

851 Cellular and molecular regulation of muscle growth and development in meat animals. W. R. Dayton*, M. E. White, and M. R. Hathaway, *University of Minnesota, St Paul.*

Insulin-like growth factor (IGF)-I and IGF binding proteins (IGFBP) play a significant role in mediating the actions of myostatin, TGF- β and anabolic steroids on muscle cells at the cellular and molecular level. Both myostatin and TGF- β suppress proliferation in porcine embryonic myogenic cell (PEMC) cultures. Treatment with myostatin or TGF- β also increases production and secretion of IGFBP-3 and IGFBP-5 by PEMC cultures. Immunoneutralization of IGFBP-3 and IGFBP-5 in the culture media of TGF- β or myostatin-treated PEMC cultures returns proliferation rate to 90% of levels observed in control cultures that were not treated with myostatin or TGF- β . Consequently, it appears that IGFBP-3 and IGFBP-5 play a crucial role in mediating the proliferation-suppressing actions of myostatin and TGF- β in PEMC cultures. Furthermore, the mechanisms by which IGFBP-3 and IGFBP-5 facilitate the proliferation-suppressing activity of myostatin and TGF- β appear to be IGF-independent and do not involve reduced phosphorylation of Smad2 or Smad3 by the TGF- β or myostatin receptors. The IGF/IGFBP system also plays a significant role in mediating the muscle-growth-enhancing actions of anabolic steroids. Steers implanted with a combined trenbolone acetate/estradiol (TBA/E) implant have increased circulating IGF-I levels and increased IGF-I mRNA levels in muscle tissue. Treatment of cultured bovine satellite cells (BSC) with E or trenbolone (TB) results in increased levels of IGF-I mRNA in these cells. Additionally, treatment of cultured BSC with either TB or E results in increased proliferation rate. Although, these data suggest that TBA/E-induced increases in muscle IGF-I levels may mediate the enhanced muscle growth observed in feedlot steers implanted with these steroids, studies utilizing the IGF-I receptor blocker JB1 indicate that the proliferation-promoting effects of TB and E in BSC cultures may not result solely from increased IGF-I levels.

Key Words: Muscle, Myostatin, Anabolic Steroid

852 Application of cellular mechanisms to growth and development of food producing animals. B. J. Johnson*, *Kansas State University, Manhattan.*

Postnatal skeletal muscle growth is a result of hypertrophy of existing skeletal muscle fibers in food producing animals. Accumulation of additional nuclei, as a source of DNA, to the multinucleated skeletal muscle fiber aids in fiber hypertrophy during periods of rapid skeletal muscle growth. Muscle satellite cells are recognized as the source of nuclei to support muscle hypertrophy. Exogenous growth enhancing compounds have been used to modulate growth rate and efficiency in meat animals for over a half century. In cattle, these compounds enhance efficiency of growth by preferentially stimulating skeletal muscle growth compared to adipose tissue. There are two main classes of compounds approved for use in cattle in the United States: anabolic steroids and β -adrenergic agonists (β -AA). Administration of both trenbolone acetate (TBA) and estradiol (E) as implants increased carcass protein accumulation 8 to 10% in yearling steers. Muscle satellite cells isolated from steers implanted with TBA/E had a shorter lag phase in culture compared to satellite cells isolated from control steers. Collectively, these data indicate that activation, increased proliferation, and subsequent fusion of satellite cells in muscles of implanted cattle may be an important mechanism by which anabolic steroids enhance muscle hypertrophy. Oral administration of β -AA to ruminants does not alter DNA accumulation in skeletal muscle over a typical feeding period. The enhanced muscle hypertrophy observed due to β -AA feeding occurs by direct, receptor-mediated changes in protein synthesis and degradation rates of skeletal muscle tissue. Often, the muscle is unable to sustain this level of hypertrophy due to no additional accumulation of nuclei to support the increased protein accretion. Proper timing of anabolic steroid administration when coupled with β -AA feeding could result in a synergistic response in skeletal muscle growth due to the effects of anabolic steroids at increasing satellite cell activity which then can support the rapid hypertrophic changes of the muscle fiber when exposed to β -AA.

Key Words: Anabolic Steroid, β -Adrenergic Agonist, Skeletal Muscle

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853 Factors affecting milk price and revenues of dairy farms in the central region of Thailand. J. A. Rhone*¹, R Ward¹, S Koonawootrittriron², and M. A. Elzo¹, ¹*University of Florida, Gainesville*, ²*Kasetsart University, Bangkok, Thailand.*

Milk prices in Thailand are based on a base price set by the government as well as premiums and deductions, based on milk quality and components, given by dairy cooperatives. The objectives of this study were 1) to determine month and year, farm location, and farm size effects on milk price, and 2) to calculate farm milk revenues across time, farm location, and farm size. There were a total of 967,110 farm milk yield and 58,575 milk price records from 1034 farms collected from 2003 to 2006. Farm milk revenues were calculated as the product of farm milk yield and milk price. Milk price was analyzed using a linear model. Fixed effects were 1) pricing system (1 = price based on milk fat and bacterial score, and 2 = price based on milk fat, bacterial score, and bulk tank somatic cell count, 2) interaction of pricing system by month nested within year, 3) interaction of pricing system by farm

size (number of cows milked per day); small: < 10 cows; medium: 10 to 19 cows; and large: > 20 cows, and farm location (4 districts: Kaeng Khoi, Muaklek, Pak Chong, and Wang Muang). All fixed effects were important ($P < 0.05$) sources of variation for milk price. Milk prices in system 1 were higher (11.54 vs. 11.71 Thai bhat, $P < 0.05$) than in system 2. Under pricing system 1, large farms had the lowest milk price ($P < 0.05$) in all districts except Kaeng Khoi. Under pricing system 2, small farms had higher ($P < 0.05$) milk prices than medium and large farms across all districts. Farms in Kaeng Khoi had the least loss of revenue due to milk price, whereas farms in Wang Muang had the greatest. Higher bacterial scores and (or) bulk tank somatic cell counts in large and medium farms made them lose more revenue than small farms. Improvements in farm management and sanitary conditions would need to be implemented if milk revenues are to be increased.

Key Words: Milk Price, Milk Revenue, Thailand

854 Factors affecting bacterial score and bulk tank somatic cell count of dairy farms in the central region of Thailand. J. A. Rhone*¹, S. Koonawootrittriron², and M. A. Elzo¹, ¹University of Florida, Gainesville, ²Kasetsart University, Bangkok, Thailand.

The objectives of the study were to determine the effects of year-season, farm location, and farm size on bacterial score and bulk tank somatic cell count (BTSCC). Collection of data was at the farm level; individual animal records were unavailable. There were a total of 58,575 bacterial score and 24,109 BTSCC count records from 1,034 farms. The BTSCC data was transformed using natural logarithms. The BTSCC and bacterial score traits were analyzed as single trait mixed and log linear models, respectively. Fixed effects were: 1) year-season, where year = 2004 to 2006, and season = winter (November to February), summer (March to June), and rainy (July to October), 2) farm size (number of cows milked per day of farms), small: < 10 cows; medium: 10 to 19 cows; and large: > 20 cows, and 3) farm locations (4 districts: Kaeng Khoi, Muaklek, Pak Chong, and Wang Muang). Random effects were farm and residual effects. Farm effects were assumed to be uncorrelated. Important effects were year-season, farm district by farm size interaction for log bacterial score (LBS), and month nested within year and farm district by farm size interaction for log BTSCC. The 2006 summer was lower ($P < 0.05$) than all other seasons and the rainy season was higher ($P < 0.05$) than either adjacent season for LBS. Small size farms in Muaklek and Pak Chong had lower ($P < 0.05$) LBS values than medium and large farms. There were no differences among farm sizes in Kaeng Khoi and Wang Muang for LBS. Small size farms in Muaklek, Pak Chong, and Wang Muang had lower ($P < 0.05$) log BTSCC values than both medium and large size farms. There was no difference ($P < 0.05$) among farm sizes for log BTSCC in Kaeng Khoi. The lower values of LBS and log BTSCC in most small size farms suggests they had better health and sanitary management than medium and large size farms.

Key Words: Bacterial Score, Bulk Tank Somatic Cell Count, Thailand

855 Effects of supplementing finger millet straw with concentrates differing in partitioning factor on microbial biomass synthesis in crossbred dairy cows. W. Jackson*¹, S. Sudha², U. Krishnamoorthy², R. Bhaskaran², and P. Robinson¹, ¹University of California, Davis, ²Karnataka Veterinary, Animal & Fisheries Sciences University, Bangalore, Karnataka, India.

Improving utilization of crop residues by obtaining maximum microbial biomass from ruminally digestible organic matter (OM) is beneficial to lactating cows. The 'Partitioning Factor' (PF) is an index of distribution of truly degraded substrate between microbial biomass and fermentation waste products as measured by *in vitro* digestion, where a high PF indicates more efficient microbial biomass synthesis. In this study, effects of supplementing finger millet straw (FMS) with concentrates differing in PF on DM intake, nutrient digestibility and N metabolism were studied in mid-lactation cows. A high PF concentrate (HPFC) and a low PF concentrate (LPFC) were formulated to be iso-metabolizable energy and iso-N, but to differ in PF. Six crossbred cows were divided into 2 groups based on BW in a switchover design consisting of 2 periods of 4 weeks. A 5 day metabolism study was conducted at the end of each period. Diets consisted of *ad libitum* FMS as the sole source of forage, and concentrate supplements to meet requirements (ARC, 1984). FMS was fed daily at 8:30 h and concentrate was fed in 2 portions at 5:30 h and 14:00 h. The ME (MJ/kg DM) and CP content (g/kg DM) of the HPFC and LPFC concentrates were 12.7, 168 and 13.4, 188, respectively, and the PF was 3.78 and 3.65. Intake (kg/d) of DM, OM and CP for the HPFC and LPFC groups were 12.72, 11.61, 0.54 and 12.40, 11.59 and 0.53, respectively, but they did not differ between treatments. OM digestibility (g/kg DM consumed) of 624 vs. 659, as well as the N retained (8.0 g/d) was also similar. Urinary allantoin excretion (UAe, mmol/d) in HPFC was higher ($P=0.05$) than in LPFC (170 vs. 131), but calculated microbial N supply to the duodenum was similar between groups (125 and 112 g/d). Total N content (g/d) in urine was higher ($P=0.0003$) in the HPFC (57.0) vs. the LPFC (43.0) group, and BW gain (g/d) for the groups was 320 and 30 ($P=0.09$). A concentrate with a higher PF tended to have a higher efficiency of microbial biomass synthesis in an FMS based high forage diet.

Key Words: Efficiency of Microbial Biomass Synthesis, Allantoin, Microbial Nitrogen

Nonruminant Nutrition: General Topics

856 Temporal changes in biochemical indices of sulfur amino acid (SAA) metabolism in the folate deficient piglet. Z. Zhang* and J. D. House, University of Manitoba, Winnipeg, MB, Canada.

The impact of folate deficiency on temporal changes in markers of SAA metabolism was determined in weanling pigs. Pigs (5.3 kg; $n=6$ /treatment) were fed a basal semi-purified diet (20.5% casein; 3474 kcal ME/kg) containing either 0 (folate deficiency, FD) or 0.6 (folate control, FC) mg/kg folate, using a pair-feeding design. Feed intake was measured daily, and body weight and plasma were collected weekly for 6 weeks. Animals were killed at the end of 6 weeks, and tissue samples harvested. Plasma folate and vitamin B-12 were determined by Quantaphase[®] Folate/B12 Radioassay. Total homocysteine (Hcy) and cysteine (Cys) were quantified by reverse-phase HPLC. Hepatic serine hydroxymethyltransferase (SHMT) was measured by a binding assay using radioactive isotope L-[¹⁴C(U)]-Serine. SHMT was statistically analyzed by PROC GLM with randomized complete block design. The mixed model was applied to analyze all the other parameters with repeated observations. In addition to average daily

feed intake, average daily gain and feed efficiency were not affected by folate deficiency throughout the experiment. Plasma folate in FD pigs was decreased from the end of the second week (FC=72.7 nM; FD=29.1 nM; SE=8.4; $p<0.001$) till the sixth week (FC=67.2 nM; FD=15.1 nM; SE=9.1; $p<0.001$). Plasma vitamin B-12 in FD pigs tended to increase over the depletion. At 6 weeks, plasma vitamin B-12 was significantly elevated by folate deficiency (FC=229 pM; FD=1074 pM; SE =198; $p<0.01$). Increases in plasma Hcy in FD pigs were detected on the fifth (FC=16.6 μ M; FD=37.0 μ M; SE=5.9; $p<0.05$) and the sixth (FC=16.6 μ M; FD=71.3 μ M; SE=5.9; $p<0.0001$) weeks. By contrast, decreases in plasma Cys in FD pigs were found on the fifth (FC=187.0 μ M; FD=146.5 μ M; SE=9.3; $p<0.01$) and the sixth (FC=226.6 μ M; FD=159.6 μ M; SE=5.9; $p<0.0001$) weeks. SHMT was not affected by folate deficiency ($p>0.05$). These results provide evidence that folate depletion perturbs vitamin B-12 and SAA metabolism in the young pig.

Key Words: Folate, Homocysteine, Pig