0.60, and 0.47% for phases 1, 2, and 3, respectively. In conclusion, the lysine requirements of IC are greater than PC (117, 135, and 117% for phases 1, 2, and 3, respectively), even after the second injection, when IC pigs are believed to become physiologically similar to PC pigs.

Key Words: immunological castration, lysine, pigs

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118 **Effects of reducing the particle size of corn on growth performance and carcass characteristics of growing–finishing pigs.** O. J. Rojas*, H. H. Stein, *University of Illinois at Urbana-Champaign, Urbana.*

In a previous experiment it was shown that the ME of corn increases linearly as the particle size of corn is decreased from 865 to 339 µm and it was hypothesized that addition of dietary lipids can be reduced if corn particle size is reduced without affecting growth performance and carcass characteristics of growing–finishing pigs. Seventy-two individually housed pigs, 36 gilts and 36 barrows (initial BW: 32.00 ± 1.58 kg), were allotted to 4 dietary treatments in a 2 × 4 factorial design with sex (gilts and barrows) and corn particle size (i.e., 339, 485, 677, and 865 µm) as factors. There were 18 pigs per treatment. Pigs were fed a 3 phase program with phase 1 diets being offered from 32 to 62 kg, phase 2 diets from 62 to 94 kg, and phase 3 diets from 94 to 130 kg. Within each phase, 4 corn–soybean meal based diets were formulated, and the only difference among diets was that the corn that was used was ground to the 4 specified particle sizes and soybean oil was added to the diets in increasing amounts to compensate for the reduction of ME in corn with greater particle size. Within each phase, all diets were formulated to contain equal quantities of ME per kilogram. Results indicated that initial BW, final BW, ADFI, and ADG were not different among treatments. For barrows, no differences in G:F were observed, but for gilts, the G:F increased (linear, $P < 0.05$) as the particle size increased (sex × particle size interaction: $P < 0.05$). Hot carcass weight, back fat, loin eye area, and lean percentage were not different among treatments, but dressing percentage decreased (linear, $P < 0.01$) as particle size increased. The pH in contents of the cecum and the colon decreased (linear, $P < 0.01$) but concentration of short chain fatty acids in colon contents increased (linear, $P < 0.01$) as corn particle size increased. In conclusion, by using corn ground to a smaller particle size, the amount of added fat can be reduced in the diets without affected ADFI, ADG, or G:F for barrows, but dressing percentage will increase if diets containing corn ground to a smaller particle size are used.

Key Words: corn, particle size, pigs

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119 **Prediction of loin, belly and jowl IV based on diet composition versus daily fatty acid intake.** T. A. Kellner*, K. J. Prusa, J. F. Patience, *Iowa State University, Ames.*

Iodine value product (IVP) is used to predict carcass fat iodine value (CIV). When higher fat diets are used, IVP tends to emphasize the quantity of fat more than its composition. The objective of this experiment was to compare the effectiveness in predicting CIV by IVP vs. individual fatty acid content in the diet or their daily intake. Forty-two gilts and 21 barrows (PIC 337 × C22/29) with an average initial weight of 77.8 ± 0.38 kg were allotted based on sex and weight across 7 treatments: 3 or 6% of each of tallow (iodine value (IV) = 41.9), choice white grease (IV = 66.5), or corn oil (IV = 123.1) and a control corn–soy based with no added fat. Pigs were housed individually to measure daily fatty acid intake. Adipose samples were collected from the jowl, loin, and belly at slaughter (d 55). Iodine value was determined using GC on diet and carcass lipid samples and averaged across the three locations. Data were analyzed using PROC MIXED (SAS 9.3) with treatment and sex as fixed effects and replicate as a random effect. PROC REG was used to compare the relationship between individual intakes of fatty acids and CIV and to compare the analyzed diet IVP vs. daily fatty acid intake on CIV. Increased daily intake of palmitic acid (CIV = 72.94– [0.06 × palmitic acid intake/d (g)]; $R^2 = -0.08$, RMSE = 4.98) and stearic acid (CIV = 72.13– [0.14 × steraic acid intake/d (g)]; $R^2 = -0.12$, RMSE = 5.07) were negatively correlated with CIV but with weak coefficients of determination ($P < 0.05$). Increased daily intake of oleic acid (CIV = 66.30 + [0.085 × oleic acid intake/d (g)]; $R^2 = 0.08$, RMSE = 4.97) and linolenic acid (CIV = 62.55 + [3040.4 × linolenic acid intake/d (g)]; $R^2 = 0.26$, RMSE = 4.45) were positively correlated with CIV but also had weak coefficients of determination ($P < 0.05$). Increased linoleic acid intake (LAI) was positively correlated with CIV and generated a strong coefficient of determination (CIV = 60.58 + [0.121 × LAI/d (g)]; $R^2 = 0.611$, $P < 0.05$, RMSE = 3.24). IVP of the experimental diets was approximately equal (CIV = 58.10 + (0.215 × IVP); $R^2 = 0.93$, $P < 0.05$, RMSE = 1.45) to the treatment means of LAI (CIV = 58.57 + [0.139 × linoleic acid intake/d (g)]; $R^2 = 0.94$, $P < 0.05$, RMSE = 1.37) as a predictor of CIV. Under these conditions, a CIV standard of 74 g/100 g can be met by limiting LAI to less than 111 g/d. Linoleic acid is clearly the fatty acid that most affects CIV, but LAI offers no significant improvement over IVP in predicting CIV.

Key Words: fat quality, iodine value, linoleic acid, swine

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120 **Regression analysis to predict growth performance from dietary net energy in growing–finishing pigs.** S. Nitikanchana*, S. S. Dritz, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, B. J. White, J. L. Nelssen, *Kansas State University, Manhattan.*

Dietary energy concentration is often altered to optimize pig growth performance and feed cost; therefore, an accurate prediction of growth performance as affected by feeding different energy concentrations is crucial. Data from 41 trials with multiple energy levels over pig's average BW from 33 to 128 kg, extracted from 17 journal articles, 10 technical

memos, and a thesis, resulting in 285 observations were used in a meta-analysis. Nutrient and energy levels in all diets were estimated using the NRC (2012) ingredient library. A mixed model using experiment within trial as a random effect was used to develop a regression equations to predict ADG or G:F. Predictor variables examined for best fit models using AIC criteria included linear and quadratic terms of NE, average BW, CP, standardized ileal digestible (SID) Lys, crude fiber, NDF, ADF, fat, and ash, including their interactions. Initial best fit models included interactions between NE and CP or SID Lys. After removal of the observations (181) that fed SID Lys below the suggested requirement, these terms were no longer significant. Resulting best fit prediction equation for ADG was ADG (g) = [0.1135 × NE (kcal/kg)] + [8.8142 × average BW (kg)]– [0.05068 × average BW (kg) × average BW (kg)] + 276. Including dietary fat in the model with NE and average BW significantly improved G:F prediction model (−601 vs. −576 AIC) resulting in the best fit equation for G:F whereas G:F = [0.000096 × NE (kcal/kg)]– [0.0025 × average BW (kg)] + [0.003071 × Fat (%)] + 0.3257. The meta-analysis indicated that, as long as diets were adequate for other nutrients (i.e., Lys), dietary NE was adequate to predict changes in ADG across a wide variety of trials with different dietary ingredients and under different environmental conditions. The analysis indicated that ADG increased by 11 g/d for every 100 kcal/kg increase in dietary NE. Also, ADG increased with heavier average BW but decreased when average BW was above 87 kg. Furthermore, G:F improved with increasing dietary NE and fat and decreased with increasing BW. Including dietary fat improved the fit of the equation indicating that NE may underestimate the influence of fat on feed efficiency.

Key Words: growth performance, net energy, pig

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121 **Effect of two net energy feeding programs in combination with ractopamine on grow–finish pig growth performance and carcass characteristics.** W. Steyn[1,*], E. C. Allen[2], C. A. P. Garbossa[3], A. P. Schinckel[2], J. M. Eggert[4], B. T. Richert[2], *[1]TOPIGS, Helvoirt, Netherlands, [2]Purdue University, West Lafayette, IN, [3]Federal University of Lavras, Lavras, Brazil, [4]TOPIGS USA, Demotte, IN.*

A total of 200 crossbred barrows (TOPIGS Tempo × TOPIGS 20) were blocked by BW (28.4 ± 0.02 kg), housed 5 barrows/pen, and randomly allocated to 1 of 4 treatments (10 pens/treatment) in a 2 × 2 factorial arrangement, with 2 net energy (NE) levels (Control vs. Low) and with or without 7.5 ppm ractopamine hydrochloride (RAC) during the last 21 d of a 105-d feeding trial. The objective was to evaluate pig performance to a decreasing net energy (NE) diet over the grow–finish period to validate TOPIGS feeding models. Diets were fed in five 21-d phases. Control diets were corn–soybean meal–corn DDGS based and Low NE diets were created by adjusting inclusion rates of soybean hulls and wheat midds; ingredient NE values were from NRC. Control NE levels (Mcal/kg) were 2.46, 2.45, 2.47, 2.50, 2.54, and 2.64 and Low NE levels were 2.46, 2.39, 2.37, 2.34, 2.32, and 2.39 (phase 1–5 and 5+RAC, respectively). Diets were formulated on an equal SID Lys:NE basis within phase and phase 5 RAC diets had increased amino acids compared to non-RAC diets. From d 0 through 84, Control fed pigs had great ADG (1.024 vs. 0.983 kg/d; $P < 0.001$), G:F (0.362 vs. 0.354; $P < 0.009$), and BW (114.4 vs. 111.0 kg; $P < 0.001$) than pigs fed Low NE diets but ADFI was similar ($P < 0.14$). During d 84 through 105, RAC increased ($P < 0.0001$) ADG and G:F whereas ADFI increased ($P < 0.008$) and G:F decreased ($P < 0.03$) in pigs fed Low NE diets. Overall, d 0 through 105, RAC increased ($P < 0.001$) ADG, G:F, and final BW whereas feeding Low NE decreased ($P < 0.015$) ADG, G:F, and final BW. Feeding RAC increased ($P < 0.0001$) carcass weight and carcass yield and Low NE diets decreased ($P < 0.0003$) carcass weights (100.6, 104.8, 95.3, and 101.0 kg; Control, Control+RAC, LowNE, and LowNE+RAC, respectively) and yields (75.2, 76.1, 73.8, and 74.6%; Control, Control+RAC, LowNE, and LowNE+RAC, respectively). Both RAC and Low NE diets increased ($P < 0.006$) carcass belly iodine values. Overall NE utilization efficiency for live BW gain was greater for Low NE ($P < 0.04$) and RAC ($P < 0.0001$) diets (0.1374, 0.1444, 0.1402, and 0.1471 kg/Mcal; Control, Control+RAC, LowNE, and LowNE+RAC, respectively). However, NE efficiency to carcass weight was only improved ($P < 0.0001$) by RAC (0.1029, 0.1102, 0.1023, and 0.1092 kg/Mcal; Control, Control+RAC, LowNE, and LowNE+RAC, respectively). Low NE diets reduced growth and carcass performance, but feeding RAC improved performance regardless of dietary NE, and NE conversion to carcass weight was similar between NE diets and was improved by feeding RAC.

Key Words: grow–finish pig, net energy, ractopamine

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122 **Effect of β-mannanase and lysine level during ractopamine feeding 35 d before marketing on growth performance and carcass characteristics of finishing pigs.** M. D. Asmus[1,*], K. D. Haydon[2], T. A. Marsteller[2], J. E. Ferrel[2], B. T. Richert[1], *[1]Purdue University, West Lafayette, IN, [2]Elanco Animal Health, Greenfield, IN.*

Crossbred pigs (343) were blocked by ancestry, sex, and initial BW (97.3 kg) and allocated to mixed gender pens (5 or 6 pigs/pen) to 5 treatments with 10 or 12 pens/treatment. Dietary treatments included 1) low lysine (0.80% SID Lys; LL), 2) LL+mannanase (0.08 MU/kg), 3) high lysine (0.95% SID Lys; HL), 4) HL+mannanase (0.08 MU/kg), and 5) As treatment 3 + 3% CWG (CWG). Diets were corn–soy based (LL and HL = 3335 and CWG = 3517 kcal ME/kg) and contained 7.5 ppm ractopamine. One pig/pen was harvested on d 7 and 21, with remaining pigs harvested on d 35. For d 0 through 7, 7 through 21, and 0 through 35, pigs fed the HL diets tended