supplementation (n = 30) or 1.4 kg/d per steer of a corn-soybean meal supplement (n = 15; 12% crude protein). Within supplementation strategy, steers were assigned to either no implant, one implant at d 0 and one implant at d 56 (EI), or one implant at d 56 (LI). Steers were weighed at the initiation and termination of experiment to determine average daily gain (ADG). Blood samples were collected on d 0, 62, and 108, and blood metabolites were quantified. Supplemented steers had greater (P < 0.0001) ADG than non-supplemented steers (0.93 $\pm$ 0.05 vs 0.57 $\pm$ 0.04 kg/d, respectively). Implanted steers (EI and LI) tended to have increased (P = 0.13) ADG compared with non-implanted steers. Concentrations of prolactin and T_4 were decreased (implant x time; P < 0.05) in control and LI (one steroid implant) steers but not EI (two steroid implants) steers at 108 d compared to d-62 concentrations. Cortisol was influenced by a supplement x implant interaction (P < 0.05). Supplemented EI steers had increased cortisol compared to supplemented LI steers (58.8 $\pm$ 10.0 vs 35.3 $\pm$ 9.2 ng/mL for EI and LI steers, respectively). However, non-supplemented LI steers had increased concentrations of cortisol compared with non-supplemented EI steers (56.8 $\pm$ 6.6 vs 42.2 $\pm$ 6.4 ng/mL for LI and EI steers, respectively). Supplemented steers, independent of timing of implantation, had increased (P < 0.001) concentrations of IGF-I compared with non-supplemented steers (211.5 $\pm$ 19.9 vs 122.7 $\pm$ 11.8 ng/mL, respectively). Concentrations of T_4 at d-0 were positively correlated (P < 0.05; r = 0.33) with ADG of steers. Management strategies may alter animal physiology, and those strategies should be considered when using physiological markers for the prediction or selection of animal growth.

Key Words: Steers, Thyroxine, Insulin-like Growth Factor-I

403   A mechanistic nutrition model to evaluate beef cow efficiency. L. O. Tedeschi*[1], D. G. Fox[1], M. J. Baker[1], and K. L. Long[2], [1]*Cornell University, Ithaca, NY*, [2]*Bell Ranch, Solano, NM*.

The beef cattle seedstock industry is searching for ways to select for improved beef cow efficiency. Most selection indexes for efficiency have a goal of using less resource while obtaining the same outcome in a sustainable environment. However, the inputs required to determine individual beef cow feed efficiency are not readily available in practical conditions. A mathematical model was developed to use inputs readily available in each production situation to estimate the ratio of cow ME required to calf-weaning weight (WW) for computing an energy efficiency index (EEI). This model ranks EEI estimates and compares individual cow EEI with the range of expected EEI using Monte Carlo (MC) methods to identify the upper and lower cutoff values. It uses the 2000 Beef NRC recommendations as implemented in the Cornell Net Carbohydrate and Protein System for energy requirements for maintenance, lactation, and pregnancy. Data containing varying levels of milk and forage intake of individual calves during the first 200 d after birth was used to develop a submodel to estimate calf forage and peak milk intake (PKM) based on calf BW and forage composition. A database collected from the Bell Ranch, NM (N = 182) was used to evaluate the ranking from most to least efficient cows. The simulation indicated that as peak milk (PKM) increases, WW increases almost linearly, the difference in the calf WW between small and large cows tended to increase, and EEI estimates improve exponentially. As PKM increased, the EEI difference between small- and large-size cows decreased. The model-predicted least efficient cows were in agreement with culling decisions made prior to evaluating the EEI ranking. The MC simulation based on the distribution, mean, and variability of cow BW, PKM, and forage quality indicated that cows having EEI lower than 30.6 or higher than 38 Mcal/kg are within the 10% more and less efficient cows, respectively. Our analysis suggested this model could assist beef producers in identifying the most and least efficient cows for their resource, and can be used to simulate different production scenarios to identify the best match of cow type to alternative management systems.

Key Words: Modeling, Simulation, Production

Nonruminant Nutrition: Minerals

404   Mineral and chromium supplementation to diets of finishing pigs. B. V. Lawrence*, D. Overend, S. A. Hansen, J. D. Hahn, and J. Hedges, *Hubbard Feeds Inc., Mankato, MN*.

A total of 765 terminal Duroc cross barrows and gilts (Compart Boar Store Line 442 X D100; 29.8 $\pm$ 1.2 kg) were used to compare three treatments: corn-soybean meal control (CTRL), CTRL diet for 63 d with Yield Pak (a blend of vitamins and trace minerals) added from 63 to 91 d (CTRL/YPC), or CTRL/YPC diet supplemented with 200 ppb Cr from chromium propionate from d 0 to 63 (Cr/YPC). Pigs (12 pens/treatment) were weighed on d 0, 63 and 91. Growth performance was similar across treatments (P > 0.10) from d 0 - 63. Day 63 to 91 gain (P < 0.05) and gain:feed (P < 0.01) were lower for the CTRL pigs. At 111.6 $\pm$ 7.3 kg, 36 gilts per treatment were tagged, tattooed, and weighed. After 8 h transit to a commercial abattoir, hot carcass weights (HCW) were obtained (84.3 $\pm$ 1.8 kg). The HCW and yield [(HCW/liveweight)*100] were different (P < 0.01) between treatments. Fat or muscle depth, lean percentage, and ham and loin pH measured at 1 and 22 h post-mortem were not different (P > 0.10) across treatments. At 22 h, a 40 - 50 g loin core was taken between the 7th and 8th ribs and held for 7 d for drip loss determination. Although there was no difference in 22-h pH or rate of 22-h pH decline, the Cr/YPC pigs had a higher (P < 0.10) drip loss than other treatments (4.78 vs. 3.43%). The NPPC measures of loin color, and firmness, as well as ColorTec L*, A*, and B* values were not different (P > 0.10) across treatments. Loin marbling was higher (P < 0.05) for the CTRL/YPC pigs than for the CTRL or Cr/YPC pigs (2.80 vs. 2.46). Forty gilts per treatment (live weight of 115.6 $\pm$ 6.1 kg) fed the CTRL or CTRL/YPC diet at the commercial finisher were processed as described previously. There was a trend (P < 0.10) for the CTRL/YPC pigs to have a higher yield (75.5 vs. 74.9%). The higher yield corresponded with a trend (P < 0.10) toward a reduction in loin drip loss (4.03 vs. 5.30%) and a numerical (P < 0.20) reduction in rate of 22-h ham pH decline (0.55 vs. 0.67 units). These results indicate that addition of YPC in late finishing may improve some meat quality characteristics of fresh pork.

Key Words: Minerals, Pigs, Meat Quality

405   Performance effects of potassium and chloride levels in swine finisher diets. B. V. Lawrence*, J. D. Hahn, and S. A. Hansen, *Hubbard Feeds Inc., Mankato, MN*.

Two trials with terminal cross Duroc sired pigs were conducted to evaluate the effect of K or Cl levels in corn-soya-synthetic amino acid diets on growth and carcass parameters. In Exp 1, 512 pigs (38.7 $\pm$ 1.1 kg) were assigned to either a Control diet (0.22% Na, 0.41% Cl, and 0.73% K), or the Control diet supplemented with 0.10% (Low), 0.20% (Med), or 0.30% (High) K supplied as KCl. Constant Na and Cl levels were maintained by altering the level of dietary NaCl and NaPO$_4$. Pens (n = 6) were weighed on d-0, 21, 42, 63, and 85. In Exp 2, 512 pigs (32.9 $\pm$ 0.8 kg) were fed one of four diets. The Control diet was similar to that in Exp 1. The remaining 3 treatments were formulated to 0.94% K and 0.22% Na and either 0.60% (High Cl), 0.47% (Med Cl) or 0.33% (Low Cl) chloride. The Cl levels were achieved by altering inclusion level of NaPO$_4$ and NaCl. Pens (n = 6) were weighed on d-0, 21, 42, 63, 85 and 96. At the end of both experiments, real-time ultrasound (RTU) measurements of tenth rib loineye area (LEA) and backfat (TRF) as well as last rib fat (LRF) were obtained on 40 barrows and 40 gilts per treatment. Yield, fat depth, loin depth, and lean percentage were obtained on 40 barrows and 40 gilts per treatment at a commercial abattoir. Data was analyzed using the GLM procedures of SAS with pen the experimental unit for gain, intake and feed conversion and individual pig the experimental unit for RTU and abattoir analysis. During Exp. 1, pigs fed the K supplemented diets had numerically higher gains, however, there were no significant (P>0.10) differences in gain, intake, or feed conversion. K supplementation had no influence on RTU or abattoir carcass parameters. In Exp. 2, pigs fed the Med Cl diets tended to have the highest (P<0.10) gain. There was no diet effect (P>0.10) on intake or feed conversion. RTU and abattoir carcass measurements were not different (P>0.10) across treatments. Yield was lowest (P<0.05) for the Low Cl fed pigs. These results suggest that K supplementation may improve growth, while the appropriate Cl level may influence gain and yield.

Key Words: Electrolytes, Growth, Pigs

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406 Comparisons of inorganic and organic trace mineral supplementation for grow-finish swine. J. L. Burkett*[1], K. J. Stalder[1], C. R. Schwab[1], T. J. Baas[1], D. W. Newcom[1], J. L. Pierce[2], W. J. Powers[1], and J. W. Mabry[1], [1]*Dept. of Animal Science, Iowa State University, Ames,* [2]*Alltech Inc., Nicholasville, KY.*

A study was conducted to investigate the effect of inorganic and organic mineral supplementation on the growth and ultrasonically measured carcass characteristics of swine. In each of the two replications, 264 pigs were used in a completely randomized design with four dietary treatments and 10 - 12 pigs per pen (n = 24) throughout the grow-finish period. A commercial line of barrows and gilts were penned by sex, and randomly assigned to one of the four treatments at approximately 27 kg. Treatment 1 (control) contained a common trace mineral supplement (Kent Feeds, Muscatine, IA), while treatments 2, 3, and 4 contained Alltech's Bioplex products at 100%, 75%, and 50% of the common trace mineral supplemental levels, respectively. Individual tenth rib backfat (BF) and loin muscle area (LMA) measurements were evaluated ultrasonically on all pigs prior to marketing (118 kg). Average daily gain and average daily lean growth on test (LGOT) were calculated from the data collected on individuals. Pen feed intake was calculated by feed weigh-back to determine ADFI, feed efficiency (FE), and efficiency of lean gain (LE). Pen was the experimental unit of measurement in this study. Data from this study were analyzed using a mixed linear model with fixed effects of replication, treatment, and sex and the interaction of sex by treatment. Pen nested within treatment was included as a random effect for the evaluation. Off test weight was included as a covariate for the analyses of BF and LMA. On test weight was included as a covariate in the analyses of ADG, LGOT, ADFI, FE, and LE. Replication and sex effects were significant sources of variation for BF, LMA, ADG, LGOT, and ADFI. Pigs fed the control diet consumed less (P < 0.05) feed per day than pigs fed the three experimental diets. This study revealed no differences (P > 0.05) among the treatment means for BF, LMA, ADG, LGOT, and LE.

Key Words: Pigs, Mineral Supplementation, Ultrasound Measurements

407 The effects of high phytase levels on nutrient digestibility, growth performance and bone characteristics in growing pigs. M. J. Azain*[1] and M. R. Bedford[2], [1]*University of Georgia, Athens,* [2]*Zymetrics, Golden Valley, MN.*

Phytase is typically supplemented at less than 1000 U/kg diet. The objective of this study was to look at the effects of higher levels of phytase supplementation in the growing pig. A total of 144 pigs (initial wt = 13 kg) were randomly assigned to one of six dietary treatments with 3 barrows or 3 gilts per pen and a total of 48 pens in 2 trials. A corn-soy diet (20% CP, 1.12% lysine) was used. Diet 1 was the positive control and contained 0.90% Ca and calculated total and available P of 0.55 and 0.28%, respectively. Diets 2-6 had less dicalcium phosphate added and contained 0.70% Ca and 0.40 and 0.13% total and available P. Diet 2 was the negative control and diets 3-6 were supplemented with 100-12,500 U/kg feed of a novel E. coli Phytase expressed in Pichia pastoris. Diets were fed for 28 d. Apparent nutrient digestibility was determined using chromic oxide as a marker during the last week of the trial. Pigs were euthanized and metatarsal bone isolated for determination of bone strength and mineral content. Pigs fed the P deficient diet had reduced growth and efficiency as well as decreased bone weight and strength. Phytase addition improved growth rate and bone parameters. Ca and P digestibility were improved with phytase, but there was no significant effect on protein or energy digestibility. Bone Ca and P content were not affected by dietary treatment. However, bone Mg was decreased and K increased on the P deficient diet. Both were normalized with the addition of phytase to the diet. Pigs fed diets with 12,500 U Phytase/kg had growth rates, nutrient digestibilities and bone characteristics that were superior to the pigs fed the positive control diet. This effect may be accounted for by the removal of the anti-nutritional effects of phytate.

Diet:					Phytase, U/kg			
	Pos Ctrl	Neg Crtl	100	500	2500	12500	SEM	P
Gain, g/d	629	465	530	549	634	712	14	0.001
G:F, g/kg	571	492	527	548	580	613	16	0.001
Digestibility, %								
CP	77.3	77.9	74.9	76.9	77.4	78.5	1.5	NS
Energy	81.9	82.8	81.3	81.1	83.0	83.1	1.0	NS
Ca	63.6	51.3	55.9	56.5	70.9	78.9	1.9	0.001
P	40.8	21.3	20.7	28.4	58.9	75.5	2.4	0.001
Bone								
Weight, g	6.28	5.23	5.52	5.85	6.51	7.10	0.21	0.001
Ash, %	34.4	28.8	28.6	30.6	34.0	37.9	0.7	0.001
Strength, kg	52.09	31.94	35.01	41.47	53.29	68.047	2.30	0.001

Key Words: Swine, Phytase, Bone Ash

408 Shifting the pH profile of *Aspergillus niger* PhyA phytase improves its efficacy in pig diets. S. U. Rice, T. G. Ko, T. W. Kim, K. R. Roneker, and X. G. Lei*, *Cornell University, Ithaca, NY.*

Aspergillus niger PhyA phytase is widely used in swine diets, but its pH optimum (5.5) is too high for an effective hydrolysis of phytate-P under the acidic condition in the pig stomach. Using site-directed mutagenesis, we have developed two mutants (TK10 and TK228) with lower pH optima than the wild-type (WT) of PhyA. The objective of this experiment was to compare the effectiveness of TK10 and TK224 with that of WT in improving dietary phytate-P availability to pigs. A total of 24 weanling pigs (8.41 ± 0.49 kg BW) were divided into three groups (n = 8), and fed a low-P, corn-soybean meal basal diet supplemented with the WT, TK10, or TK228 phytases at 250 units/kg of feed for five weeks. Growth performance, plasma inorganic P concentration, and plasma alkaline phosphatase activity of individual pigs were recorded or measured weekly. The overall daily gain of pigs fed the TK228 mutant phytase was 13% higher (509 vs 451 g, P < 0.05) than that of those fed the WT enzyme. Pigs fed TK228 also had higher (P < 0.05) plasma inorganic P concentrations at weeks 2-5, but lower (P < 0.05) plasma alkaline phosphatase activity at weeks 3-5 than those fed the WT enzyme. Feeding pigs with the TK10 mutant enzyme resulted in growth performance or plasma measures similar to those fed the WT enzyme. In conclusion, the shift of pH optimum in the TK228 mutant PhyA phytase enhanced its efficacy in the corn-soybean meal diets for weanling pigs. However, the similar shift in the TK10 mutant rendered no benefit over the WT enzyme.

Key Words: Phytase, Pigs, Phosphorus

409 Phosphorus excretion of pigs fed conventional or low-phytate corn-soybean meal diets without or with phytase. E. G. Xavier, L. A. Pettey, G. L. Cromwell*, and M. D. Lindemann, *University of Kentucky, Lexington.*

Two 5-d balance experiments were conducted to assess diets containing normal (N) corn and N soybean meal (SBM) or low-phytate (LP) corn and LP, low-oligosaccharide SBM without or with phytase (Natuphos®, BASF; 750 units/kg) on total and soluble P excretion in pigs. The LP-corn and LP-SBM were provided by Pioneer Hi-Bred International. The N-corn, LP-corn, N-SBM and LP-SBM contained 0.32, 0.26, 0.66, and 0.77% total P and 0.06, 0.17, 0.21, and 0.55% non-phytate P with estimated P bioavailabilities of 20, 75, 25, and 50%, respectively. Twelve pigs (52 kg) in metabolism crates were fed four diets (0.90% lysine) during two periods. Feeding level was equalized within replications and averaged 96% of ad libitum intake. Diets were (1) N-corn + N-SBM, 0.57% P; (2) N-corn + N-SBM + phytase, 0.47% P; (3) LP-corn + LP-SBM, 0.39% P; and (4) LP-corn + LP-SBM + phytase, 0.35% P. Diet 4 contained no added inorganic P. Ca was reduced from 0.58% in Diets 1 and 3 to 0.53% in Diets 2 and 4. All diets had the same levels of non-phytate P (0.28%) and bioavailable P (0.27%), assuming that phytase released one-third of the unavailable P. Daily feed and P intake averaged 1.91, 1.92, 1.96, 1.96 kg/d and 9.95, 8.05, 7.65, 6.88 g/d for Diets 1 to 4, respectively. Apparent P digestibility was increased by feeding the LP- vs N-diets and by phytase addition (37, 56, 66, 78%; P < 0.05). Total P in feces and urine was 3.09, 1.89, 1.58, 0.95% of DM (P < 0.05) and 21, 29, 36, 48 mg/L. Daily P excretion in feces, urine, and both

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were affected by diet (6.24, 3.58, 2.62, 1.51 g/d, P < 0.05; 0.07, 0.13, 0.19, 0.20 g/d; 6.31, 3.71, 2.81, 1.71 g/d, P < 0.05), as were absorbed P (3.71, 4.46, 5.03, 5.36 g/d; P < 0.05) and retained P (3.63, 4.34, 4.84, 5.16 g/d; P < 0.05). Total P excretion decreased by 41% when phytase was added to the N-diet, by 55% when the LP-diet was fed, and by 73% when phytase was included in the LP-diet. Soluble P in excreta, expressed as % of total P, increased (P < 0.05) with the LP-diet and with phytase (2.0, 4.4, 7.1, 12.8%), but daily soluble P excretion was not affected (P > 0.50) by diet (0.13, 0.17, 0.23, 0.23 g/d).

Key Words: Pigs, Phosphorus, Phytase

410 Estimation of Ca and P retention in bone, fat-free soft tissue, and other whole body and carcass components in growing-finishing pigs from 18 to 109 kg. L. A. Pettey*, G. L. Cromwell, and M. D. Lindemann, *University of Kentucky, Lexington*.

The distribution of Ca and P in carcass bone, carcass fat-free soft tissue (FFST), and viscera (empty)-head-blood-skin (VHBS) was determined in 50 pigs from 18 to 109 kg BW to develop equations describing the retention rates of Ca and P. Ca and P in hair and hooves was inconsequential. Data were combined from two studies in which pigs were killed at 18, 27, 36, 45, 54, 73, 91, and 109 kg. Pigs were fed fortified corn-soy diets (four phases) that exceeded NRC standards for lysine, Ca, and P by 0.1%. Carcasses were split with the right half physically separated into soft tissue, bone, and skin. Chemical analysis was conducted on each body tissue. Carcass bone represented 10.0, 9.5, 9.0, 8.2, 8.3, 8.1, 7.4, and 7.5% of BW for the eight weight groups, respectively. Bone Ca represented 98.8% of the Ca in the carcass and was constant from 18 to 109 kg BW. Carcass P contributed by bone was constant from 18 to 54 kg (71.9%), but increased linearly (P < 0.01) to 75.1% from 54 to 109 kg BW. In fresh bone, protein, lipid, ash, Ca, and P concentrations increased linearly (P < 0.01) with increasing BW, while water concentration decreased linearly (P < 0.01). Ca and P concentrations in fresh bone were 4.2, 4.8, 5.2, 5.9, 5.7, 6.6, 6.9, and 7.4%; and 2.3, 2.5, 2.8, 3.1, 3.1, 3.3, 3.6, and 3.7%, respectively. In bone ash, Ca and P averaged 33.8 and 17.7% across all BW groups. FFST was constant (45% of BW) across BW groups. Ca and P concentrations in FFST were unchanged with BW and averaged 0.012 and 0.210%, respectively. Based on days from 18 to 36, 36 to 54, 54 to 73, 73 to 91, and 91 to 109 kg BW, the retention rates of Ca and P were calculated for bone, FFST, and VHBS. The predicted Ca retention rates for 27, 45, 64, 82, and 100 kg pigs (means of the five BW ranges) were 4.03, 5.68, 6.71, 7.03, and 6.70 g/d (Y = 0.34 + 0.1635X - 0.001X^2), and predicted P retention rates were 3.06, 4.16, 4.79, 4.88, and 4.47 g/d (Y = 0.49 + 0.1158X - 0.00076X^2). When combined with Ca and P needs for maintenance, a net requirement for Ca and P can be estimated for pigs from 20 to 110 kg BW with this model.

Key Words: Pigs, Bone, Phosphorus

411 Endogenous excretion of phosphorus and calcium in growing pigs fed two varieties of soybean meal. R. N. Dilger* and O. Adeola, *Purdue University, West Lafayette, IN*.

Using the regression approach, whole body endogenous excretion of phosphorus and calcium were measured in growing pigs fed diets containing conventional or high available phosphorus (HAP) soybean meals (SBM) as the primary phosphorus and calcium source. Semipurified cornstarch-based diets contained four graded levels of each soybean meal; thereby creating a linear dietary intake of phosphorus (0.7, 1.3, 2.0 and 2.7 g/kg DM) and calcium (0.5, 0.9, 1.4 and 1.8 g/kg DM). Chromic oxide (3.0 g/kg diet, as-fed) was used as an indigestible index and pigs were fed at a rate of 0.09*BW$^{0.75}$ kg according to individual weekly BW. Sixteen barrows (average initial BW of 17.7 kg) were fitted with simple T-cannula at the distal ileum and fed the diets according to a replicated 8 X 8 Latin square design. Experimental periods were 7 d in length with 5 d diet acclimation, sampling of feces on d 5 and 12-h collection of ileal digesta on each of d 6 and 7. Apparent pre-cecal phosphorus and calcium digestibilities exhibited a linear relationship to dietary mineral intake for conventional (P < 0.01) but not HAP SBM (P > 0.10). Conversely, apparent total tract phosphorus and calcium digestibilities increased linearly to dietary mineral intake for HAP (P < 0.02) but not conventional SBM (P > 0.10). Endogenous outputs

of phosphorus in ileal digesta were different between SBM sources (P < 0.01; 7.9 vs. 4.2 g/kg DMI for conventional and HAP SBM, respectively) but not when determined in the feces (P > 0.10; 0.02 vs. 0.09 g/kg DMI for conventional and HAP SBM, respectively). True pre-cecal and total tract digestibilities of phosphorus and calcium were higher for HAP SBM compared with conventional SBM (P < 0.01). This was due in part to the 344- and 47-fold reductions (P < 0.01) in endogenous phosphorus output (DMI basis) between the ileal and fecal collection sites for conventional and HAP SBM, respectively. These data suggest the regression approach may be used to estimate whole body endogenous mineral output though an inherently high degree of variability seems to exist with this methodology.

Key Words: Endogenous, Minerals, Pigs

412 A novel procedure for measuring endogenous phosphorus losses and true phosphorus digestibility by growing pigs. G. I. Petersen* and H. H. Stein, *South Dakota State University, Brookings*.

A novel procedure was developed to estimate endogenous losses of phosphorus by growing pigs. A P-free diet was formulated using mainly cornstarch, dextrose, gelatin, and crystalline AA. In Exp. 1, two P-free diets were formulated using gelatin of either porcine or bovine origin. The apparent (AID) and standardized (SID) ileal digestibility coefficients of AA in these two diets were compared to the AID and SID in soybean meal (SBM). Results of this experiment showed that there were no differences in AID or SID for any of the indispensable AA except for trp between the three feed ingredients when fed to growing pigs. In Exp. 2, a P-free diet based on gelatin of porcine origin was used to measure the apparent (ATTD) and true (TTTD) total tract digestibility of three sources of inorganic phosphorus. In addition to the P-free diet, three other diets were formulated based on the P-diet, but each of these diets were supplemented with either monosodium phosphate (MSP), purified monocalcium phosphate (MCP) or dicalcium phosphate (DCP). The inorganic phosphate sources were added to the P-free diet to reach a total P-content in the diets of 0.2%. Each of the four diets was fed to 7 pigs for 12 d. Fecal material was collected for five d using the marker to marker procedure. Results of the experiment showed that the ATTD in DCP was lower (P ≤ 0.05) than in MCP (81.49 vs. 91.88%), while the ATTD in MCP (87.96%) was similar to the other two sources. The endogenous losses of P were calculated based on the P-concentration in the fecal samples from pigs fed the P-free diet and averaged 0.139 g P per kg DMI. By correcting the ATTD for the endogenous losses, the TTTD were calculated. For DCP, MCP, and MSP, the TTTD was 88.41, 94.93, and 98.20%, respectively. The value for MSP was higher (P ≤ 0.05) than the value for DCP, while the TTTD for MCP was not different from the other two sources. The two experiments showed that the P-free diet provides a way of estimating endogenous losses of P in pigs and can be used to calculate ATTD and TTTD in feed phosphates.

Key Words: Endogenous Loss of P, P-Free Diet, True Digestibility of P

413 Evaluation of the bioavailability of phosphorus in distillers dried grains with solubles (DDGS) when fed to pigs. R. W. Fent*[1], T. S. Torrance[2], B. W. Ratliff[1], S. X. Fu[1], G. L. Allee[1], D. M. Webel[2], and J. D. Spencer[2], [1]*University of Missouri, Columbia*, [2]*United Feeds, Inc., Sheridan, IN*.

A slope ratio assay was conducted to estimate the bioavailability of phosphorus (P) in distillers dried grains with solubles (DDGS). Seventy-two barrows (initial wt = 15.0 kg) were individually penned and allotted by weight to one of nine dietary treatments in a randomized complete block design. All diets were cornstarch-soybean meal based. Treatments 1-7 comprised the slope ratio assay consisting of a basal diet (0.25% P, 1.25% TID Lys) and diets containing 0.075, 0.150, and 0.225% additional P from either monosodium phosphate (MSP) or DDGS. The two additional diets consisted of the 0.225% P DDGS + 500 FTU/kg phytase (Optiphos#8482; Phytex, LLC) and the basal diet + 500 FTU/kg to assess the possible further liberation of phosphorus. Pigs were allowed ad libitum access to feed and water. After a 28-d feeding period, all pigs were weighed, sacrificed, and right fibulas collected for analysis of bone breaking load and bone ash content. The standard curve (MSP) and the DDGS titration both resulted in linear improvements (P < 0.01) in ADG, ADFI, gain:feed, fibula breaking load, and fibula bone ash content. The bioavailability estimate of the phosphorus contained in DDGS was estimated as the ratio of the slopes of the DDGS

curve to the standard curve. The resulting P bioavailability estimates for DDGS relative to MSP were 84.3% and 85.3% for fibula breaking load and fibula bone ash, respectively. The basal diet + 500 FTU/kg phytase resulted in greater fibula breaking load (18.7 vs 13.7 kg force) and bone ash (1.049 vs 0.896 g) as compared with the basal diet, resulting in calculated P release of 0.082 and 0.064%, respectively. The 0.225% P DDGS + 500 FTU/kg phytase also resulted in greater fibula breaking load (31.9 vs 24.6 kg force) and bone ash (1.681 vs 1.389 g)

as compared with the 0.225% P DDGS diet. Taking into consideration the response from soybean meal, phytase supplementation resulted in complete P bioavailability from DDGS. These results indicate that the bioavailability of phosphorus in DDGS is approximately 85% with the remaining phosphorus liberated with additional phytase.

Physiology and Endocrinology: Strategies for Appointment Breeding of Beef and Dairy Cattle

414   Comparison of EAZI-BREED CIDR inserts with melengestrol acetate in progestin-based protocols to synchronize estrus in beef cows. D. J. Schafer*, J. F. Bader, D. C. Busch, F. N. Kojima, M. R. Ellersieck, M. C. Lucy, M. F. Smith, and D. J. Patterson, *University of Missouri, Columbia.*

Follicular dynamics and timing of estrus and ovulation were compared in 48 nonsuckled, estrous cycling beef cows using EAZI-BREED CIDR inserts (CIDR) or melengestrol acetate (MGA) in progestin-based protocols to synchronize estrus. Cows were assigned equally (n=12) to one of four treatments (T1 to T4) by age and body condition. Cows in T1 were fed MGA ($0.5 \text{mg·hd}^{-1}\text{·d}^{-1}$) for 14 d, GnRH (100 μg Cystorelin) was injected on d 26, and $PGF_{2\alpha}$ (PG; 25 mg Lutalyse) on d 33. Cows in T2 had CIDRs (1.38g progesterone) inserted for 14 d, GnRH was injected on d 23, and PG on d 30. Cows in T3 were fed MGA for 7 d, injected with PG on d 7, GnRH on d 11, and PG on d 18. Cows in T4 had CIDRs inserted for 7 d, were injected with PG on d 7, GnRH on d 9, and PG on d 16. Transrectal ultrasonography was performed daily to monitor follicular dynamics from GnRH to estrus after PG; and every 4 h from 20 h after the onset of estrus until ovulation was confirmed. Estrus detection was performed with HeatWatch. Emergence of a new follicular wave after GnRH, and estrus after PG did not differ (P>.10) among treatments: T1, 11/12; T2, 9/12; T3, 11/12; T4, 9/12. Mean interval to estrus (h) was shorter (P<.05) for cows in T3 and T4 than cows in T1 and T2 (T1, 62 ± 2.1; T2, 59 ± 2.4; T3, 51 ± 2.1; T4, 52 ± 2.4). Follicle diameter (mm) at GnRH did not differ (P>.10) among treatments; differed at PG (P<.05) between T2 and all other treatments (T1, 12.2 ± .5; T2, 10.7 ± .5; T3, 13.0 ± .5; T4, 12.9 ± .5); and differed (P<.05) 20 h after the onset of estrus between T1 and T2. Progesterone (ng/mL) at PG was greater (P<.001) for cows in T1 and T2 than T3 and T4 (T1, 3.7 ± .4; T2, 3.9 ± .4; T3, 1.8 ± .4; T4, 1.7 ± .4). Interval from estrus to ovulation (h) was shorter (P<.05) for cows in T4 than T3 (T1, 30 ± 1.2; T2, 30 ± 1.4; T3, 31 ± 1.2; T4, 27 ± 1.4). These data demonstrate the flexibility in using MGA or CIDR inserts in progestin-based protocols to synchronize estrus in beef cows. (Supported by USDA-NRI grant 2000-02163).

415   Substituting EAZI-BREED CIDR inserts (CIDR) for melengestrol acetate (MGA) in the MGA Select protocol in beef heifers. F. N. Kojima*[1], J. F. Bader[1], J. E. Stegner[1], D. J. Schafer[1], J. C. Clement[2], R. L. Eakins[1], M. F. Smith[1], and D. J. Patterson[1], [1]*University of Missouri, Columbia*, [2]*Cow Calf Research and Consulting, Mandan, ND.*

This study was designed to compare estrous response, timing of AI and pregnancy rate resulting from AI among beef heifers that were presynchronized with MGA or the CIDR insert prior to GnRH and PGF_2 $_\alpha$ (PG). Heifers (n = 353) at three locations (location 1, n = 154; 2, n = 113; and 3, n = 85) were assigned randomly to one of two treatments by age and weight. The MGA Select-treated heifers (MGA; n = 175) were fed MGA ($0.5 \text{ mg·hd}^{-1}\text{·d}^{-1}$) for 14 d, GnRH (100 μg i.m. Cystorelin) was injected 12 d after MGA withdrawal, and PG (25 mg i.m. Lutalyse) was administered 7 d after GnRH. CIDRs (CIDR; n = 177) were inserted in heifers for 14 d, GnRH was injected 9 d after CIDR removal, and PG was administered 7 d after GnRH. CIDR-treated heifers received carrier without MGA on days that coincided with MGA feeding. Heifers were monitored for signs of behavioral estrus beginning the day PG was administered. AI was performed 12 h after onset of estrus and recorded as day of AI (Day 0 = PG). Pregnancy rate to AI was determined by ultrasonography 40 d after AI. Quantitative data were analyzed by ANOVA and qualitative data were compared by Chi-square analysis. Distribution of AI was analyzed by ratio of variance (F-test) for mean interval to AI. No interactions between locations and treatments were detected;

therefore, data were pooled for analyses. Estrous response did not differ (P > 0.10) between treatments. Peak AI occurred on Day 3 for heifers in both treatments (CIDR 122/177, 69%; MGA 93/175, 53%), and distribution of AI was more highly synchronized (P < 0.05) among CIDR- than MGA-treated heifers. Pregnancy rate to AI was greater (P < 0.01) in CIDR- (112/177, 63%) than MGA-treated heifers (83/175, 47%), however, final pregnancy rate did not differ (P > 0.10) between treatments. In summary, replacing feeding of MGA with CIDR inserts improved synchrony of estrus and pregnancy rate resulting from AI in replacement beef heifers.

416   MGA and CIDR based timed AI protocols in postpartum beef cows. D. Kreider*, N. Post, R. Rorie, T. Lester, and E. French, *University of Arkansas, Fayetteville.*

An experiment was conducted to compare two timed AI, estrus synchronization protocols in postpartum beef cows. Straight bred Angus cows (n = 125) in herds 1 (n = 54) and 2 (n=71) were sorted by BW and body condition score (BCS); then randomly assigned to treatments. Treatments were; MPGG: MGA (.5mg/hd/d) for 14 d followed by 25mg Lutalyse (PG) 17 d after MGA withdrawal and GnRH (100 μg Fertagyl) 48 h after PG; and CIDR: 100 μg GnRH plus Eazi-Breed CIDR for 7 d, then PG followed in 48 h by GnRH. All cows were inseminated 18 h after GnRH, and then placed with a fertile bull at 10 d after AI. Conception rate (CR) was determined by ultrasound at 30 d post AI and pregnancy rate (PR) was determined by palpation 55 d after bull removal. Serum was collected and analyzed for progesterone (P4) on d -6, 1 and 31 of MGA treatment for MPGG and on d -6, 1 and 7 for CIDR. Cows were assumed to be cycling if P4 was ≥ 1 ng/ml on d -6 or 1 and were considered to have a functional CL if P4 was ≥ 1 ng/ml on d 31 (MPGG) or d 7 (CIDR). BW and BCS, d postpartum at the start of treatment and CR to AI were all different between herds (P < 0.01), but treatments did not differ in initial BW, initial BCS and days postpartum, either within herd (P > 0.14) or for the combined data (P > 0.10). Percent of cows cycling at the start of treatments differed (P = 0.001) between herds (35% vs 92% for herds 1 and 2 respectively), and between MPGG and CIDR in herd 1(18% vs 54%, respectively; P = 0.006). Conception rate to AI was 25% in MPGG vs 46% in CIDR in herd 1 (P = 0.09) and overall pregnancy rate was 79% in MPGG vs 69% in CIDR (P = 0.86). In herd 2, percent cycling at the start of treatment, and conception rate to AI did not differ between MPGG and CIDR (89% vs 94%, P = 0.35; and 53% vs 65%, P = 0.19; respectively). For the combined data, percent cycling at the start of treatment and conception rate to AI differed between MPGG and CIDR (58% vs 76%, P = 0.03; and 57% vs 41%, respectively, P = 0.04). Under the conditions observed in this study, conception rates to timed AI using an MGA based protocol tend to be lower than those obtained with a CIDR based protocol in postpartum beef cows.

417   Effect of timing of insemination and estrous synchronization method on AI pregnancy rates in beef heifers. B. R. Dorsey*, J. B. Hall, W. D. Whittier, and W. S. Swecker, *Virginia Polytechnic Institute and State University, Blacksburg.*

The objectives of this experiment were to evaluate time of insemination relative to estrus and synchronization with melengestrol acetate with PG (MGA-PG) or an intervaginal progesterone insert with PG (CIDR-PG) on AI pregnancy rate in beef heifers. Crossbred heifers were blocked by weight and assigned to MGA-PG (n = 176) or CIDR (n = 173). The MGA-PG group received MGA (0.5 mg/hd/d for 14 d) followed by PG (25 mg Lutalyse, Pfizer) 19 d after last feeding of MGA. The CIDRs