T167 Abundance of mRNA expression and nutritional regulation of somatotropic axis genes in the small intestine of prepubertal dairy heifers fed high-protein high-fat milk replacers. B. T. Velayudhan*, K. M. Daniels, M. L. McGilliard, B. A. Corl, K. F. Knowlton, and R. M. Akers, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Components of the somatotropic axis and nutrition are important in regulating intestinal development as well as maturation of enterocytes. We measured the abundance of mRNA by real-time polymerase chain reaction to test the hypothesis that increased amounts of protein and fat in the diet alters the expression of somatotropic axis genes in the mucosal layer of small intestine. We measured the expression of growth hormone receptor (GHR), insulin-like growth factor-I (IGF-I), IGF-I receptor (R) and IGF binding proteins (BP) -1 to -6 in duodenum, jejunum and ileum. Twenty-four newborn Holstein heifers were randomly assigned to one of 4 milk replacers (MR; n=6/diet): MR 1 was 24 % protein and 17 % fat, MR 2 was 32:17, MR 3 was 31:24 at low level of feeding or MR 4 was 31:24 at high level of feeding. Animals were sacrificed and intestinal tissues were harvested for RNA isolation at 59±2 d. Abundance of mRNA for GHR, IGFBP-3, -4, and -5 was greater (1.8, 2.6, 3.0, 1.7 fold, respectively; P≤0.05) in high protein groups compared to the low protein group (MR 2 +MR 3 + MR 4 VS. MR 1) while GHR, IGFBP-2, -3 and -5 mRNA was greater (0.8, 1.7, 1.6, 1.6 fold, respectively; P≤0.05) with high fat feeding (MR 1 + MR 2 VS. MR 3 + MR 4). Abundance of mRNA expression for IGF-I, IGF-IR, IGFBP-3, -4 and -6 was greater (P≤0.05) in duodenum than jejunum or ileum but IGFBP-2 mRNA expression was greater (P≤0.05) in jejunum than duodenum or ileum. However, mRNA expression for GHR, IGFBP-1 and -5 was not different (P≥0.50) between different intestinal locations. In conclusion, components of the somatotropic axis in prepubertal dairy heifers are differentially expressed in regions of the small intestine and the gene expression is impacted by dietary protein and fat.

Key Words: Prepubertal Heifer, Intestinal Mucosa, GH-IGF Axis Gene Expression

T168 Effect of zilpaterol on cultured bovine satellite cells. E. K. Sissom*[1], D. A. Yates[2], J. L. Montgomery[2], W. T. Nichols[2], M. N. Streeter[2], J. P. Hutcheson[2], and B. J. Johnson[1], [1]*Kansas State University*, *Manhattan*, [2]*Intervet Inc.*, *Millsboro, DE*.

Zilpaterol is a β-adrenergic receptor (β-AR) agonist recently approved to improve production efficiencies and dressing percentage in feedlot cattle. The purpose of these experiments was to determine the effect of various levels of zilpaterol (0, 100 pM, 1 nM, 10 nM, 100 nM, 1 μM, and 10 μM) in culture media on bovine satellite cell proliferation and gene expression. Total RNA was isolated from cells following 48 h zilpaterol exposure in both proliferating myoblast cultures at 96 h, and fused myotube cultures established after 192 h in culture. Real-time quantitative-PCR was performed to estimate mRNA abundance. There was no effect (P > 0.10) of zilpaterol dose on [^{3}H]-thymidine incorporation in proliferating myoblasts. Zilpaterol (1 μM) addition to myoblasts resulted in a decrease (P < 0.05) in β1-AR mRNA. Similarly, zilpaterol (10 nM and 1μM) decreased (P < 0.05) β2-AR and β3-AR mRNA. The expression of IGF-I mRNA was increased (P < 0.05) with zilpaterol (1 μM) addition, and there was a tendency (P = 0.07) for zilpaterol (1 nM) to increase myosin heavy chain mRNA, while 10 nM and 1μM zilpaterol reduced (P < 0.05) myosin heavy chain mRNA levels. There was no effect (P > 0.05) of zilpaterol dose on the expression of genes analyzed in fused myotube cultures at 192 h. Similar to changes in mRNA, western blot analysis revealed the protein content of β2-AR in zilpaterol-treated myoblast cultures decreased (P = 0.05) relative to control. Similar to previous work with other β-adrenergic agonists, zilpaterol did not alter satellite cell proliferation but reduced both mRNA and protein levels of the various subtypes of β-AR in these cultures. The response of zilpaterol on IGF-I mRNA could be mediating changes in protein synthesis and degradation. These data indicate that zilpaterol addition can alter mRNA and protein concentrations of β-AR of muscle cell cultures which in turn could impact responsiveness of cells to prolonged zilpaterol exposure.

Key Words: β-Adrenergic Receptor, Skeletal Muscle, Zilpaterol

T169 Cloning and expression pattern of bovine adipogenin isoform. S. G. Roh*, T. Satoh, and S. Shinichi, *Shinshu University*, *Minamiminowamura, Nagano-ken, Japan*.

The generation of new adipocytes results from differentiation mediated by several transcription factors identified as master regulators for adipogenesis. Recently, we reported that adipogenin, a new adipose-specific gene, was highly expressed in adipose tissues and up-regulated during adipocyte differentiation in bovine and mice. In the process of analyzing the expression of adipogenin in adipose tissues from cattle, we found an isoform of adipogenin cDNA, generated by alternative splicing. Therefore, the objective of this study was to isolate of bovine adipogenin isoform and analyze its expression on adipose tissue and differentiated adipocytes. The putative complete coding sequence of the bovine adipogenin isoform gene is 384 bp in length. The splicing event results a new ORF that could generate an isoform of 127 amino acids. Alignment analysis using BLAST program (NCBI) with bovine genomic (chromosome 13 contig NW_001493160) and cDNA adipogenin isoform sequences indicates that flanking nucleotides of divergence point among sequences of this 133 bp fragment and adipogenin cDNA perfectly match with exonic sequences from exon 1/intron 1 and intron 2/exon 3 junctions, confirming that entire exon 2 is spliced in the another fragment. To amplify specifically the adipogenin isoform, we performed RT-PCR analysis using adipogenin isoform-specific forward primer derived from exon 1/exon 3 junction. Total RNA was extracted from bovine tissues and cultured preadipocytes and differentiated adipocytes in 6-well culture dishes, and cDNA synthesis and PCR reactions were performed. The expression of bovine adipogenin isoform mRNA in adipose tissues was significantly higher (P < 0.05) than that in non-adipose tissues examined. The expression of adipogenin isoform was signficantly highly expressed in adipocytes (P < 0.05) compared to stromal-vascular cells. The levels of bovine adipogenin isoform mRNA significantly increased (P < 0.05) throughout the 10-day of adipocyte differentiation. In conclusion, this spliced form of adipogenin may be another factor in the regulation of adipocyte gene expression and in the adipogenic process.

Key Words: Cattle, Adipogenin, Adipogenesis

T170 Δ^9 Desaturase gene expression in adipose tissues of calf-fed and yearling-fed Steers. M. A. Brooks*[1], C. W. Choi[2], D. K. Lunt[1], H. Kawachi[3], and S. B. Smith[1], [1]*Texas A&M University*, *College Station*, [2]*National Livestock Research Institute*, *Suwon, South Korea*, [3]*Kyoto University*, *Kyoto, Japan*.

There is a growing interest in documenting the effect diet on the ability to convert saturated fatty acids (SFA) to monounsaturated fatty acids (MUFA) by modulating expression of the Δ^9 desaturase gene. We propose that if cattle were raised to a constant body weight, their MUFA:SFA ratio will be the same regardless of being calf-fed (CF) or yearling-fed (YF). Twenty-four Angus cattle were acquired for this study. Baseline cattle were slaughtered at weaning at 8 mo of age (n=4), and the remaining cattle were assigned to CF and YF groups. Eight steers were assigned to the CF group and were slaughtered at 12 mo of age (n=4) and 16 mo of age (n=4). Twelve cattle were assigned to the YF group and slaughtered at 12 mo of age (n=4) 16 mo of age (n=4) and market weight of 525 kg (n=4). Intramusclar lipid (IML) of the LM, fatty acids of s.c. and i.m. adipose tissues, slip points of the s.c. lipids, and mRNA concentrations were measured in adipose and muscle samples of each of the cattle in the study. As the animals aged, a significant rise was seen in IML of both CF ($P<0.01$) and YF ($P<0.01$). Slip points (estimators of melting points) in both CF animals and YF animals significantly decreased with age; however, there was no significant difference in slip points between the 16 mo CF cattle and market weight YF cattle (difference of 1.95°C, $P=0.25$). The s.c. adipose tissue Δ^9 desaturase gene expression was virtually undetectable in both the baseline and 12 mo old YF animals, whereas there was marked expression in all the CF and the other YF cattle. This observation was confirmed by the s.c. adipose tissue MUFA:SFA ratios. The baseline and 12 mo old YF animals showed similar ratios (0.770, 0.707, respectively), whereas there was a significant increase from baseline in the animals that were being fed grain diets (CF 1.01 and 1.02, YF 0.98 and 0.96). The results indicate a repression of Δ^9 desaturase gene expression in YF cattle during the first 4 months after weaning, but a pronounced increase in desaturase gene expression by 16 mo of age, which resulted in similar MUFA:SFA ratios by the time the cattle reached market weight.

Key Words: Adipose Tissue, Beef, Fatty Acids

T171 Impact of irradiation and IgG concentration on absorption of protein and IgG in calves fed colostrum replacer. J. M. Campbell*[1], L. E. Russell[1], J. D. Crenshaw[1], E. M. Weaver[1], S. Godden[2], J. D. Quigley[3], J. Coverdale[4], and H. Tyler[5], [1]*APC, Inc.*, *Ankeny, IA*, [2]*University of Minnesota*, *St. Paul*, [3]*Diamond V Mills*, *Cedar Rapids, IA*, [4]*Texas A&M University*, *College Station*, [5]*Iowa State University*, *Ames*.

The objectives of this study were to evaluate the effect of total IgG mass derived from bovine serum fractions (colostrum replacer; CR) and level of irradiation on 24 h serum IgG levels, protein levels, apparent efficiency of absorption (AEA) of IgG, and the ability to prevent failure of passive transfer (FPT) in day old dairy calves. When irradiated, single dose packs of CR were sent to a commercial irradiation facility for electron beam (e-beam) irradiation at 3-7 kGy (low irradiation; L) or 15-20 kGy (high irradiation; H). Sixty-five Holstein, Jersey, or cross-bred calves were randomly assigned to one of six treatments: 1) 2.0 L pooled pasteurized maternal colostrum (MC); 2) 130 g IgG (460 g of CR) no irradiation (130 NR); 3) 130 g IgG (460 g of CR) low irradiation (130 L); 4) 160 g IgG (518 g of CR) low irradiation (160 L); 5) 190 g IgG (575.4 g of CR) low irradiation (190 L); and 6) 130 g IgG (460 g of CR) high irradiation (130 H). All CR were reconstituted in water and mixed in a household blender to a constant solids concentration of 23%. Maternal colostrum was poor quality providing 33.8 g of IgG/2 L dose resulting in 24 h serum IgG of 3.59 g/L which was lower ($P < 0.0001$) than CR treatments. Increasing IgG mass in the CR (130L, 160L, and 190L) resulted in a linear increase in 24 h serum IgG ($P < 0.02$), total protein levels ($P < 0.07$), and a linear decrease in AEA of IgG ($P < 0.05$). There was no effect ($P > 0.10$) of increasing the mass of IgG fed on the percentage of calves with FPT. Increasing irradiation dose to a high of 15-20 kGy (130H) resulted in a linear decrease ($P < 0.05$) in 24 h serum IgG, AEA of IgG, and increased ($P < 0.07$) the percentage of calves with FPT. Correlation between serum IgG and total protein at 24 h was positive; however, irradiation reduced ($P < 0.01$) at 24 h the serum IgG to total protein ratio. Further studies are needed to determine the effects of irradiation on IgG absorption in the neonatal calf. Colostrum replacers providing 130 g of IgG in the first feeding isolated from bovine serum and receiving either no irradiation or a low level of irradiation are sufficient to prevent FPT in calves.

Key Words: Calf, IgG

T172 Relationship between blood serum IGF-1 and GH concentrations and growth of Holstein steers. N. Torrentera*[1], R. Cerda[1], M. Cervantes[1], P. Garcez[2], and W. Sauer[1], [1]*Universidad Autonoma de Baja Cali*, *Mexicali, Baja, California, Mexico*, [2]*Universidad Autonoma de Mexico*, *Mexico*.

Insulin-like growth factor-1 (IGF-1) and GH have been studied as indicators of growth potential in beef cattle, but the relationship between these and the growth and development of Holstein steers has not been reported. The objective of this study was to relate the concentrations of GH and IGF-1 in blood serum and growth of Holstein calves. Twelve calves weaned at 4±2 d, average age and BW of 45 d and 54,6 kg, respectively, were selected to obtain their BW and blood samples every 28 d during 336 d. Ten blood samples were collected at 30 min intervals, from 0800 to 1300 h, every sampling date. Samples from the same animal and sampling day were mixed, and a serum subsample was used to analyze. The concentrations of IGF-1 and GH were analyzed using RIA test. Linear regression and correlation analyses were performed to determine the relationship between ADG and BW, and serum concentrations of IGF-1 and GH. The correlation values between serum IGF-1 and ADG or BW were consistently positive (0.47 and 0.48, respectively), but the correlation values between GH and ADG and BW were negative (-0.31 and -0.37, respectively). Serum concentration of IGF-1 explained 24% of the variation in ADG, but GH only explained nearly 10% of this variation. There was a significant relationship ($P < 0.01$) between serum IGF-1 and age of the calves. Serum concentration of IGF-1 showed a strong relationship with BW ($R^2 = 0.41$) throughout a 336 d postweaning growth performance. These data indicate that serum IGF-1 may be useful for predicting average daily gain in Holstein steers.

Key Words: Holstein Steers, IGF-1, GH

T173 Serial slaughter evaluation of growth-promoting implants on growth and carcass characteristics in calf-fed Holstein steers. J. L. Beckett*[1], L. D. Luqué[1], P. D. Bass[3], W. T. Nichols[2], and R. J. Delmore[1], [1]*California Polytechnic State University*, *San Luis Obispo*, [2]*Intervet Inc.*, *Millsboro, DE*, [3]*Colorado State University*, *Fort Collins*.

Growth and carcass characteristics of calf-fed Holstein steers implanted with and without growth-promoting implants were evaluated during a serial harvest study. A total of 120 steers (average initial weight = 127 kg) were randomly assigned to either receive implants (I; Syn C at d 0, Rev IS at d 120, and Rev S at d 240) or nonimplanted control (C). Steers were fed a finishing ration continuously from day 0 through 420. Steers were weighed every 30 days from day 0 through 420 days on feed. A total of 8-12 head per treatment group were harvested on days 0, 60, 120, 180, 240, 270, 300, 330, and 420. Data collected included HCW, REA, skeletal maturity, marbling score and fat thickness. Yield grade was calculated and quality grade was determined. By 90 d, I cattle were significantly heavier than C cattle. Average shrunk weights for I cattle were 137, 172, 214, 261, 314, 354, 410, 458, 489, 534, 580, 627, 660, and 695 kg compared with 137, 168, 208, 249, 295, 330, 372, 417, 445 481, 509, 547, 567, 570, and 597 kg for C cattle on days 0, 60, 120, 180, 240, 270, 300, and 420, respectively. Average HCW of I cattle was 19, 32, 39, 47, 59, and 56 kg heavier on day 120, 240, 300, 330, 360, and 420, respectively ($P<0.05$). Dressing percent increased linearly ($P<0.05$) from 53% on day 0 to 62% by d 420, but did not differ by treatment. Fat thickness was not significantly different between the treatments throughout the feeding period ($P>0.05$). I cattle tended to have larger REA than C cattle on days 120, 300, 360 and 420, but the effect was not significant ($P>0.05$). Average REA increased from 26 cm^2 on day 0 to 87 cm^2 on day 420. Marbling score tended to be greater for C cattle on days 120, 180, 270, 300 and 360 ($P>0.05$). Results of this study confirm that growth-promoting implants are effective throughout the growing period in calf-fed Holstein steers. Further, each successive implant is additive to prior growth enhancement.

Key Words: Holstein, Growth Promoters, Serial Harvest

T174 The effect of milk replacer composition on growth and body composition of Holstein heifer calves. S. R. Hill, K. M. Daniels*, K. F. Knowlton, R. E. James, R. E. Pearson, M. L. McGilliard, and R. M. Akers, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Twenty-four newborn Holstein heifer calves (n=6) were fed one of 4 milk replacers: 20/20 (fed at 450 g/d, 20% CP/ 20% Fat, 0.53% P); 28/20 (fed at 970 g/d, 28% CP/ 20% Fat, 0.55% P); 28/28 (fed at 970 g/d, 28% CP/ 28% Fat, 0.46% P); or 28/28+ (fed at 1460 g/d, 28% CP/ 28% Fat, 0.46% P). Calves were purchased from a commercial farm at 3±2 d and arrived in one of three groups. Treatments were assigned randomly within group. Calves were fed 3.4 L of colostrum twice within 16 h of birth. Upon arrival at the research farm, calves were fed a 20/20 milk replacer for the first two feedings. On d 3, treatments were imposed and calf starter (20% CP, 0.48%P) comprised of corn (44.4%), soybean meal (44.4%), cottonseed hulls (11.1%), and molasses (1.0%) was offered free choice. Calves were on study for ~63 d. Total collection of feed refusals, feces and urine was initiated on d 59±2d. Body weight and body size were measured weekly. Calves were harvested at 63 d to evaluate body composition and mammary development (reported elsewhere). Preplanned contrasts were used to compare 20/20 to all, 28/20 to 28/28, and 28/28 to 28/28+. Empty body weight (EBW) gain was greater in calves fed 28/28+ compared to 28/28, however those same calves also had a higher percent of EBW as fat. Calves fed 28/20 had the most protein gain compared to those fed extra energy (28/28) and also had a higher protein as a percent of EBW. The addition of fat to the milk replacer reduced protein gain (kg and % of EBW), increased fat gain (kg and % of EBW), and decreased ash gain (kg and % of EBW). Increasing the volume fed did increase protein gain, fat gain (kg and % of EBW) and ash gain. These results indicate that 20% fat may not be enough energy to support protein gain when CP is greater than 28% of the diet DM. However, frame growth appeared to increase when calves were fed the 28/20 compared to 28/28, indicated by increased ash gain and increased body measurements.

Key Words: Milk Replacer, Calf, Body Composition

Immunology - Livestock and Poultry II

T175 Long-term consumption of resistant starch reduces T cell population and apoptosis in pig colon. M. Nofrarías*[1,2], D. Martínez–Puig[2], J.F. Pérez[2], and N. Majó[1,2], [1]*Centre de Recerca en Sanitat Animal (CReSA)*, *Bellaterra, Spain*, [2]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

The aim of the present study was to assess the effects of a long-term intake of resistant starch on the colonic fermentation and intestinal morphology, including lymphocytic infiltration, apoptosis and proliferation activities. Sixteen growing pigs were fed for 14 weeks on a diet containing a high amount (350 g/kg) of either raw potato starch (RPS; resistant starch type II) or corn starch (digestible starch). On day 97, pigs were euthanised and the gut weighed and sampled. Colonic digesta were analysed for short chain fatty acids concentration. Histological study was performed in tissue samples from proximal colon. The presence of T cells, cells undergoing apoptosis, and proliferative activity were also immunohistochemically determined. After 97 days, the colonic content from RPS pigs was heavier than for CS pigs (1.52 vs. 3.04 kg; $P<0.01$), producing a hypertrophy of tunica muscularis (428 vs. 529 µm; $P<0.01$). The concentration of butyrate was 3-fold higher in proximal colon digesta in RPS pigs (5.86 vs. 16.30 µmol/g; $P=0.02$). RPS fed pigs had reduced crypt depth (429 vs. 416 µm; $P=0.045$) and tended to diminish crypt cell proliferation (35.7 vs. 32.5 cells; $P=0.09$). Fermentation of RPS reduced ($P<0.05$) apoptosis, as number of immunopositive cells for cleaved caspase-3, in the crypts (0.62 vs. 0.32/crypt), lamina propria (1.41 vs. 1.16/1000 μm^2) and lymphoid nodules (5.9 vs. 3.9/1000 μm^2) in the colon. The numbers of intraepithelial T CD3+ cells (6.1 vs. 5.6/crypt; $P=0.027$) and the presence of mucosal lymphoid nodules (0.094 vs. 0.037/mm; $P=0.09$) were also reduced in the colon of RPS pigs. Results in colonic lymphocytic infiltration and apoptosis suggest that long term ingestion of RPS could induce lower immune reactivity in the hindgut.

Key Words: Resistant Starch, Intestinal Apoptosis, Pigs