

## Growth and Development: General Topics

**660 Ovariectomy alters myoepithelial cell populations in the prepubertal bovine mammary gland.** K. E. Ballagh<sup>1</sup>, N. Korn<sup>1</sup>, L. Riggs<sup>2</sup>, R. M. Akers<sup>3</sup>, and S. Ellis\*<sup>1</sup>, <sup>1</sup>Clemson University, Clemson, SC, <sup>2</sup>Louisiana State University, Baton Rouge, <sup>3</sup>Virginia Polytechnic Institute and State University, Blacksburg.

Allometric growth of the bovine mammary gland is stimulated by ovarian secretions in pre-weaning calves. Prepubertal ovariectomy inhibits mammary development, but the mechanism of inhibition is not well characterized. Holstein heifers (n=37) were ovariectomized at d40 and sacrificed at d55, 70, 85, 100, 130, and 160 to provide tissues for analysis of ovariectomy effects. Histologic analyses unexpectedly revealed that ovariectomy caused myoepithelial development and striking changes in basal epithelial cell morphology, compared to intact animals. Myoepithelial cells were identified by location, morphology, and positive staining for  $\alpha$ -smooth muscle actin (SMA+). At least 1000 cells from 3-5 non-sequential sections and 15 or more randomly selected fields were counted per sample. Vascular smooth muscle staining served as an internal positive control for SMA staining. Z-tests and adjusted P-values (Bonferroni's) were used to compare the proportion of SMA+ basal cells between treatment groups. In d40 heifers, 80% (P<0.05) of basal epithelial cells were SMA+. Significant differences in SMA labeling were observed between ovariectomized (OVX) and intact (INT) animals at d55 (OVX 51% vs. INT 27%; P<0.05), d70 (OVX 59% vs. INT 0%; P<0.05), d85 (OVX 86% vs. INT 0.3%; P<0.05), d100 (OVX 44% vs. INT 0.6%; P<0.05), d130 (OVX 100% vs. INT 0.3%; P<0.05), and d160 (OVX 74% vs. 0%; P<0.05). We hypothesize that ovarian secretions block myoepithelial differentiation. Myoepithelial cells can limit parenchymal development through expression of growth factors, proteinase inhibitors and anti-angiogenic proteins and have been shown to inhibit tumor cell proliferation. Ovariectomy may therefore remove an estrogenic growth stimulus and permit emergence of myoepithelial cell populations that inhibit parenchymal development.

**Key Words:** Mammary, Myoepithelial Cells, Ovariectomy

**661 Dihydroxy vitamin D affects the myogenic potential of porcine satellite cells.** A. Qu<sup>1</sup>, R. P. Rhoads<sup>2</sup>, and C. H. Stahl\*<sup>3</sup>, <sup>1</sup>Iowa State University, Ames, <sup>2</sup>University of Arizona, Tucson, <sup>3</sup>North Carolina State University, Raleigh.

Satellite cells are needed for the growth and development of muscle, but the strict commitment of satellite cells to a myogenic lineage has been challenged recently. Myogenic cultures have been diverted from their myogenic fate into an alternate mesenchymal differentiation pathway. We examined the impact of 1,25 (OH)<sub>2</sub> Vitamin D on porcine satellite cells in vitro. Satellite cells were isolated from the loin muscle of 14 d old pigs, placed in proliferative media (PM, DMEM + 10%FBS), incubated at 37°C in 5% CO<sub>2</sub>, and media was changed daily until the cells reached 60-80% confluence. Cells were then harvested, counted, and seeded into poly-L-lysine and fibronectin coated 24-wells plate at 1,000 cells/well. Cells were given 24 h to attach and were then switched to their respective treatment media. The treatments were: control (PM), PM + 2×10<sup>-9</sup> M 1,25 (OH)<sub>2</sub> vitamin D (1X VitD), and PM + 2×10<sup>-8</sup> M 1,25 (OH)<sub>2</sub> vitamin D (10X VitD). Complete media changes were made daily. At 3, 6, and 9 days post treatment, cells were harvested for cytochemical staining and gene expression analysis. All experiments

were repeated as two independent studies. Within each study, n = 2 for cytochemical staining and n = 4 for gene expression analysis. Study, day, treatment and day\*treatment were considered fixed effects. Statistical significance was set at P < 0.05.

After 6 days, the vast majority of the control cells (>95%) stained positive for desmin. However, after 6 days of Vit D treatment, only approximately 25% of the cells stained positive for desmin. Although there appeared to be fewer desmin-positive stained cells with the 10X VitD versus the 1X Vit D treatment, this difference was not statistically significant. The gene expression of both MyoD and Myogenin was significantly reduced (P < 0.05), in a dose dependant manner, after 6 and 9 d of treatment with VitD. Based on these data, we conclude that 1,25 (OH)<sub>2</sub> vitamin D inhibits the myogenic differentiation of satellite cells. Since circulating levels of 1,25 (OH)<sub>2</sub> vitamin D are seen with dietary P deficiency, this may help explain the molecular basis for reduced muscle growth seen with dietary P deficiency.

**Key Words:** Satellite Cells, Vitamin D, Pig

**662 Calpain and calpastatin mRNA expressions in skeletal muscle are highly correlated with protein accretion activities in neonatal pigs.** Z. Li\*<sup>1</sup>, B. Zhao<sup>1</sup>, X. Yang<sup>2</sup>, M. Z. Fan<sup>2</sup>, and J. Yang<sup>1</sup>, <sup>1</sup>University of Hawaii, Honolulu, <sup>2</sup>University of Guelph, Guelph, ON, Canada.

The calpain-calpastatin system plays a significant role in the regulation of protein degradation in the skeletal muscle. Rapid gain in skeletal muscle mass during the neonatal period is one of the most significant physiological events in life. Little is known about protein degradation during the muscle gain. To understand the role of calpain-calpastatin system in muscle growth, we randomly selected 36 neonatal pigs from more than 10 litters. The piglets were divided into six groups and slaughtered at the age of 1, 4, 6, 12, 20 and 28 days. The expression patterns of calpain 1A, calpain 2, calpain 3A, calpastatin type 1, type 2, and type 3, obtained by quantitative real-time PCR analysis, and their correlations with the measurements of muscle protein accumulations such as protein content and RNA/protein ratio were studied. The mRNA levels of all the six genes at the age of 4 to 6 days showed a decrease by 2-4 folds compared with 1-day-old piglets. Then they were maintained at relatively low expression levels until 28 days of age. The expressions of the six calpain and calpastatin genes were highly correlated with each other, and showed significant correlations with muscle protein content, RNA/protein ratio and protein/DNA ratio. Expressions of calpain 1A, calpastatin type 1 and type 3 were also negatively correlated with birth weight and fractional rate of growth. Analysis of the expressions of calpain-calpastatin genes by quantitative real-time PCR method can be used for identifications of piglets with increased muscle protein accretion activities.

**Key Words:** Calpain and Calpastatin, Muscle Protein Deposition, Neonatal Pigs

**663 A low-fat liquid diet decreases AMPK and increases mTOR phosphorylation in skeletal muscle of 10-day-old pigs.** W. Oliver\* and J. Miles, USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.

Previous research shows that neonatal pigs respond to decreases in energy density of liquid diets with increased feed intake, resulting in similar performance to pigs fed a more energy-dense diet. The objective of this experiment was to determine if a high- (25%, HF) or low-fat (2%, LF) liquid diet affects proteins involved in energy homeostasis and protein synthesis in early-weaned pigs. Forty-eight pigs, with an initial body weight of  $3,637 \pm 85$  g, were weaned at 10 d of age and utilized in a randomized complete block design. Pigs were blocked by weight and gender, then assigned to pens (8 pigs/pen). Diets were formulated to provide a constant lysine:ME and were fed for 10 d, at which time blood and longissimus dorsi were collected. Blood was analyzed for plasma urea nitrogen (PUN) and NEFA. Longissimus dorsi was analyzed via western immunoblot for mammalian target of rapamycin (mTOR) and adenosine 5' monophosphate-activated protein kinase (AMPK) phosphorylation. Pigs gained  $347 \pm 11$  g/d, which resulted in an ending body weight of  $7,035 \pm 170$  g, regardless of dietary treatment ( $P > 0.20$ ). Pigs fed a LF diet consumed approximately 24% more milk than pigs fed the HF diet ( $2,853 \pm 23$  vs.  $2,309 \pm 65$  g dry feed•pen<sup>-1</sup>•d<sup>-1</sup>;  $P < 0.01$ ), which resulted in similar calculated ME intakes between dietary treatments ( $9.9 \pm 0.2$  vs.  $10.7 \pm 0.5$  Mcal•pen<sup>-1</sup>•d<sup>-1</sup>;  $P > 0.10$ ). Feed conversion (gain:feed) was 19% higher in HF compared to LF fed pigs ( $P < 0.03$ ). Circulating NEFA ( $137 \pm 37$  vs.  $39 \pm 13$   $\mu$ Eq/L;  $P < 0.02$ ) and PUN ( $17.6 \pm 0.8$  vs.  $3.0 \pm 0.6$  mM;  $P < 0.01$ ) concentrations were higher in HF pigs compared to LF pigs. The AMPK phosphorylation was 29% higher ( $P < 0.03$ ) in HF pigs compared to LF pigs, while mTOR phosphorylation was increased by 22% in LF pigs ( $P < 0.02$ ). Thus, young pigs consuming a low-fat diet have lower activation of AMPK and higher activation of mTOR, which, considering the difference in PUN, may indicate an improved utilization of amino acids in young pigs consuming a low-fat diet.

**Key Words:** Energy Source, Skeletal Muscle, Swine

**664 Media components including exogenous lipid and PPAR- $\gamma$  agonists influence the differentiation of primary bovine adipocytes *in vitro*.** A. J. Lengi and B. A. Corl\*, *Virginia Polytechnic Institute and State University, Blacksburg.*

Our objectives were to isolate bovine stromal-vascular (SV) cells using explants and determine media components that promote differentiation into mature adipocytes for studies of lipogenic enzyme regulation. Three published differentiation protocols utilizing DMEM were evaluated initially: (A) 10% serum, 50 ng/mL insulin (INS), 0.25  $\mu$ M dexamethasone (DEX), 5 mM octanoate, 10 mM acetate; (B) 10  $\mu$ g/mL INS, 0.25  $\mu$ M DEX, 0.5 mM isobutylmethylxanthine (IBMX), 1 mM octanoate, 2% Intralipid; (C) 5% serum, 2.5  $\mu$ g/mL INS, 0.25  $\mu$ M DEX, 0.5 mM IBMX, 5  $\mu$ M troglitazone. DEX and IBMX were removed from media B and C after 48 h. SV cells were treated with differentiation media for 8 d after reaching confluence. Differentiation was assessed by measuring radiolabeled acetate incorporation into lipids, glycerol-3-phosphate dehydrogenase (G3PDH) activity, and the mRNA expression of aP2, PPAR- $\gamma$ , and acetyl-CoA carboxylase- $\alpha$  (ACC). After 8 d of differentiation, medium B produced acetate incorporation and G3PDH activity that were 5- and 6-fold greater, respectively, compared with differentiation media A and C. Medium B increased mRNA expression of aP2 and PPAR- $\gamma$  180- and 7-fold, respectively, compared to undifferentiated control cells, but ACC mRNA expression was unaffected by differentiation media. Medium B was manipulated to further improve the differentiation protocol. Removal of 2% Intralipid did not improve any differentiation measures. Addition of rosiglitazone (1  $\mu$ M), a PPAR- $\gamma$

agonist, increased acetate incorporation, aP2 expression, and PPAR- $\gamma$  expression. Troglitazone (5  $\mu$ M), another PPAR- $\gamma$  agonist, increased acetate incorporation to a similar extent as rosiglitazone and produced the greatest expression levels of ACC, but was not superior for any other measures to media that included rosiglitazone. Cell seeding density influences the cell divisions required to reach confluence and increased plating density ( $2 \times 10^4$  cells/cm<sup>2</sup> vs.  $6.7 \times 10^3$  cells/cm<sup>2</sup>) increased acetate incorporation by 31%. We have developed a method to differentiate primary bovine adipocytes that will allow us to study the regulation of lipogenic enzymes by nutrient and endocrine factors.

**Key Words:** Adipocyte, Differentiation, Bovine

**665 Basal expression of four SLC1 (Na<sup>+</sup>-dependent glutamate transporter) mRNA by small intestinal epithelia of beef cattle differs and is altered by ruminal and abomasal infusion of starch hydrolysate.** S. F. Liao\*, E. S. Vanzant, D. L. Harmon, K. R. McLeod, J. A. Boling, and J. C. Matthews, *University of Kentucky, Lexington.*

High-affinity glutamate uptake in the mammalian small intestine is mediated by SLC1 family members: system X<sub>AG</sub><sup>-</sup> (EAAC1, GLT-1) or ASC (ASCT1, ASCT2) activity. To determine if the expression of mRNA encoding SLC1 family members by duodenal (D), jejunal (J), and ileal (I) epithelia responds to increased luminal supply of rumen-derived microbes (hence, AA substrates), energy, or both, 18 ruminally and abomasally catheterized Angus steers (BW  $\approx$  260 kg) were assigned (n = 6) to either water (basal), or ruminal or abomasal corn starch hydrolysate (SH, by  $\alpha$ -amylase) infusion treatment (at 20% of ME intake) and fed an alfalfa-cube based diet at  $1.3 \times$  NE<sub>m</sub> requirement. After a 14 or 16-d infusion, steers were killed, small intestinal epithelia harvested, and total RNA extracted. Real-time RT-PCR analysis was conducted to quantify the relative mRNA expression (SLC1 mRNA:18S rRNA). Basal expression patterns by D, J, and I differed ( $P \leq 0.10$ ): EAAC1, D = J, D < I, J = I; GLT-1, D < J = I; ASCT1, I < D < J; ASCT2, D = J = I. Ruminal SH infusion decreased ( $P = 0.05$ ) J ASCT1 mRNA expression by 46%, compared to basal expression. In contrast, abomasal SH infusion increased ( $P = 0.07$ ) I basal expression of EAAC1 and ASCT1 mRNA, by 40 and 52%, respectively. GLT-1 and ASCT2 mRNA content was not affected by SH infusion. Discovery of ASCT1 mRNA expression by small intestinal epithelia is novel, and may represent a unique role for ASCT1 in the small intestinal epithelium of cattle, especially as ASCT2 mRNA content was insensitive to increased luminal substrate or energy supply while ASCT1 responded to both. The finding that I EAAC1 and ASCT1 mRNA content was increased in the presence of increased luminal SH suggests that their expression was sensitive to the energy status of I epithelia.

**Key Words:** Bovine, SLC1 Gene Expression, Small Intestine

**666 Dry matter intake based on birth weight as weaning criterion in Brown Swiss calves.** B. Saremi\*, A. Foroughi, and A. Rahimi, *Education Center of Jihad-e Agriculture, Mashhad, Khorasan-e Razavi, Iran.*

Nineteen female Brown Swiss calves were placed randomly in treatments: 1) 1% BW 2) 1.5 % BW 3) 2 % BW dry matter intake as a weaning criterion. Calves were fed milk 8% BW two times daily and

weaned abruptly when aged at least 3 weeks, DMI equal or larger than treatments, total DMI more than 9% and body gain more than 12% of initial body weight. Calf starter (NRC 2001) fed from birth to 8 weeks post weaning adlib. Blood and rumen liquid samples were taken each 15 days. Daily DMI, body weight and body characteristics include: Body length, wither height, hip height, pin width, hip width, pin to hip, stomach size, heart girth, metacarpus and metatarsus size were measured in 15 days intervals. Nutrient digestibility was determined 5 days at weaning and at the end of experiment. Repeated measurement analysis and a completely randomized design with unequal replicates by mixed procedure of SAS 9.1 were used for statistical analyses. Means were compared using Lsmean ( $P < 0.05$ ). Data showed that milk fed period was increased from treat 1 to 3 ( $P < 0.05$ ). Calf starter intake was significantly higher in treat 3 post weaning ( $P < 0.05$ ). Feed to gain, body weight, average daily gain, stomach size, heart girth, metacarpus and metatarsus size and their increase pre and post weaning were equal pre and post weaning for all treatments. Calves in treat 3 had higher wither and hip height gain pre weaning ( $P < 0.05$ ). This trend was observed nonsignificantly for body length. A reverse trend was observed post weaning with a significantly higher body length for treat 1 ( $P < 0.05$ ). Pin to hip gain pre weaning and pin width at weaning showed significant different ( $P < 0.05$ ). Plasma Glucose, PUN, rumen pH and N-NH<sub>3</sub> was equal between treatments. Nutrient digestibility had no differ pre weaning but reduced significantly for all nutrients post weaning as milk fed time increased ( $P < 0.05$ ). Some data had not been shown in this summary saving brevity. In general, it seems that using DMI as a percent of BW could be used as a criterion for calves weaning at Iranian commercial farms management conditions.

**Table 1. Effect of different weaning methods on some calves' measurements**

Items	Treatments			SEM
	1%BW	1.5%BW	2%BW	
Milk fed days	42.67 <sup>b</sup>	50.71 <sup>ab</sup>	62.00 <sup>a</sup>	3.071
Starter intake prewean kg	15.15 <sup>b</sup>	16.50 <sup>ab</sup>	24.37 <sup>a</sup>	1.830
postwean kg	85.18 <sup>b</sup>	91.88 <sup>b</sup>	109.94 <sup>a</sup>	3.250
Wither Height prewean cm	3.67 <sup>b</sup>	4.29 <sup>b</sup>	8.83 <sup>a</sup>	0.672
postwean cm	21.17	16.71	18.17	0.974
OMD%	81.47 <sup>a</sup>	81.64 <sup>a</sup>	77.60 <sup>b</sup>	0.772
DMD%	93.72 <sup>a</sup>	93.79 <sup>a</sup>	91.95 <sup>b</sup>	0.329
CPD%	73.15 <sup>ab</sup>	77.77 <sup>a</sup>	69.43 <sup>b</sup>	1.532
ADFD%	66.11 <sup>a</sup>	61.61 <sup>ab</sup>	56.16 <sup>b</sup>	1.552
NDFD%	54.38 <sup>a</sup>	49.75 <sup>a</sup>	40.86 <sup>b</sup>	1.554

**Key Words:** Dry Matter Intake, Weaning, Dairy Calves

**667 Effects of plane of nutrition and bioavailable trace minerals on growth of transported male dairy calves.** J. S. Osorio<sup>\*1</sup>, J. K. Drackley<sup>1</sup>, R. L. Wallace<sup>1</sup>, D. Rincker<sup>1</sup>, D. J. Tomlinson<sup>2</sup>, and T. J. Earleywine<sup>3</sup>, <sup>1</sup>University of Illinois, Urbana, <sup>2</sup>Zinpro Performance Minerals, Jeffersonton, VA, <sup>3</sup>Land O'Lakes Animal Milk Products Inc., Madison, WI.

Effects of enhanced milk replacer on growth and health of transported calves are unresolved. Whether organic (bioavailable) trace minerals benefit transported calves also is unknown. Male Holstein calves <1 wk old (n=90) were purchased in 3 groups (blocks) from Wisconsin

and transported to the Illinois research facility. Calves were randomly assigned in a 2x2 factorial arrangement of plane of nutrition (PN) and trace mineral source (TM). Conventional PN received milk replacer (22% CP, 20% fat; 568 g/d) and starter (18% CP), were weaned at 6 wk, received ad libitum starter to wk 12 and 0.5 kg of mixed hay wk 10-12. In wk 13-20 calves received 2.75 kg/d of grower (16% CP) and hay ad libitum. Enhanced PN received milk replacer (28% CP, 20% fat; 810 g/d wk 1, 1136 g/d wk 2-6, 568 g/d wk 7) plus starter (22% CP), were weaned at 7 wk, received ad libitum starter through wk 12, and ad libitum grower + 0.5 kg/d hay wk 13-20. Feeds contained either inorganic salts of Fe, Cu, Zn, and Mn or bioavailable sources (Zinpro Performance Minerals, Eden Prairie, MN). Calves were housed in individual hutches bedded with straw through wk 9, group-housed by diet wk 10-12, and group-housed by diet wk 13-20. All calves had free access to water. Calves were weighed and measured (heart girth, body length, withers height (WH), hip height (HH), and hip width) weekly through wk 10 and then at wk 12, 15, and 20. Data were analyzed with the MIXED procedure of SAS with repeated measures and block as a random effect. Calves fed enhanced PN had greater ( $P < 0.01$ ) body weight (BW) and WH tended ( $P = 0.08$ ) to be greater. Significant interactions between TM and PN were found for WH ( $P = 0.05$ ), HH ( $P < 0.05$ ), and BW ( $P = 0.08$ ). Bioavailable TM increased growth for calves fed enhanced PN, but had no effect in calves fed conventional PN. Transported calves responded to enhance PN, although improvements in growth were less than observed previously with locally born calves. Bioavailable TM may increase growth with enhance PN, at least for calves under transport stress.

**Key Words:** Trace Minerals, Milk Replacer, Dairy Calves

**668 Relationship of ghrelin and leptin with growth performance and carcass composition of beef cattle.** J. S. Jennings<sup>\*1</sup>, R. H. Pritchard<sup>1</sup>, K. W. Bruns<sup>1</sup>, A. Trenkle<sup>2</sup>, D. H. Keisler<sup>3</sup>, J. A. Daniel<sup>4</sup>, and A. E. Wertz-Lutz<sup>1</sup>, <sup>1</sup>South Dakota State University, Brookings, <sup>2</sup>Iowa State University, Ames, <sup>3</sup>University of Missouri, Columbia, <sup>4</sup>Berry College, Rome, GA.

Angus steers (n=72) of similar age, weight (292±1.44 kg), and genetic background were used to determine the effects of growing phase diet on the relationship of plasma ghrelin and leptin concentrations with growth performance and carcass composition. At trial initiation (d 0), eight steers were harvested for initial carcass composition. The remaining 64 steers were allotted, by weight, to pen and treatment was assigned randomly. Treatments were 1) 60% forage; 40% concentrate diet fed during the growing period (112 d) followed by 10% forage; 90% concentrate diet during the finishing period (113-209 d) (GRW-FNSH) or 2) 10% forage; 90% concentrate diet fed for the duration of the trial (0-209 d) (FNSH-FNSH). Steers were allowed ad libitum consumption regardless of dietary treatment. Eight steers per treatment were harvested on d 88, 116, 165, and 209, and carcass characteristics were recorded. A blood sample was collected from each steer prior to harvest, and plasma was assayed for ghrelin and leptin concentrations. Hormone and carcass data were analyzed statistically using the MIXED procedure of SAS, and linear, quadratic, and cubic contrasts were performed with the hormone data. At the final harvest, carcass weight was not different between treatment groups, but FNSH-FNSH steers had more ( $P < 0.01$ ) subcutaneous fat and higher ( $P \leq 0.001$ ) marbling scores compared with GRW-FNSH steers. Plasma ghrelin concentrations were different ( $P \leq 0.01$ ) as a result of dietary treatment. Plasma ghrelin concentrations for FNSH-FNSH steers increased quadratically ( $P \leq 0.01$ ) over time, whereas plasma ghrelin concentrations were not different over time for GRW-FNSH. Plasma

leptin concentrations for FNSH-FNSH steers increased ( $P \leq 0.001$ ) from d 0 to 84 and then plateaued whereas, plasma leptin concentrations increased linearly ( $P \leq 0.001$ ) in the GRW-FNSH steers. These data are consistent with the hypothesis that plasma ghrelin and leptin concentrations differ as a result of nutritional status of the animal.

**Key Words:** Ghrelin, Leptin, Carcass Composition

**669 Carcass quality and relative content of glutamate metabolizing enzymes and transporters differ in Polypay and percentage Polypay-White Dorper lambs.** A. K. Lunsford\*, K. R. Brown, S. F. Liao, D. K. Aaron, J. C. Matthews, M. M. Simpson, D. G. Ely, and J. A. Boling, *University of Kentucky, Lexington.*

L-Glutamate (Glu) transport and metabolism by liver, kidney, longissimus dorsi (LD), and subcutaneous fat (SCF) are essential to N and energy metabolism of growing animals. The effect ( $n = 6$ ) of sheep genetic type [Polypay (PP), 1/2 White Dorper 1/2 Polypay (1/2 D), and 15/16 White Dorper 1/16 Polypay (15/16 D)] on expression of Glu transporters and enzymes by these tissues was evaluated in wether lambs that had grazed a mixed grass pasture and received a grain supplement (2% BW) for 36 to 78 d. All lambs were harvested at a common weight of 50.0 kg and tissues collected. Although age at slaughter did not differ, 15/16 D lambs had heavier rack weights and higher percentage of boneless closely trimmed retail cuts ( $P < 0.05$ ) and tended ( $P < 0.10$ ) to have greater DP, LEA, and leg weights than PP or 1/2 D lambs. The relative content of EAAC1 and GLT-1 (Glu transporters) and Glu synthetase (GS), Glu dehydrogenase (GDH), and alanine transaminase (ALT) in liver, kidney, LD, and SCF was determined by immunoblot analysis. ALT content was lower ( $P < 0.05$ ) in liver (54%), LD (72%), and SCF (51%) and tended to be lower ( $P < 0.10$ ) in kidney (34%), while EAAC1 was 89% lower ( $P < 0.05$ ) in LD of 15/16 D than PP or 1/2 D lambs. In contrast, GS (99%) and GLT-1 (25%) content tended to be increased ( $P < 0.10$ ) and GDH tended to be decreased ( $P < 0.10$ ) 39 and 46% in SCF of 15/16 D and 1/2 D lambs. To determine if altered protein content was by transcriptional control, the relative mRNA content for GS, GDH, and ALT in LD and SCF was determined by real-time RT-PCR. GS mRNA (59%) was highest ( $P < 0.05$ ) and ALT mRNA (44%) tended to be highest ( $P < 0.10$ ) in LD of 1/2 D, indicating post-transcriptional regulation of protein content. These results reveal the increased carcass quality of 15/16 D lambs was concomitant with a reduced ALT protein content of tested tissues and SCF had an increased potential to produce glutamine from plasma Glu.

**Key Words:** Breed, Gene Expression, Glutamate

**670 Sheep differing in exogenous adrenocorticotropin hormone induced cortisol responses are different in body composition and residual feed intake.** S. A. Knott<sup>1</sup>, L. J. Cummins<sup>2</sup>, F. R. Dunshea<sup>3</sup>, and B. J. Leury<sup>3</sup>, <sup>1</sup>Charles Sturt University, Wagga Wagga, NSW, Australia, <sup>2</sup>Ivanhoe, Cavendish, Victoria, Australia, <sup>3</sup>The University of Melbourne, Parkville, Victoria, Australia.

The objective of this study was to determine whether there were differences in body composition (lean tissue mass, LTM; fat tissue mass,

FTM) and residual feed intake (RFI) in sheep that were identified to have either a low (LC) or high (HC) serum cortisol response to exogenous administration of adrenocorticotropin hormone (ACTH). One hundred maternal sire cross-bred rams (initial weight  $52.9 \pm 4$  kg) received 2  $\mu\text{g}/\text{kg}$  ACTH intramuscularly. Two blood samples were collected, one immediately before and one 45 min after the injection of ACTH. Twenty two rams with low or high post ACTH serum cortisol concentrations were then selected; cortisol concentration post ACTH administration for LC ( $n=11$ ) and HC ( $n=11$ ) groups was 113.3 and 215.6 nmol/L, respectively, ( $P < 0.05$ ). Body composition was measured using dual energy X-ray absorptiometry at the start and end of a 40-day measurement period where ad libitum feed intake and liveweight (LW) were measured for estimation of feed conversion ratio (FCR) and residual feed intake (RFI). LC sheep were significantly more efficient than HC sheep in terms of RFI ( $-0.49$  v.  $0.45$ , LC v. HC,  $P < 0.05$ ) but not for FCR. There were no significant differences between the HC and LC groups in body composition or LW at the start of the study whereas after 40 days there were significant differences ( $P < 0.05$ ) in the proportion of LTM ( $0.72$  v.  $0.75$ , HC v. LC) and FTM ( $0.16$  v.  $0.13$ , HC v. LC) and absolute FTM ( $10.83$  v.  $8.91$  kg, HC v. LC), but no difference in LW. These data indicate that animals that are more responsive to an ACTH challenge are less efficient and have increased adiposity, both of which may be related to an overall increase in stress responsiveness in these animals.

**Key Words:** Cortisol, Sheep, Efficiency

**671 Wool growth is negatively related to exogenous adrenocorticotropin hormone induced cortisol responses in sheep with a low wool growth potential but not with a high potential.** G. M. Butler<sup>1</sup>, M. W. Robertson<sup>1</sup>, A. J. Tilbrook<sup>2</sup>, F. R. Dunshea<sup>1</sup>, and B. J. Leury<sup>\*1</sup>, <sup>1</sup>The University of Melbourne, Parkville, Victoria, Australia, <sup>2</sup>Monash University, Clayton, Victoria, Australia.

The objective of this study was to determine whether there were differences in serum cortisol response to exogenous administration of adrenocorticotropin hormone (ACTH) in Merino sheep with either high (HW) or low (LW) wool growth potential. Forty eight merino wethers ( $42.1 \pm 4.8$  kg) were selected for HW and LW from a larger grazing flock based on the previous season's greasy fleece weight (GWT). Sheep were yarded and fasted for 15 hours and then injected with 2  $\mu\text{g}/\text{kg}$  ACTH intramuscularly. Two blood samples were collected, one immediately before and one 45 min after the injection of ACTH and plasma cortisol measured. The wethers were then brought indoors and after acclimation to a pelleted ration commenced a study where feed intake, liveweight and mid-side wool growth were measured for up to 27 d. Ten wethers failed to adjust to the pellets and were removed. While there was no difference in basal plasma cortisol, both the incremental ( $62$  v.  $40$  nmol/L) and the final ( $104$  v.  $91$  nmol/L) post ACTH cortisol concentrations were greater ( $P < 0.05$ ) in the HW than the LW sheep. As anticipated, mid-side wool growth was correlated ( $R=0.46$ ,  $P < 0.05$ ) with the previous season's GWT and was higher ( $0.39$  v.  $0.26$  mg/cm<sup>2</sup> /kg,  $P < 0.001$ ) in the HW sheep. Mid side wool growth was negatively related ( $R=-0.55$ ,  $P < 0.05$ ) to the ACTH increment in cortisol in LW sheep but not in HW sheep. This difference in cortisol response may allow HW sheep to maintain wool growth under a range of environmental conditions.

**Key Words:** Wool, Cortisol, Sheep