

382 Dietary sources of starch affect intestinal absorption and metabolism of glucose and amino acids in growing pigs. J. Zhang¹, Y. L. Yin*¹, and G. Y. Wu^{1,2}, ¹*The Chinese Academy of Sciences, Changsha, Hunan, P.R. China*, ²*Texas A&M University, College Station*.

The objective of this study was to determine the effect of dietary starch sources on the balance of glucose and amino acids across the portal-drained viscera (PDV) of growing pigs. Four Duroc×Landrace×Yorkshire cross-bred barrows (with an average body wt of 22.5 kg) were housed individually in stainless steel metabolism cages and trained to consume feed provided daily. After a 2-wk adaptation period, pigs were fitted with permanent catheters in the portal vein, mesenteric vein, and carotid artery. After a 13-d recovery period, pigs were assigned randomly into one of 4 treatment groups in a 4×4 Latin square design representing 4 cornstarch- and casein-based isocaloric and isonitrogenous diets containing 52.0% corn, 65.8% brown rice, 65.3% sticky rice, and 51.8% Hi-Maize 1043 (resistant starch). Pigs were fed 3 times daily at 07:30, 15:30 and 23:30 at a feeding level of >963 kJ DE/kg diet. Each diet was fed to the pig

after a 6-d adaptation period. On d 7, blood samples were obtained simultaneously from the 3 catheters at 30 min prior to feeding and hourly for 8 h after feeding. Portal blood flow was measured using p-aminohippuric acid. Results showed that portal glucose absorption (expressed per 100 g feed intake) was lower ($P < 0.05$) for the resistant-starch diet compared with corn, stick rice and brown rice diets at all sampling times. In comparison with the corn diet, net portal glucose absorption was higher ($P < 0.05$) for the sticky rice and brown rice diets up to 4 h after feeding, but was reduced ($P < 0.05$) thereafter. Feeding the resistant-starch diet reduced ($P < 0.05$) the net portal absorption of total amino acids, particularly Pro, Leu, and Ile. The net appearance of total amino acids absorbed from the ileum differed ($P < 0.05$) among the treatment groups, and was 48.4, 63.8, 61.8, and 59.3%, respectively, for piglets fed the corn, brown rice, sticky rice, and resistant-starch diets. These findings indicate that dietary sources of starch affect intestinal absorption and metabolism of glucose and amino acids in growing pigs. Supported by funds from Chinese Academy of Sciences and China NSF.

Key Words: Glucose, Amino acids, Dietary starch

Physiology and Endocrinology: Metabolic Physiology

383 Fertility of lactating dairy cows administered bovine somatotropin during heat stress. F. D. Jousan*, L. A. de Castro e Paula, J. Block, and P. J. Hansen, *University of Florida, Gainesville*.

While administration of bovine somatotropin (bST) to lactating dairy cows increases milk production, it can also increase body temperature during heat stress and may therefore compromise fertility. However, bST increases secretion of insulin-like growth factor-I (IGF-I) and culture of bovine embryos with IGF-I blocks the reduction in blastocyst development and induction of apoptosis caused by heat shock. The purpose of this study was to determine effects of bST on reproductive function in lactating dairy cows during heat stress. The experiment was conducted in South Georgia from July to November 2005 using 271 lactating Holstein cows and heifers. For first service timed artificial insemination (TAI), cows were presynchronized with two injections of PGF2 α given 14 d apart followed by a modified Ovsynch protocol (GnRH given 72 h following PGF2 α). Pregnancy was diagnosed using ultrasonography on d 29 and reconfirmed by palpation between d 45-80 post-TAI. Non-pregnant cows were resynchronized with the modified Ovsynch protocol and received TAI. Treatment with bST (500 mg; Posilac, Monsanto) started 1 wk prior to the start of Ovsynch and continued at 2-wk intervals. A subset of cows (n=38) were bled for IGF-I profiles immediately prior to the first bST injection, 1 wk later, and at d 35 of bST treatment. Rectal temperatures were taken on d 29 of bST treatment. Pregnancy rates (d 45-80 post-TAI) did not differ between control (n=129) and bST-treated cows (n=142) for first- (15.5% vs 16.9%) or second-service TAI (17.2% vs 15.0%). Milk yield and plasma concentrations of IGF-I were higher for bST-treated cows following the initiation of bST treatment (bST x time interaction, $P < 0.01$) and bST increased rectal temperature ($P < 0.05$; 39.17°C vs 39.31°C for control vs IGF-I cows, SEM=0.05°C). In conclusion, treatment with bST during heat stress increased IGF-I concentrations and milk production over time and rectal temperature without compromising first- or second-service pregnancy rates. (Research Support: USDA TSTAR grant 2004-34135-14715 and IFAFS grant 2001-52101-11318).

Key Words: Dairy cows, Bovine somatotropin, Fertility

384 Effect of the addition of insulin-like growth factor-1 to embryo culture medium on pregnancy rate following timed embryo transfer in lactating dairy cows. J. Block* and P. J. Hansen, *University of Florida, Gainesville*.

Addition of insulin-like growth factor-1 (IGF-1) to embryo culture medium increases pregnancy rate following transfer of in vitro produced embryos to heat stressed, lactating dairy cows (Block et al., *J. Anim. Sci.* 81:1590, 2003). The objective of the present study was to determine whether the effect of IGF-1 on embryo survival was a general effect or one specific to heat stress. An embryo transfer field trial was conducted between March 2005 and January 2006 at 4 different locations. Embryos were produced in vitro using oocytes collected from abattoir-derived ovaries. After fertilization, presumptive zygotes were cultured in the presence or absence of 100 ng/mL IGF-1. Cows were synchronized for timed embryo transfer using the OvSynch protocol (3 locations) or 2 injections of prostaglandin F_{2 α} (25 mg, i.m.) 14 days apart (1 location). A total of 287 primiparous and multiparous, lactating cows were selected as recipients based on the presence of a corpus luteum. Grade 1 embryos were selected on d 7 after fertilization and randomly transferred to recipients that were at d 7 after anticipated ovulation. Pregnancy rate was diagnosed by ultrasonography at d 27-32 and by rectal palpation at d 41-49. The experiment was replicated 20 times with 6-28 recipients per replicate. Transfers were divided into two seasons, cool (Jan., Mar., April, Nov., Dec.) and hot (July, Aug., Sep.). There was a significant IGF-1 x season interaction for pregnancy rate at both d 27-32 and d 41-49 ($p < 0.01$). Addition of IGF-1 to embryo culture significantly increased pregnancy rate during the hot season (d 27-32: 34/69 = 49.3% vs. 15/71=21.1% and d 41-49: 28/67=41.8% vs. 13/71=18.3%, respectively), but not during the cool season (d 27-32: 19/70 = 27.1% vs. 23/66=34.9% and d 41-49: 16/73=21.9% vs. 21/74=28.4%, respectively). Results indicate that IGF-1 can be added to bovine embryo culture to increase pregnancy rate in lactating dairy cow recipients during heat stress but there is no advantage in the absence of heat stress. USDA-TSTAR 2004-34135-14715 and BARD US-3551-04

Key Words: Insulin-like growth factor-1, Embryo transfer, Cattle

385 Regulation of hepatic leptin receptor expression in periparturient dairy cows. S. R. Thorn*, R. A. Ehrhardt, M. J. Meyer, R. P. Rhoads, M. E. Van Amburgh, and Y. R. Boisclair, *Cornell University, Ithaca, NY*.

Transcription of the leptin receptor (Ob-R) gene produces transcripts encoding a single functional isoform (Ob-Rb) and truncated isoforms with poor signaling capacity. Assessing the sites of leptin action in cattle has been difficult in the absence of quantitative data on the spatial expression of Ob-R isoforms. To address this, we surveyed expression of one of the truncated isoforms (Ob-Ra), the fully functional isoform (Ob-Rb), and all isoforms (TOTAL) in tissues from four growing Holstein heifers. Abundance of TOTAL transcripts was between 2 to 500-fold higher in liver than in other peripheral tissues and 130-fold higher than in the hypothalamus, a recognized leptin target tissue. Ob-Ra and Ob-Rb respectively accounted for 95 and 2% of TOTAL transcripts in liver compared to 19 and 40% in the hypothalamus. To determine if hepatic expression was regulated, we focused on the transition from pregnancy to lactation. This period is characterized by the onset of negative energy balance and acutely decreasing plasma insulin and leptin. Liver biopsies were obtained from six dairy cows in late pregnancy (LP, 31 days prepartum) and in early lactation (EL, 7 days postpartum). TOTAL and Ob-Ra expression in liver increased by 75% between LP and EL ($P < 0.05$). Liver biopsies were also obtained from late lactating cows when underfed (UF, 30% of maintenance energy requirement) or well-fed (WF, 120% of requirement). TOTAL and Ob-Ra abundance was increased by 60% in UF cows ($P < 0.05$), suggesting that negative energy balance is partly responsible for elevated Ob-R expression in EL. Finally, we asked if insulin mediates the effects of negative energy balance by performing hyperinsulinemic-euglycemic clamps in six dairy cows in LP and EL. Insulin decreased TOTAL, Ob-Ra, and Ob-Rb abundance by 65% ($P < 0.005$) in EL but had no effects in LP. In all experiments, Ob-Ra accounted for over 75% of TOTAL abundance and Ob-Rb for less than 3%. We conclude that increased hepatic Ob-R expression in early lactation is caused in part by reduced plasma insulin and perhaps leptin. The consequence of high expression of the truncated, Ob-Ra, isoform in the liver remains unknown.

Key Words: Leptin, Leptin receptor, Insulin

386 Effect of dry period duration on reproductive measures during the subsequent lactation in Holstein cows. R. D. Watters*, M. C. Wiltbank, P. M. Fricke, J. N. Guenther, A. E. Kulick, and R. R. Grummer, *University of Wisconsin, Madison*.

In a previous study (Gumen et al., 2005; JDS 88:2401), although cows with a reduced dry period appeared to have improved reproduction, too few cows were evaluated to provide reliable data. Cows ($n=772$) in a commercial dairy herd were used in a randomized design to evaluate the effect of dry period duration on days to first ovulation, days to first AI, first service conception rate, days open, and percentage of cows pregnant at 150 DIM. Lactating cows analyzed for reproduction received a 55 (C; $n=342$) or 34 d (S; $n=353$) dry period. Cows that did not reach 45 DIM or more were classified as do not breed were removed from the study. Dry C cows were fed a low-energy diet until 34 d before their expected calving date and then all cows (C and S) were fed a moderate-energy transition diet until calving. Beginning two weeks postpartum, weekly blood samples were collected and analyzed for progesterone. Cows received AI based on removed tail-chalk after 45 DIM followed by Ovsynch and timed AI (37% of the first AIs) after 80 DIM if not previously inseminated. There was a treatment by week

interaction ($P < 0.01$) for body condition score with C greater than S at wk 3 prepartum (3.76 ± 0.02 vs 3.21 ± 0.02). Based on survival analysis, S cows had fewer ($P < 0.01$) days to first ovulation (median days = 35 vs 43 d) as determined by serum progesterone >1.0 ng/ml. Survival analysis showed a tendency ($P = 0.09$) for S cows to have fewer days to first service (median days = 67 vs 72 d); however, first service conception rate did not differ between treatments (29.8 vs 32.0%). The proportion of cows pregnant at 150 DIM was greater ($P < 0.05$) for S (51.8%) than for C (43.9%) cows. Survival analysis indicated a treatment effect for days open (median = 166 vs 130 for C vs S cows). Thus, decreasing the duration of the dry period from 55 to 34 d improved reproductive efficiency based on fewer days open and more cows pregnant at 150 DIM.

Key Words: Dry period length, Ovulation, Reproduction

387 Effects of dietary supplementation with trans- and omega-3 fatty acids on $PGF_{2\alpha}$ secretion and production parameters in dairy cows. B. C. Benefield*¹, E. Castaneda-Gutierrez¹, D. E. Bauman¹, T. R. Overton¹, R. O. Gilbert¹, N. D. Luchini², and W. R. Butler¹, ¹*Cornell University, Ithaca, NY*, ²*NutriScience Technologies, Inc., Fairlawn, OH*.

The objectives of this study were to evaluate uterine $PGF_{2\alpha}$ secretion and production responses in dairy cows fed different commercially available sources of rumen-protected fatty acids (FA). Postpartum Holstein cows ($n = 45$, 21 ± 1 DIM) were assigned to isoenergetic diets providing: calcium salts of tallow (180 g FA/d; C), calcium salts of trans-fatty acids as EnerGI Trans formula (180 g FA/d; Virtus Nutrition, Fairlawn OH; T), or calcium salts of omega-3 fatty acids as StrataG 1.0 (150 g FA/d; Virtus Nutrition; N-3). Cows were fed for 37 d and feed intake and milk yield were monitored over this period. Blood samples for determination of IGF-1 and NEFA were collected 3x/wk. At 30 ± 3 DIM, ovulation was synchronized in all cows with a modified Ovsynch protocol. On d 15 of the cycle cows were infused with 3 mg of estradiol-17 β (iv) and challenged with 100 IU of oxytocin (iv) 4 h later to stimulate uterine $PGF_{2\alpha}$ secretion; blood plasma was collected frequently over a 4 h period for determination of PGFM. Cows fed the T diet tended ($P = 0.11$) to have a greater PGFM response to the oxytocin challenge. Differences in IGF-1 were not significant. A treatment by day effect for decreased circulating NEFA was evident on d 11 on diet for cows fed N-3 and on d 18 for cows on N-3 compared to those fed T. Milk production (43.4, 42.2, and 41.8 kg/d for C, T, and N-3, respectively) and weekly fat and protein yield were similar ($P > 0.05$) across treatments although cows fed T tended ($P = 0.07$) to have increased milk fat percentage (3.20, 3.37, and 3.03%, respectively) compared to cows fed diet N-3 and tended ($P = 0.06$) to have a higher milk protein percentage (2.43, 2.55, and 2.51%, respectively) than cows fed diet C. Although FA treatments did not change milk or component yields, cows fed diet T tended to have increased uterine $PGF_{2\alpha}$ secretion in addition to increased milk fat and protein content.

Key Words: $PGF_{2\alpha}$, Uterus, Fatty acid

388 Effect of body weight gain and bovine somatotropin treatment on plasma concentrations of IGF-I in postpartum beef cows. M. J. Prado-Cooper*, I. Rubio, M. P. Davis, N. M. Long, R. P. Wettemann, and L. J. Spicer, *Oklahoma State University, Stillwater*.

Angus x Hereford cows (2 and 3 y of age) were used to determine the effects of postpartum weight gain and treatment with bovine somatotropin (bST) on concentrations of IGF-I in plasma during early

lactation. Cows (456 ± 52 kg, $BCS = 4.6 \pm 0.4$) were stratified based on calving date and BCS at calving, and randomly assigned to a 2 x 2 factorial: weight gain (WG) to gain either < 0.4 kg/d (M, $n = 18$) or ≥ 0.40 kg/d (H, $n = 19$). Cows that achieved the programmed weight gain were injected with bST (250 mg; Posilac) or saline (C) on d 31 and 45 after calving. Concentrations of IGF-I, glucose and insulin were quantified in plasma collected twice a week, from d 24 until d 59 after calving. Data were analyzed using the Mixed procedure of SAS. Before bST treatment, H had greater ($P < 0.05$) concentrations of IGF-I in plasma compared with M cows (42.3 vs 30.6 ± 3.7 ng/mL). After bST treatment, there was a WG x bST x day effect ($P < 0.001$) on plasma IGF-I. Concentrations of IGF-I in plasma on d 21 were greater ($P < 0.01$) in HbST (223.1 ± 17.1 ng/mL) compared with MbST, MC or HC (67.0 , 32.7 or 31.3 ± 17.1 ng/mL, respectively). After bST treatment, concentrations of glucose in plasma were greater ($P < 0.01$) in HbST compared with HC, MC and MbST (72.5 vs 68.4 , 65.3 and 63.2 ± 1.3 mg/dL, respectively). Concentrations of insulin were greater ($P < 0.05$) in H (0.5 ± 0.2 ng/mL) compared with M cows (0.2 ± 0.2 ng/mL). Weight gain and treatment with bST did not influence the percentage of cows with luteal activity by 60 d after calving. Weights of calves at d 60 of age were greater ($P < 0.01$) in H compared with M cows (102 vs 86 ± 2 kg). Weight gain of young, lactating beef cows, influences plasma concentrations of IGF-I after treatment with bST. Further studies are needed to evaluate the effects of weight gain and bST on ovarian function and reproductive performance of lactating beef cows.

Key Words: Beef cows, Body weight gain, Somatotropin

389 Evaluation of the mechanism of action of conjugated linoleic acid (CLA) isomers on reproduction - uterine release of $PGF_{2\alpha}$. E. Castaneda-Gutierrez^{*1}, B. C. Benefield¹, R. O. Gilbert¹, M. J. de Veth², W. R. Butler¹, and D. E. Bauman¹, ¹Cornell University, Ithaca, NY, ²BASF-AG, Offenbach/Queich, Germany.

The objective of this study was to evaluate uterine $PGF_{2\alpha}$ release (PGFM) in response to an oxytocin challenge after dietary supplementation with different CLA isomers. Lactating Holstein cows ($n = 45$, 20 ± 1 DIM) were assigned to one of 3 treatments: 70 g/d of Ca salts of tallow (CTL); 63 g/d of lipid-encapsulated CLA providing 7.1 g/d of *cis* 9, *trans* 11 CLA and 2.4 g/d of *trans* 10, *cis* 12 CLA (CLA 75:25), or ; 76 g/d of lipid-encapsulated CLA providing 7.1 g/d each of *cis* 9, *trans* 11 and *trans* 10, *cis* 12 CLA (CLA 50:50). Supplements were top-dressed for 37 d, milk production and DMI were recorded daily, and milk components measured weekly. Blood samples were taken 3x per wk for NEFA and 1x per wk for IGF-I analyses. At 30 ± 3 DIM ovulation was synchronized in all cows with a modified Ovsynch protocol. On d 15 of the cycle cows received an i.v. injection of 3 mg of estradiol 17 β and 4 hr later an i.v. challenge with 100 IU of oxytocin; blood samples were obtained frequently over a 4 hr period. PGFM was determined by RIA and area under the curve was calculated. CLA 50:50 caused 16.6% reduction in milk fat content after wk 4 ($P < 0.03$), but milk fat content for CLA75:25 was not different from CTL. Milk fat yield was similar among treatments due to a trend ($P < 0.07$, wk 4) to increase milk yield of cows treated with CLA50:50 (43.5, 42.6 and 41.9 kg/d for CLA50:50, CLA75:25 and CTL, respectively). The oxytocin challenge resulted in an immediate elevation of circulating PGFM which gradually returned to basal levels over the next 4 h Area under the curve was not different among treatments ($P = 0.2$); likewise DMI and NEFA were similar among treatments ($P > 0.05$). Plasma IGF-I tended to be higher ($P < 0.07$) in cows treated with CLA 50:50 compared to CTL (81.4, 76.3 and 72.5 ng/ml for CLA50:50, CLA75:25

and CTL, respectively). Overall, results suggest that short periods of CLA supplementation do not impact reproductive performance via affects on uterine release of $PGF_{2\alpha}$.

Key Words: Conjugated linoleic acid, Reproduction, $PGF_{2\alpha}$

390 Liver expression of the clock gene *TIMELESS* is reduced by long day photoperiod in dairy steers. T. F. Gressley^{*1}, E. E. Connor², and G. E. Dahl¹, ¹University of Illinois, Urbana, ²Bovine Functional Genomics Laboratory, USDA-ARS, Beltsville, Maryland.

Regulation of circadian rhythms in the brain and peripheral organs occurs via differential expression of clock genes in response to external stimuli including light and feeding time. An experiment was conducted to determine whether expression of five clock genes in the liver of steers is affected by photoperiod manipulation. Eight Holstein steers averaging 100 d of age were exposed to 12 h of light and 12 h of darkness (12L:12D) for a 14-d acclimation period. Following acclimation, steers were assigned to a crossover design with a long day photoperiod (LDPP) or a short day photoperiod (SDPP) for 9 weeks followed by the opposite treatment for 4 weeks. Light cycles were 16L:8D for LDPP and 8L:16D for SDPP, with lights on at 0800h for both treatments. Steers were fed a grain and alfalfa cube mix at 1000h daily and had free access to water. Liver biopsies were taken beginning at 0830h during week 1 of the acclimation period and on week 4 of each treatment period. Liver samples were analyzed by quantitative real-time RT-PCR for mRNA expression of five clock genes (*BMAL1*, *CLOCK*, *Per1*, *Per2*, and *TIMELESS*) and three housekeeping genes (*RPS18*, *GAPDH*, and *ACTB*). Fold difference in clock gene expression between each treatment period and the acclimation period was calculated after normalizing to the three housekeeping genes and correcting for PCR efficiency. Results indicated expression levels of *BMAL1*, *CLOCK*, *Per1*, and *Per2* in LDPP were 99%, 97%, 101%, and 112%, respectively, of SDPP levels, with no significant differences between treatments. However, expression of *TIMELESS* for LDPP was reduced to 73% of SDPP ($P = 0.08$). The *TIMELESS* protein is involved in regulating circadian rhythms and has recently been implicated in coupling the cell division cycle to circadian rhythms. Photoperiod manipulation appears to entrain the circadian rhythm of clock gene expression in the bovine liver and may consequently affect liver metabolism.

Key Words: Clock genes, Gene expression, Liver

391 Effects of conjugated linoleic acid on prostaglandin production by bovine endometrial cells. A. Heravi Moussavi^{*1}, R. O. Gilbert², W. R. Butler², D. E. Bauman², E. Castaneda-Gutierrez², and H. B. Roman², ¹Ferdowsi University, Mashhad, Iran, ²Cornell University, Ithaca, NY.

The study was designed to test the effects of conjugated linoleic acid (CLA) on cyclooxygenase-2 (COX-2) level, and $PGF_{2\alpha}$ and PGE2 production in cultured uterine endometrial cells. Uterine endometrium was collected by endometrial biopsy of cows in the luteal phase of the cycle and endometrial cells collected by enzymatic dispersion. Confluent cells were exposed for 24 h to 0, 50, 100, and 200 μ M of c9, t11 CLA or t10, c12 CLA. After incubation, cells were washed and stimulated with phorbol 12-myristate 13-acetate (PMA) for 6 h. The c9, t11 CLA decreased $PGF_{2\alpha}$ production in a dose depend manner ($P < 0.001$; 18.91, 12.23, 10.97, and 7.76 ± 0.64 ng/ml, respectively). $PGF_{2\alpha}$ production also decreased with t10, c12 CLA supplementation ($P < 0.001$; 15.17, 4.30, 6.56, and 5.96 ± 0.59 ng/ml, respectively). The

t10, c12 CLA was more potent in reducing PGF2 α production than c9, t11 CLA. PGE2 production decreased linearly after supplementation of c9, t11 CLA ($P < 0.001$; 28.35, 13.29, 14.46, and 6.35 ± 1.7 ng/ml, respectively). The t10, c12 CLA also decreased PGE2 production in the cultured endometrial cells ($P < 0.001$; 24.57, 2.63, 10.68, and 8.28 ± 1.31 ng/ml, respectively) but the low dose of t10, c12 CLA was more potent than the higher doses ($P < 0.01$). The PGE2 to PGF2 α ratio was significantly reduced by c9, t11 CLA ($P < 0.01$; 1.49, 1.07, 1.32, and 0.80 ± 0.11 , respectively). The 50 μ M of t10, c12 CLA decreased the PGE2 to PGF2 α ratio ($P < 0.01$). The uterine endometrial level of COX-2 protein was not affected by the supplementations. Results from this experiment demonstrate that in vitro supplementation of the CLA isomers significantly decreases PGF2 α and PGE2 production with no apparent effect on COX-2 level after PMA challenge in cultured uterine endometrial cells.

Key Words: Dairy cow, COX-2, CLA

392 Prepartum administration of 2,4-thiazolidinedione alters metabolic dynamics and production of transition dairy cows. K. L. Smith*, S. E. Stebulis, M. R. Waldron, and T. R. Overton, *Cornell University, Ithaca, NY*.

Thiazolidinediones (TZD) are potent, synthetic ligands for PPAR- γ that have been shown to reduce plasma nonesterified fatty acids (NEFA) and potentiate the action of insulin in peripheral tissues of several species. Holstein cows ($n = 9$) entering second or greater lactation were used to determine whether late prepartum administration of 2,4-TZD would affect periparturient metabolism and production. Cows were fed a TMR during the prepartum period to provide no more than 150% of predicted energy requirements. During the postpartum period cows were fed a common TMR for ad libitum intake. Cows were administered either 2,4-TZD (4.0 mg/kg BW) or saline (control) by intrajugular infusion once daily from 25 d before expected parturition until parturition. Plasma samples were collected daily from 26 d prior to expected parturition through 7 d postpartum. Plasma NEFA concentrations were similar for cows assigned to the two treatments during much of the prepartum period, but were decreased at parturition and during the first 7 d postpartum for cows administered 2,4-TZD (treatment by time, $P = 0.009$). Plasma glucose concentrations were not affected ($P > 0.10$) by treatment. Average DMI was greater for cows administered 2,4-TZD compared to controls (14.8 vs. 13.8 kg/d; $P < 0.05$). Cows administered 2,4-TZD had lower milk yield than controls during the immediate postpartum period but then produced more milk than controls during the remainder of the postpartum study period (treatment by time, $P < 0.01$). Differences in milk fat and milk protein content measured on d 8 postpartum were not significant ($P > 0.10$). Administration of TZD during the late prepartum period has the potential to substantially improve metabolic health and production of transition dairy cows and warrants further investigation.

Key Words: Transition cow, Thiazolidinedione, PPAR- γ

393 Effect of breed on leptin concentrations in early lactation. P. J. Back* and N. A. Thomson, *Dexcel, Hamilton, New Zealand*.

Cows undergo large metabolic adaptations to meet the demands of milk production and rebreeding in early lactation. Adaptation depends on nutritional history and the immediate ability to mobilize body reserves to help meet energy demands. In this study, 3 genotypes (20 Friesian, 20 Jersey and 20 Jersey/Friesian crossbred multiparous cows) were used to determine the effect of breed on circulating leptin

concentrations and the relationship to other indicators of metabolic status and the post-partum anovulatory interval (PPAI). Cows were calved at pasture and weekly blood samples were taken for the first 6 wks of lactation. Milk progesterone analysis was used to determine PPAI. Body weight was different ($P < 0.001$) between breeds but there was no difference in BCS or BCS change during the trial period. There was a significant breed effect on circulating concentrations of BHBA ($P < 0.01$), NEFA ($P < 0.001$), triacylglycerides ($P < 0.001$) and leptin ($P < 0.01$), with Jersey cows having higher concentrations of these hormones and metabolites than Friesian or crossbred cows. Despite the concentration differences, only leptin showed a significant ($P < 0.01$) effect of time across breed (as determined by spline analysis). This resulted in Jersey cows having higher leptin concentrations from wk 1 to wk 4. The PPAI tended to be different between genotypes ($P = 0.18$) with Jersey cows having a shorter PPAI (34 vs 42 and 44 days for Friesian and crossbred cows respectively: SED 4). Correlations were determined between leptin and various indicators of metabolic status. Over the 6 wks monitored in early lactation, there was a negative correlation between concentrations of leptin and BHBA ($P < 0.01$) and NEFA ($P < 0.001$). There was positive correlations between concentrations of leptin and glucose ($P < 0.001$), IGF-1 ($P < 0.001$) and insulin ($P < 0.01$). Concentrations of leptin were also positively correlated to BW and BCS post-calving ($P < 0.05$, $P < 0.01$) and at wk 6 ($P < 0.001$, $P < 0.001$). These results indicate that grazing Jersey cows appear to have a different fat metabolism, which affects the regulation of circulating leptin concentrations and this may have contributed to their apparent ability to cycle earlier.

Key Words: Leptin, Breed, Pasture

394 Effects of heat stress and rbST on production parameters and glucose homeostasis. J. B. Wheelock*, S. R. Sanders, G. Shwartz, L. L. Hernandez, S. H. Baker, J. W. McFadden, L. J. Odens, R. Burgos, S. R. Hartman, R. M. Johnson, B. E. Jones, R. J. Collier, R. P. Rhoads, M. J. VanBaale, L. H. Baumgard, *University of Arizona, Tucson*.

Study objectives were to evaluate production parameters and glucose homeostatic variables in rbST-treated lactating dairy cattle during short-term heat stress (HS) or in pair-fed animals (UF). Twenty-two multiparous (99 DIM, 656 kg BW) Holstein cows [$n = 10$ (HS), $n = 12$ (UF)] were subjected to three experimental periods: 1) thermoneutral, ad libitum intake for 7d, 2) HS or UF for 7d, and 3) HS or UF with rbST (Posilac[®], Monsanto, St. Louis MO, administered on d1 of P3) for 7d. All cows received an I.V. glucose (d5) and insulin (d6) challenge during each period. HS conditions were cyclic to mimic an AZ July day, with temperatures ranging from 29.7 to 39.2°C. Milk yield, DMI, EBAL and body temperature indices were measured daily. Heat stress reduced DMI by 30%, and by design, UF cows had similar intake reductions (28%). Rectal temperatures and respiration rates increased during HS (38.6 to 40.5°C and 44 to 89 breaths/min, respectively). During HS and UF, milk yield decreased by 27.5% (9.7 kg) and 15.3% (4.8 kg) respectively, indicating reduced DMI only accounted for 50% of the decreased milk production. Milk yield increased with rbST (~13%) in both HS and UF. Cows in both treatments were in positive EBAL (>3.7 MCal/d) but entered NEBAL during HS and UF (<-3.7 MCal/d). No effect of HS on the rate of glucose disposal (mg/dL/min or AUC) was detected, but UF and rbST caused mild insulin resistance (16-30%, based on mg/dl/min and AUC). HS and UF treatments decreased (11%) basal glucose concentrations without an additional effect of rbST. HS had no effect on basal NEFA levels; however UF (despite a similar calculated EBAL) had increased (60%) basal NEFA concentrations. We conclude that reduced nutrient intake accounts

for only 50% of HS-induced decreases in milk yield and, based upon glucose challenge and basal NEFA data, increased extra-mammary

insulin sensitivity may contribute to the additional reduction in milk yield.

Key Words: Glucose homeostasis, Heat stress, rbST

Production, Management and the Environment II

395 Incorporating environmental compliance costs into livestock diet formulation. J. C. Hadrich, C. A. Wolf*, and S. B. Harsh, *Michigan State University, East Lansing.*

The current method to derive livestock diets is to minimize cost subject to animal performance and nutritional requirements that the performance level dictates. This approach allows nutritionists and farm managers to make livestock diet decisions based on the prices of alternative feed products. This method explicitly ignores the cost of over-feeding protein and minerals which must be disposed of with animal waste. Environmental compliance is a primary concern on livestock operations which must consider farm, and field, levels of phosphorus and nitrogen. Actual compliance costs are individual to the farm situation and depend on land availability, animal density, waste management methods, and feeding practices, among other factors. However, environmental compliance costs are significant on many farms and the feeding decision is a major source of nutrient import onto the farm. We reconsider livestock diet formulation to determine the cost effective diet using environmental compliance goals and resulting costs unique to the farm. A penalty function is incorporated in the feed cost minimization decision. Farm characteristics that influence this penalty function are animal density, amount of phosphorus (P) fed to the animals, cropping program, application of commercial fertilizers, land availability for manure application, current soil P levels and distance manure is hauled. Including the nutrient penalty function the ration formulation reallocates diet ingredients to accommodate lower levels of P in the ration. In the short run it may increase the ration costs, but simultaneously decreases the amount of by-product in the ration which may lead to cost savings when the total cost of nutrients are considered. With the increasing availability of by-product feeds, producers must be aware of the total cost rather than the input cost of feedstuffs. Incorporating nitrogen levels and alternative nutrient management strategies are ongoing.

Key Words: Diet cost, Environmental compliance

396 Development and integration of a national feed management education program and assessment tools into a comprehensive nutrient management plan. J. H. Harrison¹, R. A. White*¹, T. J. Applegate², R. T. Burns³, G. H. Carpenter⁴, G. E. Erickson⁵, and A. L. Sutton², ¹Washington State University, Puyallup, ²Purdue University, West Lafayette, IN, ³Iowa State University, Ames, ⁴USDA, NRCS, Beltsville, MD, ⁵University of Nebraska, Lincoln.

In 2003, the US Environmental Protection Agency (EPA) released new guidelines for Concentrated Animal Feeding Operations (CAFO). Under the new guidelines, permitted CAFOs will be required to develop a Nutrient Management Plan (NMP). In most cases, with minor additions, a USDA, Natural Resources Conservation Service (NRCS) Comprehensive Nutrient Management Plan (CNMP) will satisfy the requirements of an NMP. One of the Core Elements of the CNMP is feed management. In 2005, a national feed management education project was funded by the NRCS Conservation Innovation

Grant program (CIG). The project will develop, test, and implement a National Feed Management Education Program and Assessment Tools into a Comprehensive Nutrient Management Plan. The goal of the project is to increase the understanding of feed management to agricultural professionals, with an emphasis on environmental and financial sustainability of livestock and poultry operations. A team consisting of consulting animal nutritionists, technical service providers (TSPs), Extension Specialists, and research scientists will accomplish the following program objectives: 1) develop and evaluate a two-tier tool for assessing the impacts of feed management practices on whole farm nutrient balance for animal nutritionists, NRCS staff and TSP advisors, 2) develop the content of a Feed Management chapter for the NRCS Agricultural Waste Management Field Handbook (AWMFH), and 3) develop and implement an education program targeting integration of feed management into a CNMP. Specific outcomes are: 1) develop educational materials that are applicable at the national level, 2) provide training for NRCS staff, agricultural professionals, and TSPs in feed management concepts and practices that minimize import of nutrients to the farm, 3) provide training in the use of computer models and software for strategic ration balancing, whole farm nutrient balance, and nutrient excretion estimates based upon feed and animal performance inputs, and 4) develop a chapter for the NRCS AWMFH on Feed Management.

Key Words: Feed management, Nutrient management, Environment

397 Decision support model of nutrient excretion in beef feedlots. C. B. Williams* and T. G. Jenkins, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

Component biological models were developed at the U.S. Meat Animal Research Center to partition ME and protein intake to maintenance and gain, and partition protein and ME for gain to fat and protein accretion in growing and mature cattle. These models were integrated with a life cycle beef production model reported by Colorado State University, and phosphorus and potassium intake and utilization functions were added. Evaluations with independent sets of experimental data documented that the beef life cycle model could accurately predict responses under different levels of nutritional management. This model represents a nutrient utilization model for ME, nitrogen, phosphorus and potassium, and it was integrated with the nutrient supply model of the Cornell Net Carbohydrate Protein System to predict nutrient supply. Nutrient excretion was predicted as the difference between supply and utilization. Use of the biological model requires knowledge of computer programming, therefore a graphical user interface consisting of easy to use screens was developed to simplify data input and make the biological model more accessible to producers and professional animal scientists. The software package provides an easy to use decision support tool that predicts nitrogen, phosphorus, and potassium excretion in beef feedlots, in response to breed, management, and different dietary formulations.

Key Words: Beef cattle, Computer simulation, Decision support