. Chang[1,*], D. S. Rosero[1,2], O. Medina[1], A. Terpening[1], E. van Heugten[1], *[1]Department of Animal Science, North Carolina State University, Raleigh, [2]The Hanor Company, Inc., Franklin, KY*

This study was designed to evaluate lipid and GE digestibility of 7 commercial lipid sources varying in chemical composition (iodine value, IV; free fatty acids, FFA) and lipid peroxidation status (anisidine value, AnV; malondialdehyde, MDA). A total of 64 growing pigs (initial BW = 30.4 ± 0.43 kg) were housed individually and randomly allotted to 1 of 8 dietary treatments. Treatments consisted of a corn-soybean meal basal diet without added lipids and the basal diet supplemented with 8% of either soybean oil (IV = 129, FFA = 0%, AnV = 3, MDA = 1 mmol/L), tallow (IV = 44, FFA = 0%, AnV = 2, MDA = 0 mmol/L), poultry fat (IV = 68, FFA = 3%, AnV = 4, MDA = 7 mmol/L), pet food-grade poultry fat (IV = 76, FFA = 2%, AnV = 1, MDA = 14 mmol/L), yellow grease (IV = 64, FFA = 7%, AnV = 19, MDA = 28 mmol/L), brown grease (IV = 65, FFA = 23%, AnV = 12, MDA = 74 mmol/L), or restaurant grease (IV = 98, FFA = 8%, AnV = 36, MDA = 18 mmol/L). Lipid supplemented diets contained 1.03% standardized ileal digestible lysine and 3.69 Mcal ME/kg. Diets were fed ad libitum for 7 days followed by fecal collections for the next 3 days. Apparent total tract digestibility (ATTD) was calculated using TiO_2 as an indigestible marker. On d 10, blood samples were collected for plasma MDA analysis as a marker of oxidative stress. Pigs fed yellow grease had a 64% lower ADFI ($P < 0.001$; 0.62 vs. 1.73 kg/d) than pigs fed other diets, resulting in an overall BW loss during the 10 d feeding period ($P < 0.001$; ADG of -0.14 vs. 0.95 kg/d). Concentrations of MDA in plasma of pigs fed yellow grease were 86% greater ($P < 0.001$; 10.76 vs. 5.78 mmol/L) than those in pigs fed other lipid sources. Supplementation of lipids to the basal diet increased ATTD of crude fat ($P < 0.001$; 81.3 vs. 40.0%) and GE ($P < 0.05$; 88.4 vs. 85.8%). For lipid supplemented diets, ATTD of crude fat ranged from 79.7 to 82.9% and ATTD of GE ranged from 87.5 to 90.0%, and they were not different among lipid sources. Results indicate that there were no differences in the DE content of commercially available lipid sources that ranged widely in saturation level, content of FFA, and oxidative stability when fed to growing pigs. Nonetheless, caution is needed when feeding highly peroxidized lipid sources to pigs, as they can negatively impact performance.

Key Words: digestible energy, lipids, pigs

321 **Effects of algae-derived β-glucans on nursery pig growth performance and immune response under commercial conditions.** M. A. Goncalves*, S. S. Dritz, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, J. C. Woodworth, *Kansas State University, Manhattan*

A total of 2,484 pigs (PIC 337×1050, initially 7.1 ± 0.12 kg) were used to determine the impact of increasing levels of a

commercial β-glucan (Algamune ZPC, Algal Scientific Corporation, Plymouth, MI) on growth performance and Porcine Circovirus Type 2 (PCV2) specific immune response of nursery pigs housed under commercial conditions. Pigs were allotted to 1 of 6 treatments in a randomized complete block design with BW as a blocking factor with 27 pigs/pen and 14 or 16 pens/treatment. Dietary treatments, fed in two phases from d 0 to 12 and d 12 to 40 postweaning, were a negative control diet or the negative control diet with 125, 250, 500, or 750 ppm added β-glucan in both phases or the negative control diet with 500 ppm added β-glucan during Phase 1 and the negative control diet in Phase 2. Phase 1 diets contained 1,910 ppm of zinc oxide. All pigs were vaccinated with PCV2 and *M. hyopneumoniae* vaccines with 2 mL per pig (1 mL Fostera™ PCV and 1 mL Respisure-One; Zoetis, Florham Park, NJ) at d 3 after birth and at weaning. Blood samples (12 pens/treatment) were collected at d 2, 18, and 38 of the trial from 12 pigs/treatment. For the immune response analysis, weight block within serum sampling period and pen within dietary treatment were included in the model as random effects. Pigs fed increasing β-glucan marginally decreased then increased (quadratic, $P = 0.09$) ADG (457, 448, 450, 453, and 461 ± 15.5 g/d) and tended to increase (linear, $P = 0.10$) ADFI (692, 675, 685, 688, and 704 ± 27.2 g/d). No evidence for differences was observed in G:F ($P = 0.36$). There was no evidence of a difference ($P > 0.54$) in ADG, ADFI, or G:F when comparing pigs fed 500 ppm β-glucan in both phases compared with pigs fed 500 ppm β-glucan only in Phase 1. There was a tendency (linear, $P = 0.07$) for decreased PCV2 neutralizing antibody titers as the inclusion of β-glucan increased. There was no evidence of differences ($P = 0.75$) in PCV2 neutralizing antibody titers between pigs fed 500 ppm in both phases and pigs fed 500 ppm only in Phase 1. In conclusion, dietary addition of up to 750 ppm of β-glucan in nursery pig diets from 7 to 25 kg had minimal impact on growth performance. Also, modulation of the specific immune response to PCV2 at d 38 after weaning was negatively related to increasing β-glucan under commercial conditions.

Key Words: β-glucans, immune response, nursery

322 **The effects of tribasic copper chloride on growth performance and carcass characteristics of finishing pigs.** J. Cohen[1], J. L. Usry[2,*], N. R. Augspurger[3], C. R. Little[3], *[1]Micronutrients, Indianapolis, IN, [2]Micronutrients, Social Circle, GA, [3]JBS United, Inc., Sheridan, IN*

A total of 540 pigs (PIC 337 × Camborough 29; initially 37.9 kg) were used in a 103-d study to determine the effects of tribasic copper chloride (TBCC; Intellibond C, Micronutrients, Indianapolis, IN) on growth performance and carcass characteristics of finishing pigs. Pens of pigs were allotted to 1 of 2 dietary treatments based on average pen weight in a randomized complete-block design with 27 pigs per pen and 10 replicates per treatment. Diets were corn-soybean meal-based with 20 to 30% dried distiller's grains with solubles. Treatments were the control diet with or without the addition of 200 mg/kg Cu from tribasic copper chloride. Both treatment diets contained 16 mg/kg of Cu from $CuSO_4$ in the trace mineral premix. Overall, ADG was increased ($P = 0.036$) by 2.3% for pigs fed TBCC compared to the control, resulting in 1.9-kg heavier ($P = 0.060$) final BW. There were no differences in ADFI between treatments. Thus, the growth response resulted in a tendency for greater ($P = 0.070$) G:F for pigs consuming diets containing 200 mg/kg supplemental Cu from TBCC. Hot carcass weights were 2.3 kg heavier ($P = 0.013$) for pigs fed TBCC compared to the control; however, carcass yield was not affected. Backfat, loin depth, and percent lean were also not influenced by dietary treatment. In summary, adding 200 mg/kg Cu from TBCC to diets for finishing pigs from 38 to 130 kg increased ADG and HCW and tended to increase G:F compared to pigs fed the control diet.

Table 322. Effect of tribasic copper chloride in finishing pigs

	TBCC, mg/kg		Pooled SEM	Probability, $P <$
	0	200		
BW, kg				
d 0	37.9	38.0	0.471	0.615
d 103	128.2	130.1	0.988	0.060
ADG, g	868	888	12.248	0.036
ADFI, g	2,497	2,517	24.855	0.474
G:F, g/kg	347	353	3.441	0.070
HCW, kg	96.0	98.3	0.655	0.013
Carcass yield, %	75.8	76.4	0.300	0.136

Key Words: copper, growth, pig

323 **Effect of Zn sources and inclusion rate on growth performance and carcass composition in grower-finisher pigs.** T. C. Tsai[1,*], H. J. Kim[1], J. L. Usry[2], J. Cohen[3], J. J. Chewning[4], J. K. Apple[1], C. V. Maxwell[1], *[1]Department of Animal Science, University of Arkansas Division of Agriculture, Fayetteville, [2]Micronutrients, Social Circle, GA, [3]Micronutrients, Indianapolis, IN, [4]Swine Research Services, Inc., Springdale, AR*

Pigs (n = 132, PIC 29 × 380) were blocked by initial BW (average: 22.25 ± 1.47 kg) and allotted to pens within six blocks. Pens were then randomly assigned to a 2 × 2 factorial treatment regimen with 2 sources of Zn [Zn hydroxychloride (Intellibond Z or IBZ) or $ZnSO_4$] and 2 inclusion rates (60 and 120 ppm) for a 5 phase grower-finisher study. A Zn-free mineral premix with an additional 166 ppm of tribasic copper chloride (Intellibond C; Micronutrients) was incorporated into all diets. In addition, diets in phase 5 contained 10 ppm Paylean. All nutrients met or exceeded 2012 NRC recommendations. Pigs were scanned for BF and LM at the end of phase 4 and at study completion (average BW: 288 ± 2.8 kg). HCW and Fat-O-Meater data were obtained at harvest. No significant Zn source by levels interaction was observed for growth. IBZ-fed